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Trinity Medical School
February 1885

A
DICTIONARY OF MEDICINE

INCLUDING

GENERAL PATHOLOGY, GENERAL THERAPEUTICS,
HYGIENE, AND THE DISEASES PECULIAR
TO WOMEN AND CHILDREN

BY VARIOUS WRITERS

THE PROPERTY OF
Trinity Medical College.

EDITED BY

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PREFACE.

THE VAST NUMBER of facts and observations, by which the recent progress of scientific and practical medicine has been marked, is diffusely recorded in the Transactions of learned societies, in journals, in monographs, and in systematic treatises. With progress so rapid, and information so diffused, it is extremely difficult alike for the practitioner, the teacher, and the student to keep pace. It was the perception of this difficulty which induced the Editor, when invited to undertake the production of a new Medical Dictionary, to engage in a task which, he was fully conscious, must be one of great labour and of great responsibility. He felt, however, that he would be rendering useful service to his profession if he could bring together the latest and most complete information in a form which would allow of ready and easy reference. Accordingly, he invited the co-operation of certain of his colleagues and professional friends, both in this country and abroad; and evidence of the readiness with which this invitation has been accepted, is afforded by the list of contributors. Each contributor volunteered or was invited to write on a subject with which he was specially familiar. The present work, which is the result of these combined efforts, may therefore be regarded not only as a dictionary, but also as a treatise on systematic medicine, in which the articles on the more important subjects constitute monographs in themselves, whilst definitions and descriptions of matters having less claim to extended notice are given as fully as is required. Thus an endeavour has been made to supply, in a clear, condensed, and readily accessible form, all the information that is at present available for the use of the practitioner of medicine.

As indicated on the title-page, the work is primarily a dictionary of Medicine, in which the several diseases are fully discussed in alphabetical order. The description of each includes an account of its ætiology and anatomical characters; its symptoms, course, duration, and terminations; its diagnosis, prognosis, and, lastly, its treatment. General Pathology comprehends articles on the origin, characters, and nature of disease, and the many considerations which these topics suggest. General Therapeutics will be found to include articles on the several classes of remedies—medicinal or otherwise—which are available for the purpose of treatment; on the modes of action of such remedies; and on the methods of their use. The articles devoted to the subject of Hygiene will be found to treat of the causes of disease, of its prevention, of the agencies and laws affecting public health, of the means of preserving the health of the individual, of the construction and management of hospitals, and of the nursing the sick. Lastly, the diseases peculiar to Women and Children are discussed under their respective headings, both in aggregate and in detail.

It may be well to explain that, although it has been found necessary to include some notice of diseases which fall more generally under the care of the surgeon, the work does not pretend to be a dictionary of Surgery; and also that, although certain drugs are enumerated in discussing subjects of general therapeutics, and of poisons and their actions, there has been no intention to invade the domain of Materia Medica.

It is right to observe that all the articles have been edited and revised with great care, so as to ensure a completeness and unity in the work, which it is not always possible to obtain in books composed by a number of writers.

The Editor desires also to state that, although the work has occupied several years in preparation, arrangements were made with the printers which have enabled him to revise every article which required revision, up to the time of going to press. Further, by the addition of an Appendix it has been possible to incorporate the latest contributions to medical knowledge.

Having thus set forth the aims and objects of his undertaking, and how far they have been carried out, the Editor has the great satisfaction of offering his thanks to his friends and colleagues, for the valuable assistance which he has received from them. He is fully conscious of the trouble which must often have been necessary in order to condense extended knowledge of a familiar subject within the limited space which the nature of this work could afford.

The Editor has further the pleasing duty of offering his special thanks to Dr. Frederick T. Roberts and to Dr. J. Mitchell Bruce, who from the first have been his Assistant-editors and fellow-labourers. Without the help which they have afforded him, it would have been impossible for him to have fulfilled the duties which he undertook. He is well aware of the time and labour which their assistance has involved; and he appreciates most fully the marked ability by which it has been characterised.

The Editor cannot conclude without a reference to some of those who were his friends and colleagues when this work was commenced, but who have since been taken away by death. He would specially mention the names of Edmund Parkes, Charles Murchison, George Callender, Thomas Bevill Peacock, John Rose Cormack, Lockhart Clarke, Tilbury Fox, Thomas Hayden, Harry Leach, Alexander Silver. The loss of these eminent men, many of them dear and valued friends, and all of them taken too soon from their unfinished labours, is to him a source of personal sorrow. The articles written by them for these pages were in most instances their last contributions to medical literature, and will be valued accordingly.

London: *September* 1882.

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A
DICTIONARY OF MEDICINE.

A

ABDOMEN, Diseases of the. — Before entering upon the study of the particular diseases which are liable to be met with in connexion with each of the principal regions of the body, it is expedient to regard them from a general point of view, as such a course helps materially in clearing the way for their clinical investigation. This general survey is particularly advantageous in the case of abdominal diseases, which are necessarily very numerous and varied, both as regards the structure affected and the nature of the morbid change they present; they are consequently difficult to recognise with certainty in many instances, and are occasionally involved in much obscurity.

Excluding a few peculiar affections, the diseases of the abdomen may be arranged under the following groups:—

I. Diseases of the anterior abdominal walls.

II. Diseases of the peritoneum and its folds.

III. Diseases of the organs contained within the abdominal cavity, namely:— 1, Stomach and Intestines; 2, Hepatic organs, including the liver, gall-bladder, and gall-ducts; 3, Spleen; 4, Pancreas; 5, Supra-renal capsules; 6, Urinary apparatus, viz., the kidneys and their ducts, and the bladder; 7, Female generative organs, including the uterus and its broad ligament, the Fallopian tubes, and the ovaries; 8, Absorbent glands.

IV. Diseases of the abdominal vessels, especially the aorta and the iliac arteries.

V. Diseases of the sympathetic or other nerves contained within the abdomen.

VI. Diseases originating in connexion with the cellular tissue, such as inflammation or abscess.

VII. Diseases springing from the posterior boundary of the abdomen; from the pelvis or the structures lining it; or from the diaphragm, and invading the abdominal cavity.

VIII. Diseases encroaching upon the abdomen from other parts, especially from the thorax.

It must be borne in mind that the groups of diseases above-mentioned may be presented in various combinations, two or more structures being not uncommonly implicated at the same time.

The special nature and mode of origin of the diseases thus summarised will be discussed under their appropriate headings, but a few general observations on this subject may prove serviceable. Several of the abdominal organs are very liable to so-called *functional disorders*, being much exposed to the repeated action of various disturbing influences, and these disorders often give rise to prominent and troublesome symptoms, which are urgently complained of by the patient. Definite *organic diseases* are also of common occurrence, many of them being of a very serious character. Some of the organs contained within the abdomen are subject to *malposition* or *displacement*, as well as to *malformations*, these being either congenital or acquired; while the hollow viscera may be the seat of *obstruction* or *accumulations* of different kinds; and each of these conditions may become clinically important.

Abdominal lesions are frequently purely *local* in their origin, but several of them are but local manifestations of some general condition, being either associated with certain acute febrile diseases, *e.g.*, typhoid fever; or with some constitutional cachexia, such as cancer. Again, symptoms connected with the abdomen may depend upon disease in some remote part of the body, or some of its organs may become the seat of morbid changes as a consequence of disease in other structures. For instance, vomiting is frequently associated with cerebral disorders; while affections of the heart are liable to lead to troublesome symptoms, as well as to serious lesions in connexion with many of the abdominal viscera. Lastly, a morbid condition of one organ within the abdomen may be the direct means of originating *secondary* mischief in other structures.

Clinical Investigation.— The clinical examination of cases in which the symptoms point to the abdomen as the seat of mischief should always be conducted with particular care and thoroughness, as well as in a systematic manner, otherwise serious mistakes are liable to be made. It is also very desirable to avoid forming any definite conclusion as to the nature of the complaint hastily or on insufficient data, but rather to wait and observe the course of events in any doubtful case, repeating the investigation from time to time, when any obscurity which may exist will often be cleared away. The past and family history of the patient, with the course and progress of the symptoms, are often of material assistance in diagnosis, and demand due attention in every instance. The chief clinical phenomena which may be associated with abdominal affections, and with reference to which it is requisite to inquire, may be thus indicated. First, there are usually symptoms directly connected with the structure implicated, such as pain and other morbid sensations, disorders of secretory or other functions, or excited action. Secondly, several of the organs mutually affect each other, either from being anatomically or physiologically related, or from a morbid condition of one part causing pressure upon or irritation of some neighbouring structure. In this way numerous symptoms are liable to arise, sometimes in remote parts, and often of material significance. Thirdly, sympathetic or reflex phenomena in connexion with organs in other regions of the body are frequently excited by many abdominal disorders, such as palpitation of the heart, convulsions, and other nervous disturbances. Fourthly, the general system often suffers seriously, and in various ways. For instance, pyrexia may be excited; the blood may become impoverished or impregnated with noxious materials; or more or less general wasting and debility may be induced. Where an abdominal disease is but a local manifestation of some constitutional condition, it commonly aggravates materially the general symptoms; while in connexion with lesions of certain of the abdominal viscera these general symptoms constitute in many cases the most prominent clinical features. Fifthly, morbid conditions within the abdomen not unfrequently interfere directly with the diaphragm and the thoracic organs; occasionally also they invade upon the chest, or actually make their way into this cavity through the diaphragm. In rare instances morbid products, such as pus, may find their way to distant parts of the body. In these different ways a variety of symptoms may be caused, sometimes of a curious nature and difficult to explain. Lastly, abdominal diseases are frequently attended with abnormal physical or objective signs, which are revealed on physical examination, and these are of such importance that they demand separate consideration.

Physical Examination. — The neglect of submitting patients to a satisfactory physical examination is a frequent source of error in diagnosis in cases of abdominal disease, and there ought to be no hesitation or delay in resorting to this method of clinical investigation whenever it seems called for. The precise course to be pursued must vary according to circumstances, but the following outline will serve to indicate the plan of procedure ordinarily required.

First, there are certain modes of examination which are applied to the abdomen externally, including *Inspection*; *Palpation* or *Manipulation*; *Mensuration* or *Measurement*; *Percussion*; and *Auscultation* (*see* Physical Examination). Of these, inspection, palpation, and percussion are by far the most important, and have, in the large majority of cases, to be relied upon for the information required. In exceptional instances *Succussion* or shaking the patient proves serviceable, by bringing out certain sensations or sounds. In order to carry out these methods properly, it is necessary to expose the abdomen sufficiently, due regard being paid to decency in the examination of females; to place the patient in a suitable position; and to see that the muscles of the abdominal walls are duly relaxed. The best position usually is for the patient to lie on the back, in a half-reclining attitude, with the head and shoulders well raised, and the thighs and knees more or less flexed. This posture serves to relax the abdominal muscles, which may be further aided by taking off the patient's attention by conversation or in other ways, as well as by directing him to breathe deeply. The position, however, has often to be varied in the investigation of particular cases, and much information is frequently gained by noticing the effects of altering the posture.

The objective conditions which may be revealed by the modes of examination thus far considered are as follows:—1. The state of the superficial structures. 2. The size and shape of the abdomen, generally and locally, as indicating an alteration in the volume of the ordinary contents of the abdomen, or the presence of some new or fresh element, such as dropsical fluid or a tumour. 3. The characters of the abdominal respiratory movements; and the presence of any unusual sensations during the act of breathing, such as friction-fremitus. 4. The sensations experienced on palpation and percussion over the abdomen, either as a whole, or in any particular part of it, such as its mobility, degree of resistance, regularity, consistence, &c.; as well as the presence of certain peculiar sensations, *e.g.*, fluctuation, or hydatid-fremitus. 5. The presence and characters of any pulsation. 6. The occurrence of abnormal movements within the abdomen, as those of a fœtus. 7. The sounds elicited, generally and locally, on percussion. 8. The presence of certain sounds within the abdomen, heard on auscultation, such as friction-sounds; murmurs connected with aneurism or due to pressure on an artery; or murmurs and sounds associated with the pregnant uterus.

Secondly, it not uncommonly happens that special modes of examination have to be applied to particular organs within the abdomen, in order to arrive at a diagnosis with any certainty. And here it may be remarked that it is highly important in all cases to see that no accumulation of fæces exists within the bowels, and that the bladder is properly emptied, otherwise very serious mistakes are liable to be made. Purgatives and enemata are needed in order to remove any fæcal collection. The urine should also be properly tested in every instance; and much information may often be gained in the investigation of affections of the alimentary canal, from a personal inspection or more complete examination of fæces or vomited matters. The abdominal organs to which special modes of examination are chiefly applicable are the female generative organs, which are investigated per vaginam (*see* Womb, Diseases of); the bladder, by means of the catheter, the sound, and other surgical instruments; the stomach, by the use of the stomach-pump, probang, &c.; and the intestines, by examining with the finger, hand, or surgical instruments per rectum, or by injecting water or air through the anus into the bowels. The ordinary modes of examination already mentioned may afford assistance when employed along with some of the special methods just indicated.

Thirdly, occasionally it is requisite to have recourse to exceptional modes of investigation, such as the use of the exploring trochar or aspirator; or to the administration of chloroform. The latter may afford direct information in certain abdominal conditions, and it may also materially assist in carrying out other methods of exploration.

The abnormal conditions discoverable by physical examination may involve the entire abdomen, giving rise, for instance, to general enlargement or retraction; or they may be limited to some particular region, *e.g.*, enlarged organs, tumours, or abscesses. This part of the body has been artificially divided by anatomists into regions, and the seat of any local morbid condition can thus be defined and described. The diseases peculiar to the several regions will be considered under their respective headings.

FREDERICK T. ROBERTS.

ABDOMINAL ANEURISM includes aneurism of the aorta, and of any of its branches within the abdomen.

Aneurism of the Abdominal Aorta is essentially a disease of middle age. Of fifty-nine cases collected by Dr. Crisp, thirty-three were under the age of forty. It is more common in the male than in the female sex in the proportion of about 8 : 1; and is usually traceable to strain, or to a blow upon the abdomen or back. The aneurism is most frequently located in that portion of the vessel included between the aortic opening in the diaphragm and the origin of the superior mesenteric artery. In this situation the tumour is deeply seated; liable to tension from the crura of the diaphragm; and likely to involve the great splanchnic nerves, the semilunar ganglia, and the solar plexus. Hence the occasional difficulty of diagnosis; and the frequency of boring pain in the back from erosion of the vertebræ, and of paroxysms of radiating pain in the abdominal viscera from stretching of the adjacent nerves. When situated lower down in the course of the aorta, the disease is less obscure, and the symptoms are less urgent. Aneurism of the abdominal aorta is usually of the *false* variety; and, as contrasted with thoracic aneurism, it is less often associated with extensive atheroma of the aorta, and with fatty or other structural disease of the heart. The symptoms referable to excentric pressure are also fewer, and, with the exception of pain, are less urgent.

SYMPTOMS AND SIGNS.—Of the symptoms, *pain* is the most characteristic and the most urgent; it is of two kinds, which are not, however, necessarily associated. In its usual form the pain of abdominal aneurism is essentially neuralgic; it is intermittent and paroxysmal,—radiating through the abdomen, back, pelvis, and base of the thorax, and not unfrequently into either groin or testicle. The accession is sudden, and usually attributable to some definite cause of vascular excitement. The duration extends over a period varying from one to three hours, rarely longer; and the cessation is equally abrupt, leaving the patient in a state of exhaustion, but quite free from actual suffering. The second kind of pain referred to is continuous and boring; fixed at a particular point of the vertebral column; aggravated by pressure at this point, by active movement or stamping, and by gently turning the patient half round upon his axis in the standing posture; but relieved by anti-recumbency or leaning forward. Pain so characterised is pathognomonic of erosion of the vertebræ. Pressure of an aneurism may affect the functions of several organs within the abdomen. Thus *jaundice* may result from pressure upon the hepatic or common biliary duct: it is, however, more frequently due to an aneurism of the hepatic or of the superior mesenteric artery. *Interference with the urinary secretion*, and the consequences thereof, from pressure upon the renal vessels; *dysphagia* from pressure upon the œsophagus; *vomiting* from obstruction of the pylorus; *displacement* of the liver forwards, or of the heart upwards—though rare symptoms—may be likewise due to the same cause. The radial pulse is not often affected. Symptoms of *constitutional* irritation and impaired nutrition are rarely exhibited, and appear only at the termination of protracted and painful cases, assosociated with great suffering and want of sleep.

The *physical signs* are those discoverable by palpation, percussion, and auscultation. The tumour usually projects to the left of the mesial line, and tends to descend; it is smooth and elastic; communicating to the hand alternate movements of lifting and expansion with increasing tension, and of subsidence with relaxation. The pulsation is all but invariably single, and synchronous with the radial pulse; it is limited to the tumour, and occasionally accompanied by thrill. Pressure upon the aorta below the tumour will increase the force of impulse, diminish or abolish the thrill, and arrest the collapse. In a few recorded examples the tumour was hard and uneven on the surface, and non-expansile; and in a still smaller number no pulsation was perceptible, the aperture of communication with the artery having been blocked, or the vessel compressed on the proximal side by the growth of the aneurism itself. Owing to the position of the hollow viscera in front, and the mass of lumbar muscles behind, the evidence from percussion is less conclusive in regard to abdominal than thoracic aneurism. If, however, the abdominal muscles be relaxed, and the stomach and bowels free from flatus, absolute dulness to the extent of the tumour may be detected. A sound, single or double, as distinguished from murmur, is rarely heard in front in connexion with abdominal aneurism; whereas the existence of sound without murmur, and usually double, at a point of the posterior wall of the abdomen corresponding to the tumour, is the rule, and, when detected, is of the utmost diagnostic value. Murmur in the recumbent posture is rarely absent in front; it is single, blowing, prolonged, post-systolic, and not transmitted into the vessel beyond. It may, however, be musical, or it may present both these characters, but at dif-

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ferent points of the tumour; in one instance it was of a buzzing quality. Should the aneurism have taken an exclusively backward course, which is the exception, a single murmur, not audible in front, may be heard in the back. In a few recorded cases a double murmur has been heard over the aneurism in front. In the erect posture the murmur is usually suspended; but in a few published cases it was audible in both the erect and the recumbent posture, and in one at least in the erect posture only. These peculiarities depend upon the various conditions of the sac, its orifice, and its contents. A small aneurism engaging the posterior wall of the vessel only, and eroding the vertebræ, may be latent as to physical signs, though attended with severe fixed pain in the back.

Diagnosis.—The diagnosis of abdominal aneurism has reference mainly to its physical signs. Strong pulsation of the aorta, simulating that of aneurism, may exist in connexion with hysteria, uterine or intestinal irritation, dyspepsia, or copious hæmorrhage. But in all these cases, irrespectively of the positive and specific evidence presented by each, throbbing exists throughout the aorta, and is propagated into the main arteries of the lower limbs, whereas it is localised in aneurism; and a careful exploration of the aorta, if necessary under the influence of chloroform, will show that its dimensions are at all points normal. In these cases, too, although a murmur may be produced by strong pressure with the stethoscope, it does not exist when pressure is withdrawn. A cancerous or other tumour pressing upon the aorta may likewise produce murmur, and may exhibit pulsation communicated from the aorta; but in most cases both these phenomena are promptly arrested by placing the body in the prone position; the tumour, in that position, gravitating *from* the vessel. The fixed local pain in the back, aggravated by pressure and motion, may be simulated by spinal rheumatism; and the paroxysmal visceral pain by biliary colic. The differential diagnosis must rest upon the specific evidence in each case, and upon the absence of the signs of aneurism.

Aneurism of the Branches of the Abdominal Aorta.—The branches most liable to aneurism are the common iliacs and their divisions; the cœliac axis and its branches; the renal and the superior mesenteric. *Aneurism of the Iliac Arteries* belongs to the domain of surgery, and will not be further referred to here. *Aneurism of the Cœliac Axis* and of its branches of division, and of the *Superior Mesenteric Artery*, are, in addition to the ordinary signs, equally characterized by mobility; and the first two varieties by jaundice, hæmatemesis, and melæna, from pressure. Renal aneurism may cause obstruction in the kidney or renal colic by pressure on the structures in the hilus.

Duration and Terminations.—The duration of life in cases of abdominal aneurism has, in the writer's experience, varied from fifteen days to eleven years. Death occurs usually (1) by rupture of the sac into (*a*) the retro-peritoneal tissue; (*b*) the cavity of the peritoneum; (*c*) the left pleura or lung; (*d*) the intestinal canal; (*e*) the inferior cava; (*f*) the psoas muscle; (*g*) the pelvis of the kidney; (*h*) the spinal canal; or (*i*) the ureter, biliary passages, or œsophagus; and in the order of relative frequency just given; or (2) by exhaustion or syncope. The duration of life after the rupture of the aneurism has ranged from a few minutes to several weeks. A consecutive false aneurism of the retro-peritoneum is specially characterised by feeble pulsation of the tumour, and diminished or arrested circulation in the femoral artery of one or both sides.

Treatment.—The *Curative* treatment of abdominal aneurism may be considered under three heads—*Mechanical*, *Postural* and *Dietetic*, and *Medicinal*. Mechanical treatment consists in pressure applied to the aorta on the proximal side of the sac, or simultaneously on its proximal and distal sides, by means of tourniquets, so as completely to stop the circulation. The bowels should be first well moved and freed from flatus; and during the continuance of pressure the patient should be kept under the influence of chloroform or ether. Five cases, if not more, in which a cure was effected by these means have been reported. The object sought to be attained being that of effecting rapid coagulation in the sac, the period during which pressure needs to be continued in these cases varies from three quarters of an hour to ten hours and a half. Where space for the application of proximal pressure does not exist, distal pressure alone may be tried. Under all circumstances, pressure must be used with circumspection, as inflammation of the peritoneum or of the bowels may result from it.

Bellingham introduced the plan of treatment by posture and restricted diet. Under this plan perfect repose of mind and body is, as far as practicable, to be maintained; the bowels being kept moderately free, and the dietary restricted to 10 oz. of solids and 6 oz. of liquids daily. According to the method of Mr. Tufnell, which is based upon the same principle, but is more rigid, the patient is strictly confined to the horizontal posture for a period varying from eight to thirteen weeks, as determined by the effect upon the aneurism, movement in bed being effected with caution; whilst, by a special arrangement, the bowels and the bladder may be evacuated without disturbance of the body. For breakfast, 2 oz. of white bread and butter, with 2 oz. of cocoa or milk, are allowed; for dinner, 3 oz. of meat, with 3 oz. of potatoes or bread, and 4 oz. of water or claret; and for supper, 2 oz. of bread and butter, and 2 oz. of milk or tea. The total amount in the twenty-four hours would be, solids 10 oz., liquids 8 oz. This system might be in some degree relaxed if the patient prove restive. Mild laxatives and opiates as required are the only medicines used. Ten cases of the successful treatment of aortic aneurism by this method have been reported by Mr. Tufnell. Abdominal aneurism was solidified in two instances, after treatment extending over thirty-seven and twenty-one days respectively.

Of the various medicinal agents used with a view to favouring or effecting a deposit of laminated fibrin in the sac, acetate of lead, iodide of potassium, aconite, and ergotin (hypodermically), alone claim attention. Iodide of potassium may be given with advantage in doses of 10 to 20 grs. thrice daily, with a view to reducing vascular tension, and thereby relieving pain and promoting deposition in the sac, whilst perfect rest in the recumbent posture and a restricted dietary are observed. The latter are, however, the more important factors in the treatment. Dr. G. W. Balfour has reported several cases successfully treated by means of iodide of potassium; and recently an example of a similar kind has been published by Dr. Dyce Duckworth. Dr. Grimshaw has lately had an example of cure mainly through the use of aconite. At the same time the allowance of liquids must be reduced to the lowest possible standard, whilst excretion is promoted. Alcoholic stimulants may be given in small quantity and at long intervals, if the pulse exhibit debility and the patient complain of a sensation of sinking; otherwise they should be prohibited.

The *Palliative* treatment as applied to Abdominal Aneurism will be found described in the article AORTA, Diseases of (*Aneurism*). The application of a few leeches, followed by a warm poultice, is very efficacious in relieving pain. The hypodermic use of morphia is still more rapidly effective. THOMAS HAYDEN.

ABDOMINAL TYPHUS.—A synonym for Typhoid Fever. *See* TYPHOID FEVER.

ABDOMINAL WALLS, Diseases of. But little more will be needed in this article than to give a brief outline of the nature of the affections to which the abdominal walls are liable, as most of these are but local forms of diseases which are fully described in other parts of this work. The parietal peritoneum will be excluded from consideration, as its morbid conditions are treated of separately.

1. SUPERFICIAL AFFECTIONS. — *a.* The skin covering the abdomen may be the seat of various eruptions. The rash of typhoid fever is chiefly observed over this region. *b.* When the abdomen is greatly enlarged, its cutaneous covering becomes stretched and thinned, often presenting a shining appearance: this may even give way, so that it exhibits superficial cracks or fissures. If it has been distended for a considerable time or on several occasions, as after repeated pregnancies, the skin becomes impaired in its structure, and is often the seat of permanent white lines or furrows—*lineæ albicantes.* In this connection allusion may be made to the umbilicus, which, in certain forms of distension of the abdomen, may become pouched out, everted, or actually obliterated. *c.* The veins of the skin frequently become enlarged and tortuous, when the return of the blood which is normally conveyed through them is in any way impeded. The particular vessels which are distended will necessarily depend upon the seat of the obstruction. *d.* The cutaneous sensibility over the abdomen is sometimes materially altered. In certain nervous diseases it may become more or less impaired or lost; but the most important deviation is a marked increase of sensibility—*hyperæthesia*—which is occasionally observed in hysterical females, and which may simulate more serious affections, particularly peritonitis, especially if it is accompanied with symptoms of much depression. This condition is characterised by extreme *superficial* sensibility or tenderness of the abdomen, the slightest touch being resented; but if the patient's attention can be taken off, and deep pressure be then made, this is borne with little or no indication of distress. The aspect of the patient, the presence of other symptoms indicative of hysteria, and the absence of pyrexia, usually serve to distinguish this affection from others of a graver nature. The surface of the abdomen may also be affected with neuralgia, which is sometimes very severe.

2. SUBCUTANEOUS ACCUMULATIONS. — *a.* The chief morbid condition coming under this head is *œdema* or *dropsy* of the subcutaneous tissue. This generally follows anasarca of the legs, and may be associated with ascites. The fluid tends to collect especially in the lower part of the abdominal walls and towards the flanks. The skin often presents a white pasty aspect; the abdomen may be more or less enlarged; the umbilicus appears depressed and sunken, if the œdema extends up to this level; the superficial structures pit on pressure, and yield the peculiar sensation of dropsical tissues; and the percussion note is frequently muffled. *b.* The abdominal subcutaneous tissue is, in many persons, the seat of an abundant collection of fat, which may be important from its causing general enlargement, and simulating or obscuring other more serious morbid conditions which enlarge the abdomen.

3. AFFECTIONS OF THE MUSCLES AND APONEUROSES.—*a.* The abdominal walls may be the seat of muscular rheumatism, which is particularly likely to follow undue straining, such as that caused by violent coughing or vomiting. It is characterised by pain, sometimes severe, evidently located in the muscular and tendinous structures, accompanied with much soreness and tenderness. The affected parts are kept as much at rest as possible, and any action which disturbs them materially aggravates the pain. *b.* As the result of violent strain, the muscular or aponeurotic tissues may be more or less torn or ruptured. As a consequence a protrusion of some internal structure may take place, forming a hernia. *c.* The abdominal muscles are liable to be the seat of spasmodic contractions, cramp, or rigidity. These are not uncommonly excited in sympathy with grave disturbance of the alimentary canal, as in cholera. In certain painful internal affections also some of the abdominal muscles are occasionally kept in a state of more or less rigid tension, as if they were involuntarily contracted in order to protect the diseased parts underneath from injury. The spasmodic contractions in tetanus not unfrequently cause great suffering over the abdomen. *d.* On the other hand, the abdominal muscles are occasionally paralysed, as the result of centric nervous disease. The movements of respiration are then altered in character; while the expulsive acts in which the abdominal muscles naturally take part are much interfered with.

4. RELAXED ABDOMINAL WALLS.—All the structures forming the walls of the abdomen are often in a relaxed and flabby state, yielding to any pressure from within, so that the abdomen becomes enlarged and prominent, especially if,

as is frequently the case, this condition is associated with much flatulence. It materially weakens the act of defæcation, and promotes constipation.

5. INFLAMMATION AND ABSCESS.—Local inflammation may be set up in any of the abdominal structures, and this may terminate in suppuration and the formation of an abscess. Purulent accumulations from within, as in cases of pelvic abscess, as well as certain abscesses originating in diseases of bones or joints, may likewise extend among the tissues of the abdominal walls, causing thickening and induration, or may make their way outwards, directly or through a sinus. Subsequently permanent sinuses or fistulæ may be left.

6. The abdominal wall may be the seat of *extravasation of blood*; and various kinds of *tumour* or *new growth* may form in its structures.

FREDERICK T. ROBERTS.

ABERRATION.—A divergence or wandering from the usual course or condition; applied in medicine chiefly to certain disorders of the mental faculties. *See* INSANITY.

ABORTION.—The *act of abortion* signifies the expulsion of the contents of the pregnant uterus before the seventh month of gestation. *An abortion* is a designation given to a fœtus prematurely expelled. *See* MISCARRIAGE.

ABSCESS (*abscedo*, I depart). SYNON.: Fr. *abcès*; Ger. *Eiterbeule*; *Geschwür*.

DEFINITION.—A collection of purulent matter, one of the results of inflammation. *See* PUS and INFLAMMATION.

PATHOLOGY.—If the material which collects in a tissue as the consequence of inflammation softens and becomes liquid (suppuration), it does so either rapidly or slowly: if the former, the result is an *acute* abscess; if the latter, the abscess is termed *chronic* or *cold*. If the material thus softened and forming pus, often mingled with fragments of dead tissue, is limited by condensation of the parts around, which are usually consolidated by the products of inflammation, the abscess is said to be *circumscribed*; but if the surrounding parts in their turn soften, so as practically to offer no barrier to the pus, then the abscess spreads and is said to be *diffused*. In an *acute circumscribed* abscess the lymph which collects around it as the result of inflammation becomes organised and forms a sac (pyogenic membrane); and this, with the compressed tissue about it, is the wall of the abscess, consisting therefore of contents (pus), of a limiting sac, and of condensed tissue around. The resistance offered to the extension of the suppuration is greatest when the parts adjacent are dense and tough, such as bone and fascia; yet, as the pus in an abscess increases in quantity, probably by breaking down of the pyogenic layer, sufficient pressure is exerted to cause the most dense structures to yield, and an abscess will thus make its way even through osseous tissue. As might be expected, an abscess always advances in the direction of least resistance, and this extension is spoken of as its *pointing*. This pointing may be towards the surface of the body, but an abscess may direct itself towards a serous cavity, such as the peritoneum, or along a track of cellular tissue, as when pus beneath the deep cervical fascia points into the mediastinum. On the side at which the abscess is pointing, its wall, as the resistance lessens, projects; and by ulcerative absorption the parts covering it become quickly thinner, until they and the abscess-wall give way and the pus escapes. In by far the greater number of cases this absorption of tissue before the pointing abscess is towards the surface, and it is by ulceration of the skin that the opening for the discharge of the matter is effected. The wall of the abscess then contracts, pus continuing for a time to be discharged; and in the end, aided by the resilience of the tissues around, the sac of the abscess is obliterated, and the orifice through which its contents were discharged heals by granulation process. To ensure this result the walls must be left at rest, or the granulations which cover them will fail to unite, and the obliteration of the sac will not then take place, as happens for example in the case of an abscess situated between the moveable rectum on the one side and the ischium on the other, where the opposite abscess-walls are prevented from joining by muscular movements on the side of the bowel, and will only unite after such movements have been stopped by cutting across the muscular fibres which occasion them. The track which results from such failure of the healing of an abscess is called a *sinus* or *fistula*.

In a *diffused* abscess the inflammation of the parts around does not limit the suppuration by organisation of the effused lymph, but such lymph, itself degenerating, forms more pus, and so the abscess extends rapidly and widely, unless checked by some barrier of dense tissue. In this way matter often spreads along tracks of cellular tissue, as along the course of veins, and in the subcutaneous structures. An abscess when formed between bone and periosteum, or otherwise hindered from reaching the surface by pointing, also tends to diffuse itself by following the course of least resistance. In most of these cases by direct pressure upon the resisting tissue or by cutting off the blood supply (as of the skin when its subcutaneous tissue is infiltrated with pus), sloughing of the parts covering in the abscess ensues, oftentimes to a considerable extent, and so the pus eventually makes its way to the surface. It is these abscesses, spreading along tracks of tissue before they can reach the surface, which are apt, however, when involving certain parts, such as the course of some of the lumbar nerves, to burst into a serous cavity with fatal consequences.

A *chronic* abscess begins in some local inflammation without active symptoms, such as results in the deposit of aplastic lymph and subsequent ulcerative changes, as caries of bone, the irritation leading to suppuration. The formation of matter proceeds in a languid manner, so that it is only by slow degrees that it collects in any considerable quantity, although eventually these chronic abscesses may acquire great size. They slowly point, and in their tardy advance occasionally traverse even serous cavities, which have been first obliterated in the line of transit by adhesive inflammation of their opposed surfaces: in this way an abscess formed in the liver (and this holds good also for those of a more acute character) may travel through the layers of the peritoneum, and may point through the anterior wall of the abdomen.

When an abscess discharges, its contents are seen to be either a thick yellow (*laudable*) pus, or pus stained with blood, or otherwise coloured, such as black or bluish-green; or the pus may be thin, almost watery, mingled with flakes of lymph; it may be inodorous or fœtid, or irritating to the touch (*ichorous*). Abscesses may also contain sloughs of tissue, or foreign bodies, or masses of inspissated pus, as hard occasionally as calculi, or fragments of dead bone, or calculi of various kinds. Sometimes a chronic abscess ceases to enlarge and if the irritation which occasioned it comes to an end, it may diminish by absorption of the fluid part of its contents, the solid drying up into a shrunken putty-like mass. It may remain in this state without giving rise to trouble, or it may become again the seat of suppuration by the formation of what under such circumstances has been termed by Sir James Paget a *residual abscess*.

The *progress* of any abscess is largely influenced by the state of the general health. In persons otherwise robust an abscess commonly runs an acute course; in those weakened by acute illness, such as scarlet fever or typhus, they form quickly, but are slowly recovered from, and severely tax by an exhausting discharge the powers of the patient. Persons in feeble health, hereditary or acquired, usually suffer from the chronic and diffused forms; and chronic affections of internal organs, as of the liver or kidneys, are not unfrequently associated with the development of such abscesses.

ÆTIOLOGY.—The cause of an *acute* abscess may be an injury, such as a blow or pressure, as often happens in persons weakened by continued fever; exposure; or the irritation of a foreign body, or that of a poison introduced from without. In the last case the abscess is often diffused. Abscess running an acute course may also be due to a foreign body or to an irritant from within, as when it follows necrosis of a portion of bone, or the escape of urine into the tissues of the perineum. It also arises in connection with blood-poisoning, as in various fevers, and affections distinguished as septic. The cause of a *chronic* abscess is usually found in changes which go with deposits of a tuberculous character; or it is found in the changes which slowly occur around an irritating body, such as a renal calculus; or chronic inflammatory changes may culminate in one of these collections of matter. They may also form in parts which are long congested in connection with obstructed vein circulation (*varix*); and they may follow, or conditions closely allied may follow, the occlusion of a main artery and the consequent cutting off of the supply of blood to a particular region.

SYMPTOMS.—The symptoms of an *acute* abscess are those of a local inflammation, with constitutional disturbance if the abscess is of any size; followed by a sense of cold or actual shivering, with increase of pain and swelling, tenderness, and throbbing. The tenderness can be recognised in the case of most abscesses; and, if pus is formed anywhere near the surface, the presence of the fluid is detected by its fluctuation. The severity of the pain is much influenced by the site of the abscess, as when the pus is held down and hindered from pointing by dense structures, such as fasciæ. Special symptoms may also arise in connection with the situation of the suppuration, as when urgent dyspnœa is caused by the pressure on the larynx of an abscess deeply seated at the base of the tongue. A *diffused* abscess, if subcutaneous, is recognised by its rapid spreading, and may be suspected if other signs point to a part as the site of the abscess in which diffusion is the rule, as, for instance, by the side of the rectum in the ischio-rectal fossa.

Of *chronic* abscess there is seldom in its early stage any evidence. The symptoms, if any, are those of failing health, and for the rest are marked by those of other changes from which the abscess is an outcome. Thus in disease of the hip joint or of the spine, unless an attack of shivering chances to attract attention, an abscess is not as a rule suspected until it has broken through its first limits, and has attained considerable size. It is not worth while to attempt to distinguish between chronic abscess and other swellings, such as extravasated blood or soft tumours, especially malignant tumours; for if a doubt in any case arises, it can be at once solved by the introduction of a grooved needle or of a fine trochar into the swelling. The true pulsation in an aneurism sufficiently tells its nature, and is not easily mistaken for the impulse sometimes given to an abscess by an adjacent artery.

VARIETIES.—The chief local varieties of abscesses which are likely to be met with in medical practice may be thus arranged:—1. Subcutaneous or more deeply seated abscesses in the limbs, in connection with low fevers, erysipelas, pyæmia, &c. 2. Abscesses of local origin in the walls of the abdomen or chest. 3. Abscesses originating in serous membranes. 4. Certain special abscesses associated with diseased bone, *e.g.*, psoas and lumbar abscess. 5. Abscesses formed in the cellular tissue around organs, *e.g.*, peri-nephritic, peri-cæcal, &c. 6. Abscesses originating in inflammation of organs, the chief of which include hepatic, renal, pyelitic, pulmonary, mammary, cerebral, splenic, pancreatic. 7. Obscure abscesses formed in the deep cellular tissue, *e.g.*, retro-pharyngeal, ischio-rectal, mediastinal. 8. Glandular abscesses, which are usually chronic and of a scrofulous nature.

TREATMENT.—The treatment of an *acute* abscess consists in rest, soothing local applications, and the use of remedies to allay pain and constitutional disturbance, if the latter exists. As soon as the presence of pus is recognised the abscess must be opened, if possible where the matter is most dependent; and as soon as its contents have escaped all troublesome symptoms will usually disappear. The opening is needed to relieve pain, and to prevent in some cases diffusion, and sometimes to relieve urgent distress, as when dyspnœa is caused by the pressure of an abscess upon the air-passages. It is also desirable to open an abscess to avoid the considerable scar which must result if the matter is left to escape by ulceration and sloughing of the superficial tissues. If it is important to avoid the scar of an incised wound, an abscess may be punctured in several places with a grooved needle, when the punctures, if kept open, will effectually drain off the pus, and the marks left will in the end be scarcely discernible. In most cases, however, it is necessary to open an abscess by an incision: a narrow double-edged knife should be used; and if the matter is deeply seated, the superficial parts only need be cut, the deeper being torn through, as Mr. Hilton recommends, by dressing forceps: the risk of dividing important structures, as in the neck, is thus avoided. After the pus has escaped, the wound should be kept open by means of a drainage tube (unless the abscess is of insignificant size), which is conveniently made by introducing a twisted slip of thin gutta-percha tissue or of oiled silk, and should be covered with carbolised oil on lint, or with a poultice of linseed and ferralum. Some surgeons protect the wound whilst operating by means of the carbolic spray or by a piece of linen steeped in carbolic lotion (1 in 20), or take other antiseptic precautions. The drainage tube should be withdrawn after the first day if the abscess is superficial, but if the pus has been deeply seated it should be only gradually withdrawn, portions being cut off as the abscess contracts. If a foreign body has caused the formation of the abscess, it must be sought for and removed before the suppuration can be expected to cease. Occasionally the vascular wall of an abscess bleeds freely, or a vessel is opened in the progress of the affection: the hæmorrhage usually ceases on laying the abscess freely open; but if this does not suffice it may be permanently controlled by pressure, and the cases are rare in which further operative interference is called for. Inflammation of the sac used not infrequently to follow the discharge of its contents, but under the treatment now employed such an occurrence is unknown. During the healing of any considerable abscess the general health should be attended to, and tonics and change of air may be useful to expedite recovery.

Diffused abscesses, whether subcutaneous or more deeply seated, require free incisions as soon as suppuration is even suspected, so as to avoid the damage which results from their spreading and from the sloughing of tissue, as of the skin, which will otherwise occur, especially with those due to poison introduced into the system or those caused by infiltration of urine. These abscesses sometimes lead to fatal results.

A *chronic* abscess may have its contents drawn off by the aspirator; or it may, when it has come near the surface, be opened, drained, and dressed with carbolised oil on lint, without any risk of constitutional disturbance, but its ultimate closing will depend upon the removal of the cause; if, for example, it is due to disease of a joint, it cannot be cured until the disease in which it has originated has in some way ended.

Sinus.—An abscess after being opened may contract until it forms a narrow track, *sinus* or *fistula*, leading to the site of primary irritation. Such a track has a dense fibrous wall from which muco-purulent fluid escapes: it may also convey secretions, as from the liver (*hepatic fistula*) or stomach (*gastric fistula*), or excretion, as from the kidneys; or it may simply carry out the pus which forms around some irritant at the deep extremity, such as a foreign body, a portion of carious or of necrosed bone. Some such fistulæ are due to the movements of adjacent muscles preventing union of the abscess walls. Unless the cause of the sinus can be removed, as by extracting necrosed bone, these fistulous tracks are difficult to manage, requiring especial treatment according to their situation. Other *fistulæ* are those forming communications between mucous canals (*recto-vesical*, *vesico-vaginal fistulæ*), and these need special treatment, such as plastic operations and operations diverting the course of excreta escaping through unnatural channels.

The tissue about healed abscesses, scar-tissue generally, and tissue spoiled by inflammation, are apt on slight provocation to inflame and suppurate, and to those collections of matter the term '*residual*' has been applied. The treatment of such abscesses in no way differs from that of others, and they usually heal in the ordinary manner. G. W. Callender.

ABSINTHISM.—Definition.—The condition induced by the undue imbibition of absinthe.

From the mode in which absinthe is taken, we should expect that the symptoms induced by its excessive consumption would be generally obscured by, and intermixed with those of alcohol (*see* Alcoholism). That it has a special effect on the organism, and that this may be diagnosed from alcoholism, has been pointed out by Motet, Magnan, and other French physicians; and the writer last-mentioned has clearly exemplified its action by numerous experiments on dogs. In persistent absinthe-drinkers vertigo and epileptiform convulsions are marked symptoms, and come on much earlier than when alcohol in other forms is habitually drunk. Hallucinations occur also without any other symptom of delirium tremens; and, when tremors coexist, these are limited more particularly to the muscles of the arms, hands, and upper extremities. Absinthe acts chiefly on the cervical portion of the spinal cord, and this readily explains the special symptoms arising from its regular use. John Curnow.

ABSORBENT AGENTS.—Definition.—In *Surgery*, absorbents are substances used to absorb fluids, as sponges, charpie, or tow: in *Medicine*, drugs which neutralize excessive acidity in the stomach—a synonym for alkalis (*see* Alkalis). The term is sometimes also made use of to designate remedies, such as the preparations of mercury and iodine, which are believed to possess the property of promoting the absorption of morbid products.

ABSORBENT VESSELS and GLANDS, Diseases of. *See* Lymphatic System, Diseases of; also Bronchial, and Mesenteric Glands, Diseases of.

ACARUS.—*Acari* or *Mites* constitute an order of the class *Arachnida*, several species of which are parasitic. The *Acarus scabiei* or *Sarcoptes hominis*, and the *Acarus folliculorum*, or more properly the *Steatozoon folliculorum*, are the only human parasites belonging to this family.

Description. — 1. The Acarus scabiei is a small roundish animal, just visible to the naked eye. Examined under the microscope it is seen to be flattened and to resemble a tortoise in shape; when fully developed it has eight legs, and on its under surface are scattered filaments and short spines, which are for the most part directed backwards. The female is larger than the male, and is provided with terminal suckers on the four anterior legs, while filaments occupy a similar position on the posterior ones; in the male, however, the two extreme hind legs have suckers like those on its fore limbs. The young *Acarus* has only six legs, the two hindmost ones, which are distinctive of the sex, being wanting; it acquires these after shedding its first skin. The male *Acarus* lives near the surface of the skin, while the female burrows within the cuticle, and deposits from ten to fifteen eggs in the cuniculus or burrow; these eggs hatch in about a fortnight. The young *Acari* escape from the burrow, but the parent does not leave it, and dies when she has finished laying eggs. The *Acarus scabiei* is the cause of the skin-affection termed *Scabies* or *Itch* (*see* Scabies).

2. The Acarus folliculorum is a very minute parasite commonly found in the sebaceous and hair follicles of the face, but its presence can hardly be regarded as indicating disease. In this animal the head is continuous with the thorax, and to the latter are attached eight very short legs, each armed with three strong claws. On each side of the head are short jointed palpi. The abdomen varies in length from twice to three or four times that of the thorax: it is pointed at its distal extremity. The presence of this parasite in the follicles of the skin is quite unimportant.
Robert Liveing.

ACCOMMODATION, Disorders of.—*See* Vision, Disorders of.

ACEPHALOCYST (ἀ, priv.; κεφαλή, a head; and κύστις, a bladder).—A headless cyst or hydatid.—This term was formerly much employed to distinguish the true hydatid from all those bladderworms that are furnished with a head visible to the naked eye. The expression is a misnomer and should be abandoned, since it is only fairly applicable to such hydatids as have failed to develop the so-called heads internally. The *Acephalocystis endogena* of John Hunter and the *A exogena* of Kuhl are merely varieties of the true hydatid (*Echinococcus veterinorum*, or *E. hominis*). *See* Hydatids, Echinococcus, and Bladderworms.
T. S. Cobbold.

ACHOLIA (ἀ, priv., and χολή, bile).—Absence or deficiency of bile. *See* Bile, Morbid states of.

ACHOR.—A small follicular pustule of the scalp. Willan's definition is as follows:—'A small acuminated pustule containing a straw-coloured matter, which has the appearance and nearly the consistence of strained honey, and is succeeded by a thin brown or yellowish scab.' Both the pustule and the scab are constituents of the disease *Porrigo*. The word has fallen into disuse, but is preserved by Schönlein in the name 'Achorion' assigned by him to one of the varieties of parasitic cutaneous fungi. The Greek word ἀχὼρ signifies scurf, or dandruff; ἀχυρὸν meaning chaff.
Erasmus Wilson.

ACHORION (ἀχὼρ, scurf) is the name given to one of the three principal dermophytes or epiphytes of the skin. It is the constituent of the crusts of Favus (Achor), and belongs to the group of fungoid plants denominated *Oidium* It consists of spores, sporidia or tubes filled with spores, and empty branched tubes or mycelium.

Achorion was the first discovered of the epiphytes of the skin, and in compliment to one of its early observers, Schönlein, has been named *Achorion Schönleinii*. It is supposed to be the agent of contagion in Favus; it has also been found in the loose cell-structure beneath the nail in Onychogryphosis.
Erasmus Wilson.

ACHROMA (ἀ, priv., and χρῶμα, colour). Absence of colour; an achromatous or colourless state of an usually coloured tissue, due to absence of pigment. In reference to the skin Achroma is synonymous with Leucoderma, Albinism, and Alphosis. *See* Pigmentary Skin-Diseases.

ACHROMATOPSIA (ἀ, priv.; χρῶμα, colour; and ὤψ, sight).—More or less complete inability to distinguish colours from each other. *See* Vision, Disorders of.

ACIDITY.—Acids are constantly passing out of the body by the lungs, the skin, and the kidneys. These acids, if we except the small quantity introduced from without in the form of acid salts of certain articles of food, are formed within the body by the disintegration and oxidation of the tissues and food. If the oxidation of organic substances in the system were complete, the sole products of their combustion would be carbonic acid, water, and urea; but as this oxidation is never actually complete, other products, as lactic acid, oxalic acid, uric acid, etc., are formed; and the increased or diminished production of these intermediary products may be regarded as the measure of the completeness with which the oxidation processes are being performed in the body. The quantity of acid matter passing through the blood on its way to the lungs, the skin, and the kidneys is considerable; since it has been shown approximatively, that a healthy man of eleven stone weight, under ordinary circumstances, passes by the two first channels an average of 890 grammes (about 28 ounces) of carbonic acid daily, and that the acid excreted by the kidneys in the same period is equivalent to two grammes (about 31 grains) of crystallised oxalic acid; whilst the volatile fatty acids passing off with the sweat have not yet been satisfactorily calculated. It is evident that if the regular elimination of this acid, by any of these channels, be interfered with, it will tend to accumulate in the system. Acidity, or excess of acid in the body, therefore depends on two causes: —1. *Excessive formation*, the result of incomplete oxidation of the elements of the tissues and the food. 2. *Deficient elimination* of acid formed either in normal or abnormal quantities. Both these causes, however, are generally found acting in conjunction. Oxidation is imperfectly performed, when an insufficient quantity of oxygen is introduced into the body, owing to insufficiency of the respiratory act, the result of disease or of sedentary habits; or when the blood is poor in red corpuscles, the carriers of oxygen, as in leucocythæmia; or from functional derangement of some large gland, as the liver, where oxidizing processes are extensively wrought. Again, the materials submitted to the influence of the oxygen within the body may be so increased, as is the case in febrile conditions, or in general plethora induced by over-feeding and insufficient exercise, that the supply of oxygen may prove insufficient for their complete combustion. Defective elimination of the acids formed within the body is due either to diseased conditions which prevent, or to want of the physiological stimulus which excites, the lungs, skin, and kidneys to exercise their respective functions properly. It will be seen, therefore, that acidity may arise in consequence of the disturbing influence of disease; or may be acquired or inherited as the penalty of transgression of certain laws of health—as the result of unfavourable hygienic conditions. In the former case, acidity is only secondary, and is generally subordinate to the disease producing it, and has rarely to be considered apart from it; whilst in the latter instance acidity is usually at first the only trouble, leading, however, if disregarded to secondary mischiefs.

Effects.—The mucous membranes and skin chiefly suffer in acidity. The former become subject to catarrh, produced, no doubt, by the irritating presence of the acid. Acidity may thus cause bronchitis, gastro-intestinal catarrh, and catarrh of the genito-urinary tract. Sometimes the acid is poured out in such quantities from the mucous membrane of the stomach as to be ejected from the mouth. In these cases digestion is considerably interfered with by the too acid condition of the gastric juice. Sometimes, however, this acidity of the stomach is produced by an opposite condition—the deficiency of the digestive fluid, and consequent acid fermentation of the food. Abnormal acidity of the urine produces not only catarrh of the urinary passages, but by decomposing the salts of uric acid causes a deposit of insoluble uric acid in the passages, thus giving rise to attacks of gravel or leading to the formation of a calculus. Acidity manifests itself in the skin by attacks of erythema, herpes, eczema, and urticuria. Rheumatism, too, may be considered as a disease resulting from the formation of acid, affecting chiefly fibrous and serous membrane; no one can witness the enormous quantities of acid sweat poured out, and the highly acid urine, in the acute form of this disease, without acknowledging that an increased formation of acid is taking place somewhere in the body; though perhaps unwilling to commit himself to accept any of the views hitherto advanced as to the nature of the acid.

Estimation of Acid.—For clinical purposes an estimation of the acidity of the urine furnishes the physician with an approximate clue as to the amount of acid formed in and passing out of the body. This is done by collecting the urine for twenty-four hours, placing 100 c.c. of this in a beaker, and then adding a solution of sodium hydrate, standardised so that 1 c.c. = ·01 gramme of crystallised oxalic acid, from a Mohr's burette, till the fluid is neutralised; the number of c.c.'s of the standard solution required to effect this is to be multiplied by ·01, which gives the percentage acidity in terms of oxalic acid; to ascertain from this the total amount of acid in the twenty-four hours' urine is only a matter of calculation. Too much dependence must not, however, be placed on the urine as a means of estimating excess or deficiency of acid in the system; it sometimes happens that in highly acid conditions the urine is alkaline. This, as Dr. Bence Jones has shown, may occur when large quantities of acid fluid are poured out of the stomach; and Prout long ago observed, that in the eczema of gouty persons the urine, so long as the disease persisted, was either of low acidity or alkaline, but that the subsidence of the eczema was frequently followed by an over-acid condition of the urine, accompanied with renal and vesical catarrh.

Treatment.—The general indications for the treatment of acidity consist in the promotion of oxidation, and the elimination of the acids formed. Active habits, which promote the pulmonary and cutaneous functions, should be encouraged. The diet should be just sufficient to meet the physiological requirements of the body; it should consist chiefly of fish, fowl, game, and eggs; saccharine and farinaceous articles being excluded. Sweet and cheap wines should be avoided; for those who cannot afford to purchase good wine, pure spirits and water is the best substitute. Carlsbad salts or Friedrichshall water may be given if there is much abdominal plethora; the habit of taking mercurials as a relief for this condition is to be deprecated. Alkaline medicines are frequently administered with a view of neutralising the effects of acid; their employment for this purpose seems, however, questionable. Dr. Parkes has stated that the administration of bicarbonate of potash (a favourite remedy in acid diseases), though rendering the urine alkaline, in reality increases very largely the excretion of the organic acids. This is not to be wondered at when we consider that the bicarbonate, although alkaline in reaction, is in constitution an acid salt. The nitric and hydrochloric acids, given in moderate doses about one hour before meals, certainly have a powerful oxidising effect, and diminish the quantity of uric acid excreted in the urine. In cases where the acidity is manifestly due to defective oxidation consequent on poverty of blood from diminution of the red corpuscles, iron and food must be freely given.

ACIDS. — Definition. — Substances which combine with alkalis, and destroy their power of turning red litmus paper blue. Most of the acids also redden blue litmus, and have a sour taste; but some, for example, carbolic acid, possess neither of these properties.

Enumeration.—Acids may be divided into *Inorganic* or *Mineral*, and *Organic*. The mineral acids used in medicine are Carbonic, Hydrochloric, Nitric, Nitrohydrochloric, Phosphoric, Sulphuric and Sulphurous acids. The organic acids thus employed include Acetic, Benzoic, and Carbolic, Citric, Gallic, Hydrocyanic, Lactic, Salicylic, Tannic, Tartaric, and Valerianic.

Action.—The stronger acids—Sulphuric, Nitric, Hydrochloric, and Glacial Acetic acids—destroy animal tissues, and act as caustics when applied to the surface. When swallowed, they produce the symptoms of irritant poisoning. (*See* Poisons.) An antidote for these poisons which is always at hand is carbonate of lime, in the form either of whiting or of plaster chipped from the nearest wall. Other antidotes are alkaline carbonates and bicarbonates, milk, oil, and soap. Diluted acids, taken into the mouth, increase the secretion of saliva, and hydrochloric acid forms an important constituent of the gastric juice, without which digestion does not go on. When absorbed into the blood, dilute acids act on the heart generally, slowing its pulsations and reducing the temperature. They are excreted in the urine and milk.

Uses.—Nitric acid is employed as a caustic application to piles, to poisoned wounds, and to spreading or unhealthy sores. Glacial Acetic acid is used to destroy corns or warts. Diluted Acetic acid or vinegar is applied as a lotion to relieve headache; to allay the itching of prurigo, lichen, and psoriasis; to check perspiration; and sometimes to hasten the appearance of exanthematous eruptions. Diluted acids, especially Citric, Tartaric, and Hydrochloric, are administered in fevers as refrigerants, because they relieve the dryness of the mouth, and diminish the thirst by increasing the secretion of saliva, as well as lower the temperature and pulse-rate. Under the like circumstances, the organic acids, Acetic, Citric, and Tartaric, when combined with alkaline carbonates in a state of effervescence or otherwise, form agents which act on the skin and kidneys. In febrile conditions, anæmia, and some forms of dyspepsia, the proportion of acid in the gastric juice is insufficient for the proper digestion of food, and the administration of dilute Hydrochloric acid, immediately before or after meals, is useful both by aiding digestion and by preventing the formation of butyric and other acids, which give rise to sour eructations. Nitro-hydrochloric acid, before meals, is likewise beneficial in preventing acidity. It appears to have some action on the liver, and is used both internally and externally as a lotion or footbath in jaundice and biliousness. It generally relieves the frontal headache common in young females, which is felt just above the eyebrows, and not accompanied by constipation. Dilute acids, especially Aromatic Sulphuric acid, are useful in checking diarrhœa, colliquative sweats, hæmorrhages, and mucous discharges. By lessening the alkalinity of the urine, they tend to prevent the formation of phosphatic calculi, phosphoric and nitric acids being most frequently employed for this purpose. Care must be exercised in their administration to nursing mothers, as they are excreted in the milk, and sometimes cause griping and diarrhœa in infants at the breast. Several acids have a special action of their own, and are considered under their respective groups, such as Hydrocyanic acid, which is a sedative; Carbolic, an antiseptic; Salicylic, an apyretic; Gallic and Tannic, astringents. T. Lauder Brunton.

ACINESIA (ἀ, priv., and κίνησις, motion).—A synonym for paralysis of motion, whether partial or general. *See* Paralysis, Motor.

ACNE (ἀκμάζω, I bloom).—The ancient Greeks showed their appreciation of the morbid states of the integument by calling this disease ἀκμαί, the *flos ætatis* of their Latin translators; but in course of transmission the μ gave place to ν, and the original term to that by which the disease is at present known.

Definition.—An inflammation of the hair follicles, or a folliculitis of the skin, associated with the development of the permanent hair of the body at and after puberty; its almost exclusive seat of manifestation being the face, the submastoid region of the neck, the sternal region of the breast, and the back and shoulders.

Ætiology and Pathology.—In its relation to other diseases of the skin, Acne is nothing more than a folliculitis; and folliculitis, however engendered, must always pursue the same pathological course. Hence folliculitis of the face, from whatever cause, especially if attended with papulation and suppuration similar to the acne of puberty, has likewise been termed *Acne*; such is the *Acne Rosacea* or *Gutta Rosacea* of adult life; and such are the varieties of folliculitis produced by iodine, bromine, and tar, which have been respectively denominated Iodine-, Bromine-, and Tar-Acne.

Description.—The pathological essentials of Acne are:—a languid and torpid skin; a tendency to accumulation of sebaceous matter within the follicles; congestion of the coats of the follicles and immediately contiguous structures; and the ordinary manifestations of inflammation, such as suppuration, infiltration, and solidification. From these, which are the ordinary signs of inflammation of the follicles, we derive the various subjective designations of the disease: for example, when accumulation of sebaceous matter, showing as a black point with little or no inflammation, is the leading feature, the condition is termed *Acne punctata*; when congestion and infiltration force up the skin into a conical pimple, *Acne coniformis*; when suppuration is present, *Acne pustulosa*; and when thickening and condensation display themselves, *Acne indurata*. The whole series, with the exception of *Acne indurata*, which represents a chronic disposition, may be called indiscriminately *Acne simplex* or *Acne vulgaris*, there being obviously no regular standard.

Diagnosis.—Acne is a well-defined eruption, and not difficult of diagnosis, its most important features being:—its limitation to the period of life corresponding to and soon after puberty; and its dependence on a physiological process at that time taking place in the economy.

Treatment.—The treatment of Acne may be summed up in a few words:—Remove any exciting cause that may exist; improve the nutritive power of the individual and of the skin; stimulate, that is, give tone and vigour to the part locally. Our best general remedies are a good hygiene, careful attention to diet and habits of life, ordinary tonics, and especially arsenic. The most efficient local application is sulphur, especially the compound hypochloride of sulphur ointment, which consists of a drachm of hypochloride of sulphur with ten grains of carbonate of potash, to an ounce of benzoated lard. Arsenic is best administered as a combination of Vinum Ferri and Liquor Arsenicalis (♏ij–iij) three times daily at the end of meals.

Erasmus Wilson.

ACONITE, Poisoning by.—*See* Poisons.

ACQUIRED DISEASES.—Diseases originating independently of hereditary transmission. *See* Disease, Causes of.

ACROCHORDON.—An outgrowth of the integument in the form of a slender cylinder, which may be compared to the loose end of a piece of string or cord—*ἄκρον* signifying a point or end and *χορδὴ* a string. Such outgrowths are usually met with in a feeble state of the skin, and particularly in elderly persons, their common seat being the neck or trunk. They are at first sessile, but become elongated; and are sometimes bulbous at the extremity, and more or less pedunculated. Pathologically an acrochordon is composed of loose areolar tissue, firmer at the surface than within, and of a fine artery and vein, connected by a capillary loop or plexus, and sometimes a little ramified. It is popularly regarded as a wart, and in medical works is termed *verruca acrochordon*, but it differs from a wart very widely in structure. When acrochordones attain a size beyond that of a pea, they fall into the category of a soft tegumentary tumour or Molluscum.

Treatment.—This consists in snipping them off with scissors, or touching them with a strong solution of potassa fusa (equal parts). When numerous and minute, they admit of being shrivelled up and removed by means of liquor plumbi, or a lotion of perchloride of mercury, two grains to the ounce. The latter, by its stimulating property, also arrests their formation.

Erasmus Wilson.

ACRODYNIA (*ἄκρος*, extreme, and *ὀδύνη*, pain). A dermatitis affecting the hands and feet, particularly the palms and soles, accompanied with burning heat, stinging and smarting pains, and numbness. The pains sometimes extend to the whole system, and there is more or less disorder of the digestive and assimilative functions. The redness is at first bright, then deeper tinted and brown, with considerable pigmentation of the rete mucosum. Occasionally there are pimples, pustules, and blisters; the cuticle desquamates, and is sometimes cast in a single piece; the disease running on for several weeks.

Treatment.—This should be directed to the regulation of the digestive and assimilative organs, and to the relief of local inflammation by means of water-dressing followed by bandaging with zinc ointment. Erasmus Wilson.

ACUPUNCTURE is an ancient mode of treatment for the relief of painful affections, now but little used, consisting in the introduction of fine round needles through the skin, to a varying depth. It is said to have been introduced into this country from China or Japan, about 200 years ago. The needles used are about two inches in length, and are set in round handles, so that they can be introduced with a gentle rotatory movement. It is now employed solely in lumbago and sciatica, in which affections it undoubtedly gives relief. The operation is thus performed. The patient being laid upon his face, tender spots are sought for—in lumbago over the erector spinæ, and in sciatica along the course of the sciatic nerve. The needles are then pushed in vertically for a depth of from one and a-half to two inches, and allowed to remain for from half an hour to two hours. The number of needles employed may vary from one to six. In sciatica it is recommended, if possible, to make the needle actually penetrate the nerve. This is known by the patient complaining of sudden pain shooting down the back of the leg. The mode of action is uncertain, but in sciatica it has been supposed that the puncture of the nerve sheath allows the escape of fluid. Acupuncture has also been employed in painful neuritis following injury, but without much effect. In a modification invented by Baunscheidt, forty punctures, about half-an-inch in depth, were made in an area of the size of a crown piece, by an instrument working by a spring. Oil of mustard diluted with olive oil was then painted on, which gave rise to an eruption like herpes. This was at one time in great repute as a quack remedy for all sorts of diseases. The term *acupuncture* is also applied by some to the introduction of needles into a cyst, in order to allow the fluid contents to escape, as in the treatment of ganglion, of hydrocele in infants, or of hydatid cyst of the liver. Puncture of the skin for the relief of œdema or subcutaneous emphysema is sometimes called by the same name. For this purpose the ordinary three-cornered acupressure needle is more convenient than a round acupuncture needle, as the puncture resulting from it allows fluid to escape more readily.

Marcus Beck.

ACUTE.—This word, when associated with a disease, signifies that such disease runs a more or less rapid course, and is generally attended with severe symptoms. It is also employed to express intensity of a particular symptom, as, for example, pain.

ADDISON'S DISEASE. Synon.: *Morbus Addisonii*; *Bronzed Skin Disease.* Fr. *Maladie d'Addison*; Ger. *Addisonsche Krankheit.*

Definition.—In his original memoir on this subject, Dr. Addison wrote—'The leading and characteristic features of the morbid state to which I would direct attention are anæmia, general languor and debility, remarkable feebleness of the heart's action, irritability of the stomach, and a peculiar change of colour in the skin occurring in connection with a diseased condition of the supra-renal capsules.'

In reality, the general symptoms of the disease, as given above, outweigh in importance any pigmentary change whatever; and it is quite possible for the disease to run its course without any unusual deposit of pigment in any part of the body.

Addison's disease might, however, be defined as 'a constitutional malady characterised by great weakness and anæmia, with deposit of pigment in the skin and some other parts of the body, and accompanied by or depending on a specific morbid change in the supra-renal capsules.'

ÆTIOLOGY.—The constitutional or general nature of the malady must ever be borne in mind, though some of its factors are strictly local; but, though constitutional, it is not transmissible either (*a*) by contagion or infection, or (*b*) by inheritance. If, however, Addison's disease itself is never an inherited malady, it is in very many cases associated with a highly hereditary constitution, that of the tubercular or scrofulous type, and in such individuals accidents like falls or blows, which would fail to make an impression on stronger men or women, may suffice to set the morbid process in motion. In not a few instances the bodies of the subjects of this disease have been found perfectly healthy apart from the morbid change in the supra-renal capsules characteristic of the malady; and, in a certain number of cases, local abscesses seem to have been the starting-point of the specific changes in the capsules themselves. Addison's disease is, moreover, essentially one of early adult life, the great majority of cases occurring between fifteen and forty. It is much more frequent in men than in women, and seems, in a great measure, to be confined to the working classes.

SYMPTOMS.—It is not at all times nor in all instances an easy task to make out a perfect clinical history in a case of Addison's disease. The earlier symptoms are often so indefinite and so insidious that it may not be until the disease is fully developed that the patient seeks medical aid, and by that time the symptoms are usually unmistakeable. It is different when the malady apparently originates in a fall or a blow, but even such a starting-point as this may only be sought for late in the history of the disease.

The mischief may be said to commence in most cases with a feeling of general weakness and of being unwell; the discolouration of the skin usually appears later, but may be the first prominent symptom. In a small number of cases the onset may be acute, with loss of appetite, sickness, headache, pain in the epigastrium, sometimes also vomiting and diarrhœa. When the disease has attained its full development the characteristics of the malady are most striking. Then the downcast, mournful look, the drooping shoulders and stooping gait, the arms hanging helplessly by the sides, and the slow and listless movements of the patient are strikingly impressive. If to this be added the darkening of the skin, the clear and pearly conjunctiva, and the breathlessness on exertion, we have almost all that meets the eye when such a patient presents himself. But to these, on enquiry, other important symptoms are easily added. The breathlessness will be found to be partly due to anæmia, partly to impaired innervation. From the same causes in part, but not entirely, we find a quiet, feeble action of the heart, readily giving place to palpitation. With these are usually associated pain and tenderness in the epigastrium and hypochondria, irritability of the stomach and nausea giving rise to retching, and frequently obstinate vomiting. Such modifications of breathing as sighing, yawning, or hiccup, are frequent. Again, from the anæmia, there is a strong tendency to giddiness and syncope, which last increases as the disease wears on, and, in many cases, carries off the patient when raising himself, or being raised in bed for the purpose of taking food or performing other necessary functions. This is not the invariable mode of death, for nervous symptoms, such as coma or convulsions, may usher in the final scene. When the prostration is great, the patient may be for some time before death apparently unconscious, but this is simply due to unwillingness to make the slightest exertion, owing to his profound weakness.

Throughout the whole disease the bodily temperature is diminished (97°–98° Fh.) rather than increased, and this is often markedly the case towards the close of the disease, though then it has been noted as high as 100·8° Fh.

From the above sketch it is plain that the two most prominent factors in the disease, as presented during life, are—

1st. General weakness and anæmia.

2nd. Abnormal deposit of pigment in various parts of the body.

1. To the former of these is to be referred (*a*) the loss of muscular power, as evidenced by diminished muscular energy and force both in the voluntary and involuntary muscles, for the heart's action is feeble and imperfect, and the bowels are usually confined. (*b*) At once a cause and consequence of the weakness and anæmia are loss of appetite, sickness and vomiting, though these, too, depend in part on other morbid changes; whilst, lastly (*c*), imperfect nutrition of the nervous system results, notably of the brain itself, whence arise vertigo, numbness, dimness of sight, deafness, tremors, and the like. The pain in the epigastric and hypochondriac regions is probably due to local causes.

2. The deposit of pigment is peculiar and characteristic. It is not uniform in disposition, and varies greatly in tint. It may only amount to a light brown or smoky discoloration in certain parts, or it may assume the appearance of a dark olive-green hue, approaching to black in some situations, especially over the genitals and nipples. Elsewhere it is most abundant on the face, where it often seems to begin, on the neck, the backs of the hands, the folds of the legs, and along either side of the linea alba. A striking peculiarity is that the conjunctivæ are clear and pearly, and that the nails are never discoloured. On the other hand, there is a great tendency to the deposit of pigment where the skin has been irritated or the epidermis removed, as by a mustard poultice or blister; but the skin is always smooth and supple. In a typical case under the writer's care, blisters had been applied to the chest for the uneasy feeling experienced there, and here the pigmentary tint was deeper than in any other part of the body, save the genitals. Cicatrices affecting the whole

depth of the skin do not seem to be so pigmented. The mucous membrane of the mouth not unfrequently becomes the site of pigmentary deposits. These are not diffuse, but, when the lips are affected, they usually take the shape of smears or lines. On the insides of the cheeks blotches or irregularly-defined spots are most common, as well as on the sides and root of the tongue. The latter spots are commonly better defined than are the others, and somewhat resemble the small well-marked black spots occasionally observed in parts already pigmented.

The site of this pigmentary deposit is in the growing layer of the epidermis, the usual site of colour in all races of mankind, and which is usually known as the *rete mucosum*; but occasionally pigmentary granules are to be found deeper, in the cells of the true skin.

An interesting clinical fact has been brought out by Dr. Greenhow, which will, probably, be noted in a considerable proportion of cases. This is the mode in which the disease progresses. Often it presents periods of remission, only to be followed by a more marked advance; but, notwithstanding these remissions, the progress is invariably towards a fatal termination. The time occupied in this progress varies much; it may be weeks or months, or it may be years, but in all well-defined cases the result is the same.

Pathology.—From the earliest description of the morbid state known as Addison's disease, the malady has been associated with disease of the supra-renal capsules. At first it was supposed that any form of disease affecting these organs must give rise to a similar train of symptoms, and some of the investigations carried on with a view to sustain this position sound absurd enough by the light of subsequent experience. Gradually it has been made clear that only one kind of lesion is accompanied by the specific symptoms just detailed. Briefly, the morbid changes are as follows:—

Normally, the supra-renal capsules consist of two parts, a cortical and medullary, differing greatly in their structure. In Addison's disease both are superseded by a new structure, which is to be seen in various stages. In the earliest of these the capsules are invaded by a kind of translucent material, which is sometimes almost cartilaginous in its hardness, and which, when examined under the microscope, resolves itself into a kind of very finely fibrillated or trabecular connective tissue, with corpuscles like leucocytes freely congregated in the interstices of the meshwork or between the fibres. This material, when seen in bulk, is grey or greenish-grey, afterwards becoming red on exposure. With it is mixed up an opaque yellow substance, varying in amount and apparently more abundant the more advanced the disease. In the earlier stages it presents the appearance of nodules embedded in the translucent material, but later almost the whole of this last may have disappeared, and the yellow opaque matter become converted into a thick creamy fluid, a putty-like substance, or even one or more cretaceous masses. This opaque material, then, is evidently, from its first appearance, indicative of fatty degeneration, and closely resembles in every respect what used to be known as yellow or crude tubercle.

The exterior of the capsules presents certain important features. The capsules themselves may be large or small, according to the stage of the disease and the nature of their contents, but, even when they are small, it may be safely assumed that at one time they were enlarged. In all cases they will be found closely and strongly adherent to neighbouring structures. Some of these structures are of great importance: for example, the semi-lunar ganglia, and the vast plexus of nerves associated therewith, in which important changes have been found. These pathological conditions have been so often observed and so carefully noted, that they cannot be looked upon as accidental concomitants of the diseased process, but rather part and parcel of it, and, in all probability, as giving a clue to some of the most marked phenomena of the malady. Broadly it may be said that these changes consist in a great thickening of the connective tissue surrounding the nerve-fibres and the ganglion-cells, giving rise to something like compression and ultimate destruction of the nerve cells and fibres. This occurs both in the cerebro-spinal nerve fibres and in those more intimately connected with the ganglionic system. The nerve-cells, moreover, are not unfrequently deeply pigmented.

These, so far as is known, constitute the main pathological elements of Addison's disease. It does not arise from mere destruction of the supra-renal capsules, for then it would be seen under other conditions, as when cancer of a neighbouring organ extends to and involves the supra-renals; but no Addison's disease follows this event. The exact mode in which these nerve lesions give rise to the characteristic symptoms of the disease are, as yet, matters of speculation, and not of exact science; and it may be said that our knowledge of the whole of this subject is yet in its infancy.

Though these are the main facts relating to the pathology of Addison's disease, there are still others of some importance. Pigmentation has been sufficiently noticed, but its origin has not been discovered. Without doubt the pigment, like other animal pigments, is derived from the blood, and this has been examined with a view to discover any change in its composition which would explain the darkening of the skin, but without result.

In making the section of the body of one who has been the subject of Addison's disease, one cannot help being struck with the amount of subcutaneous fat, especially over the abdomen, as contrasted with the difficulties of nutrition under which the patient suffered; yet a considerable quantity is almost always found. But more closely connected with this malnutrition are certain changes in the absorbent system along the digestive tract. These consist in enlargement of the solitary and agglomerated glands constituting Peyer's patches, and of the mesenteric glands; as well as of lymphoid deposits in the mucous membrane of the stomach which give rise to little projections, termed *mammillations*, on the walls of that organ, especially

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near the pylorus. Small ecchymoses are also not unusually found in the same situation. Of other organs it may be noted that the liver and spleen are often enlarged and hyperæmic, and the heart small and light.

Diagnosis.—There would have been less difficulty or doubt in the diagnosis of Addison's disease, had it been clearly enunciated from the first that a bronzed skin did not alone constitute the malady. The disease rests on a threefold basis—*general weakness, diseased supra-renal capsules*, and *bronzed skin*, the last being the least important of the three. There may be darkening of the skin from a great variety of causes, viz.: (*a*) exposure, and attacks of vermin (*morbus Reonum*, Greenhow; *Vaganten Krankheit*, Vogt); (*b*) wasting diseases, as chronic phthisis; (*c*) syphilis; (*d*) malaria; (*e*) liver disease or jaundice if long-continued; &c.; but in none of these cases should there be any difficulty if the preceding dictum is borne in mind.

Prognosis.—This is always unfavourable, but it is impossible to assign any definite period for the termination of the disease, since it often progresses irregularly, with periods of improvement followed by relapse.

Treatment.—From what has just been said it is plain that not much is to be effected by treatment as regards the cure of the disease, but much may be done by careful management to retard its progress and comfort the patient. As soon as the disease is discovered, the sooner the patient makes up his mind to an invalid life the better. Rest and careful dieting are the basis of the treatment. As regards diet, it may be briefly said that what the patient can take best suits best. As the stomach is so irritable, anything likely to upset it should be avoided. Hence, as a rule, it is better to give concentrated nourishment, as essence of meat (*not the extract*) or chicken, or raw pounded meat, when other things cannot be taken It is also important to bear in mind that the stomach will often tolerate food cold or even frozen, when hot substances would be promptly rejected. In certain stages of this malady it may well be said that the physician's success will depend more on his knowledge of the cookery book than of the Pharmacopœia—not, however, that our pharmaceutical gifts are to be despised. For the profound depression stimulants will be necessary, but these may take the shape of ether or spirits of chloroform, as well as of wine or brandy. For the irritable stomach, alkalies, with nux vomica and ipecacuan, or calumba, are of great service. So, too, in another way, are light tonics and neutral salts of iron; but the stomach should not be clogged with too much medicine. The bowels should not be much disturbed, but, if an aperient be required, a mild one, as a small dose of castor oil, or the compound liquorice powder of the Prussian Pharmacopœia will suit, if the stomach does not rebel; if so, a wineglassful of Hunyadi János water the first thing in the morning, followed by a cup of warm milk, may better agree with the irritable organ; when there is diarrhœa, a totally different line of treatment will be necessary. But in all things, and at all times, the grand rule is to save the patient's strength, to add to it if possible, and to resist the inroads of the disease whatever shape these may assume.

Alexander Silver.

ADENALGIA (ἀδὴν, a gland, and ἄλγος, pain).—Pain in a gland.

ADENITIS.—Inflammation of a gland. *See* the several glands.

ADENOCELE (ἀδὴν, a gland, and κήλη, a tumour).—A tumour connected with a gland.

ADENODYNIA (ἀδὴν, a gland, and ὀδύνη, pain).—Pain in a gland.

ADENOID (ἀδὴν, a gland, and εἶδος, form).—Glandular: resembling the structure of a gland, whether secreting or lymphatic.

ADENOMA (ἀδὴν, a gland, and ὁμὸς, like).—A morbid growth, the structure of which is of glandular nature. *See* Tumours.

ADHERENT.
ADHESIONS. }—Structures are said to be *adherent* when they become abnormally united together, the morbid formations by which this union is effected being termed *adhesions*. These are most frequently met with in connection with serous surfaces, being usually the result of an inflammatory process, but they may be observed in other structures. The adhesions vary considerably in extent, number, mode of arrangement, firmness, and other characters; they may merely consist of a few loose, slender, and delicate bands, or these bands may be thick and strong, or the contiguous surfaces may be blended and matted together to a greater or less extent, so that they cannot be separated without tearing or cutting them asunder, this last condition constituting *agglutination*. In structure adhesions consist mainly of connective or fibrous tissue, more or less perfectly developed, with a few new vessels.

Effects.—Adhesions are often found at *post-mortem* examinations, which have been of little or no consequence during life, as, for instance, many of those which form in connection with the pleural surfaces. If, however, they are extensive and firm, or if they occupy certain regions of the body, they may prove of serious moment. The principal evils which are liable to result from adhesions may be thus indicated:—1. They often bind parts together, and interfere with the movements of important organs, such as the lungs, heart, stomach, or intestines; in this way preventing the due performance of their functions. 2. When an organ is displaced in any way, as, for example, the heart by pleuritic effusion, it may become fixed in its new position by the formation of adhesions, its functions being thus disturbed. 3. It is highly probable that agglutination may lead to hypertrophy of an organ, *e.g.*, the heart, by embarrassing its movements, and hence affecting its action. 4. On the other hand, atrophy or degeneration of structure may ensue, in consequence of the adhesions interfering with the due supply of blood by pressing upon the vessels, so that the nutrition of the tissues becomes impaired. In the young, also, the development of structures may be checked. 5. Adhesions may involve important structures, such as nerves or vessels, pressing upon or destroying them, thus giving rise to symptoms of a serious nature. 6. Tubes or canals for the passage of secretions or other materials are sometimes narrowed or obliterated by adhesions. 7. When formed within the abdominal cavity, especially when they take the form of bands, adhesions may prove highly dangerous by compressing, constricting, exerting traction upon, or strangulating some portion of the intestine, in either of these ways leading to intestinal obstruction.

It is frequently difficult or impossible to determine the existence of adhesions by clinical investigation during life; but the history of some past illness during which they were likely to be formed, the results of physical examination, especially in connection with the heart and lungs, and the symptoms present, not uncommonly enable them to be discovered.

Frederick T. Roberts.

ADIPOCERE (*adeps*, fat, and *cera*, wax).—Synon.: Fr. *Adipocire*; Ger. *Fettwachs*.

Definition.—A substance formed by a spontaneous change in the dead tissues of animals.

Description.—As seen generally in a dried state in museums, adipocere somewhat resembles spermaceti in consistence, but it is less crystalline in fracture, and is of a dull white or buff colour, the surface being marked by the outlines of blood-vessels or other textures. Adipocere in the earlier stages of its formation, or when formed in a damp situation, is soft, and if rubbed between the fingers communicates a greasy feeling. The odour is peculiar and rather disagreeable.

Chemical Composition.—Adipocere dissolves in ether, leaving a delicate filamentous web; it burns with a blue flame, yielding a white ash. It is properly described as a soap composed of margaric and oleic acids in combination with ammonia, the fixed alkalies, and alkaline earths; the relative proportion of the latter ingredients varying with the age of the specimen (the ammonia disappearing), and with the composition of the fluids in contact with which the adipocere had been formed. It is said that oleic acid predominates in adipocere formed from dead fish.

Microscopic Appearances.—When the flesh of animals in which this transformation has recently commenced is examined with the microscope, it is found to be composed of broken-down or disintegrated tissues, fatty granules or particles, together with a few acicular scales or crystals. The granules may be seen in what was muscular tissue to assume somewhat the arrangement of the muscular filaments, thus presenting an appearance resembling an early stage of fatty degeneration. In old and dry specimens of adipocere the crystalline scales form the great portion of the mass, and they may be observed preserving the outlines of the muscular fibres.

Origin.—Adipocere has long been known. It is formed readily from the flesh of animals exposed to moisture, or placed in running water, in very dilute nitric acid, or in alcohol and water in the proportion of 1 to 6. It is often met with in inconvenient abundance in the specimen jars of the anatomist. The bodies of men and other animals buried in peat moss have frequently been found completely converted into adipocere. Lord Bacon mentions it in the *Sylva Sylvarum*, and so also does Sir Thomas Brown in the *Hydriotaphia*; but attention was especially called to its presence when a vast number of bodies were removed (in 1786–87) from the *Cimetière des Innocents* at Paris to the Catacombs. Fourcroy found many of these bodies converted into what he named *adipocire*, a name since retained. Gibbes (as did others) suggested the possibility of applying adipocere formed from the waste flesh of animals to some useful purposes, but the tenacity of the disagreeable odour and the presence of other difficulties have prevented these suggestions from being carried out. With respect to the immediate changes which give origin to adipocere chemists have differed in opinion. One class believes with Gay-Lussac and Berzelius that the compound results from the fat originally present in the tissues, and that the other components are completely destroyed by putrefaction. The other class, which includes the names of Thomas Thomson and Brande, maintains 'that the fatty matter is an actual product of the decay, and not merely an educt or residue.' These opinions may, the present writer thinks, be reconciled by the better knowledge we now possess of the elementary composition of tissues. We know that the combination of fat and albumin constituting one of the earliest steps in the process of nutrition is traceable in the further development and formation of nearly every texture. When that combination is destroyed by a cessation of the process of life, the tissues are as it were resolved into their primary elements. We may thus have adipocere derived not only from free fat, but from the elements of fat existing in and obtained from the decomposition of other tissues. Adipocere may thus be described as both an educt and a product. This opinion is confirmed by the researches of Bauer and Voit, who showed that fatty matter was derived from the metamorphosis of albumin in starved animals, to which phosphorus had been administered.[1]

The interest concerning this substance is not confined to the chemist. The medical jurist has studied it with the view of determining the time and progress of its formation, and of thus ascertaining the probable period at which death occurred. But hitherto no decided or satisfactory information has been obtained, owing to the varied circumstances which influence the progress of the change, in connexion not only with the condition of the body itself, but also with the character of its surroundings. The formation of adipocere has a further and a special interest for the pathologist. It was the study of this process which led the present writer to point out the analogy which exists between it and fatty degeneration in the living body, and thus to establish the pathological doctrine that fatty degeneration is the result of a retrograde metamorphosis, due to defective nutrition. (*See Medical and Chirurgical Transactions*, vol. xxxiii.)

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[1] The writer would desire to refer here to the analogy which seems to exist between the change of animal matter into adipocere, and that which occurs in vegetable matter by its conversion into peat and coal. This, however, is not the place in which to examine further such an analogy.

RICHARD QUAIN, M.D.

ADIPOSIS.—A term which properly signifies either general corpulency, or accumulation of adipose tissue in or upon an organ. *See* FATTY GROWTH; and OBESITY.

ADYNAMIA
ADYNAMIC (ἀ, priv., and δύναμις, power).—Terms indicating serious depression of the vital powers, and employed as synonymous with the '*typhoid condition*.' The adjective is applied to diseases in which the phenomena of this condition are prominent. *See* TYPHOID CONDITION.

ÆGOPHONY (αἴξ, a goat, and φωνή, voice).—A peculiar alteration of the resonance of the voice, as heard on auscultation of the chest, compared to the bleating of a goat. *See* PHYSICAL EXAMINATION.

ÆTIOLOGY (αἰτία, cause, and λόγος, word).—That branch of pathological science which deals with the causation of disease. *See* DISEASE, Causes of.

AFFINITY.—This term is the designation of a property by which elementary and compound substances unite with one another and form new compounds. It is, therefore, a property with which chemists are principally concerned. But the ideas suggested to the chemist by the term affinity are also, though less explicitly, excited in the mind of the pathologist and of the therapeutist by certain classes of facts frequently falling under their observation. The pathologist, for instance, knows that saline or earthy matter is very prone to accumulate in the midst of degenerated tissue in the walls of an artery or of a cardiac valve, so as to give rise to a patch of 'calcification'; he knows that in a gouty patient urate of soda is most apt to accumulate and form 'chalk stones' in the tissues around affected joints; he knows that, however it may be administered, arsenic in poisonous doses tends to produce inflammation of the alimentary canal, that strychnia acts with preference upon the nervous system, and that in ordinary cases of lead-poisoning this metal interferes especially with the nutrition of the extensor muscles of the forearm. Applications of the same notion in the department of therapeutics are equally familiar in respect to the action of many drugs. It may be regarded as an ascertained fact that iodide of potassium tends especially to influence the nutrition of the fibrous structures in the body, and that bromide of potassium has a no less certain action in modifying the nutrition of the nervous centres in many unhealthy states. Again, there is a whole class of substances which when taken into the system have, whatever their other actions may be, an undoubted effect in modifying the functional activity of the kidney. We have in nitrite of amyl a remedy possessing a remarkable influence over the unstriped muscular fibres of the arteries and bronchi, or else over the nerve-centres by which they are controlled. We have in woorara an agent which acts especially upon the motor side of the nervous system; and we have in digitalis an important remedy which, amidst its other effects, seems to have a decided power of improving the nutrition of the cardiac ganglia. The recent progress of therapeutics encourages us to hope that more and more of these specific effects of drugs will be accurately determined, so that the notion implied by the term *affinity* may, after a time, have a deeper meaning than at present for the practitioner of medicine. *See* ANTAGONISM.

H. CHARLTON BASTIAN.

AFFUSION.—A method of treatment which consists in pouring a fluid, usually water, either cold or warm, upon the patient. *See* WATER, Therapeutics of; and BATHS.

AFRICA, South.—*See* APPENDIX.

AGEUSTIA (ἀ, priv., and γεῦσις, taste).—Loss of taste. *See* TASTE, Disorders of.

AGONY (ἀγὼν, strife or struggle).—Agony implies bodily pain or mental suffering so intense that it cannot be endured, but excites a struggle against it. It is also applied to the final struggle that often precedes death. *See* DEATH, Modes of.

AGORAPHOBIA (ἀγορὰ, a market-place, and φόβος, fear). SYNON.: Fr. *La peur des espaces.*—By these names a peculiar nervous complaint has been recognised, characterised by a feeling of alarm and terror, accompanied with a group of nervous symptoms, which some individuals experience when they are in a certain space. The condition may be developed rapidly or gradually, and the chief phenomena observed are as follows:—A sudden sensation is experienced, as if the heart were being grasped, while this organ palpitates violently; the face becomes flushed; the legs feel weak, tremble, and seem as if they would give way under the body. There may be sensations of itching, coldness, or numbness; or profuse sweating may occur. There is no true vertigo; the special senses are unaffected; and consciousness is not at all impaired. A curious impression is sometimes experienced, as if space were elongating itself out indefinitely. Persons who are thus affected are quite sensible of the foolishness of their fear, but cannot be reasoned out of it. During the attacks they feel a strong inclination to cry out, but fear to do so. They think that their dread is known to others, and many of them endeavour to conceal their feelings, lest they should be considered insane.

The circumstances under which the symptoms just described may be experienced are various. They may be felt, for instance, in the street, especially if the shops are shut; in public buildings, such as churches, concert-rooms, or theatres; in omnibuses, cabs, or other conveyances; on a bridge; or in looking at an extended façade or flying perspective. Most persons who suffer thus in the street feel better when with some one, or when near some object, such as a carriage, or even when carrying an umbrella or a stick. Occasionally, however, they shun other people, especially acquaintances.

But little is known as to the origin and nature of agoraphobia. The complaint is not regarded as idiopathic, but as sequential to some other condition. It occurs in males and females, and the individuals affected may be strong and in good bodily health, while they are often intelligent and well-educated. A history of hereditary nervous disorder can be traced in some cases, indicated by the occurrence of insanity or epilepsy in members of the family; and the patients themselves may present indications of a nervous temperament. Their emotions may be easily excited; and they may be subject to nervous symptoms, such as headache, a feeling of heat in the top of the head, sparks before the eyes, occasional faintness, or motor disorders.

Frederick T. Roberts.

AGRAPHIA. *See* Aphasia.

AGRIA (ἄγριος, wild).—This term signifies angry and severe. Willan describes a *Lichen agrius*, which is likewise termed *Agria*; it is a circumscribed inflammatory *eczema* situated on the back of the hands. The qualities implied by agria are excessive pruritus, burning pain, thickening, fission, and copious exudation.

Erasmus Wilson.

AGUE.—A popular synonym for Intermittent Fever. *See* Intermittent Fever.

AGUE-CAKE.—A form of enlargement of the spleen, resulting from the action of malaria on the system. *See* Spleen, Diseases of; and Malaria.

AIR, Ætiology of. *See* Disease, Causes of.

AIR, Therapeutics of.—Air is employed in the treatment of disease in many ways and for many purposes. It is used, first, as *the atmosphere*, a gaseous mixture of definite composition and with a variable pressure. Secondly, advantage is taken of air as a *vehicle* for other substances in the gaseous or finely divided state. And, thirdly, it is selected as a *medium* by which *the temperature* of the body may be readily and effectively influenced. In the first of these relations only—as pure air—will its therapeutics require to be considered in this article. The application to the body generally of air that has been warmed, or warmed and loaded with moisture, will be found described in the article on Baths; while its administration to the respiratory organs, either in this form or as a vehicle for such substances as creasote, carbolic acid, alkaloids, and sulphurous acid, will be discussed under Inhalations.

Principles.—The dual relation in which the air stands to the economy—as a definite compound of certain gases, and as an atmosphere with a certain pressure—is very frequently disturbed; and this disturbance accounts for some of the most familiar phenomena of disease. Alteration in the quality or quantity of the respired air, whether from the state of the atmosphere itself or from derangement of the complex apparatus of respiration and circulation, is the cause of some of the most serious and distressing symptoms attending diseases of the chest. It might be predicted by the physiologist that under these circumstances relief would be afforded, at least to symptoms, by suitable alteration of the composition or volume of the air. The method of treatment thus rationally indicated is further readily practicable—the supply of air is unlimited; its composition may be altered at pleasure; its pressure may be increased or diminished; and such alteration will alter its chemical properties. We find accordingly that, ever since the discovery of the composition of the atmosphere, frequent trials have been made of its value therapeutically. Oxygen was early recognised as its active constituent, and came to be administered, as it still is, in the form of inhalation. From time immemorial, indeed, advantage has been taken of the purity and certain other unknown qualities of the air for the prevention and treatment of disease; and the character of the atmosphere is naturally reckoned one of the most important elements of climate (*see* Climate). More recently use has been made of the powerful properties that air possesses when *physically* changed. Within the last few years a remarkable advance has been made, on the one hand, in the physiology of respiration and the relation of the circulation to the atmospheric pressure, and, on the other, in the pathology of diseases of the chest. Clearer views have been reached on the signification of various symptoms, and especially of dyspnœa in its different forms. At the same time observations upon the effects of compressed and rarefied air have been becoming more exact. Pursuing the physiological track, modern therapeutists have availed themselves of this knowledge, and revived the use of air physically altered in the treatment of diseases of the lungs, heart, and other parts of the body. This application they are now able to make with accuracy, and the success of the reformed system of aërotherapeutics appears to be unquestionable. Although in England it is seldom heard of beyond hydropathic establishments, the system is more extensively employed on the Continent. Its leading principles and some of its most important applications will be here briefly described.

The physiological effects of compressed or of rarefied air will manifestly be different according as it is admitted to the body as a whole, or only to a part of it. Familiar examples of the former condition are afforded by descent in the diving-bell, or ascent in the balloon; and of the latter by the action of the cupping-glass, and the effect of interrupted or frequently repeated respirations upon the pulse and system generally. Under the first circumstances the alteration of pressure is absolute; under the second it is relative, and capable of producing most important disturbances in the distribution of the vital fluids. The two methods of application must accordingly be separately discussed

General Aërotherapeutics.—The effects of *compressed air* on the body as a whole have been studied in the *air-bath*, a simple mechanical arrangement in the form of an iron chamber, which can be filled with air at any pressure, whether above or below the normal, by means of steam-power. The principal physiological effects of air condensed by three-sevenths of an atmosphere were ascertained by von Vivenot to be:—Pallor of the skin and mucous membranes; a sensation of pressure in the ears;

diminished frequency of respiration, the act becoming easier; enlargement of the lungs, and increase of the vital capacity; depression of the cardiac force, and diminution of the size and strength of the pulse; rise of temperature; increased vigour of muscular action, secretion, and nutrition generally; compression of the gaseous contents of the intestines; and, perhaps, increased absorption of oxygen and excretion of carbonic acid. When the pressure is excessive, dangerous or even fatal symptoms may supervene. Frequent exposure to condensed air will induce considerable increase of the vital capacity; and most of the other effects, both physical and chemical, will tend to persist. In a word, it may probably be said that the air-bath acts on the system, first, by increasing the general mechanical pressure; and secondly, by admitting an increased amount of oxygen. In employing the air-bath, the patient is kept in it for a period of two hours, at first daily, but after some weeks less frequently. The pressure, which is employed in different cases at one-fifth to one-half of an atmosphere above the normal, must be slowly raised on admission, and reduced on removal of the patient.

The number of *diseases* in which the air-bath may be given with success is limited:—(1.) In certain forms of dyspnœa:—thus it gives great relief in spasmodic asthma, and may also afford temporary relief in emphysema, but its prolonged use appears to be positively bad, as it increases the pulmonary distension. (2.) In hyperæmia and catarrh of the air-passages, including pertussis. (3.) In imperfect expansion or threatened retraction of the chest, as in the subjects of phthisis and chronic pleurisy. Compressed air has also been extolled in some forms of cardiac disease, and in general malnutrition.

The effects of *rarefied air* admitted to the body as a whole do not demand description in this place, either in their physiological or in their therapeutical aspect. Artificially rarefied air is never employed in the form of the bath; and the natural supply in elevated regions, which has found so much favour as a means of treatment in phthisis, is a subject that belongs to CLIMATE and PHTHISIS.

LOCAL AËROTHERAPEUTICS.—When it is desired to bring compressed or rarefied air into contact with the *respiratory* surface only, a different apparatus must be employed. Several forms have been introduced, respecting which it will be sufficient to state that the air contained in a gas-holder is compressed or rarefied by simple mechanical means, and thereafter brought into relation with the air-passages by an arrangement of tubes and valves. There are four possible methods of application:—(1) Inspiration of condensed air; (2) Expiration into condensed air; (3) Inspiration of rarefied air; and (4) Expiration into rarefied air. The physiological effects of the several methods have been carefully investigated by Professor Waldenburg, of Berlin, whose account we shall follow.

Inspiration of condensed air.—Inspiration of air that has been condensed by one-sixtieth to one-fortieth of an atmosphere produces a sensation of extreme distension of the chest, accompanied by an actual expansion of the thorax and lungs, and an increased admission of air, so that inspiratory dyspnœa, if present, is relieved. At the same time the other thoracic contents are compressed, the systemic vessels fill, the arterial pressure rises, and the jugulars become distended. The lungs and heart will be comparatively anæmic. If the application of condensed air be frequently repeated, the vital capacity, the size of the chest, and the respiratory force, may all be increased, and partial relief may be permanently afforded to dyspnœa.

Expiration into condensed air is most difficult of accomplishment, and ends in apnœa in inspiratory time. The effect on the circulation does not differ essentially from that just described.

Inspiration of rarefied air.—Inspiration of air that has been rarefied by one two-hundred-and-fortieth to one one-hundred-and-twentieth—or even, after a time, by one-sixtieth—of an atmosphere, immediately causes the phenomena of inspiratory dyspnœa: the thoracic viscera are congested, and hæmoptysis may result, for the effect may be regarded as that of dry-cupping the pulmonary alveoli. The heart at the same time becomes full, and the jugulars collapse.

Expiration into air that has been *rarefied* by one-sixtieth of an atmosphere is attended with a sense of extreme compression of the thorax: at the same time there is actually a partial retraction of the lungs, an increase in the volume of expired air, and a corresponding diminution in the amount of residual air in the chest. Expiratory dyspnœa, if present, is relieved. While the lungs thus diminish in size, the other thoracic viscera are dilated—the heart and the pulmonary and other vessels within the chest being filled at the expense of those external to it, both arteries and veins. If the expiration into rarefied air be frequently repeated, the circumference of the chest will be diminished, while the vital capacity will be actually increased, along with increase of the inspiratory and expiratory force.

Applications.—The method of *inspiring condensed air* is obviously indicated in diseases where inspiratory dyspnœa is an urgent symptom. Spasmodic asthma, stenosis of the air-passages from anatomical causes, acute and chronic bronchitis, and atelectasis, have all been successfully treated by this method. In croup, where it is urgently indicated, it is most difficult or even impossible to employ. In threatened phthisis it is used prophylactically; and in chronic pleurisy it may prevent or remove the effects of collapse and retraction of the chest wall. The inhalation of condensed air should also be of use in certain forms of cardiac dilatation, especially that due to mitral incompetence. Improving as it does the general nutrition, it may be combined with other remedies for anæmia. In the administration of condensed air, a 'sitting' should last from ten to thirty minutes, once a day—seldom twice.—*Expiration into condensed air* is not used therapeutically.—*Inspiration of rarefied air* may be regarded as a means of exercising the inspiratory muscles. Like the atmosphere of great altitudes, it may therefore be employed in persons with badly developed chests; and even in phthisis it may, by increasing the amount of blood in the lungs, prevent caseation and promote absorption of the products. In disease of the right side of the heart, it would assist the flow of blood from the veins into the lungs, but it is not likely to be employed for this purpose.—*Expiration into rarefied air* promises to be the most successful and most extensively employed of all the methods. In it, according to Waldenburg, we have the physical antidote for emphysema, and in his hands the majority of such patients have been either cured or radically benefited. It has also afforded great relief in some cases of bronchitis, where it increases expectoration.

Other local applications of the physical properties of the air, as seen in aspiration, cupping, Junod's boot, and inflation, are described elsewhere in this volume. J. Mitchell Bruce.

AIR IN CELLULAR TISSUE. *See* Emphysema, Subcutaneous.

AIR IN VEINS. *See* Veins, Air in.

AIR-PASSAGES, Diseases of. *See* Respiratory Organs, Diseases of; also Larynx, Trachea, and Bronchi, Diseases of.

AIX-LA-CHAPELLE, Waters of. Thermal sulphur waters. *See* Mineral Waters.

AIX-LES-BAINS, Waters of. Hot sulphur waters. *See* Mineral Waters.

AKINESIA. *See* Acinesia.

ALBINISM (*albus*, white).—Definition.—A state of whiteness or absence of colour of the integument and certain other tissues, consequent on defect of pigment-formation. The want of colour may be *complete* or *incomplete*; *partial* or *universal*; *congenital* or *accidental*. Partial albinism may be limited to a spot of small dimensions; or there may be many such spots of variable extent, dispersed over the surface of the body, and giving rise to the appearance which is denominated *pied* or *piebald*; whereas in universal albinism the defect of pigment is not restricted to the integument, but is especially remarkable in the iris and choroid membrane of the eyeball.

General Characters.—Persons and animals affected with albinism are called *albinoes*. It would seem more correct to limit the term albino to those in whom the absence or defect of pigment is universal, and demonstrable not only in the integument but likewise in the eyeball. In the true albino, therefore, the skin is white and pink and more or less transparent, and this both in the fairer and in the darker races of mankind; but in certain of the latter, where the pigmentary function is simply defective and not totally wanting, the colour of the skin may be grey or tawny, and more or less variegated and freckled. The hair, sometimes of a pure silvery or opaque white, may be diversely tinged with yellow or red; occasionally it is flaxen or possesses a greyish hue; and in some instances the whole body is covered with a white down. The iris is grey or pink in accordance with the density of its fibrous structure, and the consequent facility of penetration of the colour of its vascular layer; or, as generally happens in the negro, it is blue. The pupil is contracted and brightly red from the absence of the screen of protection usually afforded to the choroid membrane by its pigmentary layer; and for the same reason the rays of light penetrating the sclerotic and iris give a brilliancy of appearance to the fundus of the eyeball. The absence of pigment in the eyeball is productive of several peculiarities of character in the albino. In the first place the excess of luminous rays penetrating the coats of the eyeball interferes with the correctness of his vision; his retinæ are intolerant of light; he stoops his head, or droops his eyelids, to shelter his eyes; he sees with more comfort in the dimness of evening than in the light of the sun; he is near-sighted; and there is in many cases an oscillation of the eyeballs.

Ætiology.—Albinism is met with among all races of mankind and in every country, but is most common amongst those who are subjected to insalubrious conditions of climate and hygiene. For these reasons it is not uncommon among the natives of the marshy coast of Africa; among negroes who are transferred to unhealthy districts in South America and the West Indies; among the inhabitants of the western coast of South America and Mexico; in certain of the islands of the Indian Ocean; and even in the northern regions of Europe. When albinism is congenital, it has been assumed to be due to an arrest of development; but when accidental, its existence must be referred to exhaustion of chromatogenous or pigment-producing function. Arrest of development has been inferred from the occasional persistence in albinoes of the membrana pupillaris, and of the fœtal down of the skin; from the more frequent occurrence of the condition in females than in males; and from the observation that albinoes are sometimes misshapen and feeble intellectually as well as physically. On the other hand it is well known that albinism is often associated with perfect physical strength and remarkable intellectual vigour. Among other causes to which it has been assigned are heredity, and debility, however induced.

Treatment.—The treatment of congenital albinism must consist in the application of those agencies which tend to strengthen and improve the general health. With regard to the special inconvenience resulting from the absence of pigment in the eyes, it has been observed that the difficulty felt in reading is greatly lessened by using screens or goggles made of some opaque material, such as aluminium, each perforated by a small opening, admitting only the rays of light from the object looked at. The treatment of accidental albinism will be considered under Pigmentary Skin-Disease. Erasmus Wilson.

ALBUMINOID DISEASE. — Synon.: *Waxy*, *Lardaceous*, and *Amyloid Degeneration*. Fr. *Dégénération amyloïde*. Ger. *Speckartige Degeneration* (Rokitansky); *Amyloide Entartung* (Virchow).

Definition.—A peculiar form of degeneration, affecting certain organs, and constituting in its effects a distinct and general disease.

Ætiology—In the majority of cases albuminoid disease is preceded by long-continued suppuration, most frequently in the form of bone- or joint-disease; or else of destructive pulmonary phthisis, empyema, pyelitis, cystitis, and other affections, where there has been a constant drain of pus. In the absence of obvious suppuration, there is usually present an exhausting disease, as syphilis, ague, or some more obscure cachexia. These antecedent conditions must be regarded as the cause of the malady, and it is only in the rarest instances that no such cause can be traced. It is not easy to recognise the connection, but it may be pointed out that a drain of pus involves not only a loss of highly organised protoplasmic material, but also of potassium salts, which are contained in large proportion in the solid elements of pus, and which salts, as we have seen, are deficient in the affected tissues.

ANATOMICAL CHARACTERS. — The organs affected are usually much enlarged, but sometimes they ultimately decrease in size. They are pale, dense, dry, sometimes hard, and either generally or in certain spots translucent. In an advanced stage of the disease the parts appear as if soaked in wax, or other translucent material. If iodine, in alcoholic or aqueous solution, be applied to the affected parts, they are stained yellow, orange, or a deep mahogany brown, according to the degree of the morbid change. If the portions thus coloured be further treated with dilute sulphuric acid, a purplish black colour is produced. These characters depend upon the presence in the tissue-elements of a peculiar substance, allied to the albuminates, and containing, when approximately pure, about 15 per cent. of nitrogen. It is soluble in alkalis, not digested by pepsine, and not readily altered by putrefaction; it gives with iodine the characteristic colour just noted, which gave rise to Virchow's erroneous supposition of its being allied to starch, whence the name—*Amyloid*. This *albuminoid* material being contained in the tissue-elements themselves, and not infiltrated between them, is probably not poured out by the vessels as such, but results from a transformation of the materials of the tissues. Chemical analysis of the affected organs shows a remarkable change in their mineral constituents, the potassium and phosphoric acid being very greatly diminished, as compared with healthy organs; while the sodium and chlorine remain normal, or are proportionately increased.

Albuminoid disease affects most frequently the liver, spleen, and kidneys. Next in order of frequency come the lymphatic glands, and the intestinal mucous membrane, especially its villi; more rarely the suprarenal bodies, the pancreas, the urinary mucous membrane, or the omentum are involved; and, quite exceptionally, other parts, such as the thyroid body, the generative organs, the heart, and the lungs. In most organs the blood-vessels and their appendages, (glomeruli of the kidneys, Malpighian corpuscles of the spleen) are the seat of the morbid change; but in some, such as the kidney, secreting cells may also be affected, and in the liver these structures are chiefly or solely involved. The diseased elements are enlarged, translucent, and structureless.

SYMPTOMS, DIAGNOSIS, AND PROGNOSIS.—The *general* symptoms of albuminoid disease are anæmia, debility, a cachectic appearance, and sometimes capillary hæmorrhage. The *local* symptoms are chiefly important in the case of the liver, spleen, and kidneys. Uniform smooth enlargement of the liver and spleen, which can be referred to no other cause, may be due to the albuminoid change. Where the kidney is affected, albuminuria, dropsy, uræmia, and a train of symptoms arise, which, regarded as a whole, differ from those of other kidney diseases. The *diagnosis* is greatly confirmed by (1) the simultaneous occurrence of disease in several organs; (2) a history of suppuration, or of some cachectic disease, especially syphilis. The *prognosis* is extremely unfavourable, and, when the disease is far advanced, it is hopeless.

TREATMENT.—Though in advanced cases treatment can avail but little, there is reason to think that were the occurrence of disease anticipated, or its presence earlier recognised, prevention, or even cure, might be possible. In all such complaints as chronic joint-disease, psoas abscess, syphilitic disease of bone, or prolonged empyema, the probability of this frequently fatal *sequela* should be borne in mind, and guarded against by a suitable regimen. The diet should not only be generally nutritious, but should include more especially abundance of nitrogenous food (albuminates), as well as the potassium salts, which the affected tissues lack. These are, indeed, largely contained in the juices of fresh meat, and also in the green parts of vegetables. Among drugs, nutrient tonics, of which iron and cod-liver oil are the type, must hold the first place; but the administration of potassium salts, as proposed by Dr. Dickinson, is also indicated. Of these we should be induced, on *à priori* grounds, to select those of which the local action is least violent, and which cause little vascular depression, such as the bicarbonate, or the citrate, or other organic salts. The danger of 'potash poisoning' is very remote.

J. F. PAYNE.

ALBUMINS.—DEFINITION.—Albumins are substances closely resembling egg-albumin, the chief constituent of white of egg or albumen. To distinguish between the white of egg and its chief constituent, the former is spelt albumen and the latter albumin. Albumins constitute a sub-division of the class of albuminous bodies, which includes all substances having a general resemblance to albumen.

ENUMERATION.—The sub-class properly contains only two members, *egg-albumin* and *serum-albumin*; but the name *Bence-Jones's albumin* has been given to an albuminous body differing very considerably in its properties from the other two.

CHARACTERS.—Egg-albumin and serum-albumin are semi-transparent, yellowish, and structureless when dried. They are soluble in water; and this solution is coagulated by boiling. From the same solution they are precipitated by (*a*) nitric acid; (*b*) salts of the heavy metals, for example, copper-sulphate; (*c*) acetic acid with potassium-ferrocyanide; (*d*) boiling with acetic acid and a neutral salt, for example, potassium-sulphate; (*e*) alcohol. Egg-albumin is distinguished from serum-albumin by the coagulum which it forms with nitric acid being insoluble in excess, while that of serum-albumin is soluble. Bence-Jones's albumin gives no precipitate with excess of nitric acid unless left to stand, or unless heated and left to cool, when it forms a solid coagulum. This coagulum redissolves on heating, and again forms on cooling. It may be separated from ordinary albumin by adding nitric acid, boiling, and filtering when hot. The ordinary albumin will remain on the filter while Bence-Jones's albumin will pass through, and will coagulate when the filtrate cools.

Modifications.—By the action of acids and alkalis albumin may be converted into *acid-albumin* and *alkali-albumin* respectively, neither of which is coagulated by boiling.

Acid-albumin may be formed in two ways:—First, by dissolving solid albumin in concentrated nitric or other mineral acid with the aid of heat. Secondly, by heating an aqueous solution of albumin with one of these acids very much diluted (1 in 500). Although soluble in very concentrated or very dilute acids, acid-albumin is insoluble in moderately dilute acids. Therefore, when the solution in concentrated nitric acid is diluted with water, a precipitate is formed, which redissolves when much water is added. And, conversely, when acid-albumin is made by boiling a solution of albumin in water with very dilute nitric acid, the addition of more acid will throw down a precipitate, which redissolves if a very large excess of the concentrated acid be added, and especially if it be heated at the same time. On neutralizing a solution of acid-albumin, a precipitate is thrown down, which dissolves in excess of alkali.

Alkali-albumin, or *Alkali-albuminate* as it is also called, is formed by dissolving albumin in caustic potash or soda; or by adding either of these to its aqueous solution and allowing this to stand, or heating it. This modification is not precipitated by heat, but is precipitated by neutralization; the precipitate dissolving very readily in slight excess of acid. If alkaline phosphates are present in the solution, as they are in urine, alkali-albumin requires a slight excess of acid to throw it down, and is not precipitated by exact neutralization, as acid-albumin would be under similar circumstances. T. Lauder Brunton.

ALBUMINURIA.—Definition.—A condition characterised by the presence of albumin in the urine. Other albuminous bodies, not albumins, may be present in hæmatinuria, hæmaturia, pyuria, and spermatorrhœa.

Symptoms.—Albumin may occur in the urine without any symptoms whatever, but its continuous loss leads to anæmia and changes in the circulation, which usually originate the following symptoms—a pallid pasty complexion, dry skin, and tendency to œdema of the cellular tissue noticeable on the eyelids and shins; derangement of digestion, flatulence, occasional nausea, and irregularity of the bowels; nervous disorder shown by muscular weakness, languor, lassitude, vague pains about the loins, and headache; calls to make water during the night; palpitation, and frequently accentuation of the second sound of the heart over the aortic cartilage, and reduplication of the first sound over the septum ventriculorum.

Tests for Albumin.—The two tests usually employed to detect albumin in the urine are—first, boiling; and, secondly, the addition of nitric acid; both of which produce a cloud or precipitate. If the urine is turbid the albuminous cloud may not be noticed; and therefore such urine should be filtered before the application of either test, unless the turbidity, being dependent on the presence of urates, is removed by heat.

Method of employing the test by boiling.—With the object of saving time the urine is often boiled at once, but the results thus obtained are liable to several fallacies, which will be subsequently described. In order to avoid such fallacies the following method should be pursued:—Ascertain the reaction of the urine; and, if it be alkaline or very strongly acid, add acetic acid in the one case, or liquor potassæ in the other, until its reaction is only slightly acid. Fill a test-tube to about one-third of its capacity with the urine, and hold it obliquely in the flame of a spirit lamp in such a manner as to heat the upper part of the fluid only, until it boils. If it be turbid from urates, it should be first warmed throughout until it becomes clear, and then the upper part only should be boiled. Finally, add a drop or two of acetic or nitric acid.

If albumin be present, it will form a cloud or a coagulum, more or less dense according to its amount. When there is much albumin, its quantity may be roughly estimated by allowing the urine to stand for a definite number of hours, so that the coagulum may subside, and then observing whether it forms a fourth, a third, or a half of the whole length of urine in the test-tube. A small quantity causes a cloud, but no distinct coagulum; and, if merely a trace be present, a faint haze only will be observed, which is best seen by looking through the test-tube at a dark object. The advantage of heating the upper part only of the urine is, that the lower portion, which remains clear, affords a standard by comparison with which a faint cloud in the heated part may be more readily detected.

Fallacies of the test by boiling.—The first fallacy is that albumin may be present, and yet no cloud or coagulum be produced on boiling. This may occur if the urine be alkaline or very strongly acid, because alkali-albumin or acid-albumin, which are soluble in water, may be formed. It is to prevent the formation of *alkali-albumin* that acetic or nitric acid should be added to alkaline urine before boiling. This addition of acid also causes the coagulum to separate more readily; and it should therefore be made when the urine is neutral. On the other hand, urine rarely or never contains sufficient acid to form *acid-albumin*, unless the patient has been taking mineral acids; and therefore the addition of liquor potassæ is not necessary except under these circumstances. The second fallacy of the test by boiling is, that a cloud resembling that of albumin may be produced, although the urine is free from this substance. This occurs when the acidity of the urine is too slight to hold the earthy phosphates in solution, without the aid of the carbonic acid which it usually contains. When such urine is boiled, the carbonic acid is driven off, and the phosphates are precipitated, forming a cloud like that of albumin. The two clouds are readily distinguished by the addition of a drop or two of nitric or acetic acid, when if due to phosphates it will disappear by solution; but if caused by albumin it will remain. If an excessive quantity of nitric acid be added, an albuminous cloud may also clear up; for albumin coagulated by heat is soluble in strong acid, though only to a slight extent.

Application of the nitric-acid test.—Pour some urine into a test-tube, and then allow about one-fourth of its bulk of strong colourless nitric acid to trickle slowly down the side of the tube, so as to form a layer below the urine without mixing. Or the acid may be put in the test-tube first, and the urine poured on it. Both processes give the same result. If albumin be present, a haze or cloud will form close to the line where the liquids meet.

Fallacies of the nitric-acid test.—1. Albumin may be present and yet escape detection, if the nitric acid is simply poured into the urine and mixed with it, as is sometimes done. For if there be too much or too little acid, acid-albumin is formed and dissolved; whereas, if the liquids form two distinct layers, as in the process already described, the acid gradually mixes with and shades off into the urine, so that, at a greater or less distance from the line where they join, it is certain to be of the proper strength to precipitate the albumin. 2. Albumin may be supposed to be present when it is not, from the formation of a cloud by the precipitation of acid urates or uric acid. This cloud disappears on the application of heat: and another specimen of the urine tested by boiling gives no cloud. To avoid this fallacy, it is common to employ the test by boiling, in addition to that by nitric acid. 3. The third fallacy is not of common occurrence. It is due to the presence of fat or saponified fats in the urine. Urine containing these when simply boiled gives no cloud; but if nitric acid is added to it in the cold, or acetic acid when it is hot, the fatty acids are precipitated and form a cloud resembling albumin. This is distinguished by not being formed if along with dilute acetic acid some ether is added to the urine before boiling; the ether retaining the fatty acids in solution. If the precipitate produced by nitric acid be collected on a filter, and treated with ether, it will be dissolved, while an albuminous precipitate will not. Copaiba, which can be recognised by its smell, sometimes causes an opalescence in the urine, which is increased by nitric acid, but is removed by heat.

Additional tests for albumin.—When urine contains *mucus*, which would render the presence of an albuminous cloud obscure, a solution of ferrocyanide of potassium followed by acetic acid should be added: this will produce a cloud if albumin be present, while it rather clears up a turbidity due to mucus. A solution of pyrophosphate of soda also precipitates albumin. If a drop of albuminous urine be poured into a test-tube containing one or two drachms of a saturated solution of picric acid, a precipitate is formed. These tests are sometimes useful in determining the presence of albumin in the urine in doubtful cases.

QUANTITATIVE ESTIMATION OF ALBUMIN.—There are three methods in common use for this purpose. The first is easy but inexact. It consists in boiling the urine with dilute acetic acid in a test-tube, allowing the coagulum to subside for a definite number of hours, and then estimating the proportion it bears to the quantity of urine boiled, for example, a fourth, a third, &c. The second is the most exact, but is troublesome. It is like the first; but the urine is carefully measured before boiling, and the amount of coagulum is ascertained by collecting it on a weighed filter, washing, drying, and again weighing it. The third method is easy and tolerably exact. A tube of known length is filled with urine and placed in a polarizing apparatus. From the amount of rotation which the polarized ray undergoes in passing through the urine, the amount of albumin it contains may be calculated. A fourth method has recently been recommended by Dr. W. Roberts. It consists in diluting the urine with water until it gives a haze on the addition of nitric acid, which does not become visible until between one-half and three-quarters of a minute after the acid has been added. This dilute urine contains 0·0034 per cent., or 0·0148 grain of albumin per fluid ounce; and from the degree of dilution required the amount contained in the urine may be calculated.

PATHOLOGY.—Albuminuria has been said to occur in consequence of various conditions: *e.g.*, changes in the blood, changes in the circulation, changes in the kidneys. Thus abstinence from salt, or a diet of eggs alone, is said to produce albuminuria by altering the constitution of the blood; and an alteration in this fluid is supposed to be partly the cause of the albuminuria observed in high fevers, scarlatina, diphtheria, and osteo-malacia. The albuminuria of heart-disease depends on changes in the circulation, and that of nephritis on alterations in the kidney. In order to distinguish more clearly between the different kinds of albuminuria we may divide them into—1st, *true* albuminuria, in which serum-albumin appears in the urine; 2ndly, *false* albuminuria, in which some other albuminous body, but not serum-albumin, is present. In *true* albuminuria there is always some change either in the circulation through the kidney, or in the structure of the kidney itself. In *false* albuminuria the albuminous body passes out through the kidney, without there being any alteration either in its circulation or structure.

The chief albuminous bodies occurring in *false* albuminuria are hæmoglobin, egg-albumin, and Bence-Jones's albumin. Hæmoglobin occurs in the urine whenever blood is present in it (*see* HÆMATURIA), in which case it is contained in the corpuscles; or it may occur free (*see* HÆMATINURIA), the blood-corpuscles, while still circulating in the vessels, having undergone solution. This may result from the inhalation of arseniuretted hydrogen, or from the introduction of bile-acids or of a large quantity of water into the veins. Hæmoglobin is also found in the urine in paroxysmal hæmatinuria, but the cause of the solution of blood-corpuscles in this disease is unknown. Egg-albumin is excreted by the kidneys, and appears in the urine, whenever it is injected directly into the circulation or under the skin, or when it is absorbed unchanged from the stomach or rectum. When taken into the stomach it is usually completely digested before it undergoes absorption; but when taken in such

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large quantities that the whole of it cannot be digested, part of it is absorbed unchanged and is excreted in the urine. Thus a diet consisting exclusively of eggs, especially when continued for several days, produces false albuminuria, and large enemata of eggs have a similar effect in animals and probably also in man. Bence-Jones's albumin is of very rare occurrence. It is found in osteo-malacia. Like egg-albumin, it is excreted by the kidneys when it is injected into the circulation or in large quantities into the intestine. It is almost if not quite identical with the hemialbumose, which Kühne finds to be one of the products of imperfect digestion. It seems probable that those cases of albuminuria which appear to depend on imperfect digestion are due to the passage into the systemic circulation of albuminous bodies, which have not undergone the proper transformation in the alimentary canal or liver.

In *true* albuminuria there must be some change, either in the circulation or structure of the kidney, for serum-albumin differs from the other albuminous bodies just mentioned, in not being excreted by the healthy kidney. Some regard the alterations in circulation which produce albuminuria as of two kinds:—(*a*) increased pressure of blood in the renal arteries; (*b*) increased pressure in the renal veins. Increased pressure in the arteries may depend either on general high arterial tension, or upon an increased local supply of blood to the kidney, owing to dilatation of the renal arteries, such as follows division of their vaso-motor nerves. Experiments seem to show, however, that increased tension in the renal arteries does not produce albuminuria, and that the only change in circulation which will cause it is increased pressure in the renal veins. Congestion of the renal veins may be produced by ligature of the renal arteries, and when the flow of blood through the kidney is temporarily arrested by ligature of the artery, the urine secreted after the removal of the ligature is albuminous. Venous congestion of the kidney also occurs whenever the onward flow of venous blood is obstructed, either by a ligature on the renal veins; by the pressure of a tumour or of the pregnant uterus upon them or the vena cava; by disease of the liver obstructing the vena cava; or by disease of the heart or lungs, such as tricuspid or mitral regurgitation, or chronic bronchitis and emphysema. The temporary albuminuria sometimes observed after cold bathing may also be due to venous congestion; and it is probable that albuminuria consequent upon lesions of the nervous system is due rather to the changes which these produce in the circulation than to any direct action of the nerves upon the tissues of the kidney itself. The albuminuria observed after varnishing the skin is probably due to the retention of some substance which acts as a poison. The structural changes in the kidney which cause albuminuria are acute and chronic inflammation, waxy degeneration, and cirrhosis. *See* Bright's Disease.

Treatment.—In *false* albuminuria where hæmoglobin appears in the urine, the treatment indicated is to counteract the solution of blood-corpuscles; and for this purpose quinine is very often useful. When other kinds of albumin appear in the urine, and are probably due to imperfect digestion, the treatment is to give some artificial digestive fluid. Arsenic is also useful. Regarding those cases of osteo-malacia in which Bence-Jones's albumin occurs, we unfortunately know very little.

In *true* albuminuria, depending on venous congestion, the obstacle to free circulation should be removed, if possible; and congestion lessened, both by drawing the blood from the interior to the surface of the body, and by causing contraction of the renal vessels. The blood may be drawn from the interior to the surface by means of warm baths, but in some cases they prove injurious rather than useful, and the employment of a wet pack, which has a similar effect on the distribution of blood without exciting the heart, is to be preferred. Cupping over the kidneys is serviceable: it probably acts by causing reflex contraction of the renal vessels rather than by actually draining blood away from them. The tone of the renal vessels may be increased by the employment of digitalis (*see* Diuretics); and this drug is useful even when no cardiac disease is present, although its good effects are still more marked when the congestion is dependent on disease of the heart. The constant drain of albumin from the body occasions anæmia, which not only produces many unpleasant symptoms, but tends to cause fatty degeneration of various organs, from which there is no reason to believe that the kidneys are exempt. The administration of iron, therefore, is the chief remedy in structural disease of the kidneys, and it is useful by diminishing or removing the symptoms of anæmia and the tendency to fatty degeneration consequent thereon, and also by increasing the tone of the vessels, thus diminishing the loss of albumin.

T. Lauder Brunton.

ALCOHOL. Synon.: *Ethyl-Alcohol; Vinic Alcohol; Spirit of Wine* (C_2H_6O).—Alcohol is the product of a process of fermentation induced by the action of a microscopic fungus, *Yeast*, upon certain kinds of sugar, especially grape sugar, but also upon that derived from starch of any description, and, in the same manner, upon milk sugar. In this process a peculiar metamorphosis takes place, by which alcohol and carbonic acid are produced in considerable amount, together with very minute quantities of succinic acid, glycerine, and other bodies.

Alcohol may also be produced synthetically from its elements, carbon, hydrogen, and oxygen.

As alcohol is very volatile, boiling at 172° Fahr. (78° C.), it may readily be separated by distillation from the water with which it is at first combined. Other means must be resorted to, however, in order to separate the very ultimate particles of this water, as a strong attraction exists between the two liquids.

Alcohol, diluted with about 95 per cent. of water, and subjected to the action of another microscopic fungus, is oxidised into aldehyd and acetic acid.

Physiological Effects.—Applied to the skin, alcohol produces a sensation of coolness, due to its rapid evaporation; but, if the application be continued sufficiently long, *irritation* is excited. This latter effect ensues immediately if alcohol is brought into contact with a mucous membrane. Its strong attraction for water seems to be the chief cause of this action.

Alcohol is a powerful *antiseptic*, probably from the fact that it is capable, even when diluted, of preventing the development of septic germs, such as vibrios and bacteria, as well as of paralysing the activity of those already formed.

There is scarcely any other therapeutical agent the *internal action* of which varies so much according to the dose given. In *small quantity*, and slightly diluted with water, alcohol promotes the functional activity of the stomach, the heart, and the brain; whilst a like quantity, largely diluted, exerts but a limited influence upon these organs: if, however, the dose of alcohol be often repeated, it is readily assimilated; and, becoming diffused throughout the system, undergoes combustion within the tissues of the body, imparts warmth to them, and yields vital force for the performance of their various functions. Simultaneously with this consumption of alcohol, the body of the consumer is often observed to gain in fat—a circumstance due to simple accumulation, the fat furnished by the food remaining unburned in the tissues, because the more combustible alcohol furnishes the warmth required, leaving no necessity for the adipose hydrocarbon to be used for that purpose. A quantity of 100 cubic centimetres of alcohol *per diem* (about three and a-half fluid ounces)—equivalent to about one litre of Rhine wine of medium strength—is sufficient to supply between one-third and one-quarter the whole amount of warmth requisite for the human body during the twenty-four hours. The warmth so supplied cannot be measured by a thermometer, however, any more than can that furnished by the internal combustion of other hydrocarbons, such as the oils or sugars. The subjective impression of increased warmth usually experienced after taking a dose of any alcoholic liquid is deceptive, and is only due to an irritation of the nerves of the stomach, and to the increased circulation of blood through the cutaneous vessels, particularly those of the head.

Doses somewhat larger, but still sufficiently moderate not to cause intoxication, act, for the most part, in the same way; but, as an additional effect, they produce a distinct decrease of temperature in the blood, lasting half-an-hour or more. As far as the matter has hitherto been explained, this latter effect depends upon a directly depressing influence exerted by alcohol upon the working cells of the body, and upon a temporary paralysis of the vaso-motor nerves. The latter is followed, of course, by dilatation of the superficial vessels, particularly those of the head, in consequence of which a larger surface of blood is exposed, and the loss of heat by irradiation into the air is increased, the temperature of the circulating fluid being thus lowered; whilst, the combustion carried on by the cells being retarded, the generation of heat from this source is diminished. The quantity of carbonic acid eliminated is thus diminished, as is also the amount of urea excreted. After the organism has become inured to the action of alcohol, these effects upon the temperature of the blood are less distinctly, or not at all, marked.

The agreeable excitement at first caused by such doses of alcohol is succeeded by a reaction, characterised by lassitude and drowsiness, the latter condition usually lasting longer than the previous one of exhilaration.

The symptoms of intoxication produced by *large doses* of alcohol are sufficiently well known. When the abnormal condition of excitement in the brain induced by this stimulant has been kept up, almost without intermission, for a length of time; or when it is suddenly withdrawn after the organ has been long subjected to it; the disturbance brought about is so great and persistent as to result in a complete overthrow of the reasoning faculties, and the condition known as *delirium tremens* ensues. At the same time that this pernicious influence is being exerted upon the cells of the brain, fatty accumulations may take place in other organs, particularly in the liver, heart, and connective tissues; the blood-vessels become diseased; and, in many instances, cirrhosis of the liver, kidneys, and meninges makes its appearance, as part of the general disorder of nutrition. The shrinking of connective tissue, characteristic of this last-mentioned complication, seems to depend upon the direct irritation caused by the presence of un-oxidised alcohol.

Under ordinary circumstances, and after the consumption of moderate quantities of alcohol, only slight traces of it are to be detected in the urine, and none whatever in the breath. Pure alcohol imparts no taint to the exhalations of the body; the ethers and fusel oils, on the other hand, do so by reason of their being less readily combustible. It is very likely that alcohol is completely oxidised into carbonic acid and water during the process of assimilation; at least, no other secondary products resulting from its disintegration have as yet been detected.

THERAPEUTICAL APPLICATIONS.—There can be no doubt but that a healthy organism, supplied with sufficient food, is capable of performing all its regular functions without requiring any specially combustible material for the generation of heat and the development of vital force. But the case assumes a different aspect when, in sickness, it transpires that, while the metamorphosis of tissue goes on with its usual activity, or with increased energy, as happens in many diseases, the stomach, refusing to accept or digest ordinary food, fails to supply material to compensate for this waste. Here it is, then, that a material which can be most readily assimilated by the system, and which, by its superior combustibility, spares the sacrifice of animal tissue, is especially called for; and such a material we have in alcohol. Small but oft-repeated doses of alcohol, largely diluted with water, are generally well tolerated by the weakest stomach; and, thus given, the absorption and oxidation of the spirit goes on without difficulty or effort on the part of the patient's system.

According to the experiments of Dr. Frankland and others, the burning of 1·0 gramme of alcohol yields sufficient heat to raise the temperature of seven litres of water 1°C.; and the burning of 1·0 gramme of cod-liver oil suffices for nine litres. Now, in taking three table-spoonfuls of the oil daily, we yield about the same amount of warmth to the body as is given by four table-spoonfuls of absolute alcohol—the quantity contained in a bottle of light claret or hock. The oil, however, is digested and oxidised by the organs of the body with difficulty, while, for the assimilation of the alcohol, scarcely any exertion of the working cells is required. Thus, it can be demonstrated by calculation, as abovementioned, that heat-producing material, sufficient to supply nearly one-third the whole amount of warmth required by the body within twenty-four hours, is offered in a quantity of 100 grammes (about three and a-half fluid ounces) of alcohol. In this sense alcohol is a *food*; for we must regard as food not only the building material, but all substances which, by their combustion in its tissues, afford warmth to the animal organism, and, by so doing, contribute towards the production of vital force, and keep up the powers of endurance. Alcohol, therefore, diluted with at least 90 per cent. of water (in any convenient form of beverage), may be given with advantage, in small but oft-repeated doses, in most of the acute and chronic diseases where it is desired to sustain the strength of the patient, but where at the same time the digestive organs, from any cause, refuse to tolerate a more substantial form of nourishment, at least in quantities that would answer the necessities of the case. In such cases it is certainly not sufficient to call alcohol merely a *stimulant*. If alcohol served here only in the quality of a stimulant, its effect would soon pass away, leaving the patient more exhausted than ever; for the human organism is so constituted that it cannot be driven to perform its functions by the application of measures that simply stimulate, without supplying some new force to take the place of that put forth by the organs of the body under the impulse of excitement. To take a familiar illustration, alcohol thus given stimulates no more than does the easily burning coal which we put in small quantities upon a languid fire, to prevent its going entirely out.

Medium doses act powerfully upon the brain and heart, and are therefore serviceable as real stimulants in cases where it is desirable to excite the cerebral and circulatory systems to greater activity. We must not forget, however, that, while exciting this increased activity, such doses do not elevate the temperature of the body; on the contrary, where the effect can be measured, it is found that they depress it a little. By continuing to exhibit such doses, we can sometimes (in erysipelas, puerperal peritonitis, and similar diseases) lower febrile heat by alcohol where even quinine proves ineffectual. The consequences of this decline of fever-heat are an immediate restoration to consciousness, if delirium or stupor has been present; and, in any case, a general improvement in the feelings of the patient. Todd and his school, before the application of the thermometer, called this *the effect of stimulus*, while in reality the improvement is due almost entirely to the withdrawal or diminution of febrile disturbance. As fever patients can tolerate large quantities of alcohol without showing any sign of intoxication, it is allowable, and sometimes even necessary, to rise in the scale of doses beyond the limits ordinarily prescribed.

Of late years alcohol has been given during the night to hectic phthisical patients as a preventive against copious and exhausting attacks of sweating, and with a gratifying amount of success. Such patients certainly tolerate the remedy much better than has hitherto been generally supposed. It need hardly be said that, in cases of cardiac excitement, not resulting from fever, alcohol is at least to be used with caution.

Mode of Administration.—One of the most important, but at the same time most difficult, points for decision is the exact nature and quality of the alcoholic drink to be prescribed or allowed to a patient, who may require alcohol in some form. For *general use*, a pure Claret, Hock, or Mosel wine are the preparations most to be recommended. Cognac, Champagne, old Gin or Whisky, and the heavier Southern wines, may also be used according to circumstances. But whatever drink may be selected, it must at least be free from fusel oil to such an extent that a healthy man, even after imbibing a considerable quantity, will not feel any other effects than those of a pure stimulus; that is to say, an agreeable exhilaration of spirits, neither accompanied by a sense of weight in the head, nor followed by that persistent overfilling of the cerebral vessels and dulness of ideas characteristic of the physiological effects of fusel oil.

The *Fusel Oils* (so-called from their oily qualities) consist chiefly of propyl, butyl, and amyl alcohol, of which the last-named forms the largest proportion. In order to examine any specimen of alcohol with reference to its purity from these objectionable constituents, it is only necessary to rub a few drops between the palms of the hands for half a minute, by which rapid evaporation is caused, and then to smell the moist spot left on either palm. If the alcohol be pure no odour whatever should remain, as ethyl alcohol evaporates very quickly; amyl alcohol, on the contrary, is much less volatile, and, if present in the liquid, will not have evaporated, so that its peculiar and unmistakeable odour will remain to attest its presence as an impurity in the specimen examined.

This test is not applicable to the more complicated liqueurs and wines, as these all contain certain odoriferous organic principles of their own that might disguise the smell of the fusel oil. The inoffensive quality of any given preparation, as a wine or spirit, can only be relied upon when one knows by experience that it *is* pure; and then it should always be obtained, if possible, from the same source, so as to ensure uniform purity.

By far the most pernicious of all the ordinary drinks in use is the spirit obtained from potatoes, as this contains the largest proportion of fusel oil. Even after being redistilled, this liquor is still tainted with the poison to a fearful extent. Of course, wines mixed with such spirit possess the same objectionable qualities; whilst wines made from must to which potato-sugar has been added are likewise tainted, though to a less degree. It can easily be demonstrated by experiments upon animals, that amyl alcohol is the agent to the presence of which the extremely poisonous action of many drinks upon our nerves and other organs is due. All distilled drinks made from other sources than from grapes contain it to a greater or less extent.

To facilitate the process of estimating the quantity of any particular beverage necessary to be administered in order to produce a given effect, a table is subjoined showing the percentage of absolute alcohol contained in average specimens of the different kinds of wine, beer, &c., in common use.

Absolute Alcohol contained in—

Kumiss (a fermented liquor made from whey) is from 1 to 3 vol. per cent.
German Beer [1] is from 3 to 5 vol. per cent.
Hock or Claret is from 8 to 11 vol. per cent.
Champagne is from 10 to 13 vol. per cent.
Southern Wines (Port, Sherry, Madeira, &c.) is from 14 to 17 vol. per cent.
Brandy and the stronger liqueurs is from 30 to 50 vol. per cent.

For *antipyretic purposes* one will need to give an adult daily not less than the equivalent of fifty cubic centimetres (about two fluid ounces) of absolute alcohol, in divided doses within an hour or two. Taking this as a starting-point, the dose suitable for each individual case can be estimated accordingly.

The great quantity of carbonic acid contained in certain 'sparkling' wines acts upon the temperature of a fever patient much in the same favourable manner as the alcohol itself, and when alcohol is to be taken as a food, it would seem that the impregnation with carbonic acid facilitates its absorption.

All that has been stated thus far with regard to the use of alcohol in sickness applies to children as well as to adults. Of course no reasonable person would accustom healthy children to the use of alcoholic beverages; but, in cases of disease, really good and pure wine or brandy can be advantageously employed, even for infants, either as a *stimulant*, an *antipyretic*, or as *an article of food*, according to circumstances.

For *external use*, alcohol has been superseded by various more modern agents, of which carbolic and salicylic acids may be mentioned as the most important. In this connection the author cannot omit to notice one method of applying alcohol, suggested by Dr. Richardson, namely, the treatment of diphtheria affecting the throat, by means of the inhaler, which projects the alcohol-spray with considerable force upon the infected mucous membrane, causing it to penetrate more deeply than any other caustic would be likely to do. C. Binz (Bonn).

ALCOHOLIC INSANITY. *See* Alcoholism, and Insanity.

ALCOHOLISM.—Definition.—This term is applied to the diverse pathological processes and attendant symptoms caused by the excessive ingestion of alcoholic beverages. These are very different if a large quantity is consumed at once or at short intervals; or if smaller quantities are taken habitually: and hence they are subdivided into those due to (*a*) *acute*, and (*b*) *chronic* alcoholism. To the *acute* forms of alcoholic poisoning belong the acute catarrh of the alimentary mucous membrane, rapid coma, some cases of delirium tremens, and certain special forms of acute insanity; whilst to the *chronic* class are referred the prolonged congestions, the fatty and connective-tissue degenerations of the various organs and tissues, most cases of delirium tremens, nervous affections of slow onset and course, and the cachexiæ, which, in varying combinations, attend a continuously immoderate consumption of alcohol.

Ætiology.—That ordinary vinic or ethyl alcohol, in any and every shape, is a sufficient exciting cause of such *chronic* affections is beyond a doubt; moreover, we find that the more concentrated the form in which it is taken, the more surely and rapidly are they induced, and that, although some beverages give a greater liability to certain forms of disease than to others, yet the ultimate tissue-changes produced by all are practically similar, and of a markedly degenerative character. The purest alcoholic fluids will also induce the *acute* forms; but some of the phenomena observed in the worst cases of alcoholic poisoning have been referred, with some probability, to admixture with fusel oil, essential oil of wormwood, cocculus indicus, and other substances, more deleterious even than ordinary alcohol itself. *See* Alcohol, and Absinthism.

The *predisposing causes* of a sudden debauch, such as festive gatherings, example of companions, desire of relief from anxiety and melancholy, &c., scarcely require mention. Acute alcoholic coma is generally due to the rapid consumption of a large quantity, but occasionally it is caused by taking a smaller quantity in the presence of some special condition, such as starvation, prolonged exposure to cold, or debilitating disease.

Chronic habitual drinking is undoubtedly *hereditary* in many cases; not that the ancestors have necessarily been drunkards, but that the family is of unstable nervous organisation, and that the neurotic taint which shows itself in other members in such affections as epilepsy, hysteria, insanity, is manifested in these cases by an intense craving for alcohol. Sometimes a pernicious education, by fostering habits of indulgence in early youth, has led to subsequent excess; and the prescribing of stimulants has occasionally been productive of similar harm. In the experience of the writer, the exhibition of large doses in fevers and acute affections has never done this—indeed, in several instances, a great dislike to stimulants has been produced—but the custom of recommending small quantities to young people and women as a remedy in hysteria, hypochondriasis, neuralgia, and allied disorders, or to relieve the fatigues incident to their daily life, cannot be too strongly protested against. The effect of *occupation* is very marked. Brewers, publicans, potmen, and others who trade in alcohol are, as a class, very intemperate, and so frequently are commercial travellers (Thackrah). Sedentary employments, being more monotonous, are more baneful than out-door occupations. Mechanics drink more freely than agricultural labourers; whilst night-labourers, cabmen, sailors when on shore, brewers' draymen, navvies, pitmen, and puddlers consume an enormous amount of alcoholic fluids. *Social influences,* such as domestic unhappiness, rate of wages, unhealthy dwellings, bad drinking water, or an intermittent supply, are important factors in the causation of drunkenness. Under some circumstances, alcoholic excesses do less injury than usual, for example, in persons whose employment leads to copious sweating, or necessitates abundant exercise in a keen air; and some constitutions resist their baneful influence to a remarkable extent.

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[1] English beer will contain a little more, but the writer has made no personal examination as to exactly how much.

Pathology.—A large amount of ardent spirits acts on the nerve-centres as a narcotic poison, and causes rapid death by coma. Smaller quantities produce intoxication, accompanied with or followed by an acute congestion and catarrh of the alimentary canal, especially of the stomach and duodenum. Habitual dram-drinking, by altering the chemical composition of the blood, and checking the normal changes of its corpuscles, exerts an injurious influence on the nutrition of the tissues. This is increased by the lessened consumption of food, and by the alterations in the calibre of the blood-vessels, set up at first by a special action on their vaso-motor nerves, and afterwards maintained by degeneration of their coats, as well as frequently of the heart itself. Moreover, alcohol probably interferes *directly* with the nutrition of the cell-elements of the various organs as it circulates through them; and it retards the elimination of effete materials—carbonic acid, uric acid, and urea.

Anatomical Characters.—(*a*) *Acute Alcoholism.*—Dr. Beaumont thus describes the appearances which he observed in the stomach of Alexis St. Martin, after an excess of alcoholic stimulants:—'Inner membrane morbid; considerable erythema, and some aphthous patches on the exposed surface; secretions vitiated.' On another occasion, 'Small drops of grumous blood exuded from the surface, the mucous covering was thicker than common, and the gastric juices were mixed with a large proportion of thick ropy mucus and muco-purulent matter slightly tinged with blood.' The *post-mortem* appearances in a case of rapid coma in a patient at King's College Hospital, after taking three pints of raw whiskey, were:—intense injection of the vessels of the pyloric end of the stomach and duodenum, with a peculiar blanching of the mucous membrane between them, giving rise to a vivid scarlet arborescent appearance on a white ground; two ounces of bloody serum in the pericardial sac, and about sixteen ounces in the right pleural cavity (the left being obliterated by old adhesions); double pneumonia of the lower lobes; extreme congestion of the kidneys; and engorgement of the large veins over the posterior part of the brain. Contrary to the usual statements, no alcoholic odour could be detected in the brain, and there was no increase of fluid in the ventricles. The heart, liver, and kidneys were fatty; but these changes were probably of older date. In similar cases Deverjie has noticed a bright red colouring of the pulmonary tissue; whilst Tardieu found pulmonary apoplexies in two cases, and meningeal hæmorrhages in five others. Death from *acute* delirium tremens leaves no marked characters; meningitis and coarse brain-lesions are extremely rare, whilst pneumonia is much more common. After repeated attacks, as well as in old drunkards, fatty degeneration of the viscera, and various other chronic changes are found.

(*b*) *Chronic Alcoholism.*—The amount of fat in the blood is increased, or it becomes more visible. Chronic congestion and catarrh of the stomach, leading to atrophy of the gland-cells and an increase in the submucous connective-tissue, is very constant, but chronic ulcer is not frequent. The liver is at first enlarged from congestion, and may continue so from a subsequent infiltration with fat; but more frequently it shrinks owing to cirrhosis. Lobar emphysema, chronic bronchitis, and hypostatic pneumonia are common. The heart is flabby, dilated, and presents fatty infiltration or even degeneration of its muscular tissue; but it may be hypertrophied, probably as a result of coexistent disease of the kidneys. The arteries and endocardium are studded with atheromatous deposits; the capillaries are congested; and the veins varicose. The kidneys exhibit the fatty, or, more commonly, the granular form of Bright's disease. The muscles are pale and flabby, and even in the bones formation of fat takes place at the expense of the bony texture. The nervous centres are atrophied and tough; the convolutions are shrunken; the nerve-cells and nerve-fibres are wasted; and an increased amount of serous fluid exists in the ventricles and subarachnoid space. The abnormal adhesion of the dura mater to the cranium, the large Pacchionian bodies, the opaque arachnoid, and the thickened pia mater, all testify to an exaggerated development of fibrous tissue. Occasionally hæmorrhage into, or softening of, the brain, consequent on the diseased state of its blood-vessels, is met with. The increase of connective-tissue is especially marked in *spirit-drinkers,* and explains the emaciated appearance, prematurely aged look, sunken cheeks, and wrinkled countenance which they generally present. The *beer-* and *wine-drinkers,* on the contrary, are loaded with fat, not only in the viscera, but in the subcutaneous tissue and the omenta; and hence these subjects are corpulent, with oily skins and prominent abdomens, even when the face and extremities are wasted. Gouty deposits are also frequent. These differences, however, are not nearly so absolute as is maintained by many writers. The presence of a variable amount of dropsy, a congested pharynx, chronically-inflamed conjunctivæ, turgid capillaries, and occasionally papules of acne rosacea on the face, complete the morbid anatomy of the confirmed toper. The autopsy in *alcoholic insanity* discloses no specific characters.

Symptoms.—1. *Acute Intoxication.*—In this state the successive and varying mental phenomena, the disorders of common and special sense, and of the motor apparatus, are well known. These are followed by uneasy sensations and tenderness in the epigastrium, vomiting or retching, headache and vertigo, with dimness and occasionally yellowness of vision on stooping

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end rising again. The tongue is furred, the appetite is lost, and there is a constant feeling of thirst. The urine is copious and pale, but afterwards becomes scanty and loaded with lithates. The countenance is sallow, and the general lassitude and depression are very marked.

2. *Acute Alcoholic Coma.*—In slight cases of this condition prolonged drowsiness is the chief symptom: but in the more severe forms the patient is quite insensible; the power of motion is in complete abeyance; the breathing is stertorous; the face is usually pale, the features remaining symmetrical; the pupils are generally dilated, though they may be contracted or even unequal; the pulse is slow and laboured; the skin feels cold and clammy; and the temperature is low—in one case it fell to 92° Fahr. There may be albuminuria; and occasionally the urine and fæces are passed involuntarily.

3. *Chronic Alcoholism.*—The earliest symptoms of this form are muscular tremors, especially on waking; disturbed sleep; noises in the ears; dull headache; occasional vertigo; and disorders of vision. If there be also a foul breath, slightly-jaundiced conjunctivæ, watery eyes, and flabby features, with or without papules of acne rosacea around the nose and mouth, the combination is very characteristic. Irritative dyspeptic symptoms—the *vomitus matutinus* of Hufeland—and the signs of commencing or actual cirrhosis, of Bright's disease, or of fatty heart, frequently coexist. As the affection advances, the insomnia and tremors increase; the mental condition becomes impaired; a striking deficiency of will and uncertainty of purpose are noticeable; the gait becomes ataxic; and the patient has a constant feeling of dread and anxiety.

4. *Delirium Tremens.*—This form of alcoholism occasionally supervenes on a single debauch, but it much more frequently affects the chronic drinker. It generally comes on during a drinking-bout, but this may have terminated before the attack commences. In some cases it is undoubtedly determined by prolonged abstinence from food, mental distress, surgical injury, or the onset of an acute disease, along with the ingestion of alcohol; but in others no cause but the last can be traced. The first stage is indicated by inability to take food; marked anxiety and restlessness; tremor of the voluntary muscles; furred and tremulous tongue; cool skin, which is frequently bathed in perspiration; cold hands and feet; and a soft weak pulse. There is complete insomnia, or short periods of sleep are interrupted by terrifying dreams, and the patient's nights are tormented with visions of horrid insects, reptiles, and other objects pursuing him and eluding his attempts to escape from them or to seize them. Illusions of hearing are not uncommonly added; but the sense of smell is much more rarely involved. If there is no improvement, these not only haunt his nights, but persist in the day-time; he becomes more incoherent, his mental alienation increases, and attempts at suicide are common. The pupils are now minutely contracted, but there is no intolerance of light. The pulse quickens, and is very feeble or even dicrotic; and the general symptoms become more marked. A prolonged sleep may occur in this stage, and the disease thus terminate. If it continues, the strength fails: the pulse becomes small, weak, and thready; the tremor increases; the tongue gets dry and brown in the centre; persistent coma-vigil and subsultus tendinum come on; the patient talks incessantly, and picks at the bedclothes; and death is ushered in by a delusive calm, or takes place in a paroxysm of violence. The writer has known cases in which the attack of delirium tremens always began by several severe epileptic fits.

5. *Alcoholic Insanity.*—The forms of insanity caused by alcoholism are *acute mania* and *melancholia*, *chronic dementia*, and *oinomania*. In the first homicidal impulses, and in the second strong suicidal tendencies, *due to actual delusions and not to mere passive terrors*, are added to the other signs of delirium tremens. Oinomania is a peculiar form of insanity, in which the patient breaks out into paroxysms of alcoholic excess, attended with violent, strange, or even indecent acts, due to apparently uncontrollable impulses. The attack lasts a few days, and is succeeded by a long interval of sobriety and chastity. These patients have generally some hereditary taint; and not unfrequently evidences, though often slight, of a morbid mental state may be detected in the intervals, if very carefully looked for. *See* INSANITY.

COMPLICATIONS.—Most of these have been pointed out, but chronic drinkers are especially liable to pneumonia of a low type, and to rapid phthisis. Delirium tremens is *very rarely* complicated with meningitis; acute alcoholic gastric catarrh may be followed by jaundice; and cerebral hæmorrhage may come on in a drunken fit. Temporary albuminuria is occasionally caused by the ingestion of large quantities of spirits, and even of beer.

DIAGNOSIS.—The diagnosis of *acute* alcoholic gastric catarrh, of insanity from alcohol, and of oinomania depends on obtaining a true history. Acute alcoholic coma can only be diagnosed with certainty by emptying the stomach and examining its contents. Mere odour of the breath is quite fallacious; and the writer attaches but little importance to the state of the pupils, or to the general features of the coma. Convulsions sometimes usher in the condition; and apoplexy may arise from the accidental rupture of a blood-vessel whilst a person is drunk. Opium-poisoning can only be satisfactorily eliminated by examining the contents of the stomach. Uræmic poisoning may be diagnosed by testing the urine, though here an element of uncertainty is introduced by the occasional occurrence of albuminuria in alcoholic cases; the presence of hypertrophy of the heart, of dropsy, of casts in the urine, or other changes typical of Bright's disease, must decide the question. Delirium tremens is occasionally separated with difficulty from some forms of insanity not caused by drink; but in these cases *delusions*, not mere terrors or hallucinations, are of primary importance. The delirium of acute fevers and pneumonia may be mistaken for delirium tremens; but the pyrexia, history of the case, and physical condition of the patient will guide to a correct diagnosis if the possibility of error is remembered. *Chronic* alcoholism has been mistaken for other chronic nervous affections, such as locomotor ataxy, chronic softening and multiple sclerosis of the nerve-centres, paralysis agitans, chronic tremors from metallic poisons, senile dementia, and commencing general paralysis. In all these maladies, *special* symptoms are present, besides those common to them and to chronic alcoholism.

Prognosis.—In the acute forms of alcoholism the prognosis is favourable so far as the immediate attack is in question. In acute coma, the patient generally, but by no means invariably, rallies from the state of insensibility; but he may die from the supervention of a very rapid pneumonia. The prognosis in delirium tremens is favourable in young subjects; but its gravity increases with every attack, and with the coexistence of disease of the viscera, especially of the heart, liver, or kidneys. Patients with marked symptoms of fatty heart, or in whom pneumonia sets in, but rarely recover. Chronic alcoholism may be temporarily arrested; but the ultimate issue is unfortunately as a rule only too certain, for the habit is in most cases too strong to be broken off, or even to be checked for any lengthened period. Mental impairment, persistent tremors, ataxy, and signs of coarse brain-lesions, are especially significant of a speedy termination.

Treatment.—The *acute gastric catarrh* is most rapidly subdued by washing out the stomach with copious draughts of tepid water, and then giving a saline purge. All forms of alcohol should be rigidly abstained from; and the diet must be simple, and taken in a fluid form for a day or two. Passive exercise in the open air, or, if the patient be vigorous, a brisk ride on horseback, is very beneficial.

In cases of *acute coma* the stomach should be at once emptied by means of the stomach-pump. Cold affusion, followed by energetic friction and the application of bottles filled with warm water, so as to keep up the temperature, will generally revive the patient. Galvanism, in the form of the interrupted current, may often be employed with advantage. If the patient be strong, a smart purge, or, if weak, a milder one, will be all the after-treatment that is necessary.

Delirium tremens must be treated differently in the young and in the old. *In first attacks in young subjects*, complete abstention from alcohol, light and easily assimilated food (milk diet), moderate purgation, and occasionally antimony in doses of one-eighth of a grain, carefully watched, have been most efficacious in the writer's hands. If the patient has two or three restless nights in succession, bromide of potassium (thirty grains), or chloral hydrate (twenty grains), may be given at intervals of four hours, until sleep is procured; but as the disease is spontaneously curable, sedatives must not be pushed. An experienced attendant should be always present, but no form of mechanical restraint is permissible. In *older cases*, a mild purge should begin the treatment; and light but *very nourishing* food should be administered at short intervals. Milk, beef-tea, raw eggs beaten up with milk, strong soups, and such articles are to be given freely; when, by careful management and good nursing, a very severe attack may be tided over, and natural sleep will return in from three to five days. The early administration of sedatives is to be deprecated, but should the restlessness persist, in spite of careful and assiduous feeding, a full dose of laudanum (♏ xxx.—xl.) at bed-time is of great value. In the absence of albuminuria, lung-complications, or any sign of failure of the heart's action, the writer prefers this drug to other sedatives. If the opium alone fail, its combination with an alcoholic stimulant (brandy, whisky, or *stout*) often succeeds. If there be any tendency to syncope, or if pneumonia should come on, as well as in cases complicated with shock, as in surgical injuries, a free use of stimulants is imperative. Hypodermic injections of morphia, and large doses of digitalis, are recommended by many authorities; but the writer has seen great harm attend their free exhibition. The *cautious* inhalation of chloroform vapour has occasionally cut short an attack by inducing sleep, but it much more frequently fails. Mechanical restraint is seldom, if ever, necessary, if the patient be properly nursed and attended to. All methods of self-destruction must be carefully guarded against; and a padded room, when available, is of the utmost benefit.

The great desideratum in *chronic alcoholism* is to substitute an easily-digested and nourishing diet for the alcoholic stimulants, which can then be safely dispensed with altogether. The practitioner's judgment, and his knowledge of the *cuisine*, are very important in the management of these cases. Strong meat-soups and good specimens of the concentrated preparations of meat are of great value. The strictly medicinal treatment will consist in the administration of bitter tonics, such as nux vomica, quinine in small doses, calumba, or gentian; with carminatives, such as spirit of chloroform, armoracia, and capsicum. Alkalis, effervescent mixtures, and hydrocyanic acid are peculiarly useful if the stomach is irritable. The condition of the liver and bowels should be carefully regulated. Bromide of potassium is in general the best sedative to employ against the insomnia, though chloral hydrate is more certain; but the latter should only be given occasionally, lest the patient fall into the habit of frequently resorting to it. In long-standing cases, cod-liver oil, arsenic in small doses, and oxide of zinc have all done good, but they require a long and protracted administration. Phosphorus has been of no use whatever in the cases in which the writer has tried it; but small doses of the more easily assimilable preparations of iron are occasionally well borne, and are then most useful. The craving for drink, if urgent, may be checked by small doses of opium, but this drug must be exhibited with extreme caution. Judicious supervision, and, in inveterate cases, a residence in a proper asylum, are the only means from which any permanent benefit can be expected. The treatment of insanity induced by alcoholism will not differ from that recommended in other forms, except in an enforced abstinence from its cause.

John Curnow.

ALEPPO EVIL. *See* Delhi Boil.

ALGID (*algidus*, cold).—A word implying extreme coldness of the body, used only when it arises in connection with an internal morbid state, such as cholera, or a special form of malignant remittent fever.

ALGIERS.—Warm winter climate. Mean winter temperature 59° F., liable to rapid changes. Heavy rains not infrequent. *See* CLIMATE.

ALIMENT.—Food or aliment furnishes the elements required for the growth and maintenance of the organism; and, through its action with the other life factor—air, forms the source of the power manifested.

The aliment of organisms belonging to the vegetable class is derived from the inorganic kingdom. Under the influence of the sun's rays the inorganic principles are applied to growth, and constructed into organic compounds. This constitutes the main operation of vegetable life, and in it we have the source of the aliment of animals, which can only appropriate organic compounds, and which either directly or indirectly derive these compounds from the vegetable kingdom. As the solar force employed in the construction of organic compounds, through the agency of the vegetable organism, becomes locked up in the compound formed, such compound represents matter combined with a definite amount of latent force. In the employment, therefore, of organic matter as aliment by animals, we have to look upon it not only as yielding the material required for the construction and maintenance of the body, but as containing and supplying the force which is evolved under various forms by the operations of animal life.

Aliment constituting the source from which the several elements belonging to the body are derived, it follows that to satisfy the requirements of life it must contain all the elements that are encountered. It is not, however, with the elements in a separate state that we have to deal, but with the products of nature in which they are variously combined.

The *alimentary products* as supplied by nature are resolvable by analysis into a variety of definite chemical compounds. These constitute the *alimentary principles*. Some are common to both animal and vegetable food, as for instance albumen, caseine, fats, &c.; others are peculiar to either the animal or vegetable kingdom. Starch, for example, is met with only in vegetable, and gelatine only in animal products.

With reference to the alimentary principles, it must be understood that in no case do they exist in natural products in an isolated form, and no single alimentary principle is capable of supporting life. Although, however, it is with the alimentary products as a whole that we are practically concerned, yet, regarded from a scientific point of view, a knowledge of these constituent principles is required, to enable us to assign to them their proper value as alimentary articles; and for the purpose of systematic consideration some kind of classification is needed.

CLASSIFICATION.—Prout classified the constituent principles of food into four groups, which he named (1) the *aqueous*; (2) the *saccharine*; (3) the *oleaginous*; and (4) the *albuminous*. This classification is defective, inasmuch as it omits from consideration saline matter, which is equally as essential to nutrition as any other part of an alimentary product. The saccharine and oleaginous groups also stand as primary and independent divisions, whilst physiologically they are related, and may be conveniently considered under a combined heading.

Liebig proposed a classification based on physiological principles; and, taking into account only the organic constituents of food, grouped them under the heads of (1) *plastic elements of nutrition*; and (2) *elements of respiration*. His *plastic elements of nutrition* comprise the nitrogenous principles; and to these he assigned the office of administering not only to the growth and renovation of the tissues, but also to the production of muscular and nervous power. Believing that the source of these powers issued from the oxidation of the respective tissues, he held that the exercise of muscular and nervous action created a corresponding demand for nitrogenous alimentary matter, which thus became invested with an importance that led it to be regarded as affording a measure of the value of an alimentary article. By recent experimental research this view has been found to be untenable. The nervo-muscular organs are now looked upon as holding the position of instruments, by whose agency the force liberated by chemical action is made to manifest itself under certain other forms; and what is wanted for the purpose is simply oxidisable organic material, which may be derived from non-nitrogenous as well as nitrogenous food. The *elements of respiration* or, as they were afterwards more appropriately styled, the *calorifacient principles*, represent the organic non-nitrogenous constituents of food. Their destination, according to Liebig, was heat-production. It is now maintained, however, as stated above, that they play a part in connection with nervo-muscular action; and it may be also said that they are to some extent concerned in tissue-development. From the considerations set forth, Liebig's classification loses the scientific value it was at one time supposed to possess.

The following grouping of the alimentary principles based on chemistry furnishes a classification which involves no theoretical proposition, and is practically convenient:—

Food is primarily divisible into *Inorganic* and *Organic* principles.

The *Inorganic* principles consist of water, and the various saline matters required by the system. They are as much needed for the support of life as the organic portion of food.

The *Organic* principles are sub-divisible into *Nitrogenous* and *Non-nitrogenous*: and the *Non-nitrogenous* are again further sub-divisible into *Hydro-carbons* and *Carbo-hydrates*.

The *Nitrogenous* principles contribute to the growth and nutrition of the various bodily textures, and furnish the active agents of the secretions. They also undergo resolution in the system into urea, which is excreted; and a complementary hydro-carbonaceous portion, which is susceptible of application to force-production. They are thus capable of administering to all the purposes fulfilled by the organic portion of an aliment.

The *Hydro-carbons* or *Fats* are applied to the production of heat and other forms of force. They seem also to be essential to tissue-development generally, besides yielding the basis of the adipose tissue.

The *Carbo-hydrates* (starch, sugar, gum, &c.) contribute to the formation of fat, and are also applied indirectly if not directly to force-production.

There are a few principles, such as alcohol, the vegetable acids, and pectin or vegetable jelly, which do not strictly fall within either of the preceding groups. Alcohol occupies a chemical position intermediate between the fats and carbohydrates; whilst the others mentioned are more highly oxidised compounds than the carbohydrates.

All alimentary products in the form supplied by nature contain organic and inorganic principles, and the organic principles comprise more or less of the nitrogenous and non-nitrogenous kinds; but the non-nitrogenous do not necessarily, and indeed do not generally, include both hydro-carbons and carbo-hydrates. In milk, however, which may be regarded, from the position it holds in nature, as furnishing a typical representation of an alimentary article, principles exist belonging to each of the groups enumerated in the above classification. *See* DIET.

F. W. PAVY.

ALIMENTARY CANAL, Diseases of. *See* DIGESTIVE ORGANS, Diseases of; and the several organs.

ALKALINITY.—The reaction of human blood is always alkaline; and, though the normal degree of alkalescence has not yet been determined, it is probable that, like the temperature of the body, it is tolerably constant. In disease considerable variation, no doubt, occurs, but still the blood is always found alkaline. Pettenkofer and Voit found the serum of blood acid in a case of leukæmia some few hours after death, but not during life; and Dr. Garrod states that in chronic gout the serum may become somewhat neutralized, but never acid. F. Hoffman has also found that the blood retains its alkalinity with great obstinacy; he fed pigeons for a considerable length of time on food yielding only acid ash, but the animals suffered from blood-poisoning before the alkalinity of the serum was neutralized. The alkalinity of the blood is maintained by the constant passage into it of the alkaline salts of the food, and of alkaline carbonates derived from the oxidation of the lactic, oxalic, and uric acids furnished by the disintegration of the tissues. The blood is probably prevented from becoming too alkaline by the withdrawal of its alkaline salts by the alkaline secretions, namely, the saliva, the bile, and the pancreatic fluid; whilst the acid salts, which, if accumulated, would tend to depress its normal alkalinity, are removed by the acid secretions, namely, the sweat, the gastric juice, and the urine, and by the exhalation of carbonic acid from the lungs. It has been shown that the withdrawal of acid by one secretion has a decided effect on the reaction of other secretions; thus the saliva becomes more alkaline during digestion, when the stomach is pouring out the acid gastric juice; and Dr. Bence Jones has shown that during digestion the acidity of the urine is lessened. A similar relationship is also shown to exist between the elimination of carbonic acid by the lungs and the acidity of the urine, the latter falling as the former is increased, and *vice versâ*. The importance of a proper degree of alkalescence for the blood is obvious, when we consider that this condition increases the absorption-power of its serum for gases, and is necessary to maintain its albumin in the liquid state, whilst oxidation is always more perfectly performed in alkaline solutions.

ALKALIS.—DEFINITION.—Inorganic substances, which turn syrup of violets green, and turmeric brown; and restore the blue colour to litmus which has been reddened by acids. They combine with acids to form salts, and their carbonates are soluble in water.

ENUMERATION.—The only substances which correspond with the above definition are—Potash, Soda, Lithia, and Ammonia. The alkaline earths—Lime, Magnesia, Baryta, and Strontia, and the organic alkaloids, have a similar action on vegetable blues and yellows; but the carbonates of the former group are almost insoluble in water; whilst the latter contain carbon, and are therefore classed with organic substances.

PROPERTIES.—Ammonia is distinguished from the other alkalis by its volatility. The non-volatile alkalis are readily recognised by their spectra; and by the colour they impart to the blowpipe flame, potash giving it a violet, soda a yellow, and lithia a carmine colour. Potash and soda are present as constituents of the body in considerable quantities; ammonia exists to a smaller amount; and lithia probably in traces. Soda is found chiefly in the blood, potash in the muscles.

ACTION.—When applied to the skin dilute alkalis and their carbonates act as rubefacients. Pure ammonia is a vesicant, and potash and soda have a caustic action. Both caustic potash and soda absorb water from the tissues, and form a corrosive fluid, which destroys the parts around, as well as that to which the caustic has actually been applied. To prevent this effect they are sometimes mixed with lime, which absorbs the water. A mixture of potash and lime forms the Vienna Paste. When inhaled, ammonia causes irritation of the respiratory passages, and increased secretion of mucus. This irritation excites reflex contraction of the blood-vessels and consequent rise of blood-pressure. When swallowed in quantity, the caustic alkalis and their carbonates produce symptoms of irritant poisoning. In the case of ammonia these symptoms may be accompanied by those of inflammation of the air-passages, caused by the irritant vapour. The best antidote is dilute acid, such as vinegar. In small quantities and diluted, alkalis increase the secretion of gastric juice. After absorption into the blood they render this fluid more alkaline; whilst potash appears especially to accelerate tissue-change, and is accordingly classed among the alteratives. When injected directly into the blood, potash acts specially on the muscles, which it paralyses. Ammonia stimulates the motor centres in the brain and spinal cord, the respiratory centre in the medulla oblongata, and the accelerating nerves of the heart. When injected into the veins it therefore causes convulsions like those of strychnia, and quickening of the respiration and pulse. Alkalis are chiefly excreted by the urine; and potash, soda, and lithia lessen its acidity, or render it alkaline. Ammonia is partly excreted unchanged, but a portion passes out in the form of urea; and it does not render the urine alkaline like the others. Potash and lithia act as diuretics; soda to a less extent; and ammonia least of all. The diuretic action does not depend on any change in the blood-pressure. Potash and ammonia are diaphoretic. Potash lessens the tenacity of mucus.

Uses.—Dilute solutions of potash and soda relieve itching in skin diseases. Caustic potash or soda is used to destroy warts; to cauterize poisoned wounds and ulcers; to open hydatid cysts in the liver; and to establish issues. Ammonia neutralizes the formic acid which renders venomous the stings of bees, ants, and mosquitos, and is therefore applied to relieve the pain which they cause. The intravenous injection of ammonia has been recommended as an antidote in snake-poisoning; but the value of the remedy is not established. Mixed with oil, so as to form a liniment, ammonia is used as a rubefacient in sore throats, bronchitis, rheumatic pains, and neuralgia. It is inhaled to relieve headache; as a restorative in syncope and shock, when it raises the blood-pressure; and to facilitate expectoration in chronic bronchitis. Alkalis administered after meals act as antacids, and relieve heartburn. When given before meals they increase the secretion of gastric juice, quicken digestion, and relieve weight at the epigastrium, pain between the shoulders, and flatulence. Bicarbonate of soda is usually given for this purpose, but when the stomach is very irritable liquor potassæ is preferred, as it is considered to have a sedative action on the mucous membrane. Alkalis appear to lessen the transformation of glycogen into sugar, and they are used on this account in diabetes. Liquor potassæ sometimes helps to reduce obesity. Alkalis are used in the treatment of scrofula, rheumatism, gout, and lithiasis; but in the two last-mentioned lithia is considered the most valuable, whilst potash is preferred to soda, as the urate of lithia is most soluble, and the urate of soda least so. The salts of certain organic acids, such as the acetate or citrate, may be employed as remote antacids to render the urine alkaline, as they undergo combustion and are converted into carbonates in the blood. Alkalis are given to lessen the acidity of the urine in inflammation of the bladder or urethra, and potash is employed as a diuretic in dropsies. On account of its stimulating action on the heart and respiration, ammonia is administered in adynamic conditions and in chronic bronchitis.

T. Lauder Brunton.

ALKALOIDS and other ACTIVE PRINCIPLES.—Definition.—An alkaloid is a substance formed in the tissues of a plant or of an animal, having a definite composition as regards the proportions of the chemical elements of which it is composed, and capable of combining, like an alkali, with acids to form salts.

Besides alkaloids there are other active principles found in plants, which have also a powerful influence on the animal economy but do not possess all the chemical properties just stated.

Chemical Composition and Relations.—These are briefly expressed in the above definition. Thus morphia, one of the alkaloids of opium, has always the chemical composition represented by the formula $C_{17}H_{19}NO_3$, and it may unite with acetic acid to form acetate of morphia, just as potash may unite with the same acid to produce acetate of potash. But the empirical formula $C_{17}H_{19}NO_3$ represents only the percentage composition of the substance in the simplest numbers, and does not express how the atoms of the different elements are related to each other. For, just as ethylic alcohol, with the composition C^2H^6O, is believed by the chemist, from its behaviour towards other bodies, to contain a 'radicle,' or group of atoms, C^2H^5, having certain chemical properties resembling those of a base, such as potassium, K; and just as this radicle, C_2H_5 may replace one of the elements of water, so as to form alcohol $\left(C^2H^5 + H^2O = \begin{matrix}C^2H^5\\H\end{matrix}O + H\right)$; so chemists have good reason for believing that alkaloids belong to the group known as *amines* or *amides*, which are really ammonia, NH^3, in which one or more of the atoms of hydrogen are replaced by a radicle or radicles. It is impossible, however, in the present state of knowledge, to represent the true chemical composition of alkaloids, the exact constitution of the radicles being still unknown.

It is obvious that two or more alkaloids may resemble each other in percentage composition, and still be very different, both in their chemical structure and, necessarily, in their physiological action. Thus strychnia, $C_{21}H_{22}N_2O_2$, quinia, $C_{20}H_{24}N_2O_2$, and cinchonia, $C_{20}H_{24}N_2O$, differ only in a few atoms of carbon or of oxygen, more or less; but they have different physiological actions, showing that their chemical structure, which is not indicated in these formulæ, must also be different. The physiological action of an alkaloid may also be modified by combining it with another substance. Thus, as was pointed out by Crum-Brown and Fraser, compounds of strychnia with methyl, ethyl, and amyl, do not present the well-known physiological action of that substance, but one analogous to that of woorara.

Enumeration.—The alkaloids and other active principles most familiar to the physician are:—Morphia, Apomorphia, Narcein, Codein, Thebaia, Narcotin, Papaverin; Atropia, Hyoscyamia, Daturia; Nicotin; Conia; Physostigmia; Strychnia, Brucia; Quinia, Cinchonia, Beberia; Caffein; Aconitia, Veratria; Digitalin; Curarin; Muscarin; Santonin; and Ergotin.

Sources.—The majority of alkaloids are formed by plants. The function which they subserve in the economy of the plant is not known. Some plants produce only one alkaloid, while in others two or more may be formed. A few of the alkaloids have been produced synthetically by the chemist.

Physiological Action. — Alkaloids have various degrees of physiological activity when introduced into the animal body. Many are slow in their action, and a large dose is required to produce any observable effect; while others act more rapidly, and are so potent that even a minute dose may destroy life. Compare, for example, narcotin, one of the alkaloids of opium, with nicotin, the alkaloid of tobacco. Twenty to thirty grains of the former have been taken by the human subject without producing any marked symptoms, while the twentieth part of a grain of the latter may induce symptoms so severe as to threaten death. It is also well known that alkaloids may have a different kind of action on different animals. Thus one-fourth of a grain of atropia will produce serious symptoms of a complex character in a dog, while three or even four grains may be given to a rabbit without causing any more marked effect than dilatation of the pupil. In considering the physiological actions of these substances the following generalizations may, in the present state of science, be made tentatively:—1. As a general rule, the more complex the organic molecule, and the greater the sum of the atomic weight, the more intense will be the action of the substance. This has been shown in experiments on the action of the chinoline and pyridine series of bases by McKendrick and Dewar. 2. Substances which split up quickly into simpler bodies, produce rapid but transient physiological effects, whereas substances which resist decomposition in the blood or tissues may produce no appreciable results for a time, but when they do begin to break up, the effects are sudden and violent, and usually last for a considerable time. 3. Alkaloids have frequently a double action on different parts of a great physiological system, and their action in a particular group of animals will depend on the relative degree of development of the parts of the system in that group. Thus most of the alkaloids of opium have such a double action—a convulsive action resembling that of strychnia, due to their influence on the spinal cord or on the motor centres in the brain; and a narcotic or soporific action resembling that of anæsthetics, due to their influence on sensory centres in the brain. Hence, in animals where the spinal system predominates, as in frogs, these alkaloids act as convulsants; while in the higher mammals their principal action is apparently on the encephalic centres, which have now become largely developed.

Passing to the consideration of the action of the individual substances, we cannot do more than give, by way of example, a brief *résumé* of our knowledge regarding a few of them.

1. **Morphia**—$C_{17}H_{19}NO_3$—an alkaloid of opium. In the frog this substance has an action resembling that of strychnia. At first there is a state of agitation, followed by tetanic spasms: finally, all reflex actions, including those of the heart and of respiration, are paralysed. Pigeons have been found to possess a remarkable power of withstanding the influence of this drug—an ordinary-sized bird requiring about two grains to kill it. Rabbits become partially somnolent, show a tendency to reflex spasms, and tolerate a large dose—say about one-half to one grain per pound weight of the animal. In the dog the intravenous injection of even one-tenth of a grain (for a small animal) causes agitation followed by sleep; the pulse and respiratory movements are slowed; the smaller arteries become (at least during one stage) contracted, so as to cause an augmentation of general blood-pressure; the pupil is contracted; and, if the dose be large, death may be preceded by convulsions. In the higher mammals morphia acts chiefly on the sensory apparatus, both peripheral and central.

2. Other alkaloids of opium have also been investigated.—(*a.*) **Narceia**, $C_{23}H_{29}NO_9$, is a pure hypnotic, causing profound sleep. Even in large doses it does not produce convulsions. (*b.*) **Codeia**, $C_{18}H_{21}NO_3$, has an action like that of morphia. (*c.*) **Thebaia**, $C_{19}H_{21}NO_3$, causes tetanic convulsions, thus resembling strychnia. (*d.*) **Narcotin**, $C_{22}H_{23}NO_7$, is slightly narcotic, but strongly convulsant. (*e.*) **Papaverin**, $C_{20}H_{21}NO_4$, causes a somniferous action like that of narceia. **Apomorphia**, $C_{17}H_{17}NO_2$, a derivative of morphia, has none of the characteristic actions of that substance, but acts chiefly as a vascular depressant and as an emetic. It is evident, therefore, that opium, which may contain more or less of all of these substances, must have an action on the body of a very complicated character.

3. **Strychnia**, $C_{21}H_{22}N_2O_2$,—the alkaloid of Strychnos nux vomica. In the frog very minute doses cause convulsions of all the voluntary muscles, excited by peripheral irritation. These convulsions are due to the action of the poison on the spinal cord, as they persist after decapitation. In warm-blooded animals the reflex character of the convulsions is less evident; they have more of a tonic character, and chiefly affect the extensors. The exact *modus operandi* of the poison on the cord is unknown, but in some way or other it heightens its reflex sensibility. Death is usually the result of asphyxia from arrest in spasm of the respiratory mechanism, but it may result from exhaustion. **Brucia**, $C_{23}H_{26}N_2O_4$, another substance found in nux vomica, appears to have an action like that of strychnia, but more feeble.

4. **Atropia**, $C_{17}H_{23}NO_3$,—the alkaloid of Atropa belladonna. In the frog it causes tetanic reflex spasms. Herbivorous animals, as a rule, have a tolerance of this poison, so that its effects are best studied in carnivora. Even in these the action is somewhat uncertain. Respiration may be paralysed without general convulsions: the pulse is quickened by paralysis of the inhibitory action of the pneumogastric nerve on the heart; and the arterial pressure is increased. After very large doses the arterial pressure may be diminished with paralysis of all parts containing involuntary muscular fibre. Secretion is diminished. The pupil is dilated apparently by a direct influence of the poison on the centres or nervous arrangements in the iris itself, as the effect may be observed even in an eye removed from the head. **Hyoscyamia**, the alkaloid of Hyoscyamus niger, and **Daturia**, the alkaloid of Datura stramonium, have an action like that of atropia.

5. **Digitalin**, $C_{27}H_{44}O_{15}$,—the active principle of Digitalis purpurea. A large dose causes slowing of the heart's action, and if the dose be increased the heart will be arrested in diastole,

and will not respond to direct excitation. With medium doses there is a period of acceleration of the heart's action, but this period may rapidly pass into that of slowness just mentioned. This action on the heart has not yet been clearly accounted for, and it remains to be decided whether it be due to the influence of the drug on the terminations of the pneumogastric, or of the sympathetic, or on the intracardiac ganglia themselves. Coincident with the action on the heart, the smaller arteries are contracted and the arterial tension is increased. Digitalis would appear to have little effect on involuntary muscle, but it exerts a potent action on voluntary muscle, which, after small doses, becomes feeble in contractile power, while large doses may abolish contractility altogether.

6. **Physostigmia**, $C_{15}H_{21}N_3O_2$, — the active substance of Physostigma venenosum, or Calabar bean. As has been pointed out by Professor Fraser, this alkaloid has an action antagonistic to that of atropia. Sensibility and consciousness remain until death; the voluntary muscles are paralysed; involuntary muscles are said to show tetanic contractions; respiration is at first accelerated, and afterwards slowed; the vessels become alternately dilated and contracted; secretion, especially that from the lachrymal and salivary glands, is increased; and the pupil is contracted. It appears to paralyse the extremities of the motor nerves, in this respect resembling curare.

7. **Curare** is a resinous substance, containing an alkaloid, **Curarin**, of the composition $C_{10}H_{15}N$, obtained from certain parts of South America, and used by the natives of these regions as an arrow-poison. It is probably obtained from certain plants belonging to the genera Strychnos and Paullinia. Its distinctive physiological action is abolition of the power of all voluntary movement, in consequence of its action, as was proved by Claude Bernard, upon the peripheral terminations of motor nerves—the "terminal plates" of muscle. Respiratory movements are arrested in consequence of paralysis of the muscles of respiration, but the heart may continue to beat for a considerable time. If artificial respiration be established, the circulation may be maintained for several hours while the animal is completely under the influence of the substance. All the secretions are increased, and the mean temperature falls.

8. **Muscarin**, the alkaloid of Agaricus muscarius, causes arrest of the heart's action in diastole, an effect which may be removed by the influence of atropia, thus affording an instance of physiological antagonism. In warm-blooded animals muscarin slows the heart's action; the blood-pressure falls; respiration is first embarrassed, and may be completely arrested; parts containing involuntary muscle are in a state of tetanic spasm; the pupil is contracted; and secretion is increased.

9. **Santonin**, $C_{15}H_{18}O_3$, the alkaloid of Artemesia santonica, may cause in man nausea, vomiting, hallucinations, vertigo, and a peculiar state of visual sensation—the field of vision usually appearing yellow, but sometimes violet. It is said that the stage of violet rapidly passes into that of yellow, and therefore it is probable that santonin may first excite the retinal fibres sensitive to violet (according to Thomas Young's theory of colour-perception), and afterwards paralyse them. In large doses, santonin causes loss of consciousness, tetanic convulsions, and death.

10. **Ergotin**, the active principle of Secale cornutum, causes contraction of the smaller blood-vessels, contractions of the uterus, and slowing of the pulse; and the animal may die in consequence of arrest of the action of the heart.

11. **Quinia**, $C_{20}H_{24}N_2O_2$, one of the alkaloids of Cinchona, in small doses accelerates the heart's action in the warm-blooded animal; in moderate doses it slows it; and in large doses it may arrest it, and cause convulsions and death. Research shows that its action is essentially upon the central nervous system. It destroys all microscopic animal organisms, apparently killing vibrios, bacteria, and amœbæ; but it seems to be without action on humble organisms belonging to the vegetable kingdom. It arrests the movements of all kinds of protoplasm, including those of the colourless corpuscles of the blood. It arrests fermentive processes which depend on the presence of animal or vegetable organisms, but it does not interfere with the action of digestive fluids.

12. **Cinchonia**, $C_{20}H_{24}N_2O$, is said to have an action similar to quinia, but much more feeble. Further research is needed on this point.

JOHN G. MCKENDRICK.

ALOPECIA. *See* BALDNESS.

ALPHOS and **ALPHOIDES** (ἀλφὸς, white), terms signifying white and white-looking, are associated with the whiteness of the disks of common *Lepra*: hence *Lepra alphos* and *Lepra alphoides*. *See* LEPRA.

ALPHOSIS (ἀλφὸς, white).—Whiteness, or the process of turning white. *See* ACHROMA.

ALTERATIVES.—DEFINITION.—Medicines which gradually restore the nutrition of the body to a healthy condition, without producing evacuations, or immediately exerting any very evident action upon the nervous system.

ENUMERATION.—The principal alteratives are —Nitric and Nitro-hydrochloric acids; Chlorine and Chlorides; Iodine and Iodides; Sulphur and Sulphides; Potash and its salts; Mercury and its salts; Phosphorus; Hypophosphites; Antimony; Arsenic; Taraxacum; Sarsaparilla; Hemidesmus and Guaiacum; Mezereon and Dulcamara.

ACTION.—Healthy nutrition depends on the digestion of the food, its assimilation by the tissues, the decomposition of the tissues during the exercise of their functions, and the removal of their waste products being performed in a proper manner—in due proportion one to another. If the food is not properly digested, as in dyspepsia; or is not properly assimilated, as in diabetes: if the tissues break up too rapidly, as in fever; or if the waste products are not properly removed, as in some cases of kidney-disease, nutrition suffers. Digestion and excretion may be improved by tonics, purgatives, and diuretics; but alteratives seem to exert their action upon assimilation and tissue-change. The digestion of food is effected by means of ferments, such as those of the salivary glands, stomach, pancreas, etc. Some also of the changes, such as the conversion of glycogen into sugar, which the food undergoes after absorption in the liver, and even certain so-called vital actions—such as the coagulation of the blood—are produced by a similar agency. It is not improbable that the histolytic changes in the tissues are also effected by ferments. They do not depend upon oxidation, for although during health the products of tissue-decomposition are oxidised as fast as they are formed, yet under certain circumstances the tissues are split up so rapidly that the products which they yield are only partially oxidized. This is seen in poisoning by antimony, arsenic, and still more markedly by phosphorus, where such tissues as the muscles become decomposed, yielding nitrogenous substances, such as leucin, tyrosin, or urea, and fat. The former are excreted in the urine; while the last, instead of undergoing combustion, accumulates in the place formerly occupied by the muscular tissue, which is accordingly said to be in a state of fatty degeneration. It is possible then, although by no means certain, that alteratives influence nutrition, either by modifying the activity of ferments, or by altering the susceptibility of the tissues to their action.

Mercurials in purgative doses, taraxacum, nitric and nitro-hydrochloric acids, probably act by modifying the digestion of the food in the upper part of the small intestine, or by affecting the changes which it undergoes in the liver after absorption. Potash has probably an action on the muscles. Antimony, arsenic, and phosphorus especially affect the nervous and cutaneous systems. Mercury has a peculiar power of breaking up newly-formed fibrinous, and particularly syphilitic deposits. Iodine, iodides, and probably chlorides, act upon the lymphatic system and promote absorption.

Uses.—Purgative doses of mercurials, taraxacum, nitric and nitro-hydrochloric acid are useful in cases of frontal headache, general malaise, and depression of spirits, associated with symptoms of so-called biliousness, or with the appearance of urates or of oxalates in the urine. Potash and colchicum are employed in the treatment of gout. Phosphorus and arsenic are used in cases of nervous debility, as well as in nervous diseases, such as neuralgia and chorea, in which antimony is also serviceable. Arsenic is also given in diseases of the skin; and antimony in inflammation of the mucous membrane of the bronchi. Mercury in alterative, that is, in small doses, which are absorbed into the circulation without purging, is used to break up newly-deposited fibrinous masses, as in iritis, pericarditis, etc., and to counteract the effect of syphilitic virus upon the soft tissues in the secondary stage of this disease. Iodine and iodides act on the lymphatic system, and are useful in removing glandular swellings. By stimulating the absorbent system they may also assist in the removal of the fibrinous deposits and syphilitic growths disintegrated by the mercury. The iodides are sometimes given in the secondary, but are still more valuable in the tertiary stage of syphilis.

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ALVEOLAR.—A word used in pathology as descriptive of any morbid growth which consists of small cavities or spaces (*alveoli*), usually occupied by contents, and bounded by walls formed of cells or fibres. Alveolar Cancer is the most familiar application of the term, being a synonym for Colloid Cancer. *See* Cancer.

AMAUROSIS (ἀμαυρὸς, dark).—Definition.—This term cannot be strictly defined. Literally, it means an *obscurity of vision*, a state of *blindness*, in the popular sense of the term, whereby nothing more is learnt than that the patient cannot see well enough for practical purposes, and is thereby unfitted for the usual occupations of life. Besides this, it is always tacitly understood that an external observation of the organ of vision, during the life of the patient, does not reveal any ostensible cause of blindness. It is further understood that the use of glasses is no remedy in amaurotic cases. It is rather the kind, than the degree, of blindness that is called amaurotic; but it must be observed that lesser degrees of blindness, of the amaurotic type, are generally, vaguely and indefinitely, called *amblyopic*. To add to the obscurity of the subject, some writers call some cases of moderate blindness, of the amaurotic kind, *amaurotic amblyopia*; others speak of *partial* or *incomplete amaurosis*. We now estimate any defect of vision with more accuracy, and record its area on a map, and its degree in figures, in comparison with a standard of ordinary normal vision.

Ætiology.—The causes of amaurosis have been more recently specifically attributed to morbid conditions of the percipient nervous apparatus of the eye or of vision. All cases are excluded in which, in the present state of science, and using the ophthalmoscope, we can *see* any morbid condition. But very few cases are now, in the statistical tables of the chief eye-hospitals, included under the head *amaurosis*. Some few cases seem likely, at least for some time to come, to be called by this term of reproach. The ophthalmoscope has enabled us more accurately to classify a large majority of the cases formerly called amaurotic. Many new names are thus introduced to our systematic treatises on eye diseases, whereby we gain more definite information, if only, as in *some* of them, *e.g.* 'white atrophy,' we have substituted the name of a particular ophthalmoscopic sign for an indefinite symptom. At least we can speak more accurately of the part that is or has been diseased—of the retina, or of the ocular end of the optic nerve. And, indeed, before the invention of the ophthalmoscope, the ancients, whilst professing to include only cases of disease of the percipient nervous apparatus of vision, included all kinds of obscure visual disorders. Mackenzie (1854) includes, besides retinitis, etc., choroiditis, and dislocated lenses! Of the first named he says, 'It would be superfluous to consider these states separately, because we are at present ignorant of any diagnostic signs by which, during life, the one can be discriminated from the other.' Even now, whenever the term amaurosis is had recourse to, it expresses more particularly that of which we are ignorant, and it may mean any one of so many different states that no anatomical characteristics can be assigned to it.

In a large majority of the cases commonly classed as those of amaurosis, it is found ophthalmoscopically that there is 'white atrophy' of the optic nerves. The 'disks' are nearly or quite bloodless; white, not pinky-white; and the nerve-fibres going to the retinæ, being more or less wasted, there is some excavation of the disks, perhaps so much that the lamina cribrosa, in one or both, is exposed to view, while the retinal vessels are somewhat diminished in size. The causes of this condition are, most commonly, intracranial tumours or other diseases which induce pressure upon the optic nerve, or lead to an extension of inflammation, followed by œdema or double optic neuritis (descending), these terminating in the atrophy and amaurosis. The nerve-disease is often due to syphilis. But some cases of white atrophy occur, in which there has been no precedent neuritis. Of such 'tobacco amaurosis' is an example, in which, unless smoking be given up, by an idiosyncrasy of the patient, he soon becomes blind. But nerve-atrophy or inflammation should be no longer called amaurosis—they have obtained a better nomenclature. The preceding stages of the diseases causing them, if, as is rarely the case, unaccompanied by any definite ophthalmoscopic signs, and yet producing a considerable amount of blindness, may, for want of better knowledge, at present be called *amaurotic*. Other such cases are those reported as snow-blindness; or in which blindness has been produced by a lightning-flash near the eye; a blow on the eye without other mischief resulting; disuse of an eye in children, as in some neglected squint cases; irritation from some branches of the fifth nerve (dental caries, etc.); anæmia after excessive losses of blood; suppression of menses; blood-poisoning by tobacco, lead, quinine; uræmia; and some cases of cerebral apoplexy. Embolism of the central artery of the retina occurs, but it is easy of diagnosis with the ophthalmoscope, and therefore should not be called amaurotic. The writer does not think there are any cases of *long-standing* blindness that show no ophthalmoscopic changes.

Symptoms and Diagnosis.—There is one symptom of amaurotic blindness, affecting both eyes, which is noteworthy, as constituting, *primâ facie*, a general distinction between it and the other cases of blindness *not* of nervous origin: the gait and general aspect of the patient is peculiar—he is hesitating and hopeless-looking. He no more *tries* to see objects. He holds up his head; the eyes are open and turned upwards, as eyes not in use (in sleep) always are, or because the patient has felt the heat of the sun from overhead, and has last enjoyed sensation of light, whence he knows it comes, from above. He feels his way with his feet, and his hands are extended before him. He does not look towards you, or at anything in particular. But amaurosis does not by any means imply a similar state of vision in both eyes, nor that the blindness is to be taken in the ophthalmological sense, *i.e.* wanting perception of light. It would be well if any less degree of imperfection of vision, without evident cause, might be called *amblyopic*, but the two eyes must be considered separately. To diagnose the absence or presence of a power of perception of light, certain important precautions must be taken, as almost all patients who are absolutely blind will declare, and probably believe, that they still can see light, *i.e.* objective light. The patient should be placed opposite to a bright light, such as a gas-lamp, and near to it, but not so near that he can feel the heat of it; the light is then turned up and down, and it is fully exposed and obscured, and the patient is asked many times, in quick succession, if he sees light or not. The light should be left burning and exposed, or not, during several of the successive queries, so as to do away with any doubt. The word of the patient untested is quite inadmissible. Any other blindness than this of absolute amaurosis, or originating in any other diseases than those of the percipient nervous apparatus of the eye, is never so great as to prevent the perception of light. If the patient can see light from darkness, test whether he can see shadows of some small object—of the hand, or of one finger only, passed between him and the burning light, or the light of the window only. If he can see to count fingers, his blindness is insufficient to indicate what is called amaurosis. Another point in the diagnosis of amaurosis is that, ophthalmoscopically, the appearance of the fundus of the eye is normal, or such as, independent of errors of refraction, we find in other cases compatible with standard vision, or at least with a fair amount of useful vision. This will allow of a considerable latitude, and will not include any slight or imaginary hyperæmia or anæmia of the optic disk, any physiological excavations of the same, or congenital opacities of the retina, etc. The pupil of the affected eye is, if the other be perfectly excluded from light or vision, nearly always dilated, to almost the greatest extent, though atropine dilates it yet more fully, and it is fixed, being insensible to light.

Prognosis.—After a due consideration of the cases thus classed together—and they are very unlike in fact, and often very obscure—we may say generally, that if the blindness be of one eye only, sudden and recent, the prognosis is hopeful; but if both eyes are affected, and the disease, whatever it may be, is of steady progress and of long standing, it is very serious. The cases of amaurosis are very rare indeed in which vision is perfectly restored; most of them end fatally to vision, or would so end but that the disease is sooner fatal to life.

Treatment.—This must necessarily be varied according to the cause of the amaurotic condition. For instance, if there is intra-cranial disease, treatment directed thereto must be followed out; and should there be indications of syphilis, iodide of potassium and small doses of mercury must be given for some time. When amaurosis depends on any injurious habit, such as smoking, this must be relinquished. Large doses of strychnine and iron are useful in advanced white atrophy. J. F. Streatfeild.

AMBLYOPIA (ἀμβλὺς, blunt, and ὤψ, sight).—Obscurity of vision. *See* Amaurosis.

AMBULATORY (*ambulare*, to walk).—A term applied to latent typhoid fever, signifying that the patient is able to walk about during the attack. *See* Typhoid Fever.

AMENORRHŒA (ἀ, priv.; μὴν, a month; and ῥέω, I flow).—Absence of the menstrual flow during any portion of the period of life when it ought to be present. *See* Menstruation, Disorders of.

AMENORRHŒAL INSANITY. *See* Insanity.

AMENTIA (ἀ, priv., and μένος, the mind).—An obsolete term for Dementia. *See* Dementia.

AMNESIA (ἀ, priv., and μνῆσις, memory). *See* Aphasia.

AMPHORIC.—A peculiar hollow metallic sound, elicited occasionally by percussion, but more commonly heard in auscultation. Amphoric breath-sound resembles that produced by blowing into a large empty glass or metallic vessel (*amphora*). *See* Physical Examination.

AMYGDALITIS (*amygdalæ*, the tonsils).—A synonym for inflammation of the tonsils. *See* Tonsils, Diseases of.

AMYLOID DISEASE (ἄμυλον, starch).—The name given by Virchow to Albuminoid Disease, from the belief that the material characteristic of this morbid condition is of the nature of starch or cellulose. *See* Albuminoid Disease.

ANÆMIA (ἀ, priv., and αἷμα, blood).—Synon.: *Spanæmia; Hydræmia*; *Oligæmia*; *Aglobulism*. Fr. *Anemie*. Ger. *Anämie*; *Blutarmuth*.

Definition.—Deficiency of blood in quantity, either general or local; also, deficiency of the most important constituents of blood, particularly albuminous substances and red corpuscles.

This definition is purely pathological, and the condition thus expressed presents many varieties, Anæmia in the widest sense of the term including Oligæmia, Oligocythæmia, Hydræmia, and Spanæmia, as well as Chlorosis. (*See* Chlorosis, Hydræmia, Spanæmia, Oligocythæmia, and Blood, Morbid Conditions of.) From the clinical point of view, Anæmia is a condition of system in which impoverishment of the blood, whether from want or from waste, is associated with symptoms of imperfect discharge of the vital functions.

Ætiology.—The causes of anæmia are generally multiple and complex. First, the *supply* of blood to the body may be insufficient, and that from a variety of causes, of which the chief are:—derangements of alimentation, including insufficient food, and morbid states of the lymphatic and blood-glands; such defective hygienic conditions affecting the formation and nutrition of the blood as want of light, air, and muscular exercise; prolonged exposure to the influence of certain poisons, as lead, mercury, and malaria; and, lastly, interference with the free circulation of the blood by cardiac or vascular disease, such as valvular disease or dilatation of the heart and aneurism of the aorta. Secondly, the *consumption* of blood may be increased by hæmorrhage; by profuse discharges, such as suppuration, catarrh, and albuminuria; by rapid growth and development; by frequent pregnancy and superlactation; by excessive muscular exertion; and by the presence of pyrexia, or of new growths, which rob the system of nutritive material. In a third group of cases of anæmia both the supply and the consumption are at fault. Thus derangement of the organs and of the whole process of sanguification is frequently associated with profuse discharges from various parts; and in malignant diseases and the 'chronic constitutional diseases,' such as syphilis, tuberculosis, Bright's disease, albuminoid disease, Addison's disease, and others, the cause of the anæmia is extremely complex. But the majority of the cases of anæmia that are regarded and treated as such fall into the class to which the name of *idiopathic* has been applied. In such cases the anæmic condition is due, not to any disease so-called, but to disturbance of nutrition generally, that is of the healthy relation between the demands of the system and the supply of nutrient material. This condition occurs chiefly in children and young women, at the period of bodily growth and of the development and early activity of the sexual functions; and when, as so frequently and unfortunately happens, the air, light, food, occupation, and moral relations of the individual are all more or less unhealthy.

Anatomical Characters.—The blood suffers three principal changes in declared anæmia, namely, (1) deficiency in amount (Oligæmia); (2) deficiency in red corpuscles or hæmoglobin (Oligocythæmia, Aglobulism); and (3) deficiency in albuminous constituents (Hypalbuminosis). Of these Oligæmia is the simplest, and perhaps never occurs alone; it is speedily complicated with Aglobulism, which is a very early and common, as well as the most obstinate, change in the blood. Hypalbuminosis is the most advanced and perhaps the most serious alteration of the three. (*See* Blood, Morbid Conditions of.) The blood is scanty and pale, and has a diminished specific gravity; and coagulates slowly and loosely, or in aggravated cases not at all, settling into three layers—consisting respectively of red corpuscles, white corpuscles, and plasma. The body presents certain changes directly due to the state of the blood. Whether the anæmia be local or general, the corresponding parts are blanched and 'bloodless.' The cells of the tissues become atrophied and degenerate, in consequence of, and in proportion to, the interference with their plastic and functional activity respectively; and the so-called 'anæmic' form of fatty heart, liver, kidneys, and other organs, is the result. If death occur suddenly from acute anæmia the heart is found empty and contracted.

Pathology.—When the volume of blood in the body has been reduced by repeated small hæmorrhages, the phenomena that supervene, while they express the want of blood as a whole, and of its several constituents, are chiefly referable to the loss of two of these constituents—the albuminous substances and the red corpuscles or hæmoglobin—that is, of the oxidisable and the oxidising materials. The pathology of hypalbuminosis and aglobulism is fully discussed in the article on diseases of the blood, and need not be repeated here. The same effects will be produced by a drain of the liquid part only of the blood, or by poverty of the blood from any of the causes enumerated above, whether of the nature of waste or of want; inasmuch as loss of plasma speedily affects the nutrition of the red corpuscles. These phenomena constitute the symptoms of the anæmic condition whatever may be its cause; their relative prominence naturally varying according to an immense number of circumstances.

Symptoms.—The subjects of anæmia are usually girls and young women. Their general appearance, which is striking, is one of pallor, debility, and variable loss of feminine fulness. The visible parts of the surface are pallid, often with a tinge of dusky brown on the eyelids and the backs of the hands; the clearness of the complexion varies with the normal pigmentation of the body; the skin is soft, satiny, and rather loose. The mucous surfaces also are blanched; the sclerotic is pearly blue. The loss of flesh may be moderate, or it may be considerable. The extremities are cold, and the legs and lower eyelids are often œdematous. Bodily strength is reduced; muscular force is diminished, while myalgia is common; an air of languor and want of vigour pervades the whole demeanour; and the patient is sleepy, dull, and depressed. The subject of anæmia generally complains of weakness, various pains about the body and head, and marked shortness of breath on the least exertion. The last symptom is unaccompanied by other evidence of respiratory derangement; in character the breathing is regular, and short or even panting. The symptoms referable to the circulation consist chiefly of palpitation on exertion; a tendency to faint; and pain or even distress over the cardiac region. The impulse is variable; the first sound is either hollow or murmurish, or converted into a murmur at the base, and frequently even over the whole præcordium; the diastolic sound is sharp generally. Over the manubrium and in the cervical vessels a murmur followed by a sharp sound is commonly audible, and therewith a venous hum. The cervical vessels may throb; the radial pulse is small, soft, weak, and of variable but usually increased frequency and suddenness. There is a tendency to hæmorrhages, especially epistaxis; and petechiæ are occasionally observed. The digestive system is markedly affected, as shown by loss or perversion of appetite; an anæmic, often bare, but variable tongue; dyspepsia, nausea, and sickness after meals or on rising; and constipation, which is present in the majority of cases and is frequently prolonged and severe. The menstrual functions are almost always deranged; amenorrhœa is common in some form; menorrhagia is rare (except as a cause of anæmia); dysmenorrhœa is frequently associated; and leucorrhœa is the rule. The urine is usually abundant and pale, but varies greatly. Headache and other cerebral symptoms are common. Blood drawn from the finger presents aglobulism. *See* Hæmacytometer.

The leading phenomena of *acute* anæmia are those of syncope, or suspended animation from failure of the circulation, and are described under that title.

Course and Terminations.—The course of anæmia in this form is essentially slow and progressive, unless it is checked; the *duration* is perfectly indefinite. The course of the symptomatic form will naturally vary with its cause. Idiopathic anæmia rarely terminates fatally; and, when it does so, the event may be referred with few exceptions to some complication. Occasionally, however, it proceeds steadily to death (*see* Progressive Pernicious Anæmia, below).

Intercurrent diseases may be expected to be severe in an anæmic condition, in proportion to its degree.

Diagnosis.—Anæmia is generally recognised with the greatest ease, and the chief question of diagnosis relates to its *cause*. The first point to be determined, therefore, is whether it is not *symptomatic* of some more grave state, such as tuberculosis, syphilis, albuminoid disease, or some other of the many possible causes of poverty of blood. Having settled that the anæmia is *idiopathic*, we must next exclude two diseases with which it may be confounded, namely, chlorosis and leukæmia. Chlorosis, in which the plasma is not considered to be altered, and which possesses otherwise a special pathology, is expressed by the yellow tint of skin, by the absence of wasting and of dropsy, as well as by other features (*see* Chlorosis.) Leukæmia is recognised by examination of the blood, spleen, and lymphatic glands. The starting-point of the blood-change in cases of idiopathic anæmia, can only be discovered by careful investigation of all the facts of the case.

Prognosis.—The prognosis of anæmia is favourable as regards life. In simple anæmia from loss of blood, the patient may be assured of speedy and complete recovery. In idiopathic anæmia, however, this promise can be given only when the cause can be removed or avoided. Under favourable circumstances and sound treatment, improvement will begin almost immediately; and health should be restored after a few weeks or months.

Treatment. — The treatment of anæmia, when it is symptomatic of some more grave condition, such as Bright's disease or phthisis, does not require notice here. When blood has been lost in serious quantity, without other injury of consequence, it will be naturally restored if sufficient time but be given and interference otherwise avoided. Attention to the ordinary rules of health, abundance of food and air, and moderate exercise, will surely, if slowly, restore the patient, without the administration of a single drug. Even in this case, however, treatment may be of great service, by arresting, if necessary, the cause of the anæmia, such as menorrhagia or epistaxis; and by assisting nature, if the condition should threaten at any time to become intensified by its own effects.

But before the blood can be restored in the large and ill-defined group of cases known as idiopathic anæmia, the unhealthy influences under which the patient is placed, and the functional and other derangements, which are usually accountable for the imperfect sanguification, must be discovered and corrected. Where the ætiology is complex, treatment must be equally general, and the whole system of life will have to be reformed. On the other hand, in the rapidly growing child

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and youth, and still more in girls at puberty, the great demand for nutritive material must be duly considered and every obstacle to its supply removed. When other than direct discharges are draining the blood they must be checked. Lactation may have to be forbidden; and leucorrhœa and spermatorrhœa will sometimes demand local treatment.

The removal of the cause being thus made the first element in treatment, means must next be adopted for the restoration of the blood. But before this can be accomplished, it will be necessary to bring the alimentary tract and the organs of sanguification into a healthy state. Dyspepsia and constipation require immediate treatment; and for this purpose simple alkaline and bitter stomachics with rhubarb, and free purgation by ordinary means, followed by a course of aloes and iron pill at night, are the best. The food must be carefully ordered, so that it shall not only supply the albuminous elements that are specially deficient in the blood, but be retained and absorbed; it must therefore be at once nourishing and digestible, and be taken in small quantities at frequent intervals. The patient must not be allowed to yield to the disgust that she may have for meat.

The process of sanguification may be successfully assisted by means of drugs. Iron is the sovereign remedy for aglobulism; and, practically speaking, it speedily becomes a question in the treatment of a case of anæmia in what form iron is to be given. The compound iron mixture of the pharmacopœia answers more frequently than any other; but, on the one hand, when there is much constipation, the protosulphate with purgative saline sulphates will be more suitable for a time; and, on the other hand, when there is a tendency to discharges, the per-salts with bitters will better answer the purpose. The combinations of iron with quinia or strychnia, should be given in cases where less marked anæmia occurs in older subjects with nervous depression and general want of vigour. In special cases the ferrum redactum, saccharated carbonate, vinum ferri, or the French *dragées ferrugineuses* at meal times may be ordered. Cod-liver oil may sometimes be prescribed with success. Other symptoms must be treated on ordinary principles. Uterine complaints demand special attention; and bromides, ergot, opium, and other sedatives and astringents are indicated where excitement and excessive discharge are present. While these dietetic and medicinal measures are being carried out, it is impossible to insist too strongly upon attention to bodily and mental hygiene. In a large number of cases change of air fulfils all the necessary conditions, and it is generally to be recommended. Above all, time is an essential element in the cure; and rest is scarcely less so. A frequent change in the form of the medicinal remedies is also advisable.

Progressive Pernicious Anæmia. — A peculiar form of anæmia has long been known, but has lately attracted special attention, and is variously designated as *pernicious*, *malignant*, *idiopathic*, and *progressive*, on account of the intensity of the symptoms, the obscurity of its pathology, and the frequency with which it advances to a fatal termination. This disease may occur in both sexes, but has been most frequently observed in middle-aged, pregnant women; it presents no special post-mortem appearances; and it cannot be referred to any reasonable cause. The *symptoms* are those of excessive anæmia, as described above; but gastric disturbance and general hæmorrhages are relatively prominent, and, in some cases, irregular attacks of pyrexia occur. The blood during life is said to differ from that found in ordinary anæmia, by containing an unusual amount of ill-shaped red corpuscles and granular matter. The *course* of the disease is steadily towards death, in which it generally terminates. The *pathology* of progressive pernicious anæmia is obscure. It is believed by some to be but the advanced stage of ordinary anæmia, which attracts attention by its resistance to treatment, and its fatal termination. The appearance of the blood would seem to indicate excessive destruction, rather than insufficient supply of the important elements, as the essential cause of the morbid condition; but there is probably derangement in both directions. The *prognosis* is as unfavourable as possible. *Treatment* must be ordered on general principles: transfusion has been frequently tried, but without success. J. MITCHELL BRUCE.

ANÆMIA LYMPHATICA.—A form of Anæmia which is associated with a peculiar affection of the Lymphatic System. *See* HODGKIN'S DISEASE.

ANÆSTHESIA (ἀ, priv., and αἰσθάνομαι, I feel).—Anæsthesia literally means absence or loss of sensation, which may be general or local. The word is, however, more especially employed to signify loss of tactile sensibility, as distinguished from insensibility to pain or *Analgesia*. It is further used to indicate the condition induced by the action of Anæsthetics upon the system. *See* SENSATION, Disorders of.

ANÆSTHETICS.—DEFINITION. The name given to a series of agents which are employed for the prevention of pain, but more especially applied to those used in surgical practice.

HISTORY.—The idea of annulling pain in surgical operations is a very old one. Compression of the nerves and blood-vessels, and the inhalation of the vapour of mixtures containing carbonic anhydride were practised at an early date. In the sixteenth century ether was probably the active ingredient of a volatile anæsthetic described by Porta. The use of anæsthetics was, however, but little understood and rarely practised. Even the suggestion of Sir Humphry Davy, that nitrous oxide should be used in minor operations not attended with loss of blood, was of little practical value, on account of the inefficient apparatus then available. In 1845 Horace Wells inhaled laughing gas so successfully that he may be said to have introduced the practice; but he appears to have so often failed to produce the desired effect that this agent fell into disuse on the introduction of ether in 1846 by Morton, after some communication on its properties from a chemist named Jackson. In 1847 chloroform was used by Simpson, and quickly superseded ether almost all over Europe. At the present time the comparative safety of ether has caused this anæsthetic again to be preferred by many surgeons in this country.

Enumeration.—The three agents just mentioned, namely, nitrous oxide, ether, and chloroform, are those chiefly in use, and they have each advantages in particular cases. Experiments made with other agents, such as amylene, tetrachloride of carbon, ethidenedichloride, and bichloride of methylene, have not shown that they possess sufficient advantages to counterbalance the defect of requiring special management in their administration. This list of anæsthetics might be still further increased, for in order to produce insensibility it is only necessary to reduce the supply of arterialised blood to the nervous centres, or to introduce into the blood a substance which deprives it of its power of oxygenating the tissues.

Modes of Use.—Anæsthesia may be produced for surgical purposes:—1. by benumbing the part to be operated on by means of cold; 2. by intercepting its nervous communication; 3. by arresting the activity of the nervous centres concerned in sensation. Thus anæsthetics may be *local* or *general* in their action.

Local Anæsthesia may be induced by cold. The most convenient plan is to blow a jet of anhydrous ether spray upon the part, as suggested by Dr. Richardson, and thus to freeze it. The surface to be frozen should be dry, and hence the difficulty of freezing the gum of the lower jaw, on account of the saliva. A mixture of equal parts of pounded ice and common salt contained in a bag of muslin is effective, but less easily applied. This plan is adapted for opening abscesses and boils, and for the extraction of a few teeth; but the process both of congelation and of thaw is painful. Chloroform applied locally is said to cause numbness, but it is very little used except inside the mouth, and then it owes its soothing effects to the quantity of chloroform vapour which is inhaled. Compression of nerve trunks for inducing anæsthesia is never practised at the present day.

General Anæsthesia is at present rarely obtained in any other way than by inhalation, although successful attempts have been made to induce the condition by subcutaneous and intravenous injection of chloral or morphia.

Subjects for Anæsthetics.—We may say generally that any person fit for a severe operation is a fit subject for an anæsthetic, but no one is so free from danger that care in watching its effects can be dispensed with. The cases requiring the greatest vigilance are not the young and delicate, for whom a small dose suffices, but the strong, who inhale deeply and struggle much. Ether is probably better for those suspected of fatty degeneration of the heart, although as a rule such cases are eminently satisfactory under chloroform. Many of the deaths under chloroform have occurred in intemperate drinkers, and the presence of alcohol in the system undoubtedly intensifies its effect.

Precautions.—Before commencing inhalation the following particulars should be attended to. The patient must not have recently taken a full meal; he should lie comfortably, in a horizontal position if possible, unless when gas or ether is given for a short operation; and the dress should not be tight. When the administration is begun, he should be encouraged to breathe regularly and freely. The pulse as well as the respiration must be watched. If the vapour excites either swallowing or coughing, it is more pungent than is requisite, and its strength should be diminished. Most patients are at first afraid of breathing, and some hold their breath for half a minute. The vapour should not be removed on this account, but care should be taken, by holding the inhaling apparatus farther off, to prevent the vapour becoming too strong in the interval. After volition has been abolished, any pause in the breathing should be noted, and more or less fresh air given. Further directions will be given in describing the anæsthetics specially.

Special Anæsthetics.—*Protoxide of Nitrogen, Nitrous Oxide, or Laughing Gas.* This agent is now prepared wholesale, and sold condensed into a liquid in strong iron bottles. The gas, whether supplied thus or from a gasometer, should be inhaled from a bag having such a free communication with the face that it will readily be supplied even in panting respiration. A long tube, however large, is objectionable, as the gas is less mobile than common air.

The special aim in giving gas should at first be to exclude air, and to exchange the atmosphere within the air-passages and lungs for one of pure gas. The patient should not merely be told to breathe slowly and deeply, but be shown how to do so, about fifteen times in a minute. The inspiration should not be jerking, and the expiration should be complete. It is a special merit of laughing gas that no harm can come of inhaling too freely at first. The gas-bag must be kept filled either by pressure on the gasometer, or by turning the screw tap of the gas bottle. This may be done by the hand of an assistant, or more conveniently with the foot of the administrator, by means of a contrivance invented by Mr. Braine, in which the gas-bottle is placed horizontally upon rollers and moved by the foot whilst the head of the screw is fixed. The writer's plan is to fix the bottle vertically and turn the screw by pressing the foot against an iron plate with spikes on its upper surface, and a square hole fitting the tap on its lower surface. It is imperative that the face-piece or mouthpiece *should fit accurately*, and the air-pad is almost essential to effect this in a great many cases. It should be warmed if the indiarubber is stiff. After five or six good respirations there is no need of supplying fresh gas with each inspiration. The expiring valve should be kept closed, and the inspiring valve opened. Care must always be taken that the supply of gas is sufficient to replace any that is lost by absorption into the blood or by leakage. This is more easily effected if the gas-bag is made of thin indiarubber, so as to distend easily and contract gently with the movement of breathing. It should be sufficiently filled, so that if the mouth-piece does not fit, the gas would escape instead of air entering and becoming mixed with it.

Lividity of the skin will not help us to know when the patient is fully under the influence of the gas, neither will insensitiveness of the eye lids, nor yet the state of the pupils. The breathing should become stertorous or interrupted, or the pulse very feeble, or convulsive twitchings should occur, before the face-piece is removed. A little air may be admitted by raising the face-piece, if the operation is not upon the face, and by doing so every fourth or fifth respiration anæsthesia may be kept up for several minutes. The effect of a single full inspiration may be to bring the patient into a state of excitement, and the continuance of the gas *without* air brings on convulsive movements, so that it is not well adapted for any operation lasting as much as five minutes, and requiring steadiness.

Patients are sometimes so unsteady that it is found to be almost impossible to make the face-piece fit. In such cases the best plan is to cover the patient's eyes and let him breathe air, merely preventing him from rising from the chair or bed, and not speaking till he is conscious, and as soon as he becomes so to recommence the inhaling as if nothing had happened. A violent patient often becomes perfectly rational in less than two minutes.

Sickness and headache ought not to result from the inhalation of gas, but if the use of it is prolonged, or if the patient is kept for several minutes in a semi-conscious state, breathing a little air with the gas, both these symptoms may occur. The recumbent posture, quiet, and warmth to the feet, constitute all that is likely to be required in the way of treatment.

Ether, *Sulphuric Ether*, *Ethylic Ether*, *Vinic Ether*, or *Oxide of Ethyl*, was first used for anæsthetic purposes in 1846. Before its use was well understood in England chloroform was brought forward as a more convenient agent, and much less unpleasant to the patient. Ether is less liable to become dangerous to life, as it does not under ordinary circumstances depress the action of the heart.

If ether be given from a towel or hollow sponge, the best kind is the *Æther Purus* of the Pharmacopœia, of sp. gr. ·720; but the ether of sp. gr. ·735, which contains a little water, answers very well if the towel or napkin is arranged so as to form a large cone, thus lessening the access of fresh air. The disadvantage of using the latter kind is that the moisture of the patient's breath condenses upon the surface made cold by the evaporating ether, and diminishes its volatility. When pure ether is used, a certain amount of condensed aqueous vapour is taken up before it reaches the density ·735.

In all inhalers where an arrangement is made for preventing the ether from becoming too cold, the washed ether ·735 may be used, and will be found cheaper. Not only is it sold at a lower price, but it is much easier to keep from escaping through cork or stopper.

Although it is not difficult to destroy dogs suddenly with ether, it is believed by many writers on the subject that in man it can only prove fatal by causing asphyxia, and that the signs of this condition are so easily seen and remedied that practically this anæsthetic is quite safe. The writer is not of this opinion, believing that sometimes when narcosis is far advanced, the glottis will allow ether vapour to pass of sufficient strength to stop the heart. Such cases, however, are very rare indeed. Ether is extensively administered by pouring an ounce at a time upon a very large cup-shaped sponge, which, if cold from previous use, is dipped into hot water and squeezed as dry as possible. It is to be expected that the patient will resist breathing when this is held over his face, but after a minute's struggling he becomes unconscious, and easy to manage. Compared with giving ether timidly, so as to let the patient remain delirious for several minutes, this may be a good plan; but there is no necessity for giving the ether so strongly if *we diminish the access of fresh air*. The administration of nitrous oxide from which air is at first excluded, and afterwards admitted very sparingly, has taught us how slight the after-effects are from the asphyxia so induced. Cones of leather or pasteboard lined with felt, and having a small opening at the apex, are better than sponges; but they should be larger. They may be made more effective and economical by placing a thin india-rubber bag over the apex of the cone, so that more of the expired atmosphere may be breathed again.

Morgan's inhaler is very efficient. The ether is poured into a tin chamber as large as a hat, containing sponge. This is covered by a sort of diaphragm, which rises and falls with respiration as the patient breathes into and out of it by means of a tube and face-piece. There are no valves. Anæsthesia results partly from asphyxia, and partly from the action of the ether. The amount breathed depends on its temperature, and on the freedom of respiration. If the respiratory movements are slight, as in young children, or in persons suffering from emphysema, the amount of ether supplied is apt to be too small. Ormsby's inhaler is an improvement upon it, The sponge for ether is contained in a cage near the face-piece.

An excellent inhaler for hospital purposes and for prolonged operations is sold by Mr. Hawkesley. The ether vessel is kept in a water-bath. There are valves which allow air to pass over the ether, but prevent its return, and the apparatus has an arrangement for lessening the odour of ether in the room, consisting of a tube leading to the floor, which carries off the expired air and ether.

With the view of regulating the strength of the ether vapour, the writer has contrived the following apparatus, which is made by Mayer and Meltzer. It consists of an oval india-rubber bag fifteen inches long, at one end connected with the face-piece, at the other with the ether-vessel. Within the bag is a flexible tube also leading from the face-piece to the ether vessel. By turning a regulator the patient is made to breathe into the bag either directly or indirectly through the tube and ether vessel, or partly one way and partly the other. The more the regulator is turned towards the letter E, the more ether vapour he takes. By turning it back again the amount of vapour is diminished. The ether-vessel contains a reservoir of water, which prevents the ether becoming too cold from evaporation. It is filled with ether up to a mark on the vessel. A thermometer in connection shows the temperature of the ether. The vessel should be just dipped into a basin of warm water and gently rotated till the thermometer reaches from 65° to 70°.

When used this vessel should be suspended by a strap from the neck of the administrator.

At first the regulator allows the passage from the face-piece into the bag to remain open, and the bag should be filled by pressing the face-piece more firmly against the face during expiration than inspiration. By degrees the regulator is turned towards letter E, and thus the way to the inner tube is opened, and the air breathed through it carries ether vapour from the vessel into the distal end of the bag. When the regulator allows half the inspired air to pass through the ether, the vapour is strong enough to induce sleep in two minutes, usually without exciting cough. As the act of swallowing is excited by a smaller quantity of ether than that of coughing, it should be watched for, and the regulator very slightly turned back should it occur.

This same apparatus may be used for giving laughing-gas, all communication with the ether-vessel being cut off by turning a stopcock, and by attaching the tube leading from the gas-bottle to a mount near the bag.

By far the least unpleasant and the quickest way of preparing a patient for a surgical operation is to use gas and ether combined; the change from gas to ether being made by turning the regulator above described as soon as the patient is sufficiently under the influence of gas to disregard the flavour of ether. The supply of gas should be stopped as soon as the ether is introduced; but if subsequently the patient is allowed to become conscious, the gas may be given freely as at first, in order to make him sleep again. The writer finds less sickness and more rapid recovery from the unpleasant taste of ether than when the latter is given alone. The chief difficulty is to prevent the unsteadiness of the patient, resulting from the panting character of the breathing. To lessen this the ether must be given as strong as possible without producing irritation of the throat, and the operator should wait until the influence of the ether has increased to the production of deep stertor. Air being then admitted with every fourth or fifth inspiration, the breathing soon becomes as regular as it is under ether when given in any other way.

On recovering from the inhalation of ether patients are often in a state of intoxication for a period corresponding to the time and extent of the etherization. The eyes should be covered, but the mouth and nose left free; and the room should be kept quiet, with a brisk fire, and the window more or less open. *See* APPENDIX.

Chloroform was introduced by Simpson in 1847. It should not be made from methylated spirit, and, when a drachm is poured upon blotting paper, it should evaporate without leaving an unpleasant odour. It is the most convenient of all anæsthetics, and the most easy to administer. Unfortunately, when given beyond a certain strength, it has a tendency to produce cardiac syncope, and it is not improbable that some persons are particularly liable to be so affected.

Some authorities think it desirable to give alcoholic stimulants before administering chloroform; others partially narcotize the patient with morphia or chloral. No doubt these agents assist the action of the chloroform, but if from any accident an excess of chloroform should be given, they interfere with the means of recovery, and for this reason are not to be recommended. There is less objection to the inhalation of a mixture of chloroform and ether, or of these agents with alcohol; but such mixtures, if kept for some length of time, alter their relative proportions, owing to the escape of the more volatile ingredients. Even the change from the administration of chloroform to that of ether, if made suddenly, is not free from danger, for, when a person is partially under the influence of chloroform, the glottis allows a high percentage of ether to pass; and, if the lung-circulation be slow, as is likely to be the case, the blood may be so highly charged with ether as to depress rather than stimulate the heart.

Chloroform, therefore, should be given gradually. The object should be to keep down the proportion of chloroform-vapour rather than to give abundance of fresh air. In preparing for an operation requiring perfect stillness, six to eight minutes should be allowed for the process. Sponges or lint saturated with chloroform, and held close to the mouth, are dangerous, from the possibility of liquid chloroform falling on the lips or into the mouth. In midwifery practice a piece of linen or blotting paper sprinkled with chloroform and placed at the bottom of a tumbler is a convenient plan of administration, care being taken to prevent any liquid chloroform from settling at the bottom. In general surgery a handkerchief or towel may be folded into a small cone, open at the apex, into which not more than a drachm should be poured at first, and fifteen minims at a time afterwards. A better plan is to roll and tie a piece of lint into a compress the size of a walnut. A drachm to a drachm and a-half of chloroform should be poured upon this, which is to be held about an inch in front of the patient's upper lip, the hand and compress being covered with a towel, which should gradually be drawn over the patient's face. This plan gives considerable command over the supply of chloroform, for, when the chloroform, having cooled by evaporation, is given off too slowly, the vapour can be increased by warming the compress in the palm of the hand. When it is becoming dry it ceases to feel cold, and warning is thus given that fresh chloroform is needed. This should be supplied half a drachm at a time. In doing this the towel should still be left over the face of the patient in order to keep him breathing a slightly chloroformed atmosphere. The movement of swallowing should be looked for, and regarded as evidence that the vapour is stronger than is necessary. If any sound like hiccough indicates laryngeal obstruction, the chloroform and towel should be removed, and, if the sound continue, the chin should be raised as much as possible from the sternum. Laryngeal obstruction arises from two main causes, viz., spasm of the glottis, and falling down of the epiglottis. The first is excited by the pungency of the vapour, and also by reflex action when certain nerves are injured, notably when a ligature is tightened upon a pile. The epiglottis covers the larynx every time we swallow, but the muscles coming from the chin raise it again directly. In deep narcosis these muscles are sluggish, and cannot act thus if the position of the chin places them at a disadvantage. If raising the chin fail to open the air-passage, the tongue must be pulled forward. In doing this the head should be kept back. Depressing the chin renders a partial obstruction complete. A laryngeal sound indicating obstruction is of little consequence if the pulse is good, since, although the breathing be imperfect, sufficient fresh air continues to be breathed; but if the pulse flags, or if it appears that the amount of chloroform in the air-passages is excessive, not a moment should be lost in seizing the tongue with forceps.

When a patient is delirious and struggling, extra care must be taken that the chloroform be not too strong, because he inhales deeply, carrying the vapour almost to the air-cells of the lungs, and, when he next closes the glottis and strains, the pressure of the air and vapour within the lungs is increased, and the chloroform enters the blood very quickly. The compress should be held at least two inches off the mouth, although the towel may still cover the face. Directly any stertorous noise is heard, a breath or two of fresh air should be allowed, and no more chloroform given till the pulse beats well and the respiration is free.

Skinner's apparatus—a cap of 'domette' flannel stretched over a frame—is a much better apparatus than a towel; but its virtue is simplicity, and it has little pretension to exactitude. Snow's apparatus is very efficient, portable, and economical. The addition of a water-jacket to equalize the temperature was a great improvement; but it should be provided with a thermometer.

The safest and least unpleasant mode of giving chloroform is by means of the apparatus fitted with a large bag of air containing not more than thirty-three minims of chloroform in a thousand inches of air. The apparatus is, however, too complex to be generally adopted, and the writer hopes shortly to be able to introduce a modification of it which will be more easily used. The advantage of more precise measurement of the strength of chloroform-vapour than is afforded by towels or napkins will appear when we consider the several circumstances that alter it when so given.

The *strength of vapour* given off from a known quantity of chloroform is influenced by:—

1. The extent of surface of chloroform.
2. The temperature of the chloroform, which is constantly changing.
3. The temperature of the air of the room, of the patient's face, and of the administrator's hand.
4. The distance at which the chloroform is held from the patient's face.
5. The rapidity of the current of air.
6. The height of the barometer.

Moreover, when the chloroform-mixture is of *known* strength, its effect is increased by high barometrical pressure; by low temperature of the blood; by deep or quick respiration, and especially by muscular efforts when the glottis is closed; and by slow movement of the blood through the lungs.

On the other hand, it is lessened by low barometrical pressure; by high temperature of blood; by superficial or slow respiration; and by rapid circulation through the lungs.

Under ordinary circumstances danger from these causes is easily averted with moderate care, for they do not often concur to produce the same effect; but if a patient, fatigued with struggling, takes a very deep breath just as fresh chloroform has been poured upon the towel, and then closes his glottis and makes another struggle—the barometer being high at the same time—it is evident that blood unduly charged with chloroform will gain access into the coronary arteries, and depress the cardiac ganglia. Death has occurred so rapidly under these circumstances, that it has been thought to be the result of shock from the operation.

Chloroform lessens, if it does not entirely prevent, the shock of an operation, but it is to be feared that if chloroform be given freely for this purpose, a dangerous amount of it will be administered.

If a severe operation is about to be performed, the chloroform should be given in the same gradual manner as in a slighter one, but continued to the point of fixing the pupils and producing stertorous breathing; and, when the chief shock is expected, two or three breaths of pure air should be admitted, so that, if the pulse fail, there may not be an excessive amount of chloroform-vapour in the lungs.

Compounds of Chloroform.—Under this head comes *Bichloride of Methylene*, which contains a variable quantity of chloroform. Its chemical characters and physiological effects are very similar to those of a mixture of chloroform, ether, and alcohol. It narcotizes quickly, but not safely; and, as the amount of chloroform in it is not always uniform, it is better to mix, in small quantities at a time, one part of alcohol, two of chloroform, and three of ether, and to keep the bottle so well corked that the ether is not likely to evaporate and leave chloroform in excess. The word ACE fixes the proportions in one's memory.

A mixture of one part of chloroform with four of ether is convenient for a brief operation, as this produces much less excitement than ether alone. On the whole the writer objects to keeping mixtures of this kind ready-made; and it is probable that the plan of giving at the outset sufficient chloroform to abolish consciousness, and subsequently administering ether, will be found safer than mixing them together in the liquid state.

Ethidene, &c. See Appendix.

After-treatment.—Quietude or conversation of an encouraging or soothing character is desirable during the half-minute of recovery from gas. The eyes should be covered, unless the view is tranquil as well as pleasant. If gas be given until there are intermissions in the breathing, or its administration continued for several minutes with a small allowance of air, there may be headache and even vomiting: still no other treatment than repose is needed.

After the inhalation of ether a taste will remain, varying with the strength of the vapour, and the duration of the administration. This may be got rid of by washing out the mouth, and gargling with warm fluids; while the vapour remaining about the patient and in the room may be removed by heating the surface by means of hot bottles, and making a bright fire.

When the system has been long or profoundly under the influence of chloroform or ether, nausea and vomiting are likely to ensue. The writer has not found any remedies more efficient in relieving these symptoms than warmth, fresh air, and abstinence from food. Hot tea and coffee, taken from a feeder without raising the head, and afterwards beef-tea and jelly, are sufficient for twenty-four hours, unless the patient wishes for something solid. The rule then should be to give as little as, or less than, is asked for. Ice has been recommended, and, if it does nothing else, it relieves thirst, and serves to postpone the necessity for giving solids which might prove hurtful.

Treatment of Dangerous Symptoms.—Anæsthetics in excess destroy life by stopping the action of the heart, or the respiration; generally both are affected. When laughing-gas is given to animals till the breathing has ceased, the heart continues to beat long afterwards, and artificial respiration rapidly restores them. Ether-vapour, given almost pure through a tracheal tube, will arrest the action of a dog's heart in sixteen seconds; but if administered as rapidly as possible with a cloth, without opening the trachea, the breathing fails before the heart, and the hæmadynamometer shows adequate pressure in the vessels whilst the breath is gasping, and for several seconds after it has ceased.

With chloroform the hæmadynamometer indicates diminished pressure directly the animal ceases to struggle, and the heart sometimes stops before the breathing. In case alarming symptoms should arise, the first effort should be directed to lessening the amount of the anæsthetic in the lungs, by pressing the trunk with both hands, and squeezing out as much air as possible without causing a shock. If, after this has been done two or three times, the air does not readily re-enter the chest, the obstruction is to be overcome either by lifting the chin or drawing out the tongue, and other artificial movements of the chest must be carried on. (*See* Artificial Respiration.) If pallor be noticed whilst breathing is going on, the recumbent posture and elevation of the feet are immediately required. (*See* Resuscitation.) Nelaton's plan of inverting the body has often been followed by recovery, but, considering the impediment to inspiration from the weight of the abdominal viscera, the writer is of opinion that the pelvis should never be many inches higher than the head. Nitrite of amyl—by reason of its effect in dilating the vessels of the skin—has been recommended, but without careful physiological inquiry, and upon very small clinical experience.

Electricity might be expected to prove the best agent to assist the action of a feeble heart. The writer's experimental observation has not been favourable to its employment; and certainly artificial respiration should not be delayed one moment in order to apply electricity.

Insufflation is not to be depended on. The condition would be rendered worse by distending the stomach, which cannot always be prevented by pressing the larynx against the spine.

Laryngotomy may be required in cases where in spite of throwing the head backward, and removing the chin away from the sternum, air cannot be made to enter the chest.

Hot-water injections may be of use, but there can be no necessity for brandy whilst artificial breathing is being carried on. Afterwards, if swallowing is difficult, brandy may be added to the enema.

Friction of the limbs in the direction of the heart is unnecessary, provided the feet are slightly raised. Where there has been great loss of blood, the limbs should be bandaged firmly from the fingers and toes upward, as in Esmarch's plan for saving the blood of a limb about to be amputated. In warm weather, or if the body is warm, a towel dipped in cold water may be flapped against the chest, but harm would result from cooling the body generally. Bottles of hot water and hot blankets should be applied as soon as the breathing is restored, and a brisk fire should be kept up, in order to favour the ventilation of the chamber. J. T. Clover.

ANALGESIA (ἀ, priv., and ἄλγος, pain).—Absence of sensibility to painful impressions. *See* Sensation, Disorders of.

ANAPHRODISIA (ἀ, priv., and Ἀφροδίτη, Venus). — Absence of sexual appetite. Sometimes used to express Impotence. *See* Sexual Functions, Disorders of.

ANAPHRODISIACS.—Definition.—Medicines which diminish the sexual passion.

Enumeration.—The agents employed as anaphrodisiacs are:—Ice, Cold Baths—local and general; Bromide of Potassium and Ammonium; Iodide of Potassium; Conium; Camphor; Digitalis; Purgatives; Nauseants; and Bleeding.

Action.—The erection which occurs in the genital organs during functional activity is due to dilatation of the arteries in their erectile tissues, and is regulated by a nervous centre situated in the lumbar portion of the spinal cord. From this centre vaso-inhibitory nerves pass to these arteries, and cause them to dilate whenever it is called into action. It may be excited either reflexly by stimulation of the sensory nerves of the genital organs and adjoining parts; or by psychical stimuli passing to it from the brain. Anaphrodisiacs may act by lessening the excitability of the nerves of the genital organs, as the continuous application of cold, and probably, also, bromide of potassium; by diminishing the excitability of the genital centres in the spinal cord and brain, as bromide and iodide of potassium and conium; or by influencing the circulation, as digitalis. There are also adjuvant measures, of a hygienic and moral character, which greatly assist and may even replace anaphrodisiac medicines, such as a meagre diet, especially of a vegetable nature, the avoidance of stimulants, and the pursuit of active mental and bodily exercise. Everything tending to stimulate the genital organs, or to increase the flow of blood to them or to the lumbar portion of the spinal cord, should be avoided, such as warm and heavy clothing, or pads about the hips or loins; and a hard mattress should be used in place of a feather-bed. Everything likely to arouse the passions, such as certain novels, pictures, theatrical representations, &c. should also be shunned.

Uses.—Anaphrodisiacs are employed to lessen the sexual passions when these are abnormally excited in satyriasis, nymphomania, and allied conditions. As such excitement may sometimes depend on local irritation of the genitals, in consequence of prurigo of the external organs, excoriations of the os uteri, or balanitis; or on the presence of worms in the rectum or vagina; these sources of excitement should be looked for, and, if present, should be subjected to appropriate treatment. T. Lauder Brunton.

ANASARCA (ἀνὰ, through, and *σάρξ*, the flesh).—An effusion of serous fluid into the subcutaneous connective tissues, not limited to a particular locality, but becoming more or less diffused. *See* Dropsy.

ANCHYLOSIS (ἀγκύλος, crooked).—Marked stiffness or absolute fixation of a joint, which may be due to various morbid conditions of the structures entering into its formation. *See* Joints, Diseases of.

ANCHYLOSTOMA (ἀγκύλος, crooked, and *στόμα*, a mouth).—A genus of nematoid worms. *See* Sclerostoma.

ANEURISM (ἀνευρύνω, I dilate.)—Definition.—Aneurism is a local dilatation of an artery, leading to the formation of a tumour which contains blood, and the walls of which are composed either of the tissues of the vessel, or those which form its sheath or immediately surround it. Therefore every aneurism, properly so called, consists of two parts—a *sac* and its *contents*.

Classification.—Aneurisms are usually divided, according to the varying composition of the sac, into the following varieties:—

1. *True* aneurism, in which all the three coats of the artery form the sac or a portion of the sac. This variety is rare: at least it is so rarely possible to trace all the coats of the artery over any part of the sac beyond its orifice, that some pathologists deny the existence of this so called 'true' form of aneurism, and most admit its existence in the aorta only.

2. *False* aneurism, in which the sac is formed by one only of the coats of the artery. This is almost always the external coat; but a sub-variety has been proved to exist as a consequence of wound of the outer part of the vessel, and is believed by some to take place spontaneously, in which the inner coat, or the inner and part of the middle coat, is dilated, pushed through the outer coat, and forms the sac. This is called *hernial false aneurism.*

3. *Diffused* or *Consecutive* aneurism. Here the sac is formed of the sheath, cellular tissue, or other structures around the artery, which are matted together into the form of a membrane. The name 'diffused' is applied to this form of aneurism to express the fact that the blood is at first diffused amongst the tissues in consequence of the rupture or division, whether from injury or disease, of all the coats of the vessel, either in a part or the whole of its circumference; but it is not a good term, since, as soon as the aneurismal sac is formed, the blood is diffused no longer, but, on the contrary, is encysted in the newly formed sac. So that the other term, 'consecutive,' seems a better one, expressing, as it does, the important fact that the formation of such aneurisms is always consecutive on a rupture, partial or entire, of the artery.

4. *Dissecting* aneurism is seen only within the trunk of the body, and always involving the aorta—although it may spread from the main artery down to its branches. In this form the internal and middle coats have given way, or cracked; and the blood has forced its way, usually into the substance of the middle coat, sometimes perhaps between the middle and outer coats, distending the external portion of the vessel into a kind of aneurism.

This is the nomenclature still in common use; but as the first and second varieties are practically indistinguishable during life, and the first, though called the 'true' form of aneurism, is very rare, it would be better to include both under the common name 'true' aneurism, and apply the term 'false' to the third or 'consecutive' form.

5. Besides these, which are all forms of pure arterial aneurism, there are aneurisms in which the vein and artery are simultaneously involved, and which are therefore called *Arterio-venous*, which will be afterwards spoken of; and tumours having a certain analogy to aneurism, which are formed of dilated and tortuous arteries—*Cirsoid* and *Anastomotic* aneurisms.

Other classifications of great importance are, according to the cause of the disease, into *Spontaneous* and *Traumatic*; or, according to the shape of the tumour, into *Fusiform* and *Sacculated.* In *fusiform* aneurism there is a dilated tract of artery, often of considerable length, from either end of which springs the vessel of its natural calibre. *Sacculated* aneurism springs like a bud from one side of the vessel, and the artery is often buried for some distance in the wall of the aneurism; but there are many sacculated aneurisms which approach in shape to the fusiform, the vessel being dilated for some part of its extent, so that its two openings lie at different parts, and sometimes on different aspects of the sac.

Ætiology and Pathology.—The proximate cause of spontaneous aneurism appears to be usually a loss of the elasticity of the wall of the artery, whereby it loses its power of resilience after having been dilated by the force of the circulation. This loss of elasticity is commonly caused by atheroma or else by partial calcification of the wall of the artery. In the latter case the blood often forces its way through the entire arterial wall, and an aneurism of the consecutive variety forms,[1] or the external part of the artery is dissected off, and a dissecting aneurism results. Inflammatory softening of the artery, without the presence of any definite atheromatous deposit is looked upon by many writers of credit, such as Wilks and Moxon, as a common cause of aneurism. Such low inflammation may have its origin possibly in rheumatism—and, as a matter of fact aneurism is often preceded by acute rheumatism; more certainly in violent strain, or

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[1] Sometimes, however, the bleeding will go on without the formation of any aneurismal sac, and lead to the loss of life or limb.

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in mechanical violence. Anything else which weakens the arterial wall, such as the exposure of the vessel in an abscess, is looked on as a cause of aneurism. The yielding of a weakened arterial wall is doubtless accelerated by irregularities of the circulation. The influence of syphilis and of intemperance in causing aneurism is widely believed, though perhaps as yet neither fact is absolutely established: the latter, at any rate, is rendered very probable from the consideration that chronic alcoholism tends to impair the nutrition of all the tissues, including the arteries, and is accompanied by a constantly irritable condition of the circulation. That syphilis may cause a fibroid degeneration of the vessels must also be allowed to be at least possible, and that it does so is the opinion of many eminent pathologists. If so, the transition to aneurism is natural, if not inevitable. Another proved cause of aneurism is embolism, or the obstruction of a diseased artery by a fibrinous plug, which has been known to be followed by the dilatation of the artery immediately above the plug, just as in very rare cases the ligature of a healthy vessel has given rise to the formation of aneurism above the tied part.[1] Violence is a very frequent cause of aneurism, even in cases which are not technically denominated 'traumatic.' The latter term is generally restricted to cases in which the vessel is wounded by a cut, or is known to be ruptured, and the aneurism makes its appearance at once; and in these cases the aneurism is of the 'diffused' or 'consecutive' variety. But there are, no doubt, many cases in which the artery is partially torn, and the walls, being thus weakened, afterwards slowly yield at the injured spot. This fact is illustrated by the well known experiment of Richerand, designed to explain the frequency of popliteal aneurism. The experiment consists in hyperextension of the knee in the dead subject. If this be carried on forcibly till the ligaments are heard to crack, it will usually be found that the two inner coats of the popliteal artery are torn.

All these causes of aneurism act much more powerfully in later life than in childhood, and many are unknown in early years. Aneurism, therefore, is very rare in children. In cases where the arterial system is extensively affected with atheroma, a great number of aneurisms may be found in the same person, or another may form after the cure of the first. To such cases the term 'aneurismal diathesis' has been applied. This fact shows the great importance, in all cases of spontaneous aneurism, of examining the whole body to detect disease of the heart or any second aneurism which may exist.

Almost all aneurisms contain more or less *clot*, and much of this clot is usually of the laminated variety, consisting almost entirely of fibrine mixed with more or less of the blood-corpuscles. These laminated coagula adhere very firmly to the interior of the sac; they are arranged concentrically like the coats of an onion; and usually lose their colour in proportion to their remoteness from the blood which still circulates through the sac. Their deposition depends in a great measure on the presence of rough projections from the wall or mouth of the sac, and on the shape of the aneurism. When the latter is purely cylindrical, much less coagulum, possibly none, will be found in it. When the tumour stands well away from the artery, so that the force of the circulation is much broken, the formation of coagula is greatly favoured. The deposition of such firm coagula must be looked on as the commencement of spontaneous cure, and at any rate defends the patient from the risks of rupture, or of renewed growth of the tumour at the parts which are so lined.

SYMPTOMS.—The symptoms of arterial aneurism are as follows:—There is a pulsating tumour, which is situated in the course of one of the arteries, and which cannot be drawn away from the vessel. The pulsation is equable and expansile, that is, it not only causes an up-and-down movement of the tumour, for such a movement may be communicated to any tumour by a large vessel lying in contact with it, but also expands the tumour laterally and in all other directions. The pulsation is in most cases accompanied by a *bruit* or blowing sound, heard on auscultation, which can be tolerably well imitated by the lips, and which is synchronous with the pulsation. Pressure on the artery above suspends both the pulsation and the bruit. Sometimes it may be noticed that the pulse below is retarded, that is, that it reaches the finger later than in the corresponding vessel on the other side. Besides these, which are the main signs of aneurism, there are others, which are of less constant occurrence or of subordinate importance. Thus, on compression of the artery above, the tumour will empty itself more or less completely, and the greater or less change of size under these conditions is a useful test of the proportion of fluid and solid in the sac. Sometimes pressure on the artery beyond the tumour may cause an increase in its size. The pulse below the tumour is often found to differ strikingly from that on the sound side. There are many and various symptoms due to the pressure of the aneurism on neighbouring veins, nerves, bones, and viscera—symptoms which are of subordinate importance in a diagnostic point of view in the case of external aneurism, but are often of the greatest value in thoracic and abdominal aneurisms. Thus dyspnœa and ringing cough from pressure on the trachea, spasm or paralysis of the vocal cords from pressure on the recurrent laryngeal nerve, pain in the back from pressure on the vertebræ, or neuralgic pains from pressure on the nerves at the root of the neck, are well-known symptoms of aortic aneurism; and, similarly, pain in the leg from pressure on the popliteal nerve, and œdema from compression of the vein are frequent symptoms of popliteal aneurism.

DIAGNOSIS.—The affections which are usually confounded with aneurism are tumours of various kinds lying upon arteries, abscesses, and cancerous tumours which have large vascular spaces in their interior, and therefore pulsate. The tumours which receive pulsation from arteries against which they lie are of various kinds; cysts and enlarged glands in the popliteal space, and enlargements of the thyroid body pressing on the carotid or innominate artery, are the most familiar examples. The diagnosis is usually easy. They have commonly little or no bruit, though in some cases a dull thud is produced by their pressure on the artery; they have not the expansile pulsation of aneurism; they present no change in size or form when the circulation is stopped; and they can usually be drawn away from the artery sufficiently far to lose their pulsation. An abscess has been often mistaken for aneurism, but the mistake has generally proceeded from a neglect of auscultation.[1] There are a very few cases in which aneurisms have lost their pulsation in consequence of the rupture of the sac and in which no bruit may be audible,[2] and such tumours can hardly be diagnosed from abscess except by an exploratory puncture, which under these circumstances is justifiable; these cases are, however, extremely rare. The disease most commonly mistaken for aneurism is pulsating cancer, and the resemblance has been sometimes so striking as to deceive the best surgeons, even after the fullest possible investigation of the case. These pulsating cancers almost always grow from the bones;[3] and the neighbouring bone can generally be felt to be enlarged, which is rare in aneurism. They have not usually the well-marked bruit of an aneurism, nor is the bruit universal; the pulsation also is more indistinct, and not so expansile as in aneurism; and the growth of the tumour is more rapid.

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[1] For cases of this nature see *System of Surgery*, 2nd edit. vol. iii. p. 422.

COURSE AND TERMINATIONS.—Aneurism is generally a fatal disease if left to itself. The sac enlarges; parts of it give way, either by a process of inflammatory softening or by rupture; or it produces fatal pressure on the surrounding parts; or the whole tumour suppurates, and the patient dies of fever, of pyæmia, or of hæmorrhage. But to this general statement, independent altogether of what the effects of any special treatment may be, there are numerous exceptions. In some cases, and especially in the fusiform kind of aneurism, the tumour, after having attained a certain size, remains stationary, and this stationary condition is sometimes produced by a deposit of coagulum lining the sac, and leaving a canal through which the blood-stream passes, as through the normal artery. In these cases, however, the symptoms persist, but there are others in which a complete spontaneous cure is obtained, and this may happen in various ways.

Spontaneous Cure.—The first, and probably the most usual method of spontaneous cure is by the gradual diminution of the circulation through the tumour, and the gradual filling of the sac by successive layers of fibrinous coagulum. The second is by impaction of clot in the mouth of the aneurism, whereby in some cases possibly the sac of the aneurism is cut off from the blood-stream, and its contents brought to coagulate. In other cases, where more than one artery opens out of the sac, the impaction of clot in one of the distal arteries leads to consolidation of all that part of the tumour through which the circulation used to pass into the obstructed vessel, and thus a practical cure is sometimes effected,[1] *i.e.* the symptoms are cured and the disease arrested, though the whole sac is not consolidated. The third method of spontaneous cure is by inflammation of the tumour. This is usually accompanied by suppuration of the sac and evacuation of all the contents of the aneurism, the accompanying inflammation closing the mouths of the arteries which open out of it. If the arteries are not so closed, death from hæmorrhage will occur. It seems possible that inflammation of the sac and the cellular membrane around it may sometimes produce coagulation within the aneurism without any suppuration. A fourth way in which coagulation of an aneurism has been known to be caused is by retardation of the circulation or impaction of clot, caused by another aneurism above; and there is an old idea, which can hardly yet be said to be exploded, that an aneurismal sac may by its growth compress the artery, and so lead to its own coagulation. This, however, if it ever happens, is purely exceptional.

Rupture.—The rupture of an aneurism may take place either through the skin, in which case the hæmorrhage is usually, but not always, fatal at once;[2] or into one of the cavities of the body, when death generally occurs immediately, if the rupture is into a serous cavity, and after one or two attacks of hæmorrhage if a mucous membrane has been involved; or lastly into the cellular tissue of a part. This event is marked by the cessation of the pulsation; the sudden swelling, accompanied with ecchymosis if the blood is effused subcutaneously; and the abrupt fall of temperature below the aneurism. A sensation of pain, or of 'something giving way,' is often experienced. Stethoscopic examination will probably detect a bruit.

TREATMENT.—*a.* MEDICAL.—The methods of treatment of aneurism are very numerous, and it would be impossible in a summary of this kind to discuss fully all the indications for each. In the first place, those aneurisms which are inaccessible to any local treatment, or in which local treatment would involve great danger, are treated *medically*, that is by regimen, diet, and medicine, by which it is hoped that gradual coagulation will be promoted in the contents of the tumour, and thus a complete or a partial cure will be brought about, as in the natural process above spoken of. The method of Valsalva, of which the main features were starving and excessive bleeding, and which therefore produced considerable and often dangerous irregularity of the heart's action, is now given up in favour of the opposite plan introduced by Bellingham and modified by Mr. Jolliffe Tufnell,[3] in which, by complete rest and restricted but nutritious diet, the absolute regularity of the heart's action is secured, and at a rate below that of health, both as to rapidity and force. Mr. Tufnell has given some interesting and conclusive examples of the complete cure of abdominal aneurisms thus accomplished, verified by dissection; and one, at least, in which an aneurism of the arch of the aorta was in all probability entirely consolidated, though this fact was not verified by dissection. At any rate the patient was permanently restored to health In this method of treatment drugs are only employed when necessary (as narcotics, laxatives, and tonics often are) to ensure the regularity of the functions, to control irritability, or to support the general health. The drugs which have been recommended as producing a direct effect on aneurism by promoting the coagulation of blood in the sac, such as acetate of lead and iodide of potassium, do not, in the writer's opinion, produce any such effect, nor in fact any specific effect on the disease whatever. He has often seen a certain amount of improvement under the use of these drugs, but not, he thinks, more than the regimen and diet used at the same time would account for. Other drugs, as aconite and digitalis, are recommended in order to steady and reduce the heart's action, and the latter especially is sometimes a useful adjuvant, if employed with caution, to the treatment by restricted diet and rest. The rest is *total*, the patient never leaving his bed, nor ever rising from it, or changing his position more than by occasionally turning on his side; the bowels are so regulated as to avoid both constipation and looseness; and the diet is restricted to about 10 oz. of solid food, of which one half is meat or fish, and 8 oz. of fluid (comprising 2 or 3 oz. of light wine if necessary), per diem. The period may be extended indefinitely, so long as improvement continues; but in all cases the patient and his friends should be prepared for a confinement of not less than three months. *See* ABDOMINAL ANEURISM; and AORTA, Diseases of (*Aneurism*).

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[1] See a paper by the author in *St. George's Hospital Reports*, vol. vii. pp. 175 *et seq.*

[2] See a case under the care of the writer, reported in the same paper, p. 190.

[3] In one case under the care of the writer the disease was unconnected with the bones, and affected the kidney only.—*Pathological Transactions*, vol. xxiv. p. 149.

[1] See a case of innominate aneurism with remarks in the *Lancet*, June 15, 1872, p. 818.

[2] Instances of successful ligature of the artery above after bleeding from ruptured aneurism are on record. See a case in the *Lancet*, 1851, vol. ii. p. 30, in which the femoral artery was successfully tied after the bursting of a femoral aneurism through the skin.

[3] *The Successful Treatment of Internal Aneurism*, 2nd edit. 1875.

b. SURGICAL.—Most aneurisms which occupy an external position, and are therefore amenable to surgical treatment, are curable, when the degeneration of the vascular system is not too extensive, by mechanical means. Of these the chief and by far the most successful are either the *ligature of the artery*, whether in the sac, above it, or in some special cases below; or *compression*, applied either to the artery above the aneurism, or to the tumour itself, or simultaneously in both situations, and either by the pressure of an instrument, of the fingers, or of Esmarch's bandage. But as these methods of treatment belong exclusively to the province of surgery, it is thought better in a work of this kind merely to name them, and to refer the reader to the standard works on surgery for their description.

The other methods of surgical treatment are far less successful than the above, and have the great drawback of being addressed exclusively to the contents of the sac; while in the treatment by the ligature and by compression the resilient power of the sac, and its consequent reaction on the blood which it contains, no doubt play a great part in the cure. The methods now to be mentioned, on the contrary, as far as they act on the sac at all, rather tend to contuse or to inflame it.

Galvanopuncture.—The first is galvanopuncture, in which a current of electricity of low tension, long continued, is passed through the blood in the sac, decomposing it, and causing its coagulation. Needles are plunged into the sac, and are then connected with the battery, and the action is continued until the reduction in the pulsation and the flattening of the tumour show that the blood has been partly coagulated. Authorities differ as to the details of the method. Some apply first the positive and then the negative pole to each needle, others the negative pole only, the positive being brought in contact with the neighbouring skin, while some on the contrary use the positive pole only. It will be found on experiment that a certain amount of coagulation takes place around both poles, the clot round the positive pole being smaller but firmer than that round the negative. The object of the operation is to fill the sac as much as possible with coagulum which shall gradually harden, and shall attract to itself fresh coagula. The dangers of the proceeding are those of inflammation of the sac, or of the cellular tissue around it; of suppuration within the tumour; or of sloughing of the punctures and hæmorrhage: and it must be allowed that the effects of galvanopuncture are very uncertain, both as to the amount and firmness of the coagulum produced. Still there is satisfactory evidence of benefit in many cases, and of a cure in a few. The danger of inflaming or cauterising the sac or the tissues around may be in some measure obviated by coating the needles with vulcanite, as recommended by Dr. John Duncan of Edinburgh. For a very clear exposition of the details of this method, as well as for statements regarding the success which has attended electrolysis hitherto, the reader is referred to a lecture by this gentleman, reported in the *British Medical Journal*, May 20, 1876. The writer thinks himself justified in adding that electrolysis should be restricted to cases of thoracic, subclavian, or abdominal aneurism, which cannot be cured by medical means, and in which rupture seems to be imminent, while the situation of the tumour forbids the application of pressure.

Coagulating Injections.—Another method of producing coagulation of the blood in the sac is by the use of coagulating injections. Other fluids have been employed, but the only one in general use now is the perchloride of iron. The circulation is to be suspended by pressure on the artery above, before the injection is made and for some time afterwards. The method is a very dangerous one for large aneurisms, on account of the risks of embolism, sloughing, and inflammation, but it may be used with success in small cirsoid and anastomotic aneurisms, and also in varicose aneurism.

Introduction of foreign bodies.—Aneurisms have also been treated by the introduction of foreign bodies into the sac, with the view of producing coagulation of the blood upon the foreign substance, such as fine wire, carbolised catgut, and horsehair; but no case of cure has hitherto been reported.

Manipulation.—Finally, aneurisms may be treated by manipulation. The object of this treatment is either to detach a portion of coagulum from the wall of the aneurism, which may be carried into the mouth of the sac or the distal artery, and so effect a cure as in our second mode of spontaneous cure, or at any rate so to disturb and break up the clot, that its detached laminæ may form nuclei for further coagulation. With this view the aneurismal tumour is grasped between the two hands to squeeze all the fluid blood out of it, and one wall rubbed against the other till 'a friction of surfaces is felt within the flattened mass.'[1] The proceeding is obviously a very dangerous and uncertain one, but some indubitable cures have been thus effected.

Arteriovenous Aneurisms.—A few words must be added with respect to the rarer forms of aneurism. Arteriovenous aneurisms are generally, but not always, traumatic, and are divided into two chief forms:—1. *Varicose aneurism*, in which there is a small aneurismal tumour communicating both with the artery and with a vein which is always varicose; and 2. *Aneurismal varix*, in which the opening between the two vessels is direct without any tumour interposed; the vein pulsates as well as being varicose, and the temperature of the limb and nutrition of the skin and hair are increased. In all forms of arteriovenous aneurism the artery after a time becomes thin and much dilated. The signs of arteriovenous differ from those of arterial aneurism mainly in this—that besides the intermittent blowing murmur caused by the arterial current, there is a continuous purring or rasping bruit due to the venous current; and that besides the intermittent pulsation there is a continuous thrill. Varicose aneurism may be cured by digital pressure applied directly to the venous orifice, and indirectly to the artery above at the same time; or the old operation may be performed, the clots being turned out of the sac and the artery tied above and below, the vein being of course laid open and secured either by ligature or pressure; or the artery may be tied above and below without opening the sac. Electropuncture and coagulating injections have also been used with success. Aneurismal varix does not usually require or admit of surgical treatment. If it does, the ligature of both parts of the artery is the only measure that can be adopted, on the failure of compression.

Cirsoid and Anastomotic Aneurisms.—*Cirsoid aneurism*, or *arterial varix*, is a tumour formed by the coils of a single dilated and elongated artery:[2] while *aneurism by anastomosis* is a tumour formed by the coils of numerous dilated and elongated arteries, with the dilated capillaries and veins which communicate with those arteries. It is often difficult to distinguish these two forms of arterial disease from each other. Aneurism by anastomosis frequently originates congenitally as one of the forms of nævus. The usual situation of these tumours is on the scalp. They have often a peculiar continuous buzzing or rushing murmur, which is propagated over the whole head, and much disturbs the patient's rest; while they are liable to ulcerate and to become the source of serious and even fatal hæmorrhage. Some cases of spontaneous cure are on record. Very numerous methods of treatment have been employed, of which the writer can only mention those which are most generally useful. When feasible, the total removal of the tumour with the knife is certain to effect a radical cure, but this operation is often too dangerous to be attempted. The entire removal by ligature is still more rarely practicable. The galvanic cautery is often successful; the incandescent wire being drawn through the mass in various directions divides it into portions, and obliterates the vessels by producing cicatrices at the parts cauterised. Setons have also been used with success, when combined with the ligature of the trunk-artery; and the ligature of the artery alone has been said to be followed by success, but certainly is generally unsuccessful. Finally, coagulating injections and galvanopuncture have both effected a certain number of cures.

T. Holmes.

ANGEIECTASIA (ἀγγεῖον, a vessel, and ἔκτασις, extension).—Extension or hypertrophy of the capillaries and minute vessels of the surfaces of the body, especially the skin; hence *angeiectasia capillaris*, a term applicable to several forms of vascular nævus.

ANGEIOLEUCITIS (ἀγγεῖον, a vessel, and λευκός, white).—Inflammation of lymphatic vessels. *See* Lymphatic System, Diseases of.

ANGINA (ἄγχω, I seize by the throat, strangle, or choke).—Synon.:—Fr. *angine*; Ger. *die Bräune*.

The term *angina* was originally applied by Latin writers on Physic, and is still much used on the Continent, to indicate a condition in which difficulty of breathing and of swallowing exist either together or separately, caused by disease situated between the mouth and the lungs, or between the mouth and the stomach. By a special affix to the original term, significative of the seat or the nature of the disease, several varieties of morbid states are known and described, for example:—*angina parotidea*, or mumps; *angina tonsillaris*, or quinsy; *angina laryngea*, or laryngitis; *angina pectoris*, or breast-pang; *angina maligna*, or malignant sore throat; *angina membranosa*, or croup.

These and numerous other diseases, differing essentially in their nature and pathological relations, and having nothing in common but certain difficulties in breathing or swallowing, are thus classed under the word *angina*. Such a classification is open to several objections, and has nothing to recommend it. With the exception, therefore, of *angina pectoris*, which has a special and familiar signification, the various diseases occasionally recognised by the term angina will be found described under the names by which they are generally known in this country. *See* also Cynanche.

R. Quain, M.D.

ANGINA PECTORIS.—Synon.: Syncope Anginosa; Angor Pectoris; Suffocative Breast-pang. Fr. *Angine de poitrine*; Ger. *Brustbräune*.

Definition.—An affection of the chest, characterised by severe pain, faintness, and anxiety, occurring in paroxysms: connected with disorders of the pneumogastric and sympathetic nerves and

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[1] Sir W. Fergusson, *Med. Chir. Trans.* xl. 8.

[2] See the figure on p. 534, vol. iii. of the *System of Surgery*, 2nd edition.

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their branches; and frequently associated with organic disease of the heart.

Description.—An attack of angina pectoris commences suddenly with pain in the region of the heart, generally on a level with the lower end of the sternum. The pain is severe, and of a grasping, crushing, or stabbing character; it extends sometimes across the chest, but more frequently backwards to the scapula, and upwards to the left shoulder and arm. The pain is accompanied by a distressing sense of sinking, of faintness, or of impending death. The action of the heart is generally irregular. The pulse at the wrist corresponds; but in some well-marked cases it is regular, tense, and resisting. A fear of aggravating the pain prevents the patient from breathing, though the respiratory function may not be really interfered with. The expression is anxious, the face is pallid, and the lips are more or less livid. The whole surface of the body is pale, cold, and covered with a clammy sweat. Flatulence is often present; urine in some cases is passed at short intervals, and generally in abundance. The sense of faintness causes the patient to seek support, and he rests on any object by which this may be obtained. The attack having lasted for a variable time—from a few minutes to one or two hours—comes to an end, either by a sudden cessation of the more urgent symptoms, or by their gradual disappearance. The pallor and coldness of the surface are replaced by a uniform glow—the face may even flush, the pulse becoming soft and full, and there is a general feeling of relief; a sense of numbness or tingling along the course of the nerves derived from the brachial and cervical plexuses of the affected side occasionally remains. An attack of angina pectoris frequently comes on during sleep; but it may be induced by emotion or by physical exertion, especially by walking up an ascent, or by exposure to cold air or wind. An attack of this kind may occur but once and end fatally; or it may recur after an interval of hours, days, or weeks, and be thus continued; or there may be an interval even of years. These and other modifications of the disease will be again referred to.

Pathology.—The nature of the aggregate of the symptoms or phenomena comprised under the name *angina pectoris*, cannot be understood without a clear apprehension of the relations of the nerve-elements of the organs and regions that seem to be involved in the affection. It will be well briefly to summarise them.

The nerves chiefly involved are the pneumogastric and the sympathetic, and their branches, which nerves, it should here be stated, are connected with each other at their origin in the medulla oblongata, in their course, and in their distribution to the ganglia and structures of the heart. They also communicate with certain of the cerebral nerves, and with the cervical and brachial plexuses, which supply part of the head and neck the arms, the diaphragm, and the chest-walls. Their connections with the heart are very extensive. This organ is supplied by the cardiac ganglia and the branches derived from them, which are in relation with, and, in fact, constitute part of the cardiac plexus formed by the interlacement of branches from the pneumogastric and the sympathetic nerves. The pneumogastric supplies the superior cardiac nerve and apparently the inferior cardiac nerve (which, however, is derived from the spinal accessory, and is merely distributed with the pneumogastric); the sympathetic contributes several branches through the cervical ganglia. Branches of both pneumogastric and sympathetic nerves are distributed to the respiratory passages, the lungs, stomach, intestines, liver, and other abdominal viscera.

The connection of the pneumogastric and sympathetic nerves in the medulla, to which allusion has been made, occurs at the cardiac and vaso-motor centres; and consequently these nerves, and the heart (which they supply) are thus brought into relation with the vaso-motor nerves throughout the body, and with all the systemic blood-vessels; they are also in relation with the other important centres in the neighbourhood; and with the cerebrum itself, more especially that part of it associated with the emotions.

Such being the distribution and the relation of the nerves connected with the heart and surrounding parts, we learn, in reference to their functions, that the movements of the heart are maintained by its ganglia, but that these movements may be accelerated by the action of the sympathetic, whilst they are controlled and may be even arrested by that of the inferior cardiac branch from the pneumogastric.

The superior cardiac branch of the pneumogastric has to do with the specific function of conveying impressions centripetally from the heart to the medulla, whence these impressions may be reflected through the inferior cardiac nerve to the heart, controlling for a time its movements; and also reflected through the vaso-motor centre and vaso-motor nerves, to the general circulation. By means of this latter functional relation, relaxation of the arteries, especially those of the abdomen through the splanchnic nerves is accomplished, and the heart is relieved of pressure.

With regard to other functions of the cardiac nerves, it is believed that such common sensibility as the heart possesses is more especially connected with the superior cardiac branch of the pneumogastric. Numerous communications exist between this nerve and the ordinary spinal nerves; and it must also be remembered in reference to the sites of pain in angina, that nerves may be rendered sensitive by disease which are not sensitive in health.

Lastly, it is to be noted that the pneumogastric and sympathetic nerves, as well as the heart and blood-vessels, whose functions they regulate, possess the extensive connections above mentioned with the abdominal and thoracic viscera, and thus they not only influence but are influenced by the conditions of the lungs, liver, stomach, kidneys, and other organs.

Keeping in mind this distribution of nerves and their functions, we can recognise how the movements of the heart may be affected, whether in the direction of acceleration, retardation, or even arrest. We can further understand how painful impressions originating in the cardiac nerves may be propagated so as to be referred to the associated sensory nerves and their branches; and how relations may be established with the vaso-motor system and the circulation generally. Thus the vessels throughout the body may be acted upon, producing coldness and pallor of surface from the abnormal filling of the abdominal at the expense of the superficial vessels, a condition which seems to be the cause of the diminished arterial tension noticed in these cases. We can also comprehend how morbid impressions made either on these nerves, in their distribution to the abdominal viscera or the heart, or on the peripheral distribution of the vaso-motor nerves at the surface of the body, may, passing centripetally, admit of reflex impressions and reflex actions, which in some cases may be provocative of the symptoms of this disease: also how direct impressions made on the nerves themselves in their course, or at the vaso-motor centre, or through the cerebral emotive centres, may each give rise to the phenomena which represent the symptoms constituting angina pectoris.

Pathology of Uncomplicated Angina Pectoris.—That this disease is dependent on an affection of nerves may be held to be demonstrated by the paroxysmal character of the attack; by its sudden access and sudden departure; by the nature of the causes that promote it, whether they be mental emotion or direct or reflected irritation; by the course and character of the pain, and by the fact that in severe—even fatal—instances of angina, there is often an absence of any tangible or evident organic local disease.

The morbid state affecting the nerves may be situated in the medulla; or it may be in the course of these nerves, or in their branches; or in the cardiac ganglia themselves. It may be the result of congestion or inflammation of the nerve, such as occurs in the lithic acid or gouty diathesis; or of other textural changes, such as connective-tissue growth, involving the nerve-fibres and ganglia. It may be produced by emotions acting centrifugally; or by irritation acting centripetally, reflected, as we have just said, from impressions made on the peripheral extremities of nerves. Thus acidity of the stomach distended by flatus, the result of indigestion, often gives rise to symptoms which very closely resemble, if they do not constitute, an attack of angina. The like effect has been produced by irritation reflected from the fifth nerve, as, for example, in pivoting teeth; by such irritation of the surface of the skin as results from severe herpes; by cold, or by exposure to wind. But the most frequent source of the symptoms of angina caused by reflex action is to be found in those organic affections of the heart which will be described in the next section.

Whatever the nature of the irritation or of the exciting cause, the symptoms will, in some measure, bear a relation to the nerves affected. Thus, if the sensory branches connected with the spinal nerves suffer, we shall probably have pain more severe and more diffused: whereas if the branches more immediately supplying the heart are affected, we shall have the action of that organ more or less disturbed, accelerated or depressed. And so with the branches of other nerves, more especially of those connected with the vaso-motor system, or with the lungs and abdominal viscera, modifications of symptoms are produced which it is needless to describe at this point in detail.

Pathology of Angina Pectoris complicated with Organic Disease of the Heart and Vessels.—The striking character of the symptoms of angina pectoris has led pathologists to connect the heart with the disease, and to investigate its condition accordingly. Such researches have established the fact already mentioned, that angina may exist without any discoverable disease in the heart or its appendages. On the other hand, in the great majority of cases various forms of structural disease of the heart and aorta have been observed; for example atheromatous or calcareous degeneration in the coronary arteries, in the valves, or in the aorta; dilatation of the cavities of the heart, or of the aorta; accumulation of fat in the cardiac walls; and lastly, and probably the most important change of all, fatty degeneration of the muscular tissue. A knowledge of this lesion is of comparatively recent date; it is constantly associated with the calcareous and atheromatous diseases described above, and which alone attracted the notice of older observers. Nay more, this lesion of the walls of the heart is in itself a frequent and sufficient cause of one of the most prominent symptoms of angina pectoris—faintness. This condition has been elsewhere described by the present writer (*Medical and Chirurgical Society's Transactions*, vol. xxxiii.) under the name of *Syncope Lethalis* or fatal-faintness—a designation analogous to that given by Parry to angina pectoris, which he called *Syncope Anginosa.*

ÆTIOLOGY.—When treating of the pathology of angina pectoris we have already discussed the conditions under which it occurs. We have endeavoured to show that the disease consists in a lesion of certain nerves, associated with various morbid conditions. In seeking to indicate the *predisposing causes* of these conditions, we have to point out (1) the existence of a peculiar state of the nervous system, which may be described as an undue susceptibility to impressions. What that state is we know not. It would seem to be often hereditary, and to be found in those temperaments in which there is a high development of the nervous element, associated with certain habits of life, such as sedentary employments, high living, and so on. Thus it is that this disease has been the cause of the death of many men who, by their intellectual parts, have left their mark on history. It is merely necessary to mention, as instances, Lord Clarendon, John Hunter, Dr. Arnold. (2) The influence of age is conspicuous; the disease is rare before puberty; and the writer's researches show that quite eighty per cent. of cases occur after forty years of age. (3) Sex also displays a marked influence on the disease; it is comparatively rare amongst women, a statement by the late Sir John Forbes showing that out of 49 fatal cases, only 2 occurred in females; and 4 out of 15 non-fatal cases—facts entirely corresponding with the writer's experience. (4) The peculiar diathesis which gives rise to neuralgia of various parts, and that in which lithic acid predominates in the system, would seem to be in many cases an efficient cause of the symptoms of angina.

The *exciting causes* of angina pectoris are (1) Those that affect the nerve-textures themselves. (2) The condition to which we have referred, in which organic disease of the heart exists. (3) Mental emotion, especially anger or nervous shock. (4) Irritation propagated centripetally from the surface, as by the branches of the fifth nerve; through the brachial plexus; through the sympathetic and pneumogastric nerves distributed to the abdominal viscera. (5) Cold applied to the surface, and especially cold winds. (6) Physical exertion, or any other agency by which the circulation is quickened. (7) Depressing agents, such as excessive tobacco smoking, malaria, &c.

Anatomical Characters.—Beyond the conditions indicated under the head of Pathology, there is little to be said on the morbid anatomy of angina pectoris. These several conditions, and the symptoms of angina as above described have been found to exist independently of each other. There must therefore be something in the state of the nervous tissues that acts as the predisposing or exciting cause of this aggregate of phenomena. Inflammatory changes and tumours, involving the vagus or the cardiac plexus, have been observed and described. With reference to the state of the heart itself, its cavities have been found dilated and containing blood; or contracted and empty; and theories have been founded thereupon, as to whether death occurred by spasm or by paralysis. It is more than probable that either one or the other of these conditions may occur in angina, and lead to fatal results, according to the particular nerves controlling the functions of the heart which are affected. *See* Pneumogastric Nerve, Disease of.

Clinical Varieties.—All the phenomena of an anginal seizure as above described may be more or less modified. The attack, though generally induced by exertion, may come on when the patient is at rest, and not unfrequently it sets in during sleep. The pain may be comparatively slight, and as such may recur occasionally, it may be, for months or years. On the other hand, it may be so severe as to mark a first, a single, and a fatal attack. In its character the pain may be stabbing or burning; but it is more frequently described as grasping, crushing, or oppressive. It may be limited almost to the region of the heart, or the lower part of the sternum; it may extend all over the chest to both arms, or spread to the side of the head and neck and down one or both legs; and it may in some cases apparently involve the diaphragm. The action of the heart may be slow, weak, and fluttering; or excited and bounding—constituting palpitation; and it may be regular or irregular. The pulse corresponds with the heart's action; in the early stage of a genuine attack it sometimes yields a sphygmographic tracing indicative of extremely high tension. The breathing is sometimes distressing; and although the patient can take a deep breath when asked to do so, he generally avoids this through fear of aggravating the pain. There may be laryngeal spasm. The mental functions are generally undisturbed; yet there is sometimes slight wandering as the attack passes off, and unconsciousness is said to be occasionally observed. The sense of danger of impending death is a characteristic symptom of angina, and one not often absent; whilst a sensation of gasping or choking with difficulty in swallowing is occasionally present. The position of the patient varies; sometimes he sits, sometimes he stands, resting his arms on any convenient object to obtain support; sometimes he sits and stoops, or leans forward. As a rule the attack passes off as abruptly as it commenced, leaving the sufferer free from discomfort; in other cases its disappearance is more slow. The varieties in the symptoms of angina pectoris are thus seen to be remarkably numerous, constituting a form of disease which may be comparatively mild and of long duration, or one of intense suffering, hastening to a fatal termination.[1]

Complications.—Amongst the diseases with which angina pectoris may be said to be associated, rather than complicated, are disorders of the liver and digestive functions, gout, albuminuria, diabetes, and certain diseases of the nervous system. Indeed, so marked is the latter connexion, that Trousseau dwelt on the relation between epilepsy and angina—a relation which seems to depend on the susceptibility to nervous maladies which some individuals present, rather than on any special identity between these two diseases. More than one striking example of the connexion has fallen under the writer's notice; he might mention an instance recently met with in which this susceptibility was such, that an oppressive meal of indigestible food brought on a first and distressing anginal attack, followed by others. In this case brain disease with epilepsy was subsequently developed on the disappearance of the angina.

Progress, Duration, and Terminations.—The progress and duration of this disease will depend wholly upon the nature of its cause. Cases have been recorded in which the first attack proved fatal. The writer has seen several; in three of these cases a *post-mortem* examination revealed the fact that there was slight partial hemorrhage into the walls of the heart, which had been the seat of fatty degeneration, connected with calcification of the coronary arteries. The symptoms in these cases perfectly resembled those of the most severe examples of angina pectoris. It is highly probable, therefore, that some of the cases proving fatal in a first attack of the disease are rather examples of partial rupture of the heart than of what is usually called angina. On the other hand, cases of the disease may continue with interruptions for years; the difference being entirely due to the nature of the cause on which the disease depends. Thus in many instances individuals present all the symptoms of marked angina, accompanied by most of its distressing phenomena, and by the anxieties and fears that they beget; yet these cases, having more a neurotic or gouty origin, yield to treatment, the sufferers being restored to health, and continuing for years to enjoy comparative comfort. On the contrary, in the cases in which angina is connected with organic disease of the heart or of the nerves intimately connected with cardiac action, the symptoms progress in frequency and severity; and the attacks tend, with more or less certainty, to a fatal termination—it may be within a few days or weeks, or it may be, in milder cases, not for years.

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[1] A case has recently come under the writer's notice in which a gentleman accustomed to pass lithic acid, and who for several years has had pains over the right side of the chest as low as the hypochondrium, was seized at night with a severe aggravation of these pains, coldness of the surface, irregular action of the heart, depression, and other symptoms, which, had the attack commenced on the left side of the chest, would have been really called angina pectoris. Similar attacks recurred at intervals for some weeks; they were easily brought on even by walking on a level surface for a few hundred yards. The most careful examination failed to elicit any evidence of organic disease in the organs of circulation or respiration. The patient was recommended to try a course of Homburg waters, and a short residence in Switzerland; from which he returned greatly improved, and almost free from pain. It should be mentioned that an interesting case has recently been recorded by Dr. Morison in which disease of the right side of the heart was accompanied by symptoms of angina affecting the corresponding side of the chest and arm.

Diagnosis.—A typical case of angina pectoris, such as has been described at the commencement of this article, can hardly be mistaken. But when the several symptoms constituting an attack are variously modified, some being lessened in severity and others exaggerated; or when these symptoms depend on, so to speak, remote and removable causes; it is often difficult to say how far the disease is what may be regarded as a passing neuralgia, or an attack of what is commonly recognised as angina pectoris. So also it may be difficult to say, in cases of angina, whether the seizure is dependent on organic lesions which admit of no improvement, or on some condition that is amenable to treatment. It is, therefore, with this, as with most other affections, more difficult to determine the cause on which the symptoms depend, than to recognise the presence of the disease itself. With reference to the diagnosis of the organic diseases of the heart above alluded to, it is unnecessary to repeat here what will be found described under other heads. It remains but to say that in every case the closest scrutiny must be made into the condition of the heart and great blood-vessels, with a view to determine the presence or absence of organic disease. The investigation must further extend to the other viscera, such as the liver, stomach, and the digestive organs generally, as well as to the several other sources from which symptoms of angina may be excited by reflected irritation. Certain symptoms resulting from the presence of other diseases should not be confounded with angina—such, for example, as the pain and dyspnœa caused by pressure of aneurisms or of tumours within the chest; by rheumatic or gouty neuralgia of the chest-walls; by pleurodynia, or acute pleurisy; or by indigestion. Each and all of these conditions must be considered by way of exclusion in determining the nature and origin of the disease.

Prognosis.—In anticipating the future of an attack of angina pectoris, one must be guided chiefly by a knowledge of its cause; in some respects also by its severity; and by the previous history of the case. Thus, if we can ascertain that the attack has been brought on by some clearly established and removable cause, a favourable prognosis may be fairly entertained. On the other hand, if the history of the case tells that there have been several previous attacks, increasing in severity and connected with heart-disease, one can scarcely avoid being led to the conclusion that the disease will tend, with more or less rapidity, to a fatal termination. Between these two classes of cases exist a large majority of the examples of the disease in which the symptoms of angina, of greater or less severity, depend on neurosis, on gouty diathesis, or on other sources of nerve disorder, amenable to treatment; and in which, therefore, a favourable prognosis may to some extent be given. But in all cases great caution should be exercised; for many instances occur in which, from slight and obscure beginnings, severe and even fatal examples of the disease have been developed.

Treatment.—The treatment of angina pectoris must first have reference to relief of the attack itself; and, secondly, during the interval to the removal of the causes on which the attacks may depend.

During the attack, it is necessary first, if possible, to inspire confidence, and remove apprehension. The patient should be allowed to retain the position in which he feels most comfort. Secondly, if the exciting cause is one that can be removed, this should be done; for example, if the stomach be full of undigested food, an emetic of mustard might be given with advantage; or if flatulence be present, peppermint, ether, and other anti-spasmodics will be useful. If cold have produced the seizure, the feet and hands should be immersed in hot water, hot bottles applied to the surface of the body, and poultices of linseed or mustard, or embrocations of chloroform or laudanum, should be placed on the chest. The administration of chloroform internally had better be avoided. The nitrite of amyl, as recommended by Dr. Lauder Brunton, has been found one of the most efficient remedies employed hitherto. Five or six minims of this drug (preserved in a glass capsule) should be inhaled from a handkerchief, and, if necessary, the inhalation may be repeated. Nitro-glycerine is useful ($\frac{1}{100}$ of a minim dose), and hypodermic injection of morphia may be tried with advantage. In cases where debility and exhaustion exist, the ordinary stimulants will be required; and various antispasmodics, such as ether, ammonia, &c., may be given with more or less benefit.

During the intervals.—It is of course desirable to avoid all causes likely to bring on an attack of angina, such as mental excitement, bodily exertion, exposure to cold, and the use of indigestible food or heavy meals. The leading principle in treatment should, however, be to endeavour to determine and to remove, if possible, the cause of the disease. Whether it depend on organic disease of the heart, whether on simple neuralgia, whether on gout or dyspepsia, whether on debility, or on fulness of habit—to each of such conditions must appropriate treatment be directed. A variety of specific remedies have been recommended: such as arsenic, phosphorus, steel, zinc, and the different anti-spasmodics. Galvanism, in the form of the continuous current from thirty cells, has proved successful in some uncomplicated cases, the positive pole being placed on the sternum, and the negative on the lower cervical vertebræ. Excellent, however, as each of the remedies named may be under special and suitable circumstances, the result of treatment must entirely depend on the cause of the disease, and how far it is within reach of remedy. Some cases of apparently severe angina will be found to yield to treatment; whilst, as might be expected from the nature of the disease, others unhappily proceed to a fatal termination in spite of every effort directed to their relief.

R. Quain, M.D.

ANIDROSIS (ἀ, priv., and ἰδρῶς, sweat).—Absence or want of perspiration. *See* Perspiration, Disorders of.

ANILINE POISON.—The aniline dyes, which are a modern discovery, present the most brilliant hues of yellow, blue, and red; as such they have been used for dyeing stockings, gloves, &c. These articles when worn are apt to produce an intense form of inflammation and vesication of the skin, which is rebellious against treatment, and liable to relapse for many months after the original attack has subsided. *See* Dermatitis.

ANIMAL POISONS. *See* Poisons.

ANODYNES (ἀ, priv., and ὀδύνη, pain).—Definition.—Medicines which relieve pain by lessening the excitability of nerves or of nerve-centres.

Enumeration.—Anodyne medicines include Opium and its alkaloids—Morphia and Codeia; Bromide of Potassium; Cannabis Indica; Belladonna and its alkaloid—Atropia; Hyoscyamus and Hyoscyamin; Stramonium; Aconite and Aconitia; Veratrum and Veratria; Conium and Conia; Lupulus and Lupulin; Gelseminum; Chloroform, Ether, and their allies; Chloral-hydrate; Butyl-chloral-hydrate; and Camphor.

Action.—Pain is due to a violent stimulation of a sensory nerve being conveyed to some of the encephalic nerve-centres (probably the cerebral hemispheres), and perceived there. The impression produced on all sensory nerves, except the cephalic nerves, is conveyed for a part of its course to the head along the spinal cord. The primary impression which is felt as pain, is usually made upon the peripheral ends of the sensory nerves; but it may also be made upon their trunks, upon the spinal cord, or possibly upon the encephalic centres directly, without any affection of the nerves themselves, as, for example, in hysteria. Pain may therefore be relieved, while the source of irritation still remains, by lessening the excitability of the ends of the sensory nerves which receive the painful impression; of their trunks; of the spinal cord along which the impression travels; or of the encephalic centre in which it is perceived. Opium acts by lessening the excitability of the sensory nerves, the spinal cord, and the encephalic ganglia; bromide of potassium is also believed to act on all three, although to a much less degree than opium; belladonna and atropia affect the sensory nerves, as probably does hyoscyamus; stramonium, aconite and aconitia, veratria, chloral and butyl-chloral, lupulus and lupulin, and gelseminum probably act on the encephalic centres.

Uses.—As opium and morphia act upon all the nervous structures concerned in the production of pain, they may be used to relieve pain whatever its cause. Cannabis indica and bromide of potassium may be employed under the same circumstances as opium, but they have very much less power. Chloral seems to relieve pain only by inducing sleep, and does not produce an anæsthetic effect unless it is given in dangerous doses. Butyl-chloral also induces sleep, but seems to have a special sedative action on the fifth nerve; so likewise has gelseminum—and hence both these agents are used in the treatment of facial neuralgia. As the action of belladonna is exerted chiefly on the peripheral ends of the sensory nerves, this remedy is usually applied directly to the painful part in the form of plaster, liniment, or ointment. Aconite, veratria, and opium are also used as local applications in several forms, for the relief of pain. The various anodynes may be administered not only by the mouth, but by other channels, such as by inhalation, by enema or suppository, by hypodermic injection, or by endermic application.

Several therapeutic measures are employed as Anodynes, such as the application of Dry or Moist Heat; Cold; Electricity; various forms of Counter-Irritation; Acupuncture; or the Abstraction of Blood.

T. Lauder Brunton.

ANOREXIA (ἀ, priv., and ὄρεξις, appetite).—Want or deficiency of appetite, not accompanied with disgust for food. *See* Appetite, Morbid conditions of.

ANOSMIA (ἀ, priv., and ὀσμή, smell).—Loss of the sense of smell. *See* Smell, Disorders of.

ANTACIDS.—Definition.—Medicines used to counteract acidity of the secretions.

Enumeration.—The antacids include Potash, Soda, Lithia, Ammonia, Lime, Magnesia, and their carbonates; as well as the salts which the alkalis form with vegetable acids, such as Acetates, Citrates, and Tartrates.

Action.—Antacids are divided into (1) those which act *directly*, lessening acidity in the stomach; and (2) those which act *remotely*, diminishing acidity of the urine. The alkalis and alkaline earths and their carbonates, with the exception of ammonia, have both a direct and a remote influence; for when swallowed they act on the stomach, and being absorbed from the intestinal canal, they are excreted by the kidneys, thus lessening the acidity of the urine. Ammonia and its carbonate are direct but not remote antacids; for, although they neutralize acidity in the stomach, they are partly excreted in the form of urea, and do not diminish the acidity of the urine. The acetates, citrates, and tartrates of the alkalis and alkaline earths, on the other hand, have no antacid effect in the stomach, but undergo combustion in the blood, being converted into carbonates, in which form they are excreted in the urine, and diminish its acidity.

Uses.—Excessive acidity of the contents of the stomach gives rise to acid eructations and heartburn. It may sometimes depend on the secretion of a too acid juice by the stomach, but probably is generally caused by the formation of acid from the decomposition of food when the process of digestion is slow and imperfect. Antacids are given after meals to lessen acidity in the stomach, and afford immediate relief to its attendant symptoms. They may prove even more efficacious by preventing acidity when given before meals (*see* ALKALIS). If the action of the bowels be regular, soda is preferable; but lime should be used if they are relaxed, and magnesia if there is a tendency to constipation. Remote antacids are given to lessen the acidity and irritating qualities of the urine in cystitis and gonorrhœa; and to prevent the deposition of uric acid gravel or calculus in gouty persons. For this purpose potash and lithia are preferable, as their urates are more soluble than those of the other bases.

T. LAUDER BRUNTON.

ANTAGONISM.—This term is employed to express the fact that the physiological action of certain substances may be affected, even to the extent of neutralisation, by the presence in the body, at the same time, of other substances having an action of an opposite character. It is important to distinguish between *antidotal action* and *physiological antagonism*. By an *antidote* is meant a substance which so affects the chemical or physical characters of a poison, as to prevent its having any injurious action on living animal tissues. Thus acids and alkalies neutralise each other, so as to form innocuous salts; tannin may render tartar-emetic and many vegetable alkaloids insoluble; and the hydrated sesquioxide of iron may be used to precipitate arsenious acid. In these cases, the action is limited chiefly to the alimentary canal; and the object of administering the antidote is to form insoluble salts, or compounds which will be physiologically inert. But the *physiological antagonism* of certain substances is presumed to take place in the blood or in the tissues. When such a substance as strychnia, for example, is introduced into the alimentary canal, it is quickly absorbed, and carried by the blood throughout the body. It does not, so far as observation has discovered, influence all the tissues; but it so affects the spinal cord, and possibly the brain, as to give rise to severe tetanic convulsions, chiefly of a reflex character. This effect is, no doubt, due either to some interference in the nutritional changes between the blood and the tissues composing the nerve-centres; or to some specific action of the poison on the nerve-centres themselves (*see* AFFINITY). These changes, which are termed physiological, and on which the normal action of the nerve-centres depends, are probably of a molecular or chemical nature; and it is possible to conceive that they may be modified in different ways by different substances. Thus has arisen the idea of physiological antagonism; and experiment has shown that, within certain limits, which will no doubt vary in each case, such an antagonism is possible. Antagonism may be either local, affecting one organ, as is seen in the opposite effects upon the pupil of opium or morphia upon the one hand, and stramonium, hyoscyamus, or belladonna upon the other; or it may extend apparently to more important organs or groups of organs, as in the case of the antagonism between strychnia and the hydrate of chloral. The most important investigations upon the subject of physiological antagonism are the following:—

(1) *Physostigma* and *Atropia*, by Professor Fraser—an inquiry which showed that the fatal effect of three and a half times the minimum fatal dose of physostigma may be prevented by atropia. (2) *Atropia* and *Prussic Acid*, a research by Preyer of Jena—of a more doubtful character as regards the point to be proved, but still sufficient to show that, within certain limits not yet indicated, it is possible to prevent the fatal action of prussic acid by atropia. (3) *Atropia* and *Muscarin* (the active principle of *Agaricus muscarius*):—which were found by Schmiedeberg and Koppe to have entirely antagonistic actions on the ganglia of the heart—muscarin exciting the intra-cardiac inhibitory centres, and stopping the heart in diastole, while atropia has the contrary effect. (4) *Chloral* and *Strychnia*,—an antagonism first pointed out by Oscar Liebreich, who showed that minute doses of strychnia might so rouse an animal from the effects of an overdose of chloral as even to save its life. And (5) *Strychnia* and *Chloral*—with respect to which Hughes Bennett demonstrated the converse of the last-mentioned observation, namely, that in the rabbit a fatal dose of strychnia might be so antagonised by a dose of chloral as to save life.

CONCLUSIONS. — It has unfortunately to be admitted that the practical results of the preceding researches have not been very encouraging. In all of these investigations it was quite apparent that the limits of physiological antagonism were very narrow. Three elements affect the chances of success in the way of saving life:—(1) the age and strength of the animal; (2) the amount of the doses of the two active substances—so that if either the one or the other active substance be given slightly in excess, death will probably take place; and (3) the time between the administration of the two active substances. If the stronger be introduced first, and be allowed to manifest distinctly its physiological action, it is almost impossible to counteract this by that of another substance; but if the two substances be introduced simultaneously, or if the supposed antagonist to the more active substance be introduced first, the chances of success are much greater. It is apparent, therefore, that the facts relating to physiological antagonism at present known in science do not hold out much hope of good results from their application in practice; but still the physiological facts are so definite as to indicate a precise mode of treatment. For example, no one acquainted with the investigations mentioned above would hesitate in attempting to relieve the tetanic spasms of a case of poisoning by strychnia by repeated doses of hydrate of chloral, or by the administration of chloroform. A practical result of such researches is that the principle of physiological antagonism may serve as a guide to the application of re medies in disease. Thus excessive secretion, say from mucous membranes or from salivary glands, may be modified or arrested by the use of sulphate of atropia, a striking experimental demonstration of which may be seen in the antagonism between bromal hydrate and sulphate of atropia in the rabbit.

John G. McKendrick.

ANTEFLEXION.—A bending forwards of any organ. The term is specially used in relation to the uterus, when this organ is bent forwards at the line of junction of its body and cervix. *See* Womb, Diseases of.

ANTEVERSION.—A displacement forwards of any organ. The term is particularly applied to a change of position of the uterus, in which this organ is bodily displaced in the pelvic cavity, so that the fundus is directed against the bladder, and the cervix towards the sacrum. *See* Womb, Diseases of.

ANTHELMINTICS (ἀντὶ, against, and ἕλμινς, a worm).—Definition.—Medicines which kill or expel intestinal worms.

Enumeration.—The principal anthelmintics are:—Oil of Male Fern; Kamala; Kousso; Oil of Turpentine; Pomegranate Root; Worm-seed and its active principle, Santonin; Areca; Mucuna; Rue; and drastic purgatives. As purgatives only expel the worms, they are termed *Vermifuges*; while the other anthelmintics which kill the worms are called *Vermicides.*

Action.—The oil of male fern, kamala, kousso, oil of turpentine, and bark of pomegranate root, act as poisons to tape-worms; worm-seed and santonin kill round-worms, and also thread-worms. Castor oil, jalap, scammony, and other purgatives do not kill the worms, but dislodge and expel them, by the increased peristaltic action which they occasion.

Uses.—Drastic purgatives may be used for worms of any sort; areca for both tape- and round-worms; and the other agents for the worms on which they severally act as poisons. Vermicides are generally given after the patient has fasted for several hours, in order that, the intestines being empty, the drugs may act more readily on the worms. A purgative is usually given some hours afterwards, in order to expel the dead worms. As thread-worms chiefly inhabit the rectum, they are most effectually killed by enemata, which may consist of a strong infusion of quassia; salt and water; vinegar and water; solution of sulphate, or of perchloride of iron; oil of turpentine; castor oil; decoction of aloes; or infusion of senna. As abundance of mucus in the intestines forms a convenient nidus for the growth of worms, anything that diminishes this tends to prevent their occurrence; and for this purpose preparations of iron and bitter tonics are useful.

T. Lauder Brunton.

ANTHRAX (ἄνθραξ, a coal).—A synonym for carbuncle, and for malignant pustule. *See* Carbuncle; and Pustule, Malignant.

ANTIDOTE (ἀντὶ, against, and δίδωμι, I give.)—Definition.—An antidote is any remedy which, by its physical or its chemical effect upon a poison, or in both ways, is capable of preventing or counteracting the physiological effects of that substance. (*See* Antagonism.) Sometimes, however, the term is used in a more comprehensive sense, so as to include the general treatment of a person affected by a particular poison. Thus, in poisoning by opium, the use of the stomach-pump, enforced exertion, chafing the limbs, and artificial respiration may be included in the general antidotal treatment.

Modes of Action, and Application.—Most antidotal substances form with the poison insoluble or innocuous compounds. Without attempting to give a complete list, the following are examples of the more common poisons and their respective antidotes:—(1) *Arsenious acid:* hydrated peroxide of iron, or light magnesia; (2) *hydrocyanic acid:* newly precipitated oxide of iron with an alkaline carbonate; (3) *oxalic acid:* chalk, common whiting, or magnesia suspended in water; (4) *tartar emetic:* tannin, catechu, or other vegetable astringents; (5) *acetate of lead:* sulphate of magnesia, or the phosphates of soda and magnesia; (6) *caustic potash:* dilute acetic acid, fixed oils, lemon juice; (7) *corrosive sublimate:* albumen, white of egg, flour, or milk; (8) *mineral acids:* chalk, common whiting, plaster from the walls or ceiling, or carbonate of magnesia; (9) *chloride of zinc:* albumen, milk, or carbonate of soda.

Vegetable poisons cannot thus be counteracted. If they have been taken in the form of seeds, leaves, or roots, the proper course is to remove them from the stomach or bowels as soon as possible by emetics and purgatives, and at the same time to sustain the flagging strength of the patient by the administration of stimulants. On the other hand, if the alkaloid has been taken, it is so soon absorbed that emetics and purgatives are of little avail, or may even be injurious. In these circumstances we must rely on the administration of the physiological antagonist of the poison (such as chloral hydrate in the case of strychnia-poisoning), and on supporting the strength of the patient. The following are the best antidotes to the vegetable poisons most frequently met with:—(1) *aconite root:* emetic of sulphate of zinc and stimulants; (2) *belladonna leaves* or *root:* emetic of sulphate of zinc, ammonia, stimulants, and after some time an active purgative; (3) *digitalis:* emetics, stimulants, and the maintenance of the recumbent position; (4) *hyoscyamus leaves:* emetics and stimulants; (5) *hydrochlorate* or *meconate of morphia*, or *any of the preparations of opium:* emetic of sulphate of zinc, external stimulation by warmth, turpentine or camphor liniments, enforced exertion, artificial respiration, and small repeated doses of sulphate of atropia; (6) *chloral-hydrate:* the same as for opium; (7) *strychnia* or *nux vomica:* animal charcoal suspended in water, repeated large doses of chloral-hydrate, or chloroform. *See* Poisons.

John G. M'Kendrick.

ANTIMONY, Poisoning by. *See* Tartar Emetic, Poisoning by.

ANTIPERIODICS.—Definition.—Medicines which prevent or relieve the paroxysms of certain diseases which exhibit a periodic character.

Enumeration.—The chief antiperiodics are:—Cinchona-bark and its alkaloids—Quinine, Cinchonine, Quinidine, and Cinchonidine; Bebeera-bark and its active principle, Bebeerin; Salicin, Salicylic Acid and its salts; Eucalyptus globulus; and Arsenic.

Action.—The mode of action of antiperiodics is at present unknown.

Uses.—Cinchona, and still more quinine, is almost a specific in the treatment of intermittent fevers, periodic head-aches, neuralgias, and other affections caused by malaria. Though less certain in its action than in intermittent fevers, quinine is also the best remedy in the remittent fevers of the tropics, in which, however, it must be given in very large doses. The other alkaloids of cinchona have a similar action to that of quinine, but they are not so powerful. Bebeerin is only about one-third as powerful, and is by no means so certain; and the same remark applies to the other remedies enumerated. In some cases of ague and other intermittent affections arsenic proves successful when quinine fails. Emetics and purgatives are useful auxiliaries to quinine in the treatment of ague, and are employed alone for the cure of this disease in some parts of the world where quinine is not available.

T. Lauder Brunton.

ANTIPHLOGISTIC (ἀντὶ, against, and φλέγω, I burn).—A term for any method of treatment that is intended to counteract inflammation and its accompanying constitutional disturbance.

ANTIPYRETICS (ἀντὶ, against, and πυρετὸς, a fever).—Definition.—Medicines which reduce the temperature in fever.

Enumeration.—The principal agents used as antipyretics are—Cold Baths, Cold Applications, Ice; Diaphoretics; Alcohol; Chloral; Quinine; Salicylic Acid and its salts; Eucalyptol; Essential Oils; Aconite; Digitalis; Veratria; Purgatives; and Venesection.

Action.—The temperature of the body may be reduced, either by increasing the abstraction of heat, or by lessening its production. The direct application of cold, by means of baths, affusion, or sponging, or by enveloping the body in sheets wrung out of cold water, is the most powerful and rapid means of abstracting heat. But the loss of heat which constantly occurs, even in health, by evaporation of the sweat, and the radiation and conduction of heat from the skin, may be increased by the use of diaphoretics, such as salts of potash, preparations of antimony, or acetate of ammonia; or by such medicines as dilate the cutaneous vessels, so as to allow the heated blood to circulate freely through them, and to become cooled by the external media surrounding the skin. Alcohol, in the form either of wine or spirits, and chloral, have an action of this sort, though alcohol also influences the production of heat. Alcohol, quinine, salicylic acid and its salts, eucalyptol, and essential oils lessen the production of heat within the body, probably by diminishing oxidation of the tissues. (*See* Alcohol.) Aconite, digitalis, and veratria reduce the temperature, but their mode of action is not precisely ascertained.

Uses.—Antipyretics act much more powerfully in reducing the temperature of the body in fever than they do in health. They may be used when the temperature has risen either from exposure to a high external temperature, as in thermal fever; in consequence of inflammation, as in pneumonia, or pericarditis; or in specific fevers, as acute rheumatism, typhus, and scarlatina. The most rapid and powerful antipyretic remedies are cold baths; next probably come large doses of salicylic acid and quinine. The latter seems to act very efficiently in thermic fever when injected subcutaneously.

T. Lauder Brunton.

ANTISEPTICS.—Antiputrescents (ἀντὶ, against, and σηπτικὸς, putrefying).

Definition.—An antiseptic is a substance which prevents or retards putrefaction, that is, the decomposition of animal or vegetable bodies accompanied by the evolution of offensive gases. The putrefactive change occurs only in dead matter, and requires the presence of water, heat, and a ferment. That there is no putrefaction in the absence of water is obvious, for bodies, such as albumin and blood, which in the moist state are highly susceptible of putrefaction, may be kept for an indefinite time without change if they be perfectly dry. Heat also has an important influence on putrefaction. At very low temperatures the putrefactive change ceases, while elevated temperatures, such as prevail in tropical climates, are favourable to it. An additional element besides heat and moisture is, however, required, and the opinion generally accepted at present is, that this consists of minute vital organisms, which in some way excite putrefactive decomposition.

Mode of Action.—The substances used as antiseptics act either directly on the bodies in which putrefaction is occurring or might occur, forming with them combinations that are not susceptible of the decomposing action of a ferment; or they act indirectly, by destroying the vitality or otherwise preventing the development and propagation of the organisms of which the ferment is composed. In this respect *antiseptics* are distinguished from *disinfectants*, the action of the latter being directed only towards the exciting causes and offensive or deleterious products of a class of changes which are themselves more comprehensive than those implied by the term putrefaction.

Enumeration.—There are numerous chemical agents possessing antiseptic properties, the chief of these including Chlorine, Sulphurous Acid, Nitric Oxide, and Peroxide of Nitrogen, as gases; Carbolic Acid, Creasote, Benzol, Sulphites and Hyposulphites, and the Hypochlorites, which emit vapours at common temperatures; Chromic, Boric, Tannic, and Salicylic acids, Permanganate of Potash, Sulphocarbolates, Chlorate of Potash, Chloride of Zinc, and Charcoal, from which no vapour is emitted.

Uses.—1. In therapeutic practice antiseptics are chiefly employed in the treatment of surgical operations and open wounds, to prevent the occurrence of putrefactive decomposition. Those antiseptics are best suited for this purpose which, acting efficiently on the ferment, have little action, and no injurious effect, on the parts in which the healing process is going on. Gases, except in solution, cannot be readily used, as it would be necessary to enclose the substance to be preserved in an air-tight vessel containing the gas. The volatile antiseptics which slowly emit a vapour have been preferred to those which emit no vapour, although among the latter salicylic and boric acids, being devoid of any irritating properties when applied to inflamed surfaces, would on this account present a marked advantage.

Carbolic acid has been used with success, a solution in water containing one part of the crystallised acid in from forty to one hundred parts of water being applied as a lotion, and also in the form of spray, diffused through the atmosphere during a surgical operation or the dressing of a wound. The carbolic acid solution may also be used on lint or cotton-wool for covering the affected part. Antiseptic gauze for a similar purpose may be made by adding one part of crystallised carbolic acid to five parts of common resin and seven parts of paraffin melted together, and applying the compound to coarse muslin, so as to form a thin coating of the plaster over the gauze, which, when it has hardened, is used for covering the parts to be protected. Professor Lister has also recommended a boric acid dressing for rodent ulcers, which is composed of boric acid and white wax, each one part, paraffin and almond oil each two parts. The boric acid and oil are added to the melted wax and paraffin, and the whole stirred in a mortar until it thickens, then set aside to cool and harden, after which it is to be rubbed in the mortar until it acquires the consistence of an ointment. This is thinly spread on fine rag and applied to the wound. The oil separates, and is absorbed by lint or rag placed over the dressing, while a firm plaster remains attached to the skin, which is easily removed when necessary. Salicylic acid may be substituted in this dressing for the boric acid. In some cases salicylic acid is applied alone, by merely sprinkling it in fine powder over the part affected. Its very slight solubility in water presents an obstacle to its use in solution, unless something be added to render it more soluble; and borax, which is itself a good antiseptic, may be used for that purpose. One drachm of salicylic acid, two drachms of borax, and half an ounce of glycerine, with three ounces of water, form, if aided with a little heat, a clear solution which may be used as an antiseptic lotion.

2. In medical practice antiseptics are also employed, either as local applications or as internal remedies. Those which are chiefly available include creasote, carbolic acid, the sulphocarbolates, sulphurous acid, the sulphites or hyposulphites, chlorine water, permanganate of potash, borax or boric acid, chlorate of potash, charcoal, salicylic acid, and thymol. They are principally used for the prevention and treatment of infectious fevers; and in low forms of ulceration of the throat.

3. In using antiseptics for the preservation of anatomical specimens, a wider range of chemical agents may be taken, and a selection made of substances that would be inapplicable in the treatment of the living subject. Arsenious acid, corrosive sublimate, or chloride of zinc in solution are of service for this purpose, and chromic acid, even when diluted with from five hundred to one thousand parts of water, possesses the property of preserving animal matter from decomposition, as also does a solution of one part of borax in forty parts of water.

Besides the more powerful antiseptics noticed, others of a milder nature, such as common salt, nitre and sugar, are used for preserving articles of food; while alcohol and glycerine are employed for the preservation of animal and vegetable substances as specimens. T. Redwood.

ANTISEPTIC TREATMENT is treatment directed against putrefaction, or rather, as now generally understood, against the development of fermentative organisms.

1. In Surgery, the employment of the antiseptic method is based upon the theory which attributes putrefaction and its consequences to minute organisms (bacteria, &c.) derived from without.

The treatment yields the most satisfactory results when it is so employed as to prevent, rather than to attempt to correct putrefaction. To obtain these results the surgeon must have unbroken skin to operate upon, or the wound must have been so recently inflicted that there has not been time or opportunity for the septic organisms to get beyond the reach of the antiseptic which he employs. Hence there must always be a percentage of failures in the treatment of compound fractures and large lacerated and contused wounds, owing to the amount of septic air and dirt carried into the recesses of the wounds between the time of the injury and the commencement of the treatment. In the event of putrefaction occurring in such a case, antiseptic dressings should be continued, but the question of operative interference must be determined according to the ordinary principles of surgery. Putrid ulcers and superficial wounds may certainly be rendered aseptic by suitable means, and so probably may cavities laid open during excision or amputation; but the attempt to correct putrefaction in deep sinuses, such as those connected with caries of vertebræ, is hopeless, though by appropriate dressings the putrid emanations may be rendered less noxious to the patient and those about him.

The antiseptics which have been found most suitable are carbolic acid, boric acid, chloride of zinc, and salicylic acid.

Carbolic acid is the antiseptic most generally useful. A solution of one part to twenty of water is employed to purify the skin of the part to be operated upon, the sponges, instruments, &c. A solution of one part to forty is used for washing sponges during an operation, for the hands of the surgeon and assistants, and for the changing of dressings. The volatility of carbolic acid renders it invaluable for dressing hollow wounds and abscesses. It is the active constituent of the ordinary dressing—antiseptic gauze, which is applied in eight layers, of size proportioned to the expected quantity of discharge, a piece of reliable thin mackintosh cloth (hat lining) being interposed beneath the outer layer of gauze; this serves to prevent the discharge from soaking directly through the central part of the dressing, thereby washing out the stored up acid, and allowing the direct access of putrefactive organisms to the cavity. Disastrous consequences have followed from a defect in the mackintosh. A small portion of gauze wrung out of the one-to-forty carbolic acid solution is applied over the wound before the ordinary eight-fold dressing, so as to prevent possible mischief from putrefactive organisms accidentally adherent to the inner layer of the gauze, which might not otherwise be destroyed, owing to the slight volatility, at the ordinary temperature of the atmosphere, of the acid stored in the gauze. The gauze is also useful, on account of its antiseptic properties, as a bandage in retraction of the soft parts in stumps, and in any case in which free discharge is expected.

In addition to other measures, there must be an antiseptic atmosphere provided, so that the air which gains access to the wound or abscess may be innocuous. This is secured by means of a spray of one-to-forty carbolic acid solution, for the production of which Lister's portable steam apparatus may be used. When the spray is suspended during an operation or the changing of a dressing, the wound is covered with a piece of sound calico moistened with the same solution. Of course superficial sores and wounds require neither spray nor guard.

Cicatrisation is promoted by interposing between the healing parts and the antiseptic agent an impervious, unirritating protective layer, composed of thin oil-silk varnished with copal and then coated with a layer of dextrine, which allows the oil-silk to be uniformly wetted by the antiseptic solution into which it is dipped at the moment of application. The antiseptic dressing proper must extend a considerable distance beyond the protective layer, so as to prevent the access of putrefactive organisms beneath it.

Lint soaked in a one-to-ten solution of carbolic acid in olive oil is used as a dressing for abscesses near the anus, and occasionally as a stuffing for cavities. A one-to-twenty oily solution is smeared upon urethral instruments to prevent putridity of urine and its consequent evils.[1]

Boric acid is a powerful antiseptic, but its non-volatility prevents its being used for the dressing of hollow wounds and in the form of spray. It is bland and unirritating as compared with carbolic acid, and is therefore particularly serviceable as a dressing for superficial wounds and sores. It is employed in the form of a saturated watery solution; as an ointment, in the proportion of one to six; and as boric lint, which contains about half its weight of the acid.

Chloride of zinc has the remarkable property of producing such an effect upon the tissues of a recent wound, that when applied once as a watery solution of about forty grains to the ounce, the cut surface, though not presenting any visible slough, is rendered incapable of putrefaction for two or three days, even when exposed to the influence of septic material. The patient is thus tided over the dangerous period preceding suppuration, during which the divided tissues are most prone to inflammation and the absorption of septic products. Hence this agent, though not adapted for general use, is of the highest value when it is impossible to exclude septic organisms in the after-treatment, as, for example, after the removal of tumours of the jaws, in operations about the anus, and in amputations or excisions in parts affected with putrid sinuses, which should first be scraped out with the sharp spoon.

Sometimes a peculiar, disagreeable odour is observed on removing an antiseptic gauze dressing which has been applied for several days, especially to regions which have naturally a powerful odour, as the axilla or groin; and occasionally the odorous material is so irritating as to produce actual eczema around the wound. This seems to depend upon a reaction between the discharge or excretion and some ingredient of the gauze. *Salicylic acid* has the power of preventing this reaction, or, at any rate, of obviating or remedying its bad effects, if a little of the acid is smeared upon the protective or upon the inner layer of gauze. Salicylic acid has been introduced as an independent dressing by Prof. Thiersch, but has been found by Prof. Lister to be inferior to carbolic acid for the destruction of bacteria, though very efficient in preventing fermentations. *Chloral*, *thymol*, and *Eucalyptol* are used as antiseptics. Mr. Lister recommends gauze containing oil of Eucalyptus when symptoms of poisoning follow the use of the ordinary gauze dressing.

Prepared antiseptic catgut is employed for arresting arterial hæmorrhage.

Chassaignac's drainage-tubing is introduced to prevent tension after the opening of an abscess, or after the application of antiseptics to the raw surface of a hollow wound.

Carbolised silk sutures are used, as they are not liable to catch in the dressings.

2. IN MEDICINE, antiseptic treatment is based on the hypothesis that infectious and contagious diseases are caused by the presence and multiplication in the human organism of minute parasites, termed microzymes, microphytes, micrococci, &c. On this assumption, special remedies are administered for the purpose of destroying these minute organisms, or of rendering the blood and other tissues incapable of sustaining them. The treatment further aims at preventing the spread of these diseases by the prophylactic administration of antiseptic remedies to persons who are compelled to remain in infected places.

At present a definite relation would seem to have been made out between specific microphytes and cow-pox, sheep-pox, splenic fever, and relapsing fever respectively; whilst a similar connection has been so far supported by observations in the case of measles, scarlatina, diphtheria, enteric fever, and erysipelas; but much remains to be done before the true relation between microphytes and infectious diseases can be established. Seeing that antiseptic therapeutics depends on an unestablished ætiology, it cannot be expected to be in a very advanced condition; accordingly there is at present but little that is settled or satisfactory to be said. The *sulphites* and *hyposulphites*, introduced by Professor Polli in 1857, have been freely given in zymotic diseases in twenty-grain doses every three or four hours, and with apparently good effect.

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[1] Cystitis, thus complicated with putridity of the urine, due to infection by catheters, may often be benefited by washing out the bladder with solution of boric acid. This complication of course never arises when the instruments have been carbolised from the commencement of the treatment.

Carbolic acid is also said to have been successfully used in diphtheria and in intermittent and eruptive fevers, in doses of from one to five minims or more.

The *sulphocarbolates*, introduced by Dr. Sansom in 1867, have been used with success in many diseases. They produce very little physiological effect, and seem to deserve increased attention. Dr. Brakenridge believed that he found sulphocarbolate of soda remarkably beneficial in an epidemic of scarlatina in 1875. Patients under ten years were given five grains, and those above that age twenty grains, every two hours. Also, according to this authority, the prophylactic effect of ten-grain doses three times a day was very striking.

Thymol and *salicylic acid* have also risen into favour, owing to their powerful antiseptic effects being associated with comparative physiological inertness.

Sarcinous dyspepsia is greatly relieved and sometimes cured by Kussmaul's method of washing out the stomach with solution of permanganate of potash, or some other antiseptic.

Reference must be made to solution of permanganate of potash, solution of carbolic acid, glycerine of borax or a preparation of boric acid of the same strength, sulphurous acid, and chlorate of potash, as applications to the throat in such diseases as diphtheria and scarlatinal tonsillitis, or in any form of sloughy ulceration of this part. To these may be added a five-grain solution of sulphate of quinine.

JOHN BISHOP.

ANTISPASMODICS (ἀντὶ, against, and σπάσμα, a spasm).—DEFINITION. — Medicines which prevent or allay spasm.

ENUMERATION.—Antispasmodics may be arranged in groups as follows:—Valerian, Valerianic Acid and its salts; Musk, Castor, Assafœtida, Sumbul and Galbanum, Camphor, Brominated Camphor, Oil of Amber; Ammonia and its Carbonate; Alcohol, Ether, Acetic Ether, Chloroform, Nitrite of Amyl; Bromide of Potassium, Bromide of Ammonium; Conium, Lobelia, Opium, Gelseminum, Indian Hemp, Belladonna, Stramonium; and the Essential Oils As adjuvants may be mentioned—Cold Baths, moderate Exercise, Friction, Heat, and Moisture; and also Quinine, Arsenic, Zinc, and Silver.

ACTION.—Certain nerves and nerve-centres, when excited, produce contraction of voluntary or involuntary muscular fibres; other nerves and centres arrest movements; and by the combined action of these two systems the motions of the various contractile structures in the body are regulated, and subordinated to the requirements of the organism as a whole. Excessive contraction or spasm of one part of the body may therefore arise either from excessive action of the motor, or deficient action of the inhibitory centres. Spasm may affect the involuntary muscular fibres of the intestines—as in colic; of the vessels—as in some forms of headache, and in vaso-motor neuroses of the uterus and bladder: single voluntary muscles, or groups of muscles—as in various forms of cramp: or the muscular system generally—as in tetanus, epilepsy, and hysteria. Antispasmodics may act by lessening the irritability of motor centres, as, for example, bromide of potassium and conium; or by stimulating those portions of the nervous system which restrain and co-ordinate movements, as alcohol probably does. There are no direct experiments to show the action of antispasmodics on the inhibitory centres; but it seems probable that they have such an action, although it may not be confined to these parts alone. Thus small doses of alcohol and ether, which stimulate the nervous system generally, and usually increase motor activity, will restrain and co-ordinate excessive muscular action, as in colic, nervous agitation, trembling, and hysteria. It is at present impossible to localize the part of the nervous system affected by valerian, assafœtida, and other drugs of this class. As spasms occur when the nervous system is deficient in power, nervine and general tonics, such as quinine, zinc, and iron, are often found to be useful adjuvants.

USES.—In such convulsive diseases as epilepsy, laryngismus stridulus, and infantile convulsions, bromide of potassium is the most powerful antispasmodic; in hysteria—valerian, assafœtida, and the bromides; in chorea—arsenic, conium, copper, and zinc; in spasmodic asthma—lobelia and stramonium; in spasm of the blood-vessels—nitrite of amyl. In all spasmodic affections, cold baths or sponging, exposure to sunlight, moderate exercise, and a plain but nutritious diet should be employed; and late hours, a close atmosphere, exhausting emotions, or excessive bodily or mental work should be avoided. T. LAUDER BRUNTON.

ANURIA.—Absence of urination, whether from suppression or retention of urine. *See* MICTURITION, Disorders of.

ANUS, Diseases of.—The principal affections of this part are Congenital Abnormalities; Epithelioma; Irritable Sphincter Ani; Irritable Ulcer; Prolapsus; Prurigo; Tumours and Excrescences.

1. **Congenital Abnormalities** (*Atresia*) may be classed as follows:—1. Imperforate anus without deficiency of the rectum. 2. Imperforate anus, the rectum being partially or wholly deficient. 3. Anus opening into a *cul-de-sac*, the rectum being partially deficient. 4. Imperforate anus in the male, the rectum being partially deficient, and communicating with the urethra or neck of the bladder. 5. Imperforate anus in the female, the rectum being partially deficient, and communicating with the vagina or uterus. 6. Imperforate anus, the rectum being partially deficient and opening externally in an abnormal situation by a narrow outlet. 7. Narrowness of the anus. These imperfections can be remedied, if at all, only by operation.

2. **Epithelioma.**—The anus, like other parts, where a junction takes place between the skin and mucous membrane, is liable to epithelioma. It is easily recognised by the ordinary characters of the sore. Warty growths and flaps of skin at this part are subject to this form of degeneration. The treatment applicable to this disease

is to destroy or remove the growth by caustics or excision.

3. **Irritable Sphincter Ani.**—In this complaint the anus is strongly contracted and drawn in by the action of the sphincter. Any attempt to examine the part produces spasm, and the finger passed through it is tightly grasped as if girt by a cord. In cases of old standing the muscle becomes hypertrophied, and forms a mass encircling the finger like a thick unyielding ring. This state is the source of serious trouble in defecation, owing to the expulsive power of the bowel being insufficient to overcome the impediment caused by the muscle to the passage of the fæces. Irritability of the sphincter occurs generally in hysterical females, and is relieved by mild laxatives, the local application of an opiate or belladonna ointment, and the occasional passage of a bougie coated with a sedative ointment.

4. **Irritable Ulcer.**—This is a small superficial sore, situated just within the circle of the sphincter, usually at the back part, commonly known as *fissure*, from its appearance in the contracted state of the part. The fæces passing over the sore excite spasm of the muscle, and cause a sharp burning pain which lasts for two or three hours. The distress often does not come on till an interval of ten minutes or more has elapsed after defecation. The pain is sometimes so acute that patients resist an action of the bowels, and allow them to become costive. The irritable ulcer occurs usually in middle life, and is more frequent in women than in men. It seldom gets well under the influence of local applications, but an incision through the centre of the sore sets the muscle at rest, and allows the part to heal. The French surgeons use forcible dilatation, so as to rupture the sphincter—a rough mode of treatment not to be commended. When the suffering is moderate, a cure may be attempted by giving a laxative to ensure soft evacuations; by enjoining rest in the recumbent position; and by the application of mercurial ointment with morphia, belladonna, or chloroform.

5. **Prolapsus.** *See* Rectum, Diseases of.

6. **Prurigo.**—Itching, though a common symptom in disorders of the lower bowel, may occur as a distinct affection, a neurosis liable to paroxysms. It is caused by worms in the rectum, and by congestion of the hæmorrhoidal veins. Patients suffer more after taking stimulating drinks and when heated in bed. The itching is extremely teasing and annoying, especially at night, keeping the sufferer awake for hours. Friction aggravates the mischief, excoriates the skin at the margin of the anus, and causes it to become dry, harsh, and leathery. As regards treatment, stimulants and condiments are to be avoided. The bowels should be regulated, and the part should be washed with soap and water after each evacuation. Every effort should be made to avoid friction. A piece of cotton wool soaked in oxide of zinc lotion should be kept applied to the anus, or the part may be smeared with some mercurial ointment, such as the dilute citrine, or one containing the grey oxide of mercury. Lotions of carbonate of bismuth and glycerine, of borax and morphia, or of carbolic acid, are often efficacious. In weak persons quinine and arsenic help the cure.

7. **Tumours and Excrescences.**—Besides the flaps and folds of integument consequent on external piles, tumours of a *fibrous* texture sometimes form in the sub-cutaneous areolar tissue, which as they increase become pedunculated. They are usually small in size, lobulated, and have a firm feel. These growths may be easily and safely removed by excision. *Warts* are liable to be developed around the anus, and sometimes grow so abundantly as to constitute a large cauliflower-looking excrescence. They then form projecting processes of various sizes, densely grouped together, with their summits isolated, expanded, and elevated on narrow peduncles. They give rise to a thin offensive discharge. They originate in want of cleanliness. In some persons there is so strong a disposition to the formation of warts that it is difficult to prevent their growth. If few in number and small in size, they may be destroyed with strong escharotics. They usually require, however, to be removed by excision, the quickest and most effectual mode of treatment. Astringent lotions must afterwards be used to prevent the reproduction of the warts. Flattened growths from the skin, commonly called *mucous tubercles*, a secondary result of syphilis, are liable to occur around the anus. They yield readily to the local application of mercury and specific general treatment.

T. B. Curling.

ANXIETAS.—Anxiety or distress, whether subjectively felt, or expressed in the features, attitude, or general behaviour. The term is also specially associated with a peculiar sensation experienced in the region of the heart. *See* Præcordial Anxiety.

AORTA, Diseases of.—The diseases to which the aorta is liable may be thus considered:—1. Aortitis, Acute and Chronic; 2. Atheroma; 3. Primary Fatty Degeneration; 4. Primary Calcification; 5. Coarctation; 6. Simple Dilatation; and 7. Aneurism.

1. **Aortitis.**—*Acute aortitis* is exceedingly rare. It may result from the direct irritation of an atheromatous aorta by a thrombus or an embolus, in persons of gouty diathesis; but has never been observed as an extension of acute endocarditis. The *morbid changes* consist in hyperæmia, with thickening and softening of the coats of the vessel, and deposit of fibrin upon its internal surface. The ascending portion of the arch is the part most frequently affected. The *symptoms* are acute substernal pain with oppression, palpitation, quick and feeble pulse, and elevated temperature. With these symptoms may be associated a harsh systolic murmur, originating at the seat of inflammation, and transmitted to a distant point of the aorta.

Sub-acute and *Chronic Aortitis.*—These are the usual forms of inflammation of the aorta. The disease may be general, arising from a blood-dyscrasia such as gout, from pyæmia, or from the various septic agents; but it is usually limited to a definite portion of the vascular surface, being the result of local irritation.

Ætiology.—Excessive and continued strain of the vascular walls is, according to its degree, the most frequent cause of sub-acute and chronic aortitis. Hence, the portion of the arterial system most directly affected by the impulse of the left ventricle, namely, the arch of the aorta, is that in which inflammatory irritation is first, and often exclusively, exhibited. Labour of any kind requiring great and repeated muscular effort whilst the breath is held, must necessarily subject the aorta to extreme tension, partly through the obstruction arising from the pressure of the contracted muscles upon the subjacent arteries, and partly from the back-pressure of the distended veins. Hence, sledgers, rammers, ship-porters, &c., are those who most frequently suffer from the effects of aortitis. As a necessary result of such efforts the left ventricle soon becomes hypertrophied, and the evils arising from vascular tension are thereby proportionately increased. Furthermore, the free use of alcoholic stimulants, in which such labourers habitually indulge, contributes to the same result by imparting irritant properties to the blood. The British soldier has been especially liable to the evils above sketched, owing to a vicious system of forced drill with a breathing-capacity diminished by faulty construction of his dress and accoutrements.[1]

Anatomical Characters.—Sub-acute aortitis occurs in disseminated patches, and involves all the coats of the vessel. These are infiltrated with exudation-cells at an early period; become soft and tumid, assuming a bluish-white tint; and, owing to loss of normal elasticity, project outwards, thus causing unevenness or pitting of the internal surface. In the aorta the inflammation is usually primary; but exceptionally it may be produced by the mechanical irritation of an embolus derived from an inflamed focus. Inflammatory softening is a frequent cause of aneurism at all periods of life; and in the young it is the ordinary precursor of that disease.

In chronic aortitis, which is the most common form of the disease, the internal coat is alone involved. The outer portion of the intima exhibits the result of irritation in the abundant production of new cells. These cells occupy the fusiform spaces between its lamellæ, and, gradually distending them, ultimately project the internal and unaffected portion of the tunic into the lumen of the vessel. The prominence so caused is comparatively solid, presents a faint bluish tint, and constitutes the condition described as 'fibroid or semi-cartilaginous thickening.' The inflammatory product is prone to undergo fatty degeneration, and the consecutive change called atheroma.

2. **Atheroma.**—This morbid condition is most common in the first portion of the aorta.

Anatomical Characters.—Atheroma commences with inflammatory overgrowth by multiplication of the cells of the outer portion of the intima, as described in a preceding paragraph. The neoplasts, from their situation, readily undergo fatty change and caseation; the septa of unaltered tissue intervening between them soon lose their vitality and are absorbed; and the disease thus spreads, whilst it advances through the same agency towards the internal surface of the vessel. Examined microscopically, atheromatous matter is found to consist of fat granules, crystals of cholesterine, and tissue-débris. At an early stage collections of this matter may undergo liquefaction, and, projecting into the vessel, covered only by a thin layer of the unaltered intima, constitute a so-called *atheromatous abscess*. Should this establish a communication with the artery, an *atheromatous ulcer* will be the result, and, consecutively, a false aneurism.

In the most advanced stage of atheromatous change many patches undergo calcification by deposit of lime-salts in the altered cells. The calcareous lamellæ so formed, being concentric with the vessel, and contracting by loss of their liquid constituents, may erode the intima by their sharp edges. From the injury thus inflicted aneurism may arise, or interstitial thrombosis, by which the vessel may be entirely blocked and gangrene of the extremities produced. In consequence of the foregoing changes the vessel loses its elasticity and becomes dilated; its internal surface is mottled with yellow or fawn-coloured patches of various sizes, being also rough, spiculated, and fissured; and thus the condition described by Virchow under the name of *Endarteritis Chronica Deformans* is established.

The uric-acid and oxalic-acid diatheses favour these changes, not only by stimulating the minute arteries to contract, and so raising the blood-pressure in the larger vessels, but likewise by furnishing material for cretification. The subjects of constitutional syphilis are liable to 'ulcerated steatomatous' (atheromatous) changes of the intima.

3. **Primary Fatty Degeneration.**—Virchow has described, under the name of *fatty erosion*, a form of fatty degeneration of the cells of the internal coat, unpreceded by inflammation, commencing on the free surface, and gradually extending outwards. The internal surface of the vessel is marbled with minute yellow dots, which are groups of fatty cells; these undergo liquefaction; and disintegration of the internal coat, followed by aneurism, is the usual result.

4. **Primary Calcification.**—Exceptionally, in the distant portions of the aorta the muscular fibre-cells of the middle coat are liable to calcification, as a remote result of endarteritis. Owing to the transverse arrangement of the calcified cells, fissuring of the middle coat under the pressure of the blood-current, and dissecting aneurism, are ordinary results of this change. Finally, the entire middle coat, and even all three coats of the artery, may be infiltrated with lime-salts as a primary change. This is most probably due to precipitation of these salts from the congested *vasa vasorum*, in consequence of the escape of their ordinary solvent, carbonic acid.

5. **Coarctation or Stenosis.**—This condition may be either *congenital* or *acquired*.

Congenital stenosis of the aorta is most frequently located at the point of junction of the *ductus arteriosus*, and is of very limited extent; in many cases presenting the appearance of a linear constriction, or of a perforated diaphragm. In a few examples, the vessel, at the seat of contraction, has been entirely closed and converted into a ligamentous cord. On the cardiac side of the constriction the aorta is dilated, and often thickened and atheromatous, whilst on the distal side it is reduced in calibre as far as the junction of the collateral vessels. Congenital stenosis of the aorta is compatible with life of moderate duration. In twenty-four out of thirty-eight cases analysed by Dr. Peacock the age attained varied from twenty-one to fifty years. The diagnosis of the condition rests mainly on disproportionate pulsation of the arteries arising from the aorta on the cardiac, as contrasted with those on the peripheral side of the obstruction; and on the enlargement of the collateral vessels, namely, the transverse cervical, internal mammary, and intercostals. The ordinary consequences are exhibited in dilated hypertrophy of the left ventricle, and inadequacy of the aortic valves. Death usually occurs from progressive debility and failure of the left ventricle; from pulmonary congestion; or from dissecting aneurism of the ascending portion of the arch. Congenital stenosis of the entire arch may result from imperfection of the inter-ventricular septum or patency of the foramen ovale allowing the blood to take an exceptional course.

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[1] Also by the constrained and fixed position in which the walls of the chest are placed when the shoulders are forced backwards, with the view of producing the appearance of an expanded chest.—Ed.

In the *acquired* form, stenosis of the aorta at any portion of its course may result from inflammatory thickening or calcareous change of the coats of the vessel, followed by thrombosis; or it may follow the natural cure of an aneurism. The aorta may be much reduced in calibre without being disproportionately narrowed. Such will be its condition in connection with mitral inadequacy in early childhood, should the patient survive a few years. In such cases the left ventricle will have become dilated and hypertrophied, and a marked disproportion will be observed between the force of cardiac and that of radial pulsation. This circumstance, taken in conjunction with the age of the patient, the existence of disease at the mitral orifice, and hypertrophy of the left ventricle, would warrant the positive diagnosis of narrowing of the aorta.

6. **Simple Dilatation** of the aorta consists in a uniform enlargement of the vessel or of a portion of it, from impairment or loss of its normal elasticity; and depends primarily upon arterial obstruction or resistance beyond its seat, and directly upon consecutive hypertrophy of the left ventricle. The continued tension, to which the walls of the aorta are subjected between these two opposing forces, necessarily leads to progressive impairment of nutrition and loss of elasticity in its middle coat. The immediate consequence of this change is exhibited in further hypertrophy of the left ventricle; and its remote effects in still further impairment of nutrition and deterioration of tissue in the vascular tunics, through the increased tension to which they are now exposed. No elementary change of structure is, however, discoverable. Simple dilatation of the aorta commences in the ascending portion of the arch, and to this it is usually limited; but it occasionally extends into the transverse portion. The other portions of the vessel are never dilated, except in association with atheromatous change. The condition under notice is manifestly in close relationship with inflammatory irritation of the vessel. It has, however, a distinct pathological existence, analogous to that of the early stage of vesicular emphysema of the lung.

No morbid results, with a single exception, are directly traceable to simple dilatation of the aorta. But, should the dilatation extend into the transverse portion of the arch, and engage especially its superior wall, the primary branches may become tortuous, and exhibit abnormal pulsation in the neck, simulating aneurism. In a noteworthy example observed by the writer the existence of this pulsation on *both* sides of the neck, and the facility with which it was arrested by forcibly extending the neck and shoulders, and so unbending the vessels, sufficed to establish the diagnosis. Tortuosity of the cervical arteries, dependent upon a local dilatation of the aorta, may be confined to one side of the neck.

Simple dilatation of the aorta most frequently occurs in connection with the contracted or granular form of chronic renal disease. It may, however, likewise arise from simple functional hypertrophy of the left ventricle dependent upon habitual vascular excitement; or from dilated hypertrophy consecutive to inadequacy of the aortic valves.

7. **Aneurism.**—ÆTIOLOGY AND PATHOLOGY.—Aneurism of the aorta is essentially a disease of the middle period of life. Of ninety-two cases observed or analysed by the writer, sixty occurred between the ages of thirty and fifty years; twelve over fifty; and five under thirty years. Thus, whilst deterioration of the arterial coats as typified in atheroma is most common after the age of sixty, one of its ordinary consequences, aneurism, belongs to an earlier period of life. The apparent discrepancy may be explained by the more frequent employment of men under fifty in severe labour, and their greater capacity for extreme muscular effort then than later in life, the condition of the arterial wall which favours aneurism having been already established. Aortic aneurism is more common amongst males than females in the proportion of about 8 : 1—a difference no doubt due to the more active and laborious habits of the male sex. Soldiers, mechanics, and porters suffer from it in larger proportion than those of other callings; and in most instances the first symptoms of aneurism of the aorta may be traced to a great muscular effort involving vascular strain, or to a severe shock or blow, causing a direct contusion.

Aneurism of the aorta is always consecutive to disease of its coats. Inflammatory softening, atheroma, and calcification are the usual antecedent conditions, and in exceptional instances primary fatty or calcific transformation of the internal and middle coats; whilst a definite overstrain or a direct contusion of the vessel is frequently the immediate cause of the disease.

ANATOMICAL CHARACTERS.—Aortic aneurism may be presented under the following forms, viz., (*a*) *true;* (*b*) *false* (*circumscribed*, and *diffused* or *consecutive*); (*c*) *dissecting*; and (*d*) *varicose.*

a. True aneurism of the aorta is rare; it may be either fusiform or saccular. It is essentially transitional, leading to the false variety of the disease; and differs from simple dilatation of the aorta only by its sharp limitation, and by the existence of inflammatory products in its walls. True aneurism never contains clots, save by incidental thrombosis; and rarely, as such, attains dimensions capable of producing extrinsic symptoms or signs. It may, however, unlike simple dilatation, be the cause of valvular inadequacy, and so give rise to a murmur of reflux at the orifice of the aorta.

b. False aneurism is either *circumscribed* or *diffused*. *Circumscribed false aneurism* (or, as it is also termed, *false aneurism*) is the most common form of the disease in connection with the aorta. It is necessarily confined to a portion of the circumference of the vessel, the yielding of which relieves the remainder from extra tension. Hence, it is usually saccular in general outline; but, owing to unequal resistance at different points of its surface, it may, and commonly does, present one or more secondary prominences. The internal and middle coats are usually broken;—the adventitia supplemented by the surrounding structures more or less condensed, forming the sac.

Disintegration of the inner coat, already in a state of atheromatous change by mechanical strain or vascular tension, is ordinarily the immediate cause of false aneurism. The irruption of an 'atheromatous abscess' may also give rise to it; so likewise may ulceration of the intima from fatty erosion. Rupture of the coats of the vessel by mechanical strain is usually announced by definite symptoms of the utmost significance, namely, a feeling of something having given way within the chest or abdomen; followed by faintness often amounting to syncope, dyspnœa, palpitation, and occasionally hæmoptysis. These symptoms of shock usually subside within a period of one to two hours, but the patient is thenceforward incapable of his accustomed exertion, being easily put out of breath, and distressed by excitement or rapid movement, especially that of ascent; there is likewise a fixed pain at some point of the chest, back, or abdomen. A fusiform false aneurism may become 'invaginating' by abruptly expanding and ensheathing the artery at its proximal or distal side, or in both these situations.

Diffused false aneurism (or, as it is otherwise called, *Diffused aneurism*, or *Consecutive aneurism*) is produced by escape of blood from the artery, and its diffusion to a greater or less extent amongst the surrounding structures, according to their previous condition or anatomical arrangement. It may be the result of mechanical violence by strain or shock to the artery in a previously diseased condition; or of progressive disintegration of the sac of a circumscribed aneurism. In the latter case the diffusion of the extravasated blood is usually limited by antecedent adhesive inflammation of the surrounding parts, where, as in the transverse portion of the arch of the aorta, the position of the aneurism is favourable to that process. A case of this description recently came under the writer's notice. Under ordinary circumstances diffused false aneurism of the aorta cannot occur within the pericardium, owing to the isolation of that portion of the vessel, and the fragile structure of its serous investment. Hence, a yielding of the sac proper in this situation is, in most instances, followed by instant death from hæmorrhage into the pericardium and paralysis of the heart. In a few recorded cases, owing to previous adhesion of the pericardium, the patients survived rupture of the sac in this situation for several days.

Diffused false aneurism of the abdominal aorta is frequently formed by irruption of blood into the retro-peritoneal tissue, between the layers of the transverse meso-colon or the mesentery, or into the fibrous envelope of the psoas muscle. When the aneurism grows backwards the sac is quickly eroded by pressure against the vertebræ, the naked and carious surface of which then forms its posterior boundary. Diffusion in such cases rarely occurs until the vertebræ are entirely absorbed; the blood may then escape into the spinal canal, causing general paralysis and immediate death. Diffusion may also occur amongst the muscles and areolar tissue of the loins, or behind the diaphragm into either pleural cavity, usually the left. Any portion of the aorta outside the pericardium may be the seat of diffused false aneurism, but the transverse portion of the arch and the abdominal aorta are the parts most frequently affected.

Consecutive false aneurism, consisting in a primary bulging of all the coats of the artery, the internal and middle coats having subsequently given way, constitutes the ordinary form in which false aneurism originates: it therefore demands no further notice here.

c. Dissecting aneurism consists in a breach of the internal and middle coats, and a subsequent detachment of these from the external tunic, by the force of the blood-current, to a variable extent over the length and circumference of the vessel; or in a splitting of the middle coat by the same agency. This form of aneurism is of two kinds—that with a single aperture through which the blood enters the abnormal channel and returns to the artery; and that which exhibits two openings, one by which the blood escapes from, and another through which it re-enters the vessel. The former is the more usual variety of dissecting aneurism; and it is likewise the more grave, because liable at any moment to terminate fatally by rupture of the external coat.

Any portion of the aorta may be the seat of dissecting aneurism; the ascending part of the arch is most frequently affected, and next in the order of frequency comes the abdominal aorta. The primary lesion consists in a transverse rent of the internal and middle coats; when this is close to the heart, the outer or the anterior wall of the vessel is its usual site, and detachment of the tunics rarely extends beyond the ascending portion of the arch, and seldom engages more than a limited area of its circumference. In this situation, too, an aperture of re-entrance is rarely formed, the disease usually terminating by rupture of the external coat within the pericardium. When, on the contrary, the second curve of the arch, or any portion of the aorta beyond this point, is the seat of primary lesion, separation of the coats is usually found to extend along the remainder of the length of the vessel, and over the whole or greater part of its circumference, whilst the blood has re-entered through an opening in one or both common iliac arteries.

The establishment of a second aperture of communication with the artery is an attempt at 'natural cure;' and when this happens the patient may survive for many years. Amongst the eccentricities of dissecting aneurism may be mentioned detachment of the laminated clot from the walls of the sac proper, and subsequent escape of blood by rupture of the latter; and separation of the mucous from the muscular coat of the œsophagus, with irruption of blood into the stomach. Dissecting and ordinary false aneurism may coexist, the former being usually a consecutive lesion, and the immediate cause of death.

d. Varicose or *Anastomosing aneurism* consists in a direct communication between an aneurism of the aorta and (*a*) one of the chambers of the heart; (*b*) the pulmonary artery or one of its branches; or (*c*) one of the venæ cavæ or innominate veins. This form of the disease is necessarily consecutive, and usually late as to the period of its development. In the great majority of recorded examples the primary aneurism was connected with the ascending portion of the arch, and in a large number it arose from one of the sinuses of Valsalva. The communication, with few exceptions, is formed with one of the chambers of the heart, the pulmonary artery, or the descending vena cava. Of the cavities of the heart, the right ventricle is most often implicated; next in order is the right auricle; then the left ventricle; and lastly the left auricle. The pulmonary artery and the descending cava have been frequently involved, as might have been inferred from their close relationship to the ascending aorta; the innominate veins in fewer instances, and only when the aneurism engaged the upper portion of the arch. An aneurism of the abdominal aorta has communicated with the inferior vena cava in a few cases. In the process of formation of a varicose aneurism of the aorta, the apposed surfaces are agglutinated by adhesive inflammation; and the composite septum is subsequently eroded by progressive absorption, or suddenly rent by the force of the arterial current. The immediate effects of communication are engorgement and increased tension of the receiving chamber or vessel; diminished blood-current and vascular tension in the aorta and its branches: and admixture of arterial with venous blood when the right side of the heart or one of the great veins is the seat of discharge. The special symptoms and signs by which the disease is characterised have direct reference to these results. Death has followed most rapidly in those cases in which the aneurism had established a communication with the pulmonary artery or the left auricle.

Effects upon the Left Ventricle.—Hypertrophy of the left ventricle cannot be regarded as a consequence of aneurism of the aorta. The association, when it exists, is accidental; hypertrophy depending upon antecedent or consecutive disease or inadequacy of the aortic or the mitral valves, chronic atheroma of the aorta, granular degeneration of the kidneys, or excessive functional activity.

SYMPTOMS.—The symptoms of aortic aneurism may be discussed under the three heads of (*a*) Pain; (*b*) Excentric Pressure; and (*c*) Tumour.

Pain.—The pain of aneurism is of two kinds, *intrinsic* and *extrinsic*. The former is due to subacute inflammation and tension of the sac, and varies with intra-vascular pressure. It is dull, aching, and localised, and promptly alleviated by measures which depress the circulation or reduce local tension. Extrinsic pain usually arises from pressure upon adjacent nerves, and may be direct or reflex. This kind of pain has the characters of a diffused and aggravated neuralgia, being paroxysmal, and wandering to a greater or less extent over the back, chest, shoulders, arms, abdomen, and thighs. In the abdomen, when due to pressure upon the splanchnic nerves or tension of the solar plexus, it is of the most excruciating character. The extrinsic pain of aneurism may be fixed and boring. When of this character, it is usually located in the back, and arises from progressive absorption of the vertebræ.

Excentric Pressure.—The parts affected by the pressure of an aneurism, and the symptoms thereby developed, vary according to its situation and the direction of its growth. Parts which are exposed to counter-pressure, or are otherwise fixed, suffer most; whilst those which are flexible or moveable are less injuriously affected. The symptoms have reference to the respective functions of the organs or structures pressed upon; whilst their severity is in direct proportion to the importance of those functions, and the degree of pressure exercised. Structures subjected to the remittent pressure of an aneurism are slowly removed by absorption, but between the sac and the resisting surface union has been previously established by adhesive inflammation. Hence the sac itself is at the same time absorbed, and escape of blood will inevitably occur where further resistance is not presented. When serous cavities are laid open by this process, entrance is effected by a rent; and if the cavity be large, *e.g.* the pleura or the peritoneum, death by hæmorrhage, almost instantaneous, is the result; in case of irruption into the pericardium or the spinal canal, death occurs with equal rapidity from compression and paralysis of the contained organ. Communication with a mucous canal or with the cutaneous surface is effected by a process of sloughing, and bleeding occurs by 'leakage,' in variable quantity and at uncertain intervals, till the slough is finally detached, when death by copious hæmorrhage immediately ensues. The irruption of an aneurism into a gland-duct, such as the ureter or one of the biliary passages, is fatal by obstruction and suspended secretion, the duct and its tributaries having been blocked by coagulum. Communication with the thoracic duct proves slowly fatal by inanition; and when an opening is effected into a vein, a varicose aneurism, characterised by special symptoms and signs, and of greater or less gravity according to its situation, will be the result.

The symptoms of nerve-pressure vary according to the nerves affected. Thus, pressure upon the roots or branches of sentient nerves is attended with neuralgic twinges or paroxysms referred to the seat of their peripheral distribution, and, when the pressure is extreme, with numbness in the same situation. Irritation of motor nerves is indicated by spasm or paralysis,

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according to the degree of pressure, of the muscles supplied by them. Irritation of the cervical sympathetic, or of its cilio-motor roots, is revealed by dilatation of the pupil on the corresponding side: or, if the pressure be such as to cause paresis, by contraction of the pupil with ptosis, hyperæmia, hyperæsthesia, and elevation of temperature in the eye and corresponding side of the face. The effects of pressure upon the pulmonic and cardiac plexuses have been less precisely determined, owing to the difficulty of distinguishing the symptoms due to this cause from those which arise from direct pressure upon the trachea or bronchi, the great vessels, or the heart, or from structural disease of the heart or the coronary arteries: but that the paroxysms of bronchial spasm and of angina, so often witnessed in connection with aneurism of the arch of the aorta, are in some degree dependent upon pressure on the pulmonary and cardiac nerves, and occasionally are due to it exclusively, the writer entertains no doubt. The symptoms arising from the pressure of an aneurism upon the pneumogastric or recurrent nerve of either side have reference to the larynx, and are eminently characteristic. They are of two kinds, according to the degree of pressure; namely, those due to spasm, and those to paralysis, of the laryngeal muscles on one or both sides. They are presented under the several forms of dysphonia, aphonia, stridor, metallic cough, and paroxysmal dyspnœa. The latter is frequently of the most urgent character, and sometimes is the immediate cause of death.

Adjacent organs, such as the heart, lungs, liver, and kidneys, are occasionally displaced by an aneurism, the direction being determined by that of the pressure, and in part also by the direction in which the organ is moveable. Obstruction or occlusion of adjacent arteries, as indicated by diminished or suppressed pulsation, may likewise result from the pressure of an aneurism. Pressure on a vein is evidenced by venous stasis distal to the seat of obstruction; upon the pulmonary artery, by engorgement of the right chambers of the heart and general venous congestion. Obstruction or occlusion of either bronchus or of one of its primary branches is evidenced by distress in breathing or shortness of breath; and by diminution or suppression of respiratory sound in the corresponding portion of the lung. Inasmuch as the symptoms of excentric pressure may be produced by a tumour of any kind, they possess, in regard to aneurism, a diagnostic value only correlative to other and more positive evidence of that disease.

Tumour.—The tumour formed by an aneurism of the aorta is fixed, smooth, and compressible. It is alternately tense and soft in unison with cardiac pulsation, and is especially characterised by a movement of general and equal expansion, synchronous with the impulse of the heart. It is further distinguished by a remarkable liability to vary in the rate and direction of its growth, retrocession at one point coinciding with enlargement at another; a new set of symptoms being at the same time developed by its encroachment upon fresh territory. In the progress of cure the tumour may become solid, incompressible, and uneven, by deposition of laminated fibrin within the sac.

PHYSICAL SIGNS.—The physical signs of aneurism of the aorta are those which may be elicited by *palpation*, *percussion*, and *auscultation*. They supply the most valuable, and, indeed, the only positive evidence of the disease.

Tactile signs.—The tactile signs of aneurism, *impulse*, *fremitus*, and *remittent tension*, are contingent on perceptible tumour. The impulse may be single or double. It is most frequently single, and is then always systolic in rhythm, coinciding approximately with the impulse of the heart. In character the systolic impulse is heaving and expansile; and it is diffused, in most instances equally, over the entire tumour. It is due to sudden expansion of the sac from active influx of blood during ventricular systole: hence, in those portions of the aorta which are close to the heart, it is synchronous with the apex-pulsation; but in the descending-thoracic and abdominal aorta perceptibly post-systolic in time. The force of systolic impulse and the expansion of the sac will be directly as the contractile power of the left ventricle, and inversely as the deposit of coagulum within the sac. A second and more feeble impulse of diastolic rhythm is occasionally, but much less frequently, exhibited by an aortic aneurism. This is the 'back-stroke,' or 'impulse of arrest' of authors. It coincides with the first period of ventricular diastole and the second sound of the heart, and is due to asynchronism of reaction between the aorta and the sac—that of the latter being notably later, owing to its defective elasticity. The consequence is a sudden arrest to the recoil of the sac by influx from the aorta. Diastolic impulse is therefore eminently characteristic of aneurism.

Fremitus or thrill is of more frequent occurrence than diastolic impulse, and, when not communicated from the heart, no less distinctive of aneurism. It accompanies the systolic impulse, and is due to the vibration of a thin sac from an eddy in the current of influx, produced either by a spiculated condition of the orifice, or by a pendent flake of fibrin.

Percussion-sound.—The intrinsic percussion-sound of aortic aneurism is absolutely dull to the extent of the tumour. Posteriorly the dulness is not sufficiently distinguishable from that of the vertebral column and muscles to be of positive diagnostic value; whilst laterally and in front, when the tumour is not in actual contact with the walls of the thorax or abdomen, it is modified or masked by the intervention of the lung or the intestinal canal. Under any circumstances, dulness *per se* cannot afford positive evidence of aneurism, inasmuch as it may be due to a tumour of any kind, solid or liquid, in the same situation; but, the presence of a tumour having been determined, the shifting of percussion-dulness from one point to another, or its cessation where it had been previously detected, would be in the highest degree suggestive of aneurism.

Acoustic signs.—These are *tone* or *sound*, and *murmur*. *Sound* without murmur is of frequent occurrence in aneurisms of the arch, but comparatively rare in those of the descending-thoracic and abdominal aorta. It is usually double, corresponding in time to the sounds of the heart, but exaggerated, the second aneurismal sound being especially intensified. The first sound is occasionally 'splashing,' and both are not unfrequently of a 'booming' quality,—characters no doubt due to the density, rigidity, and great capacity of the sac.

The *murmur* of aneurism is most frequently single, systolic, and blowing; it is occasionally double (systolic and diastolic); and still more rarely single and diastolic. As to quality, the systolic murmur may be accompanied by a musical note, 'cooing,' or shrill, and audible over the whole or only a portion of the tumour. Lastly, it may be, and usually is, of a 'buzzing' character in cases of varicose aneurism. The essential cause of the murmur of aneurism consists in friction of the blood against the orifice, and the production of an eddy or a 'fluid vein' within the sac. A certain force of ventricular contraction is, however, likewise necessary. Hence the not unfrequent coincidence of cessation of murmur with failure of the left ventricle for some time before death. A strongly contracting ventricle, a relatively small orifice, a capacious sac, and a liquid state of its contents, supply the most favourable conditions for the production of murmur. The orifice of entrance need not be absolutely narrow; a large fusiform aneurism, even of the true kind, with rough walls, and containing liquid blood, may yield a loud systolic murmur, as the writer has frequently witnessed. A murmur may be absent in an aneurism lined by thick laminæ of fibrin through which there is a smooth channel, or in a lateral aneurism communicating by a small orifice with the vessel.

Diagnosis.—The positive diagnosis of aneurism of the aorta may be made from the existence of a tumour, forming a second centre of pulsation and of sound; the pulsation being systolic, expansile, and equally diffused over the tumour, accompanied by thrill, and succeeded by a minor pulsation of diastolic rhythm; whilst the sound, single or double, and accompanied or not by murmur, is always sharp and ringing, and occasionally of a 'booming' quality. The foregoing signs are rarely all associated in the same case. Various other groupings of rational symptoms and signs would be scarcely less conclusive as to the existence of aneurism of the aorta. General systolic expansion, thrill, diastolic impulse, and exaggerated sound, at a point more or less distant from the heart, constitute the most positive signs of the disease.

The existence of aneurism of the aorta may be inferred with greater or less confidence from certain symptoms and signs, according to their individual or correlative value. Even negative signs, if associated with others in themselves of minor significance, may be scarcely less conclusive than the most positive evidence would be. Thus, for example, suppressed respiration with percussion-resonance on the left side of the chest, dyspnœa, hæmoptysis, fixed pain in the back, and left intercostal neuralgia—the entrance of a foreign body into the left bronchus and the existence of cancer of the posterior mediastinum having been excluded—would be all but conclusive as to the existence of aneurism. A foreign body in the bronchus might be diagnosed from the history of a misadventure in swallowing, followed immediately by dyspnœa, hæmoptysis, and the special signs of bronchial obstruction, which, in nine cases out of ten, would be on the right side: whilst the diagnosis of mediastinal cancer would rest upon evidence eminently suggestive, namely, the presence of cancerous enlargements in the neck and axilla, and of extreme dulness over the root of the lung, without corresponding pulsation or sound. Finally, aneurism of the aorta may be, though it very rarely is, strictly latent in regard to both symptoms and signs.

Prognosis, Duration, and Terminations.—The prognosis of aortic aneurism is in the highest degree unfavourable. Recovery is, however, under favourable circumstances and appropriate treatment, quite within the range of medicine. Numerous examples of cure of aortic aneurism, both thoracic and abdominal, have been lately recorded.

The duration of life, in connection with aneurism of the aorta, has varied, according to the experience of the writer, from ten days to eleven years; but it may be much longer. The situation and relations of the aneurism; its complications; the constitution of the sac, and the state of its contents; the previous health and present habits of the patient; and the advantages enjoyed in regard to rest and treatment—will all materially influence the prognosis, whether as to duration of life or prospect of recovery.

Death in aneurism of the aorta may result from—(*a*) rupture of the sac; (*b*) exhaustion from pain, loss of sleep, or leakage of blood; (*c*) asphyxia; (*d*) syncope; (*e*) inanition; or (*f*) intercurrent disease. The foregoing represents the order of relative frequency of the several causes mentioned. Rupture of the sac is not, of necessity, immediately fatal. Hæmorrhage may be stayed, and life thus protracted for several days, by obstruction from the extravasated blood, itself arrested and coagulated in the surrounding tissues, or by its pressure upon the aorta on the proximal side of the sac. Rupture into one of the chambers of the heart, the pulmonary artery, either vena cava or the innominate vein, the portal vein, or the biliary passages, is usually fatal within a very brief period; whilst rupture into one of the serous cavities in the absence of previous adhesion, into the trachea or bronchi, or into the alimentary or the spinal canal, is instantaneously fatal.

Treatment.—The treatment of aneurism of the aorta is *palliative* and *curative*. Pain from nerve-pressure is most effectually relieved by hypodermic injections of morphia, one quarter to half a grain in solution, repeated and increased in quantity according to necessity. The pain and oppression due to congestion of the sac and the surrounding structures is best treated by local or general abstraction of blood, combined with the use of cardiac and vascular depressants, especially iodide of potassium (20 to 30 grains every fourth hour), chloral hydrate (20 grains), and veratrum viride or aconite (5 to 10 minims of the tincture every third hour). Mechanical support by means of a well-constructed shield is likewise useful when the tumour projects externally. Fixed pain in the back, due to erosion of the vertebræ, is most effectually relieved by a seton or issue in the vicinity of its seat. The *curative* treatment of aneurism of the aorta may be classified under the heads of—(*a*) compression of the artery, proximal or distal; (*b*) distal ligature; (*c*) absolute rest with regulated diet; and (*d*) the use of medicinal agents promotive of coagulation within the sac. For the details of these several modes of treatment the reader is referred to the articles in this volume respectively entitled Aneurism, Abdominal Aneurism, and Thoracic Aneurism.

Thomas Hayden.

AORTIC VALVES, Diseases of. *See* Heart, Valvular Diseases of.

APEPSIA (ἀ, priv., and πέπτω, I digest).—Indigestion. *See* Digestion, Disorders of.

APERIENTS (*aperio*, I open).—Medicines which produce a gentle action of the bowels. *See* Purgatives.

APHAGIA (ἀ, priv., and φάγω, I eat).—Inability to swallow. *See* Deglutition, Disorders of.

APHASIA (ἀ, priv., and φημὶ or φάω, I speak).—Synon.: *Aphemia*, *Alalia*; Fr. *Aphasie*.

Description.—Aphasia is the name given to a defect of speech from cerebral disease, to which much attention has been paid during the last few years. When it exists the patient is found to be unable to utter any proposition, though his occasional distinct pronunciation of some one or two words shows that his speechless condition is not due to a mere difficulty in the more mechanical act of articulation. Moreover, the patient's intelligent manner and gestures may plainly show that he understands what is said, and is capable of thinking, even though he is quite unable to give expression to his thoughts. This kind of powerlessness as regards speech is most frequently encountered in persons suffering from right hemiplegia, though it is occasionally met with in those who are paralysed on the left side, and at other times in persons who are not hemiplegic at all.

The aphasic condition is not always, as it ought to be, clearly distinguished from another which may be encountered in association with hemiplegia on either side of the body, and to which the name *Amnesia* is given. The essence of this latter defect lies in the fact that the patient very frequently substitutes wrong words or names in the place of those he wishes to employ, as when speaking of his 'hat,' he calls it a 'brush;' or when seeking a 'pen,' he asks for a 'knife.' In a bad case of this kind the patient may be quite unable to arrange words into a sentence capable of conveying a definite meaning, so that his speech is rendered unintelligible. Where this species of defect exists there seems to be an inco-ordinate action of those higher cerebral centres whose function it is to translate thought into the corresponding motor acts of speech, so that we get hesitation and delay in the utterance of right words, or, what is worse, the substitution occasionally of entirely wrong words or even of a meaningless set of sounds. These amnesic or inco-ordinate defects were not at first recognised as being distinct in nature from those of an aphasic type, in which there is rather a loss than a misdirection of power in some of the higher centres, whence the incitation to the motor acts of speech proceed. The two kinds of defects, indeed, not unfrequently coexist to some extent in the same individual.

When occurring in association with hemiplegia, aphasia varies much in intensity according to the degree of general mental impairment with which it may be combined. During the first week or ten days after the onset of such an attack the special defect may be scarcely recognisable, owing to the masking influence of the general mental impairment. The patient lies, perhaps, in a restless but otherwise lethargic state, taking no notice of what is occurring around him, and not allowing his attention to be fixed even for a moment; so that there is at such a time no positive ground for concluding that he or she will subsequently manifest aphasic symptoms. But where recovery of general mental power begins to show itself, and the patient taking notice of what is passing around him, also attempts to reply to simple questions, the first signs of an aphasic condition may reveal themselves. He perhaps says 'yes' or 'no' to all questions indifferently; or if both words are used, it is inappropriately. Even in this stage, however, there may be defective power in the initiation rather than in the execution of many much simpler acts than those of speech. Attention to the nature of this defective power clearly shows that it is not occasioned by paralysis in the ordinary sense of the term. Thus a patient in this condition may not be able to protrude his tongue when simply told to do so, though it may come out with much readiness when a sweetmeat is applied to the lips, or even when he is shown rather than told what we want him to do.

After a time, however, such a patient may regain a considerable amount of general mental power, though he may be left more or less hemiplegic, and may also present the aphasic defect to a marked degree. He readily comprehends everything that is said to him, and can often understand what he reads. But at other times, as was the case with one of Trousseau's patients, though able fully to understand when read to, he does not seem to understand when he himself attempts to read. He can, perhaps, play draughts or chess well, and by means of gestures and pantomime can make his wants and most of his wishes fairly well understood by those accustomed to interpret them. Yet he may only be able to articulate some one or two words, or else combinations of mere unmeaning sounds, such as 'poi, boi, bah,' 'sapon, sapon,' or some other sounds which, doing duty on all occasions, constitute his only form of speech. On rare occasions, under the influence of strong emotion, the patient may blurt out some simple expletive or short phrase, such as 'oh dear!' Sometimes he can repeat a word which he has just heard uttered, though at other times he has no such power, and may even be unable to repeat, when told to do so, one of the stock words or sounds to which he is accustomed to give utterance. In a few cases the patient has seemed unable to understand what is said, as though from some difficulty in realising the meaning of words. Words may have to be uttered very slowly and repeated several times to such a patient, and even then they may fail to convey their meaning. Yet the language of gesture, appealing as it does to the sense of sight, may be at once understood.

The patient's power of writing is necessarily interfered with when aphasia, as is so often the case, co-exists with right hemiplegia. Many such patients, however, learn to write with the left hand to a variable extent, though others continue powerless in this respect. The variations as regards the power of writing are, in fact, almost as marked as the variations in power of speaking, though these two classes of defects by no means run parallel with one another in the same individual. The writer has known a man who was quite unable to express himself in spoken words, write a fairly good letter with very few mistakes; on the other hand, the performance of such a patient, without a copy before him, may be limited to writing his own name. At other times the patient is able to write only mere senseless combinations of letters; or writing some words correctly, he makes mistakes and substitutions with others—in fact, shows an amnesic defect in writing, and writes much as an amnesic patient speaks. Still more rarely it is found that an aphasic patient is, though not from want of manual power, unable to write even a single letter—in attempting to do so he makes mere unmeaning strokes.

Looking to the mode in which these symptoms most frequently group themselves, we find in one set of cases defects of an aphasic type only, as follows:—1. Loss of power, both of speaking and of writing (*Typical Aphasia*). 2. Loss of power of speaking, but power of writing preserved (*Aphemia*). 3. Loss of power of writing, but power of speaking preserved (*Agraphia*). At other times aphasic and amnesic defects are combined in the same individual, and then we may have—4. Loss of power of speaking, with an amnesic defect in writing. 5. Loss of power of writing, with an amnesic defect in speaking. Or, lastly, mere amnesic defects alone may exist in speech, in writing, or in both modes of expression.

PATHOLOGY.—The recent concentration of attention upon these defects of speech was started by the enunciation of Broca's views as to the dependence of the aphasic defects upon lesions in or about the third left frontal convolution. Subsequent investigations have in the main tended to confirm Broca's view as to the effects of injury to this convolution, though Meynert and others think that a lesion of the convolutions of the island of Reil on the same side is more frequently productive of aphasic symptoms. But all pathologists are now agreed as to the fact that lesions in or about the third left frontal convolution are much more prone to give rise to aphasic symptoms than are corresponding lesions on the right side of the brain. It is commonly believed, however, that amnesia may be induced by superficial lesions on either side of the brain, and by lesions also which vary much in their topographical distribution.

Aphasia occasionally supervenes, independently of paralysis or convulsions, in individuals who have been subjected to great excitement or prolonged overwork, when it may be due, perhaps, to mere functional derangements. In other cases it presents itself as a temporary condition, lasting only for a few hours or a few days, in a patient who has just had an attack of right-sided unilateral convulsions; or, lastly, as has already been indicated, it occurs in conjunction with a right-sided hemiplegia produced either by brain-softening or by cerebral hæmorrhage. Cases belonging to the latter category vary very much amongst themselves as regards the degree of co-existing hemiplegia. If the third left convolution alone is damaged by softening, the hemiplegic condition may be transient and incomplete—never, perhaps, affecting the leg appreciably. This condition is often induced by a small hæmorrhage, or by a patch of softening produced by an embolism of that branch of the middle cerebral artery which supplies the third frontal convolution; but where the hæmorrhage is larger, or where the main trunk of the middle cerebral artery is obliterated, either by an embolon or a thrombus, the aphasia is combined with much graver and more persistent paralytic symptoms.

In some cases in which typical aphasia is met with, no actual lesion of the third frontal convolution is discovered after death. This is due to the fact that these symptoms may be occasioned by a lesion which, whilst not implicating the third frontal convolution itself, severs or interferes with the efferent fibres proceeding from this convolution to the corpus striatum, the next lowest nerve-centre; so that a lesion either of the part of the corpus striatum in relation with the third frontal convolution, or of the white matter intervening between the two, should be, and is found to be, as capable of producing aphasia as a lesion of the convolution itself.

The third left frontal convolution is not now supposed, as Broca put it, to be the seat of any 'faculty of language,' though the anatomical investigations of Meynert and of Broadbent have shown that its relations with other convolutions are exceptionally complex. Whether or not certain assumed higher centres for speech are situated in this part of the brain, it must at least be conceded that this convolution is intimately concerned with the physical expression given to thought in articulate speech and in written language; it contains, in fact, the sites (or nerve-centres) from which the volitional incitations to these muscular acts usually pass downwards to lower centres.

We know that the left hemisphere is the one from which the volitional incitations proceed in the case of written language, and it is presumed that the same half of the brain also takes the lead in the production of articulate speech. It is, therefore, a point of much interest when we find that, in some of the exceptional cases in which aphasia has occurred in association with lesions on the right side of the brain and left hemiplegia, the individuals had been left-handed during life. Some of the other exceptional cases, however, have not admitted of this interpretation, so that further observations are required.

Treatment.—Where aphasia occurs after excitement or overwork, without paralysis, it is a warning of much importance, since it may be the precursor of much graver symptoms. Under such circumstances the patient requires an absolute cessation from work for a time, and most careful watching. Stimulants may need to be diminished, and bromide of potassium, with sumbul and other sedative remedies, should be administered. Where aphasia is a temporary condition in association with right-sided convulsions, or where it is lasting and co-exists with right-sided paralysis, the treatment of the aphasic condition becomes merged in that of the associated convulsive tendency or paralytic condition, since, as a rule, an amelioration takes place in the patient's power of speaking coincidently with his improvement in other respects. This, however, is not always the case where aphasia has co-existed with a partial hemiplegic condition; the paralysis may be recovered from, whilst the aphasic defect remains more or less as it was. Where this is the case, an attempt should be made to teach the patient to speak again. Such efforts have occasionally been crowned with success (see *Trans. of Clin. Soc.*, vol. iii. p. 92), but much judgment and untiring patience have to be called into play in order to obtain satisfactory results.

H. Charlton Bastian.

APHEMIA (ἀ, priv., and φημί, I speak). *See* Aphasia.

APHONIA (ἀ, priv., and φωνή, the voice).—Absence of voice, that is, of intonated utterance. *See* Voice, Disorders of.

APHRODISIACS (Ἀφροδίτη, Venus).—Definition.—Medicines which increase the sexual appetite and power.

Enumeration.—The direct aphrodisiacs include—Nux Vomica and Strychnia, Phosphorus, Cantharides; Urtication and Flagellation; Cannabis Indica, Opium, and Alcohol in small doses. Iron and bitter tonics; meat diet; warm clothing, especially around the hips and loins; and abstinence from severe mental and bodily work act as indirect aphrodisiacs.

Action.—Aphrodisiacs may act by increasing the excitability of the nerves passing to or from the genital organs, or of the genital centre in the spinal cord (*see* Anaphrodisiacs), as, for example, strychnia, nux vomica, and probably phosphorus; by causing irritation of the nerves of the genital or urinary organs or of adjoining parts, as cantharides and urtication; or by stimulating the brain, as Indian hemp or small doses of opium. Alcohol in large doses has a double action, increasing the sexual desire by stimulating the brain, while lessening the power of erection, probably by weakening the nerves through which the spinal centre acts on the genital organs, or depressing this centre itself. As the sexual passion becomes diminished when the nervous system is weakened with the rest of the body, and increases with returning strength, iron with bitter tonics, and generous diet act indirectly as aphrodisiacs.

Uses.—When the sexual functions are abnormally depressed, strychnia and phosphorus are the most generally useful of the direct aphrodisiacs. Cantharides, although sometimes valuable, must be employed with caution.

T. Lauder Brunton.

APHTHÆ—APHTHOUS ULCERS (ἅπτω, to inflame).—Synon.: Fr. *Muguet*; Ger. *Fasch*.

Description.—In some states of debility and deranged digestion the tongue, together with the other parts of the mouth, becomes studded with small flakes, like morsels of curd, which are known as *aphthæ*. Sometimes these flakes extend and coalesce, so as to form large patches of thick, soft fur. This condition is particularly apt to manifest itself at the extremes of life—in infancy and old age—but it also occurs in the later stages of wasting or debilitating complaints. The white flakes can easily be detached, but, if this is done, they are soon reproduced. It is better, therefore, not to detach them, but to aim at removing the conditions which are essential to their existence. If they are forcibly detached, they are apt to carry the epithelium along with them, and to leave the papillæ raw; and these raw spots are prone to ulcerate. *Aphthous ulcers* have a very characteristic appearance. They are small, flat, and circular or oval; generally occurring in clusters, and, as it were, in successive crops. Their bases are soft and smooth, with a thin yellowish or greyish slough; their margins are well-defined and surrounded by a bright red areola, without thickening or elevation. They are commonly situated on the fore part of the tongue and the lips, where they are always accompanied by increased heat, and vivid congestion of the mucous membrane. At the same time there is generally active gastric or intestinal irritation, as well as fever of an atonic kind.

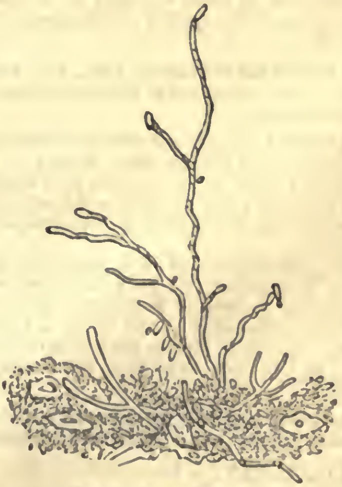

Fig. 1.—Oidium albicans.

It was not till 1842 that the precise nature of these white patches was ascertained. In that year it was shown by Gruby that they depend upon the presence of a microscopic fungus, to which he gave the name of *aphthaphyte*, or *cryptogame du muguet*. Subsequently this fungus was referred by Robin to the genus *oidium*, and by him called *oidium albicans*. It is found growing upon the tongue in close association with the epithelium. It forms delicate, horizontal filaments, which are apparently homogeneous in structure, and from which short articulated pedicels take their rise. The uppermost cells of these pedicels become expanded into oval bodies which fall off, germinate, and become new filaments. It is generally found growing in tangled masses, like minute bunches of mistletoe, mixed with the *débris* of scattered spores, cells of the *leptothrix*, and epithelial scales; but if separate filaments are followed out we may obtain such forms as those represented in Fig. 1.

Many ulcers are called aphthous which are really dyspeptic, and which owe their origin to stomatitis and irritation of the intestinal canal. The true aphthous ulcer, however, is always accompanied by the growth of the parasitic fungus that has been described above, and to such ulcers the term ought to be confined.

The *treatment* of this affection will be found described under THRUSH, a popular term which includes both aphthæ and the dyspeptic ulcers resembling them.

Some writers speak of *aphthous ulceration of the vagina*, by which is meant a severe form of vaginitis attended by the formation of small ulcers resembling the aphthous ulcers. The *oidium albicans* is frequently met with in the vaginal secretion. W. FAIRLIE CLARKE.

APHTHOUS.—A term applied to diseases in which aphthæ are present.

APLASTIC (ἀ, priv., and *πλάσσω*, I mould).—Incapable of being organized or of forming tissues; generally applied to inflammatory exudation.

APNEUMATOSIS (ἀ, priv., and *πνεῦμα*, respiration).—A synonym for Atelectasis. *See* ATELECTASIS.

APNŒA (ἀ, priv. and *πνέω*, I breathe), literally signifying breathlessness, is used by some medical writers as synonymous with asphyxia (*see* ASPHYXIA), the condition which supervenes on suspension or obstruction of the respiratory function.

By physiologists, and with more justice, the term is employed to signify the cessation of respiratory movements which is brought about by hyperoxygenation of the blood, as when an animal is made to breathe oxygen, or to breathe more rapidly than the needs of the economy require.

APOLLINARIS, Waters of.—Acidulous alkaline table-waters. *See* MINERAL WATERS.

APOPLEXY. — DEFINITION. — The word *apoplexy* means, by its etymology, a *striking from* (ἀπό, from, and πλῆξις, a striking), and was at first and is still chiefly used to signify sudden abolition of consciousness and power of motion, which, in common English, is also called *a stroke*. Cerebral hæmorrhage being the most frequent cause of this condition, 'hæmorrhage into the brain' and 'apoplexy' came to be used as synonymous expressions. Subsequently the effusion of blood itself was spoken of as *the apoplexy*, the word being used to designate the pathological condition causing the symptoms which it at first epitomised. Ultimately it was applied to a similar pathological state elsewhere, and thus hæmorrhages into the substance of the lung, the spleen, or the retina were, and still are termed respectively pulmonary, splenic, or retinal 'apoplexies.'

The term *cerebral apoplexy* is sometimes used to particularise hæmorrhage into the brain, but it is more commonly employed to denote an apoplectic condition depending on any cerebral lesion, and in that sense it will be here employed. W. R. GOWERS.

APOPLEXY, CEREBRAL. — SYNON.: A Stroke; Fr. *Apoplexie*; Ger. *Schlag*.

DEFINITION.—Loss of consciousness, of sensation, and of voluntary motion, coming on more or less suddenly, and due to a morbid state of the brain.

This condition of *coma* is termed 'apoplectic' when of sudden or rapid onset. Loss of consciousness may be due to other causes acting directly on the brain, such as defective or excessive supply or altered condition of blood; but it is customary to include among the forms of *apoplexy* only that sudden loss of consciousness which is due to cerebral congestion, and to consider as *apoplectic states* only those which result from distinct toxæmia.

ÆTIOLOGY.—The apoplectic condition may be due (1) to the influence upon the brain of a poison circulating in the blood; (2) to a sudden cerebral lesion, such as hæmorrhage or vascular obstruction; or (3) to a sudden shock or other impression arresting the cerebral functions, but causing no visible alteration in the brain.

1. The toxæmic states in which apoplectic symptoms occur are those of uræmia, drunkenness, and poisoning by narcotics, as opium, &c. These are described elsewhere, and need be referred to in this article only in respect to the diagnosis.

2. The great cause of apoplexy is a sudden cerebral lesion, which may be traumatic or may occur without external injury. Injury may lead to apoplexy by simple concussion, by laceration of brain, or by rupture of vessels and hæmorrhage. Apoplexy, not due to injury, may be caused by congestion; by thrombosis or embolism; but especially by hæmorrhage. The latter is its most common and most efficient cause. Profound coma is rarely due to any other spontaneous cerebral lesion. A very small hæmorrhage may cause apoplexy.

3. Lastly, apoplectic symptoms may occur without obvious lesion of the brain. The coma which results from concussion, that which succeeds an epileptic fit, and that which, in the absence of any recognisable cause, has been called 'simple apoplexy,' furnish examples.

PATHOLOGY.—In all these cases the apoplexy is in relation chiefly to the extent and suddenness of the lesion. Roughly speaking, its occurrence may be said to depend on the suddenness, its degree on the extent of the cerebral mischief. But the occurrence of apoplexy depends sometimes on the size of the lesion, and the degree varies not only directly with the extent of the mischief, but with the extent of brain-tissue which is exposed indirectly to the irritative influence of the primary lesion. Hence position of lesion has an important influence in determining the apoplectic symptoms. For these several reasons apoplexy is especially profound when the hæmorrhage affects both hemispheres, either by simultaneous extravasation on each side, or as the result of hæmorrhage into the lateral ventricles.

The precise condition on which the apoplexy is immediately dependent has been a matter of dispute. It was formerly ascribed to the pressure exerted by the clot on the rest of the brain, either influencing directly the cerebral tissue, or pressing on and emptying its capillaries (Niemeyer). That such pressure is exerted by a large hæmorrhage is unquestionable. The convolutions on the side of the extravasation are flattened, and the falx is bulged to the opposite side (Hutchinson, Jackson). It cannot be doubted that the intensity of the apoplexy in these cases is due in part to this cause. But this will not explain the occurrence of the symptom in small hæmorrhages, by which no general pressure is exerted, or not more than is at once relieved by the displacement of the mobile fluid which surrounds the vessels. It will not explain its occurrence in laceration of the brain, or the early loss of consciousness in severe hæmorrhage, in which, as Jaccoud insists, it should, if merely due to pressure, be a late rather than an early symptom. There can be little doubt from these considerations, and from the cases in which there is no recognisable brain-lesion, that shock is an important element in the causation of apoplexy. Thus in cerebral hæmorrhage the apoplectic symptoms are due in part to the influence on the rest of the brain of the irritation of the nerve-elements by laceration. We can thus understand why vascular occlusion causes a slighter degree of apoplexy, since the immediate irritation of the local anæmia is less than that of laceration; and also why lesions of the pons produce as they do such deep and long-continued coma, since the irritated fibres are connected with, and thus influence indirectly a large part of the cerebrum.

Simple Apoplexy was a term given by Abercrombie to the cases, once thought to be frequent, in which apoplexy occurs without recognisable brain-mischief or blood-poisoning. Some of these cases were probably instances of uræmic poisoning, and others may have been due, as Dr. Bastian suggests, to capillary embolism. But cases are not infrequent to which neither of these explanations applies, in which death occurs in an apoplectiform attack, all organs being found healthy, and the brain only exhibiting, in common with the other organs, that passive congestion which results from an asphyxial mode of death. The nature of these cases is still mysterious, but they may be grouped with those in which fatal coma follows an epileptic attack, and is apparently due to the brain-shock produced.

Serous Apoplexy is a term applied sometimes to cases of fatal apoplexy in which no lesion is discoverable except excess of serum on the surface of the brain. It is now understood that such serous effusion is met with constantly in atrophy of the convolutions, rarely in Bright's disease, and under no other circumstances. There is no reason for associating its presence with the apoplectic symptoms. The cases described under this term were probably instances of uræmia, or of 'simple apoplexy' in old persons with atrophied brains.

SYMPTOMS. – The prominent feature of apoplexy is loss of consciousness without obvious failure of the heart's action. The onset is often instantaneous, so that the sufferer falls to the ground. The face may be flushed or pale—it is rarely very pale. The heart and arteries beat, often with undue force and lessened frequency. Respiration continues, but is laboured and stertorous, with flapping cheeks. The limbs are motionless. In severe cases no reflex action can at first be excited. The pupils may be dilated, contracted, or unchanged; in profound coma they are usually dilated; and they often vary in size spontaneously, being sluggish in their action to light. The patient can usually swallow, although often with difficulty. The sphincters permit the escape of urine and fæces, or the urine may be retained. In a case of moderate severity the reflex action soon returns, the conjunctivæ become sensitive, and the patient can be roused to exhibit some sign of consciousness, shows returning power of voluntary motion, opens his eyes when spoken to, and tries, when told to do so, to protrude his tongue. On the other hand, the apoplexy may continue or may deepen in intensity, the patient dying at the end of a few hours or a few days. Death rarely occurs in a shorter time than two or three hours. In very rare instances an extensive hæmorrhage into the pons or medulla may stop the respiration and kill the patient in a few minutes.

It is not often, however, that there is this simple loss of cerebral function, uniformly distributed, and gradually deepening or passing away. Much more commonly the symptoms of a local cerebral lesion are added to those of apoplexy. Frequently such symptoms precede the loss of consciousness—unilateral weakness, deviation of the mouth, convulsion. They may be recognised during the attack: the limbs on one side exhibit more complete muscular relaxation than those on the other; they fall more helplessly when raised; or there is unilateral rigidity or clonic spasm, unvaried in its seat; or inequality of pupils is observed, or rotation of the head and conjugate deviation of the eyes. As the patient recovers, these local symptoms become more and more distinct, the tongue deviates on protrusion, speech and swallowing are difficult, or the patient may have lost the use of language.

In *ingravescent* apoplexy the commencement of the cerebral mischief is marked by symptoms of general shock, without any, or with merely transient, loss of consciousness. There is commonly pain in the head, and there may be other localising symptoms. After some hours, during which the patient may continue his occupation, coma gradually comes on and deepens into death. This form of apoplexy, first described by Abercrombie, is usually due to a slowly increasing cerebral hæmorrhage.

The temperature in cerebral apoplexy is at first always lowered, but usually the fall is small, and is succeeded, after twelve to twenty-four hours, by a rise.

DIAGNOSIS.—From the unconsciousness due to cardiac *syncope*, apoplexy is easily distinguished. In the former the heart's action fails, the pulse is weak and imperceptible, the face is very pale, the respiration is sighing and irregular, reflex action is rarely abolished, and the sphincters are seldom relaxed.

From the several forms of *toxæmia* the diagnosis is often easy, sometimes extremely difficult. It is easy when, on the one hand, the symptoms of apoplexy are preceded or accompanied by those of a local cerebral lesion; or when, on the other hand, the direct or circumstantial evidence of poisoning is clear, or the symptoms of toxæmia unmistakable. Where there are no local symptoms, and where no guiding history is to be obtained, the diagnosis is difficult, but a correct opinion may commonly be formed by an attentive comparison of the symptoms present.

There may be, as just observed, indirect evidence of toxæmia: the breath may smell of opium or alcohol; the urine may contain albumin. But albuminuria or a smell of spirits may mislead. Cerebral hæmorrhage often occurs after drinking; spirit is constantly given to a person in a fit. A smell of spirit must therefore only be allowed weight in the absence of any evidence of cerebral mischief. So, too, albumin is always present in the urine in uræmia, but it is also very frequently present in cases of cerebral hæmorrhage. Alone, this evidence of Bright's disease is of little value, except there be general œdema and the patient be young; then uræmia is more probable than vascular degeneration and cerebral hæmorrhage. But with other symptoms which indicate uræmic poisoning, albuminuria is conclusive.

The age of the patient should be considered. Late life is in favour of brain-disease. The history of a fall or blow on the head adds weight to other symptoms of cerebral mischief.

The character of the coma will sometimes guide. In uræmia, and commonly in alcoholism, it is less profound than in cerebral mischief. The patient can readily be roused. In apoplexy, in opium-poisoning, and in the most intense alcoholic poisoning, the coma may be profound. On the other hand, in cerebral hæmorrhage the patient, as Dr. Hughlings Jackson remarks, may sometimes be roused to answer questions. Violent struggling is strongly in favour of drink.

The mode of onset of the coma is important. In apoplexy it is sudden; in uræmia slow. The uræmic patient becomes first drowsy, then comatose. But with convulsions uræmic coma may come on suddenly. The onset of the coma of opium- and alcohol-poisoning is also slow. Ingravescent apoplexy is of deliberate onset, but a profound degree of coma is quickly reached.

General convulsions at the onset exclude drunkenness, and usually opium-poisoning, while they favour uræmia. Cerebral mischief sometimes commences with a convulsion, but the convulsion is then commonly unilateral, and one-sided symptoms are almost always afterwards to be recognised. Rigidity of limbs or local muscular twitching during the coma is, if constant in seat, in favour of cerebral mischief; if variable in position, it is in favour of uræmia (Reynolds). Post-epileptic coma is of course preceded by a convulsion, and should be borne in mind.

The state of the pupils is alone of little importance. Great contraction occurs in and suggests opium-poisoning, but it is present in hæmorrhage into the pons Varolii. The pupile may be normal or dilated in uræmia, in alcoholic or opium-poisoning, and in apoplexy. Inequality of pupils, an unilateral symptom, points to brain-mischief. The retina should be examined, since the presence of albuminuric retinitis points, in the absence of the signs of a localised cerebral lesion, strongly to uræmia.

Lastly, the temperature should be noted. In uræmia there is persistent uniform depression; in cerebral lesions the initial depression is succeeded by a rise to a point above the normal.

The diagnosis of the *cause* of cerebral apoplexy will be described more fully under the heads of cerebral congestion, hæmorrhage, and softening. It may be here pointed out that slight and transient apoplexy, without local symptoms, with flushed face, and coming on during effort, points to cerebral congestion; slight and transient apoplexy with marked local symptoms points to softening; early and profound loss of consciousness to cerebral hæmorrhage. Post-epileptic coma may be distinguished by the history of epileptic attacks; or, if this be not forthcoming, it may be suspected if symptoms of local cerebral lesion or indications of toxæmia are absent, if the patient be under 40, and exhibits indications of speedy recovery. 'Simple apoplexy' cannot be diagnosed during life, since freedom from the symptoms of a local lesion does not afford ground for inferring that there is no such lesion.

PROGNOSIS.—The prognosis in cerebral apoplexy depends in part upon the intensity of the attack. As long as unconsciousness is complete, and reflex action abolished, the patient is in danger of speedy death. The longer the apoplectic condition lasts without improvement, the less prospect is there of recovery. Persistent depression of temperature, or a rise of several degrees above the normal after an initial fall, are both of grave significance: such cases rarely recover (Charcot, Bourneville).

The nature, extent, and position of the cerebral lesion, when they can be inferred, furnish other prognostic indications. In hæmorrhage the prognosis is more serious than in softening. A sudden occurrence or increase of apoplectic symptoms, a few hours or days after a slighter attack, is always grave, indicating a fresh extravasation. If such apoplectic symptoms become profound and uniform, the prognosis is fatal, rupture into the ventricles or on the surface of the brain having probably occurred. If the localising symptoms point to a lesion of the medulla or pons, the prognosis is almost as unfavourable. Early return of consciousness and slight alteration in temperature are favourable signs. Previous cerebral disease renders the prognosis worse. Lastly, the prognosis must be influenced unfavourably by any impairment of the organic functions of circulation and respiration, whether independent of or due to the cerebral lesion.

Treatment.—The treatment of cerebral apoplexy must be guided by the indications of its cause. Where none can be obtained, it should be treated as cerebral hæmorrhage. Stillness is the most important condition. The patient should be moved as little as possible, but placed in the recumbent posture with the head slightly raised. The neck should be freed from constriction. If the extremities are cold, warmth may be applied to them; and cold to the head if there is local heat or flushing. Sinapisms to the neck and extremities sometimes seem to hasten the return of consciousness. The administration of stimulants should be regulated by the state of the heart. In thrombosis or embolism the heart should be kept up to the normal by very careful administration of alcohol, ether, or ammonia. In hæmorrhage it may be allowed to fall a little below the normal, but indications of failing power should be watched for and counteracted. Where no causal indication exists, the latter is the wiser plan. Venesection and purgation are remedies of similar effect, but different in degree, and are indicated by high arterial tension and cephalic congestion, shown by incompressibility of the pulse and flushing of the face. Venesection is useful where the heart acts strongly, and the pulse is full as well as incompressible. Its effect is proportioned to the rapidity with which the blood is taken, rather than to the quantity removed. Purgatives remove serum from the blood, and lessen the amount of blood within the skull by causing an afflux to the capacious intestinal vessels. The best purgative is croton oil. With a failing heart and pale surface they should be avoided. Diuretics may then be used to relieve the vascular tension. As the apoplexy clears, the nature of the case becomes evident, and the treatment of the several conditions is described elsewhere. (*See* Brain, Hæmorrhage and Softening of.) For treatment of the other causes of the apoplectic state, *see* Alcoholism, Poisons, and Uræmia. W. R. Gowers.

APPENDIX VERMIFORMIS, Inflammation, Ulceration, and Perforation of.

Definition.—Inflammation of the appendix vermiformis from lodgment of hardened fæces or a foreign body, leading to ulceration, frequently ending in perforation of the coats; to inflammation and suppuration of adjacent tissues (perityphlitis); and to peritonitis, local or general.

Ætiology.—The usual cause of this affection is a foreign body (*e.g.*, fruit-pips or -stones, a small bone, shot, pins, &c.); or a fæcal concretion imprisoned within the cavity of the vermiform appendix. Perforation has been recorded in typhoid fever and tuberculous disease.

Anatomical Characters.—Before perforation takes place the appendix may be found distended with pus; a foreign body or concretion lodged within it; and the mucous membrane ulcerated. The concretion or concretions vary in size from a small pea to a bean; are usually brown and hard; and consist of layers of condensed fæces, secretions, and phosphates, deposited around a small nucleus, which may prove to be a seed or other foreign body, or a piece of unusually inspissated fæces. These concretions greatly resemble, and are often mistaken for, fruit-stones. Ulceration and perforation may occur at any part of the appendix, usually, however, at the extremity or the lower third. There may be a circumscribed peritoneal abscess; or the perforated part of the appendix may be found adherent to the surrounding parts, for example the cæcum or the abdominal wall.

Symptoms.—Pain, generally ill-defined, in the right iliac region, may be the only symptom to attract attention, and, as a rule, it is not until local peritonitis or perityphlitis is set up that we may suspect the nature of the disorder; the absence of premonitory symptoms, of the characteristic tumour of typhlitis, and of intestinal obstruction, excluding inflammation of the cæcum. Often, however, the course from the first is latent, and the mischief is suddenly revealed by perforation into the peritoneum, followed by general and rapidly fatal peritonitis. Adhesions formed in front of the slowly advancing ulceration may localise the consecutive inflammation.

The substance imprisoned within the appendix may be dislodged by (*a*) inflammation and suppuration of the tissues around the cæcum (perityphlitis, pericæcal abscess); or (*b*) the appendix, at the point of perforation, having become adherent to the cæcum, a communication is established with this part.

Diagnosis.—Inflammatory affections of the cæcum and of the appendix can rarely be clearly distinguished from each other. Inflammation of the appendix is apt to persist, continuing to be acute and severe; while cæcitis may be subdued by free relief of the bowels. Cæcitis with ulceration is apt to follow intestinal inertia; while the alarmingly acute and rapidly fatal symptoms of inflammation with ulceration and perforation of the appendix often arise during perfect health. Inflammation of the cellular tissue surrounding the cæcum (perityphlitis) is more commonly the result of ulcerative inflammation of the cæcum than of the appendix. The complete investment of the appendix by peritoneum contributes to perforation and fatal general peritonitis.

Prognosis.—General peritonitis from sudden perforation into the cavity of the peritoneum is the great danger, recovery from which is extremely rare. Inasmuch as this may occur at any time during the course of ulcerative inflammation of the appendix, a guarded opinion should always be given when there is suspicion of the existence of this affection. Continued uneasiness in the right iliac region without indications of fæcal accumulation, or of inflammation in or around the cæcum, should not be regarded lightly. Though this serious accident is less apt to occur after the formation of adhesions around the advancing ulceration, we must not forget that well-marked local inflammation of the peritoneum, or of the cellular tissue around the cæcum, does not always prevent it, inasmuch as the adhesion which may thus form may not be sufficiently strong to withstand the pressure of pus in the appendix.

Treatment.—The patient must be kept at rest in bed, hot poultices applied, and an unirritating fluid diet allowed. Opiates, for the purpose of relieving pain and subduing the peristaltic contraction of the intestines, should be freely and continuously administered; and if irritability of the stomach exist, they should be introduced by enema or by subcutaneous injection. Peritonitis or other complications must be treated as they arise. George Oliver.

APPETITE.—In disease the desire for food may be either *lessened* or *increased*; or the appetite may be *perverted*, and a longing for various substances unfitted for or incapable of digestion may be displayed.

Loss of appetite — *Anorexia* accompanies almost all forms of acute or chronic gastritis; and as these affections constantly coexist with other diseases, great variety as regards the desire for food is manifested in various complaints. In acute gastritis there is often not merely a loss of desire for, but a positive aversion to food, and the patient resolutely resists any attempt at obliging him to take either solid or liquid nourishment. In the more chronic forms of gastritis the distaste for food may be only slight; in some cases the appetite is increased, but is quickly satisfied as soon as a small quantity of food is taken. In chronic ulcer of the stomach the appetite, as a rule, remains good, and the patient is only prevented from indulging it by the fear of the pain that will result from his so doing. Whenever the secreting structure of the organ is extensively diseased the appetite fails. Thus, in atrophy of the stomach the desire for food generally lessens along with the diminishing strength of the invalid. In cancer of the stomach there is always an extensive destruction of the glandular structure, and loss of the appetite is a constant and prominent symptom. It must be remembered that a loss of appetite may be more apparent than real. The physician is constantly consulted on account of this symptom, when a little inquiry will show that the patient is really digesting as much as his system requires, but that by a habit of eating without allowing a proper interval between his meals, or by indulging in food of too nutritious a nature, or in an undue amount of alcoholic stimulants, the sensation of hunger is prevented.

Increase of appetite—Bulimia usually occurs where there is a necessity for an increased supply of food. Thus it is common after all febrile diseases, where the stomach has been long inactive. Again, in diabetes, where a large portion of the food is passed off in the form of sugar instead of being converted into the material required to keep up the nutrition of the body, there is an unusually large appetite. A craving sensation is a common symptom in chronic catarrhal gastritis. It probably arises from the irritation set up by the mucus and fermenting substances long retained in the stomach, and is temporarily relieved by eating. The best treatment for such cases is to give alkalis about half an hour before the craving usually occurs, at the same time that the affection of the mucous membrane is combated by appropriate diet and remedies. In some persons the sensation of extreme hunger appears to arise from an irritable condition of the stomach, by which the food is passed into the duodenum before digestion is completed. The sensation is mostly complained of at night, and the writer has found it a good plan to let the patient have some beef-tea or meat lozenges, for example, either just before retiring to rest or during the night. In children a craving for food is a frequent symptom, and arises either from the irritation of worms, or from chronic catarrh of the mucous membrane of the small intestines.

Perversion of appetite—Pica is most common in pregnant or hysterical females. Curious articles, such as chalk, cinders, and slate-pencil, are sometimes swallowed. In the insane and in idiots articles of an indigestible nature are not unfrequently introduced into the stomach, such as string, paper, cocoa-nut fibre, &c.

It is a matter of great importance that all persons, but especially dyspeptics, should accustom themselves to control their appetite. Whenever a larger amount of food is taken than the stomach is capable of digesting, the residue is apt to ferment and thereby to produce gastric catarrh. This is more especially the case where the digestive powers have been enfeebled by previous attacks of gastric inflammation.

S. Fenwick.

APYRETICS. *See* Antipyretics.

APYREXIA (ἀ, priv., and πυρέσσω, I am feverish).—This word literally means absence of fever: it is also used to denote the interval between paroxysms of intermittent fever.

ARACHNITIS. — Inflammation of the arachnoid membrane. *See* Meningitis.

ARCACHON, West coast of France.—Summer and autumn resort. Sheltered by pine woods. Calm in winter. *See* Climate, Treatment of Disease by.

ARCUS SENILIS is a crescentic opacity of the cornea, within its margin, often seen in old people. The arcus is usually first observed in the upper part, and soon afterwards a smaller opaque crescent, opposite to this, appears below. In the course of years the two crescentic marks become slightly wider and more opaque, their points having at the same time extended much more considerably in proportion, so that an *annulus* or ring is formed. It probably is always widest and most opaque above, and wider and more opaque below than at the sides. An arcus is grey when it first appears, but it may attain at last to an ivory whiteness. It is especially noteworthy that arcus, besides being regular in shape, of an evenly-graduated degree of opacity, and well-defined at its inner margin, is never continuous with the opaque sclerotic external to it, but is always separated from this membrane by an extremely narrow line of demarcation of unaffected corneal tissue, which as it is normally almost transparent here at its margin, is the more conspicuous by force of contrast with the new opacity. At the same time it must be observed that the well-defined opacity is most opaque in the centre or slightly external to the centre of its width, at any part; so that, although it is everywhere well-defined, it is shaded off somewhat abruptly towards its outer circumference, and more gradually at its inner margin. The arcus is much more prone to increase in opacity than in width. It rarely attains a width, even at the upper part of the cornea, of more than $\frac{1}{8}$ in. It is very conspicuous when backed by a dark iris. The cornea within the regular boundaries of the arcus senilis remains perfectly transparent, and vision is in no degree impaired by it. Wounds in the part of the cornea thus affected heal well, and no surgeon is led by it to operate in any other part of the cornea, rather than divide the arcus itself in the part in which the corneal opening is made in almost all operations on the eye.

PATHOLOGY AND ÆTIOLOGY.—Arcus senilis is essentially a fatty degeneration of the proper substance of the cornea. It is not fully explained why it should appear just where it does, so near to the source of nutrition of the cornea; the fatty substitute for the natural tissues seeming to occupy only the circumference, and first and chiefly under the upper and lower lid, where also the conjunctiva and sclerotic overlap the cornea more particularly—a situation in which the lids exercise a certain amount of pressure, which has been regarded by Dr. C. J. B. Williams as the immediate cause of the degeneration.

If an eye suffers from chronic deep-seated disease an arcus will develop more rapidly; as, for example, in a case of old recurrent iritis of one eye only, in which there was a well-marked arcus, while in the other there was hardly a trace of it. An anomalous case is that in which the upper and lower arcus are opposite as usual, but in an inclined meridian. Arcus senilis is as capricious in its appearance as other senile changes; it is no clear indication of the age, certainly not of the number of years of life of a patient, as it may appear even in youth, and may never appear even in extreme old age; but when it occurs before forty years of age it is taken, by some life-insurance medical officers, to be an indication of concomitant fatty disease of the heart and degeneration of the arteries. But fatty heart is often found without arcus, and arcus without fatty heart. If, together with other evidence of weakened heart-power, there be an arcus, it is probable that fatty degeneration of the heart exists.

TREATMENT.—Arcus senilis is incurable, and no one endeavours expressly to check its increase, which, no doubt, is sometimes possible, as the writer is acquainted with a case in which the successful treatment of Bright's disease has, for ten years, completely arrested its advance.

J. F. STREATFEILD.

ARDOR (*ardor*, heat).—A sensation of heat, burning, or scalding, which may be felt along the urethra during the passage of urine (*Ardor Urinæ*); or in connection with the stomach (*Ardor Ventriculi*).

ARGYRIA (ἄργυρος, silver).—The slate-coloured stain of the skin produced by the internal use of the salts of silver. *See* PIGMENTARY AFFECTIONS.

ARSENIC, Poisoning by.—Arsenic is classed as a metallic irritant poison, though its action is by no means limited to that of an irritant. It acts specifically on the gastro-intestinal mucous membrane, whatever be the channel by which the poison gains access to the system. The most usual source of acute arsenical poisoning is the administration of white arsenic or arsenious acid; but the sulphides, various arsenides, and impure commercial articles, such as dyes, wall-papers, and pigments, may be fertile sources of arsenical poisoning. Poisoning by arsenic may be either *acute* or *chronic*.

A. Acute Arsenical Poisoning.—This is the usual form of poisoning ensuing on the nefarious administration of any preparation of arsenic, but usually the oxide (*arsenious acid*) is employed.

SYMPTOMS.—The symptoms do not, as in the case of corrosive poisoning, come on immediately after the administration of the poison. There is most commonly an interval of half an hour or an hour between the swallowing of the agent and the onset of prominent symptoms. The quantity of the noxious agent, and its state as regards solubility, have also an obvious relation to the commencement of symptoms. Most commonly, after a sense of faintness and depression, intense burning pain is felt in the epigastric region, accompanied by tenderness on pressure. Nausea and vomiting quickly supervene, increased by every act of swallowing. Unlike what occurs in an ordinary bilious attack, with which arsenical poisoning may be at first confounded, the pain and sickness are not relieved by the act of vomiting. The vomited matters are extremely varied, and present no characteristic appearances. At first they usually consist of the ordinary contents of the stomach, but at a later stage are largely charged with bile which has regurgitated into the stomach in consequence of the violence of prolonged emesis; and they may be tinged with blood. Ordinarily vomiting is speedily followed by violent purging, and great straining at stool, the motions being often streaked with blood. Purging may, however, be entirely absent. Other prominent symptoms are great thirst, a feeble irregular pulse, and cold clammy skin. The patient as a rule dies within eighteen to seventy-two hours in a state of collapse; but tetanic convulsions are not uncommon, and even coma and paralysis may close the scene.

DIAGNOSIS.—From an ordinary bilious attack, induced by improper diet or by decomposing food, arsenical poisoning is diagnosed by the persistence of the symptoms after the removal of the apparent cause; and not infrequently by the symptoms remitting and again supervening on the administration of food or drink of a particular kind, or given by a particular hand. From choleraic diarrhœa it is distinguished by the *sudden* onset of symptoms, thirty to sixty minutes after food or drink has been taken; by the absence of rice-water stools, or of lividity of the skin; and by the symptoms not yielding to treatment. Moreover, in poisoning by arsenic there is usually greater tenderness over the epigastrium; the diarrhœa is less passive, and accompanied with more tenesmus than in choleraic diarrhœa; the stools are more often bloody; and nervous symptoms may be more pronounced. The diagnosis is, however, often very difficult, except when aided by a chemical analysis of the matters ejected from the stomach or of the excreta which should always be made in doubtful cases.

PROGNOSIS.—This must always be uncertain, since it is rarely possible to ascertain the quantity taken, or to ensure its entire evacuation from the stomach.

TREATMENT.—Emetics, diluents, and demulcents are the appropriate remedies. The stomach-pump may also be usefully employed. In administering emetics, tartar emetic should be avoided, as it increases the depression, and its presence complicates a chemical analysis. Moreover, tartar emetic frequently contains traces of arsenic, and, in the event of an analysis being made, an unfounded suspicion may be raised. No confidence can be placed in the so-called antidotes, *ferric hydrate* and *magnesia*, except where a solution of arsenic has been taken.

B. **Chronic Arsenical Poisoning.**—This form of poisoning is not uncommon, and is, unlike the acute form, generally accidental. The inhalation of arsenical vapours in factories, or of arsenical dust, as from green and other wall-papers, and in the process of manufacturing artificial flowers, is a common source of chronic arsenical poisoning.

Those who are chiefly exposed to this form of poisoning are persons employed in the manufacture of pigments, especially green pigments; paperhangers and decorators; artificial-flower manufacturers; milliners; persons exposed to the fumes of heated metals, particularly zinc and brass; manufacturers of dyes; and leather-dressers. In the process of depilating sheep-skins, previous to the tanning or the tawing process, a mixture of lime and orpiment (*sulphide of arsenic*) is used; and serious ulceration of the hands, scrotum, nose, and cheeks not infrequently results. Persons living in rooms the walls of which are covered with arsenical paper, especially bright-green papers containing arsenite of copper, are liable to suffer from chronic arsenical poisoning. It is uncertain whether this is entirely caused by the mechanical transfer of pigmentary dust to the air-passages, or is partly due to volatilisation of the arsenic, probably in the form of *arseniuretted hydrogen*. Many brown wall-papers also contain arsenic, and arsenious acid is sometimes added to the size; such papers have been known to produce the specific symptoms of arsenical poisoning.

That some persons can take arsenious acid internally with impunity in relatively large doses (*arsenic-eating*) is now a well-established fact.

Symptoms.—The first symptoms of chronic arsenical poisoning are usually loss of appetite, præcordial pains, irritability of the bowels, and occasionally headache. Suffusion of the eyes, a peculiar and characteristic appearance of the conjunctiva, often amounting to actual conjunctivitis, and intolerance of light are early manifested. The muscular power of the limbs is impaired pretty constantly, and actual paralysis extending upwards from the lower extremities is occasionally observed. A characteristic vesicular eruption on the skin (*eczema arsenicale*) is frequent, as well as irritation of the skin, especially over the neck, scalp, hands, and armpits. Males who handle arsenical preparations are liable to ulcerations of the scrotum and penis, obviously due to a mechanical transference of the poison to the genitals when these are touched. If the source of the disease be not removed, progressive emaciation, exfoliation of the cuticle, and nervous prostration supervene; and convulsions may precede the fatal termination. The effects of green arsenical pigments are sometimes manifested by bleeding from the nose.

Diagnosis.—When a patient suffers more or less from the symptoms above described, and is also known to be exposed to any of the sources of danger from arsenical poisoning enumerated under the ætiology, the diagnosis is not difficult.

Treatment.—The source of poisoning should invariably be removed. It is found that those who suffer from working in arsenic make no progress towards recovery until they are removed from contact with the poison. Wall-papers which contain arsenic, and are suspected to be the cause of symptoms, should be taken away. Quinine, or other tonics, iron, and attention to the digestive organs will be needed. Removal to fresh country air is often productive of marked benefit. Soothing lotions to the skin, and careful attention to eroding ulcers, especially of the cheek, may be necessary. Shampooing and warm baths form the best treatment for paralytic lesions.

Morbid Appearances.—These are the same by whatever channel the poison has gained access to the system. As a rule there is marked inflammation of the stomach and duodenum, usually of the small and large intestines also; but not uncommonly the inflammation is limited to the stomach, duodenum, and rectum, the intervening alimentary tract having escaped. If the poison has been administered in a solid form, white patches of the arsenical compound may be found imbedded in thick bloody mucus and inflammatory exudation. Portions of the white arsenic are also sometimes converted by the sulphuretted hydrogen evolved during decomposition into the yellow sulphide. Ulceration of the stomach is rare, and perforation almost unknown. An ecchymosed condition of the heart is often observed; and fatty degeneration of the liver, as in poisoning by phosphorus, has been described.

T. Stevenson.

ARTERIES, Diseases of.—It is important to keep in mind the following anatomical facts in studying the morbid processes to which arteries are subject:—In immediate contact with the blood-stream in arteries lies the *endothelium*—a layer of flattened cells; outside this is the *tunica intima*, composed of elastic tissue in longitudinal arrangement: together the endothelium and tunica intima constitute the *internal coat* of the older writers. Still more external we find the *middle coat*, made up of muscular fibre arranged transversely, in the larger arteries mixed with elastic tissue; and, most external of all, the *external coat*, consisting of longitudinally fibrillated connective tissue.

1. **Acute Arteritis**, affecting a very limited portion of a vessel, and leading to ulceration, occasionally occurs. In some cases this has arisen from the irritation caused by an embolus, which, becoming detached from a cardiac valve, has blocked a distant artery; and Dr. Moxon has specially drawn attention to its occurrence in the aorta, when the ascending portion of the vessel has been exposed to the impact of a hard, freely moving vegetation on one of the segments of the aortic valve. Dr. Moxon has also described, under the designation *inflammatory mollities*, the occurrence of softening and swelling of the arterial tunics in circumscribed spots; which become flabby and inelastic, and ultimately bulge outwards and form aneurisms. He believes that this condition depends on a peculiar general state, and is the great cause of aneurism in young, hard-

working men. Except in these circumscribed inflammatory lesions, we do not meet with any condition of the arterial tunics to which the designation acute arteritis can be applied. Such a change has, indeed, been described, and the writer has seen the lining membrane of the ascending and transverse portions of the aorta of a bright vermilion hue, strongly suggestive of acute inflammatory change; but the best observers are now agreed in believing that this appearance arises from staining by hæmatin.

2. **Chronic Arteritis** has been described as pursuing a course different from the *endarteritis deformans*, which will immediately be noticed; and as causing thickening of the coats of the vessels, narrowing of their calibre, and absence of pulsation during life. As such, chronic arteritis appears to be a disease of extreme rarity. But, on the other hand, if it be considered as the first stage of atheromatous disease, it may be said to be of frequent occurrence.

3. **Periarteritis** is the term applied by Charcot and Bouchard to the morbid change which, in their opinion, eventuates in cerebral hæmorrhage. According to these physicians, cerebral hæmorrhage is not usually due to atheromatous decay of the vessels of the brain; but, in the vast majority of cases, to the rupture of miliary aneurisms, which in their turn have been produced by a morbid process beginning in the perivascular sheath surrounding the cerebral vessels; and which, proceeding from without inwards, ultimately involves all the coats of the vessels (*see* Brain, Hæmorrhage into).

4. **Atheromatous Disease**, the *Endarteritis deformans* of Virchow, is the arterial disease which is most frequently met with, and the one whose consequences are most serious. It presents three tolerably well-defined stages. (*a*) In the *first* stage we notice, when the vessel is slit open, greyish patches, by which the lining membrane is irregularly thickened; these patches seem to lie on the surface of the membrane, but this appearance is deceptive; the endothelium lies between them and the blood-stream, and is, at least at the beginning of the morbid process, unaffected. The material of which the patches are formed is really situated between the tunica intima and tunica media; it is semi-cartilaginous in consistence, and is formed by an abnormally rapid multiplication of the deeper cells of the tunica intima,—the new growth pushing up this tunic with its super-imposed endothelium, and so causing a bulging into the interior of the vessel. The process is of the nature of an inflammatory change; that is, it consists in the proliferation of cellular elements, in consequence of some influence which has excited them to unnatural growth. (*b*) In the *second* stage the cellular elements of which the new growth is composed undergo a process of fatty degeneration; and in consequence it becomes yellowish in colour and pasty in consistence: it was the paste-like appearance of the mass in this stage which originally gained for the process the designation *Atheroma* (ἀθήρη = meal). It not unfrequently happens that the whole of the internal coat with its endothelium is involved in the softening, and gives way under the pressure of the blood, leaving an excavation, the floor of which is formed by the middle and external coats of the artery. (*c*) In other instances, however, the pasty mass, instead of being washed away, becomes the seat of calcific deposit. This is the *third* stage in the process. The appearance of a vessel in which atheromatous disease has reached this stage is very striking: plates which present to the naked eye the appearance, but do not show the minute structure of bone, are observed at intervals in the walls of the vessel, and their sharp spicula project into its interior; in the aorta it is not uncommon to find such plates an inch long and half an inch broad, and in the smaller arteries the calcific matter sometimes forms a ring round the vessel. In the latter the calcareous particles appear to be deposited in the patch while it is still firm, so that the second stage of the process is wanting.

Atheromatous disease sometimes invades both the aorta and the small vessels, but the aorta may be extensively diseased and the small arteries unaffected; or, on the other hand, the cerebral, temporal, and coronary arteries may be the seat of calcific change while the great vessels are healthy; occasionally the disease is limited to a few vessels. Next to the aorta, the cerebral, coronary, and splenic vessels, and the arteries of the lower extremities, are prone to this form of arteritis.

Effects.—The dangers to which an atheromatous state of vessels exposes the person in whom it exists are varied. The stream of blood is retarded by the projection of the new growth into the vessel, and still more by the destruction of the elasticity of its coats; and hence ensues a failure in the nutrition of the organ which depends for its supply of blood on the diseased vessel:—this is said to be a cause of cerebral softening. When the paste-like mass is washed away it sometimes happens that the blood insinuates itself between the coats of the vessel, producing a dissecting aneurism; or the portion of the vessel, which has been weakened by the removal of the internal coat, yields to the pressure of the current, and a sacculated aneurism is originated; sometimes the diseased vessel bursts. Cerebral vessels, probably on account of the thinness of their walls, are specially liable to rupture when they are the seat of atheromatous change; and occasionally a diseased coronary artery has given way, filling the pericardium with blood. Arteries have been completely occluded by the deposition of fibrin on the spiculated edges of calcareous plates: this is one of the causes of senile gangrene; and embolic plugging of distant vessels at times results from the detachment of such fibrinous clots, and the washing away of atheromatous débris. Rigidity of the larger arteries from atheromatous change is likewise one of the most frequent causes of hypertrophy of the left ventricle of the heart, on which increased work is imposed in consequence of the destruction of the elasticity of the vessels. Anasarca has not, so far as the writer is aware, been mentioned by any author among the consequences of diseased arteries; but some cases which have come under his observation have led him to the conclusion that persistent anasarca, especially of the lower extremities in elderly men, is sometimes mainly due to a diseased condition of the arterial tunics. In the cases which he has observed there was likewise present dilatation with hypertrophy and commencing fatty change of the left ventricle, itself a consequence of the arterial disease; but this seemed insufficient to account for the persistent œdema of the lower extremities.

Ætiology.—The cause of endarteritis deformans is now generally admitted to be overstrain of the vessel. It was formerly thought that syphilitic impregnation of the system was a powerful favouring condition; but this opinion rested chiefly on observations made among soldiers, who, in addition to the syphilitic taint, were subject to other influences now known to be adequate in themselves to develop the disease: and the writer has himself seen the most extensive atheromatous disease in men in whom there was no trace of the syphilitic taint. Intemperate habits and gout appear to be powerfully predisposing causes; they probably render the blood impure, and its passage through the capillary vessels being thereby retarded, the tension of the arterial system is increased. Besides violent exertion, which imposes a strain on the entire arterial tree, there are other influences which act upon certain vessels. Thus the renal arteries are kept over-full in the cirrhotic form of Bright's disease, owing to the destruction of the capillary tufts, and hence atheroma of these vessels is almost constantly present in that form of renal mischief. The writer has on two occasions found extensive calcareous formations in the cerebral vessels of persons in whom cerebral degeneration had followed excessive anxiety and mental effort. The pulmonary artery is very rarely invaded by atheroma; and only in cases in which it has been kept in a state of tension by hypertrophy of the right ventricle or disease of the mitral orifice.

Diagnosis.—The diagnosis of atheromatous inflammation of the aorta will be discussed in a separate article. The existence of the disease in the arteries of particular organs can only be a matter of reasonable presumption when the patient is past middle life; when the ascertained causes of atheroma have been in operation; when symptoms of impaired nutrition of the organ are present; and when the organ (the brain or heart) is one the arteries of which are known to be prone to the disease. Calcification of the superficial arteries renders these vessels rigid and tortuous; the temporals when so affected attract the eye by their prominence, and may be felt hard and rigid beneath the finger; the brachial may equally be made the subject of examination; and, although the presence or absence of atheromatous change in such superficial vessels does not necessarily prove that the other arteries of the body are in a similar condition, it renders it more than probable that they are. Those who are not familiar with the resisting feel of the radial artery, when it is the seat of the change now under consideration, are liable to form a very erroneous estimate of the strength of the pulse: this may convey to the inexperienced finger an impression of a force which it does not possess. The error also is sometimes committed of inferring the existence of aortic regurgitation in these cases in consequence of the tortuous course and visible pulsation of the superficial vessels; but they do not collapse suddenly under the finger, as do the vessels during the receding wave in aortic patency. The sphygmographic tracing, moreover, is essentially different: in atheromatous disease of the artery the upstroke is vertical, and the summit of the tracing extended. The existence of such evidences of vascular mischief affords a fair subject for consideration to those who are called upon to form an opinion as to the eligibility of a life for assurance.

Treatment.—The treatment of endarteritis deformans is mainly preventive. It consists in the avoidance of all those influences to which we have adverted as causes of the disease, namely, indulgence in alcohol; causes originating a gouty state of the blood; excessive muscular efforts, especially in constrained positions; postures which involve the long-continued contraction of muscles which surround arteries; and, as far as the brain and heart are concerned, all those states which favour overfulness of their respective arteries:—in the case of the brain, excessive mental application, deficient sleep, and, the writer believes, prolonged periods of sexual excitement; in the case of the heart, *inter alia*, efforts which involve holding the breath, thus leading to distension of its right cavities, and imposing an obstacle to the return of blood from its walls.

5. **Fatty Degeneration**, unconnected with the atheromatous process, is sometimes, though rarely, found to affect arteries. Circumscribed opaque and velvety spots appear on the surface of the intima, and erosion ultimately occurs. Once this has taken place, the muscular coat, unable to bear the pressure of the blood-stream, fissures transversely; and the blood either ruptures the external coat, or, insinuating itself between the middle and external coat, produces a dissecting aneurism. This change has been found in the arteries of persons who seemed otherwise quite healthy; it is 'a morbid change which is simply degenerative from the first, and of whose immediate cause we know nothing' (Rindfleisch). Fatty degeneration of the external coat of the smallest arteries has also been noticed: it appears to be a senile change, and to play a part in the production of cardiac and cerebral degeneration.

6. **Calcification** of the arterial tunics also occurs unconnected with endarteritis, but more rarely than fatty degeneration. When this is the case, it is the middle coat of the smaller vessels that is the seat of the deposit, which consists of carbonate and phosphate of lime and magnesia. The process is usually limited to the vessels in which muscular fibre is abundant; but these it may affect extensively, the superficial vessels and the arteries of the brain and of the extremities being the favourite seat: it is eminently a senile change.

7. **Gummatous Disease** of the cerebral arteries in syphilitic patients has been described by Dr. Hughlings Jackson, Dr. Wilks, and others. The vessels present nodose swellings, and are thickened sometimes to three times their normal size by gummatous material infiltrating the outer coat; the calibre of the vessels is thereby narrowed, the formation of thrombi favoured, and cerebral softening produced. 'A random succession of nervous symptoms,' to use the words of Dr. Jackson, affords strong grounds for sus-

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pecting syphilitic disease within the cranium; and the writer has himself seen three cases in which such symptoms disappeared under the use of perchloride of mercury and iodide of potassium, and in which it seemed to him that the supposition of arterial disease was much more probable than that of any other form of intracranial syphilis.

8. **Albuminoid Disease**, when it attacks the spleen or kidneys, appears first in the walls of the small arteries of these organs, but is not found in the larger arteries of the body.

9. **Contraction** and final impermeability of an artery from atheromatous calcification, from the accumulation of fibrine in its rough inner surface, from pressure, or from other causes, occasionally occurs, leading to gangrene of the extremity which it supplied.

10. **Dilatation** of arteries is in the majority of cases due to previous disease of their coats; but sometimes in the aged the arteries are found dilated without any degeneration of their tunics being present,—a state of affairs which Rindfleisch suggests may depend on atony of the muscular coat, and in some cases may possibly be connected with deficient innervation.

11. **Aneurism** receives full consideration in a separate article. Here it is merely necessary to point out the ways in which atheromatous inflammation and the other morbid processes which have been described contribute to the production of dilatation and aneurism. In some cases the course of events consists in the washing away of the diseased patch of the intima; when the middle coat either dilates, or, by separation of its muscular bundles, undergoes rupture, and the external coat yields before the pressure of the blood-stream. In other cases the dilatation occurs, not at the point where the endarteritis has invaded the vessel, but nearer to the heart. At the affected point there is narrowing of the canal of the vessel, and loss of elasticity in its coats; and as a consequence we have slowing of the circulation and deficiency in the supply of blood beyond, and increased arterial tension on the proximal side of the affected spot. The effect of this tension is more serious than would at first sight appear; in health the blood, propelled by each ventricular systole, enters contracted vessels, which, yielding before it, are uninjured by its sudden impact; but a vessel in a state of tension is exposed to the full violence of the column of blood discharged by the heart, and must gradually dilate before it.

12. **Arterial Disease in Insanity.**—According to Dr. J. Batty Tuke, and other physicians who have specially investigated the morbid changes in the brains of the insane, arterial disease is almost invariably present. It consists in such alterations as would result from obstruction in the ultimate ramifications of the vessels;—thickening of the proper coats of the arteries, and of the sheath of connective tissue which surrounds the cerebral vessels; the deposition of fine molecular matter and crystals of hæmatoidin between the adventitia and the sheath; and extreme tortuosity of the vessels.

13. **Arterio-Capillary Fibrosis** is the term applied by Sir William Gull and Dr. Sutton to the hypertrophy of the walls of the small arteries found in the subjects of the cirrhotic form of Bright's disease. It is admitted by all observers of repute that the walls of the blood-vessels of the kidney are greatly thickened in this malady; but it is by no means so universally admitted that the small arteries throughout the whole body are in all such cases similarly hypertrophied. That they are hypertrophied in a certain proportion of the cases admits of no doubt; but the nature of the thickening remains to be decided. Dr. George Johnson, who early called attention to this condition, considers that there is present an hypertrophy of all the tunics of the small arteries, especially of the muscular coat—a consequence of the obstruction which impure blood invariably meets with in the capillaries. Sir William Gull and Dr. Sutton, on the other hand, assert that the thickening is due to a fibroid growth, especially seated in the external coat of the vessel; and they believe that the coexisting disease of the kidney is not the cause of the arterial change, but that both are parts of a general diseased process.

James Little.

ARTERIES, Examination of. *See* Physical Examination; and Pulse.

ARTHRALGIA (ἄρθρον, a joint; and ἄλγος, pain).—Pain in a joint. The term is more particularly applied to articular pain in the absence of objective disease.

ARTHRITIS (ἄρθρον, a joint).—A term generically used to signify any disease whatever involving a joint, but more correctly confined to articular inflammation. It is also employed to designate inflammation of *all* the structures forming a joint, as distinguished from mere synovitis. *See* Joints, Diseases of.

ARTHRODYNIA (ἄρθρον, a joint; and ὀδύνη, pain).—*See* Arthralgia.

ARTICULAR RHEUMATISM.—Rheumatism affecting joints. *See* Rheumatism.

ARTIFICIAL RESPIRATION, or the method of exciting and keeping up the movements of the chest, so as to supply air to the lungs, is a subject of the highest importance, since the hopes of recovery depend on its due performance in many cases of narcotic poisoning, in the apparently drowned or asphyxiated, and in the collapse of the advanced stage of the condition induced by anæsthetics. For its effective employment it is essential to see that no foreign body obstructs the air-passages. Children and old people are liable to swallow large pieces of meat or crust, which become impacted in the pharynx or œsophagus. These should, if possible, be dragged away with the finger or a spoon-handle, but they may require the use of a probang. Tracheotomy is rarely necessary. A knife-handle held between the molar teeth is a ready and useful gag to keep the mouth open. A button-hook, in the absence of pharyngeal forceps, is sometimes very serviceable. Vomited matter should be quickly removed with a sponge or cloth twisted round a piece of wood. In treating the half-drowned the body should be inverted for a few minutes to favour the escape of water from the air-passages, but artificial breathing should be commenced even whilst the body is in this position.

Methods.—In most cases the best method of commencing artificial respiration is to compress the chest and abdomen simultaneously, then remove pressure so as to allow air to enter the chest, and again repeat the pressure every two or three seconds. If the sound indicates that air is passing into and out of the lungs, this method may be continued for half a minute; but if we are not sure that the air is exchanged, and in all cases if the patient's condition is not decidedly improved in half a minute, we should resort to:—

1. *Sylvester's method.*—Place the patient on his back on the floor, with a block or pillow under his shoulders, and raise the arms upwards above his head, by grasping them above the elbow, and pulling firmly and steadily as long as there is any sound of air entering the chest. Some arrangement is needed to prevent the body from being dragged towards the operator. For this purpose the plan of raising the chest on a high cushion or box has been adopted, but as a condition of cardiac anæmia is often present, this is objectionable. It is better to effect the object by placing a book in front of the thighs while kneeling at the head of the patient. It may be needful to draw forth the tongue, but generally if the head falls back over a cushion placed behind the neck, this is not required. An artery forceps, or a noose of string, or a handkerchief will enable an assistant to keep the tongue well forward.

As soon as the sound produced by the entrance of air into the chest ceases, the arms should be brought down a little towards the front of the chest, and pressed firmly and steadily against it for about one second after air is heard escaping. In cases of drowning it is enough to repeat this operation every four seconds, but in the collapse resulting from chloroform or other anæsthetics, the necessity for getting the vapour quickly out of the chest justifies a more rapid performance of the movements during the first five minutes. After this time the movements should be carried on more slowly, but they should be continued for half an hour at least, and even longer if the warmth of the surface and diminution of lividity gives any reason to hope that the heart has not entirely ceased to act.

2. *Marshall Hall's ready method* is performed by placing the body on one side, and alternately rolling it on its face to compress the chest, and on its back to allow the elasticity of the ribs free movement to draw air into the lungs. The plan is not nearly so effective as Sylvester's, but if no assistant is at hand it is the best mode of artificial breathing that can be adopted.

3. *Howard's method.* *See* Resuscitation.

4. *Mouth-to-mouth insufflation* is not to be depended upon, on account of the difficulty both of keeping the larynx open, and also of preventing the air going down the gullet.

Of the *instruments* introduced for the purpose of carrying on artificial respiration, mention should be made of those invented by Dr. Marcet and Dr. Richardson; but except in the hands of the inventors or of those who had gained much experience in their use by practising upon animals, the writer thinks they would do as much harm as good. The objection to them all is that they interfere with the prompt imitation of the movements of respiration just described.

The administration of *oxygen* is indicated in most cases of artificial respiration, but the results of its use have not been satisfactory hitherto. Now that the gas can be had in a compressed state, and can be given by means of the laughing-gas inhaler, it is worthy of a further trial; but it is certain that in all cases of impending asphyxia time is of so much importance that anything which would delay the supply of oxygen would not be compensated for by giving it pure, instead of in the form of common air. Tracheotomy is not to be thought of in the first instance in any case in which air can be made to pass, even in very small quantity, through the trachea.

For supplemental and after-treatment, *see* Resuscitation.

J. T. Clover.

ASCARIDES (*ἀσκαρὶς*, a kind of worm).—This term, by long usage, is often employed to designate the very common intestinal parasites popularly known as *Thread-worms* or *Seat-worms.* Strictly speaking, these do not belong to the genus *Ascaris*, but to the genus *Oxyuris*. The fuller consideration, therefore, of their characters and clinical importance will be found under the Article Thread-worms.

Although the term as employed in the sense referred to is altogether erroneous, there are two true species of the genus Ascaris found infesting man. These are, respectively, the common round-worm or Lumbricus (*Ascaris lumbricoides*); and the moustached or margined round-worm (*Ascaris mystax*). Full particulars respecting the former will be found under Round-worms, whilst the consideration of the latter need only occupy a few words in this place.

Since the discovery and description of the *Ascaris mystax* as a genuine human parasite by the writer in 1868, six instances of its occurrence have been noticed at home and abroad, and there can be little doubt that the parasite is much more frequent in man, especially in children, than is commonly supposed. The writer has also shown that this parasite is identical with the *Ascaris mystax* in the cat, which, according to most helminthologists, is only a variety of the *Ascaris marginata* in the dog. The males are usually from 2 to 2½ inches in length; the females sometimes acquiring a length of 4 inches or more.

Treatment.—Like its congener, the falsely so-called Lumbricus, the margined round-worm readily yields to treatment by santonine. Two or three grains of this drug, followed by castor oil or a saline purgative, should be administered twice or thrice daily for a few days in succession.

T. S. Cobbold.

ASCITES (*ἀσκὸς*, a leathern sac; a large belly).—Synon.: *Dropsy of the peritoneum; Hydrops peritonei vel abdominis; Hydroperitoneum.* Fr. *Ascite*; Ger. *Die Bauchwassersucht.*

Definition.—An accumulation of fluid within the cavity of the peritoneum, more or less serous in character, the accumulation being of the nature of a local dropsy, and not originating in inflammation. The amount of fluid varies much in different cases.

Ætiology and Pathology.—The chief matter relating to the causation of ascites is to point out the morbid conditions by which it may be produced, as it almost always follows, and is a consequence of certain pre-existing organic diseases, of which it becomes a most important symptom and pathological phenomenon. The causes to which it has been attributed may be discussed according to the following arrangement:—

I. Direct mechanical obstruction affecting the portal circulation.

1. Obstruction of the trunk of the portal vein before it enters the liver, either from external pressure or internal obstruction.

2. Pressure upon or obliteration of the branches of the vein within the liver.

3. Pressure upon the trunk of the hepatic vein, or upon the inferior vena cava after it receives this vein.

II. Cardiac or pulmonary diseases obstructing the general venous circulation.

III. Disease of the kidneys.

IV. Morbid conditions of the peritoneum.

V. Miscellaneous.

I. Any direct obstruction interfering with the portal circulation must necessarily lead to congestion and over-distension of its tributaries, one of the consequences of which is excessive transudation of the fluid portion of the blood into the peritoneal cavity, while absorption is checked. The ascites is, under such circumstances, in short, merely a localised dropsy, resulting from mechanical congestion. The impediment may affect either the portal trunk before it enters the liver; its branches in the substance of this organ; or the hepatic vein or inferior vena cava near its termination.

1. The portal trunk may be pressed upon as it lies in the fissure, by prominences from the liver itself, enlarged absorbent glands in its vicinity, a neighbouring tumour (as cancer of the pancreas or a growth in the small omentum), a hepatic aneurism, or inflammatory thickening resulting from peri-hepatitis. The pressure may absolutely close up the vessel, but it more commonly causes a local clot to form, and thus its channel is blocked up. A thrombus is also in exceptional instances produced in connexion with a diseased condition of the portal vein, such as inflammation or calcification; obstruction to the circulation within the liver; or feebleness of the circulation, with an abnormal tendency to coagulation of the blood.

2. Pressure upon, or obliteration of the branches of the portal vein within the liver, can only arise as a consequence of some morbid condition involving the actual substance of this organ. The hepatic disease which by far most commonly leads to this result, and which is one of the most frequent causes of ascites, is cirrhosis. Occasionally it accompanies syphilitic and other forms of contracted and indurated liver, or it may be associated with infiltrated cancer. The extent of the obstruction thus set up will necessarily vary with that of the morbid changes in the organ. Occasionally a mass within the liver obstructs a considerable branch of the portal vein.

3. Obstruction of the hepatic vein or inferior vena cava is a rare event, but may arise from the pressure of a growth connected with the liver itself, or of some neighbouring tumour.

II. Diseases of the lungs or heart which impede the general venous circulation must necessarily exercise a speedy and direct influence upon the hepatic circulation, and may thus lead to ascites. Usually, however, in cases of this kind the legs are the seat of considerable anasarca before peritoneal dropsy is observed. In course of time the continued congestion originates serious organic changes in the liver, its vessels being more or less obliterated, and consequently it is at this period that ascites is particularly liable to set in.

III. Ascites may constitute a part of the dropsy which so often accompanies renal diseases. It is, however, of comparatively infrequent occurrence to any great extent under these circumstances, the amount of fluid being not considerable as a rule, and the ascites being but a subsidiary part of a general dropsy.

IV. More or less serous effusion into the peritoneal cavity is a pathological result of peritonitis; but, in accordance with the definition of ascites given above, this does not come strictly within the present article. In exceptional instances, however, true ascites is observed as a sequel of peritonitis, in consequence of the morbid conditions which it leaves behind. Chronic peritonitis may also occasion a simple local dropsy; but this is particularly liable to be set up in connexion with morbid formations in the peritoneum, such as cancer or tubercle, of which the writer has seen striking examples. The immediate causes of ascites associated with diseases of the peritoneum may be:—active congestion; implication of the capillaries or minute veins, or even of the larger veins, leading to mechanical congestion; obstruction of the lymphatic orifices, and consequent impaired absorption; or undue activity of the secreting structures.

V. Among the chief *miscellaneous* causes to which ascites has been attributed may be mentioned exposure to cold or wet; the sudden suppression of habitual discharges, or the rapid cure of chronic cutaneous affections; and extreme anæmia and debility. These causes are supposed to originate this symptom either by inducing active internal congestion; or by disturbing the renal functions; or in consequence of the abnormal state of the blood and tissues; but it is very doubtful whether either of them can actually of itself occasion ascites. Fluid may collect within the peritoneum as the result of the rupture of a cyst within the abdomen, especially an ovarian cyst.

It must be remembered that ascites may be due to a combination of two or more of the causes which have been indicated in the preceding remarks. For instance, there may be obstruction affecting the portal circulation within the liver and outside this organ at the same time; or the different organs may be involved simultaneously.

Predisposing causes.—Whatever tends to set up either of the morbid conditions which originate ascites, may be regarded as a predisposing cause. It may be met with at any age, but is most common during middle life. The hepatic form is much more frequent in males than females. An anæmic condition of the blood and weakness of the tissues predispose to peritoneal dropsy, as they do to dropsy in other parts.

ANATOMICAL CHARACTERS.—The essential anatomical character of ascites is the accumulation of a serous fluid within the peritoneal sac. Its amount may range from a few ounces to some gallons. As regards physical characters, the fluid is generally thin, limpid, and watery in consistence; colourless or slightly yellow; clear and transparent; and of alkaline reaction. In exceptional instances, however, it may be coloured by blood or bile; or more or less turbid and dirty-looking; or of thicker and somewhat gelatinous consistence. Soft fibrinous masses occasionally float in the fluid, or these may form spontaneously when it is allowed to stand. Very rarely the reaction is neutral or acid. The specific gravity varies considerably. Chemically the fluid consists of water holding in solution albumin and the usual salts which are found in dropsical fluids; but their proportion is very variable, though the albumin is generally in good quantity, which is evidenced by the degree of coagulation which takes place when the fluid is boiled. Occasionally it contains fibrin, cholesterine, bile-elements, or, in cases of renal dropsy, urea.

The effects of the accumulation upon surrounding structures are to distend and macerate them more or less, or to compress them. Of course along with the ascites there will be the signs of any morbid condition upon which it depends; and there may also be indications of anatomical changes resulting from long-continued pressure of the fluid upon certain structures.

SYMPTOMS AND SIGNS.—Ascites usually sets in very gradually, being chronic in its progress, but advancing steadily. Occasionally, however, the fluid collects with considerable rapidity. The clinical phenomena associated with this pathological condition differ in different cases, both in their exact nature and their degree, according to its cause, the amount of the fluid, and other circumstances, but they may conveniently be considered under the following heads, namely:—1. *Physical signs.* 2. *Mechanical effects of the dropsical accumulation.* 3. *General symptoms.*

1. *Physical Signs.*—Physical examination constitutes a most important part of the clinical investigation of cases of ascites, and it will be requisite to discuss the signs in some detail.

(*a*) If fluid collects in the peritoneum in any quantity, the abdomen presents more or less *general enlargement.* This is often the first change which attracts the patient's attention, and it may also have been noticed that the increase in size commenced below. The degree of enlargement depends upon the amount of fluid, but it may become extreme, so that the skin is tightly stretched and thin, presenting a smooth and shining appearance, or sometimes white lines are visible, due to laceration of its deeper layers. The umbilicus becomes affected in a characteristic manner, being more or less stretched and everted, and finally becoming obliterated, or in some cases more or less pouched out, and it may form a considerable prominence. Should there happen to be a weak portion of the abdominal walls, such as a hernial sac, this will be unduly protruded. The important characters of abdominal enlargement due to uncomplicated ascites are that it is of a rounded form, though tending to be more prominent or to bulge towards the lower part or in the flanks, according to the posture of the patient; that it is quite symmetrical in shape, when the patient stands or lies on his back, but that the form alters considerably with a change of position, the abdomen becoming then more prominent in the dependent region, in consequence of the gravitation of the fluid in this direction, and it may actually be seen to move as the posture is changed. In contrast with the enlarged abdomen, the chest often looks small and depressed, and the fluid may cause its margin to become everted, or it may push forwards the xiphoid cartilage.

(*b*) The abdomen feels perfectly *smooth* and *even* over its entire surface. It usually gives a sensation of *tension* of the walls, without any hardness underneath. In some instances an obscure feeling of fluctuation is experienced on palpation with the fingers.

(*c*) The tendency of ascites is to interfere with the *abdominal respiratory movements*, if it is at all considerable, by preventing the diaphragm from acting properly. At the same time the writer has not uncommonly observed that, even in cases where the accumulation of fluid has been very considerable, abdominal respiration did not seem to be much diminished.

(*d*) *Percussion* affords some of the most important signs of peritoneal dropsy; and when the fluid is present only in small quantity, this is the only mode of examination that can lead to its detection. In the first place marked *dulness* is elicited over the seat of the fluid; while a tympanitic sound, which is often abnormally clear and distinct, is heard over the intestines. When there is but little fluid, it may be impossible to detect any abnormal dulness as the patient lies in the recumbent posture, but on placing him on his hands and knees, the fluid gravitates towards the front of the abdomen, and dulness may then be noticed in the umbilical region. In most cases, however, there is no difficulty in making out the dulness, and this sign is observed in those regions towards which the fluid naturally gravitates. Hence, when the patient lies on his back, the lower part and sides of the abdomen are dull, while its upper and front part is tympanitic. As more and more fluid collects, so the dulness increases in extent, gathering in, as it were, from below and from the sides, until finally the entire abdomen may be dull, except the umbilical region, which remains longest tympanitic. The boundary line between the dulness and tympanitic sound is usually well-defined. As the posture is changed, so will the site of the dulness vary, the part which is undermost presenting this sign, while that which becomes highest is tympanitic; and thus the relative situation of these two sounds, as well as the shape of the dulness, can be altered in a variety of ways. When the patient sits up, the prominence between the recti muscles gives a tympanitic sound on percussion. In exceptional instances a distended colon gives rise to a tympanitic sound along each side of the abdomen, even when there is abundant fluid present.

Another important sign brought out by a kind of percussion is the sensation specially termed *fluctuation*, which is the peculiar wave-like movement realised on placing the fingers of one hand over one side of the abdomen, and fillipping or tapping the opposite side with the fingers of the other hand. This sensation is very easily brought out if there is much fluid present, provided it is free to move, and sometimes the motion is actually visible. Change of posture will modify the seat over which fluctuation can be produced.

(*e*) *Auscultation* yields negative results in cases of ascites, there being no sound of any kind heard over the abdomen.

(*f*) In the large majority of cases ascites is clearly revealed by the physical signs already described. In exceptional instances, however, when the diagnosis is obscure, it is requisite to resort to a *digital* examination through the *rectum*, and in females through the *vagina*. The fluid collects in the recto-vesical pouch, and on examination per rectum, the finger detects the sensation of this fluid through its anterior wall. The vagina is usually felt to be shortened, while the uterus is pushed down and flexed. In extreme cases of ascites the posterior wall of the vagina, or even the uterus itself, may protrude through the vulva.

(*g*) Now and then it is requisite to make use of the *aspirator* or a *small trochar*, by the aid of which not only can it be determined whether fluid is present in the abdominal cavity, but its nature can also be ascertained. This method of examination is further useful when ascites is associated with some other morbid condition within the abdomen, which frequently cannot be made out so long as the fluid remains in the peritoneum.

It must be borne in mind that the ordinary physical signs of ascites will be materially modified or obscured under certain circumstances. For example, the quantity of fluid may be so small that most careful examination is required in order to detect its presence; on the other hand, it may be so abundant that dulness is observed over the entire abdomen, and fluctuation may be very indistinct. The existence of peritoneal adhesions—for instance, those which may be formed as the result of repeated paracentesis—also renders some of the most characteristic signs of ascites very ill-defined. Again, the association of peritoneal dropsy with some other abdominal morbid condition, such as a new growth, an enlarged liver or spleen, or an ovarian tumour, will also modify the signs elicited. The mesentery may be abnormally short, or the intestines may be adherent, thus being prevented from floating forwards, so that the usual relative positions of dulness and tympanitic sound are not observed.

2. *Mechanical effects of the dropsical accumulation.*—The clinical phenomena resulting from the mechanical effects of ascites are both *subjective* and *objective*. The patient often experiences a feeling of uneasiness and discomfort in the abdomen, as well as more or less tension and fulness, if there is much fluid present; while there may be a sense of fatigue and aching about the loins or abdominal walls. As a rule no particular pain is felt, but colicky pains are liable to occur from time to time, and extreme distension of the structures constituting the abdominal wall may also cause painful sensations. In exceptional instances peritonitis is set up. When the fluid is abundant, the patient experiences its weight when he walks, and, during this act, he throws the head and shoulders back, at the same time keeping the legs apart. Symptoms connected with the alimentary canal are of common occurrence, but these are often to a great extent due to the same cause which originates the ascites, though the fluid must necessarily tend to interfere with the functions of the stomach and intestines. The bowels are usually constipated, but in some instances diarrhœa or dysenteric symptoms may arise. Flatulence is very commonly complained of, even a small amount of gaseous accumulation in the intestines being felt unduly, producing much discomfort, and increasing the enlargement of the abdomen temporarily. Occasionally vomiting occurs, in consequence of interference with the stomach. When considerable fluid has remained in the peritoneum for some time, it presses upon the inferior vena cava and prevents the return of blood through this vessel, and may thus lead to anasarca of both lower extremities, with enlargement of the superficial abdominal veins. Exceptionally the anasarca attracts attention at an early period. The flow of blood through the renal veins may also be obstructed, inducing mechanical congestion of the kidneys, with consequent diminution in the quantity of urine and albuminuria. In rare instances the fluid has been known to accumulate to such an extent as to rupture some part of the abdominal walls.

Ascites also frequently interferes with the thoracic organs. The bases of the lungs are more or less collapsed, and the breathing becomes chiefly upper-costal, while a sense of dyspnœa is experienced, especially in the recumbent posture and after taking food, the breath is short on exertion, and the respirations are often hurried and shallow. The heart is likewise liable to be disturbed in its action, as evidenced by palpitation, irregularity, or a tendency to faintness. This organ may also be displaced, so that its apex-beat is raised and too far towards the left, and in rare instances a basic systolic murmur has been originated as a result of this displacement.

3. *General symptoms.*—The general system is frequently seriously affected in cases in which ascites is a prominent symptom, but this usually depends upon the cause or causes which have originated the dropsy, though it may itself induce more or less debility, wasting, anæmia, and other general effects. The loss of fluid in this way has also been supposed to lead to deficient perspiration, and consequent dryness of the skin; as well as to diminution in the quantity of urine.

Diagnosis.—The first matter bearing upon the diagnosis of ascites is to determine whether this morbid condition actually exists. The presence of fluid in the peritoneum, as well as its amount, can only be positively made out by physical examination, and in the great majority of cases the signs thus elicited are quite characteristic. When the fluid is small in quantity, as well as under other circumstances in which the physical signs are obscured or modified, the diagnosis may be difficult and uncertain, but it may then be aided by a knowledge of the existence of some disease likely to give rise to ascites. That the accumulation of fluid is of a dropsical nature, and not due to acute or chronic peritonitis, is usually sufficiently obvious from the history of the case, and the collateral symptoms, while the local signs are also of a different character (*see* PERITONEUM, Inflammation of). The remaining abdominal enlargements from which ascites has to be most commonly distinguished are those due to flabby relaxation of the walls of the abdomen, combined with flatulence; accumulation of fat in the subcutaneous tissue and omentum; abundant subcutaneous œdema, which may be associated with and obscure ascites; an ovarian tumour; or a pregnant uterus. Among the rarer conditions with which ascites is liable to be confounded may be mentioned colloid disease of the omentum; a greatly dilated stomach; distension of the uterus with fluid; great accumulation of urine in the bladder; a very large hydatid tumour, usually connected with the liver; extreme cystic enlargement of the kidney; and the so-called 'phantom tumour.' Most of these conditions are described in other parts of this work, and the limits of this article forbid any discussion of their several diagnostic characters; but a consideration of the history and existing symptoms of the case, combined with the results of a proper physical examination, constitute the data upon which the diagnosis is founded. It must be remembered that ascites may coexist with other morbid conditions in the abdomen, their physical signs being combined. Should there be an enlarged organ or other solid mass, it may often be recognised by making sudden firm pressure with the fingers over the abdomen, when the fluid is pushed aside, and the underlying resistance can be felt; or paracentesis may be performed, and further examination carried out after the evacuation of the fluid.

Another most important point in the diagnosis of ascites is to make out its *cause*. For this purpose all the facts bearing upon the case must be taken into account and carefully weighed, special attention being paid to the liver and the structures in its vicinity, to the heart, and to the kidneys. The amount of the ascites, and its relation to other forms of dropsy, afford considerable aid in the diagnosis. If it results from cardiac or renal disease, ascites always follows dropsy in other parts of the body, to which it is also generally subordinate; when it is due to hepatic or some neighbouring disease, the peritoneal dropsy appears first, and is throughout most prominent. Should the vena cava inferior be obstructed at its upper part, anasarca of the legs will be observed simultaneously with, or even before the ascites.

PROGNOSIS.—The prognosis of ascites will mainly depend upon its cause; the amount of fluid present; the state of the patient; the condition of the main organs; and the results of treatment. In some cases this symptom is in itself attended with immediate danger, on account of the mechanical effects of the dropsical accumulation, especially upon the thoracic organs, and still more if these organs are in a diseased condition. In other instances it aids in reducing the patient, and in thus bringing about a fatal termination. When ascites is due to local interference with the portal circulation, great relief can unquestionably be afforded in a considerable number of cases, and life may be prolonged by appropriate treatment; while, if the local cause is not such as in itself to lead to a fatal issue, the ascites may not infrequently be permanently cured.

TREATMENT.—The principles of treatment applicable to cases of ascites are (*a*), to attend to the condition upon which the dropsy depends, and thus endeavour to get rid of its cause; (*b*) to promote the absorption of the fluid; (*c*) to improve the constitutional condition and the state of the blood, if necessary; (*d*) to remove the fluid by operation, if absorption cannot be accomplished; and (*e*) to treat any symptoms needing special attention.

(*a*) As an important part of the treatment directed to the *cause* of ascites, particular attention must be paid to those organs which are most commonly accountable for this symptom, though unfortunately in a large proportion of cases but little effect can be produced upon the dropsy in this way.

(*b*) Absorption of the fluid is chiefly promoted by acting freely upon the bowels, skin, or kidneys. The class of remedies indicated will vary in different cases, and must be adapted to the state of the different organs, but as a rule active purgatives are most efficient in relieving ascites, especially when due to local causes, of which the most useful are compound jalap powder, cream of tartar, elaterium, calomel, gamboge, podophyllin, and croton oil. These remedies must, however be used with due caution. In some instances balsam or resin of copaiba has proved useful in the treatment of peritoneal dropsy. Assistance may be derived in certain forms of ascites from acting upon the skin by means of various diaphoretic baths. Digitalis and squills may be of service as diuretics; or the application of poultices of digitalis leaves over the abdomen is occasionally attended with benefit. The administration of iodide of potassium also seems to aid absorption in some cases.

(*c*) Treatment directed to the general condition of the patient, and to the state of the blood, is undoubtedly valuable in many cases of ascites. Tonics are often of decided service, and preparations of iron are specially indicated for improving the quality of the blood, if there is any tendency to anæmia. Not only do these remedies sustain the patient, but they may also have an influence in promoting the process of absorption. The diet must be adapted to the circumstances of the case, but usually needs to be of a nutritious character.

(*d*) In a considerable proportion of cases, however, no effect is produced upon the dropsical accumulation by any of the measures thus far considered. Then it becomes necessary to determine whether it is desirable to remove the fluid by operation. The fluid may be taken away either by means of the aspirator, or by the trochar and canula. The advisability of having recourse to this plan of treatment must depend upon circumstances. The ascites is frequently not sufficiently abundant to justify paracentesis, and when the condition is of cardiac or renal origin, the operation can only afford temporary relief, so that there is no object in resorting to it unless the mechanical effects of the accumulation are such as to cause troublesome or dangerous symptoms, and it had better be delayed as long as possible. When ascites is a local dropsy, the fluid is often so considerable in amount as to necessitate its removal for the mere purpose of giving relief for the time. In cases of ascites associated with malignant disease, for instance, this is all that can be hoped for, as the fluid will certainly collect again. When, however, the condition is due to some local disease which is not in itself fatal, and especially to cirrhosis of the liver, the writer has found signal benefit result from the *repeated performance of paracentesis*, and has advocated this plan of treatment as a *curative* measure, so far as the ascites is concerned. Rarely does the operation give rise to any immediate ill-effects, and it is frequently found that remedies will act much more efficiently after the removal of the fluid than they did previously. In the writer's experience paracentesis repeated as often as the fluid re-accumulated has ultimately led to a complete cure in several instances; in others the cure was partial, a certain quantity of fluid remaining in the peritoneum, limited by adhesions; while in others still, life has been greatly prolonged, and much comfort afforded. The repeated accumulation does not seem to affect the system materially by reason of the drain upon it, and frequently not at all. Of course due care must be exercised in the performance of the operation, and in the subsequent treatment. In a few days after the removal of the fluid, the application of a bandage firmly round the abdomen, so as to exert even pressure, may prove of service in aiding the absorption of what remains, and preventing the recurrence of the ascites; and this measure may also be useful when a certain amount of fluid continues after the repeated performance of paracentesis.

(*e*) The symptoms resulting from ascites which are likely to require attention are those connected with the alimentary canal; dyspnœa; and cardiac disturbance, or a syncopal tendency. These should be treated on ordinary principles; but it must be observed that marked dyspnœa, if evidently due to the fluid, is an indication for the immediate performance of paracentesis.

Frederick T. Roberts.

ASIATIC CHOLERA. *See* Cholera.

ASPHYXIA (ἀ, priv., and σφύξις, pulse).—Synon.: Apnœa; Fr. *Asphyxie*; Ger. *Erstickung*.

Definition.—The term *Asphyxia*, though literally signifying *pulselessness*, is generally understood to mean the condition that supervenes on interruption of the function of respiration. The term *Apnœa*, preferred by many as a more exact one, has the disadvantage of being employed by physiologists in a totally different sense, viz. the cessation of the respiratory movements consequent on artificial hyper-oxygenation of the blood. There is therefore no advantage to be gained by substituting the term apnœa for the well-understood and older one, asphyxia.

Ætiology.—Asphyxia may result from many causes which obstruct or interrupt the respiration. They may be divided into two categories, internal and external.

Internal.—These include paralysis of the respiratory nerve-centres by disease or injury of the medulla oblongata; paralysis of the nerves or muscles of respiration; a rigid fixation of the respiratory muscles; collapse or disease of the lungs; occlusion of the air-passages by organic disease or spasm of the glottis, pressure of tumours, and the like.

External.—To this group belong occlusion of the air-passages by foreign bodies; pressure on the chest not capable of being overcome by the muscles of respiration; closure of, or external pressure on, the air-passages, as in suffocation, strangulation, or hanging. These are all cases of obstruction of the respiratory movements in a medium capable of supporting life. To these external causes are to be added those conditions in which, though the respiratory movements are free, the surrounding medium is incapable of oxygenating the blood, viz., submersion in a liquid medium (drowning); or being surrounded by a medium devoid of oxygen, such as nitrogen or hydrogen. These gases have a purely negative effect; but many other gases which are classed as asphyxiants, such as carbonic oxide, sulphuretted hydrogen, chlorine, chloroform vapour, etc., have positive poisonous effects, and should therefore be called by some special name, such as *toxic asphyxiants*, to distinguish them from those which have no such properties.

Phenomena.—When an animal is placed in an atmosphere devoid of oxygen, or not containing a sufficient quantity of this gas (under 10 per cent.) to maintain the respiratory process, or if the mechanism of respiration is simply obstructed, it begins to show signs of agitation and to make powerful inspiratory and expiratory efforts, in which the accessory muscles of respiration are all brought into action; the arterial tension increases; and the superficial veins become distended and livid.

After a variable period these dyspnœic efforts pass into general convulsions, in which the muscles of expiration are more especially in action, during which the sphincters are forced and the excretions voided. On these there follows a calm, during which the animal lies insensible, with dilated and immovable pupils, and with reflex excitability abolished generally. All muscular movements cease except those of inspiration, which are repeated at intervals. As death approaches the respiratory movements become shallower and less regular, and are succeeded by stretching convulsions, during which the back is straightened, the head is thrown back, the mouth gapes, and the nostrils dilate. The heart still continues to beat after other movements have ceased. The heart ultimately stops in the state of diastole. Death is then complete and final.

Course and Termination.—The time necessary to bring about a fatal termination varies in different animals, and in the same animal under different conditions. It has been noted that the young of some animals resist asphyxia longer than the adults. Paul Bert has shown that these differences are all explicable in accordance with the law that the more active the vital combustion, the greater the gaseous interchange, and therefore the more rapidly fatal the obstruction of the respiratory process. Excluding special considerations of this kind it may be stated as the result of the experiments of the Medical and Chirurgical Committee on Suspended Animation (*Med.-Chir. Trans.* vol. xlv. 1862) that when the respiration of a warm-blooded animal is totally obstructed, all external movements cease in from three to five minutes, and the heart stops within ten minutes. Certain modifications occur according to the method in which asphyxia is produced (*see* DROWNING).

ANATOMICAL CHARACTERS.—The blood is of a dark colour, owing to complete reduction of the hæmoglobin, and the proportion of carbonic acid is greatly increased. Owing to the excess of carbonic acid, the blood coagulates slowly or imperfectly; hence it remains long fluid, or forms few and soft coagula. The venous side of the heart, the great venous trunks, and the pulmonary artery are distended with dark blood; while the left side varies, being sometimes full, more often perhaps either empty or containing a small quantity of dark blood.

The appearance of the lungs is not constant. These organs are by no means always congested, as is very generally stated, being more often pale and anæmic. The posterior and dependent parts become hypostatically congested *post mortem*. The abdominal viscera are usually congested. The appearance of the brain varies, this organ being either anæmic or more or less congested. Special signs characterise special modes of causation of asphyxia.

PATHOLOGY.—Inasmuch as the cessation of respiration means both oxygen-starvation and accumulation of carbonic acid, the question is whether the phenomena of asphyxia depend on the one or the other, or on both. Various opinions have been entertained on this subject, but the experiments of Rosenthal and Pflüger would seem to show that the deprivation of oxygen is the chief factor. That the accumulation of carbonic acid has no effect at all cannot, however, be maintained, for it is demonstrable that carbonic acid has a distinct toxic effect on living tissues.

The circulation of non-oxygenated blood through the lungs and the respiratory centre in the medulla oblongata is the cause of the powerful respiratory efforts in the first stage—directly, by stimulation of the respiratory nerve-centres; indirectly, by peripheral irritation of the pulmonary branches of the vagi. The respiratory movements increase in force, and the irritation irradiates into the centres of other movements besides those directly concerned in respiration, giving rise to the expiratory convulsions which have been ascribed by some to excitation of a special 'convulsion-centre' (*Krampfcentrum*).

The respiratory centres ultimately become paralysed, but subsequently to those of conscious activity—the brain; and of reflex action—the spinal cord.

The circulation of non-oxygenated blood likewise causes contraction of the arterioles from irritation of the vaso-motor centre. Increased resistance is thus offered to the heart, and this is intensified by the convulsive muscular efforts. The arterial tension rises. The resistance to the flow through the capillaries by contraction of the minute blood-vessels occurs not only in the systemic, but also in the pulmonary circulation. Hence there is resistance both to the arterial and venous side of the heart. The ventricles become distended, and the heart's action laboured. The heart becomes enfeebled by the circulation of non-oxygenated blood in its walls, the diastolic intervals become longer, until the heart finally stops in a state of diastole, with the right side full, while the left may have succeeded in emptying itself.

TREATMENT.—Resuscitation from pure asphyxia is possible so long as the heart continues to beat. After cessation of the heart's action treatment is unavailing, except in cases of cessation from mere over-distension, in which bleeding from the external jugular vein may be resorted to with success. The chief indication in the treatment of asphyxia is to effect oxygenation of the blood by the introduction of air into the lungs. If the medium by which the patient is surrounded is incapable of supporting respiration, he must be immediately removed, or the atmosphere changed. If the air-passage is obstructed by a foreign body, this must be extracted; if this is impossible, or if the obstruction result from disease, tracheotomy or laryngotomy must be resorted to. Means must be adopted of exciting the respiratory centres or respiratory muscles to action; or if these are paralysed and non-excitable, the natural movements of respiration must be imitated artificially, or air introduced by insufflation.

The respiratory centres, if not absolutely paralysed, may be excited reflexly by stimulation of cutaneous nerves, especially those of the face and thorax. This may be effected by the stimulus of sudden cold, or better by alternate dashing of hot and cold water on the face and chest, or by flicking the skin with a towel. These reflex stimuli are often of themselves sufficient to excite respiratory movements; if not, they are powerful subsidiary aids to artificial respiration. The diaphragm may be stimulated to contraction by galvanisation of the phrenic nerve, one pole being placed on the nerve as it crosses the scalenus anticus at the root of the neck, the other on the epigastrium. Chief reliance, however, is to be placed on the methods of *artificial respiration*, which, after all, are the most simple and the most effectual, and possessed of the pre-eminent advantage of being always available. *See* ARTIFICIAL RESPIRATION.

Air may also be introduced into the lungs directly by properly constructed *insufflation-apparatus*, either by the insertion of a tube within the larynx (an operation requiring dexterity, but without danger if skilfully performed, though there is always risk of rupture of the air-vesicles from over-distension); or more easily by the insertion of the tube in one nostril, the other nostril and the mouth being closed (Richardson's apparatus). *Mouth-to-mouth-insufflation* is sometimes of advantage, especially in infants. The operator must close the nostrils of the patient, and, applying his mouth directly to that of the patient, inflate the lungs by his own expiratory efforts. The tendency to inflation of the stomach is considerably counteracted by backward pressure on the larynx. D. FERRIER.

ASPIRATOR.—SYNON.: Fr. *Aspirateur.*—The operation of Pneumatic Aspiration was introduced into practice by Dieulafoy in 1869. Before this period various instruments had been used under the name of 'suction-trochars,' but to Dieulafoy is due the credit of fully appreciating their value.

DESCRIPTION AND MODE OF EMPLOYMENT.—The aspirator consists of a glass syringe, having at its lower end two openings provided with stop-cocks. When the piston is raised and the cocks are closed a vacuum is created in the syringe which can be maintained by fixing the piston in the withdrawn position. An india-rubber tube is fitted into each of the two openings, and these must be provided with coils of wire inside to prevent them from collapsing. At the end of one tube is fixed a fine hollow needle. The needle should have only one opening, at the point, and not, as is often seen, another at some distance from it. The instrument is thus used:—A vacuum having been created in the syringe by raising the piston whilst both stop-cocks are closed, the needle is introduced into the part to be operated upon. As soon as the opening of the needle is beneath the skin the stop-cock leading to it must be opened. The vacuum will then extend to the point of the needle; and consequently, if it be gently pushed onwards the moment it encounters fluid, this will jet up into the glass syringe, when its nature may be ascertained. This mode of operating with what Dieulafoy calls the 'previous vacuum' is the essential difference between aspiration and suction. In aspiration it is impossible to pass the needle through a collection of fluid without discovering it; whereas without the 'previous vacuum' in the needle this might readily be done. If the fluid is sufficient in amount to fill the syringe, the stop-cock leading to the needle is to be closed and the other opened, by which the fluid may be discharged. The vacuum may then be re-established, and the operation repeated as often as is necessary. By opening both stop-cocks at once and allowing the discharge tube to hang down, the aspirator may be converted into a syphon. The action of the instrument may also be reversed, and it may be employed for injecting fluids. Other varieties of aspirator are in use besides the one above described. In Weiss's the receiver is a glass bottle, from which the air is exhausted by means of a separate exhausting syringe. The objection to this is that if the needle becomes choked, it cannot be cleared by pushing down the piston and driving some of the fluid back through it. Other kinds of aspirator cannot be converted into syphons, and these are objectionable. Weiss's has the advantage of being less liable to get out of order, as the fluid does not touch the exhausting syringe. The needles employed vary in size. Dieulafoy recommends that they should be about $\frac{1}{50}$, $\frac{1}{25}$, $\frac{1}{20}$, and $\frac{1}{12}$ of an inch in diameter, and calls them Nos. 1, 2, 3, and 4 respectively. The aspirator may also be applied to trochars, but then its distinctive feature is gone, and it becomes but a 'suction trochar.'

The following rules must always be observed in using the aspirator. 1st. See that the needle is pervious and clean and the syringe in order before using it. It is advisable to wash the needle well in strong carbolic acid solution. 2nd. The needle must be pushed straight on in one direction only. Its course must never be altered while the point is under the skin. If no fluid is found, it may be withdrawn and reinserted. It must be held as steady as possible during the aspiration. 3rd. If the fluid will not flow with the force of the vacuum, it is of no use squeezing and pressing the part. This can only do harm. 4th. Aspiration must cease at once when blood comes in any quantity, especially in abscesses. 5th. Keep up the vacuum during the withdrawal of the needle, lest some of the morbid fluid be left in its track. 6th. If the needle becomes choked, force a little of the fluid back through it in order to clear it.

USES.—Aspiration is used for purposes of diagnosis and treatment. Dieulafoy asserts that with the No. 1 needle it is possible to search for fluid without danger, whatever may be its seat or its nature; and experience has proved this to be practically true. In treatment it has been employed in the following affections:—

Abscesses.—In acute abscesses aspiration is usually of little value, as the pus soon re-accumulates. In chronic abscess connected with diseased bone it usually fails; and often it is impossible, from the amount of cheesy matter in the pus. In chronic abscesses unconnected with bone it sometimes effects a complete cure after three or four repetitions. It has proved successful in curing perinephritic abscess in the writer's experience. It is always well in chronic abscesses of doubtful origin to give this mode of treatment a trial. It must be remembered in treating large chronic abscesses that a dirty needle may lead to decomposition of their contents. *Diseases of the Liver.*—Hydatid cysts have been successfully treated by aspiration. In many cases the fluid becomes purulent after one or two aspirations, and in some the cyst has opened externally. For purposes of diagnosis the small needles may always safely be thrust into the liver. Abscess of the liver has been successfully treated by the aspirator. *Retention of Urine* may always be safely relieved by using No. 2 needle above the pubes. *Ovarian cysts* may be diagnosed and treated in the same way. *Hernia.*—It has been asserted that strangulated hernia may be, in the great majority of cases, relieved by the use of the aspirator. The finest needles only should be used. They remove first the fluid from the sac, after which some gas may be obtained from the strangulated gut, but fæcal matter rarely fails to choke the tube. In this country surgeons have not succeeded in sufficiently emptying the gut to allow of its reduction. Experience has, however, shown that if the needle be kept steady, any number of punctures may be safely made into the gut. *Diseases of Joints.*—Aspiration is occasionally useful in acute synovitis. Great care must be taken not to scratch the inside of the joint with the needle, as this has been known to lead to acute arthritis and suppuration. No. 1 or 2 needle should be used. *Hydrocephalus* and *Spina bifida* may be aspirated with safety with No. 1 needle. In hydrocephalus it is to be passed through the anterior fontanelle. No case has hitherto been cured by this treatment. In *Pleurisy* and *Ascites*, except for purposes of diagnosis, in the writer's opinion the aspirator presents no advantages over a trochar properly constructed so as to exclude air (*see* PARACENTESIS). *Pericarditis.*—The operation of aspiration has frequently been successfully performed for pericardial effusion. It is thus carried out:—A spot is chosen 2 to 2½ in. (5 or 6 centimetres) beyond the left edge of the sternum, in the 4th or 5th interspace. No. 2 needle is then passed obliquely upwards and inwards, taking care to turn on the vacuum as soon as the eye is covered. The moment the fluid jets into the syringe the needle must be held steadily till the flow ceases. If this be done there is no danger of wounding the heart. If there is any doubt as to the existence of fluid, No. 1 needle must be employed, with which the heart may be punctured without great danger.

MARCUS BECK.

ASTHENIA
ASTHENIC } (ἀ, priv., and *σθένος*, strength).—Terms signifying want of strength. As applied to the entire system, they indicate considerable general debility; in connexion with particular diseases, they imply that these are attended with marked weakness.

ASTHENOPIA (ἀ, priv., *σθένος*, strength, and ὤψ, the eye).—Weakness of sight. *See* VISION, Disorders of.

ASTHMA, SPASMODIC (*ἆσθμα*, from ἄω, I blow).—SYNON.: Bronchial Asthma. Fr. *Asthme*; Ger. *Bronchial-Asthma*.

DEFINITION.—An affection characterised by severe paroxysmal dyspnœa, recurring at more or less well-marked periods, generally in the night, the dyspnœa being due to spasmodic contraction of the bronchi, produced by a variety of causes.

ÆTIOLOGY.—The causes that induce an attack of asthma are very various, and may be roughly classed according to their action, *direct* or *indirect*, on the respiratory organs. In the former the exciting cause immediately affects the mucous membrane; in the latter it does so in a more circuitous manner, as through the blood or the nervous system generally:—

- Direct
  - Dust.
  - Vegetable irritants.
  - Chemical vapours.
  - Animal emanations.
  - Climatic influences.
  - Bronchial inflammation.
- Indirect
  - Through the nervous system .
    - Centric.
    - Excito-motor.
  - Through the blood
    - Gout.
    - Syphilis.
    - Skin diseases.
    - Renal diseases.
  - Heredity.

Direct causes.—Common roadside dust; fluff from woollen clothing; the dust of mills, threshing-floors, or bakehouses; and any mechanical particles when inspired, will produce in some persons an asthmatic seizure, dust of low specific gravity being more apt to have this effect than heavy particles like coal, steel filings, etc., from which arise lesions in the lung of a more permanent and serious character.

The odour evolved by certain vegetables, such as ipecacuanha; the pollen of many grasses and plants (*see* HAY-FEVER); certain chemical vapours, as that of pitch, sulphurous acid, and phosphorus fumes; the peculiar smell of some animals, as dogs, cats, horses, and hares, may each provoke a spasm in individual cases.

A still more powerful cause is climatic influence, the action of which on different patients cannot, unfortunately, be reduced within the limits of law, but depends mainly on the idiosyncrasy of the individual. Extremes of temperature, or excessive dryness or dampness, may produce an asthmatic seizure, but in the largest number of cases one of two elements appears as the chief factor. One large class of sufferers trace the attack to *dampness*, whether of soil or of atmosphere, in combination with either heat or cold; another to *closeness* of atmosphere and a want of proper circulation of air, such as is found in deep valleys and thick forests, and during thundery weather—this last class experiencing great relief when a breeze springs up. Malaria plays an important part occasionally in the causation of asthma.

Far more general and intelligible in its action is bronchial inflammation, which is the cause in 80 per cent. of asthmatic cases. It frequently happens that after whooping cough, measles, or infantile bronchitis the tendency towards asthma begins to appear. These diseases, implicating as they do both bronchial muscle and nerve supplying it, leave their mark behind, either in irritability of the mucous membrane; in induration of some portion of the lung, generally at the root; or in enlargement of the bronchial glands, causing pressure on the pneumogastrics, or on some of the branches of the pulmonary plexuses (*see* BRONCHIAL GLANDS, Diseases of); and thus we often find that the diseases which implicate the bronchial tubes in childhood lay the foundation of asthma in after-life.

Indirect causes.—This class of causes includes those acting through the general nervous system; those acting through the blood; as well as the more or less structural one of heredity.

The *centric* subdivision embraces attacks arising from emotion, anger, or fright; as well as the curious alternations of asthma, neuralgia, angina, and gastralgia due to some centric irritation in the medulla, involving the origins of the fifth and eighth pairs of nerves, and manifesting itself by affecting first one branch and then another of these nerves.

Excito-motor causes may be illustrated by indigestion or costive bowels giving rise to a paroxysm of asthma. In the first case, irritation of the medulla is induced through the gastric branches of the pneumogastric, and a motor effect is reflected through the pulmonary branches. These *peptic* attacks, as they are called, occur more frequently after suppers than dinners, probably because reflex irritability is always exalted by sleep, as we know to be the case in epilepsy and the teething convulsions of childhood.

Gout, towards old age, often takes the form of asthmatic seizures, which alternate with the articular affections. In like manner attacks of the disease have been attributed to syphilis.

The connexion between asthma and various kinds of skin-disease is intimate; the subsidence of eczema, of urticaria, or of psoriasis, has often been accompanied by fits of spasmodic breathing, which have ceased on the reappearance of the eruptions. Here, again, the state of the blood is presumed to be the origin of both maladies, as in disease of the kidneys, which will be again referred to.

Heredity can be traced in about 40 per cent. of asthmatics, though the tendency often does not show itself till late in life. The characteristic form of chest is often transmitted from parents to children; and even when this is not so, a disposition towards spasmodic symptoms in catarrhal attacks is often seen in the children of some asthmatics.

SYMPTOMS.—The patient retires to bed with few or no premonitory symptoms, and sleeps for some hours, but is disturbed in the late night or early morning—two A.M. is a common time—by a feeling of oppression approaching to suffocation, referred either to the throat, sternum, or epigastrium, which obliges him to sit up in order to breathe. Sometimes the onset is more gradual; the patient, having fallen asleep in spite of uneasy sensations, begins to wheeze during sleep, and is only aroused when the dyspnœa becomes severe. The breathing is accompanied by a humming sound, which gradually developes into a great variety of discordant noises.

In order to increase the capacity of his chest to the utmost, the asthmatic patient sits up and fixes his shoulders, either by placing his hands on either side of him, or by supporting his elbows by his knees; or sometimes he stands leaning over the back of a chair or other support. In one or other of these positions he remains immovable, with chest, back, shoulders, and head fixed; unable to speak or even to move his head; the lips being parted; the face pale, anxious, and, if the dyspnœa continue, livid; and the eyes prominent and watery. Every muscle of respiration, ordinary and extraordinary, is brought into requisition; those passing from the head to the shoulders, to the clavicles, and to the ribs become rigid, and, in place of moving the head and neck, act the reverse way, being used as fixed points to raise and dilate the thorax. The trapezii and levatores anguli scapulæ by their contraction elevate the shoulders, in order that the muscles connecting these with the ribs may act as elevators to the latter. Even the muscles of the back are pressed into the service, and they almost cease to support the back; consequently the patient stoops. At each inspiration the sterno-cleido-mastoids stand out like cords, leaving a deep hollow between their sternal attachments; the diaphragm is contracted, and hence the stomach, liver, and heart are somewhat displaced. With all this display of muscular force, the chest remains almost motionless, being expanded to a variable extent.

In spite of the great dyspnœa, respirations are not proportionately frequent, seldom exceeding thirty, and sometimes falling to nine a minute. The expiration is prolonged, being generally two or three times as long as the inspiration. The pulse is usually slow and feeble; the temperature rarely exceeds 99° Fahr., and is often below 98° Fahr. Analysis of the expired air shows the oxygen to be almost entirely replaced by carbonic acid, which may increase from the normal to as much as 11 per cent., the nitrogen varying from 89 to 93 per cent. The arrest of expiration is probably the cause of the accumulated carbonic acid, but the total disappearance of the oxygen is hardly to be explained, for that oxidation of the tissues does not proceed, is shown by the pale urine passed after the fit.

PHYSICAL SIGNS.—These reveal less than might be expected. The percussion-note is somewhat raised over the whole chest, most so in the posterior regions, where a drum-like sound occasionally prevails: this hyper-resonance is probably due to accumulation of air induced by obstructed expiration, and in incipient cases passes off with the attack.

Auscultation shows an entire abolition of the normal breath-sounds, and the existence of dry sibilant or sonorous rhonchi, everywhere varying in tone according to the calibre of the bronchial tubes; the smaller ones giving the high notes, and the larger ones the deep notes. These sounds continually change their position, springing up under the listening ear, and as quickly vanishing again to give place to profound silence.

PROGRESS AND DURATION.—A paroxysm of asthma, when once established, lasts from half an hour to several days, and generally terminates with expectoration—thin and transparent if the seizure be short; but abundant and more or less opaque if the fit be prolonged, or if the case be chronic. The urine is light-coloured and plentiful; and flatus is often expelled from the bowels. Little or no food is taken during the attack, at the close of which the patient falls asleep.

The recurrence of the attacks when once they have been excited is generally periodic, but much depends on the presence or absence of the exciting cause. In many cases the patient is quite free from wheezing and dyspnœa in the intervals, and feels and acts like other people; but when the attacks follow each other closely, a more or less wheezy condition remains behind, and a few signs of obstructed breathing are generally to be detected in the interscapular regions.

COMPLICATIONS AND SEQUELÆ.—If the asthmatic attacks become habitual, their effects are seen on the frame and on the organs implicated. The shoulders become raised, the head being buried between them; the muscles of the back, owing to their being called on to act as extraordinary muscles of respiration, are diverted from their use as erectors of the spine, which, accordingly, yields in the anterior direction, and the patient stoops. The frequent occurrence of spasmodic contraction of the bronchi causes hypertrophy of their muscular coat; and this, with or without the congestion of the mucous membrane accompanying it, leads in time to thickening of the tubes and permanent narrowing of their calibre. The more common result of asthma is emphysema, arising from the difficulty of expiration. The emphysema, at first temporary, becomes in chronic cases permanent, and gives rise to displacement of the adjoining organs (*see* EMPHY-

SEMA). Contraction of the bronchia largely influences the pulmonary vessels, and considerable obstruction of the pulmonary circulation is the result. The vessels become gorged, and sometimes the lungs œdematous. If the emphysema be extensive, we may in time expect dilatation of the right side of the heart and marked prominence of the veins of the breast and neck, and the effects may be carried so far as to cause œdema of the lower extremities with albuminous urine, as the writer witnessed in a case where the latter symptoms disappeared on the subsidence of the asthma.

PATHOLOGY.—Patients rarely, if ever, die of spasmodic asthma, though death may ensue from some of its complications and sequelæ; and the disease being a functional one, cannot be said to have any morbid anatomy. The onset and departure of the attack, and the ever-changing physical signs, led Laennec to think that, whatever obstruction in the bronchial tubes caused the phenomena, must be of a spasmodic and transitory nature. He therefore concluded that asthma was due to a spasm of the bronchial muscles which had been described by Reisseissen. Laennec also showed that an asthmatic sufferer could sometimes, after holding his breath, actually breathe naturally for one or two respirations, thus clearly demonstrating that the spasm was capable of momentary relaxation. Other theories were put forward, and doubt was thrown on the existence of muscular fibres in the bronchi, until Dr. C. J. B. Williams proved their existence by his experiments on the lungs of oxen, dogs, rabbits, and other animals, when he caused contraction of the trachea and bronchial tubes by the application of electrical, chemical, and mechanical stimuli. The muscular coat was shown to be more abundant in the smaller tubes than in the larger, the former contracting sufficiently to entirely obliterate their passages. In asthma, excitation of the muscle probably takes place through the anterior and posterior pulmonary plexûs, which are made up of branches from the pneumogastrics, recurrent laryngeals, the spinal nerves, and the ganglia of the sympathetic, thus giving the bronchial tubes a very wide area of connections. The branches of the pulmonary plexûs form a network round the bronchial tubes, and contain some minute ganglia. When the cause is direct, as dust of any kind or climatic influence, the spasm may be induced by reflex action through these small ganglia, or through the pulmonary plexûs, though it soon extends deeper into the nervous system, involving the pneumogastrics, and causing a motor effect on the thoracic muscles through the upper cervical, phrenic, and dorsal nerves. Where emotion, fright, or laughter starts the fit, the irritation is centric, and causes a motor effect on the pulmonary plexûs through the pneumogastrics. Where, again, indigestion excites it, the sensation passes through the gastric branches of the pneumogastric, and is reflected by the motor filaments of the pulmonary plexûs. Lastly, where gout, syphilis, skin-disease, and heredity are the excitants, we may regard the blood itself as causing the local irritation. Spasmodic asthma may, therefore, be considered as a neurosis of the pulmonary branches of the plexûs of that name, similar to other neuroses, as hemicrania and sciatica, and giving rise through the motor nerves of the plexûs to spasm of the bronchial muscle.

DIAGNOSIS.—Asthma is distinguished from *bronchitis* by the fugitive physical signs; by the spasmodic character of the dyspnœa; and by the scant expectoration. The breathing in bronchitis, if at all difficult, is hurried; in asthma it is slow, wheezy, and prolonged; this feature also contrasting strongly with the gasping, panting dyspnœa generally accompanying pneumonia, pleurisy, and some forms of heart-disease. From *croup* it is recognised partly, but not entirely, by the age of the patient; and partly by the character of the dyspnœa, which in croup is *inspiratory*, whereas in asthma it is mainly *expiratory*. This characteristic also distinguishes asthma from *spasm of the glottis* and the various forms of *laryngeal dyspnœa*. The diagnosis from *emphysema*, which is so often mixed up with spasmodic asthma, is founded chiefly on the paroxysmal character and violence of the asthmatic dyspnœa; and on the complete freedom of the intervals, the dyspnœa of emphysema being more or less permanent.

Aneurism of the aorta and other *mediastinal tumours* often give rise to symptoms so exactly simulating spasmodic asthma as to make the diagnosis difficult, and this is to be accounted for by these tumours pressing on the pneumogastric and its branches, and thus inducing an asthmatic spasm. These cases are, as a rule, however, accompanied by a certain amount of stridor arising from laryngeal spasm, not present in asthma, and this symptom is often of great diagnostic value in obscure cases. As the tumour enlarges, it causes greater pressure on the lungs, trachea, œsophagus, sympathetic ganglia, or other structures, and produces shrill cough, dysphagia, difficulty of inspiration, pain in the chest, impulse in the thoracic wall, and other noted aneurismal symptoms. Moreover, certain physical signs become evident, *e.g.* dulness over the first portion of sternum or to the right of it, or between the scapulæ; tubular sounds and bronchophony close to the sternum, or above one or both scapulæ; or some form of bruit or murmur in the course of the aorta. These and other symptoms and signs contrast sufficiently with those of spasmodic asthma, to make the diagnosis from developed aneurism comparatively easy.

In some cases of *renal disease* a form of dyspnœa appears, which is occasionally marked by paroxysmal features, and has been mistaken for spasmodic asthma. Renal dyspnœa differs, however, as a rule, in being more continuous; and in having for its origin œdema of the lung rather than bronchial spasm.

PROGNOSIS.—The question of recovery in cases of asthma depends to a certain extent,—

Firstly, on the possibility of the removal of the exciting cause;

Secondly, on the age of the patient;

Thirdly, on whether the attacks increase or not in frequency;

Fourthly, on the condition of the lungs and breathing in the intervals.

If the patient be young (say, under fifteen), the chest well-formed, the attacks tending to diminish in frequency and intensity, and the lungs free in the intervals, a most hopeful prognosis can be given. If, on the other hand, the patient be middle-aged, the attacks increasing in number and severity, and the breath more or less short in the intervals, we may conclude that there exists a considerable amount of permanent emphysema, which renders the prognosis of an unfavourable character. In every instance the detection and removal of the exciting cause or causes, as the case may be, exercise a chief influence over the prognosis.

Treatment.—The principal difficulty in the treatment of asthma lies in clearly ascertaining the origin of the irritation, and when this is discovered two great principles should guide us, namely, first, to avoid or remove the exciting cause; secondly, to allay and prevent the spasm.

Many of the cases arising from direct causes, as from dust, chemical vapours, &c., are cured by simple avoidance of the exciting cause. Where bronchial inflammation induces the spasm, the inflammation must be subdued by salines and expectorants, combined with some anti-spasmodic, as belladonna, henbane, or stramonium. In more chronic instances, where some thickening of the walls of the larger bronchi and enlargement of the bronchial glands exist, iodide of potassium in doses of grs. iii. to x., has been found beneficial when persisted in for long periods. Where the attacks depend on a morbid state of blood, as that associated with gout, syphilis, renal disease, or connected with skin disease, treatment must be directed to the condition of this fluid, which, if improved, will no longer induce bronchial spasm. Arsenic proves of signal service in asthma co-existing with eczema, psoriasis, and other skin-affections.

Where heredity is the predisposing cause, the origin of the disease lies generally in defective development of the frame or of the lung-structure of the patient: for such persons gymnastic exercises, swinging on the trapeze, and other means of expanding the upper part of the chest and correcting the asthmatic stoop are to be employed, combined with cold sponging and as much outdoor life as possible, with walking and riding in moderation. The tendency to catarrh is thus lessened, and the frame of the patient developed and fortified. In a large number of cases, as, for instance, those arising from climatic influences, we have to treat a simple neurosis, and to allay the spasm either by climatic or by medicinal means, of which the former is often the more important, and, owing to the leading part played by the idiosyncrasy of the patient, generally the most difficult. In obstinate cases the doctrine of contrasts appears the only safe one. Where the disease has been contracted in a moist climate, a dry one must be tried; if in an inland district, the seaside must be resorted to; but for by far the majority of asthmatics the atmosphere of large towns is suitable, and the smokier the air and the closer the streets the more good do the sufferers appear to receive. London, Glasgow, Birmingham, and Bristol are all favourable resorts for cases of neurotic asthma: and the points of difference between their atmospheres and that of the country consist, (1) in dryness; (2) in deficiency of oxygen; and (3) in excess of carbonic acid and carbon: all of which peculiarities appear to exercise a sedative effect on the neurosis. Damp, whether of soil or atmosphere, is usually found to be hurtful, and is one of the chief exciting causes of asthma.

The *medicines* most useful in asthma are anti-spasmodics, either stimulant or sedative: the former, including alcohol, strong coffee, spiritus ætheris, and nitrite of amyl, will prove more efficacious where emphysema is present; the latter comprise stramonium, belladonna, Indian hemp, lobelia, tatula, tobacco, opium with its salts, and many other drugs. These may be taken internally in the form of extracts or tinctures; or smoked in pipes or as cigarettes; or inhaled as vapour diffused through the room by burning papers or pastilles containing them. A popular and often reliable remedy is the vapour arising from the combustion of nitre-paper. In the severest attacks the patient can neither smoke nor swallow, and in this difficulty of introducing medicines into his system we find the hypodermic injection of atropine, morphia, and chloral proves effectual; but if emphysema be present, or if the pulse be weak, it must not be attempted. Chloroform often acts like a charm in the worst case, and after inhaling 20 to 60 minims the patient will gain the sleep which has been denied to him for hours, or even days; but the effect is generally transitory, and the use of the remedy not free from risk. Ether is safer, but not so effective. Chloral-hydrate in doses of 15 to 20 grs., repeated every four hours until the spasm subsides, has produced not only temporary, but even permanent good in a large number of asthmatic cases, and if watched, may be persisted in for some time. In the writer's hands it has proved the most successful remedy. In the use of anti-spasmodics we must avoid judging the effects of one from the failure of another of the same class; but in difficult cases we must try each in succession—for it often happens that the successful remedy is only arrived at after repeated trials.

Certain mineral waters, and especially those of Mont Dore and the Pyrenean sulphur springs of Eaux Bonnes, Eaux Chaudes and Cauterets, are reputed to exercise a beneficial influence over asthma, but they have not been successful in the writer's experience, and it is more probable that they relieve by reducing the catarrhal symptoms than that they either allay the spasm or prevent its recurrence.

Compressed air baths at pressures varying from $3\frac{1}{3}$ to 7 inches of mercury, and lasting two hours, have afforded considerable relief. *See* Air, Therapeutics of.

The *dietetic* treatment varies in individual cases, but as a rule asthmatics should dine early, and for the rest of the day limit themselves to liquid food, such as beef-tea, soups, and milk, combined with such an amount of stimulant as may be necessary, thus avoiding any distension of the stomach and intestines before retiring to rest. The diet should consist of brown bread, toast, and biscuits—excess of starch in any form being studiously avoided—a fair supply of plainly cooked meat, fish or poultry, and a limited amount of vegetables and fruit, care being taken to select only the most digestible of each class.

C. Theodore Williams.

ASTIGMATISM — ASTIGMISM (ἀ, priv., and στίγμα, a spot or point).—Want of symmetry in the anterior refracting surfaces of the eyeball, in consequence of which rays of light proceeding from a point cannot be brought to a focus upon the retina as a point, but only as a diffused spot. *See* Vision, Disorders of.

ASTRINGENTS. — Definition. — Medicines which cause the contraction of tissues.

Enumeration.—The chief astringents are Nitrate of Silver; Sulphate of Copper; Sulphate of Zinc; Acetate of Lead; Perchloride of Iron; Alum; Tannic and Gallic acids, and vegetable substances containing them, such as Oak Bark, Galls, Kino, and Catechu; and Dilute Mineral Acids. Some authors also include in this class of remedial agents such articles as Ergot of Rye, which contracts the blood-vessels and lessens hæmorrhage after it has been absorbed into the blood, although it has no local astringent action.

Action.—With the exception of gallic acid, the substances already mentioned coagulate or precipitate albumin. Dilute mineral acids do not coagulate albumin, but precipitate many albuminous bodies from the alkaline fluids by which they are held in solution. When applied to a surface from which the epidermis has been removed, the other astringents combine with the albuminous juices which moisten this surface, as well as with the tissues themselves, and form a pellicle more or less thick and dense, which in some measure protects the structures beneath it from external irritation, at the same time that they cause the structures themselves to become smaller and more dense. On a mucous membrane they have a similar action, and they lessen its secretion. It was formerly supposed that their action was partly due to their causing the blood-vessels going to a part of the body to contract, thus lessening the supply of fluid to it; as well as to their effect on the tissues themselves. But experiment has shown that, while nitrate of silver and acetate of lead possess this power, perchloride of iron and alum do not, and that tannic and gallic acids actually dilate the vessels. The astringent action of these latter drugs must therefore be exerted upon the tissues.

Uses.—Astringents may be employed *locally* in various forms. In the solid form, as a powder, or in various preparations, such as lotions, ointments, plasters, glycerines, &c., they are applied, especially the metallic astringents, to wounds and ulcers for the purpose of reducing the size and increasing the firmness of exuberant granulations, as well as of protecting the surface by forming a pellicle over it. They are used to lessen congestion and diminish the secretion of the various mucous membranes —as a lotion to the eye and mouth; as a gargle or a spray to the throat; in the form of an injection to the nose, urethra, and vagina; and as a suppository to the rectum. Administered internally several astringents have a powerful effect in checking diarrhœa, and certain of them may have a local action upon the stomach and intestines.

The *remote* action of such astringents as acetate of lead and gallic acid, when absorbed into the blood, in lessening hæmorrhage, is made available in the treatment of hæmoptysis, hæmatemesis, hæmaturia, and loss of blood from other parts of the body.

T. Lauder Brunton.

ASTURIAN ROSE.—The rose or erythema of the Asturias; one of the numerous synonyms of Pellagra—*Mal de la rosa; Lepra Asturiensis; Elephantiasis Asturiensis. See* Pellagra.

ATAVISM (*atavus*, a grandfather) signifies the inheritance of a disease or constitutional peculiarity from a generation antecedent to that immediately preceding.

ATAXIA
ATAXIC } (ἀ, priv., and τάξις, order). — Terms which originally meant any irregularity or disorder, but are now specially applied to irregularity of associated or co-ordinated muscular movements. The noun is frequently used as synonymous with the disease known as Locomotor Ataxy. *See* Locomotor Ataxy.

ATELECTASIS (ἀτελὴς, imperfect, and ἔκτασις, expansion).—Absence or imperfection of the expansion of the pulmonary alveoli which normally takes place at birth, the lungs thus remaining more or less in their fœtal condition. *See* Lungs, Collapse of.

ATHEROMA. *See* Arteries, Diseases of.

ATHETOSIS (ἄθετος, without fixed position).—Definition.—A name given by Dr. Hammond of New York to a condition in which the hand and foot are in continual slow irregular movement, and cannot be retained in any position in which they may be placed.

Description.—The special character of the movements in athetosis is that they are slow and deliberate. They usually affect the arm and leg on one side only. Voluntary power is retained, but is interfered with by the slow spasm. The fingers are irregularly flexed and extended: at one moment they spread wide apart, the thumb being overstretched; thereafter first one, then another is bent in to the palm, and again extended. The movement can be arrested for a moment in certain positions by the will, but is renewed with increased force. The foot is usually inverted; the toes being flexed or extended, but in less constant movement. The spasm may cause pain. The muscles sometimes become hypertrophied. The movements in some cases cease during sleep, in others they do not. Sensation is often, but not always impaired. The onset of this condition is usually sudden, and in some cases with a convulsion. The subjects have been generally in middle life.

Athetosis differs from the spastic contracture so common after hemiplegia in children in the slowness and spontaneity of the movements; but the two conditions are probably very closely allied. It cannot be regarded as a distinct disease. Typical athetosis may succeed hemiplegia.

Pathology. — It is probable that, as Dr.

Trinity Medical College

Hammond suggests, the seat of the mischief in athetosis is the corpus striatum or optic thalamus. The sudden onset of the disease, and the slight affection of sensation, render it probable that a lesion damaging, but not destroying, a portion of one of these nuclei, leads to a perverted action of the nerve-cells, so that abnormal motor impulses are originated, and those transmitted from above disturbed—'irradiated' (Nothnagel). Charcot believes that all post-hemiplegic choreoid movements depend on the implication of fibres outside the optic thalamus. In a case of simple ataxy after hemiplegia—an analogous condition,—the writer has found a cicatricial sclerosis extending across the optic thalamus, and probably left by a patch of softening.

PROGNOSIS.—This is unfavourable, but the slighter cases improve and may even approximately recover.

TREATMENT.—Nervine tonics and sedatives are the remedies chiefly indicated. Of the former arsenic, and of the latter Indian hemp, do most good; bromides are also useful. The continuous current is perhaps the agent which affords most distinct relief. In one well-marked case under the writer's care the spontaneous movements ceased entirely after some months' galvanisation. The positive pole may be placed on the spine or brachial plexus, the negative on the muscles involved. The action of the continuous current is probably in part direct, in part reflex, lessening by the peripheral impression the over-action of the centre, as do some other peripheral impressions.

W. R. GOWERS.

ATONIC } **ATONY** } (ἀ, priv., and τόνος, tone).—Terms implying want of tone, power, or vigour, and associated either with such a condition of the system generally, or of particular organs, especially those which are contractile.

ATRESIA (ἀ, priv., and τίτρημι, I pierce).—Absence of a natural opening or passage, whether congenital or caused by disease.

ATROPHY, GENERAL.—SYNON.: Marasmus.

DEFINITION.—Atrophy means, etymologically, simply want of nourishment (ἀ, priv., and τροφή, nourishment), but the term is commonly applied to the condition resulting from want of nourishment, namely, wasting or diminution in bulk and substance, even though this may have been produced by some other cause, and even though the supply of nutritive material may have been abundant. *General atrophy* is used to denote wasting in which the whole body participates. All acute diseases, if severe, are accompanied by emaciation, for at such times nutrition is temporarily interfered with. The use of the word 'atrophy' is, however, confined, as a rule, to cases where the interference with nutrition has been gradual, and the loss of flesh consequently slow.

ÆTIOLOGY.—Atrophy is common enough at all periods of life. In infants and children it is due, in the majority of cases, to chronic functional derangements which interfere with the digestion and elaboration of food. Less frequently it is a consequence of organic disease. In adults general atrophy seldom results from any other cause than organic disease, and functional disorder as a cause of serious wasting is the exception. In old age atrophy is a common consequence of the degenerations of tissue which accompany the decline of life. The interference with nutrition may, however, be aggravated by the presence of disease.

In *infants under twelve months old* there are four principal causes to which chronic wasting can usually be referred, namely, unsuitable food; chronic vomiting (gastric catarrh); chronic diarrhœa (intestinal catarrh); and inherited syphilis. Bad feeding, by setting up a chronic catarrhal condition of the stomach and bowels, is a frequent cause of both vomiting and diarrhœa, but it may produce atrophy without either of these symptoms. When an infant is fed, for instance, with large quantities of farinaceous matter—a form of food which is alike indigestible and innutritious—a very small part only can enter as nutriment into the system. The remainder passes down the alimentary canal, and is ejected at rare intervals in an offensive putty-like mass or in hard roundish lumps. The child, therefore, although overloaded with food, is really under-nourished, and loses flesh as long as such a diet is persisted in. If, as often happens, diarrhœa or vomiting be set up by the irritation to which the digestive organs are subjected, wasting is more rapid and the danger of the case is increased. Any form of bad feeding, and not only excess of farinaceous matter, will produce this result. Wasting, indeed, will be found in every case where the food selected is unfitted for the child, and thus it is not unfrequently seen in infants who are fed upon milk and water alone. The casein of cow's milk is difficult of digestion by many infants on account of its tendency to coagulate into a large firm clot like a lump of cheese. In this respect it differs from the curd of human milk, which forms light small flocculent coagula, and is digested without difficulty. Special preparation is therefore generally required to render cow's milk a suitable diet for a young child.

It is not only, however, unsuitable food which is a cause of atrophy in infants. Catarrh of the stomach and bowels may be present, although the feeding is in all respects satisfactory. Infants are excessively sensitive to chills, and catarrh of their delicate digestive organs is easily excited. Now, catarrh of a mucous membrane is always accompanied by an increased flow of mucus, and this alkaline secretion in excess acts as a ferment and sets up decomposition of food. A sub-acute gastric catarrh from this cause is not rarely seen in new-born infants, who thus are rendered for the time incapable of digesting even their mother's milk. In such cases the fault is usually attributed to the milk, which is said to be unsuited to the child; and the mother is compelled, much against her will, to wean her baby and feed it in a different way. So long as the catarrh continues, however, no food appears to agree, and the child often after a time dies exhausted.

Between *one and three years* atrophy is commonly associated with rickets. In these cases the wasting is noted chiefly about the chest and limbs, for the belly is large and swollen from flatulent accumulation. At this age children are still liable to waste from catarrh of the stomach and bowels: indeed, rickets is itself often complicated by such derangements. Cancer of the internal organs is also sometimes found at this time of life, and is attended with extreme emaciation.

After the age of three years caseous enlargement of the mesenteric glands becomes a cause of wasting.

After the fifth or sixth year chronic pulmonary phthisis begins to appear. Cases of heart-disease as a result of acute rheumatism are also more frequently seen. Diabetes, too, is sometimes met with. All these diseases may produce much interference with nutrition.

From the time that the child begins to take other food than that furnished by his mother's breast, he is liable to worms in the alimentary canal. The presence of worms is frequently accompanied by loss of flesh, not, perhaps, so much on account of the parasites themselves, as on account of the derangement of the digestive organs which is associated with them. Emaciation due to this cause may sometimes be extreme.

In the adult atrophy is rarely the result of mere functional derangement, but is almost invariably a sign of serious organic disease. All chronic ailments are not, however, accompanied by marked wasting. Purely local diseases lead to little loss of flesh unless they affect some part of the digestive apparatus, or of the glandular system which is concerned in the elaboration of nutritive material; or otherwise directly influence the processes of nutrition. Thus, emaciation quickly results from gastric ulcer or chronic dysentery, but chronic pneumonic phthisis may produce little diminution in weight if there is no pyrexia, and if the case is not complicated by diarrhœa or profuse expectoration. The most marked atrophy is produced by the so-called constitutional diseases, such as cancer and syphilis in the third stage; by those which set up a persistent drain upon the system, such as severe albuminuria, chronic hæmorrhages, and long-continued suppurations; or by those which directly impede the passage of nutritive material into the blood: and in the latter class of diseases, influences which act directly upon the thoracic duct, such as obstruction to its passage from pressure by aneurism and other tumours, must not be overlooked. There is a form of atrophy sometimes seen in hysterical females, depending upon disordered innervation, in which the most extreme emaciation may be reached. Such cases are marked by a dislike to food which may amount to absolute loathing.

Symptoms.—The symptoms of general atrophy are loss of flesh, loss of colour, and loss of strength, combined with other special phenomena arising from the particular disorder to which the impairment of nutrition is due.

Anatomical Characters.—The most marked post-mortem appearance in this condition is diminution or loss of fat, especially of the subcutaneous adipose tissue; and this is accompanied by wasting of the tissues and organs generally. The histological elements are reduced in size without undergoing, as a rule, actual numerical diminution. With the atrophy is often associated a certain amount of fatty degeneration.

Treatment.—The treatment of general atrophy consists in removing, if possible, the impediment to efficient nutrition. In the case of a child the diet must be selected with care. Excess of farinaceous food is to be avoided, and cow's milk can be diluted, if necessary, by admixture with thin barley water. Any gastric or intestinal derangement must be at once remedied, plenty of fresh air should be obtained, and perfect cleanliness strictly enjoined. In an adult the disease which is the cause of the malnutrition must be sought for and submitted to treatment. Efforts should be made on the one hand to arrest any drain upon the system; and, on the other hand, by a judicious arrangement of the dietary, and by attention to the eliminatory organs, to remove all obstacles to the entrance of nourishment. Even in cases of organic and incurable disease much benefit may often be derived from due observance of physiological laws.

Eustace Smith.

ATROPHY, LOCAL.—This condition signifies atrophy of a *part* of the body, which may be apparently congenital, or may be produced by various causes acting during life. It will be convenient to consider local atrophy according to the several forms which are met with.

Congenital Atrophy is that condition in which some part of the body never reaches its full standard of size. It is more correctly denominated *arrested growth* or *congenital smallness.* When the whole of one side of the body is thus affected, a marked and permanent disproportion between the two sides results. This *hemiatrophy* is, in theory, difficult to distinguish from hypertrophy of the opposite side, but mostly the paralytic or enfeebled state of the atrophic side shows it to be abnormal. The limbs are most strikingly implicated, while the corresponding side of the face and head is sometimes similarly, sometimes conversely affected. In many cases atrophy of the opposite half of the cerebrum was found on post-mortem examination. The same condition may be partial—*hemiatrophia partialis*—and it then chiefly affects the face, or some part of the territory of the fifth cranial nerve. These conditions must be ascribed to some perversion of innervation occurring during development. Other congenital atrophies, *local* but not *hemi*-atrophic, are more probably referred to obstruction of blood-vessels during the same process. The defective development of the brain in cretinism has been attributed to the pressure of an enlarged thyroid upon the carotid arteries.

Physiological Atrophies.—These form a distinct class, where atrophy of a part of the body takes place in the ordinary course of development. Such are the wasting of the thymus gland in early life, of the mammæ and sexual organs after middle age. Most commonly the atrophy is here closely connected either with the involution or perhaps the development of some correlated organ; but it is not possible to say what the nature of this connection is, whether one of nutrition or of innervation.

Acquired Atrophies.—The conditions thus distinguished possess most interest for the practical physician. Wasting of any part of the body during life, when not physiological, usually depends either upon some interference with the blood-supply, or some disturbance of innervation; but to these must be added, in the case of organs which have an active and continuous function, disuse or over-stimulation. Deficient blood-supply, which causes atrophy, may be produced by the obstruction of a nutrient artery, especially if it be gradual, since sudden blocking will produce more complicated phenomena. Constant pressure is a cause of atrophy, because it interferes both with the blood-supply, and with the vital actions of the tissue-elements. Intermittent pressure, on the other hand, by causing hyperæmia, is more likely to lead to hypertrophy. Moreover, inadequate renewal of blood, that is, filling of the vessels, even to excess, with venous blood, or venous engorgement, though at first it may cause enlargement mostly leads to atrophy in the end; as is seen in the granular induration of liver and kidneys caused by disease of the heart obstructing the circulation. Many forms of atrophy in old age are clearly dependent upon senile obstruction of the arteries, for example, that of the skin, spleen, and kidneys. The instances of atrophy from disturbed innervation are less easy to discriminate, except where there is actual paralysis. In two distinct diseases, however, *progressive muscular atrophy* and *infantile* or *essential paralysis*, loss of power in the muscles is followed by a remarkable wasting, far more rapid than that which results from disuse alone. Division of the nerve of a limb produces rapid wasting of the muscles no longer used, and this is accompanied in the end by some diminution in the size of the bones and accessory parts. Local atrophy of the skin is sometimes seen in regions limited by the distribution of a nerve, especially some branch of the fifth; and more extensive atrophy of one side of the face or head, equally marked out by nervous distribution, and resembling some cases of congenital atrophy, has also been, though very rarely, observed. These facts raise the interesting question whether there are 'trophic nerves.' Without discussing this question, it may be pointed out that the nerves which delineate an atrophic region are always motor or mixed branches, never solely sensory.

Disuse produces atrophy only in organs whose functions are active and constant, such as nerves and muscles. Nervous tissue wastes constantly, and sometimes rapidly when currents cease to traverse it. This is seen not only in the nerves of paralyzed limbs, but even in the nerve-centres, where any interruption of the nervous channels, either above in the cerebrum, or below in the nerve-trunks, is followed by degeneration, ending in atrophy, of the whole nervous tract leading from the cerebral cortex to the peripheral termination—so called *secondary degeneration* of the cord. In muscular tissue the wasting is almost as constant, but hysterical paralyses make an exception, the helpless limbs preserving their nutrition in a surprising manner. In organs whose functions are intermittent or periodic, disuse does not appear necessarily to produce atrophy, as is seen in the ovaries, testicles, and mammæ.

That excessive stimulation or over-work may produce atrophy is seen in degenerative diseases of the nerve-centres arising from undue mental activity; and of the sexual organs from excessive indulgence.

Unexplained Atrophies.—Cases of local atrophy occur of which it is impossible to give any satisfactory explanation. Such are the conditions known as linear atrophy of the skin; some remarkable cases of atrophy of bone, especially of the skull (*fragilitas ossium*), and of some parts of the cerebrum. We may have to attribute to changes of the latter class just mentioned, certain peripheral atrophies, without being able to account for the original lesion.

It is possible that deficiency of special kinds of food may lead to atrophy of special organs—thus deficiency of lime may make the bones soft, and deficiency of iron arrest the development of blood-corpuscles; but even these familiar instances must be accepted with a little reserve. In the same way it is still doubtful whether any special drugs, such as iodine, can produce atrophy of special glands.

PATHOLOGY.—Wasting may occur simply, or as a consequence of change of substance, or from the intrusion of some new material; in other words, there may be *simple* atrophy, atrophy from *degeneration*, or atrophy by *substitution*. The first is probably rare; generally some change of substance occurs. The most frequent degenerative process is fatty degeneration; the albuminous substance being converted into or replaced by fat, which, if afterwards absorbed, leaves a void. Organs thus affected may be apparently enlarged, though the original substance is wasted. Atrophy from substitution is seen when the connective tissue of an organ, for instance, increases, compressing and destroying the other tissue-elements, and these not being renewed when the newly-formed connective-tissue is absorbed, the whole organ is diminished in bulk. This is seen in all the changes called cirrhosis or fibroid degeneration, as in cirrhosis of the liver and kidneys.

TREATMENT.—No general rules can be laid down for treating all cases of local atrophy. Where the blood-supply is deficient, we have rarely any means of supplementing it; where innervation is at fault, it is seldom under our control. In general, harm rather than good results from any attempt to attract blood by artificial irritation. In the case, however, of atrophy from disuse of the nervo-muscular system, a line of treatment, and more especially of prophylaxis, is very clearly indicated; that is, to keep the muscles in exercise by artificial means, particularly by electricity, or by the processes of friction and kneading, known as passive motion. In this way so much of the atrophy as is due simply to disuse may be checked for the future, and even the past loss reinstated. We shall, moreover, never do harm by attempting to supply some special kind of food which appears to be deficient, as iron for the blood and phosphorus for the bones or nervous system.

J. F. PAYNE.

AUDITORY NERVE, Diseases of. *See* Ear, Diseases of; and Hearing, Disorders of.

AURA (*αὔρα*, a breeze).—A peculiar sensation, subjective in origin, immediately preceding an epileptic or hysterical convulsion, and named respectively *Aura Epileptica* and *Aura Hysterica.* The word was originally adopted because the sensation is often described as that of the passage of cold air or light vapour from the trunk or extremities to the head; but it has been extended so as to include any phenomenon, whether sensory or motor, that ushers in a fit of epilepsy or of hysteria.

AURAL DISEASES. *See* Ear, Diseases of.

AUSCULTATION (*ausculto*, I listen).—A method of physical examination, which consists in listening over various parts of the body, either by the direct application of the ear (*immediate auscultation*), or by the aid of special instruments (*mediate auscultation*), for the purpose of studying certain sounds produced in health and disease. *See* Physical Examination.

AUSCULTATORY PERCUSSION.—A method of physical examination in which the sounds elicited by percussion are studied by means of auscultation. *See* Physical Examination.

AUSTRALIA. *See* Appendix.

AUTOPHONIA (*αὐτὸς*, itself, and *φωνή*, the voice).—A physical sign obtained by studying the modifications of the resonance of the observer's own voice during auscultation. *See* Physical Examination.

AUTOPSY. *See* Necropsy.

AZORES, St. Michael's.—Warm, very moist, equable climate. Mean winter temperature 58° F. Prevailing winds N. and E. *See* Climate, Treatment of Disease by.

AZOTURIA.—A condition of the urine in which there exists an absolute and relative excess of urea, without accompanying pyrexia. *See* Urine, Morbid Conditions of.

B

BACILLUS (from *bacillum*, a little staff) is the name now given to certain filiform *Bacteria* which have assumed much importance of late, principally because of their constant presence in the blood and tissues in splenic fever and malignant pustule. *See* Leptothrix, and Bacteria; also Pustule, Malignant; and Bacilli in Appendix.

BACTERIA (*βακτήριον*, a rod) are some of the lowest known forms of life. They most frequently exist as minute rod-like bodies, about $\frac{1}{10000}$ inch in length, with a slight median constriction. They may be larger or smaller than this, and may present minor variations in form. They swarm in all putrefying solutions and mixtures of organic matter, and in many fermenting fluids in which the chemical changes are not accompanied by an emission of stinking gases. In fluids belonging to the latter category, the typical *Torula* or yeast-cell may be met with, as well as organic forms strictly intermediate between it and the typical Bacterium. From a chemical point of view, it is admitted that no absolute line of demarcation can be drawn between the intimately related processes of *putrefaction* and *fermentation*; whilst from a biological point of view we are similarly unable to erect any impassable barriers between the organic forms which are found as part of the products of change in putrefying and fermenting fluids respectively. It is unquestionably true that typical Bacteria are most frequently met with in putrefying fluids; whilst, on the other hand, typical Torulæ are only present in some fermenting fluids. But the rather long rod-like bodies, which have been hitherto named *Vibriones*, and the still longer filaments mostly known as *Leptothrix* (*see* Leptothrix), are unquestionably capable of being derived from ordinary Bacteria in certain media.

In the most highly putrescent fluids Bacteria are usually found to be very small, because, though the total bulk of living things rapidly augments in such fluids, the individual units (in consequence of the frequency with which a process of fission takes place) do not increase in size. In less putrescent fluids, however, where the chemical changes constituting the putrefactive process take place more slowly, the living forms also appear and grow with less rapidity; and owing to the co-existence of a lower frequency of fission or spontaneous division amongst such individual living units, they often attain a larger size. They then appear, according to their length, either as Vibriones or as Leptothrix filaments. These are plain, jointed, or monilated, according as partial segmentation is absent, has taken place rarely, or has occurred so rapidly as to give what would have been a plain filament the appearance of a string of beads.

Concerning the question of the precise relation of organisms to the processes of putrefaction and fermentation, opposite opinions are at present held. Believers in Pasteur's germ-theory maintain that they are invariably the initiators of these chemical processes; whilst those who reject this theory, as being too exclusive, contend that putrefaction and fermentation *may* be initiated in the absence of Bacteria and their germs. Those holding the former view believe that Bacteria are only capable of being derived from pre-existing organisms of like kinds; whilst those who reject it contend that particles of living matter, which develop into Bacteria, may be generated from the organic compounds dissolved in fermentable fluids, and that such particles of living matter are, in fact, just as much products of the fermentative process and of the fluid in which it occurs, as are the gases simultaneously generated therefrom. According to this view, these lowest living units bridge the gap hitherto held to exist between living and so-called dead matter, and afford an illustration of the natural independent origin of chemical compounds so complex and endowed with such attributes as to win for them the name of 'vital' compounds. (See *Proceedings of the Royal Society*, No. 172, 1876, pp. 149–156.)

Pasteur's 'Vital theory' of fermentation is one of great importance both to chemists and biologists, and it also forces itself upon the attention of medical men, as the parent of another doctrine which has of late assumed great prominence in relation to the science of medicine—the doctrine, namely, that lower organisms allied to those met with in putrefying and fermenting media are causally related to certain morbid processes with which they either do, or are said to coexist. Bacteria and their allies are as uniformly coexistent with a few general diseases and certain local morbid processes as they are with putrefactions and fermentations, so that the same general question as to the precise significance of this coexistence again presses for solution. Are the organic forms associated with such morbid processes the sole causes or inciters of these processes? or are they consequences (*i.e.* concomitant products) of pathological processes which have been *initiated* in their absence? The former view is warmly supported by many who regard Bacteria and allied organic forms as the contagious elements of such communicable diseases; and many of these same pathologists, resting upon analogy, wish to extend their theory, so as to make it applicable to many other communicable diseases with which organic forms have not as yet been shown to be correlative.

Thus, just as certain chemists hold that Bacteria and allied forms are the causes of all fermentations and putrefactions, so certain pathologists either do actually, or are inclined to maintain that Bacteria and allied organisms of common or of special kinds are the causes of all communicable or contagious diseases. According to such chemists all *ferments* are living organisms; and according to such pathologists all *contagia* are allied living organisms.

The coexistence of organisms is one which obtains for almost all fermentations, but only for a few of the communicable diseases, so that any argument deducible from such mere coexistence in favour of the causal relationship of the organisms, is much stronger in the case of fermentations than as regards diseases. Yet, in spite of the almost universal coexistence of organisms with fermentations, it is still necessary for us to ask whether they appear as causes or as effects of these phenomena. From this it may be judged how little the more limited 'facts of coexistence' should be allowed to influence our opinion on the derivative question of the relation of the lower organisms to disease. At least one of the reputed instances in which this coexistence of organisms has been dwelt upon, as showing that they are the causes of the morbid phenomena with which they are associated, has of late been dissipated, since in the case of the small-pox of sheep (*variola ovina*) the alleged organisms are now admitted to have no existence—certain appearances produced in the tissues by preservative media having been mistaken for organisms which have been elaborately described and figured. (See *Proceedings of the Royal Society*, No. 172, 1876, p. 140.) But even if all the alleged cases of coexistence of organisms with morbid processes were real, and if future investigations should show that such facts are more numerous than are at present imagined, still the multiplication of this evidence to any extent will never help us (any more than it has done in the case of fermentations) to solve the real question—whether such morbid processes are only caused and propagated by organisms, or whether they may at times come into existence independently?

The vital or germ-theory of fermentation would be broken down and become untenable whenever it is shown that fermentation can originate independently of the Bacteria and their germs which appear as part of the process. Similarly, the germ-theory of disease would be refuted, if it could be shown that some of the morbid processes in question could originate in the absence of the living organisms which subsequently appear as part of the pathological products. The latter refutation, however, could never be made directly, since no living being could in any circumstance whatsoever be proved —in an experimental sense—to be beyond the possible reach of some of the alleged disease-germs. But inasmuch as this problem is, from its very nature, one which does not admit of experimental proof or disproof in the strictest sense of the term, and because this germ-theory of disease is clearly a derivative doctrine from the germ theory of fermentation, it must stand or fall with the germ-theory of fermentation, which, fortunately, is capable of experimental proof or disproof. The question of 'spontaneous generation' comes, therefore, to be inextricably mixed up with the question of the truth or falsity of the germ-theory of disease, so that the study of the latter to the neglect of the former can only end in the propagation of vagueness and uncertainty. The real question is not as to the extent or frequency of the coexistence of organisms with local or general diseases, but the much more important one as to the nature of their relation to such processes. If they act as invariable and sole causes, then their presence is a matter of the deepest interest and importance. If, on the other hand, the organisms are not causes but rather concomitant products, their presence from a purely medical point of view is of trifling importance. The study of their growth and development would in that case be important only as adding to our knowledge of the structural changes pertaining to the diseases in question. *See Transactions of the Pathological Society*, vol. xxvi., and *Journal of the Linnæan Society*, vol. xiv. *See* also the articles MICROCOCCI; PUSTULE, MALIGNANT; and ZYME.

H. CHARLTON BASTIAN.

BADEN-BADEN in Germany. Thermal saline waters. *See* MINERAL WATERS.

BADEN in Austria. Thermal sulphur waters. *See* MINERAL WATERS.

BADEN in Switzerland. Thermal sulphur waters. *See* Mineral Waters.

BADENWEILER in Germany. Simple thermal waters. *See* Mineral Waters.

BAGNÈRES-DE-BIGORRE in France. Simple thermal and earthy waters. *See* Mineral Waters.

BAGNÈRES-DE-LUCHON in France. Thermal sulphur waters. *See* Mineral Waters.

BALANITIS — BALANOPOSTHITIS (*βάλανος*, an acorn, and *πόσθη*, the foreskin).—Synon.: Bastard Clap; Blennorrhagia Balani; Inflammatory Phimosis.

Definition.—Inflammation of the opposing surfaces of the glans and prepuce; sometimes acute—even gangrenous, and sometimes chronic. A purely local affection; frequently, but not necessarily, of venereal origin.

Ætiology.—Balanitis is much less common than urethritis, being met with at the Lock Hospital in the proportion of one to twenty-four of the latter. It may be either primary; or consecutive to chancres, syphilitic eruptions, warts, accumulated smegma, variolous pustules, or gonorrhœa. When primary, the common *predisposing* cause is a long, narrow foreskin. Fournier attributes two-thirds of the cases of balanitis to a long prepuce with insufficient cleansing; about one-third to irritation by chancres and gonorrhœal pus; and a very few to other causes.

Symptoms.—The symptoms of balanitis depend on the intensity and extent of the inflammation. In the simplest form there is heat and itching of the furrow, slight redness of that part, with a milky or yellowish secretion. When the inflammation is more severe and extended, swelling and pain are added, the other symptoms are more marked, and characteristic excoriations appear. They are irregular, shallow, never extending more deeply than the epithelium, but often coalescing into large raw chafings. An abundant yellowish-green matter of offensive odour bathes the surface. When the urine trickles over these excoriations there is severe smarting pain. If still further irritated, the foreskin swells enormously, is divided at the free border by deep creases, and can no longer be turned back. Aching, smarting, great tenderness, and painful erection, often accompanied by constitutional disturbance and fever, are present.

Complications.—The cellular tissue and the lymphatic ducts of the foreskin and sheath, or the lymphatic glands, may inflame to suppuration, to ulceration, and, in persons enfeebled by any cause, even to gangrene. Sloughing begins on the inner surface of the foreskin at the upper part; seldom to much extent, though the whole prepuce, except the frænum, may be lost, and when cicatrisation sets in the organ appears circumcised. Paraphimosis is caused by imprudent retraction of a swollen foreskin. Warts keep up chronic posthitis of the furrow. Adhesions, usually at the corona and the furrow, may attach the prepuce completely to the glans. Thickening and phimosis are not uncommon after repeated attacks.

Course.—The duration of balanitis depends on the anatomical condition of the parts. When remedies can be easily applied, it is not more than three or four days. With phimosis, the course is severe, and the duration is indefinite; even when limited to the furrow, posthitis is often obstinate.

Diagnosis.—This is easy when the parts can be exposed. *Herpes* is distinguished from balanitis by small grouped round ulcers, limited to one or two points of the mucous surface, without general congestion. *Simple chancre* has well-defined undermined edges and a spongy surface. The *syphilitic sore* has the indurated base and enlarged lymphatic glands. When there is phimosis, the discharge may come from the urethra or from a chancre. If from the urethra, it can be usually seen escaping thence, and there is pain along the penis, with other signs of urethritis. A chancre under the foreskin is betrayed by a hard and tender point, and after a few days consecutive sores usually appear at the orifice of the prepuce.

Prognosis in the primary form is always good. If the complaint is secondary or symptomatic, gangrene may result.

Treatment.—The chief indication is to keep the inflamed surfaces separate. After washing and thoroughly drying, the excoriations should be touched with a 10-grain solution of nitrate of silver, and a bit of dry lint laid on the glans before the foreskin is drawn forward. If there is phimosis, frequent injections of tepid water, and twice daily of a 5-grain solution of nitrate of silver must be thrown to the farthest part of the foreskin with a long-nozzled syringe. Leeches to the groins, and opium internally, as well as in injections, relieve pain. Acupunctures give vent to simple œdema, but tend to accelerate gangrene with brawny tension and erysipelatous redness. Incisions, if needed, should be free; one on each side, carried quite back to the furrow. The upper half of the foreskin can then be easily turned back, and the subsequent deformity is less than if the foreskin is divided at the dorsum. In paraphimosis, before replacing the swollen foreskin, the tension should be relieved by acupuncture and astringent lotions, or by incisions if needed. Berkeley Hill.

BALDNESS.—Synon.: Alopecia.

Description.—Baldness or loss of hair presents an extensive range of variation in degree, from moderate thinness of the hair, such as occurs in *Defluvium capillorum*, to complete baldness—*Alopecia calva* or *Calvities*, the latter not limited to the scalp alone, but involving eyebrows, eyelashes, beard, and every hair of the body. Instead, however, of being *general*, baldness may be *partial*, affecting more or less of the surface of the scalp for example, the summit and forehead in men, and the summit and occiput in women. One remarkable form of partial baldness has been denominated *Alopecia areata*, or simply *Area*, and as this was described by Celsus, it has likewise been called *Area Celsi*. Area occurs suddenly, and is a mere falling-off of the hair over a space of circular figure; there may be one or more of such Areæ, and sometimes Area is only the beginning of Calvities. Area is likewise occasionally met with in the whiskers and beard.

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Trinity Medical College.

Pathology.—The pathology of Alopecia is a loss of nutritive power of the skin, sometimes progressive and consequent on advancing age, as in general baldness; and sometimes limited to a nerve-district of small extent, as in Area. This fact is very evident in the latter form, inasmuch as, conjoined with the sudden dropping-out of the hair, the integument is pale and thin, poorly nourished, somewhat anæsthetic, and thinner in the centre than at the circumference; while the hairs which remain at the periphery are altered in structure, clubbed and broken off.

Ætiology.—The causes of Alopecia are exhausted nutritive power of the skin; nerve paresis in the case of Area; syphilis; and local injury. The Alopecia of syphilis follows the plan of distribution of its exanthem. Partial Alopecia may result from a blow; from the accidental tearing out of a lock of hair; from the sting of a bee; from nervous shock; or from other causes.

Treatment.—This consists in the restoration of nerve-power and nutritive power; and in local stimulation. The best applications for the latter purpose are the stimulating liniments of the British Pharmacopœia; *e.g.* liniment of ammonia, compound camphor liniment, and the liniments of chloroform and mustard; or the acetum cantharidis properly diluted for general Alopecia, or applied with a brush in its concentrated form for Area. In the treatment of the latter, ammonia, turpentine, and the compound tincture of iodine are likewise useful; while for syphilitic Alopecia the white precipitate ointment with camphor is the best local application, conjoined with an anti-syphilitic constitutional treatment.

Erasmus Wilson.

BALNEOLOGY (βαλανεῖον, a bath, and λόγος, a word). A scientific exposition of all that relates to baths and bathing. *See* Baths and Hydrotherapeutics.

BALNEOTHERAPEUTICS (βαλανεῖον, a bath, and θεραπεύω, I heal). That department of therapeutics which deals with the application of baths in the treatment of disease. *See* Baths and Hydropathy.

BARBADOES LEG. A synonym for Elephantiasis. *See* Elephantiasis.

BARBIERS. A synonym for Beriberi. *See* Beriberi.

BARÉGES in France. Thermal sulphur waters. *See* Mineral Waters.

BASEDOW'S DISEASE. A synonym for Exophthalmic Goitre. *See* Exophthalmic Goitre.

BATH in Somersetshire. Simple thermal and earthy waters. *See* Mineral Waters.

BATHS.—Baths may be regarded as *simple*; and *composite, medicated,* or *artificial.* They may be used in the form of liquid, vapour, or air. We shall consider them under these heads in the following description:—

A. Simple Baths.—**1. Simple Liquid Baths.**

1. *The Cold Bath.*—By a cold bath is meant the immersion of the body in water below the temperature of 70°. Anything below 50° is considered a very cold bath. The first effect of the bath is a sensation of cold amounting almost to shivering, with slight gasping for breath. If the bath is continued for more than two or three minutes, the temperature of the skin is diminished; and if it is protracted, the blood and the subjacent tissues lose a little heat, but this does not generally occur till after quitting the bath. If the cold is intense and prolonged, there is a certain degree of numbness of the skin; while the pulse becomes small, and may fall from ten to twenty beats in the minute. After a short time (the colder the water the shorter), reaction takes place, bringing redness to the skin and increase of temperature, with a certain amount of excitement; but if the bath be continued, the depression returns. The immediate action of the cold bath is to cause the capillaries to contract and repel the blood from the surface, while by its operation on the peripheral extremities of the nerves, it acts upon the central nervous system. In its more remote effects, the cold bath accelerates the transmutation of tissues, augmenting the excretion of carbonic acid and of urea from the system, and, as a consequence, increasing the appetite.

The body is usually immersed at once in cold water, but the shock of this may be diminished by first using tepid water, and then gradually adding cold to it.

The effect of a cold bath depends much on its duration. Brief immersion, that is for three or four minutes, makes both the depressing and the exciting action less; a longer duration, say of ten to fifteen minutes, increases both actions; but if the bath be very protracted, the continued abstraction of heat produces depression only. The effects of a cold bath are less intense, if the bather is able to keep himself in motion, and especially if he swims.

2. *The Warm Bath.*—A warm bath of 96° to 104° produces no shock to the system; it causes a moderately increased flow of the circulating fluids to the surface, augmenting the frequency of the pulse; and scarcely affects the respiration. There is not the depression or the excitement of a cold bath. It rather retards the transmutation of tissues. With a hot or very hot bath—from 104° to 114°, the central nervous and circulatory systems are more affected. The frequency of the pulse increases greatly. The respiration becomes anxious and quickened. The skin is in a hyperæmic condition, and a free perspiration breaks out.

3. *The Tepid Bath.*—Tepid baths of the temperature of 85° to 95°, are intermediate between cold and warm. Their effects seem to be confined to the peripheral extremities of the nerves, and they do not excite the nervous centres or the circulatory system. Neither the pulse nor the excretions and secretions are affected. As no heat is confined in the system or taken from it, there is no reaction, and the animal temperature is unaltered.

It need scarcely be said that drying and rubbing after a bath materially assist its action on the skin; or that, according to circumstances, it may be convenient to order a whole bath, a hip-bath, or a slipper-bath. The foot-bath is a very useful and convenient one, especially when some stimulant substance is added to the simple water.

Wet packing and the various processes of hydropathy, and those powerful agents hot and cold affusion, whether as shower-baths or as douches, are described in the article on HYDROPATHY.

The *duration* of a bath must depend on a variety of circumstances, for instance, on the age and constitution of the patient, on the nature of his malady, and on the temperature of the bath. It may vary from a few minutes to many hours. A very hot or a very cold bath can be supported for a much shorter time than a tepid one.

ACTION AND USES.—Cold baths are indicated for the strong, for youth, and for manhood; warm baths for the delicate, for women, for early childhood, and for old age. Tepid baths are suitable for almost all constitutions, sexes, and ages. Cold baths may in a general way be considered tonic and bracing; they are useful when judiciously employed in many nervous affections, as in chorea and hysteria, and they are the best of all for general hygienic purposes. Of late years they have been specially employed in the treatment of fever (*see* article TEMPERATURE). The great value of warm baths, besides their hygienic employment, as better detergents than cold ones, is in soothing and reducing excitement; in relieving spasms, such as colic and retention of urine; in the convulsions of children, combined with the affusion of cold water on the head; in cases of gout and rheumatism; and generally when action on the skin is desired. Where prolonged immersion is wanted, tepid baths are indicated, as in calming many chronic nervous disturbances, and in many cutaneous affections.

As to contra-indications, all baths, and especially prolonged and even tepid baths are not suited for the asthenic. Both hot and cold baths are to be avoided where there is a weak, fatty heart, or any tendency to apoplexy. No one should ever enter a cold bath when exhausted, and such baths are also contra-indicated when there is a tendency to congestion of internal organs. Under such circumstances a warm bath is usually both safer and more refreshing. The too long and too frequent use of hot baths is debilitating.

II. **The Simple Vapour-Bath.**—A vapour-bath is one in which the skin is exposed to the action of hot water presented in the form of vapour. The vapour-bath may be taken in a box with the head included or not; or in the more common form of the Turkish or Russian baths, where a large room is filled with vapour, and where therefore the vapour is inhaled; or by vapour obtained from a small and suitably constructed apparatus, which vapour may be diffused over the whole body or directed to a particular part. A very simple apparatus for the vapour-bath may be prepared by placing under a chair a shallow earthenware or metallic pan, containing boiling water to the depth of three or four inches, and from which abundant vapour can be obtained by placing in it one or two red-hot bricks. The patient sitting on the chair, surrounded by blankets and other suitable covering, will receive the full benefit of a vapour-bath. Vapour-baths produce profuse perspiration, and act in cleansing the skin much as hot-water baths do, only more powerfully. Vapour being a slow conductor, does not act so fast on the body as water. Vapour-baths can be borne hotter than warm-water baths, but their use cannot be continued so long, as vapour interferes with radiation of heat from the body. In such baths a heat of more than 122° is not borne comfortably. The vapour-bath, though falling considerably short in temperature of the air-bath, raises the heat of the blood somewhat more. The great virtue of these baths is in their sweat-producing properties. The average loss of perspiration by the use of a Russian bath has been set down at from ¾ lb. to 3 lbs. In the Russian bath a slight degree of stimulation of the skin is caused by switching it with twigs of birch, and the alternation of depression and excitement of the cold bath is obtained by placing the patient, when in a state of profuse perspiration, under a douche of cold water.

III. **The Simple Hot-Air Bath.**—There are two forms in which the hot-air bath is administered: according as the patient does not or does breathe the heated air. The action of the latter closely resembles that of a vapour-bath, but differs from it in not impeding the respiration, as the latter does by depositing moisture in the bronchial tubes. The lungs, instead of requiring to heat up the inspired air, are subjected to a temperature above their own. Hot-air baths favour the highest degree of perspiration, while the moisture of vapour baths somewhat retards it. If they are very hot, they raise the temperature of the body by several degrees.

As the arrangements for vapour- and hot-air baths are practically the same (except that in the latter it is attempted to exclude all vapour from the *calidarium* or *sudatorium*, the hottest room), the following description of an ordinary hot-air bath, the arrangements of which are closely copied from the Romans, will answer for both.

The patient after unclothing first goes into the *tepidarium*, which has a temperature of 113° to 117°, in which he remains until the perspiration bursts forth, which happens in from twenty-five to forty minutes. He next proceeds to the hottest room or *calidarium* (in which the air is heated by hot-air pipes which are inserted in the walls), of a temperature of 133° to 140°, and remains there until the perspiration runs down his skin, in twelve to eighteen minutes. An attendant then rubs off the perspiration with a woollen glove, and kneads all the muscles for four or five minutes. The patient next betakes himself to the *lavacrum*, where he has water poured over him of the temperature of 81° to 86°; next, the whole body is soaped over, the suds are rubbed off, and the patient goes to the *frigidarium*, where he lays himself on a couch and waits till his skin is completely dry. This may occupy twenty-five to thirty minutes, when the patient dresses and leaves the bath greatly refreshed.

Such is a brief account of these baths, the revived use of which is at present so general. The arrangements vary in detail. For ordinary purposes it is easy to furnish either vapour- or hot-air baths. A great variety of apparatus have been invented for this purpose, which resolve themselves into this, that the patient should lie in bed or on a seat, and have the bed-clothes or other covering secured from contact with him by the employment of a framework or cradle. Beneath this hot air or vapour is introduced, either directly or indirectly, from a suitable apparatus.

The Sand-Bath.—We may here mention baths of sand, which are a very old remedy. Of late years establishments for supplying them have sprung up in various towns. They are a convenient way of applying dry heat either locally or generally, and are employed in chronic rheumatism. Bags filled with heated sand are useful in hospital and in domestic practice.

USES.—Both hot-air and vapour-baths are indicated when increased action of the skin is desired. They are used most for the cure of catarrhs, of neuralgic and rheumatic pains, and sciatica. They have also been much employed for reducing obesity. They are useful for general hygienic purposes, but are apt to be given too indiscriminately. Hot-air and vapour-baths are often locally applied with great advantage to a hand, or leg, or arm, in rheumatism or thickened joints.

B. COMPOSITE, MEDICATED, OR ARTIFICIAL BATHS.—A great variety of substances have been used in baths at different periods. We must confine ourselves to such as are at present in use and appear to be of some real value, omitting even some that are employed, such as baths of iodine, of iodide of potassium, of iron, of fermented grapes, and of whey.

I. **Composite Liquid Baths.**

1. *The Sea-Water Bath.*—The average amount of salts in sea-water may be set down at 3 per cent.; this may therefore be considered a suitable strength for ordinary salt baths. The quantity commonly used in London hospitals is about 9 lbs. of salt to 30 gallons of water. Some use bay salt, others Tidman's. Owing to the high price of sea-salt in inland continental places, various natural salts, some of them containing a comparatively small amount of chloride of sodium, have been suggested as substitutes; and also, for economy's sake, 22 to 25 gallons have been set down as a minimum amount of water for the bath of an adult. The value of these substitutes can only be determined by observing the degree in which they stimulate the skin. Apparently it does not matter much what particular salt is employed to produce the stimulation. A salt-bath can of course be increased to any strength by the addition of salt, or of the mother lye as it is termed.

The chief uses of salt-water baths are as tonic remedies, especially for the young, when there is any tendency to scrofula or chlorosis; also in convalescence from many diseases.

2. *Alkaline Baths.* — Alkaline baths may be made by adding 6 ounces of crystallised carbonate of soda, or 3 ounces of carbonate of potash, to 25 or 30 gallons of water. Alkaline baths are of use in a great variety of cutaneous affections.

3. *The Corrosive Sublimate Bath.*—Baths of corrosive sublimate are occasionally employed. They are commonly made by adding 3 drachms of corrosive sublimate and 1 drachm of hydrochloric acid to 30 gallons of water. They are employed in some skin-affections, and in secondary syphilis.

4. *Sulphuret of Potassium Bath.*—Baths of sulphuret of potassium are made by dissolving from 4 to 8 ounces of that salt in 25 to 30 gallons of water. A little dilute sulphuric acid is sometimes added. These baths have long been extensively employed in the treatment of cases of skin-disease in which the sulphur that they contain is indicated.

5. *The Nitro-Muriatic Acid Bath.* — The nitric or rather the nitro-muriatic acid bath is made by adding nitro-muriatic acid to water. The ordinary proportion is one ounce of acid to one gallon of water. The discolouring action on clothing makes a full bath of this kind inconvenient for domestic use, and it is best to take it in a bathing establishment. For the ordinary purposes of a foot-bath at home the old directions of Dr. Helenus Scott, who introduced the use of the acid, are sufficient. The vessel must of course be of wood or earthenware. Dr. Scott added four to six ounces of the acid to three gallons of water. This made a rather strong foot-bath. The patient was to keep his feet immersed for thirty minutes: and the bath was to be repeated every other day for two or three weeks. The axillæ, the groin, and the region of the liver were to be sponged with the acid solution. The bath causes slight tingling of the skin and a taste in the mouth, and is believed occasionally to produce salivation. This bath has been used very extensively in India and in England in liver affections. There is difference of opinion as to its value; many have great confidence in it.

6. *The Bran Bath.*—The bran bath is made by boiling four pounds of bran in one gallon of water, straining, and adding the liquor to a quantity of water sufficient for a bath. Such a bath is useful in allaying the irritability of the skin, and also in diminishing the stimulating effect of other baths.

7. *The Fucus Bath.*—This is made by adding a decoction of sea-weed, or the sea-weed chopped up, to an ordinary bath; it will become more or less gelatinous if enough be added. Such baths go popularly by the name of *Ozone baths*; and they contain a certain amount of chloride of sodium and a minute proportion of iodine. They are useful in the same cases as sea-baths.

8. *The Mustard Bath.*—An extremely useful stimulating bath is the well-known mustard bath, which is made by adding a handful or two of mustard to the ordinary hot bath. The pediluvium is its most useful form.

9. *Pine Baths.* — Baths of the balsam of pine-leaves may be prepared extempore by making decoctions of the fresh leaflets at certain seasons; but the usual way is to add about one pound of the extract which is prepared from the leaves, and is everywhere for sale—at least in Germany. The extract dissolves in the bath, which is then ready for use; but of late it has been usual to add a small amount of an essence which is also prepared from the leaflets. It floats to the surface of the water, and attaches itself to the person on leaving the bath, and its aroma is grateful. Of course the quantity of the extract to be employed depends on its strength. These baths are at present largely employed. They are slightly stimulant, and are much used in hysterical, rheumatic, and gouty

affections, and also as an adjunct to the internal use of mineral waters.

10. *Baths of Conium, Lavender, &c.*—Aromatic or sedative baths are prepared by adding a decoction of lavender, hyssop, or conium to an ordinary bath.

It is scarcely necessary to add that, as a rule, all composite liquid baths should be of a temperature a little above the tepid; and that their strength, and the time that the patient is to remain in them, must be determined by the special circumstances of the case.

II. **Composite Vapour-Baths.**—Vapour-baths impregnated with *fir balsam* are popular, and are considered to be more powerful in their operation than pine-baths. The vapour which rises in making the decoction of pine leaves is conveyed to a box in which the patient is enclosed.

Aromatic vapour-baths may be given by making the steam of hot water pass through bunches of fresh aromatics (*conium, lavender*, &c.) before reaching the box in which the patient is placed. Such baths may be useful in hysteria.

III. **Composite Air-Baths.**

1. *Sulphurous Acid Bath.*—A valuable mode of applying sulphur in the form of a bath is by using its fumes—in other words, sulphurous acid. The patient is seated on a cane-bottomed chair, and his body is encircled with a cradle, over which oil-cloth is thrown, the head remaining uncovered. Sulphur is placed on a metallic plate, to the lower surface of which the flame of a lamp is applied, when sulphurous acid is disengaged. This bath is less used in cutaneous affections than formerly.

2. *The Mercurial Vapour-Bath.*—Very similar is the mode of applying the fumes of mercury. Under the chair are placed a copper bath containing water, and a metallic plate on which are put from 60 to 180 grains of the bisulphuret or of the grey or red oxide of mercury. Spirit lamps are lighted under the bath and under the plate. The patient thus experiences the effects both of aqueous and of mercurial vapour. At the end of five or ten minutes perspiration commences, which becomes excessive in ten minutes or a quarter of an hour. The lamps are then to be extinguished, and when the patient becomes moderately cool, he is to be rubbed dry. He should then drink some warm liquid and remain quiet for a time. This has often been a favourite mode of treating secondary syphilis with some practitioners. Calomel, in quantities of from 20 to 30 grains, is administered in a similar manner, under the name of the *Calomel Bath.* It may be given locally by a suitable apparatus. John Macpherson.

BATHS, Natural. *See* Mineral Waters.

BED-SORE. *See* Ulcer and Ulceration.

BELL-SOUND. A peculiar physical sign associated with pneumothorax. *See* Physical Examination.

BELL'S PARALYSIS. (Named after Sir Charles Bell.) A synonym for paralysis of the facial nerve. *See* Facial Paralysis.

BERIBERI.—Synon.: Barbiers; and numerous other local names.

Definition. — A disease characterised by anæmia, anasarca, degeneration of muscular tissue, effusion into the serous cavities, debility; numbness, pain, and paralysis of the extremities, especially the lower; præcordial anxiety, pain, and dyspnœa; scanty and high-coloured urine; and in some cases drowsiness or sleepiness. Beriberi occurs in a chronic and an acute form; in the latter often proving rapidly fatal from exhaustion, syncope, or the formation of cardiac or pulmonary coagula.

Etymology.—The etymology of the word Beriberi is obscure. Herklotts suggests the Hindi word, *Bhêree*—a sheep—from the fancied resemblance of the gait of persons affected to that of sheep. *Soond-bhêree* comes from the words numbness and sheep. *Soond-ke-baies* signifies numbness and rheumatism. *Bhêr-bheri*, a Hindi word, signifies a sore, a swelling. Mason Good says that Bontius introduced the word Beriberia, and tells us that it is of Oriental origin. Carter suggests *Bhari*, sailor, from *Bahr*, the sea; and *Bhayr*, shortness of breath. As the disease is seen among African and Arab sailors, this is probable. Some think it is derived from a Cingalese word meaning weakness, first applied to a variety of conditions, the result of scorbutic, malarious, rheumatic, and anæmic cachexiæ, on the Malabar Coast.

Geographical Distribution.—Beriberi prevails endemically in Ceylon; and in India, on the Malabar Coast, and in the Northern Circars, between 13° and 20° N. latitude, extending inland from forty to sixty miles. It is known in other parts of India, probably occasionally all over the peninsula; in Burmah and the Malayan peninsula; amongst the crews of ships trading to ports in the Persian Gulf, Red Sea, coast of Africa, Bay of Bengal, Singapore, Siam, and the islands of the Indian Archipelago; and in the Australian seas. On the West Coast and other parts of Africa beriberi also occurs, and is known as the *sleeping sickness.* In Europe *pernicious anæmia* is possibly the same disease. Beriberi is also met with in South America, and probably wherever certain conditions of food, water, soil, climate, and mode of life coexist.

Ætiology.—All observation tends to show that beriberi occurs where causes of debility have for some time operated, especially in the climates and localities previously mentioned, such as certain conditions of soil, air, and water; exposure to great alternations of temperature, especially when accompanied by wet, fatigue, mental and physical depression; food deficient in quantity and quality or variety; previous exhausting diseases; malaria, and other undefined atmospheric and telluric influences—all, in fact, that tends to depress the vital energies, impoverish the blood, and starve the nerve-centres. The symptoms, it is said, seldom begin to appear within ten months or a year after first exposure to these causes. Beriberi has been ascribed by Ranking to disease of the kidney, but there is no evidence to prove that it is due to this cause, or indeed to structural changes of any of the viscera. Morehead refers it rather to a scorbutic origin, and in some respects it does resemble scurvy; it may probably, also, be a consequence of the cachexia that so often results from long residence in a malarious climate, especially when that has been accompanied by exposure, privation, and excessive exhaustion of the vital powers. In such, the most complete anæmia, with debility, may occur, independently of the existence of organic visceral disease, though naturally they will be intensified where such disease is present.

ANATOMICAL CHARACTERS.—Serous fluid is effused generally —in the areolar tissue, in the lungs, brain, heart, and abdominal viscera. The cavities are, like the tissues, soaked with watery effusion. The tissues are soft and degenerate. Muscular fibre is fatty, especially that of the heart, which is often enlarged and dilated. The kidneys are enlarged, anæmic, and softened.

PATHOLOGY.—The recent discovery by Mr. T. Lewis in India, of the embryo of a nematode worm in the blood of persons suffering from chyluria (*see* CHYLURIA), lymphorrhœa, and elephantiasis, of which diseases it appears to be to some extent the cause, suggests inquiry whether a similar hæmatozoon may not also be in some way concerned in inducing beriberi. Fonsagrives and Leroy de Mericourt describe beriberi as general dropsy with a rapid course, no albuminuria, and weakness and loss of sensibility in the lower limbs. Dropsy commences as anasarca, and extends to the serous cavities. Though hepatic, splenic, or renal complications may exist, and intensify the severity and hasten the progress of the general symptoms, they are not essential concomitants of the disease, but appear to originate in a spanæmic state of the blood, and to be kept up by its progressive imperfect elaboration. The resulting partial starvation of the cerebro-spinal nerve-centres, and the serous effusion into and amongst them, sufficiently account for the paralysis which, in severe cases, characterises this disease.

SYMPTOMS.—Beriberi presents itself under a *chronic* and an *acute* aspect; rarely, it is said, ever occurring in either form, until after an exposure of some months to the exciting causes. The general symptoms may be said to be those of anæmia and anasarca. Œdema pervades the limbs and body generally, accompanied with numbness, pain, heaviness, and loss of power, amounting in some cases to paralysis. Along with these symptoms there occur præcordial anxiety, dyspnœa, irregularity and palpitation of the heart, pain at the ensiform cartilage, anæmic murmurs, debility, and a small quick pulse, which at the outset may be rather hard and full, accompanied by dryness and heat of skin. The appetite is at first not impaired. Later there is coldness of the extremities; torpor of the bowels; scanty, high-coloured urine, of sp. gr. 1020 to 1040, but no albuminuria as a rule. According to Horton and others, excessive drowsiness and stupor attend some stages of certain cases of the disease; also pale, flabby tongue and blanched mucous membranes; occasionally hæmorrhage from the stomach and bowels; with petechial eruptions; an anxious look; a puffy, swollen, and sometimes livid face; and a peculiar tottering gait. Death results rapidly in some of the acute cases, with symptoms of effusion into the thoracic and abdominal cavities, or within the skull, by exhaustion, syncope, or the formation of coagula, either in the systemic or in the pulmonic circulation. Beriberi frequently assumes a slight and modified form, indicated by anæmia, numbness, and a certain amount of pain in the limbs; an anxious expression; disordered bowels; scanty urine; cold skin; a low, feeble, and irregular pulse; præcordial pain or uneasiness, with palpitation; nervous depression; an unsteady, almost tottering gait; and a puffy face and neck. Dr. Paul says: 'I have met with a numerous class of cases that are not so serious (as the acute) or so often fatal, where the chief symptom complained of was burning of the feet.' Malcolmson describes this remarkable condition in connection with beriberi, to which, he says, it is allied—it is found to affect the soles and calves of the legs, the back, and occasionally the muscles of the legs.' It occurs in recent and slight examples of beriberi, and was first observed in the troops after the first Burmese war—sometimes in men who had not had beriberi; on the whole, Malcolmson thinks it is neither rheumatism nor beriberi, and may accompany or follow other diseases, as an indication of nervous debility.

In the *acute* forms of beriberi the symptoms are very severe and often rapid; and the mortality would indicate it to be second only to cholera in fatality. The chief symptoms are:—Rapid general anæmia and dropsy of the cavities; scanty, almost suppressed urine; constipation; weak, irregular pulse; intense præcordial pain; hurried, irregular, and painful breathing; occasional vomiting—sometimes of blood; swelling of the limbs, with numbness, pain, and paralysis, preceded by a feeble, tottering gait; all the symptoms of pleuritic and pericardial effusion; failing heart; and death either from syncope, or perhaps almost suddenly from embolism—in the most acute cases within a few days. In this acute form the affection is very fatal, but in the milder and more chronic form recovery is frequent. Acute cases often supervene in those who have suffered from the milder disease, or in those who are exhausted and anæmic from other causes.

TREATMENT.—Attention to diet, suitable clothing, and protection against vicissitudes of temperature, wet, and cold, are the best *preventive* measures. Bad hygiene and exhausting habits of life tend to promote the development of the constitutional condition in which the disease commences.

When beriberi is established these precautions are still necessary, and attention must be paid to the symptoms as they occur. Diuretics and diaphoretics relieve the œdema and dropsical effusions. Tonics and stimulants give vigour to the weakened muscular fibre; while appropriate remedies and diet may improve the condition of the blood.

Acetate of potash, digitalis, and squill, and occasionally calomel, are said to favour the removal of the fluid. It is needless to say that the physiological action of mercury is to be avoided. Salines, hot-air baths, diaphoretics, and turpentine may at various stages be found useful. The object being to remove the fluid and strengthen muscular fibre, quinine, iron, and other tonics are an important element in the treatment. No remedies, however, will be of much avail unless the patient be placed in favourable hygienic conditions. Malcolmson speaks highly of two remedies—*trĕak farook*, and *oleum nigrum*, which are considered to be very effective in the treatment of the disease, especially in relieving the dyspnœa and œdema, which proved very fatal until these drugs were introduced. The composition of the *trĕak* is apparently generally unknown—it seems to be diuretic and stimulating, and probably not aperient unless combined with rhubarb, in doses of four to fifteen grains. The *oleum nigrum* is a stimulant and diaphoretic, given thrice daily, and has been found by Indian physicians to be very beneficial in some cases of beriberi. Dr. Aitken says that turpentine is a useful remedy. Ergotin, iron, and belladonna with zinc in the form of pill, accompanied with sea-bathing, were useful in this disease, as seen at Bahia. Nux vomica has often been found serviceable in certain cases, as might be expected, and opium may be needed to allay pain and irritability. Hepatic and splenic complications need their appropriate remedies. Obviously the chief indications are to promote removal of the œdema; to regulate the functions of the abdominal viscera; to increase the action of the skin; and to give tone and vigour to the muscular fibre. By such measures can we alone hope to deal successfully with this profound form of cachexia. JOSEPH FAYRER.

BIARRITZ in France, on the Bay of Biscay. A fashionable sea-side resort. The climate is considered to be bracing. *See* CLIMATE, Treatment of Disease by.

BILE, Disorders of.—Disorders of the bile held a large place in the medicine of antiquity, with the exception of the theories of Van Helmont and Paracelsus; the latter looking upon the bile as the balsam of life, and therefore incapable of begetting disease; the former regarding it as a mere excrementitial fluid, and therefore equally incapable of begetting disease. Disorders of the bile have, nevertheless, held their own quite into our time. It is common enough to hear persons speak of a 'bilious attack,' or 'being troubled with the bile,' expressions the survivals of the humoral pathology. The liver was formerly credited with most of the dyspeptic disorders of the stomach. As Sir Thomas Watson says, it is an organ often blamed most gratuitously and unjustly, but no educated or scientific physician would now think of attributing a gastric catarrh, or constipation, to an 'attack of the bile,' or to a 'sluggish liver.'

Physicians have arranged disorders affecting the bile under three heads—(1) diminished secretion of bile; (2) increased secretion of bile; and (3) secretion of morbid or altered bile. This division may very well be accepted as a convenient basis for the further discussion of biliary disorders, but it is nothing more than an hypothesis. It is likely enough that the bile, in certain diseases, changes its character as regards both its amount and constituent parts: but it cannot be denied that the means by which physicians are able to ascertain these changes can scarcely be said to exist in ordinary cases. A common saying is that the patient must be making plenty of bile because the stools are high in colour. No reasoning can be more fallacious. The colour of the stools may be high if the fæces be quickly swept through the intestinal canal, because there has been no time for the bile-pigment to be absorbed into the blood. Or the fæces may be pale if they lie long in the bowel and the coloured matter absorbed. So that the colour of the stools is no sure sign of the poverty or abundance of the secretion of bile. In cases of pale-coloured fæces purgatives often do good, not because they have any special tendency to increase the flow of bile, but because they hurry the fæces out of the intestine, and thus give no time for the absorption of the bile, which, if it lay long in the bowel, would be absorbed, carried to the liver, and again excreted into the gall-ducts—the vicious circle of Schiff.

Nor is the analysis of the bile found after death in the gall-bladder of much value. Frerichs announced the presence of albumen in the bile in cases of congestion of the liver; but it is now generally thought that this appearance is due solely to a *post-mortem* transudation. Ritter also has described a colourless bile in which all the constituents of bile are present except the pigments. Most of his analyses were made on bile taken from the gall-bladder after death; but if the cystic duct be obstructed for any time, it is well known that the bile contained in the gall-bladder may become colourless without any real secretion of colourless bile having taken place in the first instance. It is impossible to be certain that the changes, which are found in the bile taken from the gall-bladder after death, have taken place during life.

The only source of what may be called knowledge of the disorders of the bile is observation of men or animals in whom biliary fistulæ have been formed either by disease or by art. Unfortunately, the majority of such observations have been physiological or pharmacological; and but few are recorded of the changes which the bile undergoes in disease. Altogether contradictory experiments are recorded of the influence of the nerves and of the diabetic puncture of the fourth ventricle upon the secretion of bile. It is an admirable field for further research, but it will be seen that our present knowledge very closely approaches to complete ignorance.

It is disputed still whether the presence of bile in the stomach puts an end to the process of digestion. By many it is thought that the bile-acids throw down the albumen of the food, and with the albumen the pepsin. It is well known that in some disorders there is an inverted action of the duodenum, and bile is poured into the stomach, as in long-continued vomiting, for instance; thus the dispute has a practical bearing. The best treatment of this state would seem to be by saline purgatives.

Bile may also be taken up into the blood, and when this occurs, jaundice results (*see* JAUNDICE).

J. WICKHAM LEGG.

BILHARZIA.—This name was given by the writer to a genus of flukes discovered by Dr. Bilharz, of Cairo, in the portal system of human blood-vessels, and the worm was subsequently found by the writer in the portal vein of a monkey. This trematode hæmatozoon was first described as a *Distoma*, but the species is now more generally known as the *Bilharzia hæmatobia*. It was originally found in the portal system, and Bilharz, Griesinger, Lautner, and others afterwards showed that this parasite also infests the veins of the mesentery, bladder, and other parts, producing a formidable disease which is endemic in Egypt, at the Cape, at Natal, and probably in other parts of the African continent, as well as in the Mauritius. The discovery that the endemic hæmaturia of the Cape of Good Hope is occasioned by the presence of *Bilharzia*, is due to Dr. John Harley, who detected the ova in the urine of a patient who had previously resided in Southern Africa. Dr. Harley's impression that he had to deal with a new species of Bilharzia has not gained general acceptance, but he furnished proof of the wide geographical distribution of this parasite, and he also added largely to our knowledge of its ravages.

DESCRIPTION.—This parasite, unlike nearly all the other known species of fluke, has the sexes separate, the females being comparatively slender worms, resembling filariform nematoids. During copulation the female is lodged in a long slit-like groove, or gynæcophoric canal, with which the abdomen of the male is furnished.

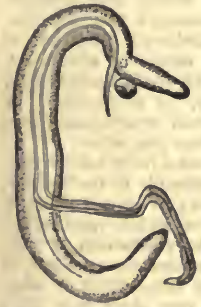

FIG. 2.—*Bilharzia hæmatobia*, male and female sexually combined. Magnified. After Küchenmeister.

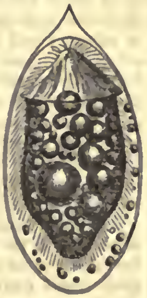

FIG. 3.—Ovum of *Bilharzia hæmatobia* with contained embryo and free sarcode-granules; × 234 diameters. Original.

The eggs, measuring from $\frac{1}{160}''$ to $\frac{1}{180}''$ in length, are peculiar, being either sharply pointed at one end, or furnished with a projecting spine, placed at a little distance from the hinder pole. This spine gives a point of resistance to the egg during the struggles of the embryo to effect its escape. Those who are interested in the organization of the ciliated embryos, and in the remarkable behaviour of the larvæ during their earliest stages of growth, will find the subject fully discussed in the writer's paper 'On the development of *B. hæmatobia*,' together with remarks on the ova of another urinary parasite, occurring in a case of hæmaturia from Natal, *Brit. Med. Journ.*, 1872.

TREATMENT.—The writer has pointed to the danger of treating cases of Bilharzia as if they were comparable to ordinary helminthiases. It is neither desirable to employ active drugs for the expulsion of the parasite and its eggs from the bladder, nor is it prudent to attempt the employment of vermicides with the view of destroying the worms. As in Trichinosis, so in the Bilharzia disease, it is essential to support the system. Thus tonics, cold bathing, and a highly nourishing diet, combined with the bicarbonate of potash and infusion of buchu, constitute our best resources when dealing with cases of endemic hæmaturia. The pathological facts clearly show that in order to effect a cure we must imitate nature herself as closely as we can. We must seek to erect artificial barriers, and thus check the hæmorrhage as much as possible. For this purpose the writer has found the astringent properties of Arctostaphylos uva ursi eminently serviceable; small quantities of hyoscyamus being usefully combined. Dr. Harley advises 'a persevering use of belladonna and henbane,' under the impression that treatment with these drugs 'will retard the development of the parasite, even if they do not effect its destruction.' The writer entirely disagrees in this view of the case, and he also objects to the employment of medicated injections. He thinks that the employment of diuretics is likewise clearly contra-indicated. Everything that will contribute towards allaying the vesical irritation, is certain to assist the natural process of cure; and, in this view, the administration of buchu-infusion, the enforcing of a liberal diet, and the taking of gentle exercise, will be found amongst the most important curative aids. In bad cases a thorough cure is not likely to be completed until after the lapse of several years. Prophylactically it is essential to remove patients from the localities in which there is every reason to believe they have contracted the disease. In view, also, of preventing infection on the part of others, it is necessary that the water employed for domestic purposes throughout the infected districts, be rendered thoroughly pure by efficient filtration. For further particulars the reader is recommended to consult the general works of Küchenmeister and Leuckart; the writer's introductory treatise on *Entozoa* (p. 197 *et seq.*); Dr. Harley's three separate memoirs (in the *Transactions of the Royal Med. and Chir. Soc.*, 1864, &c.); and also especially the recent memoir by Dr. Sonsino, entitled 'Researches concerning *Bilharzia hæmatobia* in relation to the endemic hæmaturia of Egypt, with a note on a nematoid found in human blood' (*Rend. della R. Accad. delle Scienze, &c.*, 1874). *See* also HÆMATOZOA.

T. S. COBBOLD.

BILIARY CALCULUS. *See* GALL-STONES.

BILIARY FISTULA.—There are two kinds of biliary fistula:—one, in which a communication exists between the gall-bladder and the surface of the body; the other, in which there is a communication between the gall-bladder and other internal organs. Neither kind is common, but the first is less rare than the other.

In the first variety a tumour forms, sometimes in the place of the gall-bladder, at other times near the umbilicus, in the linea alba or to the left of this line, or in the groin. The tumour, if opened spontaneously or by the surgeon, discharges a quantity of pus, bile, and gall-stones. If the cystic duct be obliterated, no bile need escape. A suppuration of the gall-bladder, caused by the presence of gall-stones, is the common cause of these fistulæ. The prognosis is good. The diagnosis, before the tumour opens, is very difficult. In a case which came under the writer's notice, it was mistaken for an abscess of the liver.

In the second kind of biliary fistula, the gall-bladder may communicate with the duodenum or colon; with an abscess of the liver; with the portal or other abdominal vein, though it must be owned that cases of this kind seem somewhat dubious; or with the urinary bladder, or at least with some part of the urinary tract. Gall-stones are in nearly every case the cause of the fistulous opening. J. Wickham Legg.

BILIOUS.—This term is used with much vagueness, and in popular language is often employed very incorrectly, though the idea is to associate it with conditions in which an excessive formation of bile is supposed to occur. The chief uses of the word are as follows:—In the first place it is employed to designate a peculiar temperament—the *bilious temperament*. Again, individuals are often said to be *bilious* when they present a sallow or more or less yellowish tint of skin, but especially if they are distinctly jaundiced. *Bilious vomiting* and *diarrhœa* signify respectively the discharge of a quantity of bile, mixed with vomited matters or with loose stools. Certain febrile diseases, attended with yellowness of the skin, are sometimes designated *bilious fever*, and under like circumstances pneumonia has been described as *bilious pneumonia*. Lastly, one of the most frequent applications of the term is to certain so-called *bilious attacks* or *biliousness*, which, however, are commonly merely attacks of acute dyspepsia or migraine. The most prominent symptoms of a supposed *bilious attack* are anorexia, furred tongue, a bitter taste, sickness, constipation, and headache, with a feeling of marked depression and general malaise. Such attacks are most effectually prevented by careful regulation of diet, and the avoidance of exposure to cold, fatigue, and undue mental exertion or anxiety; when they come on, abstinence from food is desirable, with rest in the recumbent posture, and perfect quiet. Alterative aperients and saline effervescents may be given, alcoholic stimulants being avoided as far as possible. Frederick T. Roberts.

BILIOUS TEMPERAMENT. *See* Temperament.

BITTER ALMONDS, Poisoning by. *See* Prussic Acid, Poisoning by.

BLACK VOMIT.—Vomited matters may be more or less black in different diseases, but the peculiar *black vomit* is that which occurs in yellow fever (*see* Yellow Fever).—The rejected matters are acid in reaction, and a sediment is deposited of coagulated albumen and disintegrated blood-corpuscles. Ammonia is also present. The black colour of the vomit has been attributed by some writers to altered bile, but there can be no doubt that it is due to its admixture with blood which has undergone certain changes.

BLADDER, Diseases of.—The bladder may be the seat of the following morbid conditions:—Inflammation, acute or chronic; Abscess; Neuralgia; Atrophy or Hypertrophy; Mechanical Distension, with chronic engorgement and retention of urine, commonly, but erroneously, termed 'Paralysis'; Sacculation; Displacements, such as hernia in the male, or, very rarely, inversion and protrusion in the female; Tumours or Growths, including fibrous, villous, or vascular growths; Epithelioma and Carcinoma; Tubercular Disease; Ulceration, either simple or malignant; and Vesico-vaginal or Vesico-intestinal fistula. The bladder may also be the subject of true paralysis, partial or complete, as the result of injury to the brain or spinal cord, or following disease of those organs.

Only a brief statement respecting the most important of this class of affections need be presented here, in order to facilitate an acquaintance with their diagnosis, since the treatment of almost all of them belongs to the province of the surgeon, and so far only as it consists of medicinal remedies will the subject be considered.

1. **Acute Inflammation—Acute Cystitis.**—The mucous lining of the bladder is the part affected by inflammation—and although after long and severe attacks some morbid action occurs by extension to the muscular coat, or even to the peritoneal covering, these structures are very rarely affected. An acute inflammation of a very severe kind occurs from injuries; from the presence of instruments, foreign bodies, or calculi; and from unrelieved retention of urine. A less severe, somewhat evanescent, but very painful form of cystitis arises from irritants taken internally, as cantharides. A still less severe, but often troublesome form originates by extension from gonorrhœa.

In the *first* class of cases there are not only severe local symptoms referable to the bladder, but the general system may be gravely affected.

In the *second* class, of which cantharides-poisoning is the type, the phenomena of very frequent, painful, and spasmodic attempts to eject small quantities of urine which is often bloody, occur within a very short time after absorption of the poison. A common blister is said to produce the affection in some persons. In two cases—the only two the writer has seen—it has followed the application of a blister to a surface already partially denuded of the scarf skin. In one of these a blister was applied to a knee which had been frequently painted with tincture of iodine, and was still slightly sore. In three hours after the application the patient was attacked with exceedingly painful efforts to micturate, which were at times intense. The attack lasted six hours, gradually diminishing in force, and leaving no ill-effects behind. In less than twenty-four hours no trace of the symptoms remained.

In the *third* form of cystitis, which is the most common, and of which that arising by extension from gonorrhœa may be taken as the type, the usual symptoms are undue frequency of micturition; a necessity to perform the act immediately the want has declared itself, a condition conveniently expressed by the single word 'urgency;' a desire to pass more, accompanied by pain, when all the urine has been voided; and some dull aching over the pubes; together with a general febrile state of the system, often very slight, but corresponding for the most part with the degree of local inflammation. The urine itself is cloudy, and deposits some light mucus on standing, but is not otherwise apparently altered. Under the microscope abundance of epithelium is visible, as well as some pus-cells, and if the affection is severe, a few blood-corpuscles are also present. It may be remarked here that the presence of a few pus-cells in the urine, a fact to which so many practitioners attribute considerable importance, by no means necessarily deserves to be so regarded. The very slightest attack either of this or of the preceding form of cystitis is certain to be attended by the formation of some quantity, however small, of fully-developed pus-cells.

Very rarely a *false membrane* may be produced on the surface of the mucous membrane of the bladder, and may be thrown off almost entire, leading to the belief that the inner coat has itself been exfoliated. In women this membrane has been voided per urethram in a condition for examination; in men this cannot occur, because the urethra is too small to admit of it. Now and then examples of the former have been shown at the Pathological Society of London; and one of the latter may be seen, discovered by operation, in the museum of the Royal College of Surgeons of London.

TREATMENT.—In the first form of cystitis, the removal of the exciting cause, if possible, is the chief indication.

The treatment of the second form should consist of very hot bidets or hip-baths, the former being probably preferable as capable of being used at higher temperatures than the latter; together with large doses of the tincture of henbane, say a drachm, with 10 or 15 drops of liquor opii every two hours while pain is severe; 20 minims of liquor potassæ may be given either simultaneously or alternately, in water or in any bland diluent.

The treatment of a well-marked case of the third class consists in absolute rest in the recumbent posture, mild diet, abstinence from all alcoholic stimuli, gentle laxative action of the bowels, and the administration of small doses of alkali. The writer prefers liquor potassæ to all others, frequently repeated; and this may be combined with henbane, or, if micturition is very frequent and painful, with opium or morphia, or with chlorodyne in small doses. Hot hip-baths or bidets, followed by hot linseed-meal poultices or fomentations, give great relief. The patient may drink freely of decoction of triticum repens, linseed tea, barley water, or similar demulcents. Relief rapidly follows, but care is requisite to avoid relapse, which easily occurs if exercise be taken too soon, if injections for the gonorrhœa be resumed too readily, or if alcoholic stimulants are freely taken.

2. **Chronic Inflammation—Chronic Cystitis.**—Chronic inflammation of the bladder is separated from the acute form by very distinct characters. It is mostly the result of retained urine from stricture or enlarged prostate; but it may arise from the presence of calculi, or of growths in the bladder; from over-distension, or atony of its coats; from paralysis after injury or disease affecting a nervous centre; from disease of neighbouring organs; and sometimes from altered urine: it is also met with in certain affections of the kidney. Sometimes this condition is marked by the presence of a large quantity of viscous mucus, often called 'catarrh'; but more commonly this symptom is absent, and the urine contains merely ordinary mucus or muco-pus, rendering the secretion more or less cloudy and opaque. Perhaps there are some cases in which the inflammation is mainly due to the presence of gout.

SYMPTOMS.—The symptoms of chronic cystitis are increased frequency of micturition and pain, but the latter is by no means necessarily present. The urine is always cloudy, and contains some pus-cells. There is often, but not always, some suprapubic uneasiness. The general health does not suffer unless the affection is prolonged or severe. If important causes, as the presence of stricture, calculus, &c., occasion the chronic cystitis, their specific symptoms will predominate. It is not common to find chronic cystitis as an idiopathic disease, although undoubtedly it occasionally is so; so that the writer has always regarded it as a useful maxim, 'When chronic cystitis is declared to be idiopathic, we may be sure that we have only not yet discovered the real cause.' As a general rule we may be sure that there is inability to empty the bladder, or calculus, stricture, or organic disease of some kind in some part of the urinary tract, when the group of symptoms are present which we denote by the term 'chronic cystitis.' Respecting the well-known glairy mucus, which is deposited so abundantly from the urine in some cases, in elderly people almost invariably, it should be said that it appears only in those whose urine is abnormally retained, through atony of the vesical walls, or in consequence of enlarged prostate, or as the result of sacculation of the bladder, and that medicine has little or no effect upon it.

TREATMENT.—The regular and habitual use of the catheter, and perhaps also injections into the bladder, form the essential mechanical treatment of chronic cystitis in the cases just mentioned. In the few cases in which chronic cystitis is present, and no organic cause, such as those named above, can be discovered—and also as adjuncts to mechanical treatment when these causes do exist—certain *medicinal* agents are undoubtedly useful: these are buchu, triticum repens, uva ursi, alchemilla arvensis, pareira brava, and the alkalis potash and soda. Buchu is more useful in subacute and recent chronic cystitis than in cases already of long duration. The patient should take not less than ten ounces of the infusion daily. After this, in similar cases, the decoction of triticum repens, made by boiling two to four ounces of the prepared underground stem in a pint or a pint and a half of water, of which six ounces should be taken three or four times in the twenty-four hours, is highly useful. For more chronic cases, where the urine is alkaline and deposits much mucus, and perhaps the triple phosphates also, alchemilla, uva ursi, and pareira brava may be very valuable. The alchemilla is administered in infusion, one ounce of the herb in one pint of boiling water, of which the dose is four to six ounces three times daily; the others according to the directions of the pharmacopœia. These may be taken alone or combined with potash, which in moderate quantities diminishes the natural acidity of the urine before it enters the bladder; the mucous membrane of which, although accustomed to that condition in health, is perhaps sometimes, when inflamed, irritated by urine of even the ordinary acidity. Whether this be so or not, there is no doubt that alkalis do frequently tranquillise an irritable bladder. They are often given in the form of Vichy water, Vals water, or that of Evian, all strong solutions of soda; but on many grounds the salts of potash are preferable. On the other hand, the mineral acids have been largely administered in cases where the urine is alkaline; although there is no reason to believe that the acid has any direct action through the kidneys, or that it is eliminated by those organs. Alkalinity of the urine in chronic cystitis is almost always due to inability of the bladder to empty itself, and the remedy wanted is not medicine but a catheter, at all events to ascertain whether this be the cause or not. A very small quantity of urine retained in the bladder, say one or two ounces, after every act of micturition, suffices in some cases to maintain an alkaline and otherwise unhealthy state of the secretion: while it is equally true that some patients may habitually, and during long periods of time do fail to empty the bladder, always leaving behind from half a pint to a pint, without losing the acidity of the urine. Of course other signs, and notably great frequency of micturition, are present when such is the case.

3. **Neuralgia.**—It is impossible to deny that the bladder may be, like other parts of the body, subject to symptoms which are described as neuralgia, although the occurrence is an extremely rare one. All the writer can say is, that he has occasionally met with cases in which he has not been able to account, by the existence of any lesion, for pain and frequency in micturition, or for difficulty in performing that act, and where these symptoms have been more or less periodic in their appearance. In such instances he has given quinine, and has occasionally found great relief to follow a few doses; more frequently this has not been the case. But now and then the value of the drug has been so marked as to corroborate a belief in the existence of vesical neuralgia. It must be repeated, however, that examples of such phenomena are extremely rare. The writer has also employed arsenic on the same ground. It is invariably necessary to investigate the general health, as well as the habits and diet of the patient. This, perhaps, may be the place for stating that in all chronic and slight deviations from natural and healthy function in the urinary organs, it is essentially necessary to inquire into the state of the digestive organs, to correct by diet and by medicine when necessary any imperfect action on their part, if possible. Constipation alone, when habitual, may produce considerable irritability of the bladder, so also may the unnecessary use of purgatives. A gentle, easy, and daily action of the bowels, a healthy condition of the primary digestion, the absence of flatulence and distension after food, should be ensured as far as possible in all patients complaining of frequent, difficult, or uneasy micturition; and many such may be completely cured of so-called urinary affections by strict attention to these matters. The writer's strong convictions relative to this fact, grounded on innumerable experiences of its value as an aid in practice, led him nearly twenty years ago to ascertain the great value, for such patients, of Friedrichshall water, now so extensively used; and more than ever he insists on the use of a mild and laxative regimen and diet in their management.

4. Where obstruction to the outflow of urine exists (stricture of the urethra, most forms of enlarged prostate, other tumours, &c.), the muscular walls of the bladder become the seat of **Hypertrophy,** which is a condition of compensation, therefore, and not of disease in or by itself. But such changes in the interlacing muscular fibres existing, **Sacculation** readily occurs, by protrusion of the lining membrane between the bands so produced. On the other hand, most commonly when the prostate is hypertrophied, the bladder becomes gradually distended, its coats become expanded, thinned and weakened, and a certain degree of **Atrophy** takes place. The power of the organ to expel urine is lost or diminished; and micturition being a function of simply mechanical nature, the circumstances of the case demand only a mechanical remedy, viz. the catheter. No medicine can restore power and exercise of function under these circumstances. But atrophy and loss of power may occur from complete or partial loss of nervous influence to the bladder, as in those who are the subjects of paralytic states commencing in the spinal cord or brain. When the paralytic state follows accident causing injury to a nervous centre, the nature of the case is obvious enough. But sometimes the onset and progress of chronic disease in these organs are very slow and insidious; the urinary troubles, as manifested by slowness or difficulty in passing urine, or by urine clouded through inability of the bladder to empty itself, may be the earliest signs of the nervous lesion. On the other hand, impaired gait, and other evidences of central mischief, may be and mostly are earlier phenomena, the derangement in the urinary function appearing at a later stage. For such patients, the habitual use of the catheter is often necessary [always of course when unable to empty the bladder by the natural efforts]; while such constitutional treatment as is indicated by the cerebral or cerebro-spinal lesion present will comprehend that which the bladder demands. It is therefore unnecessary to allude further to that subject in this article. The same remark also applies to those few examples of **Tubercular** disease of the urinary organs, which is always a local expression of a general constitutional state sufficiently considered under its proper head in this work. All other treatment of this malady is local and surgical.

5. Relative to **Tumours,** the varieties of which have already been enumerated, no medical treatment other than that of chronic cystitis is to be thought of.

With almost all affections of the bladder, simple or malignant, ulcerative or associated with fistula, cystitis to some extent and in some form co-exists. It is this which gives rise to the presence of an undue quantity of mucus in the urine; it is often the source of pus, sometimes of blood in small quantity. Thus in all the above-mentioned diseases, some degree of cystitis appears sooner or later. HENRY THOMPSON.

BLADDER-WORMS.—Entozoa having the character of cysts or vesicles, and being at the same time more or less transparent. This general term embraces a variety of parasitic forms, such as *Echinococci*, *Cœnuri*, and *Cysticerci*, all of which are the larvæ of different species of tapeworm. Practically, it is important to know the origin of every kind of human bladder-worm, since the adoption of appropriate hygienic measures may prevent infection by each of the various species. *See* ECHINOCOCCUS, CYSTICERCUS, HYDATIDS, MEASLE, TÆNIA, and TAPEWORM. T. S. COBBOLD.

BLAIN.—A blister, as in the case of chilblain. According to Mason Good, blains are 'orbicular elevations of the cuticle, containing a watery fluid.'

BLEB.—A large vesicle or bulla, containing for the most part a serous fluid, as in pemphigus, erysipelas, or burns and scalds. *See* BLISTER.

BLENORRHŒA, BLENORRHAGIA (*βλέννα*, phlegm, and *ῥέω*, I flow; *βλέννα*, phlegm, and *ῥήγνυμι*, I burst out). These terms are most correctly used to express excessive flow of mucus from any mucous surface. By means of an affix, the locality or nature of the discharge is expressed: *e.g.*, *blenorrhœa oculi*, *nasalis*, *urethralis*. More commonly, however, and less accurately, blenorrhœa is employed as synonymous with gonorrhœa in the male or female.

BLEPHARITIS (*βλέφαρον*, an eyelid). Inflammation of the eyelids. *See* EYE and its Appendages, Diseases of.

BLEPHAROSPASM (*βλέφαρον*, an eyelid, and *σπάσμα*, a spasm). Spasmodic movement or contraction of the eyelids. *See* EYE and its Appendages, Diseases of.

BLINDNESS.—Loss of sight. *See* AMAUROSIS, and VISION, Disorders of.

BLISTER.—SYNON.: Bleb; Bulla; Fr. *Bulle*; Ger. *Blase*.

DEFINITION.—A vesicle of the skin, caused by the separation of the horny cuticle from the rete mucosum by the transudation of serous lymph beneath the former.

ÆTIOLOGY.—Blisters may be idiopathic, as in pemphigus; or symptomatic, as in erysipelas. They are met with under the influence of any cause which depresses the vitality of the integument, as in some forms of prurigo, in chilblain, and in carbuncle; in scalds and burns; and as an effect of powerful irritants, such as cantharides or the aniline salts.

DESCRIPTION.—A blister ranges in size from that of a pea to a turkey's egg: it is more or less convex according to the amount of exudation; and conforms in colour with that of its contents, being sometimes yellow or amber-coloured and transparent, like serum, sometimes opalescent from the presence of pus, and sometimes red or purple from admixture with blood. The fluid of a blister, generally limpid and free, is sometimes held in the meshes of a delicate network, resulting from the stretching of the connecting cells of the rete mucosum and horny epidermis. This is peculiarly the case in blisters developed under the influence of acute inflammation, and especially in Dermatitis anilina. Blisters may be dispersed, or aggregated, or even single, as in Pemphigus or Pompholyx solitarius.

TREATMENT.—Blisters are essentially asthenic in their nature, and call for corroborant therapeutical treatment. Locally they should be punctured so as to admit of the gradual escape of their contents, and then dusted over with some absorbent powder, such as oxide of zinc, fuller's earth, or cinchona. ERASMUS WILSON.

BLISTERING.—A therapeutic measure which consists in the artificial production of blisters on the skin. *See* COUNTER-IRRITATION.

BLOOD, Abstraction of.—SYNON.: Bleeding; Blood-letting. Fr. *La Saignée*: Ger. *Der Aderlass*. — DEFINITION. — The withdrawal of blood from the body, either (*a*) from the general circulation, by arteriotomy or phlebotomy; or (*b*) locally, by leeches, scarifications, or wet-cupping.

It is to the first two of these methods of abstracting blood that the term 'bleeding,' or 'blood-letting,' has by common usage been restricted.

The topical abstraction of blood by means of leeches, scarifications, and cupping, though often valuable, is of secondary importance. The present article will, therefore, chiefly be devoted to *general bleeding*.

General Bleeding.—This art, practised for centuries more or less universally, has of late years in this country fallen into disfavour. Much discussion has been raised as to the grounds for so great a difference. It has been attributed—(1) to the type of disease having undergone a change; (2) to mere fashion or caprice; (3) to a better knowledge of the nature of disease, teaching us that its processes were of a lowering or depressing character, which were to be overcome, not by the abstraction of blood, but rather by the use of stimulants and support. It is highly probable that several causes have contributed to the undoubted change which has taken place. The year 1830 and subsequent years were marked by the epidemic visitation of cholera and of influenza. These diseases were characterised by extreme depression. If antiphlogistic measures were adopted, they proved failures, and taught the physician that blood-letting was not the universal panacea it was supposed to be. By degrees it ceased to be practised as it used to be. A new generation which knew not the past has sprung up; and, as in all reactionary movements, the practice has become at length as limited as it formerly was universal. It is almost certain that in either extreme there is an evil, and that we may have recourse in certain cases to abstraction of blood with some degree of that success which formerly led to its extensive use, if not its abuse. It will be well to consider the subject at some little length, and under the following heads:—

Trinity Medical College.

1. The effect of moderate losses of blood on the healthy economy.

2. The value of bleeding as a remedy in disease, together with the indications for its employment in various affections.

3. The method of performing the operations of opening an artery—arteriotomy; and opening a vein—phlebotomy.

1. Effects.—We have first, then, to consider the effect of moderate losses of blood upon the healthy economy. Upon this point we have abundant evidence, for the custom of regularly bleeding healthy people had reached such a point during the earlier half of this century that in country districts it became a practice for adults to be bled as regularly as they went to market. No better testimony regarding the effects of this practice could be adduced than that of Sir James Paget, who, when referring to these customary venesections, says: 'I can regard those as a series of venesections fairly performed for the determination of what is the influence of the removal of blood up to the point of syncope upon a comparatively healthy person. I think I can say surely that not one of these persons suffered harm.' To this might be added other and abundant testimony to the harmlessness of venesection on the healthy economy.

2. Indications and Uses.—Concluding, then, that the abstraction of a limited quantity of blood has no deleterious effect upon the healthy organism, we will next set forth the general indications for the use of bleeding in disease, and briefly refer to the various affections in which it may most suitably be employed.

Broadly stated it may be said that bleeding is indicated when there is evidence of marked over-distension either of the arterial or of the venous system. In either case the result will be cardiac distension—in the former case of the left, and in the latter of the right chambers of the heart. In such conditions general bleeding restores the lost equilibrium of the vascular system, and relieves the heart and the other parts concerned in the circulation of the blood.

The arterial system may be in a state of augmented tension from two causes: (1) contraction of the arteries (the smaller vessels) themselves with a diminished amount of blood in the arterial system; and (2) engorgement or distension of the arteries from spasm of the arterioles: both may be regarded as vaso-constrictive neuroses. In the first case there may be engorgement of the venous system and embarrassment of the right heart, calling for abstraction of blood by *venesection*; or visceral fluxion, the skin being pale: and in the second, relative emptiness of the veins with overfulness of the larger arteries, calling for blood-letting by *arteriotomy*.

In the former condition there would be, in bed-side language, a *small* hard or wiry pulse, and in the latter a *full* and hard or bounding pulse. In the former the surface of the body may present one of the two following conditions: either the skin is injected and, perhaps, dusky, and this appears to be the case ordinarily; or it is pale and cool, the blood having receded inwards, chiefly to the abdominal viscera. The second condition obtains and is well seen in cases of uræmic asthma, when the arterial system is turgid almost to bursting, while the veins are comparatively empty. 'Hardness' of the pulse is usually said to be an indication for bleeding, and in certain associations it is so; but it is necessary to discriminate carefully between the 'hardness' due to 'tension' of the sound artery arising from (*a*) excessive contraction (the small, hard, wiry pulse), and (*b*) overfulness (the full, bounding pulse) on the one hand; and that due to arterial degeneration with more or less hard deposit in the walls of the vessels, on the other. In doubtful cases inquiry should be made into the state of the brachial artery at the bend of the elbow. This can readily be done by flexing the limb, when, if calcareous degeneration have taken place, the vessel will be thrown into serpentine folds, visible, except in fat people, to the eye, and cord-like and rigid to the touch. The temporal artery is a less safe guide, but neither it nor an arcus senilis should be overlooked in this connexion. A visible and tortuous pulse in a young person may indicate aortic regurgitant disease: the age of the patient must therefore be taken into consideration.

Dilatation of the arterioles would permit of the rapid passage of arterial blood into the veins: under such circumstances, therefore, we should expect the blood issuing from a cut vein to present a more florid appearance than under ordinary conditions. Bleeding here should be undertaken with considerable circumspection, and not be pushed very far, for collapse out of proportion to the amount of blood abstracted might ensue. On the other hand, when there is spasm of the arterioles, and the abstraction of blood is deemed advisable, it would be well to resort to arteriotomy rather than venesection. The best guide here would be the sphygmograph, but, as few persons are yet accustomed to use it, the full, hard, bounding pulse must be relied on when found in association with corroborative symptoms.

Whatever leads to over-engorgement of either side of the heart may render bleeding necessary. If the left side of the heart be over-full, arteriotomy is indicated; if the right, venesection. The object of the withdrawal of blood from the general circulation is the direct relief of the overburdened heart. Whether the right or left chambers be taxed the immediate effect is the same; they are over-distended, and cannot get a grip upon their swollen currents. It is with the embarrassed heart as with other hollow muscular organs—the bladder and uterus. Over-distension paralyses them by removing the 'points d'appui' essential for the initiation of muscular contraction; the energy may be there, but it cannot be exercised. It is obvious that the amount of blood which it is necessary to withdraw, in order to free the embarrassed organ, must vary considerably in different cases. But it may be safely laid down as a rule that it need rarely exceed a few ounces. Excess in this respect is the evil which formerly existed.

On this subject we may refer to the eminently practical remarks of Sir Thomas Watson, who says: 'I hold it, then, to be certain, that for some special morbid conditions, which inflammation may or may not accompany, general blood-letting, and especially venesection, is a potent and life-preserving remedy; that there are many exigencies for which it is not only safe to employ, but unsafe and unpardonable to withhold it.'

He also gives the following judicious advice:—

'Always it is necessary to consider the age, the sex, the general temperament and condition of the sick person, when we are turning over in our minds the expediency of abstracting blood. The very young, the old, the feeble, the cachectic, do not bear well the loss of much blood. This consideration is not to deter you from bleeding such persons topically when they are attacked by dangerous inflammation, but it especially enforces, in regard to them, the golden rule that no more blood should be abstracted than seems absolutely requisite to control the disease.'

The following are some of the affections under which blood-letting would seem to be more or less indicated:—

Pneumonia.—Blood-letting in pneumonia, as in many other inflammations, is most useful in the early stages. It is indicated in healthy patients suffering from uncomplicated acute sthenic pneumonia, if they happen to be seen early enough. It relieves pain, abates fever, and if it does not arrest the disease, it certainly appears to lessen its duration. It may also be called for when there is severe pain and evidence of cardiac embarrassment. It did good, and will still do good, in cases of pneumonia, attended by embarrassment of the circulation, and that in truth is the indication for bleeding in this disease.

Apoplexy.—The same may be said with reference to cerebral apoplexy. The old belief in the importance of 'letting blood' in cases of apoplexy was, if possible, stronger than in cases of pneumonia. But here again more accurate clinical and more extended pathological knowledge have taught us to look upon 'apoplexy' very differently to our forefathers. Recognising the escape of blood from the bursting of a brittle artery as a common cause of 'apoplectic fits,' we see the futility of venesection when the 'stroke' or 'fit' is due to a lesion of this kind. Nor will bleeding unstop an artery when it is plugged by an embolus, or carry nutriment to the region thus bereft of vital fluid. On the other hand we have learnt to recognise the value of bleeding in another class of cases of so-called 'apoplexy'—those which are unaccompanied by effusion of blood or lesion of the nervous tissue, but depend on rapidly occurring compression of the nervous centres from sudden or unequal increase in the volume of any portion of the cranial contents; or in certain eclamptic cases from the circulation of blood poisoned by uneliminated urinary excreta. In cases of this description, when the right heart and venous system are engorged, phlebotomy acts well; the stertor will cease, the purple face resumes its natural hue, the clouded intelligence becomes clear, and the impending danger is for the time averted. This has not cured the patient, however, it has only 'obviated the tendency to death:' it has saved the patient's life, though he may ultimately die of the disease which afflicts him. Where we meet with evidence of cerebral congestion accompanied by fulness of the veins, a dusky countenance, and a *slow* full pulse, bleeding may most usefully be resorted to. In a word, although bleeding will not remove the effused blood in cases of cerebral hæmorrhage, it may sometimes be usefully employed to prevent further escape, when the heart is acting too forcibly; but it is altogether forbidden when that organ is enfeebled. The pulse at both wrists should be attentively examined before bleeding, in cases of cerebral hæmorrhage, for as a rule it is larger on the paralysed than on the sound side.

Eclampsia.—Indiscriminate bleeding in eclamptic seizures would be a grievous error. It would not relieve, but rather would probably intensify, convulsions of reflex origin, as in certain cases of puerperal convulsions. On the other hand, cases of puerperal convulsions accompanied by great turgescence of the vascular system, whether venous, (as is commonly the case) or arterial, would be immensely benefited by the withdrawal of blood from the general current, either by venesection or by arteriotomy, according to the indication. This treatment may serve to stop the convulsions, and though that may be far from curing the disease, it may, nevertheless, be of the utmost value, for in the first place the fits themselves may kill by their violence or frequent repetition; whilst, secondly, time may be gained for the employment of other measures calculated to relieve the oppressed system, as, for example, purging by hydragogue cathartics, vapour baths, cupping the loins, &c. This gain may be immense; for bleeding may avert impending dissolution. Moreover, permanent good may ensue, inasmuch as bleeding reduces temperature, and in the eclampsia of pregnancy the temperature is usually high. In this it contrasts with pure uræmic convulsions, in which there is lowering of temperature.

Venous Engorgement.—Engorgement of the venous system arising from chronic disease, *e.g.* pulmonary emphysema or heart-disease, does not call for bleeding, unless the condition be acutely intensified by some intercurrent mischief, such as acute bronchitis; for, as the derangement is slowly produced, the organs and structures involved learn to accommodate themselves more or less to the altered conditions. It is only when vascular engorgement suddenly occurs in apparently healthy subjects, or, as stated above, there is acute intensification of a chronic condition, that bleeding is required. Thus, in cases where mediastinal tumours impede the return of blood from the head and upper portion of the body, the condition is ordinarily of such comparatively slow production, that bleeding is seldom urgently called for; and, moreover, it would be of but small service, for the obstruction is irremediable

The lividity of the face which accompanies all fits should not be confounded with the duskiness due to engorgement of the venous system generally.

Uræmia.—In pure uræmia bleeding is useful; the kidneys being especially in default. For venesection answers a double purpose, by not only relieving the engorged right heart and venous system, but removing from the body a certain amount of poisoned blood—blood that is charged with urinary excreta. Doubtless, it does good in both ways, but the former is, *quoad* the fits, the more important because more immediate mode of its action. The second effect, that of ridding the body of damaged blood, is obviously available to us when we have to deal with uræmia, occurring in the non-pregnant; and when coma is deepening, the heart labouring, and the vascular system turgid, no remedy is so swift and sure as the lancet.

Plethora.—Blood-letting may be called for in cases of general plethora, whether sthenic or asthenic. In the former condition the vascular system generally seems to be overfull, though the excess is most marked in the arterial system. Arteriotomy, however, is seldom called for, though it might at first sight seem indicated, since venesection usually answers every purpose.

In asthenic plethora, on the other hand, the venous system only is overfilled; the right side of the heart is distended and its action is laboured. Here venesection is sometimes called for, but it should be carefully employed. It is seldom necessary to withdraw more than 6 to 10 ounces of blood, and often a smaller quantity suffices.

Peritonitis.—The relief obtained by bleeding in acute peritonitis rendered venesection a famous remedy in this affection in former times. And there can be no doubt about its efficacy in relieving the pain of peritonitis, as of inflammation of other serous membranes. It may be used when the patient is young and strong, and in that stage of the disease which is accompanied by a small, hard, and wiry pulse—the pulse of a contracted artery, of augmented tension from contraction, not from overfulness. It is worse than useless in the later stages of the disease, when adynamia has set in. But valuable as bleeding may be in certain cases of peritonitis, it rarely happens that it is admissible, for in the great majority of cases inflammation of the peritoneum is secondary to other diseases, and notably to disease of the kidneys. Where peritonitis arises after delivery it is commonly of septicæmic origin, and it is seldom indeed that bleeding is of any avail under these conditions. So that, practically, bleeding is not a remedy which we can often employ in peritonitis. A very high temperature cannot alone be held to be indicative of its use, for it so happens that such pyrexia is as a rule present only in septicæmic cases. Some cases of peritonitis, even fatal ones, run their course without any marked elevation of temperature: or indeed without showing any definite symptoms. Probably venesection is most serviceable in traumatic peritonitis, or it may be, when the inflammation is localised, though in that case leeches are more suitable.

Pleurisy.—When pleurisy attacks a young and robust patient, and is accompanied by severe pain, great relief follows blood-letting. The blood should be taken from a vein, and *pleno rivo*. But when, as so often happens, pleurisy is, like peritonitis, secondary to damaged blood-conditions—*e.g.* Bright's disease—bleeding is often inadmissible. When, as in pleuro pneumonic cases, pleurisy complicates pneumonia, bleeding may possibly be called for, if there be great pain and oppression of the chest; but it should be most circumspectly used. Local blood-letting is much to be preferred if bleeding be thought necessary; for general bleeding is usually incompatible with the strength of the patient.

Uræmic Asthma.—In the affection known as uræmic asthma, in which there is spasm of the systemic arterioles, with intense turgidity of the arterial system and engorgement of the left heart, bleeding, in the form of arteriotomy, appears to be clearly indicated.

Spasmodic Bronchial Asthma.—Pure asthma is doubtless often a nervous malady, and bleeding is not a remedy which should ordinarily be employed for its relief. It is only admissible when spasm of the pulmonary vessels, or obstruction to the flow of blood through them from bronchiole-spasm, leads to rapid engorgement of the right heart and venous system. This is the exact converse of uræmic asthma: but the effect in both is impediment to the aëration of the blood. Here the abstraction of a few ounces of blood from a vein may give immense and very prompt relief.

Emphysema.—It is not so, however, in the so-called 'asthmatic attacks,' which chronically emphysematous people are so prone to. Here venesection may be imperatively demanded when an acute attack of bronchitis has, by adding to the already difficult passage of blood through the lungs, excited rapid engorgement of the dilated heart and previously turgid venous system.

Puerperal Diseases.—Formerly bleeding was much employed in midwifery practice, and especially in inflammatory affections after delivery. We now recognise that for the most part post-partum affections arise from septic mischief and are of an adynamic type. It is but seldom that we are called upon to bleed in these cases. Nevertheless, now and again, venesection may be called for.

Disorders of Menstruation.—Bleeding is a most valuable remedy in certain menstrual disorders, and especially in the plethora of women at the change of life. Many women suffer distressingly from general vascular disturbance at this period. The flushings, headaches, giddiness, feeling of oppression and other vaso-motor phenomena which they suffer from in association with the cessation of the catamenial flow, are immensely relieved by an occasional venesection. No other measure will so quickly and so effectually relieve these symptoms. Some robust, plethoric, amenorrhœic young women require periodical bleeding. The writer has known the abstraction of a few ounces of blood to be speedily followed by the occurrence of the menses, in cases of what may be called congestive amenorrhœa of many months' or even years' duration. It may be well to state in this connexion that in certain pulmonary, intra-cranial, and other visceral lesions, danger may arise from the augmented arterial tension which for a few days precedes the flow, and that the abstraction of blood may avert hæmorrhage into the damaged organs.

After Operations.—Bleeding is less frequently called for in surgical than in medical practice. It is indicated mainly in the after-treatment of cases which present engorgement of the right heart and venous system, as in some cases of ovariotomy and other operations involving the abdominal or thoracic cavities. A turgid venous system, with a small hard pulse, and a labouring heart—a condition which is often associated with scantiness, amounting almost to suppression, of urine—indicates blood-letting after operations of the kind above referred to.

Shock.—In certain cases of shock the abstraction of a limited amount of blood may be required. This point will be found discussed elsewhere (*see* SHOCK).

Fever.—That bleeding will lower the temperature of fevered patients has been known from the earliest times. It is, however, not a remedy to be resorted to for that purpose alone, for, as the most pronounced hyperpyrexia occurs chiefly in association with conditions leading to great depression, blood-letting is under such circumstances as useless as it is dangerous.

Insolation.—There are few disorders in which blood-letting is more successful, when rightly employed, than in sunstroke. It is seldom necessary to take more than a few ounces of blood; and excess should be particularly guarded against, for fear of subsequent collapse. The insensible patient with turgid veins, a tight pulse, and labouring heart, will gain immense and prompt relief from venesection. The extreme pulmonary congestion and over-distension of the right heart so often found *post mortem* might probably be prevented by the timely abstraction of a little blood from the venous system. Bleeding is not to be thought of in the syncopal form.

3. METHODS OF BLEEDING.—The following are the methods of performing the operations of arteriotomy and phlebotomy.

Arteriotomy.—This operation is best performed on the temporal artery. The vessel should be partially cut through by a simple transverse incision, and when a sufficient quantity of blood has been obtained it may then be completely severed, so that, retraction of both ends taking place, the hæmorrhage may be arrested. A compress of dry lint should then be applied, and a tight roller-bandage applied over it.

Venesection.—The median basilic vein is the one usually selected for the operation on account of its being most readily found. The brachial artery lies immediately beneath it, and care must be taken to avoid wounding the latter vessel. The median cephalic vein is preferable, but is not so easily found. A vein on the dorsum of the foot or other part of the body may be chosen, but, as a rule, it is not desirable to open the jugular vein, especially on account of the danger of the entrance of air, and other risks.

The steps in the operation on the arm are as follows:— First, the limb is to be firmly bound above the elbow by a broad tape or fillet. This should be applied with sufficient tightness to compress, and prevent the return of blood by the veins, but not so as to intercept the current in the artery, and extinguish the pulse. An oblique slit is to be made in the vessel by means of a small lancet, care being taken not to cut too deeply. The spirting blood should be caught in a vessel and measured.

When sufficient blood has been withdrawn, the operator should firmly place a thumb or a finger on the aperture, and then, on removing compression, place upon the wound a dossil of dry lint, antiseptic dressing, styptic-colloid, or such-like, over which a roller-bandage should be twined a few times like a figure of 8, the cross being over the wound.

Local bleeding.—The object of local bleeding is the relief of congested vessels, and especially those of inflamed parts. Arteries convey more blood to, and veins convey more away from, inflamed parts; so that local bleeding may give great relief and initiate resolution, since absorption does not fully commence until inflammation has ceased.

METHODS OF LOCAL BLEEDING.—Blood may be abstracted topically by leeches, by scarifications, or by wet-cupping.

1. *Leeching.* An average leech will abstract nearly half an ounce of blood. Leeches are extremely useful in a great variety of affections, since a pretty definite amount of blood can be withdrawn from the affected or adjacent parts, or from more distant parts, through intimacy of the vascular connexion, as in diseases of the eye and ear, and in hepatic diseases, accompanied by obstruction to the flow of blood through the portal system, when the application of leeches to the anus is most valuable.

Care should be taken not to apply leeches to parts over which sufficient compression cannot be made to control the bleeding, should any difficulty arise in arresting it otherwise. Thus, leeches should not be applied over the trachea, especially in children, in whom the error of applying them over the episternal notch is sometimes made. For the same reason the fontanelles should be avoided.

The skin of the part where leeches are to be applied should first be washed, and when they do not bite readily the part may be wetted by a little milk or sugar and milk. A slight prick of a needle, sufficient to draw a speck of blood, will often cause them to bite when refractory.

Should the bleeding continue too long after the leeches fall off, pressure or styptics may be applied. If it is desired to encourage bleeding, fomentations of hot water or linseed poultice are serviceable.

In applying leeches to the cervix uteri the precaution of closing the os by a plug of wool, should not be neglected. When applied within the mouth a leech-glass should be used.

2. *Scarifying.*—Scarifications consist in small cuts of a depth not exceeding the eighth of an inch or less into the tissue whence it is desired to take blood. This mode of topical bleeding is mainly applied to the cervix uteri, to the tongue in acute glossitis, and to the palpebral conjunctiva in certain kinds of conjunctivitis; in the last case only slight incisions are permissible. Deeper punctures are made by some practitioners into the tissue of the cervix uteri, but these are punctures and not mere scarifications.

3. *Cupping.*—Cupping and the use of the scarificator constituting wet-cupping is an important method of topical blood-abstraction; and as a considerable amount of blood can thus be withdrawn, the general circulation may thereby be

affected. It is ordinarily employed, however, for its local effects.

The method of its performance is as follows:—Cupping-glasses being first put on for a brief time, as for dry-cupping (*see* CUPPING—*Dry-Cupping*), the operator applies to the part selected a spring scarificator so adjusted as to cut only to the required depth—about an eighth of an inch or less. The cupping-glasses are then re-applied, and the desired number of ounces of blood abstracted. If the glasses be too tightly attached the blood will not flow readily, and unnecessary pain may be caused. After their removal adhesive plaster or dry lint and a bandage should be applied to the part.

Cupping over the loins is extremely useful in renal ischæmia; on the temple or behind the ears in certain cerebral disorders; down the spinal column in inflammation of the spinal cord or meninges; and on the chest in certain pulmonary affections. ALFRED WILTSHIRE.

BLOOD-DISEASE.—The term *blood-disease* was used by the humoral pathologists as synonymous with *dyscrasis* or *anomalous crasis of the blood*, and expressed the idea that the blood was the seat 'almost without exception' of all general diseases. And, further, since purely local disease was considered to be exceptional, the vast majority of diseases were referred to dyscrases, and were classed under the head of blood-diseases.

The condition of the blood was considered by the humoralists to depend upon the *crasis*, that is the mixture, of its constituents; and prominent among its constituents were reckoned the *blastemata*, or germinal substances of the different tissues, which exuded through the capillary walls in the process of nutrition. When the blood-crasis was disordered or diseased, a dyscrasis was said to exist, and dyscrases were held to be in the majority of cases primary; though it was allowed that local anomalies of nutrition might and did occasionally occur, and give rise to secondary dyscrases. A blood-disease or dyscrasis being established, all morbid changes throughout the body were believed to be but local manifestations of the same. For the purpose, therefore, of a rational classification of diseases, a previous classification had to be made of the dyscrases. The principal blood-crases were said to be:—

1. The *fibrin*-crasis; including the *simple* fibrin-crasis, the *croupous* crasis, and the *tubercle*-crasis as varieties. The local expression of the fibrin crases was inflammation in some form.

2. The *venous* crasis, in which fibrin was deficient. This included a vast number of special crases, lying at the foundation of the most diverse diseases—*e.g.*, plethora, heart-disease, acute exanthemata, rickets, albuminous urine, cholera, acute tuberculosis, lardaceous disease, cancer, acute convulsive diseases, metallic poisoning, &c.

3. The *serous* crasis; associated with anæmia.

4. The *putrid* or *septic* crasis.

5. Anomalous crases; such as those of syphilis, gout, &c.

The theory of dyscrases may be said to have declined since the appearance of Virchow's *Cellular Pathology*. Virchow showed that the blood is in every relation a dependent and not an independent fluid, and that the sources from which it is sustained and restored, and the exciting causes of the changes that it may suffer, lie without it and not within it. Substances may enter the blood and affect the corpuscles injuriously; the blood may act as a medium in conveying to the organs noxious substances that have reached it from various sources; or its elements may be imperfectly restored. But never is any affection of the blood itself—any 'dyscrasis'—permanent, unless new influences arise and act upon the blood through some channel or through some organ.

At the present time, while it cannot be said that humoralism is professed by many pathologists, the notion of blood-disease, as generally entertained thirty years ago, still clings to the nomenclature, and pervades some of our pathological doctrines. Diseases that affect the whole economy—syphilis, tuberculosis, gout, and cancer—are frequently described as 'constitutional,' or 'blood-diseases,' and that whether their general manifestations are secondary to local disease, as in syphilis and cancer, or are referable to inheritance. While the *morbid conditions* of the blood are real and numerous, 'blood-diseases,' so called, are but abstractions, and, as such, a fruitful source of confusion and useless discussion. It is desirable that the term *blood-disease* should be abandoned, and that the expression *morbid conditions of the blood* should be applied to the pathological states of the vital fluid, which can be distinctly demonstrated by physical, chemical, or histological examination.

J. MITCHELL BRUCE.

BLOOD, Morbid Conditions of.—The characters, composition, and functions of the blood in health are sufficiently familiar, and do not require to be described here. But certain facts connected with the physiology of this fluid have a special bearing upon its pathology, and must be briefly considered before its morbid states can be profitably discussed.

A. PHYSIOLOGY OF THE BLOOD.—The *Red Corpuscles* of the blood consist of two portions—a colourless, sponge-like matrix; and a coloured substance of complex composition, which occupies the interstices of the former and accurately fills them. The matrix is regarded as possessing chiefly physical properties; while its contents constitute the active part of the corpuscle, and consist of hæmoglobin. The *source* of the red corpuscles is of the greatest pathological importance. In the embryo the blood and blood-vessels are developed from the same elements, and thus the two structures in their physiological aspect are essentially inseparable. In fully-developed blood the source of the red corpuscle is obscure: but there can be no reasonable doubt that it originates in the colourless corpuscle, and more remotely in the lymphatic glands, the spleen, and the medulla of bones; and that light is of the greatest importance in the formation of hæmoglobin. With respect to the properties and *function* of the red corpuscle, it is to be noted that the ultimate elements of hæmoglobin are carbon, nitrogen, hydrogen, oxygen, sulphur, and iron,

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—the last of these probably being the cause of its red colour. Hæmoglobin is soluble in water, forming a lake liquid from which fine crystals may be obtained, and which may be variously decomposed, giving rise to other 'blood crystals.' Most important of all its properties, hæmoglobin combines with certain gases to form definite chemical compounds;—with O to form oxyhæmoglobin; with CO to form carbonic-oxide-hæmoglobin; and with N^2O to form nitrous-oxide-hæmoglobin. These compounds, and especially the oxyhæmoglobin, are exceedingly unstable, being reduced even under very feeble influences to hæmoglobin and their other constituents respectively. Alternate oxidation of hæmoglobin and deoxidation of oxyhæmoglobin are constantly going on within the red corpuscles of the circulating blood; and the two changes, occurring in the pulmonary and systemic capillaries respectively, constitute the first great function of the blood—its oxygenating or respiratory function. The volume of oxygen in arterial blood is 16·9 per cent., and in venous blood 5·96 per cent. It must be clearly understood that disorders connected with the red corpuscles or respiratory elements of the body, whether in amount, composition, or circulation, directly affect the oxidation-processes only. Besides its origin and its function, there is a third relation of the red corpuscle to the organism—namely that of its *products*. These are eliminated by the ordinary channels; the salts, which are chiefly salts of potash, being excreted by the kidneys, and the coloured material furnishing the pigments of the bile and urine.

The *White or Colourless Corpuscles* of the blood, also called *Leucocytes*, are chiefly derived from the corpuscles of the lymph, and the cells of the lymphatic glands and allied organs, which they closely resemble. By escaping through the walls of the blood-vessels, they become identical with the wandering-cells of tissues and with pus-corpuscles,—from which they are indistinguishable except by locality. Such is the origin, and such are some of the functions of the white corpuscle, and its occasional development into the red corpuscle has been already mentioned. It might, therefore, be expected that morbid states of the leucocytes would be associated with disorder of the lymphatic structures and connective tissues, of the red corpuscles, and of the blood-vessels, and this will presently be shown to be the case. The proportion of white corpuscles in the blood is subject to physiological increase, without becoming excessive, as after meals, during periods of growth and development, and in menstruation and pregnancy. This state is called *Physiological Leucocytosis* (Virchow), and signifies lymph-glandular excitement.

Plasma.—The physiological relations of the plasma to the organism are extremely complex; and disturbance of these relations furnishes many of the symptoms of disorder of the blood. Its mature *function* is essentially one of nutrition—it supplies the tissues with oxidisable material for development, growth, support, secretion, and the liberation of force. The *source* of the plasma is equally extensive. It derives its principal constituents from the alimentary canal through the absorbent glands and liver; while other important albuminous substances are being constantly supplied from the tissues generally, through the lymphatic system. Lastly, the *products* of the plasma, such as carbonic acid, urea, and water, are discharged by the regular excretory channels. Thus the condition of the plasma is found to be most intimately associated with that of the organs and tissues generally, whether as regards its origin, its mature function, or its products; and it will therefore be affected by disorder or disease of every organ, whether alimentary, sanguifacient, or excretory, and of all the tissues.

Coagulation of the Blood: Fibrin.—Under certain circumstances, especially after removal from the body, the blood coagulates, and fibrin separates more or less completely from the other constituents. This change is now believed to be due to the action of three bodies contained in the plasma—two fibrin-generators, named respectively fibrinogen and fibrinoplastic substance, albuminous in nature; and the third a ferment. The *amount* of fibrin produced varies not only with the amount of these bodies, but with the amount of salts, with the degree of alkalinity and of heat, and with other influences; and these variations are subject to no law at present known. The *rapidity* of the process depends upon (1) the amount of ferment; (2) its increased activity by agitation of the blood and by elevation of temperature; and (3) the increased number of points of contact (so-called 'catalytic' action) by the presence of red corpuscles, hæmoglobin, charcoal, &c. It thus appears that the expressions 'amount of fibrin' and 'rapidity of coagulation,' however important as facts, do not afford any definite indication of the state of the blood, as has been generally believed hitherto. Three essential factors, and a large number of accidental influences, share in the process; they may do so in very various proportions and degrees; they do not vary together; the amount of fibrin is not in proportion to any one of them; and after coagulation is complete, portions of all the factors probably remain uncombined. The part played by the red corpuscles in coagulation is a double one—(1) the corpuscles, as 'points of contact,' greatly increase the rapidity of coagulation; and (2) they supply oxygen, which appears to be indispensable to the process. The leucocytes probably produce the ferment.

B. Pathology of the Blood.—The morbid states of the blood will now be considered in the following order:—1. Changes in quantity, and the effects of such changes upon the composition of the vital fluid. 2. Morbid conditions of the red corpuscles. 3. Changes in colour. 4. Melanæmia. 5. Morbid states of the white corpuscles. 6. The pathology of the blood-plasma; and of the process of coagulation. 7. The presence of foreign materials in the blood, including poisons and infective substances. 8. Organisms.

1. Changes in Quantity of the Blood.—Alterations in the total amount of blood in the body are perhaps never simple, but always associated with alterations in quality.

a. Polyhæmia, or *excess* of blood in the body generally, may be the result either of excessive ingestion of the elements of blood; of the accumulation of the same by the suppression of habitual hæmorrhages or fluxes; of the loss or obsoleteness of a part of the body, such as a limb or a lung; or of insufficient exercise. It cannot be said, however, that polyhæmia has ever been demonstrated by exact investigation, inasmuch as the total amount of blood in the body is still uncertain, and the physiological limits in this respect are very wide. Polyhæmia is believed to be present in *plethora*, along with relative excess of the solids, and especially of the red corpuscles (*see* PLETHORA).

b. Oligæmia or *deficiency* of the total amount of blood is, on the contrary, an exceedingly frequent change, and constitutes the simplest form of *anæmia*. It is, however, probably never pure, inasmuch as alterations in quality appear to be inseparably associated with it; and the terms *hydræmia* and *spanæmia* have accordingly been used as synonymous with the preceding. The manner in which diminution in quantity gives rise to alteration in quality must be considered here.

When hæmorrhage occurs to any amount, and the whole quantity of blood in the vessels is reduced, the pressure falls, and absorption of the parenchymatous plasma rapidly follows; by which, along with vaso-motor stimulation, the physical relations are restored. If the loss of blood has been moderate, the only change in its composition may be considered to be *oligocythæmia*, or diminution of the red corpuscles, which alone of all the constituents of the blood cannot be rapidly restored. If the hæmorrhage has been more serious, the fluid absorbed into the circulation from the tissues, from the suppressed secretions, and from the alimentary canal, consists of water in ever-increasing excess, which carries with it an amount of salts equal to one-ninth the loss in albuminous substances. The morbid state of the blood is now beyond oligocythæmia; there is deficiency of albuminous constituents, or *hypalbuminosis*, and the condition correctly called *anæmia* is the result. The total quantity of blood probably remains for some time below the normal. A similar impairment of the quantity, and therewith of the quality of the blood, may be slowly developed by repeated small hæmorrhages, or by any cause whatever that impoverishes the blood, whether of the nature of waste or of want. The condition which results closely resembles that just described in the acute form—oligæmia with oligocythæmia and hypalbuminosis: the same is known clinically as *anæmia* (*see* ANÆMIA).

As a *therapeutic measure* oligæmia may be desirable. It may be induced either (1) by direct abstraction of blood, or (2) by gradual impoverishment of the blood, and reduction of the intra-vascular pressure.

2. Morbid Conditions of the Red Corpuscles.—The pathology of the red corpuscles is still imperfectly understood. The following comprise the most important changes connected with them so far as they are known.

a. Polycythæmia.—Increase in number of the red corpuscles is never considerable, being generally transitory and within physiological limits; for example, in the newly-born, and after meals. It has already been mentioned as associated with polyhæmia in plethora. In the algid stage of cholera the red corpuscles are relatively in excess

b. Oligocythæmia.—Diminution in number of the red corpuscles is, on the contrary, of very frequent occurrence, and of the greatest pathological importance. Microscopically the number of red corpuscles in a given visible area of blood is diminished; and chemically the amount of hæmoglobin in a given volume of blood may fall from 15 even as low as 5 per cent. The principal circumstances under which oligocythæmia occurs are—(1) in anæmia, or diminution in the amount of blood as a whole, from any cause, whether rapid or protracted, especially as the result of fever; the red corpuscles suffering early, seriously, and persistently, as compared with the other constituents: (2) in leucocythæmia — the development of the red corpuscles being interrupted: (3) in hypalbuminosis, where the red corpuscles like other elements suffer from want of albuminous material: and (4) in chlorosis. *See* HÆMACYTOMETER.

c. Oligochromæmia.—Deficiency of the red corpuscles in hæmoglobin has been described by this name, and is a morbid condition of the greatest possible interest, inasmuch as it is one of the essential alterations of the blood in chlorosis. When the individual red corpuscle contains less hæmoglobin than normal, it is said to present a pale appearance to the eye. A more trustworthy method of determining the richness of the red corpuscles in hæmoglobin, is by means of the hæmoglobinometer (*see* HÆMOGLOBINOMETER). Or we may compare the amount of hæmoglobin in a given weight of blood with the number of red corpuscles in a given microscopical area. When the former is small in proportion to the latter, the defect must lie in the individual corpuscle; and this may be so great that the proportion of hæmoglobin falls, as in some cases of chlorosis, to 25 per cent. of the normal. *See* CHLOROSIS.

d. Aglobulism.—The effects of the two conditions of blood just described, namely, oligocythæmia and oligochromæmia, may be discussed together under the head of aglobulism, or deficiency of the blood in hæmoglobin. Want of the oxygenating substance of the organism gives rise to symptoms at once extremely various, and of the most serious import. Every vital process, whether developmental, plastic, secretory, dynamic, or nutritive, is absolutely dependent on a free and immediate supply of oxygen. All of these processes, therefore, will suffer in aglobulism. The respiratory and circulatory movements are accelerated. The complex processes of alimentation and secretion are performed imperfectly, and the results are dyspepsia, constipation, and disordered sanguification—which intensify the abnormal blood-state. Muscular contraction is feeble, and cannot be sustained. Psychical force is weak; and dulness, sleepiness, pains, and other symptoms indicate imperfect oxidation within the nervous system. Bodily growth and development—as of the sexual organs, for example—remain incomplete, and puberty is deferred. Nutrition everywhere suffers, the materials being insufficiently oxidised; and substances 'intermediate' to albumen on the one hand, and carbonic acid, water, and urea on the other hand, are formed, especially oils. Thus the organs and the connective tissues become loaded with fat and enlarged, instead of suffering atrophy, as they do when the blood-plasma is deficient. Finally the excretions are disturbed, and the subject of aglobulism presents derangement of the colouring matters of the bile and urine, which are derived from hæmoglobin.

Histological changes.—Alterations in the *size*, *outline*, and *consistence* of the red corpuscle have been frequently recorded, but such accounts are incomplete, and no successful attempt has yet been made to connect any of these changes with morbid processes in the tissues. In severe fevers, such as typhus, and in some rapid malignant diseases, the red corpuscles appear peculiarly soft, their outline being less resistant and sharp, and the bodies running together into irregular heaps, instead of into *rouleaux* with well-defined lines of contact between the elements. In another class of cases the corpuscles appear small and crenated or like the 'thorn-apple.' *Macrocythæmia* and *Microcythæmia* have also been described as temporary and variable conditions, in which the red corpuscles are abnormally large and abnormally small respectively. *Transitional cells* between the white and the red corpuscle are unusually numerous in some cases of leukæmia.

3. Changes in Colour.—The colour of the blood is chiefly due to the red corpuscles, and alterations from the normal in this direction will be best considered in this place, although the white corpuscles and the plasma may also affect the colour, as will be presently shown.

a. The chief determining cause of the colour of the blood is the chemical condition of the hæmoglobin. When this is united with oxygen, in the arteries, the blood is *scarlet*; as deoxidation advances, this colour passes into a *purple*, and finally becomes *black* or venous. The dark colour is directly due to absence of oxygen. The purest example of this change is seen in asphyxia, where oxygen is excluded from the blood; but it also occurs as the result of the action of certain injurious influences upon the corpuscle itself, such as extreme heat, or poisoning by phosphorus, prussic acid, and other toxic agents. If the change proceed no farther, the scarlet colour may still be restored by oxidation. This blackness of the blood is generally associated with imperfect coagulation or even a state of fluidity (*see Fibrin*).

b. Paleness of the blood is observed in oligæmia and oligocythæmia, and is due to deficiency of the hæmoglobin.

c. The blood may be not only pale, but present streaks of a *puriform* character, even as it flows from the living vessels, as in leucocythæmia. The same blood will settle on standing into three layers—of plasma superiorly, loosely coagulated or not; of white corpuscles in the middle—a pus-like layer; and of red corpuscles at the bottom.

d. The *milky* appearance of chylous blood will be described under the head of *Blood-Plasma*.

e. Lake blood. The remarkable change in the blood in which it becomes lake or transparent, is frequently observed as a further stage of that first described above; but it may occur under other circumstances than deoxidation, and is of the very gravest significance, inasmuch as it indicates complete and hopeless destruction of the red corpuscles. Lake blood is no longer opaque, but transparent; the hæmoglobin has left the corpuscles and is dissolved in the plasma. The change can be effected experimentally by the addition to blood of water, chloroform, the bile-acids, or other solvents; and it is probable that some of the cases of rapid death after enormous draughts of water, and the destruction of red corpuscles that is believed to occur in jaundice, may be accounted for in this way. But the most important cause of 'solution' of the red corpuscles is complete deoxidation of the hæmoglobin, which is followed by its diffusion in the plasma. Thus drawn blood is rendered lake by the addition of sulphide of ammonium, phosphorus, phosphoric acid, or iron-filings; and the same effect is produced by the intravenous injection of salts of the bile-acids. This being so, it might be expected that blood would assume the lake appearance when exposed to the prolonged action of the causes that render it black; and recent observations seem to indicate that such is the case. In a number of diseases which are attended with the accumulation of oxidisable substances in the circulation, the blood has been described as 'fluid,' 'claret-' or 'cherry-coloured,' 'clear,' and 'staining the tissues,'—but apparently without more exact observations on the colour of the living plasma. Such diseases are high fevers, hyperpyrexia, insolation, and poisoning by malaria, phosphorus, and perhaps other agents. The effect of some of these influences is obviously to produce an excessive amount of oxidisable material in the blood, while the others may lead to the same result by reducing the oxygenating capacity of the corpuscles. Persons dying under such circumstances present great lividity, from the black or venous condition of their blood; death occurs with symptoms indicative of want of oxygen, as if so much of the hæmoglobin had been diffused through the plasma; and *post mortem* the vessels are found stained with the solution, the tissues are soaked with fluid lake blood, and decomposition is early and rapid. The 'fluidity' of, or absence of clot in such blood will be presently accounted for under *Fibrin*. That a similar solution or destruction of the red corpuscle may occur in all cases of fever, but in a much less degree, is supported by several facts:—(1) the increased discharge of potash-salts in fever; (2) a similar increase of the colouring matter of the urine; and (3) the anæmia that is found at the termination of the process.

f. Other alterations in colour may occur in the blood. The blood is *light-red* after poisoning by carbonic oxide and remains so after exposure. It is *chocolate coloured* after poisoning by the nitrites, such as nitrite of amyl; and other hues have been recorded.

4. Melanæmia.—In relation with the pigment-bearing element of the blood may be mentioned a morbid condition which has been described under the name of melanæmia. In it there are found in the blood black and brown pigment-particles and flakes, free or contained in cells of various shapes. This state is especially associated with two others, namely, malaria and an enlarged deeply-pigmented condition of the spleen; and it is highly probable that the pigment-particles are produced by the fever, and find their way from the spleen into the blood. They are thus deposited in the liver and other organs, and give rise to symptoms of visceral disturbance during life, and to the peculiar slaty or grey discolouration that is found *post mortem*. It has been said that in melanotic cancer pigmented cells have been found in the living blood.

5. Morbid Conditions of the White Corpuscles.—The white corpuscles of the blood may undergo certain morbid changes both in number and appearance.

a. The most remarkable of these is *increase* in numbers, which may advance to such a degree that the white corpuscles become as numerous as the red. This condition is known as *leucocythæmia* or leukæmia (*see* LEUCOCYTHÆMIA). Short of this, however, the proportion of white corpuscles in the blood may be appreciably increased, and to this minor condition the name of *leucocytosis* has been applied. Leucocytosis, according to Virchow, accompanies, almost unexceptionally, every case of lymphatic excitement, such as inflammation, and tubercular, scrofulous, or cancerous enlargement or swelling of the glands and allied structures—Peyer's glands, the solitary follicles, the spleen, and the tonsils. Leucocytosis is distinguished from leucocythæmia by its very moderate degree; by its evanescent course; by the absence of deficiency of the red corpuscles; and by the accompanying symptoms. Leucocytosis may be appreciated even by the naked eye in the clot of drawn blood, by the presence of an irregular 'lymphatic layer'—*crusta lymphatica*, consisting of collections of white corpuscles between the red clot and the buffy coat which so frequently occurs along with it.

b. A *diminution* in the number of white corpuscles occurs in chlorosis; and, it is said, in malaria, especially during the paroxysm of fever.

c. With regard to the *structure* of the individual white corpuscles, the proportion of uninuclear or young cells, and of multinuclear or aged cells may be disturbed both in leucocytosis and leucocythæmia; while corpuscles may be found containing granules of various kinds, especially pigment-particles, bacteria, micrococci, and other structures.

6. Morbid Conditions of the Blood-plasma.—(1) WATER.—The limits of the physiological variations in the amount of water in the blood are very wide.

a. Diminution of water in the blood is observed in various degrees. It is moderate and transitory as the result of stimulation of the kidneys, skin, or bowels, but the normal proportion is speedily restored by absorption. This condition is found after severe purgation, sweating, diarrhœa, or dysentery; and its production is the rationale of several of the methods adopted for the relief of dropsy. If the drain of water continue, or if the supply fail, the anhydric condition of blood increases, so that the fluid appears black, thick, and tarry. Such is the state of the blood in the algid stage of cholera; the specific gravity of the serum rising as high as 1,080, accompanied by a comparative excess of salts, albumen, and urea. The chief symptoms of great deficiency of water in the blood are intense thirst; a shrivelled shrunken aspect of the body generally; coldness and lividity of the extremities; muscular pains; and suppression of the excretions—phenomena directly referable to loss of water, retardation of the circulation, and interference with the function of the red corpuscles.

b. Excess.—Hydræmia.—Reference has been already made under the head of oligæmia to the anæmia or hydræmia that follows it. Excess of water in the blood is perhaps never absolute, and the change may therefore be regarded with equal accuracy and greater convenience as deficiency of solids.

(2) ALBUMINOUS CONSTITUENTS.—On reviewing what has already been said under the head of Coagulation and Fibrin, the reader will observe that 'amount of fibrin,' and other expressions connected with the albuminous constituents, must be regarded at present as comparatively meaningless, in the light of our knowledge of the process of coagulation. Inasmuch, therefore, as little value can now be attached to the analyses of fibrin that have been made in different diseases, it follows that the estimates of the albuminous substances left after coagulation—that is, of the albumins of the *serum*, must also be rejected. But the total amount of albumins in the blood may be easily ascertained; and this is subject to extensive variations. The balance between the albuminous substances, which enter the blood from the alimentary tract and the lymphatic system, on the one hand, and the products of their transformation by the tissues, on the other, is represented by the albumins of the blood. These will increase accordingly when the supply is excessive, or the consumption small; and will decrease under opposite circumstances.

a. Hyperalbuminosis is the name given to *excess* of albumins in the blood. The amount has been found notably increased when the activity of the tissues is abnormally heightened, as for example in inflammatory diseases (acute rheumatism, tonsillitis, pneumonia, and pleurisy); and when fibrinogen, which is the product of this increased activity, is poured abundantly into the blood. The amount of albuminous fluid produced in an inflamed part, whether it appears as a catarrh, an infiltration, an exudation, or an effusion, is very great, and may be enormous; and, under favourable circumstances, this and much that cannot be so easily appreciated is carried into the blood, the lymphatic structures swelling *en route*. Hyperalbuminosis as a result of diminished consumption probably does not exist; for the effect of an insufficient supply of oxygen to the albumins—(want of exercise or over-feeding)—is not the accumulation of these in the blood, but the formation of 'lower' products, such as uric acid and its allies, and the deposit of fat. Relative hyperalbuminosis is a necessary but transient effect of cholera and other severe watery fluxes.

b. Hypalbuminosis, or *deficiency* of albumins in the blood, occurs under exactly opposite circumstances from the preceding,—whether the ingestion of albumins from the alimentary tract and the tissues be comparatively small, or the consumption excessive. Inanition, therefore, on the one hand, and its multitude of causes, are associated with such poverty of blood; and so, on the other hand, are loss of blood, profuse discharges of albuminous fluids, morbid growths, and other sources of waste, as well as excessive demands of growth and development. The albumins of the plasma may fall under these circumstances from 80 to 37 parts in 1.000. Such hypalbuminosis is, however, never simple: the blood cannot be deficient in albuminous substances and otherwise normal, for, as we have already shown, loss of albumen is always followed by absorption of water and salts from the tissues in definite proportions, and anæmia is the result. The red corpuscles suffer at the same time, for their nutrition speedily fails in hypalbuminosis, and aglobulism ensues. Hypalbuminosis is thus a serious disease of the blood. The relations of these conditions to each other and to oligæmia are even more complicated clinically than they are pathologically: and in this relation the whole of them are most conveniently discussed under the comprehensive head of anæmia (*see* ANÆMIA).

(3) CLOT; FIBRIN. However uncertain as a measure of any particular constituent in the blood, the amount of clot or fibrin demands a brief notice as a matter of fact.

a. Abundant clot has been considered as indicating an excess of fibrin in the blood or *hyperinosis*, the proportion being stated to rise as high as 1·0 instead of 0·2 per cent. Acute rheumatism, cellulitis, pneumonia, and pleurisy are the diseases in which hyperinosis is most marked; but it also occurs in pregnancy. The two principal conditions of its occurrence appear to be—(1) Increased activity of the tissues—including inflammation; and (2) Free and abundant communication of these tissues with the blood through the lymphatic system.

b. Deficiency, looseness, or *absence of clot*—'*Fluid blood.*'—A small loose clot is frequently observed, as for example in typhous states, or in chronic wasting diseases attended with loss of blood; and has been described as indicating *hypinosis* or deficiency of fibrin. When the condition is extreme, the clot may be absolutely wanting, as in certain cases of anæmia: the blood then separates on standing into three layers—an upper, consisting of clear liquid; a middle, puriform, of white corpuscles; and a lower, red, of red corpuscles. In another and larger group of cases, non-coagulating or fluid blood is at the same time of an intensely dark colour or even lake, and is commonly described as 'black.' The circumstances under which this condition of blood occurs, and the cause of the remarkable colour have been already noticed; and it remains to account only for the fluidity. The profound alteration of the red corpuscles, the want of oxygen, the interference with the production of the ferment, and the changes in the fibrinogen and fibrinoplastic substance—one and all combine to prevent coagulation.

c. Buffy coat. Another phenomenon connected with coagulation, from which erroneous and even dangerous conclusions have been drawn, is the so-called *buffy coat*. The process of coagulation is generally sufficiently slow to allow of the gravitation of some of the red corpuscles from the surface of the blood; and the corresponding part of the clot is accordingly paler. When the pale layer is unusually large it is known as the buffy coat or *crusta phlogistica*: it may be seen in the blood in pregnancy, inflammatory fevers, hydræmia, and oligocythæmia. When these cases are analysed, it is found that the conditions favourable to the formation of the buffy coat are probably all more or less connected with the red corpuscles, namely—(1) increased specific-gravity of the red corpuscles, as in oligocythæmia and hydræmia—allowing more rapid sinking; (2) interference with the catalytic action of the hæmoglobin, which is so powerful in determining the rapidity of coagulation, as in fevers and oligocythæmia; and (3) want of oyxgen, corresponding to the amount and condition of the hæmoglobin, as in the same diseases. One and all of these states render the process of coagulation slow compared with the descent of the red corpuscles; and the buffy coat is the result. It thus appears that the buffy coat is no indication whatever of excess of fibrin-generators, or of the opposite; and that it is found under the most diverse conditions of blood.

(4) SALTS.—The amount of positive knowledge concerning morbid alterations of the salts of the blood is but small. It is to be observed that the salts of the plasma have chiefly sodium as their base, while potassium-salts mostly reside in the corpuscles.

a. Diminution.—In febrile diseases there is an increased discharge of compounds of both bases, but at different periods; the potassium-salts appearing in excess in the excretions until the crisis is past, and the sodium-salts during defervescence. At both periods, it may be considered certain that the blood is the chief source of the salts excreted; and that it is accordingly deficient in these constituents.

b. Excess.—On the other hand, the salts of the plasma are relatively in excess in hypalbuminosis, replacing, in the proportion already stated, the lost albumen. The effect on the salts of the blood of such drains as occur in cholera has been variously stated; some authorities declaring that it is an increase, others a diminution.

c. Reaction.—The alkalinity of the blood is said to be diminished in gout, cholera, and osteomalachia.

(5) FATS.—The normal increase of fats in the plasma that occurs after meals may be exaggerated by a diet rich in oil, and, it is said, in chronic drunkards and in persons disposed to obesity. When this increase is so great that the serum presents a milky appearance the blood has been called *chylous*. A cream-like scum forms on the surface of the serum; and the milky appearance is found microscopically to be due to the presence of fine granules and oil-globules. A marked increase of fatty matters in the blood has been found in some cases of chyluria. Fat may also appear in the blood as a foreign body, by the escape of marrow into the circulation in fracture of bones—and that in such quantity as to cause fatal capillary embolism.

(6) CARBONIC ACID, which exists in arterial blood in the proportion of 30 per cent., and in venous blood of 35 per cent., by volume, may accumulate within the circulation either by increased formation or by retention. Although associated with asphyxia, this increase of carbonic acid is

probably not the cause either of the symptoms of that condition, or of the dark colour of the blood that accompanies it.

(7) OTHER CONSTITUENTS.—Amongst the most important of the other constituents of the blood, the following are to be noticed:—

a. Urea, which exists in normal blood to the amount of 1·8 parts in 10,000, may increase in uræmia by two or three times. There is still much uncertainty, however, on this subject (*see* URÆMIA). Disease of the urinary organs, which interferes with the elimination of urea and allied products from the blood, is the usual cause of uræmia; but excessive tissue-change, as in fever and inordinate muscular exercise, has also the same effect.

b. Uric acid, found in normal blood in minute traces, is increased (as urate of soda) in all cases of gout, and may amount, according to Dr. Garrod, even to 0·175 parts in 10,000. Its presence is easily demonstrated by the thread-experiment (*see* GOUT). Uric acid is also increased in leukæmia and chlorosis—probably from the imperfect oxidation associated with the condition of the red corpuscles.

c. Leucin, *tyrosin*, *hippuric acid*, *sarcin*, and other allied complex compounds, have been frequently found in the blood in small quantities, and the same may be said of *oxalic* and *lactic acids*, and of *acetone*.

d. Bile.—Certain of the constituents of the bile may occur in the plasma. The most obvious of these are the *bile-pigments*—*bilirubin* and *biliverdin*, which either by direct formation in the blood from the hæmoglobin, or more frequently by absorption from the liver, accumulate within the circulation, and by their deposit give rise to the colour of the tissues in jaundice. The *bile-acids*—*glycocholic* and *taurocholic acids*—are also under certain circumstances absorbed into the blood, where they may be detected with difficulty. They have a destructive effect upon the red corpuscles, and act further as a powerful poison to the tissues, causing the excessively severe symptoms that may occur in hepatogenous jaundice. *Cholesterin* is credited by some pathologists with being the cause of the same symptoms, and it has been found in the blood in increased proportion in some cases of severe jaundice.

e. Sugar.—The sugar of the blood is increased in diabetes, in some cases reaching 0·3 to 0·5 per cent.

7. **Extraneous Matters in the Blood.**—Besides its normal constituents and their products, the blood may occasionally contain certain matters entirely foreign to it such as the numerous poisons which act either directly upon the corpuscles, or remotely upon the organism. These, entering the circulation before they exert their specific effect, are in many instances readily discovered by analysis. The acid compounds of hydrogen with sulphur, phosphorus, arsenic, and antimony, respectively, act as blood-poisons by depriving the oxyhæmoglobin of its oxygen; while carbonic oxide and nitrous oxide unite with the hæmoglobin, and expel the oxygen from the blood. It is a matter of speculation whether other so-called poisons, the nature of which is still obscure, do not enter the blood and there exert their primary effect, such as the contagium of acute specific fevers and other infectious disorders. Similar infective matters, produced in the tissues of the body itself, are believed to be absorbed in septicæmia, pyæmia, and other allied diseases, and numerous observations support the further belief that the presence of *bacteria* is intimately associated therewith. A somewhat similar infection may occur in malignant disease, the juices being mixed with the blood-plasma, but in some instances the process may be different, namely by means of cells. We cannot expect to detect these cells in the blood *in transitu*. The same remark applies to embola, of whatever nature, and to blood-crystals.

8. **Organisms.**—The blood may contain a variety of living organisms, either foreign or peculiar to itself; the latter being called *hæmatozoa*. *See* HÆMATOZOA, CHYLURIA, and RELAPSING FEVER; also BACTERIA, FILARIA SANGUINIS-HOMINIS, MICROCOCCI, SPIRILLUM, and ZYME.

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BLOOD, Transfusion of. *See* TRANSFUSION.

BLOOD-WORMS.—This term is of general application. It refers to all kinds of Entozoa living in the blood. *See* Hæmatozoa.

BLUE DISEASE. A condition in which the most prominent symptom is a peculiar discolouration of the skin and mucous membranes, due to the circulation of dark blood in the vessels. *See* CYANOSIS; and HEART, Malformations of.

BOILS.—SYNON.: Furuncles; Fr. *Furoncle*; Ger. *Furunkel*.

DEFINITION.—Gangrenous inflammation of the skin, forming small painful swellings, and ending by expulsion of the necrosed centre or 'core.' The inflammation begins in the glandular structures, hence involving not only the skin, but also the cellular tissue immediately beneath. The sebaceous glands are most commonly the seat of boils, but occasionally the Meibomian glands (*stye*), the ceruminous glands, and the sweat-glands of the armpit; or, more rarely still, the glands of the lips, vulva, or anus are affected.

ÆTIOLOGY.—The *predisposing causes* of boils are:—the male sex; middle life; a stout habit of body; seasons of spring and autumn; a diet too full of flesh, or one suddenly changed, such as that adopted during training for rowing, &c. To these must be added the vitiation of the blood during exhausting fevers and in certain cases of saccharine urine, or induced by inhaling dissecting-room effluvia; and dirty occupations, for example, chimney-sweeping or rag-picking. Lastly, boils are sometimes epidemic.

Local causes.—The parts of the skin most exposed to dirt or chafing, the hands and face, the neck and back, the buttocks and knees are favourite sites for boils; but they may form on any part except the palms and soles. Blisters, poultices, and stimulating liniments occasionally cause them.

To these causes is added by some authors the specific contagion of a parasitic fungoid plant, the mycelium of which, by developing in a gland-cell, thereby causes limited necrosis (the slough) of the tissue in which it grows. The truth of this view is not yet clearly established.

SYMPTOMS.—Boils appear either singly, in succession, or several at once, forming then an eruption on the skin. The solitary boil begins with itching; soon a reddish pimple forms, sometimes tipped with a minute vesicle, in the centre of which a hair may generally be detected. The pimple grows larger and harder, the red area increases and grows darker, and pain begins, stinging at first, then throbbing. In about five days the summit breaks, pus oozes forth, the pain abates, and the hardness diminishes. A day or two later the core, a shred of sphacelated cellular tissue, escapes. The boil then subsides, and healing rapidly takes place; the scar is depressed, and for some time of a violet colour. Occasionally the inflammation affects chiefly the cellular tissue beneath the skin; the mass is then softer, more round and clearly circumscribed, and fluctuates like an abscess—this variety forms in the armpit. Rarely, the central slough extends rapidly beneath the surface, and communicates with the surface by several small apertures (*carbuncle*). In other cases the swelling is more diffuse; no core appears, at the surface, but a hard very painful pimple is formed, which is long in subsiding (*blind boil*). The furuncular eruption, consisting of groups of small boils, forms successive crops, and thus the disease may continue a long time. Boils are generally limited to a small region, but this is not always the case; and the greater part, even the whole, of the body may be attacked.

The constitutional disturbance is usually *nil* or slight when the boil is due to local irritation, though it may suffice to render nervous, irritable persons unfit for work. When the boils are caused by exhaustion, the general symptoms are severe and denote great depression. Prostration, agitation, stupor, low delirium, dry brown tongue, sordes, vomiting, and diarrhœa set in, and the case often ends fatally; or recovery is very slow, accompanied by much suppuration. Septic absorption and pyæmia very rarely take place.

Carbuncular Boil of the Face.—There is a rare and often fatal form of boil, the determining cause of which is unknown. It is met with only on the head and neck, notably on the lip. Mild and trifling at first, like an ordinary boil, it rapidly extends by inflammation of the veins or lymphatics, and causes poisoning of the blood. The earliest sign of this fatal change is the occurrence of violent and repeated shivers. The boil becomes a boggy swelling of blackish violet colour; the surrounding tissues become hard and brawny; suppuration ceases; sloughing occurs; the complexion grows earthy; the features, if the boil is on the face, become everted; the skin round the eyes in some cases is puffed out, and the eyes themselves project from the sockets; anxiety and laboured gasping breathing set in; and a violent constricting pain in the head, chest, or belly is frequently experienced. Delirium and coma usually supervene, but sometimes consciousness and terrible suffering remain to the last. The duration from the first shiver to the end is about four days. The veins of the face first inflame, and the phlebitis extends by the veins of the orbit to the sinuses in the skull, to the diploe, &c.; hence abscesses form in the eyelid, the forehead, the meninges, or the brain, and occasionally in distant viscera.

Diagnosis.—A boil is distinguished by the central cavity and slough—characters peculiar to it. The boil of the face accompanied with phlebitis has been confounded in this country with the 'malignant pustule' of Continental surgeons. The former is still a *boil* with a central core. The '*pustule maligne*' is said to have invariably a large vesicle surmounting a brownish eschar, with a ring of smaller vesicles round the larger one,—a condition never met with in boils.

Prognosis.—When due to local causes, the prognosis is always good, unless the patient be exhausted by old age or fever; under such circumstances the extensive sloughing and suppuration often lead to a fatal issue.

Treatment.—*General.*—First remove predisposing causes, and invigorate the patient by change of air, outdoor exercise, vapour and Turkish baths. The diet should be moderate and mixed. Alcohol, unless the patient is greatly debilitated, should be given in very moderate quantity, and the form of fermented liquor most habitual to the patient is best; much alcohol taken before the core has loosened increases the pain and throbbing. Occasionally a saline purge should be given. Of empirical remedies, yeast (a tablespoonful thrice daily) is said to put an end to the repetition of boils. Quinine and perchloride of iron are also used. Quinine should be given to an adult in five-grain doses every six hours, till singing in the ears and headache begin; it should then be gradually lowered for three or four days to three or four grains per diem, and then left off. In obstinate cases the waters of Vichy, Barèges, or Harrogate are believed to remove the disposition to boils. In diabetes omission of sugar-forming food, and the free administration of alkalis are the most effectual remedies. For the exhausting boil of the face, large doses of brandy, with quinine, are required.

Local.—When signalled by itching, a boil may be stopped by plucking out the hair of the inflamed follicle, and in a long succession many boils may thus be prevented. When the areola has formed, if the pain be slight a drop of caustic solution applied to the centre will sometimes check the progress of the boil. A better plan at this stage is to cover the boil with a galbanum and opium plaster (Erasmus Wilson's) spread on leather. Under this treatment pain at once ceases, the inflammation gradually subsides, and the separation of the core proceeds painlessly; when the boil discharges, a hole should be cut in the centre of the plaster, for the escape of the products. When the pain is stinging, and the areola wide, with restlessness and headache, warm poultices are most soothing—those of starch cause pustulation less than linseed meal poultices. Mixing lard with linseed poultice, or sprinkling it with the dilute solution of acetate of lead, has a similar effect. Poultices hasten the expulsion of the slough, but should be discontinued as soon as the hardness changes to doughiness. If the slough is large, the surface may be dressed with lint spread with Peruvian balsam, and the boil carefully protected by means of pads and compresses.

Incisions are now much less employed than formerly. They increase rather than lessen the loss of tissue in ordinary boils, and do not shorten the duration of the inflammation. They give relief to pain, however, and check the spread of diffused boils. When made, incisions should be free, crucial, or even star-like, and carried beyond the boil. In the rapidly extending boil of the face local treatment is of little avail; the free use of the actual cautery may be beneficial if employed at an early period.

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BONE, Diseases of.—Under this head are included:—Acute and Chronic Inflammation of bone and its membranes, with the consequences thereof, such as Caries, Necrosis, and Abscess; New Growths which arise both within and upon the bone; Malformations; and certain Disorders of Nutrition, namely, Hypertrophy and Atrophy. Bone-tissue should be regarded as being similar to other connective tissues, but some diseases affecting it are rendered obscure, while others are materially modified, by reason of its meshes being filled with lime-salts.

1. **Inflammation.**—As a matter of clinical convenience, it is usual to consider separately inflammations of the periosteum, of the bone proper, and of the medulla; but it should not be forgotten that these structures are throughout continuous and interdependent, and that disease is rarely exclusively confined to any one of them—it may originate or be chiefly developed in one, but it cannot long exist without involving the others to a greater or less degree.

A. **Periostitis**—*Inflammation of the investing membrane of bone* (*die Knochenhaut*). By periosteum is usually meant the thin fibrous envelope of the bone in which the vessels for the supply of blood subdivide. But between it and the bone is a layer of osteogenetic cells like the cambium-layer of a growing plant, and immediately external is a layer of cellular tissue, continuous with that of the adjacent parts; these are integral portions of the periosteum, and take an active share in all its diseased processes. Periostitis may be either *acute* or *chronic*.

(*a*) *Acute periostitis, osteoperiostitis, acute periosteal abscess*, or *acute necrosis*.—This is a formidable, but fortunately comparatively rare, disease, at least in the adult. It attacks the long bones almost exclusively, usually those of delicate children or young adults, in whom active bone-growth is still going on, and the periosteum is highly vascular. Acute periostitis probably never occurs without coincident inflammation of bone, and it is by far the most common cause of necrosis. It will be best to regard it as an acute ostitis and periostitis combined, and to call it *osteoperiostitis*, just as we call inflammation of the bone and of the endosteum *osteomyelitis*. The extent to which the bone and the periosteum are in the first instance respectively involved is always difficult, and sometimes impossible, to determine—it may be inferred from the extent of the necrosis. There are two ways in which the disease may begin—either in the fibrous investing sheath of the bone and the cellular layers beneath and superficial to it, from whence it spreads inwards to the cortical bone-substance, or even to the medulla; or in the bone-tissue—the inflammation spreading outwards to the periosteum. It is impossible in the living subject to distinguish acute osteomyelitis and osteoperiostitis arising from idiopathic causes. The disease is usually attributed to an injury, often slight, or to exposure to extremes of cold or heat. Frequently no cause is assignable.

PATHOLOGY.—Rapid exudation takes place in the layers of the periosteum, and in the Haversian spaces and canals of the bone, to such an extent as to obstruct the circulation, and probably to cause by pressure the severe pain complained of at the outset. The exudation beneath the fibrous layer of periosteum is copious, and soon becomes purulent; the periosteum is detached; the vascular supply of the bone is cut off; and necrosis results. The extent of the necrosis depends upon the extent to which the periosteum is engaged, while the thickness of the dead bone depends mainly on the depth to which the inflammation in the osseous tissue extends. Large accumulations of pus are often rapidly formed in these cases, the pus escaping through openings in the fibrous envelope into the circumjacent cellular tissue. The shafts of the tibia and femur are the parts most frequently affected; the disease occurs more rarely in the bones of the upper extremities and other parts of the skeleton.

SYMPTOMS.—One of the earliest symptoms of acute periostitis is sudden and severe pain in the affected bone, which is soon followed by intense fever. On the second or third day deep-seated swelling sets in, somewhat obscure at first. After an interval varying from five to ten days, the inflammatory signs approach the surface, the skin becomes œdematous, pits on pressure, and finally reddens and inflames. The length of interval depends on the thickness of muscles and soft parts covering the affected bone. Other things being alike in respect of pain and amount of fever, the longer the delay in the appearance of external swelling, the greater the probability that the bone is the first and chief tissue engaged, the inflammation having reached the periosteum secondarily, while the early appearance of swelling and fluctuation externally suggest that the inflammation is chiefly periosteal. Blood-poisoning, either septicæmic or pyæmic, is a common consequence of acute inflammation of bone and periosteum.

DIAGNOSIS.—This disease may be obscure at the commencement, and its nature overlooked; it has often been mistaken for acute rheumatism on account of the swollen joints, for phlegmonous erysipelas, for acute cellulitis, or for typhoid fever. The only malady with which acute periostitis need be confounded is an idiopathic inflammation of the deep-seated cellular tissue in a limb. This disease is rare. When we observe the chain of symptoms above described in a young person, we may safely assume the presence of an acute osteoperiostitis. The disease almost invariably terminates in suppuration and necrosis; resolution happens rarely, but necrosis is not inevitable, even after suppuration. In a few cases, especially in young children, if the matter be speedily evacuated, the abscess collapses, the periosteum reunites with the bone, and no necrosis takes place. This result is unfortunately quite exceptional.

PROGNOSIS.—This must be founded on the

extent of the necrosis; whether blood-poisoning has taken place; and whether the adjacent joints are implicated in the disease. Cure cannot take place until the dead bone is cast off or removed, and this is often long delayed. The usefulness of a limb may be permanently impaired by the disease, or it may require amputation, or the patient may lose his life altogether. On the other hand, the use of the limb, and the health of the patient, may become completely re-established.

TREATMENT.—Early and energetic treatment is of the greatest importance, as it affords the best prospect of averting the disastrous consequences of acute periostitis, but in hospital practice the cases are rarely seen sufficiently early. In the first stage the limb should be elevated, and ice applied; painting the limb with a strong solution of iodine is advisable. As soon as the nature of the affection is manifest, incisions down to the bone, so as to divide the periosteum, are indicated even before pus is formed. They relieve pain and tension, and, by permitting the timely escape of pus as soon as it does form, the amount of periosteal separation, and consequently of necrosis, is limited. It is the more important to make an early incision, because evidence of fluctuation is at first by no means clear or easy to make out, and this should, therefore, be done in all cases of doubt. Antiseptic precautions should always be taken. Sometimes the abscess-cavity does not readily collapse, owing to its walls being stiff and infiltrated, and its contents may become putrid, thus greatly increasing the patient's risks. If there be synovial effusion into a neighbouring joint, the limb should be kept at rest by means of a splint or a fixed bandage. When the acute symptoms subside, the abscess-cavity contracts, one or more sinuses remain, and the dead bone begins to separate (*see Necrosis*).

Where the epiphysis is engaged in the disease the case is more urgent; the fever runs higher, the suppuration is greater, and the degree of joint-implication more intense, proceeding in extreme cases to suppurative inflammation and destruction of the articulation. The œdema of the limb often indicates a deep-seated phlebitis, the precursor of septic poisoning. Under these circumstances, amputation of the limb is often the only resource. It is imperative to amputate where there is extensive bone-destruction, and the symptoms indicate commencing pyæmia; or where, with the death of a large portion of the shaft, one or both of the neighbouring joints has become gravely implicated, and great suffering and loss of strength forbid us to temporise. It is precisely in these cases, however, where the diaphysis has become necrosed up to the epiphysal junction, that good results are attainable by the immediate extraction of the dead bone. The shaft where it joins the epiphysis becomes rapidly detached and loose, and may easily be separated, while the bone can be divided with a chain saw beyond the limit of the necrosis in the other direction, and removed. It is difficult, however, in the early stages to diagnose the extent of the necrosis. Where the joints both above and below are involved, amputation is usually necessary.

A periostitis of a very acute form, almost invariably suppurating, and accompanied by necrosis, is very common in the fingers, where it chiefly affects the ungual phalanges. The pain is very great, but may be relieved by an early and free incision down to the bone, which, nevertheless, does not usually avert either suppuration or necrosis.

(*b*) *Chronic periostitis* is usually due to some diathetic cause, but may result from injury, or from some continuous pressure. It is most frequent on the superficial parts of the skeleton, as the tibia, clavicle, skull, and ribs, but may affect any bone; and it is often observed at the origin or insertion of muscles. When the disease arises from a general cause, such as syphilis, many parts of the skeleton are affected; when from a local cause, usually only one.

SYMPTOMS.—Chronic periostitis generally takes the form of what is called a *node*—a tender, more or less painful, rounded or oval swelling; at first tense and hard, afterwards softer, or even fluctuating. The pain is much greater at the outset, from the tension of the parts involved, and is generally worse at night. Subsequently the swelling becomes indolent, and painless, unless pressed upon. Nodes are due to a localised inflammation. The cambium-layer of the periosteum and its external layer proliferate and become filled with leucocytes, thus forming a well-marked projection on the bone, which may undergo resolution, suppurate, or ossify, according to circumstances.

PROGNOSIS.—In chronic periostitis this is usually favourable. Under the influence of early and suitable treatment, the inflammatory products are completely absorbed, and the bone resumes its natural shape. If the chronic inflammation of the periosteum be permitted to proceed unchecked, a deposit of new osseous lamellæ usually takes place on the surface of the affected bone, giving rise to permanent thickenings, or even to osteophytic growths. These are composed of light porous bone, with a rough surface. The skeleton of a syphilitic subject will often present numerous thickenings of this nature. On making a section of the bone, it is easy to see that the new bone is superimposed upon the old, and is formed by the periosteum.

TREATMENT.—When due to a local cause, the swelling will often spontaneously subside with rest to the part, but in obstinate cases iodide of potassium internally, and iodine ointment or blistering externally, may be required. If the subject be unhealthy, or if the original injury be considerable, suppuration may take place, when the treatment will be that of an *inflammatory abscess*. *Syphilitic nodes*, which are a very common expression of chronic periostitis, yield rapidly to the influence of iodide of potassium, which in some cases may usefully be combined with a mercurial course. Blistering or friction externally is hurtful in such cases. Syphilitic nodes are not at first prone to suppuration, and even when they become soft and fluctuating, and the skin reddens over them, they should not be mistaken for abscesses, as they readily become absorbed under suitable treatment.

(*c*) *Periostitis after typhoid fever.*—A peculiar form of chronic periostitis is occasionally observed as a sequel to typhoid fever. It occurs during

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convalescence, and without general symptoms. It takes the form of hot, painful, and tender nodes, frequently symmetrical, and often placed on the tibia; the disease is also found on the ribs and other bones. It may be associated with necrosis, but if so the extent of the dead bone is small in proportion to the inflamed area of periosteum. The general health is not seriously affected, and the disease is very amenable to treatment by iodide of potassium, combined with iodide of iron.

B. **Osteitis** is an inflammation chiefly affecting the bone-substance; this form may also be *acute* or *chronic*.

(*a*) *Acute osteitis* is neither clinically nor pathologically to be distinguished from acute osteomyelitis or endostitis (*see Osteomyelitis*).

(*b*) *Chronic osteitis* is a disease beginning in the bone, in which the chief changes from first to last occur, the periosteum being secondarily engaged. This affection may result from injury, or be excited by exposure to cold; but it often depends on constitutional predisposition, such as the syphilitic, the strumous, the gouty, or the rheumatic diathesis, the first being the most frequent cause. It may occur in any part of the skeleton; the chief changes, when produced by syphilis, occur in the shafts of the long bones. They consist mainly of hypertrophy, and the bone is ultimately increased in thickness, in length, and generally in density: its interior is often transformed into dense bone-tissue, and the medullary cavity is obliterated. Another form, associated with the strumous diathesis, is generally seated in the joint-ends of the long bones, and in the spongy bones. It is prone to end in suppuration, accompanied by either caries or necrosis. The gouty and rheumatic forms are associated with evidence of the presence of either of these diatheses.

Pathology.—Increased vascularity first takes place, the Haversian canals enlarge, the canaliculi disappear, the cancelli enlarge to contain the inflammation-products, and the earthy matter diminishes; hence the inflamed bone softens, and, if macerated at this stage, will be found comparatively light and porous. When the inflammation affects the superficial laminæ of the bone, the periosteum becomes thick and vascular; if the deeper parts are involved, similar changes will occur in the endosteum. The porous condition of the bone may become permanent, when the condition is called *osteoporosis*, the result of so-called rarefying ostitis; or the granulations become transformed into new bone, and the cancellated structure is filled with osseous deposit so that the whole of the inflamed area becomes very dense, and is then said to be sclerosed; or the inflammation-process may terminate in suppuration, followed by caries, necrosis, or an abscess of the bone, which last may be either diffused or circumscribed.

Symptoms.—These are insidious, very obscure at the outset, and may be mistaken for those of chronic rheumatism, or mere periostitis. They consist chiefly in aching, gnawing pain in the affected bone, with characteristic remissions and nocturnal exacerbations. The bone is tender on pressure, and feels increased in bulk at first, from the infiltration of the immediately surrounding soft tissues; subsequently the bone itself enlarges. There is often increase of heat in the limb. The progress is very chronic, and if unchecked by treatment may give rise to considerable deformity.

Treatment.—This should be directed to the cause of the disease. If this be syphilis, an antisyphilitic treatment will be followed by good results; even in chronic bone-inflammation, not dependent on syphilis, iodide of potassium is often of great service. Local counter-irritation may also be employed. Often the cause cannot be made out, and if iodide of potassium fail in producing an effect, we must fall back on general treatment. In the early subacute stage, rest, with elevation of the affected part, is very desirable. Warm fomentations, followed by iced compresses, relieve the suffering. If there be much pain and tension, leeches should be applied. Puncturing the tissues down to the inflamed bone with a tenotomy knife or fine bistoury, relieves the tense periosteum, and allows extravasation beneath it to escape, so that the pain is promptly abated.

(*c*) *Osteitis deformans.*—A peculiar form of chronic inflammation of bone has been described by Sir James Paget under this title, from the changes it produces, both in the form and density of the affected bones. It is a chronic osteitis of the most extreme type. It begins in middle age, and may continue for an indefinite time without influence upon the general health, which distinguishes it clinically from other bone-inflammations. It is usually symmetrical, and affects chiefly the long bones of the lower extremity and the skull. At first the bones enlarge and soften, from excessive production of imperfectly developed structure and increased blood-supply, and, yielding to the weight of the body, become curved and misshapen, but the limbs, although deformed, remain strong and fitted to support the body. In its early period, and sometimes throughout its course, the disease is attended with pains in the affected bones, which vary widely in severity, and are not especially nocturnal or periodic. It is not attended by fever, nor associated with any constitutional disease. It differs from the chronic osteitis dependent on simple inflammation of bone or that produced by gout or syphilis, in affecting the whole length of the bone. Hyperostosis and osteoporosis dependent on these latter causes rarely affect the entire bone. No treatment appears to produce any effect upon this disease.

C. **Osteo-myelitis** is an inflammation chiefly affecting the interior structure of the bone. Like the former, it may be *acute* or *chronic*.

(*a*) *Acute osteomyelitis* or *endostitis* is a suppurative inflammation of the medulla and bone, which very frequently ends in septic poisoning and necrosis. It is nearly always associated with bone-injury, and most frequently happens after amputation, or gunshot fractures, in which the cancellated structure is injured; a severe contusion of the bone, an injury to the periosteum, or exposure to sudden extremes of heat and cold is capable, under some circumstances, of producing the disease.

Symptoms.—The symptoms are obscure, more especially if there be no opportunity of examining the affected bone, as the changes in the bone are often masked by inflammation of the superficial parts. They usually make their appearance from five to ten days after the injury to the bone. The pain may not be excessive; there is fever and perhaps rigor. If there be a wound the secretion from it diminishes in quantity, and becomes less healthy; the medulla protrudes from its central cavity; the parts soon become surrounded by putrescent fluid; and the symptoms become those of more or less intense septicæmia. The periosteum sometimes, but not always, separates from the bone. In young persons the disease is sometimes arrested at the epiphysis; but in the adult the whole length of the bone is liable to be affected. The risk of septic poisoning is infinitely greater in osteomyelitis that in osteo-periostitis. Thrombosis of the bone-veins is especially prone to happen, and by the breaking down of the clot septic emboli are carried into the circulation, and deposited in the liver, lungs, and elsewhere. It is in this disease, too, that fatty embolism takes place—a condition associated with a very acute and fatal form of blood-poisoning. The prognosis is generally bad. It is impossible to distinguish acute osteomyelitis from acute osteo-periostitis, arising from non-traumatic causes. In military hospitals, in war time, acute osteo-myelitis is often epidemic.

TREATMENT.—Where the symptoms lead us to suspect osteomyelitis, although the medullary cavity of the bone may not have been exposed, it may be desirable to trephine the bone, and if suppuration in its interior be discovered, it will be necessary to amputate, and as soon as the nature of the disease is recognised, this affords the best chance of saving the patient's life. The chief difficulty consists in arriving at a correct diagnosis and deciding when it becomes necessary to interfere. This may best be done by observing the general progress of the case; and locally by the introduction of a probe into the medullary cavity when this is exposed. If it reach healthy bleeding medulla, near the surface, we may temporise, if the constitutional symptoms admit of this; but it is rare for the disease once commenced to be limited—it has an extreme tendency to become diffused. Experience shows that nothing short of amputation at, or even above, the next joint is sufficient to arrest the consequences of the malady, and this must be done before the systemic poisoning has become marked. Amputation in the continuity of the affected bone is worse than useless.

(*b*) *Chronic osteomyelitis* is an obscure affection, not to be distinguished, either clinically or pathologically, from chronic osteitis. It may terminate in sclerosis, or in the formation of an abscess. *See* Chronic Osteitis.

2. **Abscess.**—This is a term applied usually to a limited suppuration in the bone, unattended by necrosis. Young adults are most prone to the disease, or boys about the age of puberty; it is very rare in women. It is the result of a chronic inflammation of bone, which may be associated with some injury. This affection is most frequently met with in the upper or lower extremities of the tibia, just external to the epiphysal cartilage, less frequently in the ends of the femur, only occasionally in other bones, and very seldom in the compact tissue anywhere.

SYMPTOMS.—A circumscribed, slightly elevated, very tender and painful swelling may be discovered. This is due to a local periostitis with new bone-deposit, and the bone itself is often half an inch or an inch longer than its fellow, by reason of increased activity of growth at the epiphysis. The skin and superficial parts are unchanged at first, or there may be but trifling subcutaneous œdema. There is often slight local increase of temperature. The pain, on deep pressure at the central point, is often intolerable. It is intermittent at first, but generally worse at night. After a time it becomes continuous, and deprives the patient of all rest, owing to its severity. The abscess may persist with little change for months or years. The symptoms generally resemble those of osteitis, from which at the outset it is difficult to distinguish this affection. When the abscess tends to reach the periosteal surface, the soft parts become engaged, and there will be slight redness and œdema of the skin. Rarely the pus makes its way into the adjacent articulation, in which it sets up destructive inflammation; but usually the joints are free from implication. The subjects of the disorder have often suffered from antecedent bone-disease. Evidence of this should be looked for, as giving a clue to the diagnosis.

TREATMENT.—Spontaneous cure cannot occur—even if the abscess discharge itself a permanent fistula will usually remain. It is necessary freely to lay open the abscess-cavity. A crucial incision must be made through the soft parts, down to the bone, at the most tender and prominent point, and a disc of bone removed by the bone-trephine—an instrument without a shoulder, about half-an-inch in diameter. The sudden loss of resistance indicates the piercing of the abscess-cavity. The layer of granulation-tissue lining its interior should not be interfered with, but the cavity simply washed out. The pus is often foul, and greenish in colour. The wound should be dressed antiseptically; granulations presently fill it, which are subsequently transformed into a fibrous cicatrix. Immediate and permanent relief follows the operation. If the abscess is missed, the trephine may be re-applied, or drill punctures made in the most likely directions in the adjacent bone, in order to discover the pus. Sometimes an error of diagnosis is committed, and the symptoms are found to arise from chronic osteitis, without suppuration. The operation, however, affords relief in these cases also. Where there is doubt, a preliminary course of iodide of potassium will often resolve it.

3. **Caries** is a form of chronic inflammation of bone, which has been likened to the process of ulceration in the soft tissues. It is generally found in the spongy bones, in any part of the skeleton, the vertebræ and tarsus being the parts most commonly affected. There are two forms of the disease—one, *simple caries*, resembles an indolent ulcer of the soft parts, is most common in the flat or short bones, but is sometimes met with in the compact tissue of long bones; the other, *fungating caries*, is often met with in the articular ends of the long bones, and usually

terminates in joint-disorganisation. It has been called *subarticular caries*; and is part of the disorder known as *tumor albus* (*see* Joints, Diseases of). The non-articular form of simple caries often originates in a localised periostitis, and is generally due either to syphilis or struma—the latter is most frequent in young persons, the former in adults.

Pathology.—In caries the bone gradually disintegrates as the result of a chronic inflammation of its cancellated tissue. The trabeculæ become infiltrated with leucocytes, and granulations form, which prove the source of purulent discharge, just as in a granulating surface of the soft parts; but the process is interfered with and delayed by the act of getting rid of the osseous structure, in the trabeculæ of which the cells remain shut up until the dead bone finally breaks down, and comes away in the discharges, being often distinguished in the form of gritty particles. Until this process is completed the dead bone is soaked in pus, which often becomes putrid, and until it is got rid of a healthy granulation-surface is impossible.

Symptoms.—Caries is very chronic in its progress, and often causes extensive loss of bone, destruction of a joint, or loss of a limb. It is almost always associated with an impaired condition of general health; the adjacent soft parts are involved in the inflammation; abscesses form in them, generally connected with the diseased bone; these burst or are opened, and sinuses lined with gelatiniform granulations, and discharging a thin pus, persist for an indefinite time. On examination with the probe the surface of the bone is felt bare, rough, and much softened; and outside the area of carious bone periosteal deposits of newly-formed osseous tissue are often found. The diagnosis and prognosis depend upon the age, constitutional condition, and history of the patient, as much as on the local signs.

Treatment.—This must be directed to relieve the constitutional taint, as well as the local disease. Merely to excise or destroy the diseased portion of bone is not sufficient to cure the patient. Local means prove efficient only when the general condition has been sufficiently ameliorated, especially in the unhealthy chronic inflammation of bone frequently called strumous. Good air, good food, and tonics are, therefore, of great importance. If syphilis be present, an anti-syphilitic treatment must be pursued. The principle by which the local means act is to facilitate the formation of a healthy granulating surface—to transform, in fact, an indolent into a healing ulcer. The disintegration of the dead and diseased trabeculæ must be assisted. For this purpose the application of strong sulphuric acid diluted by two or three parts of water, or some other mineral acid, often proves useful. Partial gouging out of the diseased bone seldom succeeds, because of the injury done by the instrument to the adjacent bone, weakened as it is by inflammatory changes, and therefore prone to set up fresh disease. The complete *evidement* of the bone, leaving nothing but its thin outer shell, is more successful; but when the disease begins to invade adjacent joints, as in the tarsus, excision of the entire bone is best; or when several bones are involved, amputation becomes necessary. In children operations of this kind are not so often required; general treatment usually proves sufficient. In the early stages the actual cautery, applied over the most painful spot, is a valuable counter-irritant. It is undesirable to make early incisions into strumous abscesses in connection with diseased bone. It is better to empty them by a small trochar, and to preserve the diseased area as long as possible from atmospheric influence. When the carious action is arrested, the cavity fills with healthy granulations, the sinuses close, the parts cicatrise, and the gap in the osseous tissue is filled by fibrous, or sometimes by osseous material.

4. Necrosis.—The complete arrest of nutrition in a portion of bone from any cause is followed by the death or necrosis of the bone, and by a series of inflammatory changes in the adjacent parts, which result in the complete separation of the dead from the living tissue.

Ætiology.—Necrosis is most frequently the result of acute bone-inflammation or severe injury, as after amputation, fracture, or contusion. It is especially prone to happen in the compact tissue, but it also occurs in the spongy structure, as the joint-ends of long bones, or the tarsus and carpus, where it is usually associated with more chronic forms of inflammation, and is more limited. The peculiar nature of the blood-supply to bone, and the facility with which it may be interfered with or arrested under the pressure of inflammatory changes, go far to explain the frequency of necrosis as a result of bone-inflammation. Acute suppurative osteoperiostitis or osteomyelitis rarely terminates without necrosis. Whether the dead bone will be in the superficial or the deep lamellæ depends on the seat of the inflammation, and on the extent to which the periosteum and endosteum are respectively implicated. The long-continued action of phosphorus, as observed in match-makers, and also of mercury, may induce necrosis. Syphilis is a frequent cause of necrosis, through its tendency to produce chronic osteoperiostitis, the sclerosed bone thus originated being afterwads prone to necrose. It is not an uncommon sequel during convalescence from some eruptive and continued fevers. After scarlatina, osteoperiostitis, followed by necrosis, is by no means rare, although affections of the joints are more common. It is probable that many cases of necrosis occurring in childhood are connected with an antecedent attack of scarlet fever. The nasal bones may necrose as the result of severe coryza, the vertebræ after pharyngitis, or the petrous portion of the temporal bone as a consequence of otitis. Arterial thrombosis and embolism are occasional sequelæ of typhus, and may produce a local gangrene, not only of the soft parts, but of bone. This is, however, more frequent in connection with typhoid fever. In endocarditis the nutrient artery of a bone has been observed to be obliterated by an embolus, thus producing necrosis.

Pathology.—After the death of a portion of bone, the living tissue, in immediate contact with the dead, becomes inflamed. The Haversian canals and canaliculi become distended with migratory cells; loops of capillaries form from the pre-existing vessels; a granulating surface, in fact, surrounds the dead bone in a manner precisely similar to what takes place in the soft parts when a slough is being thrown off. The periosteum separates from the bone, becomes thick and vascular, while the osseous surface beneath is smooth and white, like macerated bone. In cases of syphilitic necrosis, as well as in that resulting from phosphorus, the surface is rough from antecedent periosteal deposit. How the osseous trabeculæ are dissolved or disintegrated over the surface of separation, so as to loosen the dead bone, is not certain. Probably the granulation-tissue that forms from the living bone possesses amœboid properties, and thus disposes of some of the bone-particles. The pus that is formed has a mechanical influence, while according to one theory lactic acid is produced, which transforms the insoluble into soluble salts of lime. While this loosening process is going on new bone, formed chiefly from the periosteum, is being deposited, constantly becoming thicker, and with one or more openings in it for the escape of pus, called *cloacæ*, so that eventually the dead piece becomes completely invaginated, and is named, from its position, a *sequestrum*. This sequestration of the dead bone is not invariable, as for instance in the spongy bones, the bones of the skull, and the upper jaw, or where from any cause the periosteum has been destroyed, no sheath of new bone will be formed. Necrosis very rarely takes place without suppuration; when this does happen the nature of the case is very obscure. Occasionally nearly the whole shaft of a long bone has been found necrosed, and after an interval of months or even years no suppuration may have taken place. Such forms of necrosis closely simulate malignant disease, and often they cannot be relieved or even recognised save after amputation. A chronic ostitis, followed by hypertrophy and sclerosis of the bone, is the most common antecedent condition of this form of necrosis.

TREATMENT.—The changes already described, which separate the dead bone from the living, do not cause its expulsion from the body. On the contrary, they shut it up, like a kernel within its shell, and nothing so imperatively demands surgical interference as the presence of necrosed bone. It acts as a foreign body, is a constant source of risk to the patient, and should be removed as soon as practicable. Its presence excites the periosteum to further formation of bone, so that the invaginating sheath becomes of great thickness in old-standing cases. The period at which an operation is usually undertaken is when the sequestrum has become loose, and the time required for this purpose varies with the extent and thickness of the necrosed bone. In the actively growing bones of the young the process of separation is accomplished more quickly than in the adult, especially when the sequestrum involves the epiphysal junction. Roughly estimated, a period of from three to six months might be named as that within which loosening of the sequestrum usually occurs. Beyond the latter term an effort to extract the dead bone should not be delayed, even if it cannot be felt to be loose. Among other risks involved in doing so may be that of amyloid degeneration of the viscera, principally the liver, kidneys, and spleen, which are subject to this change as the consequence of long-continued discharge from bone-disease. In order to remove a sequestrum, a director should first be introduced through a cloaca as a guide, and the soft parts sufficiently divided. An adequately large opening must now be made in the encasing sheath of new bone with the chisel, trephine, small saw, or cutting forceps, and the dead bone extracted, either in one or several pieces, as may be the more convenient. The operation may prove difficult on account of great thickness of the soft parts or of the sequestral envelope, or because the sequestrum itself is extensive. After the removal of the dead bone the cavity fills with granulations, which subsequently ossify, and the soft parts cicatrise. Finally the sequestral envelope of new bone is partly absorbed, partly consolidated, just as the redundant callus is after fracture, and the bone tends more or less to resume its normal size and shape.

5. **Tubercle.**—An examination of some cases of chronic bone-disease in scrofulous subjects seems to prove their connection with the formation of tubercle in the bone. The medullary tissue in the joint-ends of the long bones, and cancellated bone generally, are chiefly affected. The external appearances are those of fungating caries; but microscopical examination discloses multitudes of round cells like lymph-corpuscles, with protoplasmic matter, filling up the interspaces. The cells are found surrounding the soft, gray, non-vascular patches, which are often seen on section of an inflamed cancellated bone in strumous individuals, the central part of which may be the subject of calcareous, fatty, or suppurative changes. The bone when so affected is never sclerosed; hence these are not simply cases of chronic inflammation. There is, however, some difference of opinion as to whether, in strictness, they should be called tubercular in their nature, and the inference that they are so rests rather on the general condition of the patient than on any purely local characteristic.

TREATMENT.—In cases of this kind general tonic treatment becomes of the greatest importance. Rest must be given to the affected part, and exercise to the body generally, combined with fresh air both day and night, and simple nourishing food. Where the bone is extensively diseased, it must either be excised, or the part amputated. The presence of the tubercular diathesis does not forbid an operation, the local source of irritation and drain upon the system being thus removed, and a healthy traumatic surface substituted for one infiltrated with inflammation-products. The removal of the local disorder often proves a comfort to the patient, and increases his chance of regaining health and strength.

6. **New Growths.**—The bones are liable to most of the new growths forming tumours found elsewhere in the body, such as cancerous, vascular, and other tumours. The most important are the following:—

a. Some tumours are peculiar to bone, as, for instance, the **Myeloid**, so called from the many nucleated corpuscles contained in it, analogous to those found in fœtal marrow; it is of endosteal origin, causing an expansion of the bone in which it grows. It is most common in the maxillary bones, and near the epiphysal ends of the long bones. It is generally observed in young persons, requires removal, and extirpation, if complete, is not, as a rule, followed by a return of the disease.

b. **Periosteal or Fasciculated Sarcoma,** springing from the periosteum of a long bone, such as the femur, is not uncommon. The shaft of the bone may be seen on section passing through the centre of the tumour. Numerous bands of fibrous tissue, often ossified, radiate from the periosteum through the growth, like an outspread fan. The best treatment is amputation of the limb at the joint above, which does not, however, ensure against recurrence of the disease.

c. **Exostosis.**—This is a bony outgrowth developed on any part of the skeleton. It is difficult to distinguish cartilaginous from osseous outgrowths. The two structures are often mixed, and a tumour originally cartilaginous is often transformed into bone. Cartilaginous outgrowths, called **Enchondroses** are met with on the costal cartilages of old persons, also on the intervertebral discs, near the synchondroses, and arise also from the articular cartilages in rheumatic arthritis. Cartilaginous tumours, growing either from the periosteum or the medulla, have their favourite seat upon the phalanges; they are usually multiple, and from the deformity and inconvenience they produce often demand either enucleation of the tumour or, in extreme cases, amputation of the finger. The more special forms of exostosis are of two kinds, the *spongy* and the *ivory-like. Spongy exostosis* is often developed near the articular ends of the long bones, where it forms a nodulated outgrowth of cancellated bone of variable size, encrusted with a thin layer of cartilage, and having generally a bursa superimposed. This kind of exostosis is often connected with the epiphysal cartilage, and ceases to grow when the bone is fully developed. This fact, as well as the proximity of the neighbouring joint, renders surgical interference generally unnecessary, and often hazardous. Another form of spongy exostosis, sometimes called *osteophyte*, depends on a local excessive periosteal growth of bone. At first this outgrowth is porous, and but slightly connected with the bone on which it is developed. Afterwards it may become dense and hard from interstitial deposit, or it may always remain spongy. Such exostoses often depend on some local exciting cause, such as a blow; or they may be found at the insertion or origin of a muscle, as in the so-called rider's bone, at the origin of the adductor longus muscle, or the exostosis frequently found at the insertion of the adductor magnus, or the 'exercise bone' of the German soldier. They may be regarded as morbid exaggerations of the normal tuberosities of the skeleton. *Ivory exostosis*, so called from its dense, eburnated character, is more rare. It varies much in size, and may be pedunculated or sessile. Hereditary influence appears to exist in some cases, in others a predisposition to chronic periostitis, but there may be no apparent cause. The development is slow and painless.

Treatment.—Interference is seldom required in the spongy exostoses, except on account of pain or loss of function. When pedunculated they can be broken off or divided subcutaneously; and although they may reunite, it will probably be in a more convenient and painless relation to adjacent parts. Otherwise they should be excised.

Except on account of deformity, or of pressing on important structures, an ivory exostosis need not be meddled with. It can often, however, when necessary, be enucleated; and where only a partial removal is possible, the low vitality of the tumour often causes necrosis and subsequent exfoliation of the remainder. Spontaneous necrosis also occasionally occurs.

d. **Osteo-aneurism.**—Certain sarcomata and myeloid tumours, when very vascular, pulsate, and have been mistaken for aneurism. There are, however, undoubted cases of aneurismal tumours, dilating the bone, which have been cured by ligature of the main vessel of the limb. When the tumour is small it may be excised, or the actual cautery applied. Sometimes amputation is required. The causes and pathology of the disease are obscure. It is probably in some cases of a nævoid character.

e. **Bone-cysts** are tumours distending and thinning the bone, and filled with serum or bloody fluid. In some rare cases they contain hydatids. The origin of bone-cysts is obscure; some originate in the dentigerous cavities of the maxillæ, in which bone-cysts are most frequent, but they are sometimes found elsewhere. A very slow, painless increase in size takes place. The bone becomes gradually very thin, and often affords on pressure a peculiar and characteristic parchment-like crackling. In obscure cases an exploratory puncture should be made.

Treatment consists in freely laying open the cyst-cavity, and providing for subsequent drainage. The cavity gradually contracts and becomes obliterated.

f. **Hydatids.**—The formation of echinococcus-cysts in bone is exceedingly rare, compared with other parts of the body. The causes are unknown, and the symptoms very obscure, resembling those of an ordinary cyst. A cavity is formed, usually in the spongy extremities of the long bones, to contain the mother cyst. But it is also found in the medullary canal. The affection is grave. Serious inflammation often follows interference with these entozoa. It is sometimes difficult to remove the whole disease; and unless this be effectually done a relapse will occur; while in such parts as the pelvis art is unavailing. The cavity should, if possible, be freely laid open, and all the cysts carefully removed or destroyed. The actual cautery may be sometimes employed with advantage, or the surface of the adjacent bone removed, as it may be invaded by the cysts. An exploratory puncture can alone resolve the diagnosis, by finding the hooks of the acephalocyst in the fluid.

7. **Malformations.**—These consist in any departure from the normal type of the skeleton, by reason of excess, deficiency, or irregularity, either congenital or acquired. It is not necessary more than to allude to the fact, that the skeleton is often defective in parts; that senile changes occur, especially in certain bones; and that supplementary bones and processes are met with. Various deformities occur in bones from fractures, both intra-uterine and subsequent to birth, and from curvatures due to rickets or

softening. Treatment of curvature consists in gradual straightening by splints or other apparatus, or immediate straightening under chloroform, methods which, in the soft growing bones of the young, prove successful in abating many deformities. The curvatures of adult bones do not yield in this way. When there is loss or impairment of function from deformity, the bone may be safely divided subcutaneously with the chisel or saw, and the limb straightened—often with admirable results. Forcible fracture is a clumsy and somewhat dangerous method, as the force employed cannot be regulated.

8. **Hypertrophy** means an excessive growth of bone-tissue. Apart from inflammation this is rare, but in museums specimens of excessive growth are met with, especially of the bones of the face and skull. The causes are unknown, and no treatment appears applicable.

9. **Atrophy** consists in a diminution of the size or compactness of a bone. It may be the result of inflammatory changes, of senile degeneration, of disuse of a limb, or of an injury, such as a fracture followed by non-union. The bone-tissue gradually wastes away, the cortical portion often becoming a thin parchment-like layer of bone, filled with soft medulla. This has been called *excentric atrophy*. The external appearance and size of the bone remain unchanged. *Concentric atrophy*, where the size of the bone diminishes in all its dimensions, may occur in bones which have been disused for lengthened periods, as from paralysis of a limb, disease of a joint, or un-united fractures. *Spontaneous fractures*, or fractures due to trifling causes, are very common under these circumstances. The term *Fragilitas Ossium* has been applied to this condition of bone-tissue, which also frequently occurs in cases of cancerous cachexia.

10. **Softening.**—This change occurs in Rickets and Mollities Ossium. *See* RICKETS; and MOLLITIES OSSIUM. WILLIAM MACCORMAC.

BORBORYGMI (βορβορύζω, I grumble).—Rumbling sounds produced in the abdomen by the movements of gas within the bowels or stomach.

BORDIGHERA in Italy, on the Riviera. A suitable winter residence for patients suffering from some forms of chest-disease. The climate is warm and dry. *See* CLIMATE, Treatment of Disease by.

BOTHRIOCEPHALUS (βόθριον, a pit, and κεφαλή, the head).—A genus of cestode entozoa, characterised by the possession of two pits or depressions, one on either side of the head, in place of the four sucking disks usually present in tapeworms. The reproductive openings, instead of being placed along the margin of the so-called joints or segments of the body, occur at the ventral surface along the mesial line. Three species of *Bothriocephalus* are known to infest the human body. These are the broad tapeworm (*B. latus*), the Greenland tapeworm (*B. cordatus*), and the crested tapeworm (*B. cristatus*) recently described by Davaine. From a clinical point of view little need be said concerning them. The broad tapeworm is rarely seen out of Europe, and then only, it would seem, in persons who have travelled on the Continent. It is most common in Switzerland and north-western Russia; but cases also occur in Poland, Sweden, Holland, Belgium, the south-western provinces of France, and sometimes in Ireland. In reference to treatment, the parasite readily yields to the remedies employed in ordinary cases of tapeworm. In English practice we have generally resorted to male fern, but Dr. Arthur Leared has found kamela equally efficacious. *See* TAPE-WORM; and TÆNIA.

T. S. COBBOLD.

BOTS.—A term employed to designate the larvæ of certain dipterous insects called gadflies. They more rarely infest man than animals. *See* ŒSTRUS.

BOULIMIA. *See* BULIMIA.

BOURBONNE-LES-BAINS in France. Common salt waters. *See* MINERAL WATERS.

BOURBOULE, LA, in France. Thermal alkaline and arsenical waters. *See* MINERAL WATERS.

BOURNEMOUTH in Hampshire. Regarded as a suitable winter residence for patients suffering from certain forms of chest-disease. The climate is mild and slightly humid. *See* CLIMATE, Treatment of Disease by.

BOWELS, Diseases of. *See* INTESTINES, Diseases of.

BRAIDISM.—SYNON.: Hypnotism.—Braidism is the name which, after its inventor, James Braid, has been applied to a therapeutic method destined to utilise the undoubted powers of mind over body for the cure of various diseases. In essence it consists of a species of Mesmerism, the patient being reduced to a partial or complete trance-like condition, by being made to look fixedly for a few seconds at a bright object held by the operator at 'about eight to fifteen inches above the eyes, at such a distance above the forehead as may be necessary to produce the greatest possible strain upon the eyes and eyelids, and enable the patient to maintain a steady fixed stare at the object.' The patient must be made to understand that he is to keep his eyes steadily fixed on this object, and his mind riveted upon the image of it. After so short a time as ten or fifteen seconds some patients may be intensely affected, and if so, it will be found, on gently elevating the arms and legs, that the patient has a disposition to retain them in the situation in which they have been placed. 'If this is not the case,' Mr. Braid writes, 'in a soft tone of voice desire him to retain the limbs in the extended position, and thus the pulse will speedily become greatly accelerated, and his limbs in process of time will become quite rigid and involuntarily fixed.' By slightly prolonging this process a condition of profound 'nervous sleep' may be induced, in which operations may be performed as easily and in as painless a manner as if the patient had been under the influence of chloroform. All this has been abundantly proved by Esdaile and others who performed numerous operations upon Hindoos, with absence of all pain, whilst they were in the hypnotic state. In his attempts to cure morbid conditions, however, Braid only rarely proceeded so far as to induce actual unconsciousness. Whilst in a semi-cataleptic condition the patient's attention is strongly directed to the morbid part, and some very marvellous instances of relief are recorded by him, said to have been effected under the influence of this faculty only, without the aid of Imagination, since some of the patients operated upon were quite incredulous as to any good being likely to result. In a recent work on 'The Influence of the Body upon the Mind,' Dr. Daniel H. Tuke remarks: 'Braidism possesses this great advantage, that while the Imagination, Faith or Expectation of the patient may be beneficially appealed to, this is not essential; the mere concentration of the attention having a remarkable influence, when skilfully directed, in exciting the action of some parts, and lowering that of others. The short period of time required, also, compares favourably with that consumed in some other forms of mental therapeutics. . . . The great principle which appears to be involved in all is the remarkable influence which the mind exerts upon any organ or tissue to which the Attention is directed, to the exclusion of other ideas, the mind gradually passing into a state in which, at the desire of the operator, portions of the nervous system can be exalted in a remarkable degree, and others proportionately depressed; and thus the vascularity, innervation and function of an organ or tissue can be regulated and modified according to the locality and nature of the disorder.' Braidism certainly deserves more attention than it has received, though it is a method very difficult of adoption in ordinary practice, and which, however legitimate may be its foundations, would, unless the greatest care and vigilance were exercised, be apt to descend perilously near to the level of quackery. Still, if only half the results which have been attributed to Braidism would follow the systematic adoption of this method for the alleviation of many diseases, it is one which should commend itself to the earnest attention of future enquirers who may be able to place the practice upon a broader and firmer foundation than that on which it now rests. *See* MESMERISM.

H. CHARLTON BASTIAN.

BRAIN, Diseases of.—General Observations.—The range of unnatural phenomena which manifest themselves as the result of disturbed actions of the brain, whether from functional perturbations or structural disease, is wide and varied. This result is due to the fact that the brain, though spoken of as a single organ, is really a congeries of many distinct but functionally related parts; and further to the fact that this congeries of parts is continuous with the spinal cord and intimately related to a scattered network of ganglia—entering into the formation of the nervous system of organic life; whilst these several centres within and without the cranium are brought into connexion, through the intervention of nerves, with all other structures in the body, whether entering into the composition of the organs of relation, or into that of the visceral system.

The action of particular parts of the brain may be stimulated, depressed, or suppressed, and either of such altered modes of activity may entail a stimulation, depression, or suppression in the functions of one, two, or more distant parts of the nervous system. The first class of effects are spoken of as *direct*, and the second as *indirect* symptoms. It is often extremely difficult, if not impossible, for us to say which of the symptoms presented by a patient suffering from organic disease of the brain should be ranged under the one head and which under the other. Our ability to make such distinctions is at present hindered by our still incomplete knowledge concerning the anatomical details of the brain, the proper functions of its several parts, and the precise modes in which they co-operate with each other.

The effects of a shock, whether produced by injury or disease, falling on such an extensive assemblage of sensitive and mutually related organs are, as may be well imagined, subject to much variation; and as a matter of fact it happens that in different cases of structural brain disease, the symptoms produced are dependent upon three factors, viz., the *situation*, the *extent*, and the *suddenness* of the lesion. Except in so far as the nature of the lesion tends to entail variations in one or other of the above-mentioned respects, it is not of much significance from a clinical point of view (*i.e.* it does not lead to much difference in the sets of symptoms produced) whether we have to do with a case of hæmorrhage into, or with a case of softening of the brain. Thus the 'locality' and extent of the lesion in the case of a local disease of the brain has always to be enquired into as a problem altogether apart from that as to the more or less distinct nature of the pathological change in the part affected. In other words, the problem of diagnosis in brain disease is twofold; it must have reference to the region affected (Regional Diagnosis) and to the pathological cause (Pathological Diagnosis). The causes interfering with the progress of our knowledge in the former direction are both numerous and baffling, so that, as yet, comparatively little progress has been made.

SYMPTOMS.—The most frequent effects or symptoms of functional or structural brain-disease may be thus classified:—

1. PERVERTED SENSATION AND PERCEPTION.—The special senses of smell, sight, hearing, touch (fifth nerve), or taste may be interfered with by diseases of their respective nerves or primary ganglia within the cranium. Owing to the decussation of the optic nerves, disease of the optic tract gives rise (most frequently) to an affection of the sight of the opposite eye. The sense of taste pertains to different nerves. Thus the glosso-pharyngeal has to do with this special sensation in the back part of the tongue, the palate and fauces; whilst the taste-nerves for the front part of the tongue, though they pass from these parts with the lingual branch of the fifth, seem to leave it by the chorda tympani and then proceed to the brain with the facial or the fifth nerve. Disease of the intracranial portion of the fifth nerve may not affect the sense of taste, though it impairs the common sensibility of the tongue.

Disease of the primary ganglia of these nerves, whether they are separate (first and fifth) or lodged in the brain-substance at its point of connection with the nerve, will produce decided impairment of the several special senses. But disease of portions of the brain above these regions on one side only, even though very extensive, often exists without disturbing the exercise of the special senses on either side. There may, however, be *Illusions*, *Hallucinations*, or *Delusions* in connection with either of these senses in many functional and structural diseases of the brain, where the morbid condition is situated in parts higher up than the primary ganglia, or where there is a functional exaltation of the ganglia themselves. This latter functional exaltation seems sometimes to be favoured by morbid states of some of the viscera—especially of the stomach, or of the uterus and ovaries.

Disease in the brain may also impair the common sensibility of the body, and in some of the most marked cases, this impairment is strictly limited to one lateral half of the body (Hemianæsthesia). It may be very marked and last for a long time; or it may be slighter and present only for a few days. There are several modes of impressibility comprised under the term 'common sensibility.' The principal varieties are tactile impressions, impressions produced by differences of pressure and of temperature, impressions yielding pain, and lastly those of the so-called 'muscular sense.' There is, moreover, a general sensibility pertaining to the muscles and joint-textures, and the last may be profoundly impaired in some cases. The writer believes that what there is of conscious impression pertaining to that endowment known as the 'muscular sense,' is compounded of the ordinary sense of touch and pressure pertaining to the skin, plus sensations in joints and muscles accruing from the contraction of the latter.

Besides diminutions of sensibility, we often have to do with disagreeable sensations of numbness tingling, or actual neuralgic pains in parts. The two former may be widely distributed, though neuralgia from brain-disease is principally limited to the territory of the fifth nerves.

2. Perverted Emotion and Ideation.—These manifestations vary, from the mere increased tendency to emotional displays seen in a hysterical person or in persons suffering from hemiplegia, to those more complex aberrations met with in the various forms of delirium and insanity (*see* Insanity).

3. Perversions of Consciousness.—Under this head may be included the comparatively rare states known as somnambulism, ecstasy, and catalepsy; as well as the exceedingly common conditions of drowsiness, stupor, and coma. The former may be said in almost all cases to be associated with functional rather than with structural disease of the brain; at least, this is most in accordance with our present knowledge. Drowsiness, stupor, and coma are, however, amongst the commonest results of organic disease of the brain (*see* Consciousness, Disorders of), though they are also common conditions in blood-poisoning—whether arising from fevers, uræmia, or from poisonous doses of opium or of other narcotic or narcotico-irritant poisons.

4. Perversions of Motility.—These manifest themselves in many forms, which, however distinct they may appear to be, are, nevertheless, closely linked to one another.

Tremors may be general or local, and in the latter case they may be most marked in the tongue and facial muscles—principally those about the corners of the mouth or the orbicularis palpebrarum. General tremors may arise from debility, over-exertion, nervousness; or they may be due to alcoholic or mercurial poisoning, or to degenerative disease about the pons and medulla, as in Paralysis Agitans.

Twitchings may be characteristic of a highly nervous habit of body, and are especially frequent in some epileptics in the intervals between their fits, either in some of the facial muscles or in those of the neck or limbs. They may also occur in acute febrile affections, in which the functions of the cerebrum are involved, as shown by coexisting delirium, &c., and also in the course of many organic diseases of the brain. In chorea the irregular movements of different parts of the body are often of this nature; they may affect both sides of the body, or only one (hemichorea).

Spasms of a continuous or 'tonic' character are encountered in various diseases of the nervous system, such as laryngismus stridulus, trismus, hydrophobia, tetanus, hysteria, and some forms of hemiplegia and paraplegia. Such tonic spasms produce muscular rigidity, which has to be distinguished from that due to chronic changes apt to occur in paralysed limbs.

Clonic Spasms or *Convulsions* may be either unilateral or general, and may be induced by the most varied causes. When well-marked they are mostly attended by loss of consciousness, as in epilepsy and the majority of epileptiform attacks.

Co-ordinated Spasms, or movements of a struggling type, are met with in many epileptiform and hysterical paroxysms. Spasms of this type may be also limited to particular groups of muscles, as in the conjugated deviation of the eyes and neck occurring in hemiplegia, in wryneck, in writer's cramp, and other allied affections.

Paralysis may be local and limited in seat to some of the ocular muscles, the muscles of mastication, the facial muscles, those of the tongue, or to parts supplied by the spinal accessory and pneumogastric nerve, in those cases in which there is merely an implication of the intracranial portion of one or more of the motor-cranial nerves; or it may take an incomplete or a complete *hemiplegic* type, with lesions limited to one half of the encephalon; or it may be general, and involve both sides of the body, if a large lesion exists in the pons Varolii, or if the functions of both cerebral hemispheres or their peduncles are gravely interfered with. In some of these cases, and especially with right-sided paralysis, various difficulties exist in giving expression to thoughts by means of speech or writing (*see* Aphasia). Deficient action of the will (without obvious structural change of the cerebrum) may cause paralysis in hysteria and allied states.

Defective Co-ordination of muscular acts is met with, as in stammering and in some hemiplegic defects of speech; also in the body generally in some cases of cerebellar disease, producing a peculiar and unsteady gait (titubation) closely resembling that which may be met with in alcoholic intoxication. Similar motor disturbances may be induced by vertigo of well-marked extent. Vomiting, again, is a reflex motor act due to impaired co-ordination, which occurs in many forms of brain-disease. More rarely the sphincter ani and the sphincter vesicæ become relaxed, or the bladder may be paralysed. But incontinence of fæces or of urine, or inability to void the urine, are comparatively rarely met with as a result of brain-disease, except in the comatose state, or in patients who are more or less demented.

5. NUTRITIVE OR TROPHIC CHANGES.—With lesions in the motor tract of the brain in or below the corpus striatum a band of degeneration is produced, occupying part of the crus cerebri, the pons, and the medulla on the same side, and (below the decussation of the pyramids) the opposite lateral column of the spinal cord. This is one of the most important of the trophic changes occasioned by brain-disease, because the degeneration in the lateral column of the cord is apt to spread to the contiguous grey matter, and thus to give rise to some of the trophic changes prone to ensue in paralysed limbs.

Trophic changes in other organs occasioned by some severe lesions in the brain appear as low inflammations and congestions of the lungs, or as hæmorrhages into these organs; also as hæmorrhages beneath the pleura or endocardium, or even into the substance of the suprarenal capsules or kidneys.

Again, we may have acute sloughing of the integument in the gluteal region on the paralysed side, dropsy of paralysed limbs, inflammations of joints and of the main nerves of paralysed limbs, and, though more rarely, marked atrophy of paralysed muscles. Retardation or arrest of growth is also apt to occur in paralysed limbs, when we have to do with infants or young children, suffering from severe organic brain-disease.

Blanching of the hair, or altered pigmentation of the skin, also occurs not unfrequently in connection with brain-disease or violent mental emotions; whilst in the insane the nutrition of the bones and of the pinna of the ear is apt to be interfered with.

6. PERVERTED VISCERAL ACTIONS.—Exalted activity of the uterus, bladder, intestine, stomach, or heart, may be occasioned by functional brain-disturbance more especially; whilst the same brain-conditions may give rise to depressed or exalted activity of the liver or kidneys. With other functionally disturbed or emotional brain-states there may be a lowered functional activity of the salivary glands, of the heart, of the respiratory organs, of the organs of deglutition, of the organs of digestion, or of the sexual organs. These are only to be taken as mere indications of the kinds of modification that may be produced in visceral activity by brain-disease. Much doubtless remains to be learned in this direction.

It seems fitting here also to mention those contractions and dilatations of vessels which are apt to take place in different parts of the surface of the body, or in internal organs, from stimulation or contraction of vaso-motor nerves, occasioned either by direct or indirect influence exerted upon the principal vaso-motor centres in the region of the pons Varolii. These contractions or dilatations produce correlated alterations in the temperature, sensibility, and functional activity of the parts or organs affected. The temperature of paralysed parts, as well as the general body temperature, in the apoplectic state is subject to great variations, and these are now beginning to be studied more attentively. They are capable of yielding diagnostic indications of great value.

REMARKS.—Some general remarks on the subject of structural and functional diseases of the nervous system, showing how intimately these two classes of disease are related to one another, will be found in the article NERVOUS SYSTEM. Most of what is said there is applicable to diseases of the brain in particular; here, however, it is necessary to call attention to certain points specially related to brain-disease.

When paralysis occurs from brain-disease affecting one cerebral hemisphere, in the great majority of cases it is situated on the opposite side of the body, owing to the fact that the fibres conveying the volitional impulses to the muscles decussate in the medulla oblongata. It is true that many cases are on record in which the paralysis either has, or has been said to have existed on the same side as the brain-lesion. A certain number of these cases are probably due to errors either in the clinical or in the post-mortem records of the case. Others, however, still remain unexplained. The characters of the various forms of paralysis due to brain-disease are briefly set forth in the article on PARALYSIS.

Lesions of the left hemisphere much more frequently than those of the right, are associated with aphasic defects of speech; whilst, according to Brown-Séquard, lesions of the right hemisphere are more frequently and rapidly fatal than otherwise similar lesions of the left hemisphere. They are also more apt to be associated with acute sloughs of the skin on the paralysed side. Convulsions at the onset, and subsequent tonic spasms of the paralysed limbs, are also said to be more frequently associated with left- than with right-sided paralysis.

Congenital atrophy of one hemisphere, or atrophy occurring in early infancy, is mostly associated with an arrest of growth and development in the limbs on the opposite or paralysed side of the body.

Very little is positively known concerning the diseases of the cerebellum. Of its functional affections we may be said to know absolutely nothing. That is, of the various functional diseases of the nervous system with whose clinical characters we are familiar we are unable to name even one which we can positively say is a functional disease of the cerebellum. Whatever the precise mode of activity of the cerebellum may be, there is a general consensus of opinion that it is principally, if not exclusively, concerned with motility, and that it has more especially to do with the higher co-ordination of muscular acts. Atrophy of one hemisphere of the cerebrum is followed by atrophy of the opposite half of the cerebellum, so that there is a strong presumption that the functional relationship of either half is with muscles on the same side of the body. Clinically we know that disease of the cerebellum is not unfrequently associated with more

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or less marked paralysis on the opposite side of the body; but this effect is now generally attributed to the pressure which structural diseases of the cerebellum are apt to occasion on the pons and medulla of the same side.

Ætiology.—The principal modes of causation of diseases of the brain may be thus summarised:—

1. *Defective Nutrition* operates by modifying the proper constitution of nerve-tissues as well as the constitution of the blood, and thereby interfering with the normal functional relations of the several parts of the brain. Anæmia, chlorosis, syphilis, ague, and all lowered states of health, howsoever induced, and whether acquired or inherited, become predisposing or actual causes of brain-disease. To these states, favourable to the manifestation of brain-disease, should be added the various acute specific diseases, uræmia, metallic poisoning, poisoning by the narcotic and narcotico-irritant poisons generally, and also by the occasional qualities of certain articles of food, such as mackerel, mussels, mushrooms, &c.

2. *Emotional Shocks* cause cerebral disorder, especially in children, or prolonged overwork in those who are older—particularly when combined with worry and anxiety, with sexual excesses, or with protracted lactation. Religious excitement, again, not unfrequently leads to insanity.

3. *Physiological Crises*, such as the period of the first dentition, the period of puberty, pregnancy, and the climacteric period, all favour the manifestations of various nervous diseases.

4. *Visceral Diseases* or surface-irritations (especially in children or in persons having a very sensitive and mobile nervous system) may give rise to varied nervous diseases. Thus we may have convulsions or delirium in children from the presence of worms or other irritants in the intestines, or convulsions in adults during the passage of a renal calculus. Again we may have the phenomena classed as hysteria, or we may have nymphomania, in consequence of certain states of the sexual organs. Cases of paralysis are said also to have a reflex origin occasionally, though this must be a very rare event. With much greater frequency we find surface-irritations of various kinds leading, as in Dr. Brown-Séquard's guinea-pigs, to epileptiform attacks.

5. *Structural lesions* of the brain itself give rise to a very large proportion of its diseases. The various kinds of change will be found enumerated under another heading (*see* Nervous System). Hæmorrhage and softening are the most common and, therefore, the most important of these morbid conditions.

6. Brain-disease may be determined by the action of *Heat* (*insolatio*), especially when combined with fatigue and deficient aëration of blood. A somewhat similar brain-affection, however, is occasionally developed in the course of rheumatic fever or in that of one of the specific fevers, in which the body-temperature rapidly rises to a lethal extent (109°–111° F.).

7. *Concussions* (whether from blows or falls) may give rise to brain-disease, even where no traumatic injuries or lacerations of the brain are produced.

Treatment.—The treatment of brain-disease will be discussed under the articles Nervous System, Paralysis, Convulsions, and those on the several special diseases which will now be described in alphabetical order.

H. Charlton Bastian.

BRAIN, Abscess of.—This term is applicable whenever a circumscribed collection of pus is formed in any part of the cerebral mass.

Ætiology and Pathology.—Amongst the most frequent causes of cerebral abscess are severe injuries to the skull, disease of the temporal bone in connection with the ear, ligature or obstruction of a main artery, and pyæmia. Under the three first-named conditions the abscess is usually solitary, but from pyæmia multiple abscesses often result. For practical purposes we may perhaps conveniently discard the latter—since the symptoms will usually be those of general encephalitis—and confine ourselves to those cases in which single large-sized collections of pus are met with. With this limitation, abscess in the brain is by no means of frequent occurrence.

The best marked, and also the more common examples of large brain-abscess are met with in connexion with compound fractures of the skull, and by far the most definite symptom which denotes them is the formation of a fungus cerebri. Unless in a compound fracture the brain be directly injured and the dura mater torn, it is very rare indeed for any suppuration in its substance to occur. It is not to be denied, however, that now and then, after severe concussion or laceration without external wound, abscess may follow. In such cases we may conjecture that usually some slight laceration or extravasation occurred in the first instance, which constituted a focus for the inflammation. Abscess after simple concussion without lesion is probably a most rare event.

In the article Brain, Inflammation of, we shall have to define Encephalitis as a diffuse change of a large part of the cerebral mass, perhaps of a whole hemisphere, attended by the infiltration of cells and fluid. It is obvious that the term abscess in the brain is applicable to one of the results of encephalitis, but it seems clinically probable that the two classes of cases are for the most part distinct, and that diffuse encephalitis has but little tendency to result in abscess, and that abscess is rarely preceded by a stage of encephalitis. Both are usually the consequences of local injury to the brain, or of extension from local disease of its coverings; but whilst encephalitis probably resembles the erysipelatous type of inflammatory action, in localised abscess this tendency is not present. Having distinguished brain-abscess from encephalitis, we must next say a word as to the risk of confusing it with intra-cranial but extra-cerebral collections of pus. Encysted collections of matter may be met with either between the dura mater and bone; or within the arachnoid cavity; and perhaps it ought to be added, though with some hesitation, beneath the arachnoid, in the pia mater. Not unfrequently inflammation of the membranes precedes and attends the formation of an intra-cerebral abscess, and in these cases the symptoms will be mixed. In dealing with published cases it is also necessary to be on our guard as to certain errors which have crept in—cases of meningeal abscess being spoken of as brain-abscess. Mr. Prescott Hewett has expressed his opinion that the celebrated case of De la Peyronie's was an example only of extra-cerebral abscess. It is absolutely necessary to make these restrictions if we would judge correctly as to the symptoms which attend local collections of matter in the brain and the usual terminations of such cases.

Symptoms.—The symptoms of local suppuration in the brain will vary with the stage, the size of the collection, its precise situation, and, above all, with the presence or otherwise of a fistula of relief. In many of the cases which come under surgical care a fistula exists from a very early period, though not unfrequently it is liable to occlusion. Under the latter conditions the symptoms of a closed and an open cerebral abscess may be alternately studied in the same case. It will usually be observed that when the exit is closed and the abscess fills, the patient complains more or less of headache, becomes heavy and drowsy, experiences twitchings or spasms in the opposite side of the face and limbs, with some tendency to hemiplegia. Of this group the tendency to spasms is probably by far the most significant. The headache may be but trifling, and the patient may even be well enough to leave his bed, when the occurrence of spasm followed by paresis alone gives warning of what is going on. The cases now alluded to are chiefly those in which abscess results from compound fracture of the skull with laceration of the brain-substance. In these the abscess often gives way spontaneously, and a fistula forms, around the orifice of which a mass of pouting brain-granulations, known as fungus cerebri, usually forms. In these cases the canal of communication may be very tortuous, and the liability to blocking considerable. Now and then the same result may be met with after syphilitic disease of the skull and meninges. The writer had some years ago a man under his care in whom he had opened a cerebral abscess beneath a hole in one parietal bone. The patient was able to walk about, and ailed but little so long as the fistula was freely open; but spasms of the face, or even convulsions of the limbs (on the opposite side) always followed its occlusion. The softening gradually extended, and he at length died in consequence, perhaps, of the impossibility of making a counter-opening in a depending situation. Unless the abscess be in the anterior lobe, there will almost invariably be present some degree of hemiplegia, but this will of course vary with the size of the collection and the extent of destruction of tissue. The formation of an abscess after injury is sometimes very insidious, the symptoms being very slight. The cases in which violent headache and pain, vomiting, delirium, and dry tongue, are said to have been present in the early stages are, the writer suspects, usually instances of suppuration between the bone and dura mater. These symptoms occur especially when brain-abscess follows disease of the internal ear, and in these there nearly always is the complication of inflammation around the petrous bone. Such symptoms are very rarely present in traumatic abscesses, which often develop very quietly until they attain a considerable size. It is probable that some degree of rigor, attended by rise of temperature, usually occurs in the beginning of cerebral abscess, but no very precise data are extant on these points.

The contents of a brain-abscess usually consist to some extent of broken-up cerebral tissue, and in some cases there are but very few pus-cells. Especially is this likely to occur when the so-called abscess follows on ligature of the carotid or occlusion of a cerebral artery. In these cases, it is in the first instance at least the result of a process of softening rather than of true suppuration.

If a large abscess be permitted to develop without relief, the symptoms of compression will in time ensue: first spasm, then hemiplegia, then hebetude and coma, preceded possibly by violent convulsions.

Diagnosis.—The diagnosis between cerebral abscess and meningeal abscess is exceedingly difficult, and often a guess is all that can be made. The almost invariable occurrence of spasm or convulsions in the former, and their frequent absence, with the greater degree of pain and headache in the latter, are the most reliable signs. Sometimes—as, for instance, when trephining has been practised, and no inflammatory products are found between the bone and dura mater or under the latter—the diagnosis may be helped by this negative knowledge. In such cases, if hemiplegia, preceded by spasm, have been gradually developed, the surgeon will be well justified in making an incision or puncture into the hemisphere. Optic neuritis may equally be present in both, and its presence or absence will scarcely help the diagnosis.

Prognosis.—In addition to the danger of death by compression, there is the risk that the abscess may break into the ventricles or into the subarachnoid space. Some cases are on record in which spontaneous openings into the nose or into the ear occurred, and profuse discharge followed, the patient in the end recovering. It may be doubted whether these were not instances of meningeal abscess.

Treatment.—It is needless to say that if abscess be diagnosed with any degree of confidence an opening is essential. There is little or no room for medical treatment. For the prevention of abscess, in all cases in which injuries likely to produce it have occurred, the utmost precautions should be enforced. Mercury in small doses, freqently repeated, should be given from the first; the injured region should be covered with lint soaked in a strong spirit-of-wine lotion, frequently re-wetted; purgatives should be administered; and the patient should be kept very quiet until long after the healing of the wound.

Jonathan Hutchinson.

BRAIN, Anæmia of.—Definition.—A condition in which the blood contained within the capillaries of the brain is deficient in quantity, or defective in quality.

The blood within the brain is contained in arteries, capillaries, and veins. The functional condition of the brain depends on the quantity and quality of the blood circulating in its capillaries, and it is to these that the special symptoms are related. Deficiency in the quality of the blood supplied to the brain is always of gradual occurrence, and affects the whole brain; deficiency in quantity of blood may affect the whole brain or part only, and it may be sudden or gradual in its production.

ÆTIOLOGY.—*General cerebral anæmia* may be due to the following causes:—(1) It may be a part of systemic anæmia—defect in quantity or quality of the whole blood, and due to causes which are considered elsewhere. This is often seen in cases of hæmorrhage, of exhausting discharges, or of defective blood-nutrition, as in chlorosis. (2) The supply of blood to the brain may be deficient, the quantity of blood in the body being normal. This may be due to cardiac weakness, or to causes acting through the nervous system on the heart, as in swooning. In systemic anæmia, the lessened cardiac power increases the cerebral deficiency. Whatever lessens the amount of blood discharged from the heart at each systole, such as aortic or mitral disease, may be a cause of cerebral anæmia. Pressure on the vessels conveying the blood to the head, as by an aortic aneurism, has a similar effect. Unequal distribution of the systemic blood is another cause. The intestinal vessels, if dilated, are capable of containing a large part of the blood of the body, and the effect of their engorgement is often seen after paracentesis abdominis. One theory of shock ascribes its mechanism to vaso-motor dilatation of these vessels, and consequent anæmia of the rest of the system. The effect of each cause is increased by the action of gravitation in the erect posture. Some causes act only in that position. (3) The capacity of the cerebral vessels may be diminished by pressure on the brain, exerted by effusions of fluid (hydrocephalus), of blood (in cerebral and meningeal hæmorrhage), or by growths within the skull.

Partial cerebral anæmia is due to some obstruction to the passage of the blood through the vessels. To be permanently efficient such obstruction must be situated beyond the circle of Willis. Ligature of one carotid causes immediate symptoms of cerebral anæmia, but permanent symptoms are not frequent. Pressure on, or disease of one carotid, for the same reason rarely gives rise to symptoms. Obstruction in certain arteries of the brain may cause local anæmia, sudden or gradual, temporary or permanent, according to its cause. Such obstruction may be due to narrowing of the calibre of the vessel by atheromatous changes in its wall, or by spasm of its muscular coat, or may be due to actual occlusion by embolism or thrombosis. The pressure-effects of an intruding substance within the skull (tumour, or clot) act most intensely in, and may influence only one region of the brain.

It is obvious that of these causes some act suddenly, others gradually, and the symptoms produced will differ accordingly.

ANATOMICAL CHARACTERS.—The principal anatomical character of cerebral anæmia is pallor of the brain, observable chiefly in the paler tint of the cortical substance, and the diminished number of red spots in the white centre. The pallor may be partial or general. The membranes are usually pale, but in some cases of partial anæmia they are hyperæmic. Effusion of serum in the meshes of the pia mater and between the convolutions, may be found in general anæmia.

SYMPTOMS.—The symptoms of this condition vary according as the anæmia is suddenly or slowly produced, and as it is general or partial.

(1) In *sudden* general anæmia of the brain the sufferer feels drowsy; the special senses are dulled; noises in the ears and vertigo are complained of; the pupils are at first contracted; sight may fail; muscular power is weakened; respiration is sighing; the skin is pale, cold, and moist; nausea is common; and headache is rare. If the anæmia is more intense, consciousness is lost; there is universal paralysis; and general convulsions may occur, epileptiform in character, these being especially frequent in sudden extensive losses of blood in strong subjects. The pupils dilate, and the coma may deepen to death. The loss of sight in cases which recover may persist as permanent amaurosis.

(2) When general anæmia of the brain is *slowly* produced, the state of the cerebral functions is usually that of 'irritable weakness.' Their action is imperfect in degree, and excited with undue facility. There is mental dulness and drowsiness; sometimes, however, insomnia is troublesome. Delirium is common in severe cases, and is conspicuous in some forms of imperfect blood-nutrition, as in the so-called 'inanition delirium.' Headache, usually general, is a common symptom. Sensory hyperæsthesiæ, tinnitus, muscæ volitantes, and vertigo are frequent. Convulsions are rare, but muscular power is generally deficient. All these phenomena are more marked in the erect than in the recumbent posture, especially when the erect posture is suddenly assumed. It has been remarked that some anæmic persons can think well only when lying down. In young children, after exhausting discharges, as diarrhœa, symptoms referable to cerebral anæmia are common, namely, somnolence and pallor, with depressed fontanelle and contracted pupils. The somnolence may deepen to coma with insensitive conjunctiva, and the coma increase to death. Such symptoms have been called *hydrocephaloid*, from some resemblance to those of acute hydrocephalus.

(3) Partial cerebral anæmia causes, if complete, loss of function in the affected area; and if it be permanent, as in obstruction of a vessel beyond the circle of Willis, necrosis of the cerebral tissue results (*see* BRAIN, Softening of). If incomplete and sudden, there is temporary arrest of function. Ligature of one carotid, for instance, causes transient weakness and numbness in the opposite half of the body. There may be at first an overaction of grey matter, causing, in certain regions, unilateral convulsions. If slowly developed, as in atheroma of arteries, pain and vertigo are common, with recurring local symptoms, such as numbness, tingling, and weakness.

In all cases of long-continued cerebral anæmia, permanent damage to the nutrition of the brain may result. In the child the development of the brain may be arrested; in the adult, loss of memory and of general mental power indicate the deterioration of structure.

PATHOLOGY.—The symptoms are, as already stated, dependent mainly on the defective quantity and quality of the blood circulating in the brain. Some influence may probably be ascribed to the diminution in the blood-pressure to which the nerve-elements are ordinarily exposed (Burrows). Nothnagel has pointed out that the symptoms indicate an early affection of the respiratory centre in the medulla, and of the cortical grey matter. Kussmaul and Tenner ascribe the convulsions in acute anæmia to the irritation of the medulla; Nothnagel, to that of the pons Varolii.

Diagnosis.—The diagnosis is not difficult. It rests on the recognition, in a given case, of the causes of cerebral anæmia; and on the exclusion of graver maladies, as organic cerebral disease. With the latter, it should be remembered, anæmia of the brain, local or general, often co-exists. Some symptoms of hyperæmia of the brain closely resemble those of anæmia. A common pathological state of imperfect blood-renewal probably exists in both conditions.

Prognosis.—The extent to which the cause of the anæmia is amenable to treatment, and is of transient character, must influence the prognosis. As a rule this is favourable when there is no organic disease of heart, vessels, or brain. In the so-called 'pernicious anæmia,' the prognosis is, of course, unfavourable. Hydrocephaloid symptoms in infants, if met by prompt and suitable treatment, are usually recovered from.

Treatment.—The treatment necessarily varies in the several forms of the affection, but it is in the main causal. The beneficial effect of the recumbent posture in affording immediate relief to the symptoms, and obviating permanent damage to the cerebral nutrition, must be always remembered. In acute anæmia from loss of blood, the head must be kept continuously low, stimulants freely administered, and as a penultimate resort bandages applied to the limbs from below upwards may increase the proportionate supply of blood to the brain. If this fails transfusion must be had recourse to. In chronic anæmia sudden change of posture should be carefully avoided, and ferruginous tonics are needed. In spasm of the cerebral vessels, bromides are useful. In the cerebral anæmia of syncope, the recumbent posture, stimulants to the skin, cold water, faradisation, sinapisms, and ammonia to the nasal mucous membrane, assist the recovery of cardiac action and the return of consciousness. In all cases, carefully regulated food and stimulants are needed; beef-tea should be given in small quantities, at frequent intervals. The group of symptoms called hydrocephaloid require similar treatment.

W. R. Gowers.

BRAIN, Aneurism of. *See* Brain, Vessels of, Diseases of.

BRAIN, Atrophy of.—Atrophy of the brain may be congenital, due to arrest of development in very early fœtal life; or the constituents of the brain may have been perfectly developed, and may subsequently disappear from one of several causes. This morbid state is regarded as *primary* when there has been no pre-existing disease of the brain or its membranes; *secondary*, either when there has been such pre-existing disease, and the atrophy has occurred from absorption of the part broken down by inflammation, softening, hæmorrhage, &c.; when atrophy of some special cerebral organ follows upon destruction of the particular nerve that arises from it; or when localised atrophy has taken place in a very gradual manner from pressure of a tumour, of ventricular effusion, &c. To take these forms in order:—

1. *Congenital atrophy.*—This is usually associated with weakness of intellect, even to the extent of idiocy: there is atrophy of the body opposite to the side of the cerebral lesion, and this atrophy involves all structures, even the bones. Paralyses of various intensity supervene, often with contraction of the paralysed parts; there being no particular sensitiveness of the special senses, possibly because of the mental hebetude. Epileptic attacks are common; vitality is low; and the patient easily succumbs to other diseases.

2. *Primary atrophy.*—In this variety there is general diminution both of volume and of weight, affecting most usually the cerebral hemispheres, and that in pretty equal degree. It is most common as a condition of old age—*senile marasmus, atrophia cerebri senilis.* It sometimes in earlier life follows exhausting diseases; and may also be caused by deficient or impure blood-supply to the brain. In close connexion with this mode of causation it is seen after repeated attacks of intoxication, especially after delirium tremens. In this last condition the cerebral atrophy may be acute and rapid.

3. *Secondary atrophy.*—This may be *general* or *partial*. When *general*, the convolutions have a shrunken appearance, and there is always an increase of the subarachnoid fluid. This condition follows various lesions of the brain, especially of the convex surface, such as hæmorrhage of the convexity, encephalitis, or more accurately that form of encephalitis that attacks only the grey matter or perhaps only one layer of the grey matter, as in some mental diseases. When the atrophy is *partial*, there are found depressions in an otherwise normal hemisphere, at which point a localised hæmorrhage or patch of softening, inflammatory or depending on thrombosis or embolism of vessels, has been absorbed, leaving only a cavity of greater or less extent, filled with fluid and sometimes lined with a thin membrane. A certain portion also of the brain may become atrophied by the gradual pressure of a tumour or any foreign body. Even the little sieve-like depressions seen in various situations after constantly repeated congestion of vessels may be the result of atrophy from compression by the distended vessels. Functional inactivity and atrophy of the optic nerves has led to a similar abnormality of the corpora quadrigemina.

Anatomical Characters. — The atrophied brain or portion of brain will vary in appearance on minute examination, according as the lesion has or has not been preceded by inflammation. When the atrophy is primary and due to gradual interference with blood-supply, there is seen a shrunken condition of the nerve-tissue, especially of the calibre of the nerve-tubes. The cells are smaller than usual and pigmented, the arteries being decreased in size or themselves diseased. If the lesion has had an inflammatory origin, the process in order of sequence is, first, inflammation, then softening with fatty degeneration then partial absorption, and so atrophy;

the appearances differing according to the stage of the lesion. Traces of fatty degeneration of all the tissues,—vessels, nerve-tubes, and cells,—may be found, with the neuroglia either wanting or sclerosed.

Dr. Rudolph Arndt has lately thrown doubt on the possibility of determining atrophy of the ganglionic bodies or nerve-tubes by their size. The size of these bodies varies so greatly, within the limits of health, that he considers this test a very uncertain one. Almost the only trustworthy sign of atrophy, in his opinion, is the appearance in the substance of the ganglionic bodies and in the medullary sheath of nerve-bundles, of black shining globules, somewhat fatty-looking. In process of time these globules increase in number, and at last the whole of the bodies appear permeated by them. These globules are not fatty, they are certainly more or less pigmental. Exactly similar bodies appear at post-mortem examinations, and are a sign of simple decomposition The duration of this condition, irrespective of pre-existing lesions, is protracted.

Symptoms.—The symptoms of atrophy of the brain necessarily vary according to the seat, extent, and ætiology of the lesion. Primary atrophy of the cerebral hemispheres and the first form of secondary atrophy will most usually induce imbecility, or some lesser degree of mental insufficiency, loss of memory, slowness of thought, and other mental diseases. Headache, giddiness, delirium, and stupor are seldom met with. Interference with speech is more common. Affections of sight, and of the motor condition of the eye, do not depend on general atrophy of the brain; they own a more local cause.

Convulsions, paralysis, stiffness of muscles, or contractions are often met with in connexion with this general lesion, as well as various irregularities of locomotion: but it must be remembered that general atrophy of brain is not seldom associated with atrophic or sclerotic lesions of the spinal cord, and even where this is not so, several of the morbid phenomena, and particularly convulsion and paralysis, may derive their origin, not from the atrophy, but from the condition pre-existent to the atrophy, such as hæmorrhage of the convexity, meningitis, or peri-encephalitis.

In secondary atrophy of a more limited extent, the symptoms are apt to be more strictly localised, such as partial loss of power in a single limb, slight imperfections of speech, or strabismus; but here again the positive diagnosis of atrophy is hindered by the complication of pre-existent disease, the local congestions, hæmorrhages, softenings, tumours, or other conditions of which the atrophy is only the sequence. Still less characteristic are the phenomena attending general or partial atrophy of the cerebellum, the pons, and the medulla oblongata.

Treatment.—Treatment is useless as to the atrophy of the brain: it must be directed to supporting the powers of the patient.

E. Long Fox.

BRAIN, Carcinoma of. *See* Brain, Tumours of.

BRAIN, Compression of.—The brain is compressed in the pathological sense whenever its structure is so squeezed that its functions are in any degree interfered with. This squeezing may be effected either by the effusion of blood within the skull, the growth of a tumour, the accumulation of pus or serum, or lastly by the depression of some large portion of the bony parietes. The general belief that depressed fractures are frequently the cause of compression is probably quite a mistake. In such cases the fragment displaced is rarely of sufficient size to cause serious compression of the contents of the skull, and the symptoms usually supposed to indicate that state are really due in most cases to laceration and contusion, or to subsequent inflammation. This point is of great importance in practice, for upon its recognition depends much of the validity of the reasoning by which the operation of primary trephining in compound fractures is defended or condemned. It also offers a most serious fallacy as regards the interpretation of the symptoms due to compression.

By far the best examples of uncomplicated compression of brain are supplied to us by the not very infrequent cases in which a middle meningeal artery is injured, and a large blood-clot is effused between the dura mater and bone. It is from observation of cases of this kind that the assertion is justified, that a very considerable intrusion into the skull is permitted without the production of any symptoms. No doubt the suddenness or otherwise has much to do with the results, but there seems good reason to believe that, as a rule, the brain will easily accommodate itself to quantities not exceeding an ounce or two, and that usually so large a quantity as four or five ounces is required to cause death. It is very rarely indeed that a depression of bone in the least approaches such an extent of intrusion as this, and the majority of such cases are, as regards the amount of possible squeezing, quite trivial. The manner in which the accommodation is effected is by the removal of the fluid contents of the skull, first the subarachnoid fluid, and secondly the blood. Of the blood-vessels the veins and venous sinuses are probably emptied first, and lastly the arteries and capillaries. A brain in a state of strong compression is an exsanguined brain. In this respect, the brain in the last stage of compression differs very much from that in cases of insensibility from concussion or contusion. It by no means follows that because the brain is pale, the face should be pale also; but it is perhaps usually the case that extreme compression so much enfeebles the heart's action that the pulse is weak or flickering, the respiration shallow and irregular, and the skin pale and cold. That stertorous breathing, a laboured pulse, and a suffused and dusky countenance, are (as according to the classical description) symptoms of compression, is probably for the majority of cases a mistake. Such a group much more frequently denotes laceration, contusion, or central extravasation. Nor is it true that hemiplegia, excepting of the most transitory kind, is often due to compression. A clot of blood poured out over one hemisphere may, if rapidly effused, produce for a while weakness of the opposite limbs, but the brain mass is soft enough to allow of considerable yielding, and in the course of a few hours the effects of the displacement will have become general, and not local. In a case recorded by the writer in which a post-mortem, some weeks later, proved the presence of a large blood-clot, there had been partial hemiplegia without unconsciousness at first, but on the next day all trace of it had disappeared, and it never returned. In many of the cases of bleeding between the dura mater and bone, from the meningeal artery, the hæmorrhage takes place on several different occasions, with, it may be, intervals of a day or two, much as is often observed in wounds of arteries, such as the palmar arch. Thus the observer is able to appreciate the symptoms caused by different degrees of compression, and further proof is afforded that, if the intruded quantity be but moderate, the brain bears it without obvious inconvenience. Often at the autopsy it is quite easy to distinguish clots of very different dates, and to feel sure that the original one was of considerable size. It is clear then that in speaking of the symptoms of compression we must allow for differences in amount of the compressing substance, and also for differences in the rapidity or suddenness of its application.

When compression is produced instantaneously, as by a large fragment of bone driven down, the case is almost invariably complicated by contusion. If paralysis or even insensibility be present, it is usually impossible to say to which lesion they are really due. We may, however, hold it almost certain, from what we know of other cases, that the effects in such would be a temporary hemiplegia, with symptoms of shock if the depression were but moderate; and insensibility, probably soon followed by death, if the depression were very great. The cases in which depression of bone has alone been sufficient to produce long-continued compression with insensibility are possibly somewhat apocryphal. It is possible that compression under such circumstances might be attended by stertor and laboured pulse, but it is possible also that the pulse might be extremely feeble, the countenance pale, and inspiratory efforts weak and irregular.

The depression of bone is perhaps the only condition which can be supposed capable of producing compression suddenly. When blood is poured out from a ruptured artery, the symptoms come on rather gradually. The patient complains perhaps of headache, and then becomes more or less confused in manner, his gait is unsteady, and the limbs on the side opposite to the injury show special weakness. Vomiting may occur and the weakened limbs may twitch, and unless, as is often the case, the intracranial bleeding stops, these symptoms are soon lost in a state of complete insensibility, with pale face, feeble pulse, and symptoms of shock. Convulsions may now occur, and death often supervenes very quickly. In such a case the whole course of the symptoms may occupy less than an hour. The surgeon ought, of course, to trephine and let out the blood, and he must be prompt, or his patient may die during his preparations. More commonly this rapid termination occurs unexpectedly after one or more previous attacks of temporary head symptoms, and the patient may have appeared quite well in the intervals. In cases in which the symptoms progress without interruption, their rapidity, no doubt, depends upon the size of the vessel ruptured. Certain special symptoms will also depend upon the precise position taken up by the clot which may chance to press upon special nerve-trunks as well as upon the brain-mass. In ordinary cases the clot is beneath the squamous bone and the lower part of the parietal, and passes downwards into the sphenoidal fossa. In the latter region it may press upon the nerves going to the sphenoidal fissure; and it is of importance for the surgeon to know that dilatation of the pupil on the affected side is often produced. This important symptom is probably due to pressure upon the third nerve.

There is yet another class of compression-cases in which that condition is produced by the slow accummulation of the products of inflammation within the skull. Much will depend, as regards special symptoms, upon the position of the abscess, either within or without the brain. If in the substance of the brain, it must more or less disorganise its structure, and thus cause symptoms due to laceration as well as compression. Under such conditions some degree of hemiplegia, with, probably, preceding spasms of limbs, can scarcely fail to be present. Now and then cases occur in which an irregular sinus leads into an abscess-cavity in the brain, and this sinus being sometimes free and sometimes blocked, the surgeon has repeated opportunity of estimating the effects of filling of the cavity. In such cases, headache, stupor, unilateral twitching of limbs, partial hemiplegia, with, perhaps, vomiting, and, it may be, general convulsions, are the symptoms to be expected. The position of the abscess as regards different regions of the brain is also of much importance, but its discussion cannot be entered upon in any detail here, and it obviously concerns rather disorganisation of structure than simple compression.

When a large accumulation of pus takes place between the bone and dura mater, the symptoms produced are much the same as those caused by blood-clot. We must make, however, much allowance for the fact that these cases are almost always attended by meningitis, and thus the symptoms of compression are masked by those due to inflammation. Chronic abscess under the bone without arachnitis may occur now and then in syphilitic and other disease of the skull-bones, but such cases are very rare. Such cases will differ from those of hæmorrhage in that the symptoms are always produced very slowly. The writer once had the opportunity of watching such a case, in which the patient died of compression, very gradually produced, and without any complication. The chief symptom was constant wearing headache, which prevented sleep. The man was pale and feeble, but not paralysed in any part, excepting that both eyelids drooped. He was rational, but spoke slowly, as if in a state of partial stupor. During the last two or three days of life he had convulsions, and finally, for twenty-four hours, he was in a state of increasing insensibility.

DIAGNOSIS.—It will be seen from what has been said above that the diagnosis of compression by symptoms is exceedingly difficult, and that the utmost use must in each case be made of the history of the case. In those of blood-compression after injury to a meningeal artery, there is almost always the fact that the patient between the date of the injury and the supervention of symptoms had an interval during which there appeared to be little or nothing the matter. This history is, if the symptoms have developed rapidly and without the signs of inflammation, by itself conclusive for diagnosis. Under such conditions trephining ought to be at once resorted to, or possibly it might be yet better practice to first tie the carotid artery.

The diagnosis of abscess in the brain-substance has already been discussed, and that of inflammatory collections from meningitis will be examined in its proper place (*see* MENINGES, Diseases of).

TREATMENT.—The treatment of compression of the brain is almost wholly surgical, and consists in the use of the trephine and knife to elevate depressed bone, or evacuate collections of blood or pus. JONATHAN HUTCHINSON.

BRAIN, Concussion of.—We class under the head 'Concussion of Brain' all symptoms which result simply from the shaking, more or less violently, of the contents of the skull. It will be obvious, however, that most cases of severe shake of the brain are likely to be complicated by visible lesions. The skull may be broken and the brain may be contused, lacerated, or ecchymosed. It is highly probable, however, that well-marked and even serious symptoms may be produced by shaking only, and without the existence of any lesion discoverable either by the unaided eye or the microscope. We must further clearly understand that this element of concussion (*i.e.* the results of shake independent of lesion) enters into almost every case of injury to the head. Whatever be the other lesions, it is usually the fact that the brain has been more or less severely shaken. Thus it may easily happen in cases in which conspicuous lesions are present, such as fracture of the base or local contusion, that still the results of the shake are the most important. It might be convenient if we were in the habit of speaking of most cases of severe injury to the head as *Concussion plus other lesions*, with the endeavour to assign to each added complication its proper share in the general result. These explanations are necessary before we put the question—Can concussion alone cause death? Although it is highly probable that we ought to reply with a very confident affirmation, and to assert that it is very common for concussion to be the chief cause of the fatal event, yet it is very difficult to prove it, since the cases are extremely rare in which severe concussion is produced without some attending lesion. The symptoms caused by concussion of the brain may be studied in very numerous cases of very various degrees of severity, which yet recover perfectly. From what is observed in these, we may infer as to the part which concussion takes in complicated cases many of which prove fatal.

The results of concussion may be divided into three stages—the first stage is that of *collapse*; the second, that of *reaction*, or of vaso-motor paresis, or, if named from its most prominent symptom, the *sleepy* stage; the third is that of *convalescence*, or recovery. The symptoms of the first stage, or stage of collapse, vary with the severity of the case, but if at all well-marked consist in feebleness of pulse, pallor of skin, coldness of extremities, and dilatation of pupils. They may approach a condition which threatens immediate death. There is no stertor, for the respiration is too feebly performed. Although the collapse may be very great, the insensibility is rarely quite complete. It is of great importance in this stage to establish the negative as regards all forms of paralysis. If any non-symmetrical symptoms are present, the case is more than mere concussion. During this stage nothing should be done, except placing the patient in a condition of comfort, and preventing the cooling of the body. Stimulants, unless the collapse is extreme, should be avoided. After the collapse has lasted some little time (half-an-hour to two, three, or more hours), it begins to pass off. The patient moans, manifests discomfort, turns on his side, and draws his knees up. Very often at this period sickness occurs, and it is almost invariable if the patient's stomach was full at the time of the accident. Consciousness is now usually restored, and, by rousing, the patient may be induced to speak, and will tell his name, &c. Gradually, during a period of some hours, the case slides on into the sleepy stage. The pulse is now relaxed and full, the skin is warm or even hot, the face may be somewhat flushed, and the pupils are contracted. The patient is overpowered with sleepiness, and can only be awakened with difficulty. It is, however, always within possibility to awaken him, and he usually rouses himself to the calls of nature. Very commonly the pulse is irregular, especially if the patient be young. At this stage again care must be taken to ascertain whether there are any non-symmetrical symptoms, any weakness of a limb, of one side of the face, or of any single eye-muscle. If the patient passes his urine or fæces in bed, or if there is long-continued retention of urine, it is very probable that there is more than mere concussion—namely, laceration or contusion. The sleepy stage may last for a day or for a week, and it is in severe cases so well-marked that the patient's eyelids may be held open, and the pupils examined, without awaking him.

During this stage the measures of treatment called for are spare diet, purgation, cold to the head, and quiet. When the sleepy stage passes off, the patient is left weary, torpid, unfit for mental effort, and often with distressing headache. These are the symptoms of the convalescent stage, and they may last more or less for a considerable time. The patient should still be kept carefully quiet, no stimulants should be allowed, and purgatives should occasionally be used. Some of the symptoms present during the stage of convalescence may persist so long that they may rank rather as sequelæ. Thus there may be for years nervousness, inaptitude for business, liability to headache, and peculiar susceptibility to the influence of stimulants. As a rule, however, even after very severe concussions, no such ill-results are left, but the patient regains after a time perfect cerebral health. This remark must, however, not be held to apply to concussion when received in railway accidents; for in these cases there is a prospect of pecuniary compensation, and the sequelæ are often severe, prolonged, and very peculiar.

Jonathan Hutchinson.

BRAIN, Congestion of. *See* Brain, Hyperæmia of.

BRAIN, Hæmorrhage into. — Synon.: *Cerebral Apoplexy*; Fr. *Hemorrhagie cérébrale interstitielle*; Ger. *Hirnschlag*.

Definition.—Escape of blood, by rupture of a vessel, into the substance or cavities of the brain. Hæmorrhage into the meninges is separately described.

Cerebral hæmorrhage is commonly due to the rupture of an artery, very rarely to that of a vein. Occasionally, minute extravasations are caused by rupture of capillaries. Hæmorrhage from arteries or veins may also be due to their laceration by injury.

Ætiology.—Arterial hæmorrhage is usually due to the coincidence of weakened vascular wall and increased pressure within the vessel. The causes of these states may be regarded as the conditions *predisposing* to cerebral hæmorrhage. Hereditary influence is sometimes distinctly seen, as a tendency to vascular degeneration, or to conditions which, as renal disease, produce such degeneration. Similarity of vascular distribution may also be inherited, and may determine the locality of strain, and, therefore, first of degeneration, and ultimately of rupture. Cerebral hæmorrhage is most frequent after fifty years of age, but occurs at any age, though rare during the first half of life. It is nearly twice as common in men as in women. It is said to be more frequent in temperate than in tropical climates, in winter than in summer, and at high than at low elevations. Certain acquired conditions act as predisposing causes. Chronic Bright's disease leads to early and extreme degeneration of vessels, as well as directly to hypertrophy of the heart and increased blood-pressure: hence it predisposes powerfully to cerebral hæmorrhage. In purpura and scurvy, cerebral hæmorrhage occasionally occurs—it is said in consequence of acute vascular degeneration and increased blood-tension. The state of vascular repletion known as plethora was formerly thought to be a frequent cause of cerebral hæmorrhage. It probably does aid other causes, but rarely co-exists with the most efficient, and so takes a very subordinate position. Chronic alcoholism and opium-eating are said to promote vascular degeneration.

The *proximate* causes of cerebral hæmorrhage are the weakened state of the wall of the vessel, and commonly some increase of blood-pressure. The vessel-wall is weakened by degeneration, and is often imperfectly supported in an atrophied brain. The increase of pressure within the vessels may be permanent, as in peripheral obstruction, with or without hypertrophy of the heart; or temporary, as in excited action of heart, or impeded circulation during effort. These causes are considered more fully in the article on Brain, Vessels of, Diseases of.

Hæmorrhage from a vein is rare, except as the result of laceration by direct injury, or of ulceration invading the vein secondarily. Varicose veins in the pia mater may sometimes rupture (Andral).

Capillary hæmorrhage is usually due to venous obstruction, especially to thrombosis in a vein.

Anatomical Appearances.—In intra-cerebral hæmorrhage, the blood is extravasated into the substance or into the ventricles of the brain—into the latter usually by rupture of a previous extravasation within the cerebral substance. In the latter situation the blood occupies a cavity formed by laceration of the brain-tissue; rarely, when very minute and 'capillary,' by merely separating the fibres. In size an extravasation varies from that of a pea or even smaller, up to that of the fist. The blood is clotted, and reddish-black in colour; and fragments of brain-tissue are mingled with it. The cavity containing it is often very irregular in shape; its walls are uneven, present projecting shreds of lacerated brain-substance, and are blood-stained and softened—at first by imbibition of serum, and later by inflammation. Many small extravasations are often seen in the neighbourhood of a larger clot. Usually there is only one large extravasation: sometimes, however, there are two or three. The extravasated blood exercises pressure; the convolutions are flattened; the falx is bulged to the opposite side (Hughlings Jackson, Hutchinson); and the rest of the hemisphere is anæmic. The effused blood may tear its way into the lateral ventricle; it then speedily distends both lateral ventricles and the third and fourth ventricles, and escapes by the openings at the lower extremity of the fourth ventricle, central and lateral, into the subarachnoid space. Or the blood may escape to the surface, infiltrate the pia mater, and tear its way into the subarachnoid cavity, often by a very small opening. It is rarely that the artery from which the blood has escaped can be detected. Occasionally the extravasation can be traced to the rupture of an aneurism of some size. In other cases miliary aneurisms may be found on many vessels. The larger arteries commonly present atheromatous changes.

After a time the extravasated blood undergoes changes. The clot shrinks and gradually becomes, first chocolate, then brown, and ultimately a reddish-yellow; and it then contains chiefly fat-globules, pigment and other granules, and hæmatoidin crystals. The rapidity with which it undergoes this change is doubtful, and certainly varies. It is said that the distinctive blood-colour has disappeared as early as the twentieth day. Meanwhile the walls of the cavity undergo changes. The inflammation, in rare cases excessive and purulent, is usually conservative, and leads to the formation of connective tissue. A firm wall is thus developed, the inner surface of which becomes smooth by the softening and removal of the loose fragments of brain-substance; by this means a cyst is formed. It is said that connective tissue may extend across its cavity, and that in rare cases, the fluid being absorbed, the cyst walls may unite, and a cicatrix result. Such cicatrices are, however, much more frequently due to softening than to hæmorrhage. It is asserted that a cyst may be developed in thirty or forty days under favourable conditions.

Hæmorrhage may occur in any part of the brain, but is more frequent in some situations than in others. The most frequent seat is the corpus striatum and the region just outside it: nearly half the intra-cerebral hæmorrhages are in this situation. Other primary seats, in the order of frequency, are the pons and peduncles, the cerebellum, the cortex, the optic thalamus (often affected by an extension of the hæmorrhage from the corpus striatum), the posterior portion, and the anterior portion of the hemisphere. The frequent extravasation into and outside the corpus striatum, is explained by the vascular supply. (*See* BRAIN, Vessels of, Diseases of.)

Traumatic hæmorrhage occurs into and from a lacerated portion of brain, and is most frequently found on the surface, occupying mainly the middle of the convex portion of each convolution, and some other regions much exposed to injury, as the surface of the temporo-sphenoidal lobe, and the under surface of the frontal lobe. Ventricular hæmorrhage sometimes results from traumatic rupture of a small vein on the surface of the corpus striatum (Prescott Hewett).

Soft tumours (especially glioma) are sometimes the seat of hæmorrhage. The distinction from simple hæmorrhage (sometimes difficult) rests on their position being commonly one in which cerebral hæmorrhage is rare; and on some gelatinous-looking tumour-substance being found, into which hæmorrhage has not occurred, and which has characteristic microscopic features.

Other organs may be healthy, or present the changes which have been mentioned as predisposing causes; the lungs are usually secondarily congested, often intensely.

SYMPTOMS.—The occurrence of cerebral hæmorrhage is indicated by cerebral symptoms of two classes, the one general and more or less transient, the other local and more or less permanent. In addition to these there are sometimes premonitory symptoms; and commonly general symptoms manifested by pulse, temperature, &c., which are secondary to the brain-lesion.

Premonitory symptoms, somewhat rare, are those of altered cerebral function due to local vascular disease, headache, vertiginous feelings, local weakness or numbness, slight mental changes, and slight affection of speech (*see* BRAIN, Vessels of, Diseases of, and BRAIN, Anæmia of). They are less frequent than in cases of softening, and more commonly precede cerebral hæmorrhage in the old than in the young and middle-aged.

The *onset* of hæmorrhage is usually accompanied with apoplexy, *i.e.* loss of consciousness and of power of motion and of sensation, often with relaxation of the sphincters and loss of reflex action (*see* APOPLEXY, CEREBRAL). These symptoms are profound and lasting according to the size of the hæmorrhage and its position; being especially marked in large and double effusions, in intraventricular hæmorrhage, and in hæmorrhage into the pons. In a case of moderate severity they last only a few hours, and gradually pass away. In severer cases they may deepen until death occurs from failure of respiratory power. Death is rarely very speedy, life being usually prolonged for some hours even in the most rapidly fatal cases. In rare instances of hæmorrhage into the medulla, and also in meningeal hæmorrhage, death has occurred in five minutes, probably in each case from the rapid interference with the respiratory centre.

The temperature is at first lowered one or two degrees, the pulse becomes less frequent, and the respiration slow. The Cheyne-Stokes respiratory rhythm often precedes death. After a few hours the temperature rises to the normal and in mild cases stops there, but in graver cases it rises above the normal two or three degrees. In some very grave cases the initial fall or subsequent rise may be extreme and go on until death occurs, sometimes reaching 90° in the one case, and 107° or 108° in the other (Bourneville).

In slight cases of cerebral hæmorrhage there may be no loss of consciousness. Vomiting in such cases is not unfrequent. In other rare cases of large hæmorrhage, especially between the external capsule of the corpus striatum and the island of Reil (Broadbent), the loss of consciousness comes on gradually, after other symptoms, as of shock, for example, have lasted for an hour or two. These cases have been termed *ingravescent*.

Local symptoms, often permanent, and always of longer duration than the loss of consciousness, are present in all cases of circumscribed cerebral hæmorrhage, except in the rare instances in which, by its central position in the pons and medulla, it causes directly bilateral effects only, which are added to and intensify the general symptoms caused indirectly. In a unilateral cerebral lesion, the direct symptoms are unilateral loss of power of voluntary movement and often of sensation, accompanied sometimes with convulsion or rigidity. These local symptoms may commence a few minutes or longer before the loss of consciousness. They coexist with the apoplectic condition, and may often be recognised, even during coma, by the flaccidity of the paralysed limbs, which fall more helplessly than those of the opposite side; by inequality of the mouth and of the pupils; by conjugate deviation of the head and eyes towards the side of the brain injured; by convulsive movements; and, as the apoplexy clears, by the detection of unilateral defect of sensibility. The coma passing away, these signs become more distinct, and all the symptoms of hemiplegia remain, varying in intensity and extent according to the position of the lesion. The apoplectic state may recur after its disappearance—a grave symptom, usually indicating that a fresh hæmorrhage has occurred in the same or the other side of the brain, or more frequently that the blood has escaped into the ventricles. In the former case the unilateral symptoms, conjugate deviation of the head and eyes, &c., are increased on the same, or transferred to the opposite side; in the latter the unilateral symptoms disappear, and general powerlessness and deep coma supervene, with stertor, relaxation of the sphincters, lowered temperature, and impeded respiration. Death always ensues.

Convulsion may be a conspicuous symptom at the onset or subsequently. It is usually unilateral in its course or commencement, beginning on the side paralysed, rarely affecting only the non-paralysed side. Where convulsion is not met with, muscular twitching or rigidity may occur. General or widely-spread rigidity or twitching points to a bilateral lesion; if with coma, to ventricular hæmorrhage.

After a day or two symptoms of irritation about the cerebral lesion come on, such as headache, delirium, and rigidity in the paralysed limbs. During this period the temperature rises above the normal, and the pulse becomes quick. On their subsidence, these symptoms, if the lesion is slight, may be scarcely recognisable, and a stationary period ensues, at the end of which recovery of power over the paralysed limbs begins. In slight cases power may be recovered very speedily. Its return depends upon the structural recovery of slightly damaged tissue, and on other parts taking on an increased function in compensation for that which is destroyed. The electric irritability of the muscles exhibits little change. Sometimes, however, when there is great irritation at the lesion propagated downwards to the cord, a marked initial increase in irritability may precede a considerable depression, coincident with rapid wasting. Recovery of power is rarely complete except in those cases in which the area of damage is very small; and when the damage is large and affects an important motor region, there may be no recovery, loss of power persisting, commonly with more or less 'late rigidity' in the paralysed limbs. Slight permanent mental change often remains, and as the motor power is recovered, ataxic and other disorders of movement may supervene in the limbs which were paralysed, although much less commonly than after softening.

Diagnosis.—The diagnosis of cerebral hæmorrhage rests on the symptoms of a localised cerebral lesion, occurring suddenly. The conditions from which it has most commonly to be distinguished are—congestion of the brain; softening of the brain, embolic and thrombic; and, sometimes, tumour. For the distinction from it of other causes of apoplectic loss of consciousness, uræmia, post-epileptic coma, &c. *see* Apoplexy, Cerebral. From *congestion* the chief distinction of cerebral hæmorrhage lies in the transient nature of the loss of consciousness; and in the slightness and general character of the symptoms which characterise the former. Congestion generally, hæmorrhage only sometimes, comes on during effort: and the absence of history of effort is in favour of the latter. Similarly, the premonitory symptoms which are usually present in congestion, are generally absent in hæmorrhage. The loss of motor power, and the symptoms of cerebral shock, are much greater in hæmorrhage than in congestion. It must be remembered that the two states frequently coexist. From *softening* consequent on *embolism* cerebral hæmorrhage has also to be distinguished. The subjects of the latter are usually of an earlier age than those of hæmorrhage; their vessels are healthy, but they have organic heart-disease, which is often grave. There may be evidence of embolism elsewhere, in spleen, kidney, or retina. Loss of consciousness may be absent in embolism, and the paralysis often comes on deliberately. An extensive capillary embolism, causing deep coma, cannot be distinguished from hæmorrhage. From *softening* due to *thrombosis* the distinction is often difficult. Age, and the state of the vessels, no longer serve as guides. The presence of chronic Bright's disease is in favour of hæmorrhage. The occurrence of previous hemiplegic attacks points to softening. In the attack, loss of consciousness is much more considerable, in proportion to the subsequent paralysis, in hæmorrhage than in softening. But the distinction on this ground is often very difficult, since loss of consciousness may be absent in slight hæmorrhage, and considerable in an extensive softening. A deliberate onset is in favour of softening, and so are much mental change and early rigidity. Paralysis of sudden onset, in cases of *tumour*, may be ascribed to hæmorrhage, to which it is indeed sometimes, but not always, due. Usually, enquiry elicits a history of gradual, long-continued symptoms; intense headache and optic neuritis are strongly suggestive of tumour.

Hæmorrhage into the substance of the brain is distinguished from *meningeal hæmorrhage* by the pain and mental excitement being less conspicuous, convulsion rarer, and by the presence of symptoms of a local lesion. *Hæmorrhage into the ventricles*, which resembles meningeal hæmorrhage in the generality of its symptoms, is usually distinguished by succeeding the symptoms of a circumscribed lesion.

Prognosis. — During the attack itself the prognosis in hæmorrhage into the brain must be guided by the intensity of the symptoms, and by the place of the lesion, as far as that can be ascertained. Death is probable if the coma is profound or long-continued, and if the early depression, or the subsequent rise of temperature and pulse-rate is great. When the symptoms indicate ventricular hæmorrhage, or hæmorrhage into the pons, the patient will certainly die. Consciousness being recovered, and the danger of immediate death over, the freedom from much secondary pyrexia, from lung-congestion, and from bedsores, are favourable indications. The chance of recovery from the paralysis is estimated by evidence of position of the lesion, and by any indications of improvement. Early contraction of the flexors is unfavourable. The danger of recurrence is in proportion to the extent of vascular disease, and the existence of irremovable causes of increased arterial tension. Hence the prognosis is rendered unfavourable by advanced age, or chronic renal disease, and by the evidence of general premature decay.

Treatment.—*During the attack.* Rest is the most important. The patient should remain, as far as possible, where he is seized; stillness must be secured: and all effort is to be avoided. The posture should be recumbent, with the head raised. Any cause of passive cerebral congestion, such as a tight collar, must be looked for and removed. Venesection was formerly almost always employed in such cases—certainly too universally; but it is now quite discarded—perhaps too absolutely. Loss of blood lessens the force of the heart and vascular tension; it thus hastens the cessation of external bleeding. Doubtless it acts in the same way in internal hæmorrhage. It may be used with probable advantage if the arterial tension is great (that is if the pulse is incompressible), the heart acting strongly, and there is reason to believe that the intra-cranial hæmorrhage is increasing. A small quantity of blood should be taken rapidly. In ventricular hæmorrhage, venesection is probably powerless for good. It should not be employed where there is any evidence of failing heart-power. Its indications are drawn as much from the state of the patient as from the fact of hæmorrhage. Bright's disease is no contra-indication.

If bleeding is not employed, the objects to be aimed at by other measures must be to divert the blood as far as possible from the brain, by relaxing the systemic vessels, while endeavouring to obtain contraction of the cerebral vessels. Warmth may be applied to the limbs, aided by sinapisms. Dry-cupping to the surface, and purgatives, as croton oil, will divert the blood to the surface, or to the capacious intestinal vessels. Drugs which would cause contraction of the vessels are to be avoided, since their influence being on the smallest vessels and universal, their tendency is to increase arterial tension and hæmorrhage. Contraction of encephalic vessels may be furthered by cold to the head or sinapisms to the neck, according as the head is hotter or colder than normal. The heart should be allowed to fall a little below the normal in force, but failure of power must be warded off by stimulants given with great care. Convulsion is more effectually checked by cold than by bromides; the latter may be given if the convulsion recurs.

After the attack.—During the stage of irritation, rest must be maintained, and all sources of annoyance must be avoided. The bowels should be kept gently open by laxatives or by injections. Stimulants must be avoided, and the diet should be light. Pain may be relieved by cold to the head, a blister to the neck, or by Indian hemp or by bromide of potassium.

During reparation the diet must be nutritious, but carefully regulated; and constipation of the bowels must be avoided. Rubbing of the limbs, and their gentle exercise, will aid their recovery, and after the symptoms of irritation have passed, faradisation will improve muscular nutrition, and is especially indicated where rapid loss of irritability indicates probable wasting. Nervine tonics are useful; none more so than a combination of hypophosphite of soda and tincture of nux vomica. In anæmia the syrup of the phosphate of iron is good. Warmth, change of scene, and cheerful mental surroundings are useful adjuncts, especially in the later stages of recovery. W. R. GOWERS.

BRAIN, Hyperæmia of.—SYNON.: Congestion of the brain.

DEFINITION.—Increase in the quantity of blood within the capillaries of the brain.

Since neither the arteries nor the veins of the brain-substance can be over-distended with blood without capillary hyperæmia, and since it is to capillary hyperæmia that the functional disturbance of the brain is related, this may be justly taken as the essential pathological element in cerebral congestion. The congestion may be *active*, when the capillaries contain, in consequence of arterial distension or dilatation, oxygenated blood passing rapidly through them; or it may be *passive*, when, from venous obstruction, the capillaries contain slowly-moving blood, becoming, and in great part already, venous.

ÆTIOLOGY.—(A) *Active* congestion of the brain may be *general* or *partial*. Of the *general* form the *remote* causes are as follows:—Men are said to be more liable to it than women. Age increases its frequency (but this is more true of the passive form); yet children, from the sensitiveness of their vaso-motor system, occasionally suffer from active cerebral congestion. Heredity has only an indirect influence. The plethoric condition is a powerful predisponent. The *immediate* causes of excessive flow through the arteries of the brain may be thus stated—(1) Increase in the blood-pressure—either general, from excessive action of the heart (as in extreme hypertrophy or functional overaction); or partial, from an obstruction elsewhere, throwing an undue proportion of the pressure upon the cerebral vessels. This is seen in contraction of the aorta beyond the origin of the vessels to the head, and in sudden contraction of a large number of the systemic arterioles, as those of the surface, in exposure to cold and in ague. (2) Active arterial dilatation of vaso-motor origin may result from prolonged mental work, severe moral emotion, insolation, digestive disturbances, or from the presence in the blood of various poisons, such as alcohol and amyl-nitrite. In these cases the vaso-motor disturbance may precede and cause, or may succeed and result from the overaction of the brain-tissue, which is intensified by it. In acute alcoholic poisoning the cerebral congestion is, as Niemeyer suggests, probably secondary to the disturbance of brain-tissue; in chronic alcoholism it may possibly be primary. In pyrexia the headache and delirium have been thought to be due to congestion, but this is not certain. (3) Increased atmospheric pressure may cause congestion of the brain. (4) And, lastly, gravitation in the recumbent posture may alone cause cerebral hyperæmia, or may powerfully aid other causes in producing it.

Partial active congestion of brain-tissue occurs chiefly along with disease of the arteries, which perverts blood-pressure; in organic brain-diseases, as tumour, hæmorrhage, &c.; and after blows on the head.

(B) *Passive* congestion of the brain, when *general*, is the result of impeded return of blood from the head. It may be due to pressure on the veins in the neck, as by tumours or tight collars; pressure on the innominate veins by tumours or aneurism; or obstruction to the circulation from violent respiratory efforts, as cough or blowing wind-instruments. It may be caused by impediments within the circulation, such as tricuspid insufficiency and its causes in the lungs, or disease on the left side of the heart. The recumbent posture assists all these influences. In arterial obstruction from diseased vessels, a weak heart, insufficient to overcome the obstruction, may permit venous stasis, but the capillary condition is one of anæmia.

Partial passive congestion may occur from thrombosis in a cerebral vein, or from pressure by a growth on one of the cerebral sinuses.

ANATOMICAL APPEARANCES.—The capillaries are not visible to the naked eye even when over distended, but with the microscope they are seen to be dilated, often to twice their normal calibre. Their distension is indicated by a deeper tint of the grey substance; and the fullness of the small arteries and veins shows itself in an increase, often very great, in the number and size of the red points visible on section of the white matter. In active congestion the arteries are said to be distinctly larger than normal, and their perivascular spaces lessened in size; the minute vessels of the meninges are distended. In passive congestion the veins and sinuses are gorged with blood. It must be remembered, however, that such engorgement of the veins occurs in all cases of death from interference with respiration, and that the vessels of the most dependent portion are always fullest. The state of the cerebral veins must therefore be carefully compared with that of the veins of other organs. Active congestion may sometimes leave no visible traces. After a time blood-pigment collects outside the vessels (Bastian), and serous effusion into the pia mater may be found; and after long-continued congestion, the vessels may be permanently distended; the spaces in which they run are increased in size. Such increase is common apart from pathological congestion, but it is so great in some cases of long-continued congestion that this effect cannot (with Moxon) be altogether denied.

Symptoms.—It is probable that many symptoms have been erroneously ascribed to cerebral congestion, some because hyperæmia, due to the mode of death, was found *post mortem*, others because an assumed congestion was the readiest mode of explanation. Moxon has indeed maintained that cerebral hyperæmia never causes symptoms except perhaps in death from strangulation. It is doubtful whether our knowledge of the conditions of the cerebral circulation is sufficiently exact to justify this conclusion, which is difficult to reconcile with clinical facts.

The symptoms commonly referred to cerebral congestion may be grouped in two classes—those of excitement and those of depression. Either of these may exist alone; those of excitement may precede those of depression; or they may partially co-exist. They may be slight or severe; acute or chronic. In all cases they are increased by the recumbent posture or by depressing the head, by expiration, and by effort; and they are usually aggravated by constipation, and by indulgence in alcohol.

In *general* cerebral hyperæmia, among the symptoms of excitement may be mentioned mental irritability; headache—slight or violent, with feelings of fulness or throbbing in the head, and vertiginous or other unpleasant sensations; increased or perverted functions of the organs of special sense, such as flashes of light and noises in the ears; contraction of the pupils; sleeplessness, restlessness, startings, twitchings or slight actual convulsions; and mental excitement. The pulse is quick. There may be vomiting. The face varies, participating in the congestions of circulatory origin, and in some of vaso-motor disturbance, such as that which may occur during digestion. In other forms of supposed congestion of vaso-motor mechanism, as in those which result from excessive brainwork, the face may be pale, but the nature of these cases is doubtful.

Among symptoms of depressed brain-function, are dullness of the special senses; motor weakness; mental indifference and slowness; somnolence, especially after meals; dilatation of the pupils; and infrequency of the heart's action. Consciousness may be lost suddenly, and the loss, it is commonly believed, may deepen into coma. As a rule there is no fever, but in children the temperature may be raised a degree or so.

In the *chronic* forms of cerebral congestion, these symptoms, variously grouped and moderate in degree, continue for days, weeks, or months. Their course is marked by great variability. Durand-Fardel has pointed out that in these cases there is often much viscid secretion of the conjunctiva.

In the more *acute* forms of cerebral congestion, the symptoms of muscular spasm, of mental disturbance, or of loss of consciousness, may be so predominant as to give a special character to the attack:—

In the *convulsive* form pain or uneasiness in the head commonly precedes the muscular spasm. The latter is usually slight. Consciousness may or may not be lost.

The *delirious* form is seen under two aspects—(1) in old age, after emotional excitement; in this the wandering is slight, and often related distinctly to the recumbent posture; (2) a much more violent delirium, which is apparently related to cerebral congestion, and is seen sometimes after mental work or emotional excitement, or after alcoholic poisoning. Occasionally death results.

The *apoplectic* form is marked by sudden loss of consciousness, occurring commonly during effort. The unconsciousness usually lasts only a few minutes, and incomplete general weakness remains for a day or two. In rare cases the loss of consciousness deepens into coma, with stertorous breathing and relaxed sphincters, and death may occur from the extension of the cerebral depression to the respiratory centres. *Vertiginous* sensations sometimes give a character to an attack.

In children congestion of the brain is a rare but occasional cause of convulsion or delirium. Headache and contracted pupils make up a group of symptoms resembling meningitis, but fever is rarely present, and if it exists it is slight, and the symptoms usually come on suddenly and pass away in a day or two.

Partial hyperæmia leads to localised symptoms of excitement or depression. Local convulsion or paralysis may result. Headache is often intense and localised. If nothing more than congestion is present, the symptoms usually soon pass off.

Pathology.—The pathology of cerebral congestion is still obscure, since we know little of the relative part played by the blood-vessels and the nerve-elements in determining the symptoms and their form. An excessive supply of arterial blood is, in all organs, attended with functional activity, and it is easy to understand that active congestion should result in symptoms of excitement. Subsequent depression of function has been accounted for by inferring compression of brain-tissue by effused serum. The reaction of exhaustion may contribute. In passive congestion the nerve-tissue is imperfectly supplied with oxygenated blood, and compressed by distended vessels, and its functions are impaired by the presence of effete products. Hence the predominance of symptoms of depression over those of irritation.

Diagnosis.—The diagnosis rests on the discovery of circulatory and other causes of cerebral congestion; on the circumstances of posture, effort, &c., under which the symptoms came on; on the existence of concomitant congestion in other parts supplied by the carotids, as the face (by no means invariable); on the diffusion of the symptoms; on their speedy disappearance; and on the absence, in the adult at any rate, of elevation of temperature. The diagnosis of the special forms of cerebral congestion from the diseases which they most resemble is considered under the head of those diseases.

Prognosis.—The prognosis is generally immediately favourable, but from a severe attack death may probably occur. The apoplectic form is most dangerous, the convulsive least so. Degenerated weakened vessels render the immediate prognosis less favourable. After many attacks, permanent nutritive changes in the brain supervene.

Treatment.—The most important elements in the treatment of cerebral congestion are posture, removal of blood, purgation, cold to the head, and warm and stimulating applications to the surface. Whatever be the cause, it is important to raise the patient's head, so that gravitation may impede the flow and aid the return of the blood. By this means alone insomnia from hyperæmia may often be prevented. The removal of blood is useful in extreme forms of congestion, either active or passive, especially in those forms of active congestion in which the face participates. Venesection or leeching may be employed according to the severity of the attack; in active congestion the blood which is taken should be removed quickly. The relief which in such cases follows an epistaxis illustrates the value of this method of treatment. It is not advisable in those cases in which, from overaction of brain-tissue, or from cold to the surface, dilatation of the cerebral vessels results, while the face remains pale. In all forms of congestion, purgation is useful. It removes from the blood some of its serum, and it affords immediate relief to the cerebral circulation, by causing an afflux of blood to the capacious intestinal vessels. In plethoric states diuresis is also most useful, and has succeeded where venesection and purgation failed (Reynolds). Cold to the head is of most value in reflex or secondary dilatation of the cerebral vessels, as after mental work, insolation, fatigue, and some toxæmic states. In the same class of cases, stimulation of the peripheral nerves by sinapisms, blisters, &c., applied to the neck, will, by reflex influence, assist in obtaining arterial contraction. Hot applications to the limbs act in part in a similar manner, in part by causing local afflux of blood and thus lessening the tendency to encephalic engorgement. They are most useful in active congestion. Alcohol and opium must be avoided in all forms of active congestion, but in passive congestion they may be of service. Bromide of potassium is useful in those cases in which the congestion is produced by vaso-motor mechanism, excited either by stimulation of brain-tissue or of distant nerves. In passive congestion from heart-disease the treatment is that of the cardiac condition. All persons liable to congestion of the brain should live regularly, avoid hot rooms, and attend carefully to the stomach and bowels, relieving the latter by frequent moderate purgation.

W. R. Gowers.

BRAIN, Hypertrophy of.—Hypertrophy of brain is a misnomer. True hypertrophy would consist of increase in number or in size of the nerve-cells, nerve-tubes, connective stroma, and supplying vessels: and there might be expected, as a result of this condition, some manifestation of a higher intellectual development. Such a condition is never found. A so-called hypertrophied brain is one that is larger and heavier than normal. On removing the skull-cap, the encephalon seems to expand, so as to render it difficult to affix the bone-covering in its place; the membranes are dry, the sulci have nearly disappeared, and the whole organ appears pale and bloodless. On section there is a sensation of toughness, though less in degree than in a case of general sclerosis. There is no sign of pressure upon the orbital plates, such as is met with in chronic hydrocephalus. The lesion affects only the cerebral hemispheres, especially on the convex surface, and perhaps the posterior lobes in particular. The base of the brain and the cerebellum are unaffected except by pressure.

On minute examination, the nerve-cells and nerve-fibres, far from being found augmented in number or in size, may even be compressed and diminished; and there is often also some interference with the normal calibre of the vessels. Gintrac, however, records a case in which the calibre of the nerve-tubes was almost double that of the normal. What increase there is affects the white matter of the brain, and this structure is very pale and of an elastic consistence. The real and sole lesion is hyperplasia of the connective tissue. It differs from sclerosis in affecting the cerebral hemispheres more universally than is the case with sclerosis; and also that in sclerosis there is not only increase of the connective tissue, but subsequent retraction, and, as a frequent consequence of this, an absolute destruction more or less of the nerve-elements of the organ. When the disease is far advanced it may possibly cause absorption of the inner table of the skull, and thus produce a roughness or thinning of the bone, or, in extreme cases, even perforation. The sinuses are generally distended with blood. Hypertrophy of smaller portions of the brain is rare: still various cases are on record in which, under the name of neuromata of the nervous centres, white or grey matter has been found in certain parts of the brain over and above the normal constituents of this organ. Hyperplasia of the pineal gland is closely allied to glioma. It should be distinguished from encysted dropsy of that organ.

Ætiology.—Hypertrophy of the brain has been said to be sometimes secondary, and caused by the irritation of morbid growths. This, however, is rare. It is generally primary, and may be a disease of intra-uterine life; but it is generally developed after birth, especially in rickety children. Some forms of encephalocele, without hydrocephalus, seem to be due to the growth of compact masses of cerebral substance in excess of what is normal. The conditions for the production of this morbid state are infancy; bad diet; repeated congestion of the cerebral vessels, such as might be induced by frequent cough; and, perhaps, lead-poisoning.

Symptoms.—The symptoms of so-called general hypertrophy vary according as the sutures are closed or not. If, from insufficient occlusion of the sutures, the head expands in proportion to the increase in size of the encephalon, the symptoms may be very slight. Children thus affected show no intellectual hebetude. In them, as long as the abnormality is uncomplicated with local inflammation of membranes or with hæmorrhages, there may be no headache, no affection of sight, no sensory or motor paralysis, and no convulsions. Convulsions, however, are common in cases in which the occlusion of the sutures has prevented expansion of the head proportionate to the internal increase of tissue. In such cases also there is generally more or less motor paralysis, often some anæsthesia of the limbs, headache, vomiting, and mental hebetude—symptoms, in fact, either of marked interference with the intra-cranial circulation, or of irritation from inflammatory complications. The prognosis is always bad, but in rachitic cases the course may be chronic.

Treatment.—All treatment seems to be ineffective in diminishing cerebral hypertrophy.

E. Long Fox.

BRAIN, Inflammation of.—Synon.: Encephalitis.—Encephalitis is a term which ought perhaps to be strictly limited to inflammatory changes in the brain-substance itself, to the exclusion of all forms of meningitis. It may be either *diffuse* or *local*, but for our present purpose we have chiefly to do with the diffuse form. Local encephalitis will generally result in abscess (*see* Brain, Abscess of) and will usually be met with, if we put aside the results of injuries, in association either with disease of the ear, with tubercular growths, or with pyæmic deposits.

It may perhaps be doubted whether the occurrence of diffuse inflammation of the brain-substance as an acute disease has as yet been proved, excepting as a result of wounds. Even as a traumatic lesion, its special features have by no means been accurately studied. It is, however, highly probable that after penetrating wounds of the brain, its substance may inflame, just as the cellular tissue of a limb may, the inflammatory processes beginning at the site of the wound and rapidly spreading through a large part of the hemisphere. It is probably in the perivascular spaces that the process chiefly spreads, and it is in these that the microscope will detect the most abundant results. Such a condition of diffuse encephalitis may exist without there being any visible changes in the brain. It may perhaps be a little softened or a little congested, but very probably there is nothing about which the most experienced pathologist could feel certain until the microscope is resorted to.

Symptoms.—It is not possible, in the present state of our knowledge, to speak with any certainty of the symptoms of diffuse encephalitis. They will vary, of course, with the region affected; and disturbance of function, followed by more or less complete loss, will be the most frequent occurrences.

Treatment.—When the symptoms of encephalitis are once recognised, it will usually be too late for treatment, and measures of prevention are those of chief importance. The early use of mercury, beginning in anticipation of, rather than waiting for symptoms, is probably the most important; and next to it come cold to the head, purgatives, and counter-irritation.

Jonathan Hutchinson.

BRAIN, Laceration of.—In the more strict sense of the word, the brain is but little liable to laceration from injury. Yet, in connection with injuries, such as penetrating wounds of the skull, fractures with great depression of bone, and even with violent concussions, the brain-substance is not unfrequently, to some extent, torn. In so soft a structure, however, and under the influence of modes of violence which are usually rather of the nature of blows than of anything likely to cause stretching, we rarely meet with results comparable to laceration of any of the firmer textures of the body. Whenever the brain is 'lacerated' it is also contused, and the contusion often extends widely around the rent, and is by far the more important lesion. In the peripheral parts of the brain-mass this is especially true, and it is of little practical use to speak of lacerations excepting as complications of very severe contusions. In the central parts, the crura especially, we meet now and then with a laceration properly so called, and it is not very infrequent to find the trunks of single nerves torn across. The consideration of those forms of laceration which are produced by the effusion of blood from ruptured vessels of size sufficient to supply a stream forcible enough to break up the surrounding substance, will be found in the articles Apoplexy, Cerebral; and Brain, Hæmorrhage into.

In the case of injuries to the head from falls or blows without perforation, certain definite parts are prone to suffer from contusion and laceration. Usually some slight evidence of injury is found immediately beneath the part of the skull upon which the blow was received, but by far the chief bruising will be at the opposite point. If the occiput be struck, the anterior lobes will be contused; and if one parietal eminence, the opposite sphenoidal lobe. This law, however, is greatly modified by the differing conditions under which different parts of the brain-mass are placed as regards their surroundings. In the posterior half of the skull the brain-mass is bulky, and between its hinder lobes and the cerebellum is a strong flexible membrane, well calculated to break vibrations gradually, and thus to prevent contusion. Nor are there in these regions any strongly marked bony ridges against which the brain might be dashed. These conditions are reversed as regards the anterior lobes and the middle lobes, and the consequence is that whilst severe contusions are often seen in the latter, they are much more rare in the cerebellum and posterior two-thirds of the brain-mass. In cases of compound fracture, with tearing of the dura mater, and deep depression of bone, the brain-substance may, of course, be injured at any part; but even in respect to this kind of violence the hinder regions of the skull are specially protected.

Symptoms.—We know enough of surface-lacerations of the brain in parts other than the anterior and middle lobes, to be able to assert that, unless the lesion extend very widely or deeply, it does not reveal itself by any special symptoms. If very extensive, weakness of the opposite limbs and side of the face is usually observed. Injury to the anterior lobes, unless extensive, cannot be diagnosed, but it may be guessed at in a few cases where the sense of smell is lost in one or both nostrils; for it is very common for the olfactory bulbs to be damaged at the same time. If the anterior lobes are severely lacerated, the symptoms will be those of very severe concussion, with the difference that the insensibility is more nearly complete, and that it increases instead of diminishing as the days pass on. When a sphenoidal lobe is contused there is usually, according to the writer's observation, incomplete hemiplegia of the opposite side, involving sensation as well as motion, and the face as well as the limbs. From these symptoms the patient may, in the course of months, wholly recover. It is usually the apex of the sphenoidal lobe which is lacerated, but if the lesion extends higher, and if it occur on the left side, aphasia may be present.

In connexion with recent discoveries (Dr. Hughlings Jackson, Dr. Ferrier, and others) as to localised functions, no doubt we shall be able before long to diagnose more accurately as to the precise regions injured. It would, however, as yet be premature to attempt to do so.

Treatment, and Prognosis.—In the treatment and prognosis of lacerations and contusions of the surface of the brain, much depends upon whether or not the case is complicated by compound fracture and the admission of air. If air have been admitted there is risk of meningitis or encephalitis, denoted in either case by the occurrence, within a few days of the injury, of hemiplegia of the opposite side. To prevent this must be the object of treatment. The scalp should be shaved, the wound closed with sutures as far as practicable, and lint wetted in a spirit-and-lead lotion should be laid over the part and systematically re-wetted every hour. If the case be treated in hospital it may be well, in addition to this, to wash the wound with the lotion before closing it, or to dress with Lister's antiseptic precautions. In cases of laceration without access of air death may ensue from diffuse softening around the part. If this happens the case will probably end within a week or ten days. It is probable that many cases of fractured base with more or less severe laceration of brain recover; in some with permanent paralysis, but in others without. It must be added that many of the cases in which death occurs within a few hours or a day or two after fracture of the base are attended by laceration. In these the symptoms are often difficult to distinguish from those of compression. Profound insensibility, a bloated face, stertorous breathing, and a full pulse, are often present, but they may be substituted by pallor and a feeble pulse in connection with great depression of the heart's action. If any deviation from symmetry as regards the paralysis of the limbs can be proved, it is in favour of laceration and against compression, but the differential diagnosis is a matter of extreme difficulty.

Laceration of Cranial Nerves.—Lacerations of single nerves within the cranial cavity are not by any means uncommon. This occurrence is to be suspected whenever the parts supplied by a cranial nerve are completely paralysed, without accompanying symptoms indicative of severe lesion of the brain-mass. Cases of laceration of the brain itself may be complicated by laceration of nerve-trunks, and thus the symptoms may become difficult to interpret with confidence.

Of single cranial nerves the olfactory bulbs are the most liable to suffer from contusion; and the third, fourth, and sixth nerve-trunks are those most frequently torn through.

Jonathan Hutchinson.

BRAIN, Malformations of.—The malformations of the cranium and its contents may be divided into two series:—A. Those which are scarcely compatible with life; and B. Those in which life is possible, although the intellectual power may be more or less modified from a healthy condition.

A. The *first* series will include at least seven forms, in all of which life is so rare that it is impossible to speak of more than the pathological anatomy.

1. *Dicephalia*—in which two heads are found upon a single body, or upon two bodies pretty extensively connected. In the first variety, one head may be attached to the vault of the palate of the other, or may be united to the convexity of the skull. In the second variety the heads may sometimes spring from a single neck. This dicephalous condition is frequently accompanied by malformation affecting the spinal column and spinal nerves, as well as by some incompleteness in the development of the brain.

2. *Monocephalia*—the union of two heads into one, on two separate bodies. The two cranial cavities are united into one. Dissection of the dura mater points to this membrane having been formed out of two, and in like manner the cranial contents are either double, or appear to be single from the union of double organs.

3. *Acephalia*—the complete absence of head. An acephalous monster is usually a twin; and when this is not the case, it is associated with the morbid condition of the uterus of the mother known by the name of uterine hydatids.

4. *Paracephalia*—the head not entirely wanting, but deprived of most of the cranium and of the face. A monster of this kind is generally a twin.

5. *Anencephalia.*—The absolute meaning of this term would be the absence of all cranial contents, but it is made to include certain vario-

ties, differing according to the amount of the encephalon developed. The aspect of the head, resembling that of a frog, the considerable projection of the eyes, the flattening of the forehead, and the absence of the cranial vault, are the chief characteristics of this abnormality.

In the first degree, there is absence of cerebrum, cerebellum, mesocephale, and spinal cord In cases of this kind the cranial vault is generally absent, and the bones at the base of the skull convex and thickened.

In the second degree, the cerebrum, cerebellum, and mesocephale are absent, but a portion of the spinal cord is found. This portion of cord is most usually the lower part.

In the third degree, the spinal cord is pretty complete, but there is still an absence of the cerebrum, cerebellum, and mesocephale.

A few cases have been recorded of the fourth degree, in which no cerebrum or cerebellum are found, but a normal spinal cord, and a pretty complete mesocephale.

In the fifth degree, the cerebrum alone is entirely or almost entirely absent, whilst the rest of the nervous centres are present, though not always in a perfectly complete condition. The seat of the absent cerebrum is often filled by fluid.

Lastly, one case has been recorded in which the cerebrum was present, whilst the cerebellum, mesocephale, and spinal cord were wanting.

Anencephalia, like the other previously mentioned malformations, is due to arrest of development, such arrest depending either on physical injuries to the uterus at a very early period of pregnancy, or to some mental shock experienced by the mother during the first two months after conception. It differs from acephalia, not only by the partial formation of the head, but by the presence of the heart, and other thoracic organs. The ganglia of the sympathetic are usually well-developed.

6. *Pseudencephalia.* In this malformation there is anencephalia *plus* a very considerable thickening of the meninges, which take the place and often imitate the aspect of the brain. Its varieties exactly correspond to those of anencephalia. The tumour formed by the development of the membranes is of variable size and position. It may be frontal, fronto-parietal, or occipital. The real seat of the lesion is the pia mater. The abnormality consists in extreme hypertrophy of this structure, with complete arrest in the development of the encephalon, or of some portion of it. Several observers have recognised certain vesicles in the interior of the membranous tumour, and these have been supposed to be cerebral cells in process of development. It is more in accordance with observation to believe with Giatrac that they are connected with the development of the choroid plexus.

7. *Cyclocephalia.* In this monstrosity there is an approximation or actual fusion of two eyes in a common orbit. It is connected with certain abnormalities in the brain, that militate against viability, or at least prolongation of life. The brain itself is generally more or less deficient, especially in its anterior and central portions, and in some cases the nose and mouth are very ill-developed.

B. The *second series* of cases owe their abnormal conditions to injury arising in the course of fœtal life; and some forms at least may be due to lesion occurring at a later period than in the first series.

8. *Atelencephalia*—incompleteness of brain or of membranes—is the chief of these forms. This incompleteness manifests itself in seven varieties according to the part of the encephalon injured by the lesion.

In the first variety, the dura mater is somewhat deficient, being altogether absent in certain situations at the base of the brain. The falx cerebri may be wanting, or from incomplete development it may seem perforated with holes; or the tentorium cerebelli may be absent. There are no symptoms which allow a positive diagnosis of any of these lesions during life.

In the second variety, there is general incompleteness of the brain, or imperfection of several portions of it at one and the same time. Whilst the cranial vault is thrown back, and the lower jaw is short, the base of the skull is large, the cerebral convolutions almost absent, and the cerebellum large. The head is almost always small, and it may present various irregular forms. This coincides with certain internal lesions, partial or general atrophy with consequent serous effusion under the membranes, inflammatory conditions, or thickening of the cranial bones and of the meninges. The incompleteness of the brain varies exceedingly, from a condition in which the whole brain is atrophied, to spots of deficiency, such as the absence of a single convolution, of the septum, or of the pineal gland. The symptoms will necessarily vary much according to the amount of cerebral incompleteness. Where this is general, affecting in some degree all the convolutions, the intellectual powers, as in the microcephalous Aztecs, will be very slightly developed, and their language of the very simplest form. With the brain still more imperfect, there is generally complete idiocy or a condition closely allied to it. The special senses are dulled, particularly sight and hearing. Speech is in abeyance, or is limited to monosyllables. There are various motor phenomena, such as muscular debility, hemiplegia, paraplegia, contraction, convulsion, loss of power over sphincters, dysphagia, vomiting, or feebleness of respiration.

The third variety includes incompleteness of the central parts of the brain. The corpus callosum, the septum, the fornix, the corpora striata, and the cornua ammonis may be imperfectly developed. The cerebral hemispheres may thus be in some sort fused together, and the shape of the ventricles altered. The symptoms differ from those of the preceding variety, in that the special senses are seldom involved; and that, although complete idiocy may accompany these lesions, it is more usual for the brain to be found capable of some slight intelligence, though unequal to the conception of abstract ideas.

In the fourth variety, the lateral portions of the brain are incomplete. This lesion generally occupies one side of the brain, leaving the other hemisphere intact. Several points in the hemisphere may be affected, or the whole of a single lobe. Most usually there is a depression occupying the seat of one or more convolutions. Such a lesion occasionally attacks the whole hemisphere, giving it the appearance of a large pouch filled with fluid. Sometimes also the neighbouring ventricle communicates with it; or there may be much ventricular effusion, with imperfect development of the corpus striatum, the optic thalamus, the cornua ammonis, the mamillary tubercle, the crus cerebri, and the optic and olfactory nerves of one side. In a considerable proportion of patients so affected, the lesion is accompanied by idiocy, and possibly the inability to speak is connected with this mental condition. Some few patients, however, possessed with some intelligence, have yet been unable to speak; this has been the case even when the lesion has existed on the right side. Deafness is rare; feebleness of sight, various forms of strabismus, and nystagmus common. Very frequently there is hemiplegia of the side opposite to the lesion, and certain other affections of the limbs,—emaciation, incomplete development, contraction, various deformities of the hands, &c. Sensation even in the paralysed limbs is normal; convulsions are not uncommon.

In the fifth variety, there is incompleteness of the anterior portion of the brain. Here both the anterior lobes are affected together. This condition may be associated with some deficiency of the corpus callosum, fornix, and corpora striata. Idiocy is not uncommon: mutism is the rule, but in some patients not idiotic a few words have been possible. Other phenomena—amaurosis, strabismus, and various motor abnormalities—have occurred so irregularly in these patients that it is probable they were symptoms not so much of this lesion as of certain further complications.

Incompleteness of the cerebellum forms the sixth variety. This is sometimes associated with a similar condition of one side of the brain. Usually one lateral lobe only is affected. General hydrocephalus is an occasional complication, and a collection of fluid under the tentorium cerebelli is very common. The symptoms are very negative. In general terms it may be said that there is no loss of muscular co-ordination, and no loss of sexual power.

In the seventh variety, there is incompleteness of the mesocephale and medulla oblongata. This is not carried very far. Certain modifications in form and volume are alone compatible with the preservation of life. It is not a common lesion, and has generally been associated with idiocy.

9. *Congenital hydrocephalus.* One variety of this congenital effusion of fluid is rare, viz., when the fluid is outside the dura mater, between this membrane and the pericranium, and the cranial bones are found floating in the midst of the fluid.

The second variety is that in which the fluid lies outside the brain. The writer believes that serous effusion in this position is not the cause of the atrophy, flattening, or induration of the subjacent cerebral organs, but the effect; that where fluid is found in this situation it is only the consequence of some one of the lesions already mentioned, notably atrophy of brain from whatever cause, and of atelencephalia. This view is, however, opposed to that of some authors.

The third variety is congenital hydrocephalus of the ventricles. In some such cases the increase in the size of the head occurs before birth; in others, not until after. The head increases rapidly in size in the first four weeks after birth. The sutures are widely separated, the cranial bones very thin, the integuments of the head injected, and the hair deficient. The muscles are badly developed, locomotion is imperfect, the intellect is generally obtuse, but the special senses are not particularly affected, unless it be that sight is deficient.

10. *Synencephalia* is merely a matter of pathological interest. The head of the fœtus is sometimes found adherent to the membranes or to the placenta, as a consequence of intra-uterine inflammation. At the point of adhesion the place of the cranial bone is taken by a thin vascular membrane. This condition is sometimes accompanied by, and indeed perhaps causes, encephalocele.

11. *Exencephalia.*—Here a large portion of the brain is situated outside the cavity of the cranium. Practically it includes all the other malformations of the brain that are yet to be spoken of. Thus, if only a limited portion of the brain finds its way outside the skull by an abnormal opening, the displacement is known by the name of *encephalocele*, or *hernia cerebri*; if this hernia coincide with a hydrocephalic condition of the ventricles, it is called *hydrencephalocele*; and if the hernia is composed not of the brain, but of the membranes, distended with fluid it may be, the lesion is called *meningocele* or *hydromeningocele*. Exencephalia proper may be subdivided into *frontal*, *sincipital*, and *occipital*, according to the direction taken by the extruded brain.

In encephalocele only a portion of the brain more or less limited is found outside the skull. The exit takes place most frequently at the occipital, and next in the frontal region; but the temporal and parietal regions are occasionally the seat of this lesion. The symptoms may be very negative. Encephalocele unless pressed upon externally is not often attended by convulsion or paralysis, by intellectual feebleness, or by difficulty of speech. This latter symptom is sometimes found when the hernia includes the cerebellum. Neither is this lesion incompatible with the prolongation of life. The chief diagnostic difficulty is the possibility of the tumour being cephalhæmatoma, but this is frequently situated over the parietal bones, an unusual position for encephalocele: and external pressure of the former tumour causes none of the cerebral phenomena—stupor, dilatation of pupils, paralysis, convulsion, so constantly seen from compression of an encephalocele. E. LONG FOX.

BRAIN, Malignant Diseases of. *See* BRAIN, Tumours and New Growths of.

BRAIN, Membranes or Meninges of.—*See* MENINGES, Diseases of.

BRAIN, Morbid Growths of. *See* BRAIN, Tumours and New Growths of.

BRAIN, Œdema of.—DEFINITION.—Infiltration of the brain and pia mater with serum.

ÆTIOLOGY AND PATHOLOGY.—In chronic maladies attended with general œdema, especially Bright's disease, fluid is effused around the brain. into the meshes of the pia mater and between the convolutions. Occasionally the cerebral substance is infiltrated, but this is uncommon. The perivascular canals afford a ready means of escape for effused serum, and in Bright's disease, at least, the substance of the brain often contrasts, by its firmness, with the condition of other organs. In senile atrophy of the brain the space between the shrunken convolutions is occupied by serum, and the ventricles contain an excess of fluid. The brain-tissue may appear to contain more fluid than usual in consequence of the distension by serum of the enlarged perivascular canals. In hyperæmia, especially passive, such as occurs in heart-disease, serum is commonly effused from the engorged vessels Such effusion is also common in insanity, especially in acute dementia. The serum may infiltrate the pia mater, distend the perivascular canals, and even infiltrate the brain-tissue.

The effusion of fluid in these cases is usually slight. Occasionally it is more considerable, and the cerebral substance may be enlarged, the convolutions being flattened, and the tissue much lessened in consistence. The same softening is seen in the neighbourhood of effusions of fluid into the ventricles; the brain-tissue for a depth of some lines from the ependyma being softened to a pulpy consistence. The post-mortem imbibition always increases the apparent amount of the œdema.

SYMPTOMS.—Little is known of the symptoms of œdema of the brain. The œdema is usually secondary to some other condition, the symptoms of which mask those of the œdema. General œdema seems attended by slow diminution of mental power and motor force. The effusion of serum in cases of congestion, and consequent pressure on the nerve-elements, has been considered as the cause of the symptoms of depression common in that condition. Cases occasionally occur in which effusion of serum into the ventricles and the pia mater is the only post-mortem condition to be found after an apoplectiform seizure, and such cases are often spoken of as instances of *serous apoplexy*. In so far as the effusion of serum is related to the apoplectic attack, it is probably merely as the consequence of a cerebral congestion which has left no recognisable post-mortem hyperæmia.

TREATMENT.—The treatment of cerebral œdema is usually secondary to the condition, commonly conspicuous enough, which is its cause,—Bright's disease, passive cerebral congestion, &c. If œdema be suspected where no causal indication for treatment exists, purgatives and diuretics, with iron if there be debility, are the remedies most likely to be of service.

The effusion of fluid into the ventricles is described under HYDROCEPHALUS.

W. R. GOWERS.

BRAIN, Sclerosis of. *See* SPINAL CORD, Diseases of.

BRAIN, Softening of.—DEFINITION.—A pathological state of brain-tissue, depending commonly on vascular obstruction; attended by diminished consistence, usually local; and indicated, during life, by mental, motor, and sensory symptoms, which vary according to the seat of the lesion.

ÆTIOLOGY.—Local softening of the brain, occurring during life, is due to one of two causes, inflammation or vascular obstruction. Most cases were formerly thought to be due to inflammation; but it is now known that very few are. The vascular obstruction, which is the usual cause of softening, may be arterial or, rarely, capillary; it may be due to a coagulum formed *in situ* (thrombosis), or to a plug of fibrin conveyed into the vessels by the blood (embolism). The predisposing and exciting causes of these conditions will therefore be those of softening of the brain (*see* BRAIN, Vessels of, Diseases of). The chief concomitant conditions are—in thrombosis, vascular degeneration; in embolism, valvular disease of the heart: and as predisposing conditions we usually find, in cases of thrombosis, advanced age, Bright's disease, chronic alcoholism, or syphilis; in cases of embolism, acute rheumatism, chorea, or scarlet fever. Senile vascular degeneration is the most common cause of all of softening of the brain, and hence the disease is met with most frequently in the old, especially in its recurrent and chronic form. Embolism, due to valvular disease of the heart, and thrombosis due to syphilitic disease, are the most frequent causes of acute local softening in the young and middle-aged.

ANATOMICAL CHARACTERS.—The characteristic feature of cerebral softening is diminished consistence. This may, however, arise from ante-mortem or post-mortem changes. In each case the diminished consistence depends on the breaking-up of the myelin, of which the nerve-fibres are composed, into globules and granules, and the separation of these by an increased quantity of fluid. Thus the continuous structures of which the brain consists are broken up into disconnected fragments, and the consistence of the tissue is accordingly diminished. In *post-mortem* softening there is nothing more. The globules of myelin are often large, and the separating fluid abundant. The softened tissue has the tint of the normal cerebral substance. The process is the result of the imbibition of fluid from some collection of serum, in the ventricles or elsewhere, and occurs in the greater degree in the immediate vicinity of this. In *ante-mortem* softening there are, in addition, certain changes in the tissue-elements. The process of segmentation of myelin results in the formation of finer granules. These are in part aggregated into 'granule corpuscles,' round or oval masses of globules and granules, sometimes contained within a distinct cell-wall. Some of these bodies may arise by simple aggregation, many certainly by the degeneration and distension of connective-tissue cells, and some by the degeneration of nerve cells. The walls of vessels in the softened area also present fatty degeneration The specific gravity of the tissue is diminished (Bastian). No further change may exist, and the area affected may present simply a diminution of consistence, its colour remaining unchanged. It is then called *white* or *grey softening*. Very frequently, however, in the part thus diseased, distension of capillaries with blood occurs, most considerable in the periphery, and blood is actually effused, chiefly by rupture of capillaries, in part perhaps by migration of corpuscles. In proportion to the amount of blood extravasated, the colour is changed, and thus *red softening* is produced. After a time, the effused blood degenerates, its tint becomes altered to yellow or orange, and *yellow softening* is produced. Ultimately, it is said, the colour, if at first moderate, may be removed, and white softening result.

Red softening is found chiefly in the grey substance, where the vessels are numerous, especially in the cortex and central ganglia. The tint varies; the red colour is usually punctiform, or mingled with yellow and white. If the extravasations are large and numerous, 'capillary apoplexy' results. The diminution of consistence is usually moderate. According to the amount of effusion of serum and blood there is swelling, and the diseased area may project above the cut surface. Inflammatory changes result from the vascular distension, and in proportion to these, increase in the nuclei of the neuroglia is found. From this cause and from the migration of white corpuscles, pus-like cells appear. The vessels are dilated, and may present a moniliform appearance. Their perivascular sheaths are often distended with blood. Commencing degeneration of the effused blood may cause a brown tint.

Yellow softening results from red softening, by degenerative changes in the blood effused. It has a similar seat, being frequently met with in the convolutions, where it constitutes *plaques jaunes* of the French. Its consistence is usually slight, its aspect granular. The colour depends on the presence of minute pigment granules, diffused colouring matter, and hæmatoidin crystals.

White softening has the tint of the normal cerebral substance. In consistence it varies; it may be only a little below that of the cerebral substance, or it may be diffluent. Its aspect is uniform, or white flakes are scattered through it. The limits are usually gradual. Under the microscope it presents the detritus of nerve-elements, a few nuclei from the connective tissue, granule-corpuscles, and, ultimately, corpora amylacea. White softening is chiefly found in the white substance of the hemispheres. It occasionally has a gangrenous odour, and then may be found in the white or in the grey substance, probably resulting from the obstruction of capillaries by septic material.

Ultimate changes.—White and yellow softening may remain for years unchanged. Sometimes the changes in the elements of the neuroglia and the extravasated white corpuscles result in the formation of a considerable quantity of connective tissue, consisting of fine fibre-cells and fibres, most abundant in the margins of the softened area, which become firm and dense, while trabeculæ of connective tissue cross the cavity. After a time the fluid may be absorbed, the fat removed, and a sort of cicatrix result. In other cases the walls alone are thus altered, the solid particles are removed from the softened tissue, and a cyst is formed. The outer portion of the cyst or cicatrix may be limited by a zone of dilated blood-vessels.

Seats of softening.—There is no part of the brain in which softening has not been found, but its most frequent seats are the cortex, the corpus striatum, and the optic thalamus. In the cerebellum, pons Varolii, and medulla it is also frequently found. Its occurrence, position, and characters depend on the distribution of the vessels. The small arteries of the corpus striatum and optic thalamus are 'terminal arteries,' having only capillary communication with other vessels. The arteries to the surface of the brain are usually for the most part terminal, but sometimes possess arteriole-anastomoses with other branches. Hence obstruction in the central arteries leads invariably to softening. Obstruction in the superficial arteries also usually causes softening, which involves the grey substance of the convolutions and some of the subjacent white centre to which the vessels penetrate; but occasionally the anastomoses of the superficial vessels are so free that softening does not result. An obstruction of a main trunk (as the middle cerebral) may lead to softening of the central region (corpus striatum), while the convolutions escape; but usually both suffer.

SYMPTOMS.—The *premonitory* symptoms of softening depend upon its cause. In embolism other symptoms than those of the cardiac trouble are usually absent. Occasionally a slight attack of loss of cerebral function, due to a slight embolism, may precede a graver attack. In softening due to arterial disease, premonitory symptoms of local cerebral anæmia are frequently present. There is defective nutrition of many parts of the brain, revealing itself by symptoms of wide range—mental deterioration, numbness, pains in the limbs, pain in the head, or slight local weakness. These symptoms are of especial significance when associated with evidence of arterial degeneration elsewhere; with the conditions—as chronic Bright's disease, alcoholism, and senility—in which atheroma of the cerebral arteries is common; or with constitutional syphilis.

The symptoms of *actual* softening are those of loss of function in the damaged portion of the brain. The onset of the symptoms may be sudden, as in embolism, and sometimes in thrombosis; or it may be gradual, as occasionally in thrombosis. In the former case the symptoms of initial shock are added to those proper to the locality. The latter are fully considered in the articles on Localisation. Hemiplegic symptoms and mental alteration are the most common. Hemiplegia especially occurs in embolism, on account of the frequency with which the middle cerebral artery is obstructed, and of the important motor regions (corpus striatum and motor parts of the convolutions) to which that artery is distributed. From the distribution of the artery to the lower frontal convolutions and adjacent region, aphasia is frequently present when the obstruction is on the left side.

When the symptoms come on suddenly, they often follow some exertion, or occur during exhaustion. If the area damaged be extensive, there is loss of consciousness, and there may be all the symptoms of an apoplectic seizure. The loss of consciousness is rarely profound, and the symptoms of apoplexy soon pass off. In the most severe cases, however, they may deepen to fatal coma. Symptoms of irritation commonly succeed those of apoplexy as the collateral hyperæmia sets in, or they may be marked at the onset. Convulsions, often unilateral, may occur and be repeated for days. The patient may pass from the apoplectic condition into one of delirium. In the old, delirium may be the chief symptom of the onset. According as these symptoms are chiefly marked at the onset three varieties have been described, the *apoplectic, convulsive*, or *delirious* forms.

Recovery from the special symptoms of the attack is often incomplete; permanent weakness may remain, as hemiplegia, and mental power is weakened, the patient passing into the chronic state about to be described. The persistent hemiplegia is often accompanied by rigidity, or by motile spasm, such as, in its most marked form, has been described as *athetosis*. Whether recovery is complete or incomplete, return or relapse is common, and is almost invariable where the arterial disease, to which the softening is due, is widely spread.

Chronic softening is a term applied to a group of symptoms, of wide range, indicative of failure of brain-power. These may supervene on more acute symptoms of softening, or may be gradual in their onset. There is mental dulness, defective perception, drowsiness, loss of memory (especially for recent events), often slight wandering; emotional manifestations are easily excited. The patient complains of headache, pains in the limbs, and feelings of 'numbness,' which may or may not be associated with actual loss of sensibility. Physical power is defective, usually generally, sometimes locally. The more delicate motor actions are imperfectly adjusted: articulation becomes confluent, and the handwriting indistinct or illegible. These symptoms may progress into actual imbecility, or may be cut short by some more profound cerebral seizure, or by some intercurrent pulmonary affection, rendered grave by the deficient muscular respiratory power. They depend upon degeneration of brain, commonly due to arterial disease. Spots of softening, often widely spread, may be associated with this condition, and may be, indeed, the cause of the symptoms. But the state may come on without any local softening; and atrophy of brain, with or even without degenerated vessels, may be the only anatomical condition. It often follows any grave local lesion—softening, hæmorrhage, or tumour—and then depends on a direct prejudicial influence on the cerebral nutrition, or on a secondary effect through the perturbed vascular system.

Diagnosis.—The *acute* form of softening has to be distinguished from acute congestive apoplexy and from cerebral hæmorrhage. It is distinguished from the former by the persistence of the symptoms indicative of local mischief, and by the absence of evidence of cephalic hyperæmia. From hæmorrhage the diagnosis is often difficult. In softening from thrombosis, the initial apoplectic symptoms may be absent, or, if present, are slight and brief. They are more often preceded by symptoms of local cerebral anæmia, due to the vascular disease, than is the onset of cerebral hæmorrhage. Improvement occurs earlier than in cerebral hæmorrhage. The temperature rises soon after the attack, but falls in a day or two; in hæmorrhage the rise occurs later (Bourneville). There is more marked mental change than in hæmorrhage, shown at first in excitement, subsequently by depression and deterioration of power. In the cases in which the onset is sudden and the apoplexy profound, a diagnosis from hæmorrhage is often impossible. In softening from embolism the patient is usually below middle age, heart-disease is present, and evidence of arterial disease is absent. The onset of the attack is commonly sudden, but the loss of consciousness is less profound than in hæmorrhage. In capillary embolism, if extensive, a distinction from hæmorrhage often cannot be made: the loss of consciousness is profound and lasting.

Softening may be distinguished from local cerebral anæmia, which often precedes it, by the definiteness and persistence of local symptoms; but a small area of softening may produce symptoms identical with those resulting from a large area of anæmia. Softening is distinguished from tumour and chronic meningitis by the slight pain and the absence of optic neuritis. From simple atrophy of the brain, *chronic* softening differs by its less uniform course, and by the sudden occurrence and persistence of symptoms indicative of local lesions.

Prognosis.—The immediate and ultimate prognosis in an attack of softening of the brain depends on its severity in degree and extent, as indicating the extent of the lesion, and on the region of the brain damaged. Both the immediate and the ultimate prognosis is much graver in damage to the medulla and pons Varolii than when the corpus striatum or cerebral hemispheres are affected. Youth and general health favour the rapidity and the degree of recovery. Where actual softening has occurred, the damaged tissue probably never regains its functional power. The congested periphery recovers in proportion to the inherent vitality of the tissues, and to the freedom of the vessels from disease. The chances of a recurrence of softening in another situation depend on the extent to which its causal condition is widely spread or can be removed. In vascular degeneration recurrence is almost certain. In embolic softening there is usually organic valvular disease in the heart, and embolism recurs in a considerable proportion of the cases, though less frequently than senile thrombosis. The prognosis in syphilitic disease of the vessels depends upon the recognition and treatment of the syphilitic influence.

Treatment.—During an acute attack the patient must be kept at perfect rest, with the head moderately raised, in a uniform temperature. During the initial stage of shock, warmth, by hot-water bottles, &c., should be applied to the surface, to equalize the circulation. The bowels, if confined, should be made to act gently; but, unless the evidences of encephalic congestion are early and conspicuous, purgation should be avoided. Should stimulants be administered? It has been proposed by stimulation of the heart to aid the establishment of the collateral circulation. But it must be remembered that the imperfect collateral flow arises from the minute size of the arterial anastomoses. The obstruction of one vessel always increases the adjacent pressure to such an extent as to distend the vessels to their utmost strength, and any further increase would, by rupturing them, impede rather than further the object in view. If, therefore, the heart is acting feebly, stimulate it by small quantities of alcohol to the normal force, but not beyond. If the diagnosis from hæmorrhage be in any degree doubtful, great caution should be observed in stimulation. After the stage of depression has passed, the irritation due to collateral hyperæmia, and indicated by elevation of temperature, may be relieved by purgatives, dry-cupping, and even, in some cases, by the application of leeches, though the latter are only necessary when the evidence of general vascular irritation is great. When convulsion is an early and recurrent symptom, mustard plasters to the neck and extremities, and bromide of potassium in large doses, are useful.

After the attack has passed, recovery must be aided by maintaining the general health in the best possible condition. The secretions should be kept free, the digestive organs in good order, the habits strictly regulated, and nervine tonics, cod-liver oil, hypophosphite of soda, strychnine, quinine, and iron, may be given with advantage. The symptoms of chronic softening, whether occurring after an acute attack or coming on gradually, should be treated in a similar manner. Great care should be taken that the peripheral obstruction to the circulation, indicated by augmented arterial tension, (incompressibility of pulse), is kept at its minimum by the avoidance of excess in diet, and by prompt purgation when any increase in tension is observed.

W. R. GOWERS.

BRAIN, Syphilitic Disease of. *See* BRAIN, Tumours and New Growths of.

BRAIN, Tubercle of. *See* BRAIN, Tumours and New Growths of.

BRAIN, Tumours and New Growths of. —The intimate connection of the brain with its membranes makes it impossible, except in the most general terms, to draw any marked distinction between tumours of the cerebral substance, and tumours arising from its envelopes. A growth pressing inwards from a membrane must impinge upon brain-tissue: a growth originating in brain-tissue must in many situations involve the membranes.

ANATOMICAL CHARACTERS.—The tissues from which tumours have their origin seem to present the best ground for a scientific classification of these lesions: and it is not devoid of interest to mark that the absolute nerve-elements of the brain are never primarily the source of a morbid growth.

Cerebral tumours, then, may be roughly separated into three series:—

1. Those whose centre of origin is some one or other of the membranes, external to the brain, or dipping into the ventricles.

2. Those which spring from the blood-vessels.

3. Those which own the neuroglia as their starting-point.

Taking this subdivision, which is Rindfleisch's, the tumours which are placed in each series differ somewhat from his arrangement.

In the first series five kinds of tumour are found, arising from the membranes or from the free surface of the ventricles. These are Pacchionian granulations; spindle-celled sarcoma; myxoma of the membranes; psammoma; and lipoma.

The second series will include, first, aneurysms, depending upon disease of one or more of the arterial coats; and, secondly, such tumours as have their origin in the sheaths of the vessels, comprising carcinoma cerebri simplex; fungus of the dura mater; cholesteoma; epithelioma myxomatodes psammosum; papilloma of the pia-mater and vessels; papilloma myxomatodes; and tubercle.

In the third series may be counted glioma; myxoma of the nerve-substance; syphilitic gumma; and fibroma.

Included under none of these headings, echinococci and cysticerci cellulosæ must be mentioned, as they affect the brain.

Each of the growths enumerated will now be briefly described.

1. *Pacchionian granulations.* These are granulations of the arachnoid, sometimes met with in childhood, very constantly from middle age onwards, and scarcely recognised as morbid lesions. Their ætiology is unknown. They do not give rise to any symptoms. They are chiefly situated along the superior longitudinal sinus, which in rare cases is perforated by them. They form groups of papillæ, consisting of striped connective tissue, poor in cells, and proceeding directly from a thin but a continually renewed layer of sub-epithelial germinal tissue.

2. *Sarcoma.* This sometimes has its origin in the nervous tissue itself, but more frequently arises from the dura mater, especially at the base of the skull. From their situation sarcomata are especially apt to interfere with one or more of the cerebral nerves. They may attain the size of a pigeon's, or even of a hen's egg.

When sarcoma attacks the dura mater it originates from its internal side. The most usual situation is the membrane about the sella turcica and the pars petrosa. It forms a depression in the brain, while the bone becomes atrophied behind it. The growth is composed of fusiform cells, with tolerably numerous, and sometimes dilated vessels. Sarcomatous growths are not freely developed above the surface, but rather in the depths of the tissue; they distend the cerebral convolutions, form deep depressions on the surface, and even penetrate far into the brain. They occur under two forms—*hard sarcoma* with compact fibrous fundamental tissue and small cells, often called fibrous tumour; and *soft sarcoma*, with a loose scanty intercellular substance, and numerous cells of comparatively large size. The cells are mostly fusiform, but sometimes round and multinuclear, and the two latter may be surrounded by the former. Sarcoma in this situation is generally single. It may attain the size of a nut or even of an apple; and is frequently hæmorrhagic.

In the cerebral tissue itself the hard sarcoma attains a great degree of density: it is sometimes fibrous, at other times cartilaginous, of a dense homogeneous structure, whitish or bluish-white, with a yellow tinge here and there, and with very few vessels. It is distinguished from the brain that surrounds it by a very vascular zone. It can be easily separated from the parenchyma, and may thus be recognised after death from simple sclerosis and hard glioma of the brain. The softer form—fibro-cellular sarcoma—is generally either a myxo- or a glio-sarcoma: but pure fuso-cellular sarcoma is met with. The tumour is a clear grey, almost like the grey matter of the corpus striatum. It is often vascular, with a reddish tinge. These sarcomata are often almost spherical, and easily detached from the surrounding brain-substance. Others, however, seem to be continuous with the neighbouring tissue, and to be little more than simple hypertrophies of the cerebral tissue. Especially is this the case in tumours of the corpus striatum and optic thalamus. The cells of cerebral sarcoma are frequently the seat of fatty degeneration, and the whole tumour may be hæmorrhagic. Its most frequent situations in the brain are the ganglia at the base.

3. *Myxoma.*—Myxoma of the membranes is rare, and generally has its origin from the convexity of the brain, being connected with the inner surface of the dura mater. It is a small growth, soft, fragile, having a gelatinous aspect.

Myxomata are frequently met with in the cerebral hemispheres, and then take their origin from the neuroglia. Such growths are probably malignant, the proof of their malignancy being that they are often multiple locally; that they frequently recur when removed from a peripheral nerve; and that they not seldom affect internal organs. Myxoma probably includes all that has been called colloid cancer. When this lesion affects the cerebral hemispheres it may be of large size. The mucus is a constituent part of the tissue; it is not a product of secretion, as in mucous cysts.

4. *Psammoma.*—Psammomata have been met with in the brain, spinal membranes, spinal cord, and nerves: they are not uncommon in the choroid plexus, but are most usually found in the pineal gland. There are two kinds of these growths. In the first, the sand occupies the interior of the meshes of the connective tissue in very varied forms, as compact cylinders, as pear-shaped masses, as spines, or as globes, surrounded by connective tissue, and connected by it with the other parts of the tumour. In the second form, the sand lies without cohesion in the parts and between them, so that the different grains of sand may be easily isolated. In this latter form, the psammoma is composed most generally of round elliptical corpuscles, and sometimes also of large complex conglomerations. These little tumours have usually an internal concentric arrangement.

5. *Lipoma.*—This is a rare form of tumour. It may be connected with the inner surface of the dura mater, or with the ependyma of the ventricles. The fatty matter is contained in cells, and the cells are surrounded by an organised membrane. Lipoma is usually single, seldom multiple; of irregular shape; and varies in size from a small nut to a hen's egg. Small pieces of carbonate of lime have been found in these tumours.

6. *Aneurisms.*—The larger cerebral aneurisms have been observed from early times. More recently Liouville has called special attention to the subject of miliary aneurisms, and has shown that they are common; that they are multiple; that they frequently give way in the brain or in the pia mater; and that they often co-exist with aneurisms of the larger vessels in other parts of the body. Aneurism of the middle meningeal, of the internal carotid within the cavernous sinus and at its exit from it, of the anterior cerebral, of the anterior communicating, of the arteries of the corpus callosum, of the middle cerebral, of the posterior communicating, of the vertebral, of the basilar, of the posterior cerebral, and of the arteries supplying the cerebellum, are all met with not unfrequently. The middle cerebral and the basilar, however, are the vessels most usually affected with this lesion.

The minute miliary aneurisms have been observed in the pia mater, at the surface of the convolutions or in their substance, in the optic thalami, the pons, the corpora striata, cerebellum, crura cerebri, and medulla oblongata; more rarely in the centrum ovale. These miliary aneurisms may be visible to the naked eye. The smallest are seen under the microscope as ampullæ of the vessels, containing coagulated blood or granules of hematoidin. The arterial walls have generally undergone some form of degeneration. The vessel, dilated at some parts, is constricted at others. The lesion may be a consequence of atheroma of the vessel, but far more commonly it is the result of arterio-sclerosis of the inner coat of the vessels, either at the seat or in the immediate neighbourhood of the aneurism. *See* BRAIN, Vessels of, Diseases of.

7. *Carcinoma cerebri simplex.* Cancer, excluding from this term sarcoma and glioma, may originate in the cranial bones, the dura mater, the pia mater, the cerebrum, the cerebellum, the pons, and the medulla oblongata. The medulla oblongata, the fornix, and the corpora quadrigemina, are the regions least often affected, whereas the cerebral hemispheres are the most favourite localities. All forms of cancer are met with, in all cases having their origin in the coats of the vessels. Epithelial cancer has been generally believed to have its starting point in the peripheral layer of the arachnoid, the tissue that lines the under surface of the dura mater. Encephaloid cancer is, however, the most common form met with in the brain.

8. *Fungus of the dura mater* can scarcely be separated from the preceding form. It arises from the outer surface of the dura mater, penetrates with the vessel from which it springs into the compact tissue, destroys the vitreous table, and spreads out in the diploë: in its progress it may penetrate the external table and lift up the integuments of the cranium. The internal table invariably suffers more than the external. Sometimes there is coincident passage of the tumour inwards, and the subjacent membranes become glued to the dura mater and to the cerebral substance. There may result simply

the depression of surface consequent upon pressure from above, but more commonly cell-growth similar to that of the original tumour takes place, first from the vessels of the pia mater, and afterwards from the vessels of the cerebral convolutions.

9. Closely allied to the epithelial cancer that has its origin in the dura mater is the *cholesteoma*, which is generally situated at the base of the brain. Rindfleisch considers it a squamous epithelioma, whose cellular cylinders are wholly converted into a mass of pearly nodules with a silky lustre. It is covered by the arachnoid, and springs either from the vessels of the pia mater, or more rarely from the perivascular sheath of the vessels in the substance of the brain.

10. Last of the cancers is a tumour that has been found in the third ventricle—*epithelioma myxomatodes psammosum*, consisting of globes and cylinders of epithelial cells, embedded in a very bulky stroma of mucous tissue.

11. Springing also from the vessels, two forms of *papilloma* are met with—papilloma of the pia mater and vessels; and papilloma myxomatodes. The former is composed of a number of branching papillæ, each of which contains a blood-vessel with a small amount of connective tissue, and a double coat of epithelium, of which the outer layer is columnar. In the latter, which is probably a mere variety of the former, the structure of the tumour is the same, but the columnar cells secrete a vast amount of viscid mucus.

12. *Tubercle* springs from the middle tunic of the small arteries of the pia mater, or of the nerve-substance. It rarely attacks the membranes in the form of tumour, rarely also the white matter of the brain, but prefers as its principal seat the grey matter of the convolutions and of the deeper parts. Tubercle of the dura mater is, however, sometimes met with, and it may induce obliteration of sinuses. The cerebellum is a frequent seat of tubercle, which exists here in the form of superficial granulations. The pons also is frequently affected with tubercle, both in the form of small tumours of its substance, and as polypous tubercles of the fourth ventricle. Tubercle is separated from the surrounding cerebral substance by a very delicate reddish envelope.

Tubercular tumours of the cerebral substance are often multiple, and not unfrequently large; they are of very slow growth; persist long in the caseous state; and may be found cretified. Sometimes there is cerebral softening around them. Virchow states that the increase of tubercles takes place by apposition or juxtaposition, and that the apposition takes place not by layers primarily caseous, but by zones of new grey proliferation, usually in the form of miliary tubercle. A very delicate layer of connective tissue of new formation, a species of encysting false membrane, represents the mother-tissue for the subsequent generation of young tubercles.

13. *Glioma*, called by Billroth *granulated sarcoma*, or *round-celled sarcoma*, is practically a local hyperplasic development of the neuroglia. It may appear in three forms, either as a *soft glioma*, rich in cells—the most common kind; as *hard glioma*, fibrous, and, if the vessels are much developed, telangiectasic; or, thirdly, as a *myxoglioma*, a complex tumour, in which part of the tumour takes the appearance of mucous tissue. The nature of the tumour is partly determined by the nature of the tissue from which it springs; thus glioma of the brain is generally, but not always, soft; glioma of the ependyma hard. The soft gliomata are closely allied to myxomata. The intercellular substance is found in moderate quantity. In the more mucous gliomata the network is regular and large, and the tissue has little cohesion. If the meshes are larger still, and the mucous element abundant, this variety passes into a myxoma. If there be a considerable increase of cells, whilst the trabeculæ become narrower, we get a medullary glioma, which may be transformed into a medullary sarcoma if the cells continue to grow and multiply. These transitions are not uncommon even in the same tumour, especially in the posterior lobes of the brain. If the vessels are developed in great abundance we get hæmorrhages and a kind of fungus hæmatodes. Hard glioma is closely allied to fibroma, with which indeed it may be combined to form a fibro-glioma. In hard glioma the fibres are not arranged in a network, but in parallel lines, like felt. The nervous elements, naturally contained in the neuroglia, are absent in these tumours. The walls of the vessels are frequently thickened.

The glioma of the ependyma is of little importance; it is seen as fine granulations on the surface of the lateral ventricles in chronic hydrocephalus; on the floor of the fourth ventricle it may grow to the size of a cherry. In the cerebral substance, gliomata may attain the size of a fist, or even of a child's head; and they are often mistaken for cancers or sarcomata of the brain. Hard glioma may be distinguished from sclerosis, in that sclerosis encloses the normal nerve elements. In glioma, too, there is great proliferation of neuroglia cells. There is no distinct limit between glioma and the surrounding brain-substance, but the tumour on section shows greater vascularity, greater consistence, and a more transparent constitution, as well as often a bluish-white appearance compared with the white brain-matter. The demarcation in grey matter is imperceptible to the naked eye, especially if the glioma be soft. Soft glioma is generally single; hard is often multiple. The membranes may adhere, but form no part of the tumour.

Virchow thinks that glioma is not malignant; that hard glioma has an inflammatory origin; and that the soft variety is set up by local causes, such as injury. Gintrac, on the other hand, unites gliomata and sarcomata under the head of cancers.

Soft glioma is most frequently situated in the posterior lobes, less often in the upper and lateral parts of the cerebral hemispheres. It may be congenital. It gives rise to complications, namely, first, great congestion, causing cerebral compression, irritation, pain, excitement, or apoplexy; and, secondly, hydrocephalus of the ventricles, which in protracted cases is seldom absent. The latter occurs most rapidly in glioma of the optic thalami, or of the posterior lobe, compressing the choroid veins, the venæ Galeni, or the transverse sinus.

14. *Myxoma of the nerve-substance.*—This is not common in the brain. It owns the same origin as glioma, having the neuroglia as its starting point.

15. *Syphilitic gumma.*—Gummy tumours of the brain are generally found at the circumference, and especially at the base of the brain. Their origin is either from the membranes, from the vessels, or from the neuroglia of the cerebral substance. They have infective properties, or at any rate they are multiple, and may be met with at the same time affecting the dura mater, the pia mater, the brain, nerves, and cranial bones. They are often accompanied by inflammatory phenomena, a point which distinguishes them from large tubercles. Gumma is not the usual form in which syphilis attacks the dura mater on its external surface. It may, however, affect the arachnoid surface of the dura mater. In this situation the gummata may vary in size from a hemp-seed to a nut. They may be found just above the convexity of the hemispheres, or at the anterior part of the base of the brain, especially about the sella turcica, or on the tentorium cerebelli. They have been met with in the falx cerebri. The inflammatory condition around these tumours often unites them to the pia mater, and the subjacent portion of brain is frequently softened, either by the inflammation, or by arterial obliteration.

When the pia mater is united to the dura mater, gummata very small in size may form in the former membrane. The subjacent brain may be softened or sclerosed. Much larger gummata, however, from the size of a nut to that of a hen's egg, originate from the pia mater, and are most usually situated in the region between the optic chiasma and the pons, or on the crura cerebelli. On the convex surface they are much smaller. Gummata of the cerebral substance occur in situations most subject to traumatic influences. The chief seats are the cerebral hemispheres, the large ganglia, especially the optic thalami, and next in frequency the pons, and crura cerebri and cerebelli. The tumours attain to a good size, but are not so large as those of the pia mater. They may be multiple, but often exist singly. *See* BRAIN, Vessels of, Diseases of.

16. *Fibroma.* True fibromata, distinct from hard gliomata and sarcomata, probably do not exist in the brain or its membranes. Fibromata are essentially composed of connective tissue. Such increase in this tissue is sclerosis, and its arrangement is too indefinite, its amount too small, to be considered a tumour. Rindfleisch is probably wrong in stating that there are solitary tubercles of the brain which deserve rather to be called fibroid tumours; although it may be true that in some cheesy nodules of the nervous centres the growth of fibres and the condensation predominate enormously over the corpuscular structure. Practically, however, both *enchondromata* and *osteomata* are fibrous tumours. An enchondroma is a heterologous tumour not developed from a pre-existing cartilage, but produced by a change in the type of formation by proceeding from a non-cartilaginous matrix. Although osteoid enchondromata may be malignant, yet true osteomata are not so. These tumours may attack the cerebral dura mater, and on the convexity are multiple. If the tumour attack the falx cerebri it is solitary. Its starting-point is the internal surface of the dura mater. It is distinguished from exostosis of bone by having a fibrous layer between it and the bone. It may set up irritative pachymeningitis. Such tumours also are found small in connection with the cerebral arachnoid, as simple united patches or pointed prolongations. Their favourite seat is the convex surface of the anterior lobes. The nervous centres are very rarely the seat of these tumours. Their matrix is formed by connective tissue, not cartilage, the product of irritation of the neuroglia, and so a consequence of circumscribed encephalitis.

17. *Hydatids* are rare within the skull, but are met with occasionally in all parts of the brain, between the membranes, in the ventricles, and lying free at the base of the brain. They are more common in children than in adults. The brain may suffer from pressure either in the way of softening from interference with the vessels, or from sclerosis.

Cysticerci are also met with in various parts of the brain or its membranes. They may be surrounded by connective-tissue capsules; or may lie free, arranged in a racemose form. They may be single, or may attack the same individual in several hundred places at once.

SYMPTOMS.—Even in tumours of considerable size all symptoms may be latent. The more tolerant portion of the brain will include the hemispheres and the white commissural regions, whilst the mesocephale, the optic thalami, and the corpora striata are amongst the least tolerant portions. It is not unusual, moreover, to meet with decided intermissions, especially in the early period of the disease; such intermissions depending on temporary lesions in the immediate neighbourhood of the tumour.

Even with these intermissions the diagnosis of the presence or position of the cerebral tumours would be comparatively easy, if the symptoms invariably depended upon direct excitation. Many of the phenomena pass the limits of the immediate sphere of the tumour, and are the results of reflex action. Sometimes also the symptoms due to direct and reflex excitation may coincide, and this is particularly the case in tumours of the base. The main difficulties lie in the possible latency of all symptoms; in their intermission; in the distinction and combination of direct and reflex excitation; and in the remissions following physical or psychical excitement.

Symptoms then may depend on direct or reflex excitation, and consist of exaltation of functional activity, such as contractions, partial or general convulsions, hyperæsthesia, and hyperideation. Others are produced by secondary lesions in the neighbourhood of the tumour—congestion, hæmorrhage, inflammation, &c.—and these may include not only all in the previous division, but temporary or persistent paralysis, fever, and other phenomena. Then there may be symptoms of direct compression, definite paralyses, and gradual enfeeblement of the sensorial and intellectual faculties.

Taking some of the more common conditions in order, and viewing them as dependent on direct or reflex irritation, the most frequent certainly is headache; and except a tumour of the cerebellum, when the headache is almost invariably occipital, there is no symptom less useful in determining the position of the lesion. It is less frequently due to direct excitation than to reflex. The pain is very severe, indeed, more so than in any other disease, excepting, perhaps, meningitis: it persists through the whole malady; and is increased by vibration of all kinds, light, sound, or movement of the head. It may be confined to a single spot, or be diffused over the whole head. Connected with headache in many cases, and often equally the effects of radiated influence, are tinnitus aurium, morbid acuteness of hearing, and painful sensitiveness to sound; disturbances of vision, diplopia, muscæ volitantes, and strabismus, which may be transient; formication, and sometimes hyperæsthesiæ of greater or less extent. In some cases there is an agitated condition of the intellectual faculties, and even delirium. Disturbances of sight are very common. The retinal lesions will be subsequently described. It is a remarkable fact, as bearing upon reflex phenomena, that the affections of sight usually implicate both eyes, even where the tumour has involved only one optic nerve, and is not situated near the optic chiasma or the corpora quadrigemina. Hearing is far less often affected than vision. Generally a slight diminution only of this function is observed; and, in the rare cases in which complete deafness is met with, it is unilateral. Taste and smell are seldom interfered with. When these special senses are morbidly affected, the tumour in the first case will probably be located in the posterior portion of the base; in the second at the anterior half of the base of the brain.

The symptoms of compression may be included in the expression 'lowering of function,' comprising apathy, feebleness of memory, want of attention, confusion, and a general enfeeblement of ideas. These conditions are often accompanied or preceded by certain diffused symptoms, such as vertigo.

Vertigo is the first symptom in many cases: it is felt especially when the patient is in the upright position. It often produces uncertainty of gait, even where the tumour is not in the cerebellum. Strange sensations in the head are also complained of, a feeling of liquid in the head or of a mobile body; or the sensation may be that of a solid body filling the head, or pressing upon some portion of it.

These phenomena often coincide with evidences of irritation of the mesocephale, whether due to direct compression or to radiated irritation of the medulla oblongata. Chief amongst these symptoms is vomiting. It is not accompanied by nausea or other manifestations of dyspepsia, and it will occur when the stomach is empty. It can frequently be checked only by keeping the patient in a recumbent position. Constipation also is often obstinate.

Epileptiform convulsion has an important bearing on the diagnosis of these lesions. Very frequently convulsion is preceded by many of the phenomena already touched upon, such as headache or vertigo. Frequently, however, convulsion precedes all other morbid phenomena, and the patient may be in perfect health in the intervals of the attacks. Given, therefore, convulsion as the one factor in forming an opinion, it is necessary to consider the liability of the patient to convulsive attacks from causes other than tumours; to realise whether the family history shows any suspicion of epilepsy; and to eliminate from the case the possibility of saturnine, alcoholic, and uræmic poisoning. If this is done, and especially if we find early convulsion associated with headache and with vomiting, this symptom will prove an important aid in the diagnosis of tumour.

The phenomena depending on the presence of tumour itself may be associated with others due to complications, such as œdema, congestion, encephalitis, or meningitis of the surrounding parts. A high temperature, for instance, will point to inflammation either of the nervous substance or of the meninges near the lesion; and meningeal inflammation seems to be accompanied by the highest temperature. Syphilitic gumma, however, may coincide with syphilitic meningitis on some other portion of the encephalon not directly connected with the immediate surroundings of the tumour.

Passing for the moment the subject of definite paralyses with the remark that the sphincters are seldom affected, even in cases in which the paralysis takes a paraplegic form, it may be mentioned that a want of equilibrium seems to be a not unusual evidence of the presence of tumour in the cerebellum. Aphasia may not only be due to the special localisation of tumour in Broca's region of the left anterior lobe, but also to the presence of this lesion in any part of the track (corpus striatum, optic thalamus, or crus cerebri) which unites this portion of the hemisphere to the medulla oblongata, the highway by which the centre for the production of articulate speech is connected with the coordinating centre for this function. Anæsthesia of the skin is seldom met with as a symptom of cerebral tumour. When present it is found only in the limbs affected with motor paralysis, and is scarcely ever complete.

Symptoms of special localities.—It remains to take special regions of the encephalon separately and to endeavour to differentiate the position of the tumour by the symptoms attending its presence.

Tumour in the *medulla oblongata* will be accompanied by various disturbances of sensibility, especially headache, and sometimes by convulsions. The pressure of a tumour is seldom limited to the medulla oblongata, and the symptoms therefore are complex. In several of the cases recorded there has not only been amaurosis and deafness of one side, but interference with taste and smell.

Tumour of the *fourth ventricle* may manifest itself by the presence of sugar or of inosite in the urine. Tumour here, as in the medulla oblongata, frequently destroys life quickly, before there has been time, so to speak, for much local lesion to be set up. Vomiting is a frequent symptom.

Tumour of the *crura cerebelli* and of the *corpora quadrigemina* cannot be diagnosed by any peculiar symptoms. In one case, in which the corpora quadrigemina seemed wholly transformed into a tuberculous mass, the sight remained good, but there was double ptosis.

In tumour of the *cerebellum* there is little disturbance of sensibility except occipital headache. There are various disturbances of motility, especially convulsions and irregularity of locomotion, but no true paralysis. Amblyopia, amaurosis, and convergent strabismus are common. There is no interference with the psychical functions, or with speech, as a general rule. Vomiting is very common. In 76 cases collected by Ladame, there was no abnormality in the genital functions, except in four instances.

In tumours of the *pons*, the disturbances of sensibility are general or partial anæsthesia, and in some cases more or less headache. Hemiplegia of unequal degree on the two sides, and other forms of paralysis are observed, but no convulsion. Various and manifold disturbances of the special senses; phenomena of depression of mind; frequent alteration of speech; and early disorders in swallowing occur.

Tumours of the *crura cerebri* follow the example of the same lesion in the pons with reference to disturbances of sensibility. Equilateral hemiplegia opposite to the lesion is met with, and paralysis of the oculo-motor nerve on the same side as the tumour, often gradually extending itself to both oculo-motors.

Tumours of the *pituitary gland* are accompanied by intense frontal headache; by no definite disturbances of sensation or of motion; by double amblyopia or amaurosis, unequally developed; and by no loss of speech.

Tumours of the *middle cavities of the cranium* seem to affect mainly the third and the fifth nerves, anæsthesia or pains in the face and ptosis being the prominent symptoms, with some interference with the free action of the other muscles of the eyeball supplied by the third. In one case, in which a scirrhous tumour of the left side was situated on the inner surface of the sphenoid bone, extending laterally to the internal auditory meatus and backwards to the pons, not only were the third and fifth nerves paralysed, but colour-blindness supervened some time before death.

In tumour of the *corpora striata* and *optic thalami*, headache is less frequent than in other regions. Hemiplegia and convulsions are frequent, the former especially so. Hardly any disturbance of the special senses is observed. Intelligence and speech are frequently disordered.

In tumour of the *corpus callosum*, there is frequently some mental aberration, and often convulsions.

In tumour of the *middle cerebral lobes*, headache is frequently a prominent symptom, but otherwise the sensory disorder is mainly anæsthetic. Hemiplegia is common, as is also convulsion of an epileptiform character. These convulsive attacks are not rarely unilateral, and sometimes affect at first one limb only. In fact the position of a tumour towards the anterior portion of the middle lobe may be determined by symptoms with tolerable accuracy. Various disturbances of sight and of hearing are met with; as well as various psychical abnormalities, ranging from mere confusion of ideas to absolute imbecility.

In tumour of the *anterior lobes* there is general headache, seldom of the frontal region particularly. No other sensory disturbance occurs. Sight and smell are frequently affected, speech seldom. Hemiplegia, convulsions, and psychical disturbance will occur much as in tumours of the middle lobes.

In tumour of the *posterior lobes*, there is general headache, seldom localised in the occiput: no other sensory disturbance. Slightly marked hemiplegia occurs, and convulsive attacks are very frequent. There is no disturbance of the organs of special sense. The mental faculties are greatly altered, particularly in the tendency to depression.

All three lobes may be affected with tumour coincidently, and the headache is then very intense; the epileptiform convulsions exceed the paralytic phenomena; the organs of special sense are little affected; and there are various mental disturbances.

In tumour of the *convexity*, the headache is generally limited either to the frontal regions, to one side of the head, or to the occiput. There is neither anæsthesia, nor paralysis, but intense convulsions occur. The special senses are not disturbed. The mental condition is one of irritation, evidenced by delirium and excitement.

Lastly, very various regions of the brain may be simultaneously the seat of tumour, and the morbid phenomena will be necessarily complex.

Retinal changes.—It has seemed more convenient to speak of retinal changes dependent on cerebral tumour separate from the other symptoms. Great variations in the lesion occur according to the position of the tumour; its direct interference with the optic centres; its complication with meningitis; and its pressure on the optic nerves and chiasma.

Taking choked disc, optic neuritis, and atrophy of the optic nerve as the three chief lesions, cerebral tumour may very frequently induce choked disc, by interfering with the venous ebb from the eye; optic neuritis, if meningitis is associated with the tumour; optic atrophy, by pressure of the tumour on the optic nerve, or by this pressure of the tumour or of hydrocephalus secondarily induced by it on the optic centres or tracts, or by softening around the tumour, such softening implicating the optic centres, or, lastly, by the propagation of sclerosis. Any tumour situated far back in the encephalon may interfere with the venous flow through the venæ Galeni, and so produce hydrocephalus of the ventricles, and the retinal effects of hydrocephalus.

There are no retinal changes from tumour in the corpus callosum, nor as a rule from tumour in the optic thalami. Tumours of the cerebral hemispheres all influence the optic nerve, if they interfere with the base of the brain.

Tumours of the cerebellum may cause pressure on the lateral sinuses, the straight sinus, the venæ Galeni, or the torcular Herophili: pressure in any of these situations may produce choked disc. Or the tumour may affect the corpora quadrigemina; or softening around it may spread to these organs, and atrophy of the optic nerve be the result. *A fortiori*, tumour of the corpora quadrigemina themselves will lead to atrophy of nerve.

Tumour of the crura cerebelli causes hydrocephalus, and its effects on the retina.

In a similar way tumours springing from the bone or the membranes at the base of the brain may produce choked disc or atrophy, according to the position of the pressure, optic neuritis by complications with meningitis, or neuro-retinitis by irritation of the connective elements of the nerves. *See* OPTHALMOSCOPE IN MEDICINE.

COURSE.—The clinical course of cerebral tumours is intermittent and paroxysmal. In many cases, such as those of glioma, it is very slow. Two groups of phenomena may complicate its ordinary course, namely, those associated with meningitis and apoplexy.

SPECIAL TUMOURS.—Aneurismal tumours may sometimes be distinguished by the sense of throbbing in the head; by the patient being of adult age or young; by his being attacked in the midst of perfect health; by vomiting being rare, apoplexy frequent, paralysis of cranial nerves early and unilateral; and by absence of mental phenomena. Aneurism situated in the cavernous sinus produces exophthalmos. *See* next article.

The symptoms of echinococci differ very little from those of other slow tumours: headache, dizziness, vomiting, syncope, and epileptiform attacks are most frequent. Disturbances of the motor and sensory functions, and also of the mind itself, are sometimes met with, and vary according to the situation of the lesion. The prognosis is unfavourable; the diagnosis impossible, unless echinococci exist at the same time in the liver.

Cysticerci manifest their presence in the brain by epileptic attacks, which augment in number and severity; the health of the patient between the fits is at first good, then apathy and torpor supervene; hemiplegia is rare, and never early; cranial nerve paralyses are exceptional; the symptoms are diffuse and bilateral, owing to the position of the parasite in the grey convolutions, and in many spots at a time. The age of the patient is above 40. Perhaps there may be evidence of the presence of cysticerci elsewhere.

Syphilitic tumours coincide with actual or previous syphilis. The headache attending this form of tumour is generally intensified at night.

In tubercle of the brain there is often a tuberculous family history, or the presence of tubercle elsewhere in the body. It seldom compresses cranial nerves. Its clinical evolution is often by paroxysms, and grave cases are combined with tuberculous arachnitis and hydrocephalus of the ventricles. Tubercle in the cortical substance of the brain and cerebellum may, however, be attended by no special symptoms.

In cancer also there is frequently a family history of this malady; and the cancerous cachexia may be present. Cancer seldom exists elsewhere when it is cerebral. This growth is much less often accompanied by symptoms due to congestion and hæmorrhage than glioma or sarcoma, being less vascular.

PROGNOSIS.—The prognosis of cerebral tumour is always bad, except in syphilitic gumma, and perhaps aneurism.

TREATMENT.—In syphilitic gumma and in aneurism large doses of iodide of potassium may be used with more or less success. This remedy is also useful in dispersing the results of the meningitis which so often accompanies tumour of the base. Beyond this there is little to be done, except in the endeavour to relieve pain and to support the strength of the patient.

E. LONG FOX.

BRAIN, Ventricles of, Diseases of. *See* VENTRICLES OF BRAIN, Diseases of.

BRAIN, Vessels of, Diseases of.

1. **Aneurism.**—The larger arteries of the brain, and their minute branches in the cerebral substance, are both liable to aneurismal dilatation.

(*a*) *Aneurism of the larger cerebral arteries* is more common than that of vessels of a similar size elsewhere. The large vessels of the base, or their primary branches, may be affected. The basilar and middle cerebral arteries are those most frequently diseased, aneurisms of those two vessels constituting three-fourths of the cases. Next in frequency is the internal carotid. The vertebral, anterior and posterior cerebrals, anterior and posterior communicating, and anterior cerebellar arteries are occasionally, but less frequently, involved. In one or two recorded cases the aneurism has been situated in the interior of the pons Varolii or cerebellum. The arteries of the two sides of the brain are affected with equal frequency, with the exception of the middle cerebral, which, with its branches, suffers twice as frequently on the left side as on the right. There may be more than one aneurism, situated on different arteries or on different branches of the same artery. The aneurism is usually sacculated, rarely dissecting. Its size varies from that of a pea to that of a nut; but aneurisms of the anterior or middle cerebrals have attained a much larger size. When this is the case the brain-tissue is pressed upon and softened.

ÆTIOLOGY AND PATHOLOGY.—These aneurisms are rather more common in men than in women. They occur at all ages, being more frequent before the ordinary degenerative period than aneurisms elsewhere. Nearly half the recorded instances have occurred between ten and forty years, and about one-seventh between ten and twenty. The change in the arterial wall resembles that giving rise to aneurism elsewhere —a fibroid degeneration, with loss of muscular and elastic tissue. This may be part of a widely spread arterial change, or more frequently is local. When local, it is sometimes due to syphilitic disease of the arterial wall, but still more frequently to the consequences of embolism. Dr. Church first pointed out the frequent association in young persons of cerebral aneurism and valvular disease of the heart, and many facts have been published which support the hypothesis that the aneurism in these cases may be the consequence of incomplete obstruction by embolism. There is often evidence of inflammatory and degenerative changes (thickening, calcification) in the arterial

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wall after embolism, especially when the plug comes from an inflamed endocardium. If the obstruction is incomplete, the altered wall may yield to the blood-pressure. In harmony with this theory are the frequent absence of degeneration in other arteries, the frequency with which the left middle cerebral is the seat of the aneurism, and the occasional occurrence of several aneurisms on branches of the same arterial trunk. The efficient agent in the production of the aneurism is the high blood-pressure in the cerebral arteries.

Rupture has occurred in about three-fourths of the recorded cases of cerebral aneurism. The blood may escape rapidly or slowly, and the hæmorrhage may take place into the subarachnoid space, or into the adjacent cerebral substance. In the former case, meningeal hæmorrhage is the result. Rupture into the cerebral substance is not uncommon. An aneurism in the fissure of Sylvius may cause a hæmorrhage into the substance of the brain, bursting into the lateral ventricle; and an aneurism on the posterior cerebral artery may burst into the substance of the pons. Two causes may determine this rupture into the substance of the brain—first, thickening of the subarachnoid tissue adjacent to the aneurism, hindering its rupture outwards; secondly, the gradual escape of the blood, producing a slow disintegration of the brain-tissue, and thus preparing a channel for the effusion. In such cases only a small quantity of blood may have trickled into the ventricles or subarachnoid space. In rare cases a communication with a sinus forms, and constitutes an arterio-venous aneurism. This has occurred between an aneurism of the internal carotid and the cavernous sinus.

SYMPTOMS.—Symptoms of the existence of an aneurism may be entirely absent. When present they depend on the pressure which the tumour exerts on neighbouring parts. They vary widely according to its seat, and they are rarely by themselves distinctive. Mental disturbance is uncommon. Headache is a very uniform symptom. It is often intense, sometimes throbbing, and may be localised, as in the occiput in basilar aneurism. Convulsions occur in some cases, and are said to be more common when the disease is near the medulla. Paralyses are frequent, and depend on the pressure of the tumour: the most common are those of the cranial nerves which lie adjacent to the aneurism, as of the nerves of the orbit in aneurism of the internal carotid. Such symptoms are suggestive of an aneurism when they indicate pressure in the known situation of a vessel. In some cases a murmur can be heard by the patient, and in still rarer cases (of aneurism of the internal carotid) it has been audible on auscultation. Aneurism elsewhere may increase the probability that an intracranial aneurism is present, and so, in the young, may valvular disease of the heart.

Rupture of cerebral aneurism gives rise to symptoms which vary, as in rupture of aneurisms elsewhere, according as the blood escapes quickly or slowly. If quickly, the blood usually escapes into the meninges and causes sudden apoplexy with general paralysis, rapidly deepening to a fatal issue. If slowly, the symptoms are less sudden, and unilateral paralysis or convulsion may occur. This is especially the case when the blood escapes slowly into the cerebral substance, unilateral symptoms occurring, and gradually increasing during a few hours or days, with or without initial loss of consciousness, but ending in fatal coma.

TREATMENT. — Little can be done in cases where intracranial aneurism is suspected. Even when it is of syphilitic origin, drugs can only partially restore the damaged and dilated vessel. Hypodermic injection of ergotin ($\frac{1}{8}$-grain) has been recommended by Langenbeck and advocated by Bartholow. Iodide of potassium may also be given. Rest is important. All causes of increased intravascular pressure, such as effort and low positions of the head, are to be avoided. The bowels should be kept regular. In rare cases where progressive paralysis of orbital nerves suggests the probability of aneurism of the internal carotid, and a murmur renders the diagnosis certain, ligature of the common carotid may be, and has been, resorted to with success.

(*b*) *Minute 'miliary' aneurisms* occur in the small arteries of the pia mater and substance of the brain (Virchow, Charcot and Bouchard). They are found at all ages, but more frequently in the old. They may involve vessels not more than the $\frac{1}{100}$ inch in diameter, but are most common on vessels a little larger than this; the walls suffer fibroid degeneration of the outer and middle coat, commencing, it is said, as nuclear proliferation. The muscular tissue of the middle coat disappears, and the whole wall at the spot becomes dilated into a sacculated aneurism, varying in size from the $\frac{1}{25}$ to the $\frac{1}{125}$ of an inch. These dilatations have been found in all parts, but most frequently in the optic thalamus, and next most frequently in the pons Varolii, the convolutions, the corpora striata, the cerebellum, the medulla oblongata, the cerebellar peduncles, and the centrum ovale (Bouchard). They often rupture and cause minute hæmorrhage. They are found frequently in cases of large cerebral hæmorrhage; and Charcot and Bouchard believe that such hæmorrhage is frequently due to their rupture. Liouville has pointed out that minute aneurisms of the retinal arteries sometimes coexist.

The rupture of a minute artery into its perivascular sheath distends it with blood, causing what has been termed a minute dissecting aneurism. Such are frequently met with in cases in which the vessels are exposed to extreme pressure, as in death from asphyxial conditions; or in the increased tension in collateral vessels when vascular obstruction has occurred.

No SYMPTOMS are known to be associated with the existence of these minute aneurisms. The symptoms of rupture are described under 'BRAIN, Hæmorrhage into.'

2. **Degeneration.** (*a*) *Of Arteries.* — The larger cerebral arteries are very common seats of the thickening of the inner coat, called by Virchow 'Endarteritis deformans,' and which, when fattily degenerated, constitutes 'atheroma.' On the cerebral vessels the fatty change occurs quickly and frequently; and opaque yellow

thickenings are the result. Only one or two of these may be present; or the change may involve the whole of the larger vessels at the base and extend for a considerable distance along the chief cerebral branches. The distribution of the degeneration may be symmetrical. It may coexist with a similar change in arteries elsewhere, or may be isolated. Degeneration of the cerebral arteries is common after middle life, being found in seven-tenths of the subjects examined (Bichat). It occasionally occurs much earlier, especially in cases of chronic Bright's disease. Bright's disease and alcoholism are its chief diathetic predisponents. The exciting cause of this disease is probably the strain to which the badly supported cerebral vessels are exposed. It is not easy to explain their occasional freedom from atheroma when this is abundant elsewhere. The degenerated patches rarely soften and open into the vessel, so as to permit the formation of a dissecting aneurism. More commonly they undergo calcification. The result of these nodular degenerations is to lessen the calibre of the vessel, sometimes to close it altogether, and to favour the formation of a coagulum. The lessened area of the vessel causes local anæmia of the brain. If the vessel becomes occluded, or if coagulation takes place in it, softening occurs in the part supplied by it. Where the degeneration has led to only slight thickening of the wall, the artery may be dilated at the spot. The degenerated vessel may burst under the pressure of the blood and hæmorrhage result. The minute arteries of the cerebral substance undergo similar changes, less conspicuous from their smaller size. Fatty degeneration of the cells lining the perivascular sheath is common at all ages. Under circumstances similar to those in which the larger arteries degenerate, all the coats of the small vessels suffer. Simple fatty degeneration of the middle coat occurs also at all ages. Miliary aneurisms may be formed, or rupture occur, as a consequence of these changes.

Symptoms.—Atheroma of the cerebral vessels leads to the symptoms of local anæmia of the brain, and is a common cause of the transient cerebral symptoms so frequent in the old.

Treatment.—Tonics, cardiac stimulants, and substances which, as cod-liver oil, promote the nutrition of the nerve-tissue, are the most useful remedies.

(*b*) *Of Veins.*—Degeneration of the walls of the veins is much less frequently observed than degeneration of the arteries, perhaps on account of the less degree of pressure to which they are exposed. Occasionally the veins of the pia mater may be found varicose in advanced life, and in one case recorded by Andral rupture of such a dilated vein was the cause of meningeal hæmorrhage.

3. **Embolism.** — Definition. — The obstruction of arteries or capillaries of the brain by solid particles carried by the blood-current from some other part of the vascular system.

Ætiology.—The source of the embolic particles is almost invariably situated between the pulmonary capillaries and the obstructed vessels, *i.e.* in the pulmonary veins, the left side of the heart, or the arteries. In arterial embolism it is necessarily so, since no particles large enough to obstruct even a small artery could pass through the capillaries of the lungs. In almost all cases the heart is the source of the plugs, a particle of fibrin being washed by the blood from a deposit on a diseased valve or in some recess (as the auricular appendix). Endocarditis, or chronic valvular disease, therefore, usually coexists with the embolism. Mitral stenosis is an especially frequent source of emboli, probably because the surface is commonly much altered, and the blood-current is in part slow (in diastole, allowing deposit), and in part very rapid (in auricular systole, detaching loose fibrin). Disease of the aorta—atheroma or aneurism—is the next most frequent source, and, less frequently, disease of the carotid or vertebral arteries, and coagulation in the pulmonary veins, large or small—the latter in some rare cases of inflammation and growths.

Particles obstructing capillaries may come from some softened atheromatous patch or fibrinous deposit, from pigmentary formations, or from deposits in ulcerative endocarditis. In the last case the obstructing material has a septic character, and the inflammation it causes may be suppurative.

Anatomical Characters.—Almost any of the cerebral arteries may be obstructed, the internal carotids and middle cerebrals or their branches most frequently, the anterior cerebrals or the basilar less frequently, and the posterior cerebrals still less frequently. Obstruction of several vessels is sometimes found, having occurred at the same or at different times. The cerebral arteries of the two sides are plugged with nearly equal frequency; the internal carotid much more frequently on the left side than on the right. It seems that a large fragment is influenced in its course by the more direct path through the left carotid, while smaller fragments find their way with almost equal readiness to either side. The middle cerebrals are very frequently affected, sometimes on both sides; and, when the bilateral symmetry of the vessels is great, each may be obstructed at the same place.

The plug is usually arrested at some spot at which the vessel is narrowed by a branch being given off. Here the fragment may be found, usually decolorised, and commonly closing altogether the lumen of the vessel. On each side of this is a secondary clot: the distal extends far into the contracted branches of the vessel, the proximal as far as the next large branch. The obstruction may lead to inflammation of the wall of the vessel at the spot, especially when the plug has been carried from a place at which inflammation is going on. The inflammation leads to change of texture and degeneration, fibroid or fatty; the former may permit an aneurism to be formed, the latter may cause a thickened patch, in which calcification may occur. The inflammation may spread to the adjacent tissue, leading to induration around the spot.

The first effect of embolism is to arrest the blood-supply to the part to which the artery is distributed. It is only when the obstruction is beyond the circle of Willis that damage to cerebral structure (softening) follows. Softening occurs more uniformly in obstruction of the arteries of the central ganglia than in those of the convolutions. Capillary embolism also causes softening, and when the obstruction is from a septic source, 'metastatic abscess' may result.

For the symptoms, diagnosis, and treatment of cerebral embolism see Brain, Softening of.

4. **Rupture.**—Rupture of cerebral arteries is common and is the cause of cerebral hæmorrhage, and rupture of capillaries is not unfrequent. Rupture of veins is extremely rare, except as the result of injury.

(*a*) *Of Arteries.*—The proximate causes of rupture are weakening of the arterial wall, and increased pressure within the vessel. The conditions which give rise to these two factors are the remote causes of rupture. The actual rupture is commonly due to a temporary sudden excess of intravascular pressure.

Ætiology.—The wall of the vessel is weakened, especially by degenerative disease—chronic periarteritis, or (rarely) simple fatty degeneration. Aneurismal dilatation and thinning may have resulted from the chronic change. In some diseases attended with a tendency to extravasation (purpura, hæmophilia, &c.) it is conjectured that the vascular walls have undergone rapid degeneration, or are unusually thin. Defective external support, from atrophy of the brain, causing increased size of the perivascular canals, was formerly thought to be a potent cause, and is now perhaps underrated. The mobile perivascular fluid which surrounds the vessels must afford a less efficient support than cerebral tissue.

When vessels are much weakened, they may rupture when the extravascular pressure is at, or even below, the normal; very commonly, however, there coexists increased pressure. Loss of arterial elasticity leads to a jerky pressure. Arterial degeneration, and still more constantly, arterial contraction, in Bright's disease, cause increased tension by obstruction; and the hypertrophy of the heart, which develops to overcome the obstruction, adds materially to the pressure within the arteries. Hypertrophy to overcome an obstacle near the heart has probably no influence in causing rupture of cerebral vessels.

The instant cause of rupture is generally some temporary increase of the blood-pressure due to effort—as in cough, straining at stool or vomiting; excited action of the heart; suddenly developed heart- or lung-disease obstructing the circulation; local obstruction to return of blood; contraction of the arterioles, general or local; or the action of gravitation in the recumbent posture. The last two causes probably acting together determine the frequent occurrence of rupture during sleep.

The conditions which produce these proximate causes are the remote causes of rupture. The most efficient are those which determine weakening of the vascular wall, and have been already spoken of (*see* Degeneration). Age is an important element—rupture is most common after fifty, but may occur from local vascular disease at any age. Hereditary predisposition is seen in a tendency to early degeneration. Position of degeneration is probably largely influenced by the distribution of the vessels: and the latter may be strikingly hereditary, as the retina sometimes shows. Sex tells probably by exposure to the greater pressure entailed by muscular effort (men suffer from rupture twice as frequently as women). Alcoholism leads to early degeneration. But the most efficient predisponent is Bright's disease, which leads to great intravascular pressure, and weakens the cerebral vessels by causing degeneration. It is probable that some acute diathetic diseases in which rupture is common act in a similar manner.

Certain of the cerebral arteries give way more frequently than others, especially the arteries of the corpus striatum and pons Varolii. This seems due (1) to their origin at right angles from vessels of very considerable size (basilar and middle cerebral), and their consequent exposure to the full pressure within the parent trunk. (2) To their 'terminal' character, which precludes collateral relief (Duret, Heubner). One artery, which very frequently gives way, passes from the middle cerebral through the anterior perforated spot, outwards between the island of Reil and the lenticular nucleus, the outer part of which it perforates, and then passes through the white 'internal capsule,' between the lenticular and caudate nuclei, to ramify in the anterior part of the latter. The arterioles supplying the convolutions on the surface of the brain are not often ruptured, except from injury. They are exposed much less directly to the blood-pressure, and sometimes possess considerable anastomoses.

Symptoms.—The consequence of rupture of an artery is cerebral hæmorrhage, the symptoms and treatment of which are described elsewhere (*see* Brain, Hæmorrhage into). In traumatic laceration of the brain the arteries are torn, and often cause much hæmorrhage.

(*b*) *Of Capillaries.*—The minutest arteries and veins and the capillaries rarely rupture, except when exposed to sudden pressure by venous thrombosis, when the obstruction in the part from which the vein proceeds may determine numerous capillary hæmorrhages into the cerebral substance. In general venous congestion, as in asphyxial states, such hæmorrhage may occur; but a more frequent result is rupture of a vessel within its perivascular sheath, which thus becomes distended with blood.

For symptoms *see* Brain, Hæmorrhage into.

5. **Syphilitic Disease.** — The arteries of the brain are occasionally diseased in the later stages of syphilis. The large arteries at the base and the minute arterioles may be both involved. The wall is thickened at circumscribed areas by a fibro-nuclear growth, which causes a nodular projection on the exterior, and diminishes also the calibre of the vessel. The structure of the growth resembles that of syphilomata elsewhere. It is said by Heubner to begin by a nuclear proliferation between the inner coat and the elastic lamina; and in some cases it attains its chief development in this situation, the elastic lamina being pushed outwards and the lumen of the vessel obliterated. The middle coat may ultimately disappear. Vessels may form in the substance of the growth, and its centre may undergo fatty degeneration. The disease is sometimes sym-

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metrical on the arteries of the two sides. The growth or secondary thrombosis occluding the vessel, softening may result in the area of brain-tissue supplied by it. The softening resembles in its occurrence and characters that which is produced by degenerative changes in the arteries, but is more varied in its seat, and it affects younger persons. The diminished elasticity of the diseased wall, when the thickening is slight, may permit the dilatation of the vessel into an aneurism. Possibly the same result may follow the fatty degeneration of the new tissue.

Symptoms.—No symptoms are produced by the arterial disease until it causes local anæmia or softening, the symptoms of which resemble those due to other causes.

Treatment.—This is that of the later stages of syphilis. It must be remembered that the removal of arterial disease may not restore the damaged cerebral tissue.

6. **Thrombosis.** Thrombosis,—the coagulation of the blood *in situ*,—may occur in the cerebral arteries; or in the cerebral veins and sinuses.

(*a*) *In the Arteries.*

Ætiology.—The causes of arterial thrombosis are the following:—

(1) An alteration in the wall of the artery, by which the blood comes in contact with an abnormal surface. The most common condition is atheroma, and hence arterial thrombosis is most frequent when atheroma is most common—in the old. Syphilitic disease of the artery sometimes leads to it. Much more rarely it is caused by an arteritis, spontaneous, or the result of adjacent inflammation or traumatic damage.

(2) Retardation of the blood-current. This may result from weakened action of the heart in debilitating diseases (as phthisis and cancer); and in extreme fatigue. It may be part of the effect of a convulsive fit; or it may be caused locally by the arterial diseases mentioned already, which lead to narrowing and loss of elasticity.

(3) An increased tendency of the blood to coagulate. This is seen in many diseases, especially in marasmic states in young and old (such as are caused by phthisis and cancer), in acute rheumatism, and in the puerperal condition. A slight cause then suffices to produce coagulation, and the weak heart, so common in many of these conditions, may cause sufficient retardation of the blood-current.

(4) Lastly, thrombosis in an artery may be *secondary* to its complete or partial obstruction by an embolus.

Anatomical Characters.—The arteries occluded may be one or several, and large or small. Of large arteries the basilar, middle cerebral, and carotid are those occluded most commonly, and with nearly equal frequency. The vascular wall may present any of the local causative conditions, or may be healthy. After a time thickening from secondary arteritis occurs. Within this vessel is a coagulum which usually fills its interior, and is adherent to the wall. It may not fill the vessel, either because originally imperfect, or because the clot has shrunk. A recent quickly-formed coagulum is red, but after a time it becomes pale and yellow. A slowly-formed coagulum is pale, and may be laminated. A secondary clot usually forms far into the contracted distal branches, and on the proximal side as far as the nearest large branch. Ultimately the clot may, rarely, soften, the channel being sometimes re-established. More commonly it undergoes calcification, or, with the artery, contracts and becomes atrophied. The brain-tissue, in which the artery was distributed, may be at first anæmic, but quickly becomes congested. It ultimately undergoes softening—red, yellow, or white, according to the amount of vascular distension. If the collateral circulation is free it may remain unsoftened.

Symptoms.—Where chronic arterial disease is the cause of thrombosis, the symptoms of local cerebral anæmia may precede (*see* Brain, Anæmia of) The thrombosis itself leads to the symptoms of loss of function in the part to which the artery passed. The onset of these symptoms is slow or sudden, according to the rapidity with which the coagulum forms; and their degree depends on the size of the vessel occluded, its position, and its relation to other vessels which may supply blood to the area involved. Thrombosis of a small vessel in the cerebral substance usually leads to transient brain-disturbance, headache, vertigo, tingling, and temporary weakness in the limbs, which soon pass away if a collateral circulation is established; more slowly, if softening ensues, by compensatory action elsewhere. The occlusion of a large vessel causes commonly more marked symptoms. Complete hemiplegia is frequent, and its onset may be marked by loss of consciousness (*see* Brain, Softening of).

Diagnosis.—Diagnosis rests on a combination of the symptoms of local cerebral disease with the causal condition—vascular mischief (indicated by probable age, degeneration elsewhere, or syphilis), and with conditions leading to relaxation of the blood-current, or increased coagulability of the blood. The diagnosis is rendered more probable by the symptoms if slight being transient, if severe being of gradual onset, and, whether slight or severe, being preceded by the premonitory indications of local cerebral anæmia.

The prognosis and treatment of thrombosis in arteries are considered under its consequence, Brain, Softening of.

(*b*) *In Cerebral Veins and Sinuses.*

Ætiology.—Thrombosis in sinuses may be primary, and due to changes in the constitution or the circulation of the blood; or secondary, and due to local causes inducing coagulation directly at the spot affected. The same conditions of retarded circulation and altered blood-state which permit coagulation in arteries, favour it also in veins, and it is often seen in such conditions as phthisis and cancer, and especially in marasmic states in children. Local retardation of the circulation from narrowing of the sinus, or compression of the jugular vein, occasionally assists. Local change causing coagulation is usually the extension to the sinus of adjacent inflammation, or of a clot produced in a tributary vein by such inflammation. Caries of the bones of the skull, especially of the temporal bone, and meningitis are common causes. Inflammation outside the skull, in the scalp, neck, or face, has led, by means of venous connections, to intracranial thrombosis. Lastly, injuries of the skull involving the sinuses sometimes cause coagulation in them.

Anatomical Characters.—Of primary thrombosis the superior longitudinal sinus is the most common seat, and thence the clot spreads into the veins on either side, and often also into the lateral sinuses. When secondary, the thrombosis occurs in the sinus nearest to the local mischief; in disease of the petrous bone, the lateral sinus is usually involved. The sinus is distended by firm clot, commonly (not invariably) adherent, sometimes in concentric layers. The walls of the vessel are healthy when the thrombosis is primary or secondary by extension of clot, but thickened and brittle when invaded directly by adjacent inflammation. After a time the clot may soften and break down.

The consequence of venous thrombosis is local arrest of the blood-current, the tributary veins and capillaries becoming enormously distended with blood and rupturing, and the cerebral substance being crammed with minute capillary extravasations which often coalesce. The condition is frequently seen in the convolutions. Blood is also effused into the meshes of the pia mater, and into the subarachnoid space. Into the looser tissues and into the ventricles serum may escape. Thrombosis of the veins of Galen is one cause of ventricular effusion. Ultimately the brain-tissue, the seat of the ischæmic congestion, undergoes softening, first red, and then yellow or white. Occasionally the softening of the clot leads to pyæmia.

Symptoms.—The symptoms are at first those of mental excitement, namely, intense headache and muscular spasm, shown as contractions in the limbs, or as convulsion, often beginning locally, according to the position of the congestion. These symptoms, after one or several days, are succeeded by those of depression; with coma, and dilatation of pupils. The coma may come on suddenly, and the first stage may be little marked. Convulsions, when present, often continue till death. When the superior longitudinal sinus is plugged, epistaxis, œdema of the forehead, and exophthalmos have sometimes been observed. When the lateral sinus is obstructed, there may be painful œdema behind the ear, and the jugular vein on that side has been noticed to be less full than on the other.

Diagnosis.—The diagnosis rests on the occurrence of severe cerebral symptoms in association with a causal condition, constitutional or local.

Prognosis.—This is always serious, death being, in most cases, speedy.

Treatment.—The indications for treatment are mostly causal. In primary thrombosis stimulants and nutritious diet are necessary, and tonics if they can be taken. In secondary thrombosis, occurring in robust individuals, leeching or cupping is recommended; purgatives should be given; and, in the less severe cases, a blister may be applied to the neck, and the utmost care taken to afford free exit for pent-up inflammatory products. Pain and convulsion are relieved most effectually by cold to the head.

W. R. Gowers.

BRAIN-FEVER. A name popularly applied to any kind of febrile state in which symptoms of cerebral excitement are prominent; as well as to cases of inflammatory disease of the brain or its membranes.

BREAK-BONE FEVER. A synonym for Dengue. *See* Dengue.

BREAST, Diseases of.—This subject will be treated under the following divisions:—

I. *Diseases before puberty*, in both sexes. II. *Diseases about the age of the establishment of puberty; and after that period*, in the female,—(A), in the *active* state of the gland; (B), in the *passive* state. III. *Diseases* affecting the rudimentary organ *in the male*. IV. *Diseases of the nipple.*

The diseases of an organ composed essentially of glandular structures have here to be described. The mammary gland is classed with those termed racemose; but it differs from every other organ in the body of a similar class, inasmuch as it only arrives at maturity when its function is to be subservient to the nourishment of the offspring. In its perfection it appears, normally, only in the female sex, and even then it does not become developed until the internal organs of generation are capable of performing their functions.

Hence, to describe systematically the diseases of the breast, it is requisite to treat of them not only in reference to sex, but also in relation to the different periods of life at which certain diseases appear. Briefly then, from a histological point of view, they occur: (*a*) in the rudimentary state of the gland; (*b*) in its mature state; (*c*) when it has become a secreting organ; (*d*) during a state of degeneration.

I. In the *rudimentary period* of the gland the tissues composing it are rarely liable to morbid derangement. Usually, soon after birth, especially in male infants, the rudimentary nipple and the skin of the region within the zone of the areola become slightly elevated and of a pink hue. In some infants a secretion, slightly milk-like, oozes from the ducts. In this state, the injudicious rubbing practised by the attendant excites inflammation, which, if not arrested by desistance from that pernicious interference, may advance to suppuration. When that happens, the usual local application of warmth and moisture suffices to give relief.

II. *About that age, in both sexes*, when the development of the generative organs advances with greater rapidity to maturity than in early life, the breast-gland enlarges, and may be painful, thus causing anxiety to the individual. Usually, symmetrical development takes place in the female; but, when the gland of one side takes precedence of that on the other, the circumstance need only be regarded as a departure from the ordinary rule, for no trouble will result, and in due time both will attain their normal proportions. In the male, pain or uneasiness sometimes occurs for a few days about this period, very often excited by the pressure of the dress. The removal of this cause is sufficient to arrest further mischief.

In the female the development of the breast having reached maturity, the gland is now associated by sympathetic influences communicated through nervous stimuli with the functions of the pelvic generative organs. This physiological fact should ever be remembered when investigating the nature of the morbid affections of this organ.

In a clinical point of view, it is essential to examine the diseases of the breast under the two states before mentioned, namely, (A) whilst the gland is undergoing metamorphosis into a secreting organ, and during lactation. (B) As a mature gland, but passive as regards its function.

Glancing at the various morbid states of the body of the gland as a whole, they may be divided, primarily, into two groups:—the *Functional* derangements; and the *Organic* or histological diseases.

We will now proceed to discuss these affections, as they are presented at the different periods mentioned above.

A. After conception the breasts soon begin to enlarge, and at their borders and surface minute pisiform indurations may be felt. Occasionally, but very rarely, this normal increase in bulk is attended with considerable pain and irritation extending throughout the nervous relations of the gland. The pain is referred to the back, neck, inside of arms, shoulders, and side of thorax, over, in fact, the area of distribution of those filaments which pass off to the skin from the same dorsal branches of the spinal nerves, the intercostals which send filaments to the breasts. It affords a good example of reflected irritation. This state usually occurs after the first conception, and in women of excitable, nervous temperament. Attention to ordinary hygienic measures during the progress of the metamorphosis of the organ into a secreting gland, with its accomplishment, affords relief to the pain. In large, lax, pendulous breasts, the separate lobes of which each is composed may excite apprehension of the existence of a tumour. But tumours composed of new tissue are so extremely rarely developed during pregnancy, that the greatest caution must be exercised in the diagnosis of their nature.

Very rarely, no change whatever in the breasts accompanies pregnancy, under which circumstances there is an absence of the secretion of milk after parturition—**Agalactia.**

Inflammation of the Breast.—Mastitis.

Ætiology.—Before lactation, inflammation of the breasts is very uncommon. Afterwards, on the contrary, it is very frequent. This morbid state is often the result of carelessness or ignorance on the part of the nurse. The slightest unusual fulness or 'knottiness' discovered after the infant has been sucking, and when the ducts and their terminal secreting vesicles should be empty, requires immediate attention. Congestion of a lobule or lobe with milk produces the nodule, and the cause of the impediment to its escape should be sought for. The state of the nipple is generally the cause of the difficulty. Either the orifice of a duct may be obstructed by epithelium, or a superficial ulceration around one exists. The morbid or defective states of the nipple are the most fruitful causes of inflammation and its results in the breast. Prophylactic measures should always be instituted when there is reason to fear that a defective development of the nipple will interfere with the free flow of the milk. Even with some mothers it would be advisable to resign the duty of suckling, rather than subject themselves to the almost certain misery arising from persistent and ineffectual attempts to do so. Inflammation, generally passing on to suppuration and abscess, either within the body of the breast or on its surface, is most frequent in primiparæ, and within the first month after parturition.

Symptoms.—First, hardness is felt, 'a knot,' in some part of the substance of the organ; this enlarges, and may attain to considerable dimensions before causing pain or even uneasiness. Next, pain is felt during suckling; this increases each time the infant sucks, and 'the draught' is produced. The integuments then become pink, and afterwards red, tense, shining; more or less of the breast feeling very inelastic, firm, prominent, and heavy. Pain is now often very severe, and great constitutional disturbance is excited. In the centre of the redness the skin becomes of a purplish tint, around this it is œdematous, and with the finger, at the centre of the purple zone, a slight depression and softening spot can be detected. An abscess now exists, and in proportion to the quantity of pus fluctuation is more or less marked. At the purple centre the cuticle has probably by this time separated from the cutis, and a vesicle containing serum, either yellow or slightly tinged with blood, indicates that ulceration of the cutis is proceeding, and that the pus will soon escape. The above is a brief description of the objective signs indicating the morbid processes noticeable in all cases of local inflammation advancing to and terminating in suppuration and abscess. It is not possible to state with any degree of exactness the period of time required for the accomplishment of these definite changes. It varies according to so many local and constitutional circumstances, that it would be idle to attempt to predict any certain definite period or stage for each phase. It will be more useful to describe the treatment by which the progress of the disease may be arrested or limited and its painful course mitigated.

Treatment.—Great attention should always be given to the nipple of primiparæ. In many women, this important division of the gland is very small and undeveloped, perhaps only on one side, so that the infant, especially if not very strong, has great difficulty in obtaining sufficient milk to appease the appetite, and its efforts cause pain in the part. This circumstance induces the mother to prefer suckling most with that breast the nipple of which is perfect, and the infant soon appreciates the advantages of that side. Consequently the gland-tissue of that breast having the imperfect nipple becomes congested. Every time the infant sucks it becomes worse, more and more pain and irritation are excited, the orifices of one or more of the ducts in the nipple become blocked, and perhaps the infant refuses to suck the breast. But the gland becomes more and more distended, the nipple deeply buried, until at last suckling is impracticable. Probably none of these increasing troubles have been stated to the attendant surgeon; and, when he is consulted, he finds the breast to be in the state above described. The perfect development of the nipple should be always a subject of anxious solicitude on the part of the obstetric practitioner. If that organ be imperfect, precautions should be taken to prevent the gland itself from becoming congested, and if the infant cannot draw the milk sufficiently, some mechanical means should be employed to effect this object. The nipple itself should be carefully examined. If its end be more than usually coated with a white secretion, or the openings of the ducts seem to be obstructed with an excess of epithelium, attempts may be made to remove it. If minute abrasions, ulcers, 'cracks or chaps,' are visible between the rugæ, some soothing application should be used. Frequent ablution with warm water, even the contact of a little moist cotton fibre covered with tissue gutta-percha, is very preferable to the dry dress; or, if there be much secretion from the glands on the nipple, after cleansing its surface, some dry powder, such as carbonate of magnesia, oxide of zinc, or starch powder is beneficial.

When actual congestion of the gland-tissue exists, mechanical means should be used to reduce it. Supporting the gland with strips of plaster and a bandage is sometimes very useful. When inflammation is excited, local applications of warmth and moisture are indicated, and the constitutional condition of the sufferer demands special attention. When suppuration has taken place, its relation to the adjacent parts and the exact site of the abscess when formed should be carefully examined. Great diversity in the progress, duration, and sufferings of the patient depends upon the locality of the pus. It may be situated over the body of the gland, within it, and beneath it. When overlying or superficial to the body of the breast, the course of the disease is rapid, the pus soon points and escapes, and the wound heals. In those cases the constitutional disturbance is usually trifling. Water-dressing before and after the escape of the pus is preferable to the heavy poultices usually employed. The entire organ may be supported with strips of adhesive plaster and a bandage during cicatrisation. But a bandage dexterously applied should be always used.

Both the local and constitutional symptoms are much more severe when inflammation affects the body of the gland, and pus collects between its lobes. The progress of the disease is tedious, pointing of the pus slow, and the exact spot at which it may reach the surface is for a long time doubtful. In the majority of cases it makes its way between the ducts and reaches the surface near the areola or within its area; usually to the sternal side of the nipple, where the gland tissue is thinnest. The surgeon should note this fact, for as soon as he can detect a softening of the cutis, by ulceration, he may, with advantage, make an incision at that spot, and thus give immediate relief by facilitating the escape of the pus. In these cases recurrent abscesses are not uncommon, and therefore the incision should be free, and its premature closure by adhesion must be avoided. All incisions should be made in a line parallel to the course of the ducts, never transversely to their axis. Manual pressure to hasten the escape of the pus is not admissible, the natural contractility of the tissues being quite sufficient for the purpose.

When the abscess forms behind the breast the local appearances are quite characteristic. The gland itself seems little involved, but it is pushed prominently forwards and seems to repose upon a cushion of fluid. To the touch the elasticity of the swelling is very striking, and, without producing additional pain, a slight bulging of the walls of the abscess may sometimes be produced at the periphery of the gland when, with the palm of the hand and outspread fingers, compression is made from the front backwards against the thorax. The patient should be recumbent. The pus in these cases often points somewhere around the borders of the body of the gland.

During the time occupied in the formation of a mammary abscess and its local treatment, the constitutional powers of the patient must be well supported, and the general health maintained by every means.

The *sequelæ* of suppuration in an organ composed of so much connective-tissue, and endowed with its peculiar function, frequently cause great trouble. They are protracted induration, sinuses, and fistulæ, through which last the milk persistently escapes. Induration of the whole or part of the breast subsides when lactation ceases, and the organ in due time resumes its healthy state. Sinuses and fistulæ may require incisions, but the ordinary plan for their cure should be adopted before having recourse to a treatment often involving much subsequent deformity.

At the time for weaning the infant inflammation rarely occurs. Considerable milk-congestion of the secreting structure may sometimes produce irritation and inconvenience, to be relieved by mechanically drawing the milk in just sufficient quantity only to diminish the fulness.

Galacticele.—An accumulation of milk, to which the above term is given, forms a tumour in the connective-tissue of the organ, and results from the bursting of a lactiferous tube. The swelling always appears first during lactation. It may vary in size from time to time; sometimes enlarging rapidly as suckling goes on. Two varieties are met with. In one form there is a single swelling near the nipple, quite superficial, and quickly recognizable by its objective signs. In the other there may be several swellings distinguishable in the substance of the gland, as well as on its surface, all of comparatively small size, very firm and globular. In the same gland they vary very much in size, and in the degree of resistance they offer to manipulation. The discrimination between these tumours and others in the breast is easy, if the surgeon is able to ascertain with exactness that the swelling appeared somewhat suddenly during suckling, and that its size varied conformably with that function.

In cases of long standing, the contents of the cyst become solid in proportion to the quantity of the fluid constituents of the milk absorbed, and the cyst wall itself is very often rigid and even may become gritty.

Treatment.—The treatment of this malady consists in cutting into the cyst, removing its contents, and allowing the wound to heal by granulation.

B. The diseases affecting the mature gland, in its *passive* state, *from the age of puberty to that period of life when the catamenia cease*, may be grouped as follows:—the *functional* affections, or those which are characterised by changes in the secreting portion of the gland, accompanied by more or less induration, inconvenience, and pain; the *organic*, or those diseases characterised by some new-growth, formation, or tissue-structure altogether a superaddition to the organ, and growing within its sphere of nutrition, often resembling, more or less, gland-structure in composition; and others the minute elements of which are nucleated cells of various shapes, definitely and diversely arranged.

In this state of the breast *inflammation* rarely occurs. Nevertheless, both the acute and chronic varieties of that morbid process terminating in abscess are met with, and careful discrimination is necessary to avoid mistaking such diseases for tissue-tumours, especially in patients above forty years old. The history of the case, tactile examination, and the variations occurring during the progress of the affection, commonly suffice for the detection of such cases. The treatment should be the same as for abscess in general.

Functional Derangements.—The functional derangements of the breast in its passive state demand special attention. They are characterised by a peculiar activity of its secreting portion, which undergoes structural changes of a specific kind. When the tissues composing a mature gland, but perfectly passive, are examined with a microscope, the cæcal terminations of the ducts are scarcely perceptible, and little else than fibre-tissue is seen. Here and there, perhaps, cæci may be detected containing minute aggregations of epithelium. But when, under some sympathetic excitement, with derangement of the functions of the pelvic generative organs, the secreting cells of the gland become active and are distended with epithelium, they induce more or less enlargement of the breast. But of such affections there is this important fact to be noticed. The whole breast need not be necessarily involved. On the contrary, one lobe only may be excited, and when this occurs the existence of a tumour is declared. When, after excision, such enlarged lobes are carefully examined with the microscope, normal gland-tissue is seen, the cæcal ends of the ducts are readily recognised, and their immediate association with the excretory ducts may be observed. The former are gorged with epithelium; and true gland-tissue, less its peculiar secretion, has been developed.

Symptoms.—Associated with this state of the tissues of the breast, the patient complains of pain, both locally and spread over a very wide area. To express as briefly as possible the superficial regions affected and over which pain is felt, the reader must be reminded of the distribution of the nerve-filaments of the lower cervical plexus, and of the dorsal from which the second, third, fourth, and fifth middle and anterior intercostal nerves pass off. From these, special filaments are distributed to the breast; and to the site of exit of one or more of them at the intercostal foramina, the course of the pain is referred by the patient. The skin of the neck, shoulder, side of thorax, and inside of arm receives filaments from the same source. Hence an explanation of the widely-diffused pain.

It is of the first importance to discriminate between this state of the gland tissue and substantial new growths, especially because the latter cannot be removed by natural processes, whilst the former most probably will be. The objective signs are the following:—to the touch the excited gland-tissue is nodular, irregular over its surface, much identified and mingled with the body of the organ. If the whole breast be large and relaxed, the tips of the fingers may be insinuated between the borders of the indurated lobe and the lobes not affected. If the entire body of the gland be morbidly firm, it feels like a disc-shaped mass lying on the thorax, under the borders of which the fingers can be pressed. Occasionally, at one or more spots along the periphery of the gland irregular nodules are perceptible, projecting into the connective-tissue around them. When one lobe is affected, the shape of the induration corresponding with that of a lobe, namely, broad at the periphery and gradually narrowing towards the areola, may be detected. Pain as a subjective indication is of great assistance in the diagnostication of these cases; but the source and course of the pain must be carefully traced. Generally manipulation of the induration produces increased pain; occasionally touching the induration, even however gently, is intolerable, and persistence in or repetition of the act strongly opposed by the sufferer. Light pressure should be made over the intercostal foramina, both the middle and anterior, when the pain excited thereby will correspond with the nerve-filaments of the affected lobe. Usually, pressure along the upper dorsal spinous processes excites pain also. The morbid affections above described occur in single women, married but sterile females, and young widows, at ages between twenty years and forty. More or less disturbance of the catamenia co-exists, either in relation to the frequency or quantity of the discharge. The patient complains of languor, inability for bodily or mental exertion, and is desponding and often alarmed for the possible consequences of the affection suggested by sympathising friends. She becomes irritable, restless at night, loses appetite for food, as well as all desire for social enjoyments, and becomes highly susceptible and emotional.

Diagnosis.—An exact diagnosis of these histological changes may be made if the manipulator examines the organ methodically. He should, first, gently grasp the induration between the thumb and fingers, when it will be distinctly appreciable. Afterwards, placing the palmar surface of the fingers over the surface of the breast and gently pressing backwards against the thorax, the induration cannot be detected. Should there still remain any doubt on the subject, let the patient recline on her opposite side on a sofa, and in this posture, if there exists a substantial new-growth, the integument is usually elevated by it.

Treatment.—The treatment of these cases consists in attention to the general health. Every hygienic direction should be enjoined, and such medicines administered as conduce to its improvement. Local soothing applications are usually futile, and, except in those cases of extreme pain, are not advisable, since it is desirable to avoid manipulation of the part, and the frequent recurrence of the patient's thoughts to it. Should the gland be heavy and pendulous, a suspensory bandage, as thin as possible, may be adjusted.

New Formations.—We shall next describe the diseases of the mature gland arising from the development of new formations—either of tissues constituting new-growths; or of conditions causing collections of fluid of distinct and specific kinds. All of these may be thus arranged in three groups:—first, the *fluid* tumours; second, the *solid*: and, third, those composed of both *solid and fluid*.

A. **Cysts.**—The *fluid tumours*, commonly termed *cystic*, consist of a membranous sac with its contents. Now, calling to mind the histological divisions of the breast, and dwelling on the structural differences between its parts, the secreting apparatus and the excretory, there is little difficulty in assigning to the cysts their true histological affinities. Thus there are cysts associated with the secreting apparatus; others with the excretory, the ducts; and some due to the extravasation of the gland's secretion, the milk, into the connective tissue. Effusions of blood also give rise to the development of cysts, either independently of other diseases or associated with them. Another variety of cyst is produced by the development of entozoa, notably of echinococcus hominis. An ordinary examination of the fluid derived from these cysts at once establishes the fact that heat and the admixture of nitric acid produce coagulation in that abstracted from some of them, whilst that from other cysts remains unaffected by the treatment. The cysts are thus divisible by the nature of their contents into two distinctly defined groups:—

a. Those containing fluid without the admixture of any coagulable element.

b. Those enclosing fluid which does contain coagulable material. Other characteristics of these two fluids are not less conspicuous.

From an objective point of view all cystic tumours of this gland may be classed in two groups, thus:—first, those associated with its ducts, the evidence of which is afforded by the escape of fluid at the nipple; and secondly, those not connected with the ducts by any such evidence.

The following tabular arrangement will place before the reader, at a glance, all the varieties of cysts met with in the breast.

I. *Cysts associated with the ducts*, communicating and connected with them.

1. Containing milk.
2. Enclosing growths; with serum, coagulable and often tinged with blood:—
    a. Adenoid growths.
    b. Granulation cell-growths.
    c. Cancer.

Cysts not connected with the ducts.

1. Surrounding effused blood.
2. Enclosing milk.
3. Simple cysts. } Fluid not coagulable.
4. Entozoon cysts. }
5. Investing growths; with serum coagulable, tinged with blood and containing cholesterine:—
    a. Adenoid growths.
    b. Granulation cell-growths.
    c. Cancer.

1. We have described above, under the name *galacticele*, a tumour observed during suckling and composed of milk. But, occasionally, the surgeon is consulted about a swelling which, at first sight, would seem to have no reference to that function. Nevertheless the milk, or all that remains of that secretion, constitutes its entire bulk. If exact enquiry be made, the patient states that a tumour has existed, unaccompanied by pain, from the period of the last weaning, perhaps not having been observed until the gland ceased to secrete, and that its size slowly diminished until a certain period, since which it has remained of unvarying bulk. This decrease is due to the absorption of the serum of the milk, and the solid parts remain. The cyst should be incised, the contents removed, and the wound allowed to heal by granulation.

Cysts containing the solid parts of the milk are sometimes associated with perfectly new growths of the glandular type.

2. True *sero-cysts*, that is to say, a collection of serum circumscribed by a fibrous membrane, are frequently met with, and are most commonly associated with adenoid, granulation, and cancerous growths. They occur in the breasts of middle-aged women. The fluid which these cysts contain is sometimes quite clear, and of a yellow tint; at others it is tinged with blood-colouring matter, and is turbid. It always contains some constituent coagulable by heat and the admixture of nitric acid. These are the exudation-cysts of the mammary gland. After the fluid has been removed with a trocar and canula the cyst soon refills.

3. Other cysts containing a fluid like serum, until its composition is carefully examined, are developed in the breast, and are probably associated immediately with the secreting part of the gland. For the sake of identification the writer would designate them *mucous cysts*. The contained fluid is not coagulable by either heat or acid. Its colour is brown, more or less inclining to a greenish hue; it is opalescent, of variable specific gravity—about 1020, rather greasy when rubbed between the fingers, and exhibits an alkaline reaction. When sufficient quantity is collected in a test-tube and allowed to cool, in a few hours the lowermost stratum of the fluid becomes clearer than the upper. The uppermost always remains opalescent. If a little of this last be examined with a microscope, oil globules are seen, together with the bodies called colostrum cells. The greasy nature of the fluid can be detected by smearing a drop of it on a piece of glass.

The development of these cysts is not very common. We may here remark that they seem to have escaped the observation of surgeons, as no special notice of them occurs in the most recent monographs. Yet they are so distinctly separated from all the other cysts which are formed in the breast, in respect of the composition of their fluid contents, their progress, and their prognosis, that they constitute a marked, distinct, and isolated class We meet with them in the breasts of single women, in married but sterile females, and in widows between forty and fifty years of age. Usually they are accidentally discovered in any quarter of the gland when about an inch in diameter. Their shape is globular or ovoid; to the touch elasticity is the main feature, and if sufficiently large and superficial, fluctuation may be detected. In some instances the tips of the fingers may be insinuated into a sort of furrow around them. Pain is rarely complained of. The treatment consists in emptying the cyst with a trocar and canula. After this the fluid does not again form. These cysts usually appear singly and in one breast only, but the writer has seen a patient in whom they were multiple and on both sides.

4. Cysts containing blood—*hæmatomata*, are very rarely formed in the breast, except in association with some new-growth from which blood, or more often bloody serum, oozes.

5. True *entozoa-cysts* are developed in the breast. They are certainly rare, and cannot be distinguished from other cysts until incised. Extirpation by excision is the speediest means of effecting a cure.

B. **Solid Tumours.**—We have next to describe the solid tumours. These are essentially new growths of tissue superadded to the normal gland. Generally, therefore, a characteristic feature of the existence of such growths is an increased bulk of the affected organ; another, the firmness or resistance to pressure with the fingers when contrasted with the group of tumours before described. The solid tumours have long been classed in regard to their local and constitutional effects, and their results on the life of the individual affected with them, into two groups—the *innocent* or harmless; and the *malignant* or life-destroying.

1. *Adenoma.*—In the first class are placed those growths more or less closely resembling in their tissues those composing the glandular structure of the breast. Various terms have been assigned to these tumours, namely, Chronic mammary tumours, Pancreatic Sarcoma, Tumeur adénoide, Corps fibreux, Hypertrophie partielle, Mammary glandular tumour, Fibroma, Adenocele. Their composition is chiefly fibre-tissue, the cæci or acini of secreting structures, with more or less distinctly marked traces of ducts, being interspersed throughout the mass. The elementary nucleated cells are those of the gland and fibre-tissues.

Adenomata are developed in the breasts of young, unmarried women from the age of puberty upwards; rarely after thirty, but very commonly before that age. They may be intraglandular, occupying the substance or body of the gland, and having the normal gland-tissue investing them. In other instances they seem to be attached by a kind of pedicle either to its surface or margin. In every instance they are placed within the fascial investment of the organ. When attached, as just described, their remarkable mobility, slight lobulation of surface, and firmness, coupled with the youth of the patient, are sufficient indications of the harmlessness of their nature. Usually they occur singly and in one breast; they may be multiple and in both breasts. The only means by which they can be removed is excision. However large the tumour, its removal should be always attempted without cutting away any portion of the normal breast. In most cases this can be done, especially if the patient be youthful and the growth of medium size, even should it be developed in the body of the gland and extend through it to the pectoral muscle. After thirty-five years of age it is expedient to remove the breast as well. Want of space precludes a lengthened histological description of these growths. It must suffice to state that a section shows a solid, uniform surface, divided into lobes and lobules by fibrous septa, sometimes slightly broken up by fissures or clefts in which there appears a little clear tenacious fluid. The growth is often very succulent, at other times only moist; its hue may be greyish, yellow or almost white. Its vascularity is scarcely perceptible. The prognosis of these cases is invariably favourable. In many instances excision is not necessary, and the surgeon must be guided in recommending an operation by the exigencies of the case specially under observation.

2. *Fatty tumour.*—Lipomata or masses of adipose tissue are developed in the breast, or rather in relation with it, to speak with accuracy. They are characterised by the usual indications, and require no special mention.

3. *Nævus.*—It may be questioned whether nævus, or a growth of true trabecular vascular fibre-tissue, is ever developed in the substance of the breast, that is to say, in the gland-tissue. The integument around the mammilla may certainly be so affected in early life before the development of the gland, and a subcutaneous nævus may exist at the site of the future organ; but to describe such a growth, in a girl of *six* years old, as a recent writer has done, as an example in which the whole organ was like a sponge and as large as half an orange, must be regarded as an error in pathology.

4. *Fibro-plastic.*—Under the term 'fibro-plastic' we include a group of new-growths composed of elementary nucleated cells of a fusiform or oval shape, disposed in a stroma of more or less fibre-tissue. They are developed in women of middle age, increase rapidly, and after excision are liable to grow again.

5. *Colloid.*—Colloid growths are very rarely met with in the breast. They appear in middle life, and are not distinguishable from other solid tumours until after excision.

6. *Carcinoma.*—Carcinoma, commonly called cancer, is developed in the breast in two distinct forms. The first, and most common, is that variety which is due to infiltration of the normal tissues of the gland by the elementary cells of cancer. It constitutes the *scirrhous* variety, the *carcinoma fibrosum* of the present day. The second is that kind which is produced by the development of a mass of true cancer-growth, and is termed *tuberous*, often *medullary*. Both varieties are met with in women after forty years of age, but the first much the most fre-

quently. Previously to that age the disease is rare; from forty to fifty it is most commonly seen; and it becomes relatively less frequent as age advances. A larger number of married women are affected by it than single, and prolific women who have suckled their children are quite as prone to the disease as the sterile or those who have not suckled.

SYMPTOMS.—*Scirrhous* cancer commences in any region of the mammary gland, although most frequently perhaps in the axillary segment. A small, firm nodule is usually accidentally discovered, without the attention of the patient having been attracted to it by pain. Rarely, the whole organ is simultaneously infiltrated, but most frequently one lobe only is affected. The infiltration is often central in the body of the gland, especially when the organ is atrophied, and the reverse occurs when the extreme edge of a lobe is affected at its periphery. The infiltration may steadily increase until the whole breast forms a rigid, solid mass, but most frequently the larger part of the organ remains unaffected. The disease gives rise by its contraction to much deformity of the region, to dimpling, corrugation, and irregularities of the otherwise rotund integumental surface. The nipple, just in proportion to the effect of the growth upon the ducts, becomes retracted or drawn towards the tumour. Such are the ordinary objective signs of infiltrating cancer in its early stage. The progress made by the disease is subject to very remarkable variations in different individuals, and the stage above described may be long delayed. In some cases many months or even years may elapse before the growth assumes any grave importance. Sooner or later, however, the integument over the growth becomes adherent to it, infiltrated, and red, and advances towards ulceration. An ulcer now forms, the edges of which are everted, ragged, and attached to the growth beneath. A hole extending into the tumour becomes deeper and deeper; ichorous discharges, more or less profuse, continue without much pain; and the patient becomes at last worn-out, or succumbs to the ravages of a cancerous growth in a vital organ.

The *tuberous* variety commences in a small circumscribed, globular nodule in the body of the gland; grows rapidly; separates the lobes of the organ; extends equally in all directions; and becomes adherent to the skin, which commonly sloughs and allows of a protruding, fungating mass.

In both varieties the axillary lymphatic glands sooner or later become involved in the disease, which may also spread to those in the neck and within the thorax.

TREATMENT.—Local applications exert little if any influence on the growth of cancer, but certainly those which reduce the local temperature are the best. The vital powers of the patient should be supported as much as possible by hygienic measures, and especially by ferruginous tonics. The removal of the primary growth before the contamination of the lymphatic system is of great importance, but whether by excision with a scalpel, or by means of escharotics, space will not admit of discussing. The writer inclines to the first method in the majority of cases.

C. **Mixed Tumours.**—To the group of mixed tumours belong:—1 Those composed of cysts, intracystic growths, and solid interspersed masses of new tissue. 2 *Granulation cysts*—cysts with growths attached to their walls, the elementary tissues of which resemble those of ordinary granulation-growths—whence the term applied to them. 3. Cysts, so-called, often formed upon the surface of cancers, in consequence of the slow exudation of serum from the growth itself.

1. Tumours of the first class belong pathologically to the group of adenoid formations, and although they differ so remarkably in their external objective appearances, they are, when unalloyed with other growths, perfectly harmless. The sero-cystic disease of Brodie, and the proliferous cysts of Paget belong to this class.

2. The *granulation-cystic* growths constitute a class of themselves. It is only of late years that attention has been attracted to them. They are rarely met with, and when pure are unattended by untoward circumstances.

3. To the third class belongs a group of cases thoroughly cancerous in their nature, and differing only from the ordinary forms of that disease by the accidental formation of cysts. *See* TUMOURS.

III. Diseases of the Male Breast.—The male has sometimes a well-developed mammary gland, and the part is subject to the same diseases as the female. But the simple enlargement of the organ is harmless, and should not be interfered with. At the age of puberty the mammary region often becomes painful, owing in part to the pressure of the dress upon the mammilla and the rudimentary organ. Inflammation followed by suppuration has been observed at this time.

IV. Diseases of the Nipple.—A *defective formation* of the nipple is of grave importance, and when it exists measures should be adopted to assist its elongation. This is to be done by using an exhausting glass, such as those employed to empty the gland of milk.

Inflammation and its effects produce much suffering, and at the period of suckling frequently excite deep-seated mischief. The small ulcers, called 'cracks,' 'chaps,' &c., which form between the rugæ on the apex and sides of the nipple, may be cured with an application of water-dressing, or by powdering the part with carbonate of magnesia or oxide of zinc, far more readily than with ointments.

Pendulous cutaneous growths occur on the nipple, and should be excised.

Cystic follicular tumours are sometimes seen within the zone of the areola. *See* NIPPLE, Diseases of.

JOHN BIRKETT.

BREATH, The.—The expired air, or what is familiarly termed *the breath*, is important both from an ætiological and a clinical point of view, and the object of the present article is to present a brief summary of the main facts relating to this subject, with which, for practical purposes, it is necessary to be acquainted.

1. The ætiological relations of the breath will be more appropriately discussed under the general subject of ætiology (*see* DISEASE, Causes of), but a few of the more striking examples of the manner in which it affects the health may be

given here. It is well known that the expired air, if re-breathed by the same individual without having been purified by a proper admixture with atmospheric air, will produce serious effects upon the economy, and will ultimately lead to death by asphyxia. Again, the breath of a number of persons collected together in an ill-ventilated place may prove injurious to such individuals; the impure atmosphere thus generated tends to lower the general health, to retard the development of the young, to increase the virulence of infectious diseases, and to predispose to pulmonary affections. Indeed, some writers regard re-breathed air as one of the most prominent causes of pulmonary phthisis. Further, undoubtedly the expired air is a most important channel by which the poison of different infective diseases—for example, that of measles, scarlatina, or diphtheria—is conveyed from one individual to another. It has been affirmed that phthisis can be transmitted directly in this manner, but adequate proof of this statement is entirely wanting.

2. In a clinical point of view, the expired air may afford useful information in diagnosis; or it may present characters giving important indications for prognosis and treatment. It might be requisite in different cases to submit the breath to a more or less complete examination, and the following outline will serve to suggest the particulars to which attention should be directed in this examination, and to point out the practical uses which it may serve.

a. The breath has been made use of to distinguish between *real* and *apparent death.* For this purpose a delicate feather or a light is held before the mouth or nostrils, and it is noted whether either of these is disturbed; or a cold mirror is placed before the mouth, when, if breathing is going on, its surface will be clouded by the moisture condensed upon it. These tests are, however, not considered very reliable.

b. The *temperature* of the expired air may be important to notice. In some conditions it becomes exceedingly cold, and this may be readily perceptible to the hand, the breath having a chill feel, or it may be visible in consequence of the moisture in the expired air being condensed, even when the surrounding atmosphere is warm. This phenomenon is observed, for instance, in the collapse-stage of cholera. On the other hand, the temperature of the breath may be raised more or less, as in febrile diseases.

c. Chemical examination of the breath may prove of service, and it is probable that this might afford useful information, if it were resorted to more frequently than is the custom at present. In the first place this examination may be employed to determine the proportion of carbonic acid present. In certain affections, as during an attack of asthma, or in cases of extensive bronchitis, the amount of carbonic acid in the expired air is more or less increased; in others, such as in the collapse-stage of cholera, this ingredient may be very deficient. Again, chemical examination of the breath may reveal the presence of a poison in the system, introduced from without, for example, hydrocyanic acid. It has also been employed to show the existence of deleterious products generated within the body, especially in cases of renal disease. It is affirmed that ammonia may be detected in the breath in some cases of this kind, by holding a glass rod dipped in hydrochloric acid before the mouth, the ammonia being a product of the decomposition of urea.

d. Microscopic examination of the expired air has been attempted, but at present no results of practical value have been obtained.

e. The *odour* of the breath is the most important character demanding attention in a practical point of view. It is easily recognised, and the practitioner should always be on the alert to notice the smell of the breath of a patient, as this often affords material aid in diagnosis, and may even reveal certain morbid conditions which otherwise are liable to be entirely overlooked. Besides, patients not uncommonly seek advice on account of 'foulness of breath,' as a symptom for which they require special treatment. The following summary will indicate the principal circumstances under which this clinical phenomenon may prove of service in diagnosis, and in the course of the remarks it will be pointed out in what conditions the breath is particularly offensive. At the outset it must be observed that in some individuals the breath seems to have naturally a more or less disagreeable odour, which cannot be referred to any particular cause, and this amounts occasionally to extreme foulness. In females this may only be noticed at certain periods, and in some instances it seems to pass off in course of time. Again, it must be borne in mind that the breath is frequently unpleasant, either temporarily or constantly, from persons eating certain articles of food, or indulging in certain habits, such as excessive smoking, chewing tobacco, &c.

(i.) The odour of the expired air may aid in recognising poisons in the system. The smell of prussic acid or laudanum, for instance, may be revealed when either of these is present in the stomach. Alcohol, however, chiefly demands attention in this relationship. In cases of acute alcoholic poisoning, the odour of the alcohol or of its products is at once apparent; and in persons who are found in a state of unconsciousness, the cause of which is not known, the smell of the breath is made use of as one of the diagnostic signs of drunkenness, though it must be taken with great caution. It is in the chronic forms of alcoholism that the breath gives the most valuable information. In very marked cases of chronic alcoholism it has an intensely foul odour, which is quite characteristic; but it gives extremely important indications in less confirmed cases, where the other symptoms of alcoholism are not so apparent; and especially does it enable us to detect dram-drinkers, and to explain the symptoms of which they so frequently complain. These persons, if their habits are inquired into, generally give themselves an excellent character for temperance, and seem entirely to forget that those with whom they come into contact are endowed with organs of smell. Again, the breath may reveal the presence of certain metallic poisons in the system, of which mercury is the most important example, but lead may also affect its odour. The expired air is said to present the odour of ammonia in exceptional instances of uræmia, due to the exhalation of carbonate of ammonia derived from the decomposition of urea.

(ii.) The breath has a peculiar, or more or less disagreeable odour, in connexion with several diseases. That which is associated with the febrile condition is well known. In various disorders of the digestive organs the breath is often very offensive, but it is not practicable to refer any particular odour to particular diseases of either of these organs; it may, however, be affirmed that an unpleasant smell is frequently associated with habitual constipation. In cases of stercoraceous vomiting the breath may have a fæcal odour. In this relation it may be mentioned that in some cases of phthisis the writer has noticed a sickly smell of the breath which is quite characteristic, and which seems to depend upon the state of the stomach. In cases of cerebral diseases also, the breath often becomes exceedingly offensive, on account of the condition of the alimentary canal. Local morbid conditions about the mouth, throat, or nasal cavities constitute a most important class of affections which influence the odour of the breath; in many cases it becomes extremely foul, and may be quite peculiar in its characters. Among these conditions should be specially mentioned want of cleanliness of the mouth and teeth; decayed teeth; diseased bone in the mouth or nose; ulceration or gangrene about the mouth, especially cancrum oris, and gangrenous ulceration along the gums; suppuration, ulceration, or gangrene in the throat, either of local origin, or associated with syphilis, scarlatina, diphtheria, &c.; ulceration of the nasal mucous membrane, and chronic ozæna; and malignant disease. The smell of the breath is of special value in drawing attention to some of these conditions, for they may exist without giving rise to any local symptoms whatever, and the patient may be quite unconscious that there is anything wrong. Several striking illustrations of this statement have come under the writer's observation. Again, certain conditions of the respiratory organs are liable to affect the odour of the expired air, and may render it unbearably fœtid. Among these may be mentioned sloughing ulceration about the larynx, pulmonary gangrene in any form, and the decomposition of retained morbid products in dilated bronchial tubes or in certain cavities. Here, again, the smell of the expired air may reveal what otherwise is liable to be entirely overlooked, and especially when the patient coughs, so as to expel some of the retained air out of the lungs. Lastly, the breath may have a peculiar odour in some special diseases, such as pyæmia and diabetes.

TREATMENT.—It is only intended here to offer a few remarks as to the treatment of *foulness of breath*. The first great indication is, of course, to seek out the cause of this symptom, and endeavour to remove or remedy this, by which in a large proportion of cases a cure may be readily effected. The habits should be duly regulated; the mouth and teeth properly cleansed; the alimentary canal maintained in good order; and any special affection requiring treatment attended to. When unpleasant breath depends on the stomach, it may often be improved by taking charcoal powder or biscuits, at the same time remedies being employed suitable for the particular affection present, and calculated to promote the functions of the alimentary canal, the bowels being also kept freely open. When the bad smell depends on local causes, it may be diminished by the use of antiseptic mouth-washes and gargles, such as solution of Condy's fluid, carbolic acid or creasote. Antiseptic inhalations are indicated when the respiratory organs are accountable for fœtor of breath.

FREDERICK T. ROBERTS.

BREATHING, Disorders of. *See* RESPIRATION, Disorders of.

BRIGHT'S DISEASE.—The term *Bright's Disease* is now universally recognised as generic, and as including at least three different diseases of the kidney. Each of these maladies involves chiefly one of the individual structural elements of the organ, and only secondarily affects the others. There is thus a disease originating respectively in the uriniferous tubules, in the blood-vessels and particularly in the Malpighian tufts, and in the fibrous stroma. That which originates in the tubules is always inflammatory in its character, although the inflammation may be *acute* or *chronic*; that which commences in the vessels consists in a peculiar degenerative change, the so-called waxy, lardaceous, albuminoid, or amyloid degeneration; that which is proper to the stroma is an extremely chronic process, supposed by many to be inflammatory, but as it appears to others, rather of an hypertrophic character. In the following article are described:

I. The *inflammatory affection*, affecting the tubules, or the stroma, or both.

II. The *waxy* or *amyloid affection*, originating in the vessels.

III. The *cirrhotic* or *gouty affection*, originating in the fibrous stroma.

DEFINITIONS.—I. *Inflammatory Bright's disease* is an acute or chronic affection of the kidneys; caused by exposure to cold, and by scarlatinal and other blood-poisons; consisting in inflammation of the elements, passing through various stages of transformation, viz. inflammatory enlargement, fatty degeneration, and atrophy; characterised in the earlier stages by diminution of urine, albuminuria, frequently hæmaturia, tube-casts, and dropsy; in the later stages by the same symptoms, in a more or less marked degree, with secondary changes in the heart, blood-vessels, and other organs; terminating frequently in recovery in the early stage, rarely in the later, often in death by dropsy, uræmia, or intercurrent affections.

II. *Waxy Bright's disease* is a chronic affection of the kidney, caused by phthisis, syphilis, caries, suppuration, and other exhausting conditions; consisting in waxy or amyloid degeneration of the Malpighian bodies, small arteries, and sometimes the basement membrane, with, in many cases, transudation into the tubules; passing through various stages of transformation, viz. simple degeneration, enlargement from transudation, and atrophy; characterised by a large flow of albuminous urine of low specific gravity, and absence of dropsy; often attended by evidences of waxy disease of other organs, particularly the liver, spleen, and intestinal canal; resulting probably in some cases in recovery, usually in death by exhaustion, uræmia, or coexisting affections of the kidneys and other organs.

III. *Cirrhotic Bright's disease* is a chronic affection of the kidney, caused generally by the abuse of alcohol, sometimes by the poison of gout, occasionally by plumbism, and by unknown conditions; consisting in increase of the fibrous stroma, with thickening of the capsule, and ultimate atrophy of the organ; characterised by a very insidious commencement, by the absence of the early symptoms of either of the other forms, by albuminuria, at first slight, but possibly absent, and by the ultimate appearance of enlargement of the heart, polyuria, albuminuric retinitis, œdema of the lungs, and uræmia; resulting ultimately in death from uræmia, œdema of the lungs, or other intercurrent affections.

Ætiology.—I. Of the *inflammatory form.* Cold is the commonest cause in the adult. It acts especially on those who have been exposed to its influence whilst perspiring. It frequently contributes towards the production of the disease in persons otherwise predisposed. Various blood-diseases, while they induce temporary albuminuria along with their more ordinary symptoms, have renal inflammation as a common sequela. Among these scarlatina occupies the first place, diphtheria stands next in order, followed by erysipelas, measles, pyæmia, typhus, ague, acute rheumatism, and pneumonia. Many of these maladies being most common in childhood, it follows that in the earlier years of life they are the chief causes of inflammatory Bright's disease. Pregnancy, heart-disease, gout, and malaria contribute towards its production in some cases; and the undue use of cantharides, turpentine, or alcohol may also be reckoned as causes.

II. Of the *waxy form.* Constitutional syphilis, phthisis, prolonged suppuration, caries or necrosis of bone, and other exhausting diseases, such as cancer and chronic rheumatism, induce this degeneration. There is at present no satisfactory evidence as to the precise connexion between these influences and the morbid process.

III. Of the *cirrhotic form.* The commonest cause is the abuse of alcohol, particularly in the form of ardent spirits. After this, though at a long interval, rank gout and lead-poisoning. Congestion from cardiac disease is also by many authorities, but erroneously, held to be a cause. (*See* Kidneys, Congestion of.) As experience shows that the disease is often met with in people who have neither indulged in alcohol, been exposed to lead, nor suffered from gout, it is obvious that other efficient though yet undiscovered causes must exist.

Anatomical Characters.—I. Of the *inflammatory form.* When a case of this kind is prolonged, the renal disease passes through several conditions, which, for convenience of description, may be divided into three stages. (*a*) *Stage of active inflammation.* In this stage the kidney is enlarged; its capsule strips off readily; its surface appears more or less red, sometimes of a deep purple colour; and occasionally extravasations of blood are present in its substance. On section the cortical substance is found to be relatively increased in bulk. Its vessels, as well as those of the cones, are congested. The structure appears somewhat coarser than natural, while the convoluted tubules often present a swollen opaque appearance, and occasionally contain blood. On microscopic examination the congestion of the vessels becomes very apparent, and the tubules are found to be dark and opaque, their lumen being frequently occluded. The individual epithelial cells are granular, and in a state of cloudy swelling. In some cases almost all the tubules appear affected, in others comparatively few. The enlargement of the organ is in part due to congestion, in part to exudation into the tubules. As the exudation increases the congestion becomes less marked, so that in the later period of this stage the kidney appears paler and more opaque. Unless recovery or death takes place, this condition passes into (*b*) The *second stage*, that of *fatty transformation.* In this stage the organ is still enlarged. Its capsule strips off readily; the surface often presents stellate veins, and its colour is mottled. At this time extravasations are very rarely observed, but there are alternating patches of yellowish opaque sebaceous-looking material, mingled with more natural structure. On section the cortical substance is seen to be relatively increased. There is no congestion of the vessels, and the Malpighian bodies are not prominent. The convoluted tubules are in many parts occupied by the sebum-like material, and sometimes the straight tubules present the same appearance. On microscopic examination the tubules alone are found affected. Many of them present under low powers a black appearance, due to fatty degeneration of the contents of the tubules. It is in the cells alone that this change occurs, and not, so far as the writer has seen, in the free exudation which binds the cells together. Many of the tubules are completely blocked up by this material; and sometimes in making the section there is such an amount of oil set free, that it permeates the whole structure of the organ, and is liable to produce the impression that the fatty degeneration is universal. This condition may be developed within a week or two of the commencement of the inflammation, and it may continue for years. During the whole course of the second stage it must be understood that inflammatory action is going on, although much less acutely than at first, and less widely diffused. The disease is sometimes recovered from, and if the patient survive long enough it passes into (*c*) The *third stage*, that of *atrophy.* The organ is then reduced to or even below the natural size. Its capsule strips off with little difficulty, and without tearing the surface. The surface is uneven; it rarely appears coarsely granular, as in the cirrhotic form, but rather presents a series of depressions, which give it an uneven or finely granular character. Its colour is very similar to that described as occurring in the second stage, but there is less of the sebaceous-looking material. On section the cortical substance is found relatively diminished. The Malpighian bodies are not prominent. The tissue feels more dense; and many of the tubules are occupied by sebaceous-looking material. The blood-vessels,

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and particularly the small arteries, are sclerosed; the intima and the adventitia are frequently, the middle coat almost invariably, thickened. The fibrous stroma is relatively increased, especially towards the surface of the organ, and the tubules may be traced in different stages of atrophy. On close inspection that atrophy is found to result not from pressure of the fibrous stroma, but from molecular absorption of the contents of the tubules. Besides the typical form of the inflammatory affection just described, notice should be taken of other varieties, such as the *glomerulo-nephritis* of Klebs, in which the glomeruli are especially affected. The anatomical changes met with in other organs are described along with the complications.

II. Of the *waxy* or *amyloid form*. This chronic morbid process may also, for convenience of description, be divided into three stages. Of these the first is, (*a*) *The stage of degeneration proper*, in which the organ presents an almost normal appearance. The size is natural; the capsule strips off readily; and the colour is not altered. On section all appears normal, excepting that the Malpighian tufts, without being congested, are prominent, and in certain lights may be seen even by the naked eye to present dim translucency characteristic of waxy degeneration. On applying a little aqueous solution of iodine, the Malpighian tufts and the small arteries assume a peculiar mahogany hue. On examination with the microscope, the stroma and tubules are found to be healthy, the vascular structures being alone affected. The affection is often first seen and is most distinct in the middle coat of the arteries, the swollen transverse fibres taking on the colour, and producing what has been described as the ipecacuanha-root appearance. How long this condition may last without the tubules becoming affected it is impossible at present to say, for it has only been met with in patients who had died of one or other of the causal complications while the renal malady was still in an early stage. Sooner or later it passes, however into the condition most commonly met with, (*b*) the *second stage*, that of *degeneration with secondary changes in the tubules*. In this condition the organ is enlarged. Its capsule strips off readily, the surface is smooth and pale, presenting, in pure examples, little or no mottling. On section the cortical substance appears relatively increased, and looks much paler than the cones. The structure usually is denser than natural. The vessels appear prominent, and the Malpighian tufts resemble minute grains of boiled sago. On the addition of iodine the degenerated parts become characteristically coloured, and stand out prominently from the tubular tissue, which does not exhibit the characteristic reaction. On microscopic examination the vessels are found altered as in the earlier stage, but the change is more advanced. The stroma is normal, but many of the tubules are altered. Some are blocked up by a dimly translucent, wax-like material, which however does not assume the mahogany colour on the addition of iodine. The epithelium in many of the tubules presents a finely granular appearance, and occasionally is somewhat fatty, but the epithelium and the basement membrane very rarely present the characteristic reaction. This change in the tubules is thus secondary to the degeneration proper, which is confined to the vessels, and these secondary changes consist in some alteration of the nutrition of the epithelium, with exudation or transudation of coagulable material into the lumen of the tubes. This condition may last for years, but should the patient live long enough it passes into (*c*) the *third stage*, that of *atrophy*. The organ is then below the normal size; the capsule strips off readily; the surface presents an uneven granular appearance, and is pale. On section the cortical substance is found relatively diminished. Its small arteries are prominent and thickened; its Malpighian bodies are very conspicuous, and are grouped together in consequence of the atrophy of the intervening structure. The stroma is relatively increased, and many of the tubules are destroyed, while of those which remain not a few present the characters above described as being met with in the second stage. The organ may, in extreme cases, be diminished to less than half its natural size.

III. Of the *cirrhotic form*. The course of this affection is even more chronic than that of the waxy form. It consists essentially in an increased growth of the fibrous stroma, with secondary changes in the tubules and vessels. In an early stage the organ may be found of fully the natural size. The capsule strips off less readily than in health. The surface is somewhat uneven, and may present cysts. On section the cortical substance is relatively enlarged, and this is due merely to an increase of the stroma, not to any change in the vessels or in the tubules. But it is in the more advanced stages that the disease is commonly seen. Then the organ is reduced in bulk, it may be slightly, it may be to one-fourth of its normal size. Its capsule cannot be peeled off without tearing the gland. The surface is uneven and granular, and often of a reddish colour. On section the cortical substance is found relatively diminished, its structure being dense and fibrous. The small arteries are thickened and very prominent, all their coats, but especially the middle, being increased in volume. Many of the tubules are atrophied, but the epithelium of such as are not involved is for the most part natural. Cysts are numerous, and are found in connexion with the tubules, the Malpighian bodies, and the cells.

There are two points worthy of being specially kept in view by those who desire to attain to clear conceptions of Bright's disease—viz. (1) That its different forms are very frequently combined—in particular that the inflammatory affection is found associated sometimes with the waxy disease, sometimes with the cirrhotic; but that the descriptions here given are derived from pure examples of each process; and (2) that atrophy results in all the forms if the disease lasts long enough; that is, that a small, uneven-surfaced kidney may result from either the inflammatory disease of the tubules, or the waxy disease of the vessels, as well as from the increased growth and subsequent contraction of the fibrous stroma in the cirrhotic form.

Symptoms.—1. Of the *inflammatory form*. The leading clinical features of this variety, in addition to the albuminuria which exists in all the forms of Bright's disease, are diminution in the quantity of urine, and the presence of dropsy.

The onset of the disease may be sudden or gradual. Sometimes it is the diminution and alteration of the urine that attracts attention, sometimes the dropsy, sometimes the gastric derangement and general uneasiness; but whichever symptom may appear first, the others usually speedily follow. The urine is generally diminished in quantity, often somewhat opaque, and smoky or even bloody. It contains much albumen and numerous tube-casts. The casts are granular, being composed mostly of epithelium in a state of cloudy swelling; sometimes bloody; frequently hyaline or fibrinous. The urea is diminished, it may be, to one-half, one-fourth, or even a less proportion of the natural amount. This leads to a corresponding reduction of the specific gravity, unless there be a compensatory diminution of water, or increase of albumen. The dropsy is generally distinct in the face, and swelling of the eyelids is well marked in the morning. Towards evening, if the patient be out of bed, the legs are chiefly affected. The scrotum and penis are often swollen, and sometimes the abdomen is also dropsical. There is little quickening of pulse or elevation of temperature, but a good deal of general uneasiness is experienced, with debility and pain in the loins; and dyspeptic symptoms are often present, due to gastric catarrh. Such is the usual condition at the commencement of the disease, and during the period which has been already described as the first stage. But sometimes at this stage a much more serious condition is developed—namely, suppression of urine, followed by coma or convulsions leading to a fatal result; or dropsy may increase to such an extent as of itself to cause death. Or, again, without or even with the most unfavourable symptoms, under appropriate treatment the kidneys may begin to act more freely, the urine increasing in amount and improving in characters, with consequent gradual disappearance of the dropsy, and restoration of health. Or, as often happens, the general condition improves, but a chronic albuminuria remains, and the disease passes into the second stage. The urine is then no longer bloody; the quantity is greater, though still below the normal; the specific gravity is low; there is albumen, along with tube-casts, fatty, hyaline, or mixed, partly fatty and partly hyaline. The urea is below the normal standard. The dropsy may continue, and may even gradually increase, or it may pass off and only appear when the patient is fatigued, or when he has caught cold. The general symptoms remain unchanged, except that anæmia comes on, and the patient's debility steadily increases. This course of events may pass on to a fatal result; or there may be complete, or, as is more common, merely partial recovery. In this condition the patient may linger for many months, occasionally suffering exacerbations, and he may succumb to one of them, or to one of the numerous complications to be presently described. If the patient passes into the third stage, he appears prematurely old. His urine is of natural amount or even somewhat increased in quantity, but of low specific gravity. It contains albumen and a few casts, mostly hyaline, with scattered fatty cells imbedded in them. The urea is still diminished. There is dropsy of the feet and ankles in the evenings, and slight exposure brings on more general attacks. The face is pale and pasty, and the eyelids are often œdematous. The pulse becomes hard and tense; the arteries gradually become thickened from sclerosis and atheroma; while the apex-beat of the heart passes downwards to the left side, owing to hypertrophy, particularly of the left ventricle. In this condition a fatal result may be induced by an acute exacerbation with general dropsy; by chronic, or, more rarely, acute uræmia; or by intercurrent attacks of inflammatory or other affections of various organs.

2. *Of the waxy disease.* The onset of this affection is gradual and insidious. A patient who has suffered from phthisis, syphilis, or other wasting malady passes an excessive quantity of urine, and finds himself obliged to rise several times during the night for micturition. The urine is pale, of low specific gravity, containing at first no albumen, subsequently only a trace, ultimately a considerable amount. The urea is little, if at all, diminished; the tube-casts are extremely few, and mostly hyaline. There is no dropsy, but evidence of concomitant waxy affections of other organs is frequently afforded. The liver is enlarged, its margin being easily felt and sharply-defined. The spleen is also increased in size. The blood is slightly altered, the white corpuscles being somewhat increased, and the red being rather flabby and ill-defined. These conditions gradually become more distinct, and the strength of the patient diminishes, partly from the disease of the kidneys and other organs, partly from the wasting diseases which have induced the degenerative changes. A case of the kind has been known to go on for nearly ten years, during which time the urine continued of the characters just described, and dropsy never appeared. At length the vital powers of the patient became depressed, head symptoms gradually supervened, and death ensued. It is not often that such an uncomplicated case is met with. More commonly the exhausting disease which led to the degeneration causes death before the waxy change has gone so far. Sometimes also intercurrent complications induce the fatal result. Clinical observation renders it probable that the kidneys, as well as the liver and spleen, may recover from their degeneration, in cases in which the causal malady has been got rid of.

3. *Of the cirrhotic disease.* The onset of this affection is extremely insidious, and it may exist for a long time without distinctly manifesting itself by symptoms. Its existence is often discovered only when dyspepsia, uræmic convulsions, or blindness from retinitis leads the patient to consult a medical man. The earliest symptoms are occasional slight albuminuria, and frequent calls to micturition during the night, the urine however not being excessive, its specific gravity being low, and the urea somewhat diminished. But when the disease has existed for some time the complexion becomes altered; the eye assumes a peculiar appearance from œdema of the conjunctiva; the patient is subject to dyspeptic

attacks; the heart becomes hypertrophied, and the vessels sclerosed and degenerated; while there is little or no dropsy. When the disease is advanced, these changes in the circulatory organs are well-marked, and the cachectic condition becomes distinct. The occurrence of various complications, such as severe gastric catarrh, diarrhœa, anæmia, dyspnœa, bronchitis, œdema of the lungs, headache, uræmia, and the characteristic retinal affection, render the diagnosis easy. Frequently towards the end there is an increased flow of urine, of low specific gravity. This is in some cases a very prominent symptom. The disease is never recovered from, and the fatal result occurs from uræmia; from some inflammatory complication, such as pleurisy, pericarditis, bronchitis, or pneumonia; or from some result of degenerative change, as hæmorrhage from a mucous surface or into the brain.

COMPLICATIONS—(a) **Connected with the Abdomen and Alimentary System.**

Gastric affections are met with in all the forms of Bright's disease. Catarrh of the stomach—acute, sub-acute, and chronic—is common to them all, and is characterised by an unusual tendency to nausea and vomiting. It is especially frequent during the first stage and in acute exacerbations of the inflammatory form, and is often a chief source of suffering during the most advanced stages. It is not uncommon during the whole course of the waxy form, but is most usually met with in the cirrhotic variety. So close indeed is the relationship between them, that in the management of cases of cirrhosis regard should constantly be had to the state of the stomach, and in no case of chronic gastric catarrh should the physician neglect to enquire into the state of the urine. This affection, when complicating the early stage of the inflammatory form, often owes its origin to the same cause as the kidney-affection is due to. When complicating the later stages of the inflammatory, and any of the stages of the cirrhotic disease, the catarrh is probably a result of efforts at elimination of materials retained in the blood by the failure of the action of the kidneys. When occurring in the waxy form, it is frequently due in part to the existence of waxy degeneration of the vessels of the gastric mucous membrane. In the waxy disease we sometimes find blood mingled with the vomited matters, just as we find hæmorrhage occurring in other organs when this degeneration exists.

Catarrh of the intestine also occasionally occurs, sometimes producing an exhausting diarrhœa, especially in advanced inflammatory and cirrhotic cases; but it is along with the waxy disease that intestinal symptoms are most common. These are due to waxy degeneration, and consequent ulceration; or to ordinary tubercular disease of the intestine. Both of these affections induce diarrhœa, but there is evidence that not only may it thus occur, but that blood may also be discharged, although there be no ulceration recognisable by the naked eye.

Hepatic affections.—Functional derangements of the liver occur in the course of all the forms of Bright's disease. The chief organic changes are fatty degeneration, waxy degeneration, cirrhosis, and syphilitic affections. The first-named is not specially related to any of the forms. The waxy degeneration and the syphilitic affections are of course commonly met with as accompaniments of the waxy disease; whilst cirrhosis attends upon the cirrhotic kidney.

Ascites is often seen as a manifestation of general dropsy in the inflammatory form of Bright's disease; and sometimes this is a prominent symptom in mixed forms, when waxy liver is associated with a waxy and slightly inflammatory condition of the kidneys.

Peritonitis is occasionally the cause of death in all the forms of Bright's disease. It may result from local affections, or from the state of the blood; and may be acute, severe, and therefore obvious, or so insidious as scarcely to attract attention.

(β) **Complications connected with the Blood, or with the Lymphatic- and Blood-glands.**

The *spleen* is usually unaffected in cases of inflammatory Bright's disease, except such as prove fatal in the earliest stage, and in which the spleen is affected in common with the kidney. In the waxy and cirrhotic forms corresponding lesions are frequent in this organ.

The *lymphatic glands* are rarely altered excepting in the waxy form, in which they are sometimes the subject of the waxy degeneration, sometimes of tubercular disease, or of strumous inflammation.

The *blood* itself is altered in its chemical composition. In the inflammatory form its density is diminished, the corpuscles and albumen being deficient, while the water is correspondingly increased. The quantity of urea is above the normal. In long-standing cases of waxy disease similar changes are found; and not unfrequently there is a slight numerical increase of the white corpuscles, and flabbiness of the red blood discs when the spleen is affected. In the cirrhotic form like alterations also occur.

Hæmorrhage is apt to occur in advanced stages, especially of the cirrhotic form. It may take place from the kidneys, or from the mucous membranes, particularly that of the nostrils. In the inflammatory affection hæmaturia is common in the early stage; in the waxy variety this symptom occasionally occurs, but rarely to a serious extent.

(γ) **Complications affecting the Circulatory system.**

Hypertrophy of the heart is almost always present in cases of advanced cirrhotic disease, and also in the advanced stages of the inflammatory affection. One may trace in patients the gradual development of this hypertrophy, advancing *pari passu* with the progress of the renal affection. It is comparatively rare in the waxy form. *Hydropericardium* is met with in some cases, as a manifestation of general dropsy. *Pericarditis* occurs as an intercurrent affection in all the forms, but especially the inflammatory and the cirrhotic. It is apt to be overlooked, owing to the absence of local pain, or from the pain being referred to the abdomen. *Endocarditis* is also frequently associated with the various forms of Bright's disease.

The *arteries* are sclerosed and atheromatous in the advanced stages of the inflammatory and in the cirrhotic, but not so much in the waxy disease. In that affection the small vessels in other parts are frequently the seat of waxy degeneration. Thickening of the arteries occurs constantly in the more advanced stages of the inflammatory and cirrhotic diseases, and is due in great part to hypertrophy of their middle coat, in lesser degree to sclerosis of the tunica intima, the tunica adventitia, and perhaps the perivascular lymphatic sheath. The *pulse* becomes tense and sustained in chronic cases, partly from the hypertrophy of the heart, partly from the changes in the capillaries and smaller arteries.

(δ) Complications connected with the Respiratory system.

Acute bronchitis is common, especially in the advanced stages of Bright's disease, and tends to pass into the chronic state. Bronchitis may originate also as a sub-acute or chronic affection. *Œdema of the lungs* is very common in advanced stages, and frequently occurs as a manifestation of general dropsy in the early, as well as in the later stages of Bright's disease. It may be very suddenly developed in cirrhotic cases, and may rapidly prove fatal. *Pneumonia* occurs sometimes as a cause of inflammatory Bright's disease, sometimes as a consequence of exposure to cold during the course of chronic cases. *Phthisis* in its various forms is found causally associated with these renal affections, frequently with the waxy, and more rarely with the inflammatory form. It usually proves fatal while the renal malady is yet in its early stage. *Hydrothorax*, acute or chronic, is often seen in dropsical cases. *Pleurisy* occasionally occurs with all the forms of Bright's disease, and may be due to the state of the blood; or, as seems more likely, to increased susceptibility to inflammatory changes, which results from the lowered vitality of the organism. *Dyspnœa* is frequently met with in the inflammatory and cirrhotic forms of the disease, and may be independent of any local lesion, being probably a result of uræmic poisoning. *Œdema glottidis* is apt to occur in inflammatory cases, when even a slight laryngitis has from any cause been brought on.

(ε) Complications affecting the Skin and Subcutaneous tissues.

Dropsy, in the form of anasarca, is almost constantly present in the early stage, and during exacerbations of the inflammatory form. It can scarcely be said to occur in uncomplicated waxy and cirrhotic cases. *Eczema* is occasionally troublesome in chronic cases. *Erysipelas* is met with now and then, always constituting a serious addition to the other malady.

(ζ) Complications affecting the Urinary organs.

The chief of these is scrofulous disease of the kidney, and more rarely of the bladder and prostate. They occasionally occur along with the waxy affection.

(η) Complications affecting the Nervous system and Special senses.

Uræmic blindness may occur, which is sudden and usually temporary, being unaccompanied by any lesion recognisable by the ophthalmoscope. It is generally met with in advanced cirrhotic and inflammatory cases. *Retinitis albuminurica* is a peculiar and characteristic inflammation of the connective tissue of the retina, leading to the formation of white patches and lines, with fatty degeneration. With it are also frequently associated minute hæmorrhages into the substance of the retina. This occurs by far the most frequently in cirrhosis. It is often also seen in the advanced stages of the inflammatory form, and is rarely recovered from except in the case of pregnant women, in whom it seems apt to occur as a passing condition.

Uræmia includes a group of the most striking symptoms of Bright's disease. It may occur at the commencement of the acute inflammatory affection, or in its later stages, or in the chronic forms. The condition is, however, rare in the purely waxy disease, but common in the cirrhotic. There are several types of uræmia, of which the most important are:—(*a*) Sudden acute convulsions, followed by coma and death; (*b*) Gradually advancing torpor, passing at last into coma. The clinical features of these and minor varieties are described, and the hypotheses as to their origin discussed, in the article URÆMIA.

Headache is frequently complained of by patients suffering from Bright's disease. *Apoplexy* from hemorrhage into the substance of the brain is common in the later stages of the inflammatory and cirrhotic diseases. It is due partly to the degenerated state of the vessels, and partly to the increased pressure resulting from cardiac hypertrophy.

(θ) Complications affecting the Locomotory system.

Of these the only ones of importance are *disease of bone*, which has been already referred to as a causal complication in waxy cases; and *gouty affections*, which have been mentioned in connexion with the cirrhotic disease.

DIAGNOSIS. **(a) Of Bright's Disease from other affections.** From *passive congestion of the kidneys* due to cardiac disease these maladies are distinguished by the general condition of the patient; the absence of cardiac disease, and of congestion in other organs; and the characters of the urine. In heart-affections the urine is generally scanty, high-coloured, not of low specific gravity. It may contain albumin, and deposits urates, but rarely blood, renal epithelium or tube-casts. Hyaline casts may be present, but never in any large quantity. The presence of epithelial and fatty casts, or marked diminution of the amount of urea in any case, proves at least the co-existence of actual inflammation of the kidney. From *paroxysmal hæmatinuria* and *albuminuria*, Bright's diseases are distinguished by the abrupt commencement and brief duration of these maladies; by the marked nervous symptoms, with gastric catarrh, and sometimes slight jaundice; and by the absence of dropsy. In hæmatinuria also the condition of the urine is very distinctive; the dark-red colour being due, not to blood-corpuscles, but to granular pigment, the deposit consisting mostly of this material and of hyaline casts. In paroxysmal albuminuria again the amount of albumin is very large, and the number of tube-casts extraordinary *Hæmaturia*, with tendency to suppression of urine, is distinguished from Bright's disease by the small proportion of epithelial tube-casts, and in some cases by the complete absence of casts. There may be a question whether the case is one of hæmaturia or of commencing acute inflammatory Bright's disease; or again whether it is one of a chronic affection, cirrhotic or cystic, in which hemorrhage has come on. The cases in which Bright's disease simulates hæmaturia are generally the sequelæ of scarlatina or diphtheria; and, therefore, even when these diseases have been overlooked, the presence of desquamation or of paralysis may afford a clue; but the peculiar reddish-brown deposit rich in cells and in epithelial tube-casts, which occurs in Bright's disease, makes the case clearer even when, as often happens, there is no dropsy, or when, as we sometimes see, the albumen is not coagulated by heat or by nitric acid. Again, when the question is between simple hæmaturia and hæmaturia with cirrhosis or cystic disease, the evidence afforded by the tube-casts is not important, but the hypertrophy of the heart, the thickening of the arteries, the character of the pulse, the albuminuric retinitis, the low specific gravity of the urine and the small amount of urea which it contains, as well as the tendency to hæmorrhage from other sources, afford evidence of the presence of the chronic organic disease.

Slight *pyelitis*, with or without renal calculus or gravel, may simulate Bright's disease, but the history of pain, the presence of mucus and pus-corpuscles in the urine, of oxalate of lime or uric acid, with the full proportion of urea, and the absence of tube-casts, indicate the nature of the case.

(β) Of the different forms of Bright's disease from each other. The discrimination presents in simple cases little or no difficulty. The points to be attended to are the history of the patient; the amount and characters of the urine; the presence or absence of dropsy; and the nature of the complications. The previous occurrence of exanthematic affections, of chronic wasting disease, or of intemperance, gout, or plumbism, would afford some obvious indications. The mode of origin and progress of the malady is very important. Thus a case commencing actually with dropsy and diminution of urine is inflammatory; one of less acute character with polyuria is waxy; and one commencing insidiously, with no marked symptom until perhaps convulsions or dimness of vision appeared, would be an example of cirrhosis. The leading symptoms of the *inflammatory* variety are diminution of urine; an abundance of albumin and of epithelial tube-casts, with diminution of urea; and marked dropsy. Of the *waxy* kidney, the prominent features are early and persistent polyuria; waxy degeneration of other organs; and absence of dropsy. In the *cirrhotic* form the insidious commencement; the gradual development of vascular and cardiac changes; with in the later stages, in many cases, polyuria, are the most important phenomena. Other indications may be gathered from the complications of each form of Bright's disease. It must be remembered that mixed forms frequently occur, and that in these careful inquiry and patient investigation are essential to the establishing of a correct diagnosis.

Prognosis.—The prognosis, though always grave, varies in the different forms of Bright's disease. In the *inflammatory* affection it is least unfavourable, although this affection is the most immediately dangerous. During its first stage we may always hope for complete recovery, especially in cases of post-scarlatinal origin. Of forty-one successive cases treated by the writer in the Royal Infirmary, Edinburgh, twenty-two recovered entirely, while twelve died, and seven passed into the second stage. If this be the proportion in hospital cases, which are generally sent there on account of their severity, and are rarely sent in the earliest stages of the disease, it is obvious that the proportion of recoveries must be much larger in private practice. When the disease reaches the second stage, the prognosis is more grave, complete recovery being rare, and death sometimes taking place from sudden or gradual increase of the symptoms, or from intercurrent affections. But even in this condition complete recovery may be brought about, and in many cases the patient goes on for long periods, presenting few symptoms to attract attention. In the third stage the prognosis is entirely unfavourable, the system becoming steadily more deteriorated, and death occurring, either from the direct effects of the disease, or from complications. Still, even such cases often go on for long periods, if placed under favourable hygienic and therapeutic conditions.

In the *waxy* form the prognosis must almost always be unfavourable, although the malady is never rapidly fatal. On the contrary, its course is always chronic, in some cases extending over five or even ten years. The fatal result is due to complications more frequently than to the disease itself. Recovery probably sometimes takes place, but only when the cause of the degeneration is removed, and the general surroundings of the patient are favourable. It is certain that the liver and spleen may to a large extent recover from waxy disease, and recovery has been witnessed in cases which presented all the symptoms pointing to implication of the kidneys.

In the *cirrhotic* form the prognosis is very unfavourable, but the progress of the disease is so slow that it is often unadvisable to say anything about it to the patient, as the fatal result may be long deferred. It must, however, be kept in view that the disease may be far advanced before its existence is made out.

Among the symptoms and complications which are fitted to cause special alarm when they occur in connection with any of the forms of Bright's disease, we must recognise suppression or great diminution of urine, especially if accompanied by nervous phenomena or general dropsy; uræmia, more particularly its chronic form; and acute inflammations and hæmorrhages. Retinitis albuminurica is always a very serious symptom, except when it occurs in pregnant women.

Treatment. (1) Of the *inflammatory form*. The objects to be kept in view are to arrest the inflammatory action; to remove the inflammatory products from the kidneys; and to obviate the deleterious effects upon the system generally of the accumulation of effete materials. One remedy or plan of treatment may meet more than one of these indications. The most useful means of subduing the inflammatory action, or at least the congestion which attends it, are local blood-letting by means of leeches or wet cups; dry-cupping; and the application of hot fomentations, poultices, and counter-irritants. Blood-letting is only serviceable in the early stage of the disease, or when severe exacerbations with suppression of urine occur. Poultices or hot fomentations are of use in the same circumstances. Counter-irritation is helpful in the more chronic conditions. Iodine and croton oil inunction are the best fitted for its induction, whilst cantharides must be avoided on account of its tendency to irritate the kidneys.

The removal of the inflammatory products which block up the uriniferous tubules is of the utmost importance, and is in the great majority of cases best effected by means of diuretics. Water and diluent drinks are the safest, and are sometimes found sufficient. The medicinal diuretics must be non-irritating, and the best of all is digitalis, which may be given safely even when the urine is bloody. It may be administered in the form of infusion, tincture, or made up into a pill. Of the infusion from a drachm to an ounce, of the tincture from five to thirty minims, of the powder from half-a-grain to two grains, should be given three times a day. The infusion or the tincture may be combined with spirit of nitrous ether, with acetate of potash, or with tincture of perchloride of iron. Its action is often favoured by the addition of squill and carbonate of ammonia. Sometimes it happens that diuretics do not suit the case, the urine becoming diminished and more bloody under their use; and in other cases the symptoms become so urgent that death might take place before there would be time for diuretics to act. In either of these conditions relief must be obtained by the bowels or skin. The bowels are best acted upon by means of from twenty grains to a drachm of the compound jalap powder, or one-twentieth to half-a-grain of elaterium. The action of the skin may be excited by the use of acetate of ammonia or antimony; but pilocarpine, hot air, vapour-baths, and the wet pack are the most efficient agents. Throughout the whole course of the disease constipation should be avoided, and the action of the skin encouraged. When the disease has become less acute, and certainly when dropsy persists during the second stage, other diuretics are of the utmost value, particularly the acid tartrate of potash, the oil of juniper, and the decoction of broom. Iron must be assiduously administered, to make up for the waste of the materials of the blood. Gallic acid, ergot, and belladonna have all been praised as tending to diminish the discharge of albumin resulting from a persistent chronic inflammation of the tubules. The treatment of special symptoms and complications will be considered after indicating the general management of the other varieties of Bright's disease.

The diet during the earliest stages should be easily assimilable, and not too rich in nitrogenous elements. Milk is, as a rule, well borne. Some practitioners laud skimmed milk as an unfailing remedy in the disease. It is a good diuretic, and, when it suits the stomach, a good article of diet, but possesses no other therapeutical virtue. In the more chronic stages the food should be of the most nourishing kind, and a moderate allowance of stimulants may be needed.

(2) In the treatment of the *waxy form*, the most important indication is to seek to remove the cause of the degeneration, if still existing. If there be disease of bone or chronic abscess it must, if possible, be cured; constitutional syphilis must be combated by appropriate remedies. The tincture of perchloride of iron, quinine, nux vomica, and such combinations as Easton's syrup of the phosphates, are useful. The patient must also have good food, and should lead an easy life.

(3) In the *cirrhotic form* it is probable that no remedy we at present possess can influence the pathological process, although arsenic and alkaline remedies, and particularly iodide of potassium, enjoy a certain reputation. It is of course the duty of the skilful physician to obviate the results of the morbid process. It is obviously of great importance to avoid the causes of the disease. Lead-poisoning should be avoided; the gouty tendency kept in check; and the abuse of alcohol forbidden.

(4) In the management of the *combined forms* of Bright's disease these plans of treatment must be conjoined according to circumstances, but, on the whole, treatment is much less successful than in the simple cases. In the combined waxy and inflammatory affection, for instance, it is not uncommon for dropsy to persist, although the diuretics bring the urine up to or above the natural standard.

(5) With regard to the special *symptoms* and *complications* of Bright's disease, the sickness and vomiting are best relieved by counter-irritation over the stomach; and by giving ice, milk, and hydrocyanic acid internally. These symptoms are, however, often very intractable. Diarrhœa must sometimes be let alone; at other times it must be treated by means of astringents or sedatives, either administered by the mouth or as enema or suppository. Ascites must be treated as a manifestation of dropsy, and occasionally the abdomen requires tapping. Peritonitis must be combated by hot fomentations and opium, but the latter requires great care in its administration. All through the disease in all its forms hæmatic tonics are demanded; iron in some form should be constantly administered. For hæmorrhages the pernitrate of iron, local astringents, ergot and ergotine, gallic acid, or acetate of lead must be tried in various combinations. The best results have followed the use of ergotine in 3- to 5-grain doses injected subcutaneously. The irritating effects sometimes observed after the subcutaneous injection of ergotine may often be obviated by boiling the solution, or by the addition of a minute quantity of salicylic acid. Hydropericardium and pericarditis must be treated in the usual way. The vessels and the heart are not amenable to treatment. Bronchial catarrh must be carefully attended to, by the avoidance of exposure to cold; by the application of counter-irritation externally; and by the internal administration of expectorants. Œdema of the lungs must be treated by counter-irritants, and by remedies fitted to reduce the general dropsy. Pneumonia, phthisis, and pleurisy must be treated on ordinary principles. Hydrothorax may demand paracentesis. General dropsy is one of the most important complications, and should be combated by means of

diuretics, purgatives, and diaphoretics; in many cases puncture of the œdematous parts is demanded. When puncture has been determined upon, precautions must be taken to avoid inflammation. Eczema and erysipelas, when they occur, should be dealt with according to the principles of the art. Headache is relieved in different cases by iron, by hot or cold applications to the head, by quinine, or by inhalation of a few drops of nitrite of amyl. When uræmia occurs in acute inflammatory conditions, or with suppression of urine, dry-cupping or wet-cupping over the renal regions should be tried, along with free purgation and hot-air baths and, especially in puerperal cases, general blood-letting. Bromide of potassium should be given in drachm doses, and if convulsions be severe, the patient must be kept under the influence of chloroform. In the more chronic and gradually advancing form of uræmia, counter-irritation at the back of the neck and over the scalp sometimes appears to be useful. But treatment is not so often of advantage in this as in the other form. In the eye-affections, iodide of potassium enjoys some reputation. Hæmorrhagic apoplexy demands no special measures for its treatment.

T. Grainger Stewart.

BROMISM.—Definition.—Bromism is the term applied to the morbid effects produced by the administration of the salts of bromine under certain circumstances.

Description.—The effect of the salts of bromine, when administered in medicinal doses, is to reduce nervous activity; and thus, with a certain amount of anæsthetic influence, to promote rest and sleep. When such doses have been long continued, or in certain idiosyncrasies, or when excessive doses are administered, results are produced which constitute a state of disease, and to this condition the term 'bromism' is applied. These results are manifested on the brain and spinal cord; on the skin; on the mucous membranes and glandular structures; and on the organs of circulation and respiration.

1. *On the Brain and Spinal Cord.*—When the therapeutic action intended to be obtained from the use of a salt of bromine is exceeded, the quiet or sleep becomes more pronounced, and there is more or less constant somnolence; the memory becomes impaired, words being forgotten or misplaced, whilst written and spoken language is confused, the tongue is tremulous, and speech is difficult. The gait becomes feeble and staggering, with inability to control movement, and somewhat resembles the condition observed in locomotive ataxy. The special senses—sight, hearing, taste, and touch—are impaired: reflex excitability is diminished, and this is especially observed in the fauces, occasionally to such an extent as to cause difficulty in swallowing. Sexual feelings are diminished or altogether suppressed. The general aspect of a case of well-marked bromism much resembles one of senile imbecility.

2. *On the Skin.*—A very frequent result of the internal use of the bromides is a follicular eruption of the skin, closely resembling acne, which is generally situated on the face, chest, and shoulders. When the use of the drug is continued, the acne becomes aggravated, and boils appear. A more rare form of skin-disease similarly caused has been described by Dr. Cholmeley, Mr. Hutchinson, and M. Voisin. This disease appears as vesicles, which become aggregated into clusters or patches. These proceed to suppuration, and are soon followed by scabbing, their base being slightly raised, hard, sometimes ulcerated, and surrounded by a red areola. In a later stage the eruption presents the appearance of dusky red stains. It has been observed more especially on the limbs and head. Eruptions having more or less the characters of erythema and of eczema have also been described as following the use of these agents.

3. *On the Mucous Membranes and Glandular Structures.*—Dryness of the mouth and tongue is often experienced in bromism; but in some cases there is said to be an increased flow of saliva. Nausea, flatulence, eructations having a saline taste, heat and fulness at the epigastrium, and occasionally gastric catarrh and diarrhœa, have been observed; it is said that acute enteritis and even a typhoid condition have occurred.

4. *On the Organs of Circulation and Respiration.*—The salts of bromine are said to produce contraction of the capillaries. The skin may present a peculiar pallor, and the extremities feel cold. The action of the heart is rendered slower and weaker; and may even cease altogether, under the continued operation of these drugs. The action on the respiratory organs is similar to that upon the heart. It has been observed that bromine—recognised by its peculiar odour in the expired air—is eliminated from the respiratory mucous membrane. Bronchial catarrh occurs, and instances are recorded in which pneumonia is said to have followed and proved fatal.

It must be remembered that, although it has been thought desirable to discuss separately here the effect of these drugs on the several systems, these effects are combined in various degrees. In some cases the affection of the skin is alone noticeable; in others, that of the nervous system; while in a third class there is produced a combination more or less of all the phenomena, constituting what may be called a *cachexia.* In such cases we find loss of flesh, strength, colour, and mental power; paralysis of the muscles; loss of reflex and general sensibility and of the functions of the special senses; complete apathy and general prostration, the countenance having a semi-idiotic expression; coldness of the extremities; and gradual failure of the heart's action.

Pathology.—The condition just described is but the extreme effect of the ordinary physiological action of the salts of bromine. This condition may be due either to idiosyncrasy—that is, to undue susceptibility on the part of the individual—or to the administration of large quantities of the drug, either in medicinal doses for a long period, or in excessive doses administered within a short time. The individual susceptibility may depend upon the want of capability to eliminate the drug; on the general state of health; or on the presence of a disease which resists its action. Under these circumstances, as well as in the presence of certain modifying influences, such as the action of other remedial agents simultaneously administered, it is difficult to fix upon the amount of a bromine salt capable of producing morbid symptoms in any given individual. The writer has seen a nightly dose of ten grains of bromide of potassium, continued for some weeks, produce marked somnolence during the day, and impairment of memory; whilst it has required the enormous doses of 200 or 300 grains a day, which seem to be administered on the Continent, to produce the extreme effects above described. The rapidity with which these effects are produced, constituting the *acute* and *chronic* forms of bromism, will depend on the amount and frequency of the dose, and on the susceptibility of the individual. The effect of a sudden considerable increase in the dose has been observed by the writer in a case which first directed his attention to the subject of bromism in 1872. This case he saw in consultation with Mr. Alfred Burton. Half-drachm doses of bromide of potassium had been taken twice a day for several weeks, when by mistake the quantity of the drug was doubled; then, after three days, symptoms closely resembling senile imbecility were rapidly developed.

Diagnosis.—Recognising the value of the bromides, and the frequency with which they are used, it is extremely important that the peculiar results which they are capable of producing should be borne in mind; for if they are not recognised in time, and if the use of the drugs be persisted in, disastrous effects which might otherwise be avoided will follow. Without going into details of diagnosis, it will probably be sufficient to point out the necessity for remembering that the symptoms which have been described above can be produced by the use of bromides; and that when such a combination of symptoms does occur during their use, it is highly probable, in the absence of disease capable of accounting for them, that the symptoms have originated from the operation of those agents.

Treatment.—This consists in stopping the use of the drug, and hastening its elimination by promoting the action of the kidneys and other excreting organs. It is said that arsenic in combination acts as a preventive of the eruptions.

The above description refers to the effects of bromide of potassium; but like effects are produced by other salts of bromine, though to what extent by each has not yet been ascertained.

R. Quain, M.D.

BROMIDROSIS (*βρῶμος*, a stench; and *ἱδρῶς*, sweat). A term for fetid perspiration. *See* Perspiration, Disorders of.

BRONCHI, Diseases of.—The diseases of the bronchi may be discussed in the following order:—1. Acute inflammation; 2. Chronic inflammation; 3. Plastic inflammation; 4. Dilatation; 5. Narrowing or obstruction; 6. Cancer.

1. Acute Inflammation — Acute Bronchitis — Acute Bronchial Catarrh.

Definition.—An acute inflammation or congestion, general or partial, of the bronchial tubes.

Ætiology.—The causes of acute bronchitis may be classed as (*a*) *predisposing* and (*b*) *exciting*.

(*a*) Of the *predisposing* causes age is one of the most important. The disease is indeed confined to no period of life, but it is most frequently met with in the young and the old, and in these subjects it assumes its most serious characters. The imperfect development of the infant, and the diminished vitality of the aged, seem to render them especially liable to attacks of bronchitis, and to make the disease exceptionally fatal in them. Sex appears to have no influence as a predisposing cause. The habits of life have an important influence in the causation of bronchitis. The practice of living in heated rooms, especially where gas is largely consumed, and of breathing the vitiated atmosphere produced by the assemblage of large numbers of persons in apartments, is undoubtedly a fertile predisposing, as well as exciting, cause of the complaint; so also is the practice of keeping children too much within doors on the one hand, or, on the other, of exposing them to inclement weather when insufficiently clad. Temperament can scarcely be considered a predisposing cause, but the state of the general health exercises a powerful influence. A weakly constitution, or one weakened by overwork, improper food, &c., predisposes to bronchitis; whilst such affections as Bright's disease, gout, and diseases of the heart, alike favour its occurrence. Again, certain occupations are favourable to the development of bronchitis. Independently of the fact that living or working in heated and confined rooms predisposes to the disease, such occupations as lead to the inhalation of irritating particles, as those of steel, cotton, &c., give rise to it. The climate most favourable to the production of bronchitis is probably that which is at the same time both cold and damp, and where sudden variations of temperature occur. The seasons of the year in which it prevails most are the late autumn, the winter, and the early spring.

(*b*) *Exciting causes.*—Although undoubtedly cold directly applied to the surface of the body is in a large number of cases the exciting cause of bronchial inflammation, still the transition from cold to heat—passing from a cold atmosphere to a heated one—is a large factor of the disease. There can be little doubt that bronchitis is often produced directly by the effects of heated and vitiated air on the bronchial membrane, and on the system at large; and that in the latter instance, the affection is merely a local manifestation of a general influence. Bronchitis may also be caused by the direct action of irritants contained in the air—as irritant vapours, minute particles of steel, cotton, or ipecacuanha, and the emanations (pollen) from flowering plants. Again, morbid conditions of the blood, the result of specific febrile affections, act as exciting causes of the disease; as do also the poison of syphilis, and the altered condition of the blood produced by gout. Bronchitis is, moreover, a constant accompaniment of influenza.

Anatomical Characters.—The mucous membrane is mainly affected in acute bronchitis, but morbid changes may be produced in the deeper structures. The mucous membrane is red—the redness being arborescent, streaked, or mottled, but not usually spread uniformly over a large surface. The injected condition of the membrane does not, as a rule, extend into the finer bronchial tubes, but in some cases where there have been frequent attacks of inflammation, the smallest bronchi have a red appearance. The membrane is sometimes thickened and soft, but ulceration is very rare. The tubes are generally found more or less filled with secretion, either frothy mucus, muco-pus, or even actual pus. Sometimes the secretion is very abundant, filling all the tubes. Fibrinous masses are occasionally met with, which may form casts of the tubes. Collapse of portions of lung-substance—lobulettes or whole lobules of the lungs—is not unfrequently found, as are also patches of lobular pneumonia. The venous system and the right side of the heart are overloaded, and the blood is dark. In many cases fibrinous deposits are found in the cavities and great vessels of the heart.

In speaking of the pathology of bronchitis, it is necessary to refer to the distribution of the bronchial blood-vessels. The bronchial arteries when they have fairly entered the lungs have no accompanying veins. The so-called bronchial veins are some small vessels which return the blood supplied to the structures about the roots of the lungs. The blood which is supplied to the bronchial tubes, when they have commenced their divisions, passes into radicles of pulmonary veins, and is returned directly to the left side of the heart. The question whether there is a communication between the bronchial arteries and the pulmonary artery, is still *sub judice*. If such communication exist, it is only slight. The blood of the bronchial arteries, after supplying the mucous membrane and other structures of the tubes, passes, either wholly or in very large part, to the left side of the heart, not having circulated through the aërating portion of the lungs. The circumstances of this anatomical arrangement are most important in a practical point of view. Anything which embarrasses the circulation on the left side of the heart—such as mitral regurgitation—must necessarily cause a very loaded condition of the bronchial vessels; and all physicians are familiar with the form of bronchitis which is so common in these cardiac affections. The congested mucous membrane, and the profuse bronchial secretion, are the result of the direct impediment to its circulation which the blood meets with, from passing at once into vessels which go straight to the left side of the heart. The relief often afforded in this form of bronchitis by the exhibition of digitalis, is explained by the circumstance above referred to.

Symptoms.—The symptoms of acute bronchitis vary according as the larger or smaller tubes are affected. The disease attacks, first, the larger and medium-sized tubes; and, secondly, the smaller ones. To this latter form of the affection the name of *capillary bronchitis* has been given.

1. Acute bronchitis of the *larger tubes*. The attack is usually ushered in by symptoms of catarrh,—sneezing, lachrymation, a sense of fulness about the nose and eyes, with frontal headache; the throat becomes dry and sore, and then increased secretion sets in; the follicles at the back of the pharynx become enlarged; the upper part of the larynx is often involved, there being slight hoarseness; and the affection gradually creeps down into the bronchial tubes. The disease is not ushered in by decided rigors, but chills and sometimes shiverings are experienced; the pulse is not much affected, but its frequency is increased in some cases; there is a general sense of malaise, as well as a want of energy. When the disease has set in fully certain local symptoms are found. More or less pain is felt behind and above the sternum; the sensation is increased by a deep inspiration; the pain shoots at times over the chest in the direction of the larger bronchial tubes; and there is a tickling or unpleasant irritation felt behind the sternum, which gives rise to cough. Dyspnœa is not a marked feature of this form of bronchitis; it exists, however, sometimes; and in the most severe cases a sense of oppression, weight, and tightness about the chest is experienced. Cough is one of the earliest and most prominent symptoms; it is at first dry, and there is usually at this period some hoarseness. The cough is paroxysmal, and often very violent; it becomes attended with expectoration as the disease progresses. This varies at different stages of the affection; at first watery and frothy, and almost transparent, it becomes as the disease progresses more consistent, viscid, and opaque, passing through the stages of mucus to muco-pus and pus; it is sometimes distinctly nummulated. Small streaks of blood are occasionally seen mixed with the sputa. Examined under the microscope the sputa are found in the early stages of the disease to contain epithelial cells from the mucous membrane; and, later, many of the so-called exudation-corpuscles, molecular and granular matter, pus-cells, and occasionally blood-discs.

In the milder cases of this form of bronchitis there is but little general disturbance; and even in the more severe cases the febrile reaction is not usually very great. The pulse rises a little, but does not become very frequent; the temperature rarely becomes high; there is in many cases but little interference with the appetite. A general feeling of depression, which in some cases is very marked, is usually experienced.

2. Acute bronchitis of the *smaller tubes—Capillary bronchitis*. This is a very formidable disease It attacks the finer bronchial tubes, and probably extends to their smallest ramifications. Its symptoms are very grave. Some of the worst cases of capillary bronchitis are met with in connexion with emphysema of the lungs. It may be an extension of inflammation from the larger tubes; or the capillary tubes may be attacked simultaneously with the larger ones, or alone. The early symptoms are more severe than those of ordinary bronchitis, and rigors are more common. Dyspnœa is marked; it may vary from mere rapid respiration to constant or paroxysmal orthopnœa. The respirations may rise to fifty in a minute. Cough is almost continuous, at times becoming very violent and most distressing. Expectoration is attended with difficulty. The sputa soon become very abundant, and rapidly assume a purulent character; or they are very viscid and ropy.

The general symptoms are very severe. The fever is high—the temperature reaching to 103° Fahr. and upwards; and the pulse is frequent, rising to 120 or 140. The temperature rarely attains the height which characterises acute tuberculosis or pneumonia. There are often profuse perspirations, and in some cases excessive debility is felt. If the disease progresses unfavourably, symptoms of very imperfect aëration of the blood come on. The face becomes turgid and bloated, the lips and ears get livid, the veins are distended, the temperature falls, cold clammy perspirations break out, the pulse becomes very small and rapid, delirium supervenes, the respiration is shallow and catching, and the patient dies of apnœa, and from the presence of fibrinous clots in the heart and great blood-vessels.

Physical Signs.—The physical signs of both forms of acute bronchitis may be referred to together. Inspection reveals little of practical value in simple bronchitis. The chest-form is not altered. In severe cases the abdominal movements are in excess. The costal movements are frequently those of elevation rather than expansion. In extreme cases the lower end of the sternum and the connected cartilages sink with inspiration; while the expiration-movements are slow, laboured, and inefficient. If the hand is applied to the chest, rhonchal fremitus may be often felt, sometimes over a large area. The percussion-sound may be somewhat exaggerated from overdistension of the lungs, especially in children; not appreciably altered; or deficient in resonance, owing to the accumulation of secretion at the bases of the lungs, to œdema or congestion (as in typhoid fever), or to pulmonary collapse. In young children a sound resembling the cracked-pot sound may be occasionally produced, variable in site. The sounds heard in auscultation vary according to the stage of the disease. The breath-sounds are loud when the tubes are free; when the latter are plugged by secretion, they often become feeble or even totally suppressed, from closure of a tube leading to a portion of the lung. The adventitious sounds of bronchitis include the various rhonchi, dry or moist: the dry rhonchi are heard in the early stages of the disease for the most part, but when once secretion has set in, the moist rhonchi or râles are more or less extensively heard, depending for their character on the size of the tubes which are the seat of inflammation. Thus they are called *mucous* when produced in the large tubes, *sub-mucous* and *sub-crepitant* when produced in the finer ones; the latter term being used to characterise the râles of capillary bronchitis. When the large bronchial tubes are filled with a secretion which is not viscid, the sounds may have a rattling character. The various rhonchi may be heard over different parts of the lungs at the same time, according to the seat and stage of the bronchitis. In capillary bronchitis sub-crepitant râles, accompanying inspiration and expiration, are abundantly heard, towards the bases of both lungs especially. As a rule there is no displacement of organs in bronchitis, but the diaphragm is sometimes depressed from great distension of the lungs, and the heart is occasionally displaced towards the right.

Diagnosis.—The diagnosis of acute bronchitis, except in a few instances, presents no great difficulty. In the early stages of whooping-cough it is impossible to decide whether the case is one of simple bronchitis or not, but subsequently the paroxysmal character of the cough settles the point. In some cases of bronchitis occurring in children the breathing may resemble that of croup, but here the presence of catarrh; the wheezing nature of the respiration; the absence of much fever; the characters of the sputa obtained by wiping the back of the tongue, and its freedom from membranous shreds; and the physical exam nation of the chest indicating the presence of rhonchi, will be sufficient to establish a diagnosis. From laryngitis the discrimination is not difficult.

Pneumonia may generally be easily diagnosed from capillary bronchitis, with which form it can perhaps be alone confounded. Capillary bronchitis is not ushered in, as pneumonia usually is, by a well-marked and prolonged rigor; the general febrile disturbance is less, and the temperature not so high; moreover the absence of dulness on percussion, and of increased vocal resonance and fremitus will aid in the differentiation. From lobular pneumonia in children the diagnosis is not always easy. In this disease there is often no dulness to be perceived on percussion; whilst, on the other hand, in bronchitis dulness may exist from pulmonary collapse.

The diagnosis of capillary bronchitis from acute phthisis often presents difficulties. The main points to be relied on, independently of the family history, which may aid, are that in capillary bronchitis the fever is less and the temperature lower; signs of apnœa soon come on; and there is free expectoration of muco-purulent matter. In one form of acute phthisis there is evidence of pneumonic consolidation, followed by signs of the formation of cavities. In the miliary tubercular form there are in many cases scarcely any physical signs except râles, most marked at the apices of the lungs.

Prognosis, Duration, Termination, and Mortality.—The prognosis in an ordinary case of bronchitis is favourable, but when the disease occurs in the very young or the aged the prognosis should always be guarded. In the milder forms the affection may last only a few days, or two or three weeks. Severe cases are more protracted. The disease may terminate in perfect recovery, in death, or by passing into the chronic form. It may be the starting point of emphysema of the lungs, or of certain forms of phthisis. The mortality is much influenced (1), by age, being greatest in the very young and the very old; (2), by the previous state of health, which, if lowered by any circumstances, will render recovery more doubtful; (3), by the extent of the inflammation, especially when the disease is of the capillary form; (4), by the existence or non-existence of any organic disease of the heart, lungs, or kidneys; (5), by the disease being epidemic or otherwise; and, lastly, by the time the case has come under treatment, whether early or late.

Treatment.—In the treatment of bronchitis regard must be had to the constitutional condition of the patient. Care must be taken to ascertain whether the disease is secondary to some organic affection; or the result of mechanical irritation, of the presence of gout or rheumatism in the system, or of influenza; or whether it arises idiopathically. The treatment of the disease as a primary affection will be considered first.

In an ordinary case of acute bronchitis it is very desirable to keep the patient confined to his room and, if the case is at all severe, to his bed. The temperature of the apartment should be maintained at from 60° to 65° Fahr. A higher temperature than this is generally not favourable to the progress of the case. In the early stages of the attack it is well to allow the air of the room to be more or less saturated with steam. A free action of the skin should be promoted; and for this purpose warm drinks, with or without some form of alcohol or some diaphoretic medicine, may be given; or a hot-air bath may be used in bed. Great relief is often experienced from the application of a large mustard or mustard and linseed-meal poultice to the chest; and it is well, if mustard is applied first, to apply immediately afterwards a large hot linseed-meal poultice, to be renewed every few hours. This constant application of warmth and moisture to the chest is often productive of very great relief to the symptoms.

Cases of acute bronchitis do not require venesection, nor is the application of leeches often, even if ever, called for. Severe counter-irritation is moreover to be prohibited. It is generally desirable to act on the bowels, and a mercurial, followed by a saline purgative, will often be of great service. In the old and debilitated, as also in the young, all lowering treatment must, however, be avoided. In the early stages of the affection, before secretion has commenced, and when the mucous membrane is dry and the cough hard, diaphoretics with ipecacuanha may often be given with advantage; but as soon as secretion is fairly established, carbonate of ammonia, spirits of chloroform, ether, cascarilla, senega, or such-like drugs should be administered. Indeed in almost every stage of bronchitis carbonate of ammonia is one of the most valuable remedies we possess. Care should be exercised, especially with the aged, that nothing should be given which will so nauseate as to prevent food being taken. In the exhibition of medicines to alleviate the cough, regard must be had to the condition of the patient and the stage of the disease. Opium in all its forms should be given with caution, especially in the young and old. It no doubt often succeeds in checking cough, but in doing so it also checks expectoration, and causes an accumulation in the bronchial tubes, which sometimes becomes very dangerous to life. Chloral in small doses is often of great use for relieving cough, and it may be combined with oxymel of squills. It has also a good effect in allaying spasm of the tubes, if this exist. In some cases of bronchitis the question of procuring sleep becomes an important one. Opium in its various forms is generally inadmissible, in consequence of its tendency to increase the condition of apnœa; but chloral may be given with safety, and the recovery of a patient may sometimes be dated from the sleep which this agent procures.

In reference to the exhibition of alcoholic stimulants, except in the early stages, and in certain cases dependent on a gouty or rheumatic condition, they should usually be given in smaller or larger quantities. They increase expectorating power, and ward off the tendency to apnœa. In the old they are especially called for, and, together with carbonate of ammonia, should form the main therapeutic agents to be relied on. In the treatment of capillary bronchitis, ammonia and alcoholic stimulants should be exhibited from the commencement, and the quantity must depend on the symptoms of each case. There is one source of danger in capillary bronchitis which should always be borne in mind, viz., the formation of fibrinous clots in the heart and great blood-vessels. These deposits become the proximate cause of death in many cases, and they are especially liable to form when there is emphysema of the lungs. Their presence may often be diagnosed during life from the respiration becoming very rapid, shallow, and laboured; the pulse being quick, weak, and small, although the heart may at the same time be felt beating vigorously; the voice becoming feeble; and the mental faculties seriously impaired. After death a large portion of the cavities of the heart may be found occupied by these deposits, the calibre of the pulmonary artery and aorta being also materially diminished by them.

In many cases of bronchitis, when the acute symptoms have passed off but the secretion continues profuse, as well as in those cases called bronchorrhœa, the exhibition of iron is often of great service. It seems to give tone to the relaxed capillaries of the mucous membrane, and to diminish the secretion. It may be given in combination with carbonate of ammonia, in the form of the ammonio-citrate; or the tincture of the perchloride with ether or spirits of chloroform may be employed, or the ethereal tincture of the acetate (Ph. Ger.), which is a very valuable preparation in some cases.

Inhalations are useful for allaying cough in the earlier stages of the affection, or for the relief of spasm. In some cases of severe bronchitis where apnœa has been threatened, recovery has followed the exhibition of large doses – half an ounce—of turpentine. In this dose, however, it sometimes produces alarming symptoms, and it is perhaps better to exhibit it in smaller quantities tentatively. An emetic may be serviceable, especially in children, if the tubes are much loaded. Children suffering from severe attacks of bronchitis should not be allowed to sleep long, for fear of dangerous accumulation in the tubes, and care should be taken that the secretions do not collect about the back of the mouth.

Patients should not be kept on a low diet even at the beginning of an attack, and as the disease progresses the quantity of food allowed may be increased according to the appetite. In the treatment of gouty bronchitis, or bronchitis associated with a tendency to the formation of uric acid in the system, colchicum and the alkalis must be given, and the general measures used which are applicable to the constitutional condition. If bronchitis depend on a gouty state, it will not yield to the ordinary treatment, but when its cause is recognised and the appropriate remedies are administered, the symptoms usually soon begin to improve.

In the cases of bronchitis which are connected with heart-disease, and especially with mitral regurgitation, digitalis is often of great value. By steadying the action of the heart it relieves the overloaded pulmonary veins, and thus directly diminishes the congestion of the mucous membrane, as mentioned in the paragraph relating to the pathology of the disease.

It is impossible in the scope of this article to refer specially to the treatment of bronchitic attacks arising from the various kinds of mechanical irritation. There is, however, one form of bronchitis which may be mentioned, viz., that connected with hay-fever, arising either from the inhalation of pollen, or caused by some peculiar atmospheric influence acting on a peculiar nervous system. It is very difficult of cure. In the writer's experience no remedies seem to have any particular influence over it, and it is usually only to be relieved by removing the patient from the exciting cause of the affection. In the treatment of bronchitis depending on constitutional syphilis, the appropriate measures for that affection must be resorted to.

2. Chronic Inflammation—Chronic Bronchitis—Chronic Bronchial Catarrh.

Definition.—A chronic inflammation or congestion, more or less extensive, of the bronchial tubes.

Ætiology. — Chronic bronchitis very frequently results from repeated attacks of the acute disease, but it may be chronic from the beginning. Emphysema of the lungs, dilated bronchi, and phthisis are causes of the complaint; as are also various forms of heart-disease, and some blood-affections, such as gout. The inhalation of irritating particles gives rise to chronic bronchitis; and it is also met with in connexion with chronic alcoholism. It is most common amongst the old.

Anatomical Characters. — The bronchial mucous membrane is discoloured, being of a dull-red tint, greyish, or brownish. The discoloration is for the most part partially, but sometimes evenly, diffused. There is swelling and increased firmness of the mucous membrane, and the submucous tissue in old-standing cases becomes infiltrated and indurated. The fibrous and muscular tissues are hypertrophied; the cartilages in the larger tubes are sometimes calcareous; and there is generally more or less emphysema of the lungs.

Symptoms.—The symptoms of chronic bronchitis vary greatly in different cases. They resemble in kind those of the acute affection. There is cough, expectoration, pain, soreness or uneasiness behind the sternum, with more or less dyspnœa. The constitutional symptoms may be very slight, scarcely any effect on the general health being apparent; or they may be very severe. Three forms of chronic bronchitis are recognised clinically:—1. That which includes the ordinary cases of the disease, varying much in severity; 2. that characterised by excessive secretion—*bronchorrhœa;* 3. that form which is called *dry catarrh.*

1. In the first form of chronic bronchitis the cough is at first slight, perhaps only occurring during the winter, being altogether absent in the summer. After a time the attacks become more frequent, and at last the patient is never free from the affection, which is aggravated at times. The cough in such cases is more or less severe, but usually most so in the morning. It is often paroxysmal, and sometimes very violent. The expectoration, in some cases being scanty, viscid, and difficult to discharge, is in others, especially old-standing cases, copious and easy. The sputa vary much both in appearance and quantity. They may be yellowish-white muco-purulent matter, or more decidedly purulent, of a greenish-yellow or bright or dark green colour; they are but little aërated, sometimes not at all, so that they sink in water; at times they are nummulated and quite opaque. In some cases the expectoration is fœtid, constituting the form of the disease denominated 'fœtid bronchitis,' the odour resulting either from sloughs of minute portions of the mucous membrane, or from chemical changes taking place in the sputa. Occasionally streaks of blood are met with. Microscopically the sputa are found to consist of epithelium, pus-cells, and granular matter, with at times blood-corpuscles.

The constitution does not suffer much in mild attacks, but when chronic bronchitis is permanent and general, the system at large sympathises more or less severely: the appetite fails, sleep is disturbed by the cough, emaciation sets in and sometimes becomes marked, but it does not proceed beyond a certain point, unlike that of phthisis, which is usually progressive. In all cases of chronic bronchitis there is great risk of an acute attack coming on, especially amongst the aged. These attacks are very dangerous, in consequence of the rapid extension of the disease throughout the lungs, and its asphyxiating character.

2. The second class of cases is characterised by excessive secretion from the bronchial tubes —*Bronchorrhœa.* This form is often met with in the old and feeble, and especially in cases of valvular disease of the heart. The cough is paroxysmal, and attended with the expectoration of a large quantity of thin watery glairy fluid, or of thick ropy gluey matter, like white of egg. The quantity expectorated is sometimes very large. This form of bronchitis may cause death somewhat suddenly by apnœa. During the paroxysms of cough there is dyspnœa, but at other times it is absent, except when heart-disease exists. The constitution suffers little, and the flux seems sometimes to be beneficial in cases of obstructive cardiac disease.

3. The third variety, or *Catarrhe sec,* is characterised by very troublesome cough, oppression of breathing, tightness of the chest, and sometimes severe dyspnœa. Expectoration is either absent or very scanty, the sputa consisting of small masses of tough viscid semi-transparent mucus. There is usually no febrile disturbance. The disease is met with in gouty people, and is often associated with emphysema of the lungs. Pathologically it seems to consist in a congested condition of the bronchial tubes.

Physical Signs.—Inspection reveals nothing abnormal in the form or size of the chest, unless emphysema of the lungs is present. The expansion in long-standing cases is usually deficient; the chest being raised more than in health. Expiration is often prolonged. Rhonchal fremitus may be felt more or less, depending on the state of the bronchial tubes. There is often increased resonance, from the presence of emphysema. The breath-sounds are more or less changed; they are harsh and loud, and the expiration is prolonged in cases that have existed for a considerable period. The rhonchi vary; they are dry, coarse, moist, or bubbling according to the condition and contents of the tubes. Vocal resonance varies; it may be bronchophonic, normal, or deficient.

Diagnosis.—There is usually but little difficulty in the diagnosis of chronic bronchitis. The affection is most likely to be confounded with phthisis, but the character and degree of the wasting, and the absence of increased temperature, of hæmoptysis, and of the physical signs of consolidation, will generally enable the practitioner to decide in favour of the less important disease. The main difficulty lies in the diagnosis of cases where the bronchi are dilated; this will be referred to hereafter.

Prognosis.—Although in itself not a dangerous malady, chronic bronchitis becomes so in consequence of the liability which exists to the occurrence of acute symptoms; when once established in middle or advanced age it is almost incurable. The complaint is further serious from its tendency to produce emphysema and dilatation of the bronchi. *Per se* it can scarcely ever be said to kill.

Treatment.—No case of chronic bronchitis can be successfully treated without due regard to the constitutional condition of the patient. In some cases it is impossible to cure the disease, and all efforts should be directed towards preventing its extension; alleviating the symptoms to which it gives rise; and warding off acute attacks. Attention must be especially paid to the state of the heart and kidneys; the duration of the affection; the age of the patient; the characters of the expectoration; the state of the lungs, as to the existence of emphysema or other morbid conditions; and the presence of gout or rheumatism. Speaking generally, chronic bronchitis must be treated by the use of a generous diet, with more or less stimulants; by the exhibition of expectorants and tonics; and by the avoidance of all depressing measures. The function of the liver must be looked to, and the administration of a few doses of blue pill with a saline aperient often gives great relief, and alters the character of the bronchial secretion. If gout, or a tendency to the formation of uric acid, is present, colchicum with alkalis and other remedies for gout, such as a course of Friedrichshall or Carlsbad waters, will prove of great service. If cardiac disease exist, whether in the form of valvular incompetence, or of weak, flabby, or dilated heart, digitalis combined with iron frequently produces marked benefit.

In the treatment of ordinary cases of chronic bronchitis, not dependent on any organic disease or constitutional condition, the patient's general health has to be looked to. The affection has a tendency to lower the health and to diminish strength, and therefore the various tonics may often be given with great benefit. Of these the most useful are quinine, the preparations of iron and those of zinc. Cod-liver oil is also very valuable in some cases where there is much wasting. The cases of bronchitis marked by excessive secretion are generally best treated by tonics; whilst those where the secretion is slight—cases of 'dry catarrh'—being often associated with a gouty condition of the system, are more amenable to the use of colchicum, the alkalis, iodide of potassium, and mineral waters.

In what may be called the symptomatic treatment of the affection, the various expectorants are useful—carbonate of ammonia, ipecacuanha, squill, cascarilla, senega, chloroform, &c., and these may often be beneficially combined with some form of tonic. In many cases of chronic bronchitis the expectorating power is diminished, and stimulating expectorants are of great service. Great caution must be exercised in the administration of opiates and other narcotics or sedatives. When, however, the mucous membrane is very irritable, and when there is but little secretion with a troublesome cough, these remedies are indicated. Opium is of great value, and chloral-hydrate is also very useful, as well as, in some cases, henbane and hydrocyanic acid, or, whenever spasm is present, stramonium, lobelia, the ethers, and cannabis indica. Inhalations are sometimes very beneficial, as of the vapour of warm water, iodine, creasote, and other substances. The inhalation of creasote is especially valuable if the expectoration is fœtid.

Counter-irritation is one of the most important means we possess of relieving chronic bronchitis. The irritation should not be excessive, but should be long-continued. The application of iodine over a large surface of the chest, so as to keep up a constant slight inflammation of the skin, is perhaps the best that can be used; but other irritants may be tried, such as sinapisms, or the various stimulating liniments.

The general management of the patient is most important. A mild climate should, if possible, be chosen in the winter. The patient should live as far as possible in an atmosphere which is mild and dry. Although some cases are benefited by a moist and warm atmosphere, the majority of cases of chronic bronchitis do better in a drier one. The skin must be carefully looked to, its action should be well maintained, and warm clothing always worn. A moderate amount of some alcoholic stimulant is generally desirable; and the food should be nutritious and of easy digestion. Relief will often be found from wearing a respirator.

3. Plastic Bronchitis.—This is a rare form of disease, and of its particular causes nothing is known. It is perhaps connected with some peculiar diathesis. Sir John Rose Cormack suggests that it may be a variety of diphtheria. It may occur in either sex, and at any period of life, but is most frequent in those who are of a strumous or phthisical constitution. It has been known, however, to attack persons of apparently healthy frame and in the enjoyment of robust health.

Anatomical Characters.—Plastic bronchitis is anatomically characterised by the formation of concretions in the bronchial tubes. These concretions consist of fibrinous exudation from the mucous membrane; they form casts of the tubes, and are expectorated. These casts are either solid or hollow, and on examination are always found to consist of concentric laminæ. They are, for the most part, poured out into the finer bronchial tubes, sometimes, however, into the larger ones, but never into the trachea. The casts are of a whitish colour, but they are often stained with blood. Microscopically they consist of an amorphous or fibrillar material, with exudation-corpuscles, granular matter, and oil-globules.

SYMPTOMS.—This disease is essentially chronic, but it has been met with as an acute affection in children. At the times when the casts of the tubes are expelled exacerbations occur, the patient being attacked with pain and a sense of constriction across the chest, dyspnœa, and an irritating cough. After a time, varying from some hours to a few days, the dyspnœa becomes very urgent, and the cough very severe; then, after a paroxysm of coughing, it is found that the patient has expectorated some solid material, either with or without blood, usually intermixed with ordinary bronchitic sputa. The dyspnœa and cough now subside, to recur after an interval of a few hours or longer. The disease may last for weeks, months, or even years, marked from time to time by severe accessions, and relieved by the expulsion of further concretions. The matter expelled is often in small masses, but at times casts of bronchial tubes with several ramifications are expectorated. The disease may recur at intervals for many years; the general health in such cases does not seem to suffer, the breathing during the intervals being unaffected. There is, in some instances, an absence of febrile symptoms during the attack, whilst in others the fever is more marked. With the general symptoms are combined the *physical signs*. These are somewhat peculiar. The bronchial tubes being obstructed, portions of lung are deprived of air; the breath-sounds are therefore faint or absent. There may be dulness more or less complete on percussion, from collapse of the lung-substance, or, as occurs in some cases, from localized pneumonia. Apnœa may be threatened if a large tube is blocked up.

DIAGNOSIS.—The diagnosis of this affection turns on the peculiarity of the expectorated matters. Doubtless the disease may be mistaken for ordinary bronchitis or pneumonia, but when once the fibrinous casts of the tubes are observed in the sputa, the nature of the case becomes clear.

PROGNOSIS, DURATION, TERMINATIONS, AND MORTALITY.—The prognosis, if the disease is uncomplicated, is favourable; but there is great liability to recurrence. The complaint may last for many years; and may terminate in complete recovery. A fatal result generally depends on the presence of some other organic disease, such as phthisis or pneumonia.

TREATMENT.—But little can be advanced as to the value of any special treatment for this affection. Iodide of potassium is said to have been employed with success. The chief object should be to maintain the general health by hygienic measures, and the exhibition of tonics, such as iron, quinine, and cod-liver oil, especially if there be any tubercular taint. During the exacerbations the administration of ammonia and the use of inhalants should be resorted to, and the general principles on which ordinary bronchitis is treated should be carried out.

4. Dilatation.—Bronchiectasis.—This is a rare disease, which arises as a secondary affection. It is often associated with serious pulmonary mischief, and is at times difficult of diagnosis. There are two forms of bronchiectasis, namely *general or uniform dilatation*; and *saccular or ampullary dilatation*.

1. The *general* or uniform bronchiectasis consists in a cylindrical dilatation of one or more of the tubes throughout a considerable portion of their extent. The tubes are evenly widened for the most part, and end abruptly.

2. The *saccular* form of bronchiectasis consists of a globular dilatation of a tube at one point, or at several points. The dilatations vary in size, being from half an inch to an inch or more in diameter. On the tracheal side they usually communicate with a slightly enlarged bronchial tube, whilst on the peripheral side the continuity of the tube is almost or entirely lost from narrowing or actual obliteration. Sometimes the cavities communicate with one another.

The two forms of bronchiectasis often coexist.

The walls of the dilatations undergo changes in the course of the disease. The mucous membrane becomes granular, swollen, and congested; while at a later stage it presents a velvety or villous appearance, and in some cases there is even ulceration with superficial necrosis. The muscular and elastic coats become atrophied, and coincidently with this dilatation increases. At times the wasting of these coats is partial; some portions of the walls retaining their natural volume, and forming bands or ridges elevated above the surrounding membrane. The dilated tubes occasionally present an appearance of hypertrophy; the walls are thickened, but the thickening depends on changes which have taken place in the mucous membrane. The cartilages resist the destructive metamorphoses longer than the other structures, but they sometimes partake of them. The contents of the tubes may be either muco-pus, or pus; and casts of the minute bronchi are met with. At times the contents are very fœtid. Crystals of margarin are occasionally found, and sometimes fragments of pulmonary tissue. It is said that the contents may become calcareous.

Dilatation of the bronchi may be unattended with any change in the surrounding lung-tissue, but, generally speaking, condensation of the latter takes place, either as the result of pressure or of chronic pneumonia. In some instances the tissue forms an abscess, in the centre of which the walls of the bronchus are found, whilst in others the walls of the bronchi and the surrounding tissue are destroyed by gangrenous inflammation. It is generally not difficult to distinguish between a phthisical cavity and a dilated bronchus. The latter is not characterised by the broken irregular surface which usually exists in the former; its shape is generally more regular; and it is usually continuous with bronchial tubes. The surrounding lung-tissue has no tubercular infiltration.

The *mechanism* of bronchiectasis has occupied much attention. It is probable that the elastic and muscular fibres lose their elasticity and contractility as the result of chronic inflammation, and thus yield to the distending influence of coughing. When once a dilatation is produced, accumulation of the secretions takes place, which tends further to increase the dilatation.

SYMPTOMS.—The symptoms of bronchiectasis are those of chronic bronchitis aggravated in some important respects. The cough is frequent and paroxysmal. The expectoration is very abundant, very purulent, and, when the disease has lasted some time, very fœtid. The breath also becomes fœtid. Hæmoptysis is occasionally met with, even to a considerable extent. There is more wasting than in ordinary bronchitis, and the blood is more imperfectly aërated. Night-sweats are not uncommon. In fact, the general symptoms approach those of phthisis. The digestive functions are usually not much impaired.

PHYSICAL SIGNS.—The movement of expansion is diminished in bronchiectasis, while that of expiration is prolonged. Over the affected portions of the lung there may be slight retraction. Vocal fremitus is increased, and rhonchal fremitus is sometimes well marked. The percussion-note is altered. If a dilated tube is surrounded by condensed lung-tissue, or is full of secretion, there is dulness on percussion; but if it is situated near the surface and empty, some degree of tubular resonance may exist. Cracked-pot sound may be at times elicited. The respiratory sounds are harsh, or loudly bronchial with a more or less blowing character, and they may be distinctly cavernous. Vocal resonance is often greatly increased. The pulse becomes rapid in the later stages. The temperature rarely if ever reaches the height that it does in phthisis with cavities, and the daily oscillations are not so marked.

DIAGNOSIS.—The main difficulty as regards diagnosis is in the differentiation of certain cases of phthisis with cavities from bronchiectasis with large globular dilatations. The points to be relied on are that in the latter disease the morbid physical signs are usually met with at the middle and lower parts of the lungs, whilst in ordinary phthisis they are found at the apex; that the temperature differs in the two affections as mentioned above; that emaciation and night-sweats are not so marked in bronchiectasis; and that, if cases are watched, there is usually observed a progressive advance of symptoms in phthisis, whilst in bronchiectasis the symptoms may remain stationary. In phthisis signs of consolidation precede those of cavities, whilst they follow them in bronchiectasis. Bronchial dilatations and tuberculous cavities have been found in the same lung. The fœtor of the breath and sputa in bronchiectasis may cause a suspicion that gangrene of the lung is present; but the general symptoms will usually enable the practitioner to differentiate between the two affections.

PROGNOSIS.—Bronchial dilatation is probably never cured. It may last for years.

TREATMENT.—The treatment of bronchiectasis must be that of chronic bronchitis with the use of such measures as are applicable to wasting diseases in general. The fœtor of the breath is best relieved by the inhalation of creasote.

5. **Narrowing or Obstruction.**—Narrowing or obstruction of the bronchial tubes is by no means uncommon, and may depend on intrinsic or extrinsic causes. Complete obliteration of a tube is sometimes found in connection with bronchiectasis, immediately beyond a globular dilatation.

ÆTIOLOGY.—The *intrinsic* causes of obstruction are a thickening of the mucous membrane resulting from bronchitis; the retention of viscid secretions; the exudation of plastic material into the interior of the tubes; and the deposition therein of tubercle or cancer.

Amongst the principal *extrinsic* causes are: the pressure of adjacent tuberculous or cancerous deposits; the contraction of plastic matter exuded into the tissues surrounding the tubes; solid formations in the pleura; enlarged bronchial glands; and aneurismal and other thoracic tumours.

Obstruction is most frequently met with in the smaller tubes, but the pressure of thoracic tumours not unfrequently causes obstruction, or even obliteration of a main bronchus, which occasionally—as in the case of aneurisms—becomes perforated.

SYMPTOMS.—If a large bronchial tube becomes suddenly and greatly obstructed, dyspnœa of an urgent character sets in, and death from apnœa may speedily result, unless the obstruction be removed. When the obstruction is on a smaller scale, being confined to the smaller tubes, or when a large tube suffers only from slow, gradually increasing obstruction, the symptoms are by no means urgent for a time, and slight dyspnœa, sometimes accompanied by stridor, is the most marked feature.

PHYSICAL SIGNS.—Complete obstruction of a bronchial tube invariably leads to collapse of the portions of the lung to which the tube is distributed, and thus an entire lung may collapse if its main bronchus be obliterated. Where partial collapse is produced, emphysema of the neighbouring lung-tissue commonly follows, and if one lung become collapsed, the opposite lung becomes enlarged and emphysematous. The existence of collapsed lung gives rise to dulness on percussion over the affected part, unless this be situated away from the chest-walls, or masked by the presence of emphysema. Further, obstruction of the bronchi causes a weakness or deficiency of the respiratory sounds, with a prolonged expiratory murmur, attended at times with sonorous and sibilant rhonchi. Over the collapsed portion of the lung, or over portions of the lung supplied by a tube which has become completely obstructed, the breath-sounds are absent. Deficiency or absence of vocal vibration is another physical sign of obstructed bronchial tubes.

TREATMENT.—The treatment of obstruction of the bronchi must depend on the nature of its cause. The chief interest of the affection arises from the means of diagnosis of thoracic tumours which it may afford.

6. **Cancer.**—Cancer of the bronchial tubes occurring independently of cancer in the lungs, or mediastina, is probably never seen; but can-

cerous matter has been found in the tubes: (1) in cases where the lungs have been infiltrated with a similar deposit; (2) where a cancerous tumour connected with the root of a lung has perforated a tube; and (3) in some cases of cancerous disease of the lung, a tumour of a similar nature being found connected with the mucous membrane of a tube. (4) Cancerous matter has also been found *in transitu* in a tube, having been detached from a cancerous mass.

A. T. H. WATERS.

BRONCHIAL GLANDS, Diseases of.—SYNON: Fr. *Adénopathie Trachéo-bronchique;* Ger. *Krankheiten der Bronchialdrüsen.*

DEFINITION.—Disease of those lymphatic glands which are situated at the bifurcation of the trachea, between the right and left bronchus, or upon these tubes and their primary divisions.

GENERAL DESCRIPTION.—A short reference to the anatomical relation of these glands in connexion with their pathological and clinical history will be useful. Taking the bifurcation of the trachea as a starting point, we find in the space between the right and left bronchus a group of glands. They are from ten to fifteen in number, and they vary in size from that of a small pea to that of an almond. The glands towards the right bronchus are larger than those towards the left. Glands are also situated upon the tubes; they are few in number and small. The vascular supply of the glands, which is free, is derived from the bronchial arteries, and the blood is returned to the bronchial veins. Afferent lymphatics reach the glands from the lungs, from the pleura, from the neck, and other neighbouring parts. Besides these groups of comparatively large glands, numerous minute lymphatic glands are found in connection with the primary division of the bronchi, chiefly at the back of these tubes at their bifurcations and at those of the pulmonary artery. The central group of glands is in relation in front with the pericardium, the arch of the aorta, and the pulmonary artery; behind with the pulmonary plexus of nerves, the œsophagus, the aorta, the vena azygos, &c. The ganglia on the upper, anterior, and posterior surfaces of the right bronchus are four or five in number and smaller than those of the central group. Their situation brings them into relation with the arch of the aorta, the innominate and subclavian arteries, with the brachio-cephalic vein, and with the vena azygos, the pneumogastric nerve, and its recurrent branch. The ganglia on the left bronchus are still smaller than those of the right side. Their position gives them relations with the arch of the aorta, the origin of the left carotid and subclavian arteries, the left branch of the pulmonary arteries, with the large veins, with the left pneumogastric nerve, and especially with its recurrent branch. Lastly it should be stated, as a guide in clinical examination, that the bifurcation of the trachea takes place in front of the body of the fifth dorsal vertebra, or between the fourth and fifth, and behind the lower end of the first bone of the sternum. The glands, except when diseased, are proportionately larger in children than in adult or aged persons. Knowing that these glands in common with other lymphatic glands, are liable to such diseases as enlargement, abscess, morbid deposits, growths, and other textural changes, and bearing in mind, as just mentioned, their relations to surrounding organs, we can readily see that the study of their diseased conditions is important. Not only is their study important in reference to the diseased glands themselves, but by reason of their modifying or masking the symptoms of disease in other organs, as results of the pressure which when enlarged they cause on nerves, air-passages, blood-vessels, &c. Throughout English and foreign medical literature numerous cases will be found described, in which there existed, more or less conspicuously, striking disease of the bronchial glands, little notice, however, being taken of less striking, though far more numerous, examples of disease. It is only within a comparatively recent time that the subject has received special attention and been discussed as a disease *per se.*

MM. Rilliet and Barthez, in their well-known *Traité des Maladies des Enfants,* have described the disease in infants, and Dr. West, in his work on *The Diseases of Infancy and Childhood,* has fully and clearly described—under the head of Bronchial Phthisis—the tubercular diseases of these glands in young subjects. It is, however, to M. Noel Gueneau de Mussy, following up and widely extending the investigation of his predecessors, that we are especially indebted for our knowledge of the effects of these lesions, and to his pupil M. Barety, who has published an exhaustive memoir upon these, under the title *L'Adénopathie Trachéo-Bronchique.* The subject has attracted the present writer's notice since (or even before) the year 1853, and the notes of nearly sixty cases which have fallen under his observation will form the bases of some of the conclusions to be subsequently stated in this article.

MORBID ANATOMY AND PATHOLOGY. — The bronchial glands participate in the diseases which affect lymphatic glands generally, and which will be found described in another article. (*See* LYMPHATIC SYSTEM, Diseases of.) Here it will suffice to enumerate the principal morbid changes to which they are liable, referring briefly to any special circumstances in connection with these particular glands.

a. The bronchial glands are liable to *congestion* with enlargement as are glands in other situations. *Hypertrophy* will be the result of this last condition becoming chronic. The glands in this situation become after childhood almost invariably studded with black deposits, the quantity of which may be so considerable as to constitute *melanoma.*

b. These glands are liable to *acute* and *chronic inflammation.* Acute inflammation in this situation, terminating in *abscess,* is rare, but several cases of the kind have been recorded. Chronic inflammation of the glands is by no means uncommon. It may lead to permanent enlargement, to contraction and induration of the glandular textures, with the presence of calcareous particles, or to abscess The contents of the abscess may be more or less completely absorbed, leaving a partially filled *sac* or *cyst,* containing thick pus or cheesy matter. But these glands, when inflamed and enlarged, may form adhesions with surrounding parts, and the contents of an abscess, if it exist, may be discharged, by an *ulcerative* process, into the substance of a lung, into the mediastinum, into the trachea, or œsophagus, or even into a blood-vessel. *General emphysema* has occurred in such cases; whilst the emptied sac has assumed in some instances the character of a *cavity* connected with the lungs. When the matter is discharged into the air-passages, *purulent expectoration* is the result. Two or three examples of such cases were noticed in the writer's observation. and the possibility of their being mistaken for the discharge from a cavity in the lungs, or an empyema, was remarked upon at the time. The abscess may discharge into the mediastinum. A remarkable instance of the kind is recorded in the case of the late much lamented Dr. Fuller. A chronic abscess of the bronchial glands had opened into the posterior mediastinum. This led to pyæmia, the formation of abscesses in the brain, and to the loss of a valuable life.

c. These glands are liable to suffer especially from *tuberculous* or *scrofulous disease*, from various forms of *malignant disease*, and in *secondary* or *tertiary syphilis*. Of the latter form of disease, some striking examples have fallen under the notice of the writer, in which symptoms closely resembling phthisis existed, but which yielded to treatment directed to the specific disease.

ÆTIOLOGY.—The causes which give rise to disease of the lymphatic glands being discussed in another article, reference will here be made only to the special circumstances which influence the particular glands, and thus it will be sufficient merely to allude, amongst *predisposing causes*, to hereditary predisposition, to general impairment of health, and the like. With regard to the influence of age and sex, reference has already been made to the works of Rilliet and Barthez, of Dr. West, and of other authors who described the frequency of the disease in childhood. The writer's observations made on young persons and adults show that of 58 cases (of whom 21 were males and 36 females—in one case the sex was not recorded) 2 were under 10 years of age, 9 were between 10 and 20 years of age, 18 were between 20 and 30, and 26 were over 30 years of age. In three cases the age was not stated. If these observations justify any inference, it is that females are more liable to disease of the bronchial glands than males, and that the disease occurs with increasing frequency after the age of puberty. Amongst the *exciting causes* of disease in these glands we may leave to be considered elsewhere those general conditions which give rise to disease in these and other glands, such as scrofula, tubercle, malignant disease, &c., and pass on to the consideration of the more immediately *local* exciting causes. *Cold* leads frequently to congestion and enlargement of the bronchial glands. But it is to local irritation or inflammatory disease in organs or tissues with which these glands have a connection that the source of disease may be frequently traced. As we find the submaxillary or cervical lymphatic glands enlarged from irritation or disease in the mouth or throat, or the axillary glands or inguinal glands enlarged from irritation or inflammation about the hands and feet, so we may find the bronchial glands enlarged temporarily or permanently from inflammatory disease in parts the lymphatics of which pass to these glands. These glands have been observed to be enlarged in the course of or after certain acute specific diseases, such as scarlet fever, measles, and typhoid fever. In whooping cough this enlargement has been so frequently observed by M. Guéneau de Mussy, that he believes this disease to be an exanthem of the bronchial mucous membrane, and that this local condition leads to enlargement of the glands, which, again, by pressure on the pneumogastric and recurrent nerves, gives rise to some of the special phenomena of the disease, such as crowing cough, and even to the vomiting so frequently observed in this disease. It is right to remark here that the late Dr. Hugh Ley speaks interrogatively, in his work on Laryngismus stridulus, of enlarged bronchial glands being capable of producing a cough like that of pertussis, and he further alludes to some cases of whooping cough in which the glands by the side of the trachea were enlarged. He asks, 'May it not be that an enlargement of these glands from a specific animal poison, similar to that of the parotid gland in mumps, is after all the cause of whooping cough?' (Note, p. 440.) The same author gives several beautiful illustrations of diseased bronchial glands pressing upon the pneumogastric and other nerves. The black deposit so often found in the glands is the result of the absorption of carbonaceous or pigmentary matter from the lungs.

SYMPTOMS.—The symptoms which have been recorded by the writer as more or less characteristic of the presence of enlargement of the bronchial glands are as follows:—

1. *Cough*, which is noted as being a prominent symptom in 39 cases. In 21 of these cases it was stated to have been the most troublesome of the symptoms present. In 6 cases it was described as harsh and laryngeal; in 4 cases spasmodic, resembling whooping cough. In other cases, 5 in number, it was characterised as short and hacking, constant, incessant, and in one case the sound resembled that made by the cough of a sheep.

2. *Pain* is, in regard to the frequency of its occurrence, the next symptom recorded. It was mentioned as being present in 22 cases. The seat of pain was almost constantly referred to the situation of the fourth and fifth dorsal vertebræ at one or both sides of the spinal column. The pain was mentioned in a few cases as existing only in front, beneath and at one or both sides of the upper end of the sternum and below the clavicles. The feeling was described in some cases (5) as of distressing tightness, and in one case as a 'spasm.' Tenderness on pressure over the seat of pain was very frequently observed. The persistence of the pain was very varied.

3. *Difficulty of breathing* was a noticeable symptom in several cases. In 13 it was recorded as being specially so; in 4 it had all the characters of spasmodic asthma, occurring at intervals and especially during the night.

4. *Difficulty of swallowing* was noticed in 10 cases; in one of these the difficulty was remarked especially in swallowing liquids.

5. *Hæmoptysis* was present in 10 cases. The amount of blood varied in these cases from

marked streaks to copious expectoration, lasting two or three days. No case was recorded as presenting this symptom except on tolerably clear proof that it depended on bronchial gland enlargement, and on no other cause.

6. *Congestion* and puffiness of the face have been mentioned as present in 3 cases.

7. *Expectoration of mucus*, such as results from bronchial catarrh, was frequently present. Expectoration of pus was present in 3 cases. In each it resembled the contents of an ordinary glandular abscess mixed with air. In one of these the discharge was intermittent. The frequent occurrence of cough without any expectoration was remarked in many cases. Calcareous particles are mentioned also as having been expectorated.

8. *Loss of voice* (4 cases) and hoarseness (2 cases) are recorded as striking symptoms.

9. *Vomiting* is mentioned as having been present twice.

10. Lastly, the *position* assumed with least discomfort by the patient when in bed was noticed in 41 cases. Of these 23 rested on that side on which the glands were mentioned as being chiefly if not wholly affected. In 15 cases an opposite condition was noticed. In 2 cases lying on the back was the most comfortable position. One patient, unable to lie down, sat when in bed, and stooped forward. One patient, a little boy, could only rest on his face and knees. This case was further remarkable in reference to the clearness with which the disease was recognised and the successful result of subsequent treatment.

It might be mentioned here incidentally that the glands of the right side were noticed as being chiefly affected in 28 cases, and of the left in 22 cases—in 4 both sides seemed equally affected, and in 4 no record was made. The general or constitutional symptoms connected with the malady under notice need not be discussed here. They are in nowise peculiar, and will be found discussed elsewhere. The symptoms described above have special reference to the bronchial glands. The cough and its peculiar characteristics are, no doubt, in a great measure dependent on pressure or on irritation communicated to the pneumogastric nerves and their branches. So likewise pain and difficulty of breathing, in a great degree, through direct pressure on the air-passages, may also cause or aggravate these symptoms. Aphonia especially seems to have relation to the condition of the recurrent nerves. In one of the cases which the writer saw with Mr. Lennox Browne, paralysis of the left chorda vocalis existed. The diagnosis of glandular disease was clear, a conclusion confirmed by the results of treatment. Vomiting is mentioned in two cases. M. de Mussy says that this is a more frequent result when the left pneumogastric nerve is pressed upon. He sees a connexion between the troublesome vomiting which occurs in some cases of tubercular disease of the lungs with like pressure upon nerves. The puffiness of the face and eyes noticed in these cases is due to the pressure on the venous trunks, a condition which also accounts not only for hæmoptysis, but for bleeding from the nose, occasionally present. Copious and sometimes persistent hæmoptysis has been traced to the perforation of a vessel (ulceration in connexion with disease of the glands).

The Physical Signs noticed in the 58 cases referred to were: 1. *Dulness.*—It was present in 47 cases. It was found between the margin of the scapula and the spinal column at one or both sides, on a level with the fourth and fifth dorsal vertebræ. It varied in degree, and was more readily manifested when the muscles of the back were made tense by folding the arms across the chest, and was often strikingly distinct when one side was contrasted with the other. Dulness was present in front, in 8 cases (whether coincidentally with dulness at the back or not is not clearly stated), beneath the top of the sternum and at each side below the sterno-clavicular junction. The dulness here was best elicited by the patient holding the head backwards whilst percussion was being made.

2. *Flattening* of the affected side in front was mentioned in 3 cases. *Diminished mobility* of the affected side, independent of flattening, was recorded in 4 cases. Prominence in front was not recorded in any case, though, no doubt, it occurs sometimes.

3. *The respiratory sounds* were variously modified. *Marked tubular breathing* was recorded as being present over the seat of disease in 14 cases. In 10 the expiratory murmur was described as being *very loud*, various modifications of the inspiratory murmur being found at the same time. *Feebleness* of the respiratory murmur as a whole was noticed in 14 cases. In some this deficiency extended over the whole lung; in others it existed over the upper or lower portion of a lung, behind or in front. The observations made on the voice by the writer were few, but M. de Mussy and M. Lereboullet speak of a peculiar and increased reverberation of both the voice and the cough. Dr. Eustace Smith has described in the cases of children a venous hum, heard at the root of the neck when the head is thrown back, caused by the pressure of the enlarged glands on the venous trunks.

Diagnosis.—In the present article those cases are not kept in view in which the bronchial glands becoming the seat of constitutional disease in association with other glands in the neighbourhood, constitute large and manifest tumours —such will be found described under another head (*see* Intrathoracic Tumours). Nor has it been intended to give prominent consideration to the state of the glands when they enlarge in acute disease—such as eruptive fevers; nor in those diseases—such as typhoid—where the glands play a secondary part. The writer has been anxious to describe and to assist in recognising the presence of a condition in which the disease of the bronchial glands constitutes to some extent a disease *per se*, or gives rise to complications which it is important to discriminate. He believes the symptoms and signs above described will suffice for the purpose, always remembering that in the present and in all similar instances it is necessary to take means for excluding in our investigations diseases which may produce like phenomena. Thus we may find cough, pain, tenderness on pressure, and aphonia in a case of hysteria without any evident structural disease. On the other hand a small tumour, say, a small aneurism, may produce all the signs of pressure which are above given as the signs of bronchial gland-enlargement. It is the duty of the physician to recognise these differences and distinctions, to trace them to their origin, and thus establish as far as may be the nature of the disease under investigation.

Prognosis will in this, as in like instances, so entirely depend on the nature of the disease, on its amount and its condition, on its relation to and effects on surrounding organs and textures, that each case must be regarded independently. It would be impossible to discuss them fully here—all that can be said is that the simple enlargements generally yield to treatment and within a reasonable period.

Treatment.—In several cases of morbid gland-enlargement, treatment has proved very effective. These cases would seem to be those of simple chronic enlargement. Many such cases have yielded to the use of iodide of iron in the form of pills or syrup, and to the external application of a solution of iodine, composed of equal parts of the tincture and the liniment of iodine, between the shoulders. The same treatment has likewise proved very effective in cases in which a syphilitic origin for the disease could be traced. Symptoms such as cough, difficulty of breathing, pain as well as dyspnœa, loss of flesh, strength, &c., will all require more or less suitable treatment. The cough and difficulty of breathing may in some cases be relieved by simple expectorants or antispasmodics. A useful application when pain is a prominent symptom, is an embrocation composed of equal parts of chloroform, belladonna liniment, laudanum, and spirits of camphor. A couple of drachms of this composition sprinkled on the surface of piline and applied on the painful part for a few minutes, often affords relief. Hypodermic injection of morphia may be required when pain is very severe. Under all circumstances it is necessary to improve the general health by wholesome diet, pure air, and the other conditions which will promote good digestion and elimination from the excreting organs.

R. Quain, M.D.

BRONCHOCELE (*βρόγχος*, the throat, and *κήλη*, a tumour). A synonym for goitre. *See* Goitre.

BRONCHOPHONY (*βρόγχος*, the throat, and *φωνή*, the voice). The resonance of the voice, as normally heard on auscultation over those parts of the chest which correspond with the main bronchi, and, in certain mordid conditions, beyond these situations. *See* Physical Examination.

BRONCHO-PNEUMONIA. A synonym for catarrhal pneumonia. *See* Pneumonia.

BRONZED SKIN. A peculiar discolouration of the skin frequently associated with Addison's disease. *See* Addison's Disease.

BROW-AGUE. A synonym for frontal neuralgia, or tic-douloureux. *See* Neuralgia; and Tic-Douloureux.

BRUIT. (*Bruit*, Fr., a noise.) A word used to designate various abnormal sounds heard on auscultation, in connexion with the heart or vascular system. *See* Physical Examination.

BUBO (*βουβὼν*, the groin).—Synon.: *Apostema inguinis*; *dragoncelus*; Fr. *Bubon*; Ger. *Leistenbeule.*

Definition.—An affection mentioned in the most ancient medical writings, but not properly distinguished in its several varieties until the present century. Inflammation of any lymphatic gland, set up by irritation of the surface connected with the afferent ducts of that gland, has been called *bubo*; but the term is almost exclusively confined to swelling of the glands of the groin consequent on venereal irritation of the genitals, and will be so employed here.

Varieties.—Buboes are divided into:—1. *Simple bubo*, known also as *sympathetic bubo*, due to inflammation of a gland through ordinary irritation from an inflamed surface. 2. *Specific bubo.* (*a*) The *chancrous* or *virulent bubo*, or abscess inoculated with the pus of a chancre. (*b*) The *syphilitic bubo*, or indolent enlargement of the lymphatic glands accompanying the development of the initial sore of syphilis.

The glands first affected in the sympathetic and in both kinds of specific bubo are always those in most direct communication with the sore. Further, according to Ricord, when chancrous matter has reached a gland through the absorbent ducts, it never passes beyond that gland into another more remote in the series. On the other hand, the effect of syphilitic absorption is general, and affects those remote from, as completely as it does the glands nearest to, the inlet of the poison.

Buboes occur most frequently on the side of the body occupied by the source of irritation, still not rarely on both sides, and sometimes only on the side opposite to the position of the exciting sore. The crossing of the irritant is due to anastomosis or interlacing of the lymphatics at the mesial line. When bubo forms in both groins, there is usually a sore at the mesial line or on each side. Bubo, including simple and virulent, occurs in about thirty per cent. of chancres; how often with urethritis and other lesser venereal affections is not known.

1. Simple Bubo—Adenitis (*ἀδὴν*, a gland).

Ætiology. — This variety may be caused by:—(*a*) Mechanical irritation of the surface; such as erosions or fissures irritated by dirt or by caustic applications. (*b*) Urethritis, balano-posthitis, or a chancre when acting as a simple local irritant. Simple bubo is also often excited by herpes, erysipelas, boils, or other non-venereal irritants of the genitals. (*c*) Lastly, though nearly all buboes can be traced to a lesion of the part where their absorbents arise, there are a very few with which no lesion is present. Such are caused by excessive sexual intercourse or excitement; they are met with generally among young lads and girls. This form has received the names of *idiopathic bubo*, *bubon d'emblée.*

Symptoms.—There are two forms of simple bubo:—1. Slight swelling and tenderness of one or several glands, ending in a few days by resolution. This occurs most frequently in urethritis, balano-posthitis, or simple chafings.

In genuine chancre the next and more serious form is most frequent. 2. Swelling, commonly of one, seldom of several glands; brawny thickening of the surrounding tissues; redness of the integuments; great tenderness and pain, especially when walking. In a few days this condition terminates either by abscess, by gradual subsidence to the normal state, or by chronic induration of one or more glands. When the bubo suppurates, the matter, instead of pointing at once, may burrow in various directions among the layers of cellular tissue before it breaks through the skin. The pus of this form of bubo is always the ordinary pus of inflammation.

Such cases may terminate by gradual conversion into chronic fistulæ, or the glands may degenerate in scrofulous persons by enlargement and suppuration, or there may be successive formation of abscesses around the glands with undermining of the skin. This is most frequently seen in persons who have previously had constitutional syphilis, erysipelas, and other septic inflammations.

PROGNOSIS.—This form of bubo is seldom dangerous, but serious where it terminates in burrowing; it is then often very tedious and exhausting to the patient.

2. **Specific Buboes.**—(a) *Virulent bubo.* This is in reality an enormous chancre, identical in all but size with the sore whence it was inoculated. This form is never met with in gonorrhœa or in syphilis, being a consequence of the local sore only. It may be generated in two ways. 1. By touching the surface of a simple open bubo with chancrous pus. 2. By absorption of chancrous pus along the lymphatic ducts leading from the chancre to the gland most directly connected with the sore. Two pathological facts prove the reality of this mode of origin. First, occasionally small circumscribed abscesses form in the course of the lymphatic ducts before they reach the gland. These little abscesses when opened present the peculiar characters of the chancre. Secondly, until the necrosing action has laid open the interior of the lymphatic gland nearest the original chancre, the abscess about the gland retains its ordinary phlegmonous character.

The conditions which assist or hinder the conveyance of chancrous pus along the lymphatic vessels are wholly unknown.

The proportional frequency of virulent bubo to the number of chancres is not known. It is far less frequent than simple bubo. It is said that women suffer more rarely than men in proportion.

When not accidentally inoculated, virulent buboes are almost wholly confined to the groin, and originate in the gland which lies commonly in the centre of the group over the great bloodvessels. Occasionally with chancre on the finger, the epitrochlear or axillary glands develop into virulent bubo. Hübbenet of Kiew experimentally inoculated a soft chancre on the cheek, which was followed by virulent bubo of the gland in front of the tragus of the ear. This bubo is generally unilateral; rarely are both sides of the body affected; in such cases the chancre is usually at the mesial line, or there are two chancres. Still more rarely the bubo forms at the side of the body opposite to that of the chancre. The time for appearance is generally in the first or second week of the existence of the chancre; but it may occur at any time while the chancre is spreading.

SYMPTOMS.—At first the symptoms of specific bubo are those of acute abscess forming rapidly round a single gland. Thus far they differ nowise from those of simple bubo. When the contagious pus reaches the abscess accidentally from without, or from within the gland by ulceration or incision of its capsule, the simple suppurating cavity becomes a spreading ulcer, which rapidly makes itself widely open by destruction of the integuments. The skin, thin as tissue paper, gives way at several points, and lets out a large amount of matter, which is thin, yellowish-grey or yellowish-red, with shreds of a chocolate colour floating in it. When perforated, the skin breaks rapidly away until the cavity is widely exposed.

The further progress varies. In the least severe variety the edges of the skin ulcerate irregularly for a short distance, then thicken and begin to granulate; the floor of the ulcer loses its unevenness and rises up to the level of the skin, and cicatrisation follows. But commonly a much greater destruction of tissue is effected. The skin is eaten away into wide gaps; the floor burrows under the skin in long channels, or dives deeply among the great vessels. In other cases serpiginous ulceration produces a large shallow sore. The contagious condition of these buboes often continues for weeks or months, so that consecutive inoculation of the skin is not infrequent. The characters of the fully formed virulent bubo are those of the chancre. The surface is greyish-brown, dug-out, 'worm-eaten;' the borders at some parts are thickened, everted, and pared away, at others sharply eroded or undermined and curled in. The matter is thin, shreddy, plentiful, reddish in colour, and inoculable. Again like the chancre, the virulent bubo passes through periods of *extension*, *stagnation*, and *repair*. The last stage is often long postponed by *phagedæna*, a characteristic of no other bubo, but another mark of kinship to the chancre. Phagedæna very rarely attacks a bubo if it attacks the original sore. The virulent as well as the simple bubo is liable to erysipelas and inflammatory sloughing.

The *duration* of virulent bubo for the reason stated is wholly indefinite—in a few cases ending in a week, in many lasting for months or even several years.

Phagedæna.—The form of the sloughing in phagedæna is most commonly serpiginous. In this way the bubo may wander over the abdominal wall, the hip, thigh, and perineum, healing here and spreading there, or digging deeply among the muscles. Generally proceeding at this imperceptible speed, the phagedenic action may suddenly destroy the tissues with great rapidity for a time, and then pause altogether till another rapid extension is made. In this manner years may pass before healing is complete.

DIAGNOSIS.—The virulent bubo has in its early stage no distinguishing mark from the simple acute bubo. After it has become inoculated with the contagious matter it is distinguished from every other affection by the characters already described. The earliest signs of virulence are two; the matter which escapes when the bubo is lanced is thin and shreddy, and the edges of the cut become in a day or two eroded and partly covered by adherent sloughs. Subsequently other characters develope and remove all doubt. Nevertheless, in some cases the signs of virulence are so feebly marked throughout that the diagnosis remains uncertain. This difficulty may be increased by the primary sore having healed before the suppuration of the bubo, or by its being hidden in some unusual position (urethra, anus).

Prognosis.—This is not always grave. Virulent buboes often reach cicatrisation in a few weeks, and meanwhile cause no serious inconvenience. On the other hand, they are prone to inflammation, or to phagedæna, and thus may permanently cripple or even destroy life.

(*b*) *Syphilitic Bubo* (*indolent multiple bubo, pléiade ganglionnaire*).—This enlargement of the group of lymphatic glands in nearest connection with the initial sore is the constant, or at least almost constant, symptom of early syphilitic infection. In this it differs much from the bubo of chancre or gonorrhœa, in which affections the bubo is more often wanting than present. Four conditions have been noted to exist in patients in whom the enlargement of the glands could not be detected, namely, 1. Phagedæna of the sore. 2. Obesity; in such persons the lymphatic system as a rule is small. 3. Second infection; *i.e.* a primary sore on a patient who has had constitutional disease before. 4. Scantiness of the induration of the primary sore, the sore itself being ill-developed. But these exceptions are most rare. Fournier gives five instances only in 265 cases of hard sore, accompanied by well-marked general syphilis; or 2 per cent. In 176 similar cases noted by the writer, three had no apparent inguinal enlargement. One of the patients was a very fat man, and in another the initial sore was only slightly hardened.

The seat of this bubo is, in the great majority of cases, the groin, whither, besides the lymphatic ducts of the external genitals, those of the anus, perinæum, buttocks, and lower part of the abdomen are directed. But the glands of other regions, epitrochlear, axillary, sub-maxillary, buccal, cervical, and nuchal are all occasionally found primarily enlarged when the syphilitic poison enters the body through the regions whence their absorbent ducts are derived.

In the groin the bubo is generally *double*, that is, the glands are enlarged in both groins, those on the side of the sore being most affected. On the other hand, only those on the same side as the sore, in a few cases, enlarge, and in rare examples only those of the side opposite to that of the sore. This enlargement affects the group widely, for when the deeply-placed glands can be examined they are found to be similarly enlarged along the iliac vessels and lumbar vertebræ. Indeed, in some persons all the lymphatic glands of the body are temporarily increased in size.

The enlargement of the glands is first perceived about eleven days after the induration of the sore, though probably the affection commences at the end of the incubation of the poison. In extremely rare instances enlargement is delayed until the third or fourth week after the induration of the sore.

Symptoms.—The distinguishing marks of this bubo are swelling, wholly devoid of inflammatory character, and rarely surpassing an almond or a hazel nut in size; gristly hardness; ready isolation and mobility; insensibility to pressure; natural hue and condition of the overlying skin; and absence of fulness of the cellular tissue.

The gland in most direct communication with the sore is most enlarged; in rare exceptions only a single gland is enlarged. Copious enlargement of the glands does not always attend copious induration of the sore, nor is scanty induration of the sore always accompanied by small swelling of the glands, though commonly this is the case. So also, though absence of tenderness is the rule, the glands may be slightly painful if pressed. Again, though the glands remain distinct in most cases, they have been known to coalesce into a single mass, which becomes fixed to the fascia. In many patients the dorsal lymphatic vessel of the penis becomes indurated sufficiently to be easily distinguished under the skin.

This bubo reaches full development in one or two weeks, and remains without apparent change for several weeks, or even for two or three months. Then it begins to diminish slowly, but is generally still evident in the fifth or sixth month after infection, and now and then even for years afterwards. In rare cases the enlargement vanishes in two or three weeks. The long duration of enlargement renders this bubo a valuable sign of constitutional syphilis when the primary sore has disappeared. Again, the conspicuous enlargement of a group of glands may indicate the place of entry of the syphilitic poison when that is hidden.

Terminations.—In nearly all cases the glands revert to their natural state. Now and then suppuration takes place, not from the syphilitic change, but from ordinary irritation, and then produces a simple phlegmonous abscess. This is apt to occur in strumous persons. The glands enlarge still more, grow soft, and coalesce; presently matter forms in the thickened cellular tissue around the glands, and the further progress becomes that of scrofula.

Diagnosis.—This is generally easily drawn from the character of the swelling, aided by the presence of other syphilitic signs (hard sore, rash on the skin, &c.) This bubo may be confounded with chronic inflammatory enlargement, but in such cases the history and attendant symptoms remove doubt.

Prognosis.—Apart from its connexion with syphilis, the prognosis is good. The only untoward termination is scrofulous degeneration.

Treatment of Buboes.—1. The *syphilitic bubo* hardly needs treatment. It usually causes no trouble, and gets well independently of anti-syphilitic remedies. If tenderness or aching occur, rest and a few warm baths are sufficient. If suppuration take place the abscess must be incised and poulticed. The scrofulous degeneration is best met by anti-scrofulous remedies—

iodide of ammonium, or of iron, cod-liver oil, nutritious food, sea-air, and other tonics. Mercury, in $\frac{1}{25}$-grain doses of the bichloride, combined with the iodide of sodium or with solution of perchloride of iron, may be added to the treatment. Locally, the abscesses and sinuses must be emptied as fast as they form, and cleared by syringing with weak astringent lotions.

2. *Simple acute bubo* arising from any cause demands the same treatment, namely, that of acute abscess. In the early stages, antiphlogistics (rest in bed, the constant application of a cream made of equal parts of extract of belladonna and glycerine, warm poultices, fomentations, and baths, sometimes even leeches) are requisite. Caution must be observed in applying leeches if chancre be present. They should be used only in the early stage of congestion, lest the bites be converted by inoculation into chancres. Again, the leeches should be applied at the circumference of the swelling, so that they may be removed as far as possible from the centre where pointing is most probable. If suppuration arrive more speedily than was expected, and the bubo prove a virulent one, incision must be postponed as long as possible, and the leech-bites protected by collodion, carbolic lotion, iodoform, or other antiseptics.

When active congestion has ceased, the subsidence of the glands may be aided by pressure with a pad and spica bandage. Stimulating ointments and plasters, iodine, and similar preparations are of doubtful service, and may possibly re-kindle the inflammation. When pus has formed, it should be let out by a vertical incision at once. The proper drainage of the cavity should be insured by making the incision long ($\frac{3}{4}$ in. usually), and by placing a bit of lint or drainage tube between the edges of the incision during the first twenty-four hours. Early evacuation reduces undermining of the skin to a minimum, and prevents burrowing. When matter forms at several points, a small incision should be made at each fluctuating point. When free exit has been given to the pus, the groins should be well poulticed for two days, and then dressed with zinc ointment spread under a compress, the bandage of which, slackly applied at first, may be tightened as the swelling subsides.

3. The *chancrous bubo*, not being distinguishable during the inflammatory swelling and consequent suppuration from ordinary sympathetic bubo, requires the same treatment — calmants and an early single incision. By early incision the cavity of the abscess, subsequently the chancrous ulcer, is kept as small as possible; by a single incision the number of chancres is restricted. Occasionally, but only when the abscess has already undermined the skin, more than one incision is necessary. Caustics have no advantage over the knife for opening the abscess, while they make a larger gap. When the abscess has been opened and the chancrous nature is suspected, it should be well cleared at the time by injections of one part of carbolic acid to eighty of water, 5–10 grains to the ounce of nitrate of silver, of tartrated iron, or of some other astringent and disinfectant. This injection may be repeated three times in the first twenty-four hours; and constant drainage maintained by a drainage-tube and a compress of Lister's antiseptic gauze or boracic lint. Should these precautions fail to prevent the conversion of the abscess into a chancre, it must then be dressed as a chancre. It must be sedulously washed by injection twice daily, dried by careful mopping with bits of cotton-wool, and well dusted and packed with iodoform in powder; the whole cavity being loosely filled with pellets of cotton-wool, and compressed gently with a layer of lint and a bandage. Should this fail, as it sometimes will, caustic may be applied. The *caustics* most suitable are the strongest and most penetrating; such as Vienna paste, acid nitrate of mercury, Ricord's paste (powdered charcoal and the strongest oil of vitriol). To apply the caustic thoroughly the patient should be anæsthetised. If the least part of the surface is left undestroyed, that will reinoculate the whole. Complete cauterisation is practically very difficult to accomplish, hence caustics should be reserved for the cases where iodoform, which is painless, fails. Overlapping bands of skin should be divided, that the dressing may be fairly applied.

Phagedæna.—When the ulceration by its obstinacy or by its rapidity deserves this title, plan after plan of treatment must be tried till the destruction of tissue is arrested—caustics being reserved for the last. When the patient's general health is good, the ulceration seldom fails to yield to iodoform, applied thoroughly in the manner directed. While the nocturnal gnawing pain continues, the patient should be narcotised with opium or other narcotic. The cessation of pain is a signal that the eroding action has stopped. When iodoform alone is insufficient, the continuous warm hip-bath seldom fails. By it pain is at once arrested and healing soon set in motion. As continual immersion in a bath becomes extremely irksome in many cases, the phagedæna may be arrested by keeping the patient in water for sixteen hours every day, and allowing the night to be passed in bed—in this interval the wound should be carefully packed with iodoform. When the phagedæna is stopped, the bath may be discontinued and iodoform alone used. If the water-bath fail (and such a result has not yet happened during a considerable employment of this method at the Male Lock Hospital), caustics may then be used.

The strength of the patient, generally much exhausted, should be restored by tonics, good diet, stimulants, and other general means.

Abortive treatment of bubo.—This once favourite method of treating buboes has fallen into disuse as the varieties of bubo have been better understood. The chronically enlarged glands of syphilis have little or no tendency to suppurate, but subside spontaneously if let alone. Others only suppurate when freely irritated, hence the best abortive treatment for such, is to guard against the increase of irritation, and assuage that which exists by antiphlogistics. In the bubo virulent by absorption suppuration is inevitable. Thus, the sympathetic bubo is the only one which can be acted on by abortive treatment. To *antiphlogistics* may be added *counter-irritants*, but these are uncertain in their effect. Those least open to objection are vesicants, and the form most beneficial is repeated 'flying' blisters. By this means a series of small blisters are produced round about, not over the swelling. Any other plan is most uncertain—painting the part with tincture of iodine, or other mild irritant, is simply waste of time. To enter at length into even a narration of the multitudinous ways in which irritants, vesicants, and even caustics have been employed would occupy much space to little purpose.

Compression is of great value for reducing indolent enlargement, or for removing the boggy condition of the groin where several abscesses have formed, with more or less undermining of the skin. It is useless for the syphilitic bubo and mischievous for the virulent bubo. The simplest and most effectual method of applying compression, is by a graduated compress of lint kept firmly in place by a spica bandage of calico, or of elastic tape. For abscesses, careful packing may be added to the compress. Each focus of pus must be laid open, and bridges or tunnels cut across, so that narrow strips of lint soaked in *liquor plumbi subacetatis* and lightly pressed between the fingers, to drive out the dripping excess of fluid, may be laid into the hollows and under overhanging borders of skin. The strips must be renewed every day at first, and the cavities well cleared by syringing with water. In a few days, when the discharge is very small, the strips may be left for three or four days unchanged. The first application is painful, but very soon an insensible crust is formed over the ulcerating surface, and fresh applications cause no discomfort. As soon as healthy granulations are formed, the plugging should be laid aside.

Berkeley Hill.

BULBAR PARALYSIS. A synonym for glosso-laryngeal paralysis; derived from the pathological relation of the disease with the bulb or medulla oblongata. *See* Labio-Glosso-Laryngeal Paralysis.

BULIMIA (*βοῦ*, a particle signifying excess; and *λιμὸς*, hunger). Excessive or voracious appetite. *See* Appetite, Disorders of.

BULLÆ (*Bulla*, a bubble). *See* Bleb.

BURNS. The morbid effects produced by the direct application of excessive dry heat. *See* Heat, Effects of.

BURSÆ MUCOSÆ, Diseases of.—Bursæ mucosæ are spaces in the connective, tissue lubricated with a small amount of serous fluid, and situated at points exposed to repeated pressure or friction. Structurally they are composed of a layer of condensed cellular tissue, fusing externally with the areolar tissue of the part, and lined internally with an imperfect layer of flattened endothelial cells, similar to those found in the pleura or peritoneum. Some bursæ, as that over the patella, that under the deltoid, those about the great trochanter, and many others, are constantly present; but new bursæ, equally perfect in their structure, may form at any part exposed to abnormal pressure and friction, as over the outer malleolus of a tailor, under an old corn, or over the head of the metacarpal bone of the great toe (*bunion*). Like the great serous cavities, bursæ are in direct communication with the lymphatics, and inflammatory products are consequently absorbed from them with great readiness, often giving rise locally to a diffuse inflammation of the surrounding cellular tissue, closely resembling phlegmonous erysipelas in appearance, and always accompanied by high fever.

Bursæ are liable to four forms of disease:—

1. **Acute inflammation and suppuration—Acute bursitis.**—This is usually the result of some more or less violent mechanical injury. It may occur in any bursa, but is most common in the bursa patellæ, those about the hip and over the olecranon, and in the small false bursa formed beneath an old corn, or in a bunion. The symptoms are those of acute inflammation generally, but the redness and swelling often extend a remarkable distance up and down the limb. Thus, a drop of pus beneath a corn may cause œdema and redness to the knee. The febrile disturbance is usually proportionately severe. About the trochanter the abscess may assume a chronic form.

Treatment.—Hot fomentations, and the application of glycerine and extract of belladonna (equal parts), may be of use. It is very important that pus should be let out early, or it may burrow extensively, especially about the knee. The antiseptic treatment, as recommended by Lister, will be found especially useful in the treatment of suppurating bursæ.

2. **Chronic Bursitis—Dropsy of the bursa** consists simply of an accumulation of serous fluid distending a bursa more or less tensely. The wall becomes somewhat thickened and opaque, but is otherwise unchanged. The fluid is clear, straw-coloured, and albuminous in character. The cause of the disease is usually repeated slight mechanical injury, but in some cases it may be due to some of those obscure conditions spoken of as 'rheumatism.' The symptoms are merely those of a collection of fluid in the situation of the bursa, perhaps accompanied by a feeling of weakness in the neighbouring joint. There is no pain or tenderness. The commonest form of this disease is the so-called housemaid's knee, but it is not unfrequent in the bursa of the popliteal space.

Treatment.—Avoidance of the mechanical injury, whatever it may be, which has caused the disease, is most important. The swelling may be painted with tincture of iodine twice a day for some weeks, or a series of small blisters applied over it. If this fail, a seton may be passed through and left in for a few days. Or an incision may be made into the swelling under antiseptic precautions, and a small drainage-tube introduced for a week or ten days. But before either of these means is adopted, care must be taken to ascertain that the bursa does not communicate in any way with the neighbouring joint. In the ham it is safer never to operate in any case, except perhaps by means of the aspirator.

3. **Chronic enlargement of the bursa, with fibroid thickening of its walls.**—This affection is most common in the bursa patellæ, but may occur in that situated over the tuberosity of

the ischium. The bursa becomes converted into a dense fibroid mass of almost cartilaginous hardness. On section it is found to be composed of concentric layers of dense fibroid tissue. There is usually a small central cavity containing a little fluid. The cause of this change, as of simple dropsy, is repeated mechanical injury of a slight nature. The only treatment is removal by the knife.

4. Chronic enlargement of the bursa, with the presence in it of the so-called melon-seed bodies.—In this form of disease, in addition to some thickening of the wall and accumulation of fluid in the bursa, small oval, flattish, smooth bodies of a white colour are found floating freely in its interior. These are similar in nature to those found in some forms of ganglion (*see* Ganglion). This condition is recognised by the peculiar soft crackling feeling perceived on palpation, combined with the ordinary symptoms of an enlarged bursa. Marcus Beck.

BUXTON in Derbyshire. Simple thermal waters. *See* Mineral Waters.

C

CACHEXIA (*κακὸς*, bad, and *ἕξις*, a habit or constitution of body). Synon.: Fr. *Cachexie.* Ger. *Kachexie.*

Definition.—A chronic state of ill-health associated with impoverished or depraved blood, arising from mal-nutrition, persistent loss of blood-elements, or the presence of a morbific agent.

In such diseases as tabes mesenterica, lymphadenoma, and the like, the patients become cachectic from direct depravation of the blood, in consequence of disease of organs which are importantly concerned in its nutrition and elaboration. In other diseases persistent loss of blood-elements arising from chronic suppuration or from repeated hæmorrhages (especially observed in some uterine conditions) induces a cachexia which is well described by the term *secondary anæmia.* Again certain poisons introduced from without or nurtured within the body may produce marked cachexia. The syphilitic and malarial poisons are good examples of the first kind. Of cachexiæ produced by the presence of morbific agents which have been generated within the body we may instance those arising from defective elimination, as the uræmic and gouty cachexiæ from defective functional activity of the kidneys and liver. In the latter connexion it should be noted that, as has been hinted by Sir James Paget in reference to cancer, the malignant cachexia may arise from blood-contamination with the waste products yielded by the morbid growth in the process of its nutrition; such a growth not only abstracting material from the blood for its nutrition, but also contributing effete material to it.

It must be further observed that in the opinion of some of the best pathologists the term cachexia implies much more than the secondary anæmia consequent upon the ravages of a given local or general disease upon the system. It rather signifies the morbid constitution which *is* the disease, and which may precede its local manifestation. Thus we may have the cancerous cachexia, culminating in scirrhus of the breast, the tubercular cachexia in pulmonary tuberculosis, and the like. It is thus evident that with many observers the terms *cachexia* and *constitutional disease* have the same significance. R. Douglas Powell.

CACOPLASTIC (*κακὸς*, bad, and *πλάσσω*, I mould or form).—A term applied to products of inflammation which are more or less incapable of organisation.

CADAVERIC (*cadaver*, a dead body).—This word signifies 'belonging to the dead body;' and it is applied to the aspect, colour, odour, and other phenomena resembling those of death which are sometimes observed in the living subject.

CÆCUM, Diseases of.—The structural peculiarities and anatomical relations of the cæcum are specially favourable to the occurrence of the diseases to which this part of the large intestine is most liable, viz., (1) accumulation of the solid and gaseous contents of the alimentary canal, and (2) inflammation.

I. **Accumulations.**—Hardened fæces, biliary and intestinal concretions, foreign bodies, stones of fruit, balls of worms, lumbrici, and gases resulting from decomposition, are apt to collect in the cæcum, and cause varying degrees of local disturbance. Sometimes, as in elderly patients of torpid habit, the cæcum is found loaded with fæces, without inducing pain or other signs of inflammation. The right iliac region may be full and hard, and in it may be felt a well-defined, almost painless, doughy mass; the tumour is of the shape of the cæcum. As a rule, however, sooner or later the accumulation leads to one or more of the following results:—

(*a*) *Obstruction of the bowels.* This may be partial, as in the various degrees of constipation; or complete. When complete, it may even prove fatal without the cæcum or peritoneum exhibiting signs of inflammation. On the other hand, general peritonitis supervening, obstruction in the cæcum may be quickly obscured; still, however, the chief pain and tenderness will be found in the right iliac region. (*b*) *Pressure* on adjacent nerves, vessels, or other structures, producing numbness and œdema of the right leg, retraction of the right testicle and other symptoms. (*c*) *Inflammation* (typhlitis, peritonitis).

It is of clinical importance to bear in mind that the cæcum, when overloaded or enlarged, may occupy an unusual position, *e.g.* a site between the right and left iliac regions, or it may descend somewhat into the pelvis and press on the urinary bladder.

Tympanitic distension of the cæcum is generally associated with some fæcal accumulation or obstruction in the colon or other part of the large intestine (*see* FLATULENCE).

II. Inflammation.—SYNON.: Typhlitis; Fr. *Typhlite*; Ger. *Blinddarmentzündung.*

DEFINITION.—Inflammation of the walls of the cæcum, liable to terminate in perforative ulceration; in peritonitis, local or general; or in inflammation and suppuration of the cellular tissue behind the cæcum (perityphlitis).

ÆTIOLOGY.—As *predisposing causes* may be regarded the anatomical peculiarities of the cæcum, favouring the accumulation of solids and gases liable to irritate; the causes of constipation and retention of fæcal matter, or of inertia of the large intestine; the period of childhood and adolescence; and previous attacks of typhilitis. *Exciting causes.*—Attacks of typhlitis have been ascribed to exposure to cold, to irritating ingesta, unripe fruit, &c. Inflammation of the cæcum may form part of an attack of enterocolitis or dysentery.

ANATOMICAL CHARACTERS. — Inasmuch as 'there are no cases on record of acute typhlitis proving fatal, in which post-mortem examination did not show the existence of perforation of the cæcum or appendix,'[1] we invariably find serious pathological changes complicating the appearances presented by simple inflammation of the walls of the cæcum.

In all cases the peritoneum investing the cæcum is involved, as indicated by opacity and injection; and generally adhesions exist between folds of the intestines, in the vicinity of the right iliac fossa. General peritonitis is usually found associated with perforation into the sac of the peritoneum, and the escape into it either of the contents of the cæcum, of an abscess in the cellular tissue behind the cæcum, or of a circumscribed peritoneal abscess.

SYMPTOMS.—Inflammation of the cæcum is met with either as part of a more extensive inflammation—*e.g.* enterocolitis, dysentery; or alone. In the former case its symptoms are merged into those of the more general affection to which it is subsidiary, while in the latter they are special and characteristic. Clinically, two classes of cases may be recognised:—(*a*) The inflammation is of the catarrhal type, does not end in ulceration, pursues a favourable course, and affects children more particularly. Probably it is strictly confined to the mucous lining of the cæcum. (*b*) The inflammation is more severe, is ulcerative, and is apt to terminate in perforation of the walls of the cæcum, and to induce tedious or fatal sequelæ. It would seem that all the coats of the cæcum are rapidly involved. This form of typhlitis is generally observed after the period of childhood.

Though typhlitis usually commences somewhat suddenly, most frequently there is a preliminary history of intestinal derangement, either in the form of obstinate constipation, or of catarrhal diarrhœa alternating with constipation. The characteristic symptoms are pain, and a tumour in the right iliac fossa.

The pain is continuous, and is increased by pressure and by movements, such as those induced by deep inspiration and coughing. The right iliac region becomes exquisitely tender and tense; and, to relieve the muscular tension over it, the patient reclines towards the right side, with the thighs drawn up.

In typhlitis from retention of fæces in the cæcum (Typhlitis stercoralis) there is a well-defined tumour from the first, which may attain a very large size; while in other cases there is often merely fulness in the early stage, and afterwards a distinct tumour. In all cases the tumour is of the shape of the cæcum, is sharply circumscribed, the lower part specially so, while the upper is less distinct, and may be traced into the ascending colon if this part be also inflamed. When the tumour arises from inflammatory thickening of the walls of the cæcum, it is less dull on percussion than when consisting of fæces. The abdomen is enlarged. Fever is usually slight or absent. The walls of the cæcum failing to contract, there is obstinate constipation, with tormina and vomiting. As a rule, in children vomiting does not become feculent. In typhlitis stercoralis intestinal obstruction may arise from the accumulation completely blocking the ileo-cæcal opening; then the paroxysms of pain become very severe, and the vomiting urgent and stercoraceous. Not uncommonly inflammation, though commencing thus in the cæcum with characteristic symptoms, extends all over the colon (*see* COLON, Diseases of); then constipation will give place to diarrhœa, and tenesmus with muco-sanguinolent evacuations will indicate a similar affection of the sigmoid flexure and the rectum.

The attack, having lasted from two or three to ten or twelve days, usually subsides by resolution—the bowels are copiously relieved, the vomiting ceases, and the pain, tenderness, and tumour disappear from the right iliac region. Even symptoms of intestinal obstruction which excite much anxiety may terminate thus favourably.

Not unfrequently, however, the course becomes tedious and dangerous. The accidents most to be feared are:—(1) Phlegmonous inflammation of the cellular tissue behind the cæcum (*see* PERITYPHLITIS); and (2) peritonitis. As a rule, inflammation of the peritoneum is confined to that portion covering the cæcum and adjacent structures; it may, however, become general from extension of this local inflammation, but more frequently from the bursting into it of the contents of the cæcum, or of an abscess.

PROGNOSIS.—Inasmuch as typhlitis without perforation almost invariably ends in recovery, the prognosis depends on the occurrence of inflammatory complications and sequelæ, and is, therefore, merged in that of perityphlitis. As a rule, perforative ulceration is less common during childhood than after the tenth or fifteenth year. If, notwithstanding the relief of constipation and the cessation of vomiting, the signs of local inflammation persist, ulceration of the cæcum, or the earliest stages of perityphlitis, may be suspected.

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[1] Meigs and Pepper, *Diseases of Children.*

Treatment.—The indications are, (*a*) to relieve constipation and dislodge accumulations from the cæcum with as little irritation as possible, using laxatives combined with sedatives, *e.g.* calomel, colocynth, confection of senna, or saline aperients with opiates, and large warm enemata; the latter are indicated when aperients by the mouth set up or increase vomiting, or fail to relieve the bowels, or cannot be prescribed because of obstinate vomiting. (*b*) To subdue inflammation by rest, poultices, blisters, and opiates. The diet throughout should be fluid, consisting of beef-tea, milk, and such articles. All strong aperients are to be condemned—they are apt to increase the inflammation and the risk of perforation, and, while aggravating the vomiting, may fail to move the bowels. When local inflammation is severe, as indicated by great pain and tenderness, aperients by the mouth should be avoided, enemata used, opium given freely, as in peritonitis, and leeches may be applied.

III. Dilatation, Contraction, and Perforation.—The cæcum may be (1) *dilated* from accumulation within it of solids and gases, or from obstruction in the colon; (2) *contracted* from deposits (cancer, &c.), growths (polypi), or cicatrising of ulcers (tubercular, dysenteric); or (3) *perforated* from ulceration (simple perforating, enteric, tubercular, cancerous, dysenteric ulcer), or tearing of the wall by over-distension. Perforation may lead to different results, according to the part of the cæcum selected. When in the anterior surface, which is completely invested by peritoneum, a rapidly fatal peritonitis is most apt to follow; while in the posterior part, resting on the connective tissue of the iliac fossa, suppuration is usually the result.

George Oliver.

CALCAREOUS DEGENERATION.—A form of degeneration characterised by the deposit of earthy salts, especially of salts of lime, in the tissues. *See* Degenerations.

CALCULI (*Calx*, chalk).—Definition.—The term calculus is now applied to any kind of concretion formed in the ducts or passages of glandular organs; though older writers limited its employment to the designation of concretions met with in the kidneys and urinary bladder.

Varieties.—The following is a concise summary of the principal calculous concretions met with in the human body, given according to their alphabetical order.

1. **Biliary Calculi** vary considerably in size, number, form, and composition. In size they range from minute grains about the size of a pin's head to a mass as large as a hen's egg. The smaller they are, generally the larger is their number. Their form is very irregular—when solitary they are usually round or oval, when numerous they are generally more or less irregular in shape, their surfaces being flattened and facetted from compression. The colour is usually a blackish-green or brown, less frequently yellow or greyish-white. In consistence, some are soft like wax; others hard, dry, and friable. On section they will be found to differ widely—some being granular, and made up of sub-morphous particles without any apparent nucleus; others crystalline, the glistening white crystals (cholesterine) radiating from a central nucleus, which is frequently found to consist of inspissated bile. Biliary calculi consist almost entirely of cholesterine and bile-pigments, mixed with a variable proportion of insoluble organic matter and traces of the earthy phosphates. To separate the cholesterine, finely powder the gall-stone and thoroughly exhaust with ether; the ethereal solution on evaporation yields amorphous cholesterine. To obtain it in the crystalline form, it must be redissolved in boiling alcohol, which on cooling deposits it in characteristic, glistening, rhombic plates. The pigmentary matters can be obtained by exhausting the residue of the crushed gall-stone, from which the cholesterine has been removed, successively with water, alcohol, and dilute hydrochloric acid. The dried residue is then boiled with pure chloroform for some time, and the chloroform extract is distilled to near dryness, and several volumes of alcohol are added, which throws down bilirubin. Bilirubin thus obtained is an orange-red powder insoluble in water and ether, slightly soluble in alcohol, but very freely soluble in chloroform. On passing a current of air through an alkaline solution of bilirubin the solution acquires a green colour—biliverdin. According to Städeler biliverdin is formed from bilirubin by the addition of one atom of water in the presence of oxygen. A brown pigment, bilifuscine, can also be obtained by acting on bilirubin with strong sulphuric acid.

2. **Intestinal Calculi** are rare in man and carnivorous animals, but are not uncommon in herbivorous animals. They consist almost entirely of ammonia, magnesium phosphate, calcium phosphate, and calcium carbonate, deposited round a nucleus, generally a fragment of some undigestible material of the food, such as stones of fruit, husks of grain, or portions of bone. There is a kind of intestinal calculus occasionally met with among Scottish and Lancashire people, who use oatmeal largely as food, which is chiefly composed of the hairs and fragments of the envelopes of the oat, encrusted with calcium phosphate and carbonate. Magnesium carbonate when taken habitually and in bulk is apt to accumulate in the bowels and concrete there; there is now less risk of that danger since the fluid forms of magnesia have come into such general use.

3. **Pancreatic Calculi** are the rarest of all glandular concretions. When found they are generally numerous, being met with in the main duct, the accessory duct, and even in the smaller radicles. The size varies greatly, the largest that has come under the writer's observation being quite one inch in length. They are generally oval in shape, and their surface has frequently a worm-eaten appearance, of whitish colour, which when rubbed acquires an enamel-like lustre. When broken, the fracture often presents a white, glistening, porcelain appearance. One calculus analysed by the writer gave a percentage composition of organic matter ·24, fixed inorganic salts ·76. The bulk of the fixed inorganic salts consisted of calcium carbonate, calcium phosphate being present in much smaller proportion.

4. **Prostatic Calculi** consist essentially of calcium phosphate and calcium carbonate, though

incidentally traces of uric acid, calcium oxalate, and ammonio-magnesium phosphate may be found. They occur in three forms, namely, (*a*) small, rough concretions, from the size of a pin to a hazel nut; (*b*) irregular masses with porcelainous appearance; and (*c*) large regular concretions. The quantity of earthy matter that may be deposited in the prostate gland is often enormous. When the calculi are of the small variety, fifty or sixty may be present, and a gland may feel like a bag of nuts. The museum of the College of Surgeons contains a specimen showing the enormous size these concretions may attain. *See* PROSTATE, Diseases of.

5. **Salivary Calculi** are generally rough externally, irregular in shape, and are usually found near the orifice of the duct, which they obstruct. The nucleus frequently consists of some foreign body which has accidentally found its way into the duct, as a splinter of wood or a fragment of bone. Their chief component is calcium carbonate, of which they contain more than any other kind of concretion, and traces of early phosphates.

6. **Urinary Calculi** vary considerably in size, form, colour, and general appearance, according to their composition. The constituents that form these stones are uric acid, urates, cystine, xanthin, calcium oxalate, calcium phosphate, magnesium phosphate, ammonio-magnesium phosphate, calcium carbonate, and also concretions of blood and fatty substances (urostealith). Any of the above-named substances, combined with a varying proportion of organic matter, may constitute the sole ingredient of a calculus; more commonly, however, two or more are associated together. To fully ascertain the composition of the mass of the calculus it must be sawn across, and if made up of different layers, a portion of each layer must be analysed. *See* OXALIC, PHOSPHATIC, and URIC ACID CALCULI, and URINE.

PATHOLOGY.—The manner in which these concretions are formed, especially renal and urinary calculi, has long been a matter of speculation with physicians, some regarding them as of purely local origin, others endeavouring to show that they are the result of some peculiar diathesis, wherein uric acid, the phosphates, &c. are formed in the body so profusely, and are eliminated in such quantities as to be precipitated in the passages. The researches of Ord and Carter have thrown much light on this obscure subject. They have shown that the particles constituting the bulk of the calculus are not mere accretions, formed in the urinary passages by a process of chemical precipitation, in the presence of blood, mucus, &c.; but consist of structures, designated as 'sub-morphous'—granules, spheroids, laminæ, &c.—and which require considerable time for their formation. They have shown that this modification of form, *i.e.* the change from the crystalline to the sub-morphous type, can be artificially produced by allowing two saline solutions to intermix slowly through a colloid medium; as gum, albumen, &c.; the more slowly the mixture is effected and the denser the colloid, the more perfect is the change to the sub-morphous condition. On the other hand if the colloid medium is attenuated, and the admixture rapid, the crystalline form is more or less retained. The nature of this colloid medium has not been clearly made out. The fact that calculus rarely accompanies Bright's disease shows that the ordinary effusion of blood or albumin into the renal tubules does not furnish the necessary medium. Indeed if simple effusion of fibrin, or increased secretion of mucus, furnished the colloid, calculus, instead of being comparatively a rare disease, would be extremely common. Some authors have regarded the 'entangling mucus' as the product of a specific catarrh. Thus Meckel speaks of a stone-forming catarrh (*steinbildendend Katarrh*); and Dr. Owen Rees has pointed out that among the many evils attendant upon gout is 'a tendency of mucous membranes to secrete a viscid mucus, which modifies the ordinary crystalline character of uric acid, causing it to appear in agglutinated masses, which adhere to the sides of the urinary passages.' In speculations as to the origin of stone, too little attention has as yet been paid to the condition of the renal cells. These cells normally eliminate the urinary constituents; and it is not difficult to imagine that under certain conditions of vital impairment these substances may be retained and deposited, instead of being eliminated, the cell itself furnishing the colloid medium. The objection urged against this view is that recent observers have discovered no satisfactory signs of cell-structure in the matrix of calculi; but this objection can hardly be considered fatal, since the accretion of particles within the cell would gradually destroy the cell-structure. Professor Quekett, however, figured (*Med. Times*, vol. xxiv., p. 552, 1851) crystals of calcium oxalate and triple phosphate contained in cells taken from human tubuli uriniferi; and though his observations have not been confirmed by others, still the accuracy of his work has never been questioned, and it may be when the tubuli uriniferi of persons dying of calculous affections come to be more frequently examined by pathologists, cells containing calculous constituents at an early stage of deposition may be observed—that is, before the cell-wall is destroyed. It is a remarkable fact that calculous deposit commencing in the kidney tubules is rarely met with in the convoluted portion of the tubule, but invariably occurs at the apices of the mammillary processes, the extremities of the ducti papillares. Now less blood circulates through this portion of the kidney than through any other part of it, and moreover in the ducti papillares, the basement membrane (tunica propria) disappears and the wall consists of epithelium alone. May not these anatomical differences render the cells of this part of the tubule more liable to calculous deposit—in short, to undergo calculous degeneration?

CALIPERS.—An instrument employed for measuring diameters, more especially in medicine the diameters of the chest. *See* PHYSICAL EXAMINATION.

CALVITIES (*calvus*, bald). SYNON.: *Alopecia calva.* A synonym for baldness. *See* BALDNESS.

CANARIES, The (Teneriffe), in North-east Atlantic Ocean. Mean temperature in winter, 64° to 85°. Warmer, drier, but more variable, than Madeira. East winds from Africa.

CANCER (*Cancer*, a crab).—Definition.—The word cancer is without histological meaning. We find it and its synonym, *carcinoma*, used as long ago as the time of Hippocrates, and the latter term was then, as is the former at the present day by the vulgar, applied to any new growth of a malignant character. The name originated in the large ramifying veins and puckered furrows which spread from a cicatrizing cancer that is involving the skin. When the broad distinction between the epithelial and connective-tissue type of tumours was established by Virchow and others, it was decided to retain the word *cancer* as the name for the more malignant or epithelial growths; while the equally meaningless but less formidable word *sarcoma* has been from this time confined to those tumours which have connective tissue for their type. *See* Tumours.

In this sense of the word the cancers form a class which is, on the whole, easily distinguished by definite microscopical and clinical characters, but at two points, at least, the difference from simpler growths is almost imperceptible. First, as a matter of accident, one sarcoma (the alveolar) resembles a cancer so closely in microscopical structure, that it is impossible to distinguish between them without reference to clinical facts; and, in the second place, as cancers are essentially depraved modifications of epithelial, epidermic, or glandular structure, they may be found to differ so slightly in histological characters from simple hypertrophies, that the fact of ultimate malignancy is often all that can decide between, say, a papilloma and an epithelioma, a glandular cancer of the rectum and a simple polypus, or a scirrhus of the breast and a chronic mammary tumour.

Histological Structure. — Histologically, cancers are distinguished by consisting partly of cells of an obviously epithelial origin and partly of connective tissue. The connective-tissue forms alveolar spaces, and may vary in structure from a loose fibro-cellular material to strong and old fibrous tissue. The alveolar spaces communicate with each other and contain the epithelial cells. These vary much in shape, size, and arrangement, but are always easily separable from the surrounding connective-tissue, while they are never separated from one another by a stroma of any sort.

Clinical Characters.—Clinically, cancers are distinguished by the structures in which they originate; by the method of their recurrence and their mode of growth; as well as by a few characteristics apparent to the eye and touch.

Seat.—As their nature would have rendered almost certain *a priori*, cancers probably never originate except in connection with epithelial or epidermic structures—*i.e.*, in skin, mucous membrane, or secreting glands; but as the epidermis and epithelium, the original upper and lower layers of the embryo, are widely diffused throughout the body, and often intimately associated with the descendants of the cells of the middle layer, it is not surprising that primary cancers have been described as occurring in organs which have their origin from connective-tissue only. Such are the instances of primary cancer of bone and lymphatic glands the possibility of the occurrence of which may be at present considered undecided.

Recurrence.—The first recurrence is almost without exception in the lymphatic glands, which collect their supply of lymph from the seat of the original tumour; when this has occurred the process may be repeated in the next proximal lymphatic glands, or numerous distinct tumours may appear in different parts of the body; but if a single growth occur in another locality without previous glandular enlargement the case may probably be looked upon as a double primary development. A soft cancer may burst into the abdominal cavity, where its small particles may stick to various parts of the peritoneum and form the starting points of new growths (disseminated cancer of the peritoneum); it is probable that a similar seeding may take place into the lungs when an ulcerated epithelioma projects into the trachea.

Mode of growth. — Cancers increase in size by infiltration of the surrounding tissues, and this gives rise to the very important clinical facts that they are not enclosed by a capsule like many simpler growths, and that they have a great tendency to implicate the skin and cause ulceration.

Naked-eye appearances.—The contraction of the connective-tissue forming the alveoli in its advance towards fibrous tissue gives rise to puckering of the surrounding skin; and the looseness of the connection between the epithelial and connective-tissue elements causes a milky juice consisting of the former to escape on scraping a recent section. This characteristic was made much of by our predecessors before the word *cancer* had lost its inclusive meaning; we know now that many rapidly growing *sarcomas* yield a similar juice, but in less abundance than cancers; and thus it has come to pass that a milky juice is now more diagnostic of the malignancy than of the genetic origin of the growth.

This completes the list of the signs by which cancers may be distinguished from other tumours. Tables have been published to show the relative frequency with which cancer attacks different organs; they are not upon the whole trustworthy, and this question will be best considered in discussing the subdivisions of the genus.

Classification.—The subdivisions of cancers are as follows:—

Hard cancer or *Scirrhus.* *Soft cancer* or *Encephaloid.*	Glandular type
Cylindrical Epithelioma. *Lobular Epithelioma.*	Epithelial and Epidermic type.
Colloid.	

Typical hard and soft cancers stand obviously at opposite ends of one series which is built upon the type of a secreting gland: between the two are an infinitude of intermediate stages. The two forms of epithelioma are, quite as evidently, monstrous growths of skin or mucous membrane. Colloid is probably the result of degeneration of any one of the other forms. Besides these, other varieties are often mentioned which do not justify a more complicated classification; amongst these are tumours, which though of nearly normal glandular structure are nevertheless malignant,

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and those which have received the names *Melanotic, Teliangiectasic, Osteocancer*, &c.

DIAGNOSIS.—The diagnosis depends upon the clinical characters of the several groups. That of an advanced case of cancer is generally easy; in the early stages it is mostly impossible.

PROGNOSIS.—The prognosis is always bad, especially in encephaloid cancer, but least so in epithelioma; this suggests the much-debated question of the constitutional nature of the disease. If in its origin a cancer be purely local, early removal ought to effect a permanent cure; but if there be at the bottom a constitutional taint, a reprieve should merely be granted until a suitable fresh irritation arise. There is probably some truth on both sides. The cancerous cachexia is often spoken of; it depends chiefly, if not altogether, on the weakening effects of the discharge after ulceration has taken place; mental worry may have some share in causing it; but it must be remembered that cancerous patients, who, before they are attacked, are frequently amongst the most robust, often retain their health for a remarkably long time.

COURSE.—The course of a cancer depends upon its seat, and the symptoms must accordingly be sought amongst the articles on diseases of special regions. If, however, life be not shortened as a result of interference with the functions of the organ attacked, death is caused either by marasmus—the result of prolonged suppuration and pain, or by extensive or repeated hæmorrhages. The rate of progress is more slow as age advances.

TREATMENT.—The treatment of cancer in the early stages can only be undertaken by the surgeon, and the reader is accordingly referred for information on this head to surgical text-books; in the later stages the physician may be called upon to treat symptoms, but up to the present time all the specifics introduced either by regular practitioners or by charlatans have proved quite inefficient, if not actually harmful.

We shall now discuss the varieties of cancer.

I. **Scirrhus.**—Scirrhus, as its name implies, is amongst the hardest of tumours, if bony growths be excepted. Its hardness, as compared with soft cancer, depends upon the larger proportion which the alveolar stroma bears to the contained cells; and this is probably the consequence of the soil in which the tumour originates, and the rapidity of its growth, rather than of any specific difference between them.

Seat.—The female breast is the most common seat for scirrhus, but it also occurs in the stomach, uterus, tongue, œsophagus, and the liver and other glands, and it has been described as primary in the prostate, testicle, skin, and other structures.

Naked-eye appearances.—A section through the centre of a matured hard cancer of the breast presents to the naked eye well-marked and constant appearances, which, with the exception of such peculiarities as are due to the situation, will serve as a description of such a tumour occurring elsewhere. These are clearly explained by the microscopical arrangement, and when looked at by the light which it affords, fully account for all the clinical characters. The knife passes through it with a creaking noise, and the cut surfaces are at once hollowed in the centre. There is not a sharp edge to the growth, and the circumference is of a greyish or pinkish white tint, projecting a little above the surrounding tissues, into which it sends small lobular prolongations; the hollow centre is very hard and of a glistening white colour. Scirrhus is evidently fibrous in structure, and receives from all quarters fibrous bands, which often pass far out into the fat of the breast or the skin, and some of which can nearly always be traced to the principal milk-ducts. Between the centre and the edge is the greater part of the tumour, on the whole of a pinkish-yellow colour, but notably pink and soft externally, and yellow and hard internally. The surface yields a milky juice on scraping, and may show some of the following appearances, which are, however, accidental: round the circumference little masses of healthy fat may be included, though this but rarely happens; cysts containing grumous grey or red fluid may have formed by the breaking down of the new growth or by hæmorrhage; or such a hæmorrhage may have resulted in patches of yellow or even black pigmentation.

Microscopical appearances.—Without discussing the merits of the opposing theories as to the origin of cancer-cells, the following may be taken as the undoubted microscopical appearances of scirrhus; the grey outer layer is made up of indefinite smallish round cells, resembling white blood-corpuscles, infiltrated through the tissue into which the growth is spreading, amongst which are scattered a few which have the appearance of epithelial cells. The next or pink layer represents full development and shows fibro-cellular stroma, enclosing large epithelioid cells, and containing a copious supply of vessels. In the third or yellow layer the stroma has become fibrous and the cells are undergoing fatty degeneration; and in the inner white centre the cells are replaced by indefinite masses of granular débris, and the stroma consists of firm and old fibrous tissue. *See* figs. 125, 127, and 126.

The relation of these appearances to the clinical peculiarities of scirrhus is as follows: the excessive hardness is explained by the great development of fibrous tissue; the peculiar indefiniteness of the edge, and the tendency to involve the skin and ulcerate, by the manner of growth; while the puckering, retraction of the nipple, and indirectly (from the manner in which cutaneous nerves are involved) the pricking and shooting pains, are due to the contraction or cicatrization of the stroma. To the latter is also due a very important but not generally recognized diagnostic character of an early scirrhus, namely, that long before the skin is involved it is seen to be dimpled when gently moved to and fro over the growth. A scirrhus which has involved the skin forms a purplish-red, flattened, and shining tumour, covered with small veins and tender to the touch; the ulcer which results from its breaking down is ragged, with a hard base and hard irregular undermined edges, and a dirty surface covered by knobby masses of pseudo-granulations, which have a great tendency to bleed and often slough. As it is often removed it often returns in the scar. When occurring in the liver it is

CANCER.

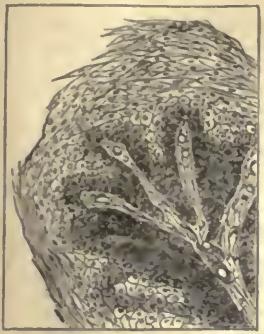

FIG. 117. Papilloma of Soft Palate.

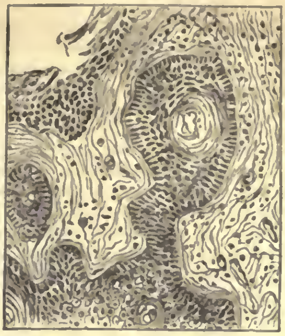

FIG. 118. Epithelioma of Lip.

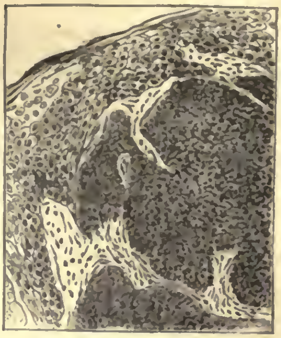

FIG. 119. Edge of Rodent Ulcer.

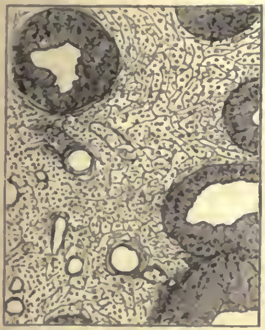

FIG. 120. Simple Polypus of Rectum.

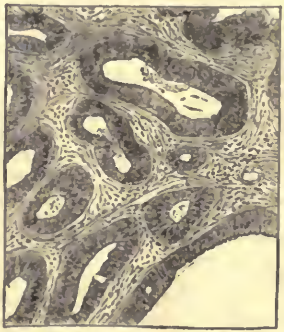

FIG. 121. Columnar Epithelioma of Intestine.

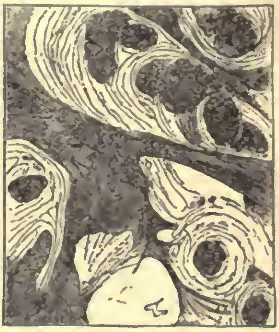

FIG. 122. Colloid of Breast.

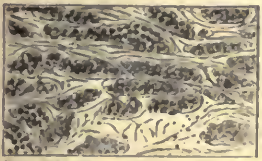

FIG. 123. Cancer of Liver (Scirrho-encephaloid).

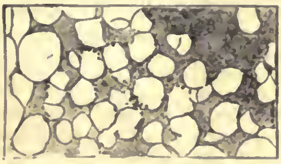

FIG. 125. Scirrhus, Infiltrating Fat.

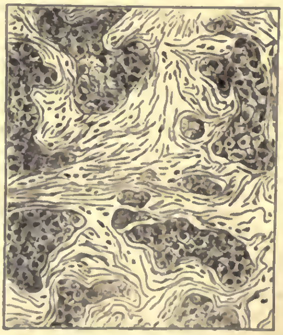

FIG. 127. Scirrhus of Mamma.

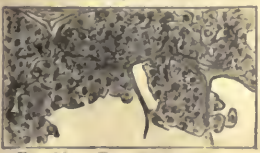

FIG. 124. Encephaloid Cancer.

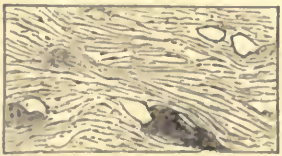

FIG. 126. Cicatrizing Cancer.

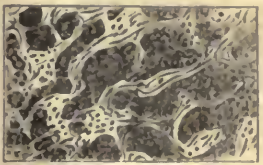

FIG. 128. Adenoid of Upper Jaw (Benign).

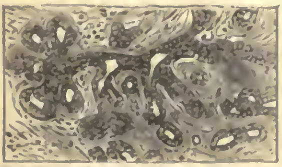

FIG. 130. Adenoid of Breast (common type).

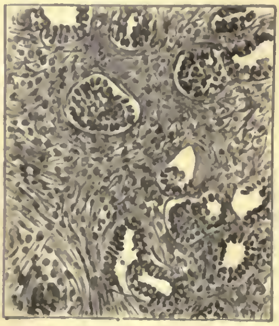

FIG. 132. Adenoid of Breast (Adeno-sarcoma).

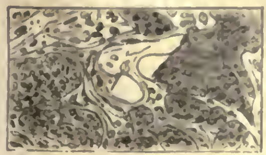

FIG. 129. Ulcerated Adenoid of Parotid (Malignant).

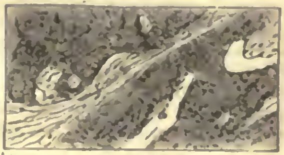

FIG. 131. Adenoid of Breast (epithelial element in excess).

Drawings Illustrating a Series of Tumours of the Epithelial Type. All drawn to the same scale (× 87 diameters).

[illegible]

softer than elsewhere, and the name of scirrho-encephaloid is often given to it. *See* fig. 96.

II. **Encephaloid.**—Encephaloid, medullary, or soft cancer, so named from its usually brain-like appearance and consistence, is softer and grows more rapidly, and is more frequently observed in internal organs than scirrhus, often indeed forming enormous intra-abdominal tumours.

Seat.—It has hitherto been observed as primary in the salivary and mammary glands, testicle, ovary, and prostate, the thyroid body, and in the mucous membrane of the nose, the liver, and the stomach. It has with some degree of looseness been sometimes called the cancer of childhood by those who consider scirrhus as almost peculiar to old age.

Naked-eye appearances.—To the naked eye a fresh section usually presents a convex surface; it is whitish, but generally mottled by coloured patches, the result of old or recent hæmorrhages, and yields very copiously a milky juice on scraping.

Microscopical appearances.—Encephaloid cancer differs from scirrhus only in the relative proportions of the two chief factors. The cells are more numerous and are contained in larger spaces; they are sometimes small, but generally much larger than in scirrhus; and the stroma is delicate and fibro-cellular and very small in amount. *See* fig. 124.

Its method of extension is the same as that of other members of the class. It is by far the most malignant form of cancer, because of its rate of growth and recurrence, and the rapidity with which it causes general cachexia.

Epithelioma.—Lobular epithelioma, epithelial cancer, or cancroid, develops in connection with skin and mucous membrane, and though consisting essentially of squamous epithelium, may start from a part which is covered by the cylindrical variety. It occurs near the natural orifices of the mucous tracts — as, for example, on the mouth and tongue, anus, penis, or vulva; but also at other parts of the skin — as on the scrotum (chimney-sweep's cancer) and at the upper end of the œsophagus. The history of a local irritation is often obtainable, but more frequently nothing of the kind can be discovered.

Naked-eye appearances.—The first appearance is that of a pimple, which soon breaks down in the centre, forming a small sore. When fully developed there is an irregular ulcer with an extensive hard and nodular, generally inflamed base and circumference; the edges are abrupt or undermined, and the floor grey or reddish, very uneven, discharging a foul pus, and with a great tendency to bleed. As a rule there is considerable pain, and the proximal lymphatic glands are very generally enlarged. A section to the naked eye shows a number of minute cylinders of yellowish-white colour, cut sometimes longitudinally, sometimes transversely, fusing together into an indefinite mass superficially, but more or less discrete below, and infiltrating amongst the subjacent tissues. On squeezing the section little nodules like sebum appear on the surface.

Microscopical appearances.—The cylinders or lobes of epithelioma are found to be made up of squamous epithelium, which generally exhibits in parts a crenated margin (Max Schultze's spine-cells). As in the skin, the deeper—that is the circumferential—layer of cells in each lobe, which are the youngest, are roundish or oblong, with large nuclei, and staining readily; further in, the cells are larger and flatter, and in the centre are found the well-known globes or nests. These were considered at one time as peculiar to epithelioma, but are now known to occur in warts and corns; they consist of onion-like arrangements of epithelial cells, varying much in size and the number of concentric layers, and containing in the centre sometimes an amorphous mass, sometimes large and irregular cells. The tissues beneath and between the lobules are infiltrated with small cells, and often contain in sections what appear to be isolated masses of epithelium; these are, however, the ends of divided divergent lobules. Opinions differ as to the exact starting-point of an epithelioma, the share which the sweat- and other glands take in it, and also as to the rationale of the formation of the globes. *See* fig. 118.

Epithelioma seems to be more local in its nature than other cancers—that is, a complete and early removal has not unfrequently given the patient a long lease of life. It recurs, as a rule, in the lympathic glands, which inflame and suppurate, and in the scar, and generally proves fatal from the constitutional disturbance it gives rise to. Later but more rarely it may appear in the internal viscera, bones, &c.

Cylindrical Epithelioma.—The cylindrical epithelioma—badly named adenoid or glandular cancer—is specially the cancer of the alimentary mucous membrane, but may occur in the bladder and elsewhere.

Naked-eye appearances.—To the naked eye it forms at first a prominent tumour in the interior of a viscus, which has a tendency like other cancers to ulcerate and involve surrounding tissues, so that the mass may reach an enormous size, and may even make its appearance through the skin. To the naked eye a section is generally whitish and has a granular appearance, which is given to it by the tubules of which it is made. It frequently causes death by obstruction of the bowel, but if it last sufficiently long, it recurs unaltered in the lymphatic glands, and then in the viscera and other parts of the body. It is not unfrequent to find recurrences in the liver with little if any implication of lymphatic glands.

Microscopical appearances.—Cylindrical epithelioma consists essentially of irregular tubules lined with columnar epithelium in one or more layers, which are the much overgrown crypts of Lieberkühn, and differ in microscopical structure from simple papilloma of the digestive tract only in the greater irregularity of the cells and in the larger proportion of connective-tissue stroma between the tubes. *See* fig. 121.

Colloid.—Colloid, or alveolar cancer, named from its jelly-like appearance, has given rise to much discussion in reference to the question whether it is developed originally in its mature form, or whether it results from the degeneration of one of the classes of cancer described above. The latter view is that most widely held, though it must be allowed that epithelioma seldom degenerates in this way, and also that the colloid change usually takes place *pari passu* with the growth of the tumour.

Seat.—Colloid cancer is found most frequently in the abdominal viscera and peritoneum, but may occur elsewhere, as in the breast. Its malignancy is great, but is shown chiefly by the rapidity with which it involves surrounding tissues; it thus forms primary tumours of enormous size, but as a secondary growth is less common; it does, however, occur in lymphatic glands and other parts. It causes death in most cases by interference with the functions of the organs attacked.

Naked-eye appearances.—Colloid cancer consists to the naked eye of a mass of semi-transparent jelly, varying slightly in colour, but mostly pale yellow: this is intersected by delicate white fibrous bands, forming alveolar spaces of different sizes, visible to the naked eye. The consistence of the growth depends upon the relative proportions of these two constituents.

Microscopical appearances.—The bands are found to be actually fibrous; the contained jelly is arranged in concentric laminæ between which are minute granules, and in the centre of which is a granular mass, sometimes quite indefinite, but often showing clearly that it consists of the remains of altered cells. These cells are seen in the more recent parts of the growth to be the subjects of colloid degeneration. The source of the colloid material must be considered still undecided; that some of it is formed by the cells is certain, but it is not equally clear whether the stroma takes any share in its deposition. *See* fig. 122.

Conclusion.—Our knowledge of the pathology of new growths is undergoing a process of rapid evolution. While, therefore, the writer has endeavoured in this article, and in that on Tumours, to represent the opinions most widely accepted at the present day, he is conscious that in a very short time these opinions may require considerable modification. R. J. Godlee.

CANCRUM ORIS (*Cancrum*, a sore; and *oris*, of the mouth). Synon.: Gangrenous Stomatitis; Noma; Fr. *le Nome*; Ger. *Wasserkrebs.*

Definition.—A phagedænic ulceration of the cheek and lip, rapidly proceeding to sloughing.

Ætiology.—Cancrum oris is usually seen in delicate, ill-fed, ill-tended children; and in these subjects it is commonly a sequela to one of the eruptive fevers. Formerly it used sometimes to be due to excessive doses of mercury.

Symptoms.—The disease commences by swelling and tenderness near the angle of the mouth, and if at this stage the mucous membrane is examined, it will usually be found that there is some superficial ulceration on the inside of the lip or cheek—that is, ulcerative stomatitis. From this slight beginning the disease rapidly advances. The soft tissues become much swollen, brawny, shining, and red. Presently a livid spot makes its appearance in the centre, and the surrounding part becomes purplish or mottled. If the patient can open his mouth sufficiently to give a view of the gums, they will be seen to be red, congested, spongy, and bathed with a profuse and fœtid saliva. The livid tissues of the cheek rapidly slough, the disease perhaps involving the lip, or spreading to the gum, laying bare the alveolar processes, and loosening the teeth. This local affection is attended by a high degree of pyrexia, and by great prostration.

The disease is very fatal. Rilliet and Barthez state that not more than one in twenty cases recover.

Treatment.—This consists in the application of strong nitric acid to any points where the ulceration and sloughing are spreading. Poultices should be kept constantly on the cheek, and from time to time the sore should be syringed with a disinfecting lotion. The constitutional treatment consists in the administration of a full amount of beef-tea, milk, eggs, &c., with a moderate allowance of alcoholic stimulants, as well as bark, ammonia, and other suitable tonics. Regular and systematic administration of food and medicine is of the utmost importance; and if the patient is unable to swallow, nutritious enemata must be used regularly.

W. Fairlie Clarke.

CANITIES (*canus*, hoary or greyhaired).—Whiteness or greyness of the hair. *See* Hair, Diseases of.

CANNES in France, on the Mediterranean coast. A dry, bracing, fairly mild winter climate. Exposed to N.W. Abundant accommodation, both near and at some distance from the sea.

CANTHARIDES, Poisoning by. *See* Appendix.

CAPE OF GOOD HOPE.—A warm, generally dry climate, but very variable, and liable to sudden storms. Living dear, and locomotion difficult.

CAPILLARIES, Diseases of.—The morbid conditions of the capillaries may be described in the following order:—1. Fatty Degeneration. 2. Calcareous Degeneration. 3. Albuminoid Degeneration. 4. Pigmentation. 5. Changes in Inflammation. 6. Dilatation. 7. Narrowing and Obliteration. 8. Thrombosis. 9. Embolism. 10. Rupture. 11. The New Formation of Capillaries. 12. Capillaries in New Growths and Tubercle. 13. Changes in the Perivascular Space and Sheath. 14. Teleangiectasis.

1. **Fatty Degeneration** is the most common disease of the capillary-wall, and is frequently associated with fatty degeneration of the surrounding tissues. The cause of this change in the protoplasm of the capillary is, as elsewhere, interference with nutrition, and especially with oxidation. It is accordingly found in morbid conditions of the blood; in interference with the blood-supply; and in lesions of the nervous system. The microscopical characters of the early stages of fatty degeneration when it affects the capillaries are not peculiar; in advanced stages the diseased vessels may present the appearance of opaque granular cords; and the lymphatic sheaths of the cerebral capillaries are sometimes found, under such circumstances, filled with oil-globules and fatty cells. A frequent termination of the disease is rupture and hæmorrhage. Fatty

degeneration of the capillaries occurs most frequently in the nervous centres, in the kidneys, in certain tumours, and in the products of infarction and inflammation.

2. **Calcareous Degeneration** is rare in capillaries.

3. **Albuminoid Degeneration** affects the Malpighian glomeruli in the early stage of albuminoid disease of the kidneys. In other parts of the body the capillaries are less subject to albuminoid change than the small arteries.

4. **Pigmentation.**—Pigmentary granules may sometimes be found in the walls of capillaries, but they more frequently occupy the perivascular space. In either situation pigmentation is the result of chronic congestion or inflammation, or of hæmorrhage.

5. **Changes in Inflammation.**—The changes of the capillaries of an inflamed part constitute an important factor of the process of inflammation. *See* INFLAMMATION.

6. **Dilatation** of capillaries, which is one of the changes in inflammation just referred to, may become permanent if the process be chronic. Changes in the nutrition of the capillary-wall, combined with disturbances of the circulation, such as increased pressure, produce local dilatation or **Aneurism** of the vessels and subsequent rupture. This is one form of *miliary aneurism* as it occurs in the brain.

7. **Narrowing and Obliteration.**—Narrowing of capillaries may be temporary, as in inflammation; or permanent, from external pressure, or from interference with the blood-supply. Narrowing may proceed to complete obliteration.

8. **Thrombosis** commonly occurs in capillaries as a consequence of embolism or of thrombosis in the associated arteries or veins. Less frequently the coagulation of blood is primary, and is due to one or more of the usual causes of thrombosis, namely, feebleness of the circulation and alteration of the blood.

9. **Embolism.**—The phenomena of ordinary embolism in a great measure affect the capillaries corresponding with the obstructed artery. But besides this change, capillaries are themselves subject to embolism, or impaction of particles within them. The products of inflammation or degeneration, pigment-particles, oil or fat drops from the marrow of fractured bones, organisms, and various substances artificially introduced into the circulation, have been discovered obstructing the capillaries in different instances. All the possible results of embolism in large vessels may follow, according to circumstances; and in the case of the cerebral vessels definite symptoms are believed by some to result, such as delirium and choreic movements. *See* CHOREA.

10. **Rupture.**—Three circumstances specially determine the occurrence of this lesion of capillaries, namely, disease of the vessel-wall, increase of the blood-pressure, and a 'terminal' distribution of the branches of the artery that supplies them. The most common diseases of the wall are fatty degeneration and aneurism. The blood-pressure rises within the capillaries of any part in ventricular hypertrophy, in increased tension of the arteries of other parts, and in venous obstruction. When an artery is 'terminal,' that is, unprovided with other anastomoses than through its capillaries, no lateral relief can be afforded in sudden and excessive rises in the force of the circulation. For these several reasons, rupture of capillaries is most frequent when the vessel-walls have been weakened in the fatty degeneration of senile decay, in septicæmia, inflammation, purpura, fever, and scurvy; in chronic Bright's Disease, with increased blood-pressure; and in such organs as the corpus striatum, retina, spleen, kidney, villi, and skin. Disturbances in the pressure of the air within the chest powerfully influence the occurrence of capillary-rupture in the respiratory tract. When a capillary-wall gives way, the blood is extravasated either on a free surface, constituting hæmorrhage; into the substance of the tissues around; or along the lymphatic sheath of the ruptured vessel, where it gives rise to the appearance that has been described as *dissecting capillary aneurism.*

11. **New Formation of Capillaries.**—Capillaries grow or develop in nearly all forms of new growth, whether inflammatory or otherwise. The young capillaries are derived either from cellular buds upon previous capillaries, which become hollowed by the blood-pressure; from anastomosing exudation-cells, or connective-tissue corpuscles; or, in some cases, from the parallel disposition of exudation-cells.

12. **Capillaries in New Growths and Tubercle.**—The capillary-walls are believed to play an important part in the production of certain forms of new growth. *See* TUMOURS and TUBERCLE.

13. **Changes in the Perivascular Space and Sheath.**—The perivascular or lymphatic sheath, which probably envelopes all capillaries, is liable to certain morbid conditions, which are chiefly secondary to changes in the vessel within it. Thus the space may become filled with blood from escape of the corpuscles by rupture or otherwise; with leucocytes in inflammation; with oil-globules and fatty corpuscles in degeneration of the wall; with pigment particles; or with serum in disturbances of the circulation. The calibre of the perivascular canal, which varies inversely with that of the contained capillary, may thus be increased, and present uniform or irregular dilatation.

Changes in the *outer* sheath, or wall of the lymphatic space, have also been observed, including fatty degeneration of the lining cells and hyaline thickening.

14. **Teleangiectasis.**—At least one form of vascular tumour consists of a local over-growth of capillaries, which are both enlarged and multiplied. *See* TUMOURS. J. MITCHELL BRUCE.

CAPILLARY BRONCHITIS.—Inflammation involving the minute bronchial tubes. *See* BRONCHI, Diseases of.

CARBOLIC ACID, Poisoning by. *See* POISONS.

CARBONIC ACID, Poisoning by.—The inhalation of carbonic acid causes injurious or fatal results, according to the length of time and degree of concentration. Carbonic acid accumulates in large quantities, almost undiluted, in pits, cellars, wells, mines (especially after explosions, constituting what is called choke-damp), volcanic grottoes, fermenting vats, lime-kilns, &c. A continuous contamination of the atmospheric air with carbonic acid goes on from the respiration of animals and the combustion of fuel. The gradual exhaustion of oxygen and proportionate accumulation of carbonic acid in ill-ventilated apartments is one of the factors of the evil results of bad ventilation, but not the only one, as other animal exhalations contribute largely to the result.

As a rule excess of carbonic acid means corresponding deficiency of oxygen in the atmosphere, and the proportion cannot exceed 10 per cent. without rapidly fatal results ensuing; but much less than this causes injurious, and even the like consequences if long inhaled; and less than 2 per cent. cannot be breathed for any length of time with impunity.

If the amount of oxygen be not correspondingly diminished, carbonic acid if present in sufficient quantity in the atmosphere respired will still act fatally. Thus Bernard found that a bird died instantaneously in an atmosphere of equal parts of oxygen and carbonic acid, and Snow found that 20 per cent. of carbonic acid in an atmosphere containing the normal proportion of oxygen soon proved fatal to small animals, and that even 12 per cent. might cause death after a longer interval.

Symptoms.—Undiluted carbonic acid is not readily inhaled, as it tends to induce spasm of the glottis, but immersion in such an atmosphere is rapidly fatal. It seems to act like a narcotic. The patient falls down prostrate and insensible, and death occurs almost immediately. This effect is seen occasionally when labourers incautiously descend an old well, or when miners enter a region filled with choke-damp. Not unfrequently more than one fall victims, as one goes to see what has happened to the other and meets the same fate.

When the carbonic acid is more diluted the symptoms are headache, giddiness, and sense of oppression; followed by drowsiness, and singing in the ears; and passing into a condition of stupor and insensibility, with stertorous breathing and muscular prostration, death usually occurring quickly and without convulsions. If the excess of carbonic acid corresponds with deficiency of oxygen, we have in addition to the essentially narcotic effects of carbonic acid, the dyspnœa and other symptoms of asphyxia (*see* Asphyxia).

Post-mortem appearances. — These are largely those of asphyxia, viz., a general engorgement of the venous system. This is generally seen in the brain, more frequently than in asphyxia pure and simple. The blood is dark and fluid. The hæmoglobin is completely reduced. Animal heat is said to be retained long after death, and rigidity is well-marked and enduring.

Pathology.—As has already been said, carbonic acid does not act merely as a negative asphyxiant by taking the place of oxygen, but has a distinctly toxic narcotic effect. Very frequently in cases of poisoning by carbonic acid there is a combination of asphyxia, essentially due to defect of oxygen, with the narcotic symptoms due to carbonic acid.

Treatment. — 1. *Prophylactic.* -- Caution should be exercised in exploring wells, mines, &c., where there is likelihood of the accumulation of carbonic acid. The introduction of a lighted candle is a rough and ready test of considerable value. The mere fact of a candle continuing to burn in an atmosphere is no test of its being respirable with impunity, for a candle will burn in an atmosphere containing 10 per cent. of carbonic acid if the oxygen is present in the normal amount, and the presence of an amount of carbonic oxide sufficient to cause death will not materially affect the flame. If carbonic acid reaches the proportion of 16 per cent. the candle will be extinguished, however. If a candle is extinguished, then certainly the atmosphere cannot be breathed, and therefore the test is of sound practical value. If carbonic acid does exist it should be expelled by creating a draught of some kind. Thus wells may be swept by some such contrivance as an inverted umbrella, and a stream of air can be directed into enclosed spaces.

2. *Restorative.*—Artificial respiration and its various accessories are needed to restore a person actually in a state of coma from carbonic acid. This treatment, of course, is subsequent to instant removal from the impure atmosphere. Pure oxygen should also be administered if at hand.

D. Ferrier.

CARBONIC OXIDE, Poisoning by.—Carbonic oxide is a much more dangerous agent than carbonic acid, and to it are due many of the effects sometimes ascribed to the latter. Pure carbonic oxide is rarely generated out of the chemical laboratory, but mixed with other gases carbonic oxide is not uncommon. This is especially the case in the fumes of burning charcoal. The carbonic acid of the burning charcoal while passing over the heated embers loses an atom of oxygen, or takes up an atom of carbon, and is converted into carbonic oxide, which burns with a bluish flame at the top. The toxic action of charcoal vapours is essentially dependent on the carbonic oxide they contain. Usually charcoal fumes contain from 2 to 3 per cent. of carbonic oxide, to 25 of carbonic acid, along with some heavy carburetted hydrogen. The vapours, however, are still as effective after being passed through lime-water, which fixes the carbonic acid. Poisoning by charcoal vapour is not an uncommon form of suicide, more particularly abroad; and many cases have occurred accidentally in this country, from sleeping in rooms in which there was no flue for the escape of the fumes of burning charcoal, or into which there has been leakage from stove pipes, &c.

Carbonic oxide also exists in coal gas, and constitutes its main danger. It is likewise found in the emanations from brick-kilns.

Carbonic oxide is an extremely active poison. Letheby found that ·5 per cent. of carbonic oxide in the respiratory medium killed small birds in three minutes, and that 2 per cent. killed a guinea-pig in two minutes. Many similar experiments have been performed with similar results. The animals soon become insensible, and die generally without exhibiting convulsive phenomena beyond a few tremors or flutterings.

Symptoms.—In man inhalation of carbonic oxide for a short time, as Sir H. Davy and others have proved on themselves, causes headache. pulsation in the temples, giddiness, nausea, and great prostration, tending to drowsiness and insensibility death being preceded by a state of complete coma. Usually death occurs quietly, but signs of vomiting are frequently observed near those who have been poisoned by charcoal fumes.

Post-mortem Appearances.—The specially characteristic appearance of death from carbonic oxide is the cherry-red colour of the blood and internal organs. The post-mortem hypostasis exhibits a similar bright red tint. Frequently in those poisoned with carbonic oxide the face retains a ruddy hue. The red tint of the blood is due to the compound which carbonic oxide forms with hæmoglobin. Carbonic oxide displaces the oxygen and forms a very stable compound with the hæmoglobin, not readily broken up, and hence the oxygen-carrying power of the corpuscles is paralysed.

In the spectroscope carbonic oxide blood exhibits two absorption-bands very similar to those of ordinary blood-colouring matter or oxyhæmoglobin, but a difference in the exact breadth and position of the bands can be made out by means of the microspectroscope when the two are compared together. Carbonic oxide hæmoglobin resists reduction in the usual manner, and here again differs from normal blood-colouring matter. Hoppe-Seyler gives as an additional test the action of caustic alkalies on carbonic oxide, and on ordinary hæmoglobin. With the latter it causes a green colour when mixed with it on a porcelain plate, while in the former the colour continues red.

Pathology. — Carbonic oxide acts in the manner indicated, viz., by paralysing the blood-corpuscles, as Bernard expresses it, and rendering them unable to take up oxygen. Hence internal respiration is prevented, and death ensues from asphyxia.

Treatment.—As carbonic oxide hæmoglobin is a very stable compound, and offers considerable resistance to displacement by oxygen, though not absolute as was at one time considered artificial respiration is not likely to be successful by itself. The best treatment is venesection and transfusion of fresh blood. This method of treatment has proved successful in one or two instances in which it has been employed.

D. Ferrier.

CARBUNCLE. — Synon.: Anthrax; Fr. *Anthrax*; Ger. *Karbunkel.*

Definition.—A specific local inflammation of the subcutaneous areolar tissue, rapidly leading to sloughing of the deeper and more central parts, followed by destruction of the skin; the whole of the dead tissues finally separating in the form of a slough.

Ætiology. — Carbuncle is a constitutional affection, dependent upon conditions of general debility or plethora, and often associated with gouty or diabetic tendencies. It is more commonly seen in men than in women; is rarely met with under the age of twenty; and attacks all ranks of life.

Symptoms. — The most usual seat of carbuncle is the back of the trunk or neck, but it may occasionally be found in other situations. The affection usually begins as a painful, hard, slightly elevated, and ill-defined swelling, which gradually increases in extent and assumes a dusky red tint. A vesicle containing bloody serum soon forms over the most prominent part, and on rupturing discloses several small apertures in the subjacent skin, which give exit to a glutinous purulent discharge. This sieve-like condition of the undermined integument often persists throughout the course of the disease; occasionally, however, owing to the destruction of the intervening skin, the several apertures merge into a single, large, ragged opening, and thus expose the characteristic ash-grey, slimy slough, which separates slowly by suppuration, leaving an irregular cavity with deeply undermined edges. The cicatrix left after healing is usually uneven and may be permanently discoloured.

In the early stage of the disease, while the inflammatory œdema is still extending, the patient generally complains of a burning, throbbing sensation in the part, which may become intensely painful; but on the full exposure of the slough, the pain diminishes, and in the later stages it may cease entirely.

When the carbuncle is large, or involves a portion of the scalp. there is usually considerable constitutional disturbance of an asthenic type. Death may then occur from exhaustion, which is sometimes aggravated by free hæmorrhage resulting from incisions; but the most frequent cause of a fatal termination is pyæmia.

Diagnosis.—Carbuncle is distinguished from boil by the size and extent of the swelling, and by its tendency to spread; by the livid tint of the skin, and the early formation in it of more than one aperture; by the character of the slough, by the severity of the pain, and the marked constitutional disturbance; and finally, by the fact that carbuncle, unlike boil, usually occurs singly.

Prognosis.—This will depend chiefly upon the age of the patient, and upon the seat and extent of the disease, which proves most dangerous to life when situated or encroaching on the scalp, especially in a person over fifty. The coexistence of albuminuria or chronic saccharine diabetes is always a grave complication.

Treatment. — The *constitutional* treatment and the management of patients with carbuncle are best conducted on general principles. In ordinary cases the diet should be of good quality and sufficient in quantity, with a moderate allowance of stimulants, proportionate to previous habits. Should the patient's strength and the situation of the carbuncle allow him to move about, he need not be confined to his room, and may even be allowed exercise in the open air

In the more severe forms of the disease, the frequent administration of dietetic stimulants and good nourishment in an easily assimilable form is usually necessary. The bowels, if they require it, should be cleared out by some non-irritating aperient, and the patient put on a course of quinine or bark and the mineral acids. Opium may be required in the earlier stages to relieve the intense sufferings of some patients;

while in the after-course of the disease, it may be sometimes needed to procure sleep.

For *local* treatment *see* Boils.

For *carbuncle of the face*, an affection distinct from the Malignant Pustule described by Continental surgeons, *see* Pustule, Malignant, and the article on Boils. William A. Meredith.

CARCINOMA. *See* Cancer.

CARDIAC DISEASES. *See* Heart, Diseases of.

CARDIALGIA (κάρδια, the heart, and ἄλγος, pain).—A synonym for heartburn, originating in a popular impression that this painful sensation, which is situated in the epigastrium, is connected with the heart. *See* Heartburn.

CARDIOGRAPH, The (κάρδια, the heart, and γράφω, I write). This is an instrument for registering graphically the form of the heart's movements. We owe the invention of the cardiograph to Marey, who in his physiological researches on the circulation of the blood, obtained by the following means the form of movement of each cavity of the heart. He introduced into the auricles and ventricles of a horse, hollow sounds terminating in elastic ampullæ filled with air. The air communicated through the sounds and elastic tubes with terminal ampullæ, or tympana covered with elastic membrane, on each of which rested a light lever. The movements communicated by the heart to the closed column of air were amplified by the levers and recorded by them on a revolving cylinder. In this way tracings of the forms of movement of each cavity, as well as of the exposed apex-beat itself, were obtained, and an explanation of the several parts of the complex apex-tracing rendered possible. The cardiograph used for clinical research is a modification of the above, and consists of a hollow cup containing a small spring which can be depressed by means of a screw so as to rest firmly on the chest-wall where the impulse is felt. The cup communicates by means of an elastic tube with a tympanum covered with elastic membrane carrying on its surface a lever. When applied to the chest the cup hermetically seals the air column which transmits as waves the motion received by the spring to the lever resting on the tympanum. These movements are recorded by the end of the lever either on the plate of a sphygmograph or on a revolving cylinder.

By means of this apparatus a very perfect representation of the cardiac movement can be obtained, the auricular and ventricular elements traced, and the duration of each measured. The transmission of the motion through an elastic medium like air has been objected to, as liable to modify the tracing by (1) the production of secondary oscillations in the air column; and by (2) gradual change in the form of motion caused by the elasticity of the medium. Practically, however, these objections are not valid, as is shown by the fact that the last of a series of cardiac pulsations is often an exact reproduction of the first, and also by the close resemblance between the tracings obtained in this way and those registered by the sphygmograph, or a modification of it, applied over the apex-beat. A cardiogram collected by the instrument described on a healthy person is given in the margin. Two cardiac revolutions are recorded. The several waves may be interpreted as follows: the wave *a*, in the line of ascent, corresponds with the early part of the ventricular diastole. The wave *b* corresponds with the true auricular systole; from *b* to *d* the line marks the true impulse caused by the ventricular contraction, the rounding of the heart, and its pressure against the chest-wall. The wave *c*, at the summit of the curve, indicates the closure of the auriculo-ventricular valves; *c* does not always form the summit of the curve, but occasionally in slower cardiac contractions forms a wave below the summit. The waves between *c* and *d* are referred to oscillations produced by the closure of the auriculo-ventricular valves, but are probably manufactured by the instrument. The break in the line of descent at *e*, marks the closure of the sigmoid valves. In the above cardiogram the period of ventricular contraction is measured by the space between the commencement of the line of ascent after the wave *b*, to the point *d*, which marks the termination of the systole. When the heart is hypertrophied and acting vigorously this termination is often registered as a slight elevation of the trace.

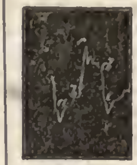

Fig. 4.

The clinical value of the cardiograph has yet to be fully established. It has hitherto been useful in showing the relation of præsystolic murmur and thrill to the ventricular and auricular contractions; in demonstrating modifications of the form of impulse in adherent pericardium; in recording a considerable increase in the wave *a* and a sudden rising of the trace after *a*, as signs of aortic insufficiency; and in the recognition of the relation between reduplication of the heart-sounds and respiratory influences. The cardiograph is also of great value in registering the form of movement of pulsating tumours and aneurisms. In its application it is sufficient to hold the instrument firmly over the apex-beat and to record the pulsations at the end of expiration, the breath being stopped for a brief interval. Occasionally, when the influence of respiration is to be observed, this precaution is of course unnecessary; but it must be borne in mind that the movement of the chest-wall modifies the tracing.

Balthazar Foster.

CARDITIS (κάρδια, the heart). Inflammation of the substance of the heart. *See* Heart, Inflammation of.

CARIES (*caries*, rottenness).—A destructive inflammatory disease of bone, analogous to ulceration of soft tissues. *See* Bone, Skull, and Spinal Column, Diseases of.

CARLSBAD, in Bohemia. Thermal alkaline sulphated waters. *See* Mineral Waters.

CARMINATIVES (*carmino*, I card, or cleanse).

Definition.—Substances that aid the expulsion of flatus from the stomach and intestines, and relieve griping.

Enumeration.—The principal carminative remedies are—the Essential Aromatic Oils; Chloroform; Charcoal; Ethers; and Camphors; and substances containing them.

Uses.—The uses of carminatives are sufficiently indicated in the preceding definition. They are extensively administered in cases of flatulent dyspepsia, especially when it is associated either with disease or disorder of the heart or with a nervous or hysterical state of the system. A combination of several different carminatives is usually more successful than the exhibition of a single drug. With antacids they are useful in correcting acidity; and they are frequently prescribed with purgatives to prevent pain.

CARNIFICATION (*caro*, flesh, and *fio*, I become).—A condition of the lung in which its tissue resembles flesh. The term was formerly applied to the transformation of any tissue into a flesh-like substance. *See* Lung, Collapse of.

CARPHOLEGY } **CARPHOLOGY** } (*κάρφος*, chaff, and *λέγω*, I collect). The movements of the hands and fingers observed in delirious patients, as if they were searching for or gathering imaginary objects. A familiar illustration of the act is 'picking of the bedclothes.'

CARTILAGE, Diseases of.—For a due appreciation of the abnormal conditions to which cartilage is subject, a brief description of this tissue in its healthy state is necessary.

The *temporary* cartilage which forms the early skeleton, gradually undergoes conversion into bone, leaving at the joint surfaces a thin layer, the *articular* cartilage, which never becomes ossified. Certain other portions of the skeleton also retain their cartilaginous condition throughout life; these are known as the *permanent* cartilages, and as examples the cartilages of the ribs, ears, and nose may be given. The extremities of the long bones, or *epiphyses*, remain separate from the shaft for a varying period after birth, and so long as the bone continues to grow, they are attached to it by a thin but important layer of cartilage, called the *epiphysial* cartilage. There are yet the *fibro-cartilages*, in which the fibrous and cartilaginous elements are found in varying proportions, according as the tenacity of the one or the elasticity of the other material is required.

Cartilage is altogether destitute of nerves, and therefore of sensibility; and it is equally devoid of blood-vessels, being nourished by imbibition from the vessels of the neighbouring parts. All cartilages, except the articular and the fibro-cartilages, are covered by a fibrous membrane, the *perichondrium*, which is similar to, and subserves the same purpose as the periosteum. When cartilage has been destroyed it may be replaced by fibrous tissue, or by bone, but it is never reproduced.

Under the microscope a section of cartilage presents a transparent, structureless matrix, studded with nucleated cells; these cells are flattened and arranged parallel with the free surface of the cartilage, whilst more deeply they are elongated and grouped vertically. The nutrient materials are absorbed from the neighbouring blood-vessels, and transmitted throughout the cartilage by means of these cells. In those cartilages where tenacity or flexibility are needed, this hyaline substance is denser and more distinctly fibrillated than in the others.

Summary of Diseases.—Cartilage being nonvascular, its inflammation is of a modified type, but it may undergo degenerative changes as a result of impaired nutrition. In uncomplicated disease of cartilage there is no inflammatory exudation, and when lymph or pus is found in a joint, it is obvious that other structures have become inflamed.

1. The ensiform and costal cartilages, with those of the trachea and larynx, show a great tendency to *ossification*, as the result of morbid change or senile decay; they are also liable to *necrosis*. The articular cartilages never ossify, but large portions of them may perish and be detached, in consequence of some interference with their supply of nutriment.

2. The cartilages of the epiglottis, ears, nose, eyelids, and eustachian tube have little disposition to ossify, but they are liable to *ulceration*, especially of the syphilitic variety; in these cases the diseased action commences in the skin or mucous membrane, and spreads to the cartilage by contiguity.

3. The cartilage of the external ear is often the seat of *chalk-stones* in gouty persons, and similar deposits may also be found in the articular cartilages.

4. The epiphysial cartilage may take on an ulcerative action, which leads to separation of the shaft from the epiphysis, a condition which, whether the result of disease or accident, is of great moment, inasmuch as the destruction of this layer of cartilage checks further growth at the end of the bone.

5. Cartilage is not primarily attacked by *cancer*, but it may become involved by the spread of a malignant tumour. The *epithelial* form of cancer not infrequently extends from the mucous or cutaneous surface, in which it originated, to the subjacent cartilage.

6. The articular cartilages are liable to certain structural changes as the result of disturbed nutrition; and the fibro-cartilages are also subject to the same abnormal conditions.

Ulceration, absorption, degeneration of cartilage are terms used to denote a series of destructive changes which take place in the substance of articular cartilage, and lead to its partial or complete removal. These changes may originate in the cartilage itself, or they may be secondary to disease of the bone or synovial membrane: however this may be, the morbid action is the same, and consists in increased cell-development, with disintegration of the hyaline substance.

According to the observations of Goodsir and Redfern, the cartilage-cells become enlarged, filled with nucleated corpuscles, and arranged irregularly; the distended cells then burst, and set free their contents upon the surface of or amongst the altered hyaline substance. Whilst the cell-changes are taking place, the matrix softens: in acute cases it rapidly disintegrates and is discharged; but when the disease is more chronic, it splits up into fibres, which remain attached by one end to the cartilage, and by the other project loosely into the interior of the joint, giving a villous appearance to the affected spot. The remains of the matrix, and the granular contents of the cells together form a fibro-nucleated membrane, which ultimately is converted into fibrous tissue, and constitutes the sole medium of repair when a cure is effected. When this membrane is recent it has an indistinct granular appearance, from the presence of nuclei amongst the fibres, and according to Rainey these nuclei are often converted into fat-globules; when the membrane is of older date it is distinctly fibrous; and no doubt the several appearances which the membrane presents under different circumstances has led to the several terms *fibrous*, *fatty*, and *granular degeneration* being applied to this disease, in the belief that they were really distinct pathological conditions.

Ulceration generally commences upon the free surface of the cartilage, but it may begin at any part. It is usually superficial, but sometimes extends completely through the substance of the cartilage, exposing the bone: commonly limited in extent, it occasionally spreads over the whole surface; it is ordinarily confined to a single joint, but more than one may be affected. As a rule the disease progresses slowly, but it may run its course more rapidly. *See* JOINTS, Diseases of.

7. *Hypertrophy* of the articular cartilages has been described, but, as in these cases the cartilage was found swollen and soft, it is probable that they were examples of commencing disease, rather than of actual increase of texture.

8. *Atrophy* has been observed as the result of pressure, and of the natural wasting which occurs in advanced life; it is also said to be occasionally produced in younger subjects by disease.

GEO. G. GASCOYEN.

CASEOUS DEGENERATION.—A form of degeneration in which the products have the appearance of cheese. *See* DEGENERATIONS.

CASTS. (*Kast*—Swedish and Danish—a throw.)

DEFINITION.—A term applied to moulds of gland-tubules and hollow viscera, thrown off in certain states of disease.

CLASSIFICATION.—The varieties of casts met with may be represented according to the following arrangement:—

A.—CASTS OF GLAND-TUBULES.

- **I. Of the Uriniferous Tubules.**
  - Blood-Casts.
  - Pus-Casts.
  - Hyaline Casts.
  - Granular Casts.
  - Epithelial Casts.
  - Fatty Casts.
- **II. Of the Seminal Tubules.**
- **III. Of the Gastric Tubules.**
- **IV. Of the Cutaneous Glands.**

B.—CASTS OF HOLLOW VISCERA AND PASSAGES.

- **I. Of the Alimentary Canal.**
- **II. Of the Urinary Bladder.**
- **III. Of the Female Genital Passages.**
- **IV. Of the Respiratory Passages.**

A.—CASTS OF GLAND-TUBULES.

I. Of the Uriniferous Tubules.—Dr. F. Simon of Berlin is usually credited with having been the first to describe these bodies in his work on *Medical Chemistry*, published in 1842; but it appears that before then they had been noticed and described by Vogla in 1837 and 1838, by Rayer in 1838, and by Nasse of Marburg in 1842. These observers, however, do not seem to have entered on the question of the origin, structure, or significance of these bodies, and for years they were looked upon rather as curiosities, and by some writers, notably Glup, were wholly disregarded. Heller, in 1845, appears to have been the first to refer their origin to the coagulable matter of the blood, but it was some time after that date before their value in the diagnosis and prognosis of renal diseases came to be appreciated. This result has been mainly effected in this country by the labours of Basham, Beale, Johnson, W. Roberts, Dickinson, and Grainger Stewart.

Casts may be formed in any part of the kidney. They have been found in the convoluted tubules even up to the Malpighian capsules, and also in the straight tubules. Not infrequently small casts formed towards the terminations of the tubules come to be enclosed in their passage onwards within casts of the larger ones.

CHARACTERS.—The urinary casts are mostly cylindrical in shape, frequently somewhat coiled and bent, and occasionally forked. Their length, depending very much on accidental circumstances, varies considerably. In sections of the kidney they may be traced occasionally for some distance in the tubules, becoming broken up into smaller pieces after leaving the kidney. In diameter the casts range between 1·1000th and 1·500th of an inch—the former being known as 'small,' the latter as 'large' casts. The greater number are of a 'medium' size of 1·700th of an inch. The diameter of the casts is in part determined by the calibre of the tubule in which they are first formed, and in part by any subsequent additions they may receive in their passage outwards. Dr. Beale has suggested that after their formation the casts may probably shrink. In tubules that have become abnormally dilated or contracted, casts beyond the limits above mentioned may be found.

The appearance of renal casts varies considerably, not only in different kidney-diseases, but also in various stages of the same affection. In all cases the cast consists of a solid cylinder of a transparent or a very faintly granular substance, which in certain cases is fibrillated. What the nature of this base-substance is is still uncertain, and it appears probable that its composition is not constant in the different varieties of casts. It was formerly accepted that these bodies were produced by a coagulation of fibrin due to an escape of blood-plasma into the tubules, and hence they were known as 'exudation-cylinders'—a term still often employed. It is easy to understand the formation of casts in this manner, and it is certain that such *blood-casts* do occur, whether as shreds of fibrin with abundance of blood-corpuscles in its meshes, or as casts consisting of little more than pure fibrin with its characteristic fibrillated appearance. In a similar manner *pus-casts,* so called, may be produced.

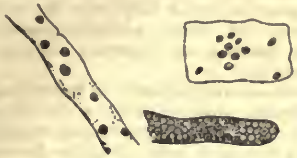

FIG. 5.—Blood Casts.

In those forms of renal disease, however, in which casts are found in the urine, when no hæmorrhage into the kidney tubes exists, one of the commonest appearances of these bodies is that of a transparent and faintly granular, tolerably uniform cylinder, frequently somewhat rounded at the extremities, and often overlooked unless searched for with care. In them no sign of fibrillation is to be discerned, and they do not correspond in their chemical behaviour to fibrin. These are the *hyaline, transparent,* or *waxy* casts, which may be large, small, or medium in diameter. What the substance is of which they are composed is uncertain. It is distinctly not fibrin, nor is it inspissated albumin, as has been suggested. In many cases a considerable proportion of mucin has been obtained from them. Though frequently called 'waxy,' and often occurring in the urine from a waxy and amyloid kidney, it is extremely doubtful if they ever consist of the amyloid matter which is produced in the lardaceous degeneration of that organ.

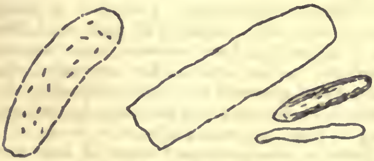

FIG. 6.—Hyaline Casts.

According to the writer's view this cast is the result of a colloid degeneration of the renal epithelial cells, comparable to what is met with in other protoplasmic tissues. In consequence of this change in the cells they lose their normal appearance, and form into homogeneous, transparent masses, occupying the now denuded renal tubules, from which they are subsequently washed out by the urine secreted behind them. Other observers have regarded them as being formed of a substance secreted by the renal epithelial cells, rather than an actual conversion of the cells themselves. And Dr. Beale has 'thought it not improbable that these casts of the uriniferous tubes may really be composed of the material which in health forms the substance of epithelial cells. In disease this substance, perhaps somewhat altered or not perfectly formed, collects in the tubes and becomes inspissated.' Whatever may be the true explanation of their formation, they present themselves as semi-solid and somewhat viscid cylinders, readily entangling adjacent matter. Due to this property is much of the variety they offer; thus, should the epithelium of the tubules be loosened, from any cause, the cells will cohere to the cast which has been formed in the lumen of the tube, and an *epithelial cast* will be voided. Should the cells have undergone fatty degeneration the cast will be pervaded with oil-globules of all sizes, more or less escaped from epithelial cells, according to the extent of the degeneration; this constitutes a *fatty cast.* Very frequently the casts are finely or coarsely *granular,* this appearance being produced by the involvement in the base-substance of the cast of granular matter derived from broken-down epithelial cells or blood-corpuscles, molecular fatty matter, or very frequently amorphous urinary salts. In a similar way casts may be found containing *crystals* of oxalates, triple phosphates, &c. Very slight proof exists of any of the numerous theories that have been offered to explain their formation.

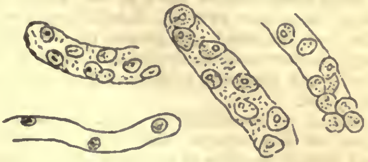

FIG. 7.—Epithelial Casts.

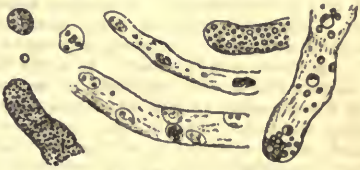

FIG. 8.—Fatty Casts.

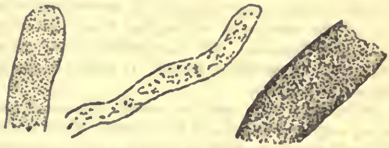

FIG. 9.—Granular Casts.

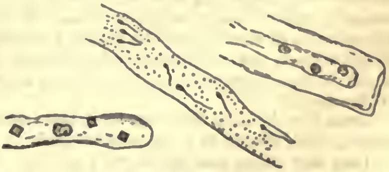

FIG. 10.—Casts enclosing crystals; and a smaller cast; also of seminal tubule with spermatozoa.

It is very commonly the case that more than one variety of cast occurs in the same urine, epithelial and hyaline, or granular and fatty, often co-existing. Corresponding to the casts in the urine, free epithelial cells, blood corpuscles, fat globules, and salts, amorphous or crystalline, are always found. The epithelial cells, whether free or on the cast, are rarely quite normal in appearance. The pathological changes which have led to their desquamation have at the same time altered them more or less. Not infrequently the cells of an epithelial cast present all the microscopic characters of leucocytes, having been produced by an abnormal proliferation of the renal epithelium.

Method of examination.—Samples of urine (three or four ounces) suspected to contain casts should be allowed to stand at least three hours in perfectly clean conical glasses, and a few drops should be removed from the bottom with a pipette, and covered in the usual way on a glass slide. For all practical purposes a ¼-in. objective, giving with the eye-piece a magnifying power of about 350 diameters, is sufficient. The hyaline casts are often so transparent as to escape any but the most careful observation, and then a little magenta or carmine staining fluid, introduced beneath the cover-glass, much facilitates their detection; cutting off some of the light used has a similar effect. As a rule there is no mistaking a renal tube-cast, but occasionally a transparent or granular streak may be noticed, the nature of which cannot be positively stated; shreds of mucus, especially when mixed up with granular matter, are the commonest objects which simulate casts; their disappearance on the application of a little heat to the slide determines their character.

Clinical significance.—Valuable—almost indispensable—as is the evidence afforded by the detection of these bodies in the urine, their recognition and comprehension is nevertheless but one of the means to be employed in the study of renal diseases. Of themselves they afford practical information, rarely, if ever, conclusive when taken alone.

Without doubt certain renal diseases may exist, and may continue throughout their course either to recovery or death, without the occurrence of casts in the urine. But for all practical purposes it may be accepted that when casts do occur, they indicate the existence of a disease of the kidneys which is possibly incurable, certainly serious. Besides the value of casts in determining the existence of kidney-disease, they are further most important aids in helping to distinguish what variety or stage of disease it may be, and also in making out the actual condition of the kidney, thus furnishing valuable data on which to form a prognosis, and to suggest a plan of treatment.

Little is to be seen, however, from one examination. This should be performed frequently, as in that way alone can the morbid progress in the kidney be recognised.

From what has been said of the nature of casts, it should be expected—as is the case—that several varieties of these bodies occur at the same time in the urine. It is rare for any variety to exist singly, at least for any time. In such cases their significance is ascertained by careful study of coincident circumstances, and especially by a frequent comparison, in order to determine which variety is in excess.

The fact that casts are very abundant in any sample of urine is not in itself of necessity a serious sign. Thus in 'granular kidney'—one of the most serious of all renal affections,—the casts may be, and usually are very few, and require careful looking for; whilst in the convalescence from acute nephritis they may be extremely numerous. In chronic nephritis, however, the number becomes an important element in the consideration.

Blood-casts are diagnostic of hæmorrhage into the tubules, whether that be due to intense arterial hyperæmia or to venous congestion—such as exists in acute Bright's disease from whatever cause—resulting in escape of blood from the vessels.

Pus-casts may indicate the bursting of a renal abscess into the tubes, and coagulation of the escaped pus. Very often, however, the leucocytes which take part in the formation of a pus-cast have another origin, viz. from the renal epithelial cells, being the result of their proliferation in the inflamed state.

Hyaline casts.—The large forms of this variety chiefly occur in chronic nephritis, and are therefore usually a grave sign. Produced in tubules which have been denuded of their epithelium, or in others that have become dilated from contractions in the intertubular substance, they indicate an advanced condition of disease. Exceptions to this do occur, and large hyaline casts may be found in acute and curable cases.

Small hyaline casts are formed in both acute and chronic forms of renal disease. They therefore become valuable as means of diagnosis only in conjunction with other signs, such as the history of the case, the character of the other urinary sediments, &c. They are frequently seen in acute nephritis, particularly in the later stages of the disease, and are then formed in tubes which have not been stripped of their epithelial lining. In simple congestion of the kidney they may be formed, from a coagulation of the fibrin of the effused plasma. When associated with the large variety they usually indicate a chronic and advanced stage, being then found in tubules that have become contracted. These two varieties of hyaline casts are common in the albuminoid kidney, and similar casts have been met with in the tubules in cases of diphtheria.

Granular casts.—The significance of these is very variable. As has been said, the granular casts differ much in nature, and no positive diagnosis can be made upon them alone. They may occur in conjunction with blood-casts where the corpuscles have broken down, and they will then generally indicate a commencing recovery from an acute stage. A similar interpretation may sometimes be put on casts whose granulation is due to fat molecules resulting from the degeneration of inflammatory products. Large, dark, and coarsely granular casts are more particularly noticed in 'granular kidney,' where indeed they may be the only casts found. In such circumstances they become a very serious sign. In the later stages of chronic nephritis the epithelial cells disintegrate and produce granular casts.

Epithelial casts.—These are more especially met with in the earlier stages of nephritis, and their significance much depends on the character of the epithelium cells. They may be very abundant at first; later on, when the hyaline variety appears in the urine, becoming less numerous. The epithelium cells may differ but little from the normal renal epithelium, or they may be fatty and more like leucocytes in appearance.

Fatty casts.—Probably no casts are so general in their occurrence as these. Their presence may be of the gravest import, or they may betoken commencing recovery, and more than any, therefore, must they be considered in connexion with other circumstances. The casts that are found in the later stages of acute nephritis during convalescence are in part fatty. The inflammatory products undergoing this degeneration are those thrown off. Hyaline casts, both large and small, frequently present a few oil-globules on their surface. And in certain forms of chronic nephritis the casts may appear as if made up of oil-globules only. In such case an advanced stage of fatty degeneration of the gland is distinctly indicated, and the persistence of fatty casts is generally taken to signify the same; though such casts have been known to continue in numbers for some weeks, and to be followed by recovery.

Casts in non-albuminous urine.—The existence of renal casts in such urine has been noticed for some time past. If the casts were formed from any of the elements of the blood, their appearance could not be explained; but if, as has been said, these bodies owe their formation to the degeneration of, or of a secretion from, epithelial cells, their occurrence under such circumstances is intelligible. The conclusion that the urine is non-albuminous must not be too readily made; there may be so small an amount as to escape notice with the ordinary rough method of testing, and there may be only a temporary disappearance of the albumin. The casts that are formed in non-albuminous urine are of the hyaline variety.

Those that are frequently found in the urine of persons suffering from icterus from whatever cause, and which are stated by Nothnagel to be in direct proportion to the intensity of the jaundice, are said not to be associated with albumin. The pathology of these casts is not as yet understood.

II. Of the Seminal Tubules.—Dr. Beale has pointed out the occasional existence in urine of casts containing spermatozoa (*see* Fig. 10). The base-substance of their bodies is a viscid tenacious mucus, and they are usually much larger than the casts derived from the uriniferous tubules. They have not been found associated with inflammatory conditions of the testicle, and do not correspond pathologically to the renal casts above described.

III. Of the Gastric Tubules.—In inflammation of the gastric mucous membrane, especially in scarlet fever, a desquamation of the epithelial coat involving the glands has been noticed. The casts of the follicles have been found in the vomit, and more abundantly in the contents of the stomach *post mortem*. Their length is variable, and in width they range from $\frac{1}{500}$th to $\frac{1}{1000}$th of an inch. The base-substance is described as fibrinous, and is covered more or less completely by altered epithelial cells and granular *débris*.

IV. Of the Cutaneous Glands.—In the various skin-affections which are associated with desquamation of the cuticle, casts of varying length, coming from the sweat- and sebaceous glands, are thrown off as part of the general shedding of the epidermis. Such bodies are hollow tubes, and bear no resemblance to the inflammatory casts in nephritis.

B.—CASTS OF HOLLOW VISCERA AND PASSAGES.

From time to time, more or less perfect casts of these organs are met with. The conditions which determine their occurrence are but imperfectly understood; they are in some cases associated with inflammation of the surfaces from which they are thrown off, but in other cases appear to be independent of any such morbid changes.

I. Of the Alimentary Canal.—Inflammation of any part of the canal, from mouth to rectum, has been known to give rise to the detachment of flakes of the superficial epithelium embodied in a very viscid, tenacious mucus. It is in scarlet fever that this condition has been usually seen, where the degeneration of the mucous membrane corresponds to the skin-shedding. Occasionally complete hollow moulds of portions of the intestine are found, and large pieces have been recognised as coming from the stomach (Beale). Similar results may follow croupous and diphtheritic inflammation.

II. Of the Urinary Bladder.—A complete exfoliation of the mucous membrane of the bladder has been occasionally observed in puerperal women. It does not appear to be always the result of inflammation, and though the detachment may be complete, perfect recovery may follow. In structure such bodies consist of epithelial cells in varying stages of degeneration, felted together by mucus and fine granular material. The surface is frequently thickly coated with urinary salts. The conditions giving rise to their formation are quite unknown, though retention of urine is associated with their occurrence.

III. Of the Female Genital Passages.—Casts of the uterus and vagina have been frequently noticed. Occasionally they are thrown off periodically, and may then be accompanied with much pain and hæmorrhage (membranous dysmenorrhœa). Partial casts of the passages have also been found associated with diphtheria. These false membranes may form complete casts of the uterus, leaving only the orifices of the internal os and Fallopian tubes, and appear as shaggy bags, consisting of the epithelial layer of the organ. Sometimes these bodies may be the decidua in an early stage, but they have also been met with in virgins.

IV. Of the Respiratory Passages.—Casts of some portion of the air-tubes are of frequent occurrence, associated with a special form of inflammation, known as croupous or diphtheritic. In such cases the epithelial covering of the mucous membrane comes to be replaced by a layer of material which is derived from the metamorphosed epithelial cells, with a variable amount of coagulated fibrin formed from the effused blood-plasma. Such false membrane appears under the microscope to be made up of interlacing fibres of a clear homogeneous-looking substance, felted together in all directions, and containing in the meshes leucocytes, altered epithelial cells, blood-corpuscles, and a small quantity of serum. The exact method of formation of such a membrane is still a matter of dispute—how far it depends for its occurrence on blood-fibrin, and how far on 'croupous metamorphosis' of the original epithelial cells, such as was described in speaking of the formation of hyaline renal casts. The fibrous material of the membrane, however formed, strongly resists the action of ordinary reagents.

It is easy to understand that the extent to which the materials constituting this membrane infiltrate the deeper layers of the mucous membrane, must vary considerably; yet in the extent of infiltration and consequent adherence, very much depends the distinction, such as it is, between croupous and diphtheritic exudation. In the larynx and trachea, the new material forms more or less complete layers, covering the vocal cords, dipping into the ventricles, and even blocking up the laryngeal cavity completely. By the effusion of serum beneath the membrane, it is loosened and may be expectorated in pieces varying in size from mere shreds up to complete casts.

When this inflammatory product originates in the bronchial tubes, it forms the so-called bronchial polypi, so characteristic of Plastic Bronchitis. It is rare for more than very limited areas of the air-passages to be so affected, but within these areas perfect casts of the entire extent from trachea to alveoli may be obtained. Expectorated as irregular, rolled-up, and twisted masses, they are capable of being shaken out in water into ramifying whitish, or pinky white, moulds of the tubes. They are either hollow and membranous or solid, and in the latter case frequently present indications of being made up of concentric layers. Similar casts of the smallest tubes are found in the expectoration of acute croupous pneumonia. It would seem then that the material formed on the surface of the mucous membrane of the air-passages throughout their whole extent, and which may form more or less perfect casts of their passages, is identical in structure, and probably in method of formation, wherever be its situation, whether limited to the larynx and trachea (croup and diphtheria), or only in the terminal air-tubes (acute croupous pneumonia), or throughout the entire length (plastic bronchitis).

W. H. Allchin.

CATALEPSY (κατάληψις, a seizure).—Definition.—A disease of the nervous system, characterised by attacks of powerlessness, commonly with loss of consciousness, accompanied by a peculiar form of muscular rigidity, in which the limbs remain for a time in the position in which they are placed.

Ætiology.—Catalepsy may occur at all ages between six and sixty years, and in both sexes, but it is incomparably more frequent in the female sex and in early adult life, at or soon after puberty. It is, in the majority of cases, associated with distinct evidence of hysteria: and in other cases, in which no hysterical symptoms have preceded it, the affection may be traced to such exciting causes as give rise to the hysterical paroxysm. Nervous exhaustion is the common predisponent; and emotional disturbance, especially religious excitement, or sudden alarm, and blows on the head and back, are frequent immediate causes. It occasionally occurs in the course of mental affections, especially melancholia, and as an early symptom of epilepsy. In an imperfect form it has appeared to be due, in some cases, to paludal poisoning or to other toxæmic states, as chloroform-narcosis. In a few cases meningitis, and other organic cerebral or spinal diseases, have caused a cataleptoid condition: but these cases are too rare and diverse to allow of any inference from them.

Symptoms.—In some cases headache, giddiness, or hiccough, has preceded the attack. The onset of the special symptoms is usually sudden, commonly with loss of consciousness. The whole or part of the muscular system passes into a state of rigidity. The limbs remain in the position they occupied at the onset, as if petrified. The muscular rigidity is at first considerable, and movement is resisted; but after a short time the limbs can be moved, and then remain in the position in which they may be placed. The resistance to passive movement is peculiar: it is as if the limbs were made of wax, and hence the condition has been termed *flexibilitas cerea*. The rigidity commonly yields slowly to gravitation. The countenance is usually expressionless. The respiratory movements and heart's action are weakened. Substances placed in the back of the mouth are swallowed, but slowly. The state of sensibility varies; in profound conditions of catalepsy it is lost to touch, pain, and electricity, and no reflex movements can be induced even by touching the conjunctiva. In other cases partial sensibility remains, and reflex phenomena may be excited. In rare instances paroxysmal hyperæsthesia is present. Consciousness is frequently lost, but may remain, rarely intact, more often in an obscured condition. The temperature is commonly lowered. The attack may last a few minutes or several hours. Recovery is gradual or sudden; it is common for the patient at first to be unable to speak. Sometimes a strange periodicity may be observed in the occurrence of the paroxysms. In the intervals between the attacks, headache, giddiness, or hysterical manifestations may be present, or the patient may feel and seem perfectly well.

Pathology.—Concerning the nature of the disease there has been much speculation, but little definite knowledge. It may probably be placed between epilepsy and hysteria in the scale of maladies. There is distinct interference with the intellectual processes, and interruption of the connection between the will and the motor centres. The rigidity has been thought by Rosenthal to be reflex, but the abeyance of other reflex symptoms makes it more probable that, as Holm suggests, it is of central origin.

Diagnosis.—Many cases of simple trance have been included under Catalepsy, but it is better to restrict the name to the condition in which the peculiar rigidity exists. Hysteria with tonic spasm has also been erroneously termed catalepsy. The condition is sometimes simulated:

in true catalepsy the rigid limb slowly yields to the influence of gravitation, and more rapidly if a weight be attached to it; in the feigned form the limb and weight are held firm.

PROGNOSIS.—The prognosis is favourable in simple catalepsy, in proportion to the freedom of the intervals from affections of sensibility or motion. In pronounced hysteria and psychical affections the condition is often obstinate, and, by interfering with the due nourishment of the system, may cause grave inanition.

TREATMENT.—During the attack itself little can be done save an attempt, which may be repeated at intervals, to rouse consciousness by external stimulation. The ordinary applications, ammonia to the nostrils, cold douches, &c., often fail. A pinch of snuff will, however, often succeed. Another effectual stimulant is Faradisation. It may be applied to a limb or to the cervical spine. The current should be gentle at first, and gradually increased. Emetics are also useful in cutting short an attack. Injections of tartar emetic into the veins have been used with success by Calvi, but can hardly be recommended. Subcutaneous injection of apomorphia, $\frac{1}{8}$th to $\frac{1}{12}$th of a grain, the writer has found an efficient remedy for similar paroxysmal conditions; with the onset of nausea, about five minutes after the injection, consciousness is regained, and all spasm ceases. In the intervals between the attacks the treatment is that of hysteria. Iron, antispasmodics, especially valerian, alvetic aperients, and cold baths, are the most effectual measures. Firm moral treatment is also indispensable. Removal from home influences is often necessary to effect a cure. W. R. GOWERS.

CATAMENIA, Disorders of. *See* MENSTRUATION, Disorders of.

CATAPLASM (κατὰ, down, and πλάσσω, I mould or smear).—A synonym for a poultice. *See* POULTICE.

CATARACT (καταράκτης, a waterfall).—DEFINITION.—Cataract is an opacity of the lens—the want of transparency being sufficient to prevent, at least in that part of the lens which is opaque and to the extent of the opacity, the discrimination, with the ophthalmoscopic mirror, of the details of the fundus of the eye.

ÆTIOLOGY AND PATHOLOGY.—Cataract is produced in various ways. Any change in the normal relationship of the lens-fibres may cause such a degree of opacity of the lens as is understood by the term cataractous. This is usually a senile change, and it is then a sclerosis of the lens. The question of the normal nutrition of the lens is yet unanswered. If there be a solution of continuity of the capsule of the lens, so that the aqueous humour has access to the lens proper, unless it be in cases of minute punctures and small, clean-cut wounds, which soon heal and scar, the whole lens becomes swollen by endosmosis, grey, and cataractous. A symmetrical change in the lenses, somewhat similar in appearance, is observed in some cases of diabetes, and is occasionally seen in albuminuria. The lens may be found to be ill-developed and cataractous at birth; while others, apparently as a consequence of ill-development, but not during the whole period of growth of the lens, are partly cataractous and partly transparent, and show opaque concentric lamellæ. Besides this instance, showing the anatomical configuration of the lens, cataracts not unfrequently demonstrate its normal trifid division as transparent lines; and the striæ of striated cataracts are always in directions radiating to or from the centre of the lens, in the course of the fibres.

Besides these scleroses, endosmoses, and imperfections of the lens proper, there are many opacities appertaining to this part of the refractive apparatus, which were formerly, and are still commonly called cataract. Among these there are the *capsular cataracts*, which do not imply any real opacity of the capsule of the lens, but only an opacity of that part of the lens which is next to the capsule—the rest remaining transparent—or the deposit of some opaque matter upon the lens-capsule externally. *Pyramidal cataract* is formed by the deposit on the anterior surface of the front of the lens-capsule, at or near its centre, of a patch of lymph, when an ulcer has formed in the cornea, and perforation has occurred, by which the aqueous humour is evacuated, the anterior chamber obliterated, and the lens approximated to the cornea, if it is not brought into actual contact with it. When the aqueous humour is again retained, the mass of lymph is drawn out into the pyramidal form, and if, in any case of pyramidal cataract, there has been no perforating ulcer to evacuate the aqueous humour, it must be remembered that these so-called cataracts only occur in early life, when the anterior chamber is very shallow. There is a large class of cataracts called *secondary*, where the condition is due to an earlier disease of the eye, and in which the latter is of course in the first place to be considered. Such cases are the *glaucomatous*, in which, when excessive intraocular pressure has existed some time, the lens, no doubt by interference with its due nutrition, becomes cataractous; and iridectomy for glaucoma is chiefly indicated, whether or not the lens should require to be extracted subsequently. Other secondary cataracts are those called *posterior-polar*, in which the opacity begins at the centre of the back of the lens and is preceded by some deep-seated disease of the fundus of the eye, which is of greater and certainly of prior importance.

SYMPTOMS.—A patient, having uncomplicated cataract, complains of his vision, if he complains at all, for a small definite opacity is easily disregarded, even if it be in or near the centre of the lens or of the axis of vision. If it occupies a considerable portion of the pupillary area, it can of course be no longer considered small, or be disregarded by the patient. If the cataractous opacity begins in the circumferential parts of the lens, and only there, it may, on the contrary, make very considerable progress before it is found out by the patient. In the majority of the various cases of cataract, the patient sees better with his pupils dilated—he prefers to sit with his back to the light, he holds his hand over his eyes, or he holds his head down and frowns in order to see better—he is cheerful, and is always trying to see. In such cases as these quacks have made profit of the benefit the patient has derived from each visit, when a drop of belladonna or atropine solution has been used for the 'cure' of the malady.

The only complication or ill result of the existence of non-traumatic cataract as such, is in the congenital forms, in which for want of use the retina suffers and nystagmus follows. It is therefore imperative that cataract in infancy should be operated on at an early age.

Diagnosis.—The diagnosis of cataract is, in most cases, easy enough. The position and shape of the crystalline lens being known, an opaque body is seen to exist in its place, or in a part of it. The cataractous opacity varies from milky to chalky white; striæ in it often appear glistening, like newly-dissected tendon; some cataracts are amber-coloured. A drop of liquor atropiæ sulphatis should be used to dilate the pupil; and, this being effected, the opacity behind it cannot be one of the results of a past iritis, which would not leave the pupil free to dilate fully and circularly. The ophthalmoscope should then be used, not only for the diagnosis of a cataract, but also for ascertaining the degree of opacity, and, if not too late, the state of the fundus; and for determining thus the probable future need and success of an operation for its removal. If, notwithstanding an evident opacity in the situation of the lens, otherwise seen, all the details of the fundus viewed with the ophthalmoscope are unobstructedly discernible, it is not a case of true cataract. Senile lenses have, as a rule, an evident diffused opacity which does not imply any beginning of cataract formation. There are generally striæ in the cataractous lens, which converge to the centre from the circumference, or diverge from the centre to the circumference, and if the fundus can be illuminated with the ophthalmoscopic mirror, the opaque parts of the lens appear dark, the reflected light coming from behind them; but, on the other hand, if the ophthalmoscopic convex lens be used to concentrate the lamp-light obliquely on the cataract, the opaque parts appear light, as they reflect the light, and are backed by the fundus which is not thus lit up. Striæ on the posterior surface of the lens are seen to be concave; and, in senile cases, being viewed through a lens having the natural yellow tint of senile lenses, they also appear yellowish. Some cataracts begin as a haziness, chiefly in the centre, the so-called *nucleus*, which is always increasing; and, seen by oblique illumination, there is in these cases, on the side of the light, a shadow of the iris cast on the light-reflecting opacity, and the lens-opacity seems to be most on the side furthest from the light, whichever that may be.

Prognosis.—The prognosis of cataract, in a medical sense, is bad. It is very doubtful if it ever can be at all arrested in its progress, not to say cured or even lessened. In all probability the cataractous opacity is scarcely ever diminished—on the other hand it does not always progress. Very many old persons have cataractous striæ in the marginal part of their lenses, which are of no inconvenience to them, and are only by chance discovered by the surgeon. If the striæ should invade the pupillary area, vision, in one eye at least, will be very likely still sufficient for the requirements of the patient, and the interference of the surgeon will never be called for. As to the prospects of success in operating—uncomplicated cataract, of course, never leads to absolute blindness—the patient sees and evidently observes the light and light-reflecting objects; the field of vision is perfect; the pupil is active; the general health is good; the cataractous opacity is not of the posterior-polar variety, and there are no other complications; all parts of the lens are more or less opaque. Immature cataracts must not be extracted unless neither eye is good for vision, and the progress towards maturity is exceedingly tedious, because the transparent parts of the lens, unseen, are likely to be left behind in the operation, and then to set up inflammation. The dangers from cataract operations are less in childhood than in older persons. In early life any subsequent inflammation threatening the eye can be averted by timely interference with a certainty of success, and an operation should therefore be recommended, although the cataract only affects one eye. In old age if one eye be available for vision, an operation for mature cataract in the other eye is not to be performed unless the patient himself desires it.

Treatment.—Cataracts have seldom, the writer believes, any practical bearing as regards medical treatment. In cases of diabetes and of temporary albuminuria, in which a cataractous condition occurred, the state of the lens has been found to improve with the general health of the patient. In a patient with diabetic cataracts appropriate treatment may remove the opacity of the lenses and restore vision; and the writer has seen senile cataract advance rapidly when the patient has been in any way lowered in general health, and then again advance slowly as before when the health has been restored.

Besides the palliative treatment by atropine drops constantly used (if vision be improved by their use), the capital surgical treatment is the only one available for cataract—the opaque lenses must be removed, and spectacles of different powers must be worn as substitutes for the natural lenses and power of accommodation. Exception must be made in the case of some lamellar cataracts, with a wide transparent margin, in which an iridectomy is sufficient for the restoration of vision. In infancy and youth the best proceeding is the needle-operation, by which, with a fine needle only, entered through the cornea, the anterior capsule of the lens, and the lens itself also to some extent, are broken up, and, by repetitions of the same operation, the whole is exposed to the action of the aqueous humour and thus gradually absorbed, the posterior lens-capsule being left as a barrier to the vitreous humour behind it. It is very safe when atropine drops are constantly used, and the case is continually watched, so that, if too sudden or too great a swelling of lens-matter should at any time occur by the admission of the aqueous humour, and there be a threatening of iritis as a consequence of mechanical pressure on the iris, the swollen lens-matter may be at once evacuated by the introduction of a broad needle through the cornea, and then of a grooved curette or suction-syringe, by which the semifluid mass, or a sufficient quantity of it, may be got rid of. In old age, and generally in adult life, the cataractous lens to be removed should undoubtedly be extracted as a whole and at one time. The needle operations, which in young persons are not completed in any case in less than a few weeks or months, take a longer time to complete in proportion to the age of the patient; in adults the process is much slower, and in old age it would be indefinitely prolonged; more important still, the eyes by age become less and less tolerant of what may be called a foreign body, and more liable to iritis, while the iritis is less easily subdued. Then again the central part or nucleus of the lens especially grows harder as the patient becomes older; and if the patient be too old for the safe adoption of the minor operation, this so-called nucleus would become a much more likely source of irritation, particularly if it floated freely in the aqueous humour, than the swollen soft lens-matter of the juvenile lens when thus operated upon. The so-called hard cataracts of old age must, without doubt, be extracted. A section with a knife is made, of somewhat less than half of the corneal circumference; then, as is usually practised now-a-days, that part of the iris lying beneath the corneal section is excised, for the easier and more safe extrusion of the hard lens; the anterior capsule of the lens is freely lacerated; and, by pressure in the ciliary region opposite to the opening made, the lens is gradually forced out of its capsule and out of the eye, including subsequently all the softer circumferential cortical parts of the cataractous lens. The edges of the corneal wound being rightly in apposition, the eyelids are closed, and both eyes are firmly but lightly bandaged for some days, until at least the corneal wound is healed, so that the aqueous humour is again retained. The cataracts of adults, though they may not be old people, in most cases should also be extracted. But at this age cataracts are not common, except traumatic cataracts, and these, and many other varieties, cannot be briefly described in a general way.

J. F. STREATFEILD.

CATARRH (*κατὰ*, down, and *ῥέω*, I flow). SYNON.: Coryza; *Catarrhus* (Cullen); *Catarrhus Communis* (Good); *Rheuma*; Fr. *Catarrhe, Coryza*; Ger. *Katarrh, Schnupfen.*

DEFINITION.—The term catarrh is applied generally to inflammations of the mucous membranes attended with increased secretion. Thus authors speak of *catarrh of the stomach, intestines, bladder, &c.* In the present article the term is limited to the inflammatory affections of the upper part of the air-passages, resulting from cold, and attended by discharge from the nostrils, soreness of the throat, hoarseness, and cough. The term coryza is, however, more especially limited to the cases in which there is copious discharge from the nasal passages, while catarrh is applied to affections of the whole mucous membrane, including the fauces and larynx.

SYMPTOMS.—The attack generally commences, shortly after exposure to cold or more particularly to cold and damp, with a feeling of indisposition, sense of cold down the back or general chilliness, weight in the forehead, headache, especially frontal, and dryness of the nares and throat. These symptoms are succeeded by the discharge from the nostrils of a thin acrid fluid, watering of the eyes, pains in the face, soreness of the throat and hoarseness, with aching in all parts of the body, and disinclination to bodily and mental exertion.

At first the affection is often confined to one nostril, and there is pain in the corresponding temple, eyebrow, eyeball, and side of the face, and lachrymation on that side, but it soon appears in the other nostril, and involves both eyes and all parts of the face; and there is great sense of weight and pain in the forehead and eye-brows. The discharge, also, loses the thin character and becomes mucous, and is often very profuse; there is copious lachrymation, the throat becomes decidedly sore, the hoarseness is greater, and there is pain in speaking and sometimes almost entire loss of voice. There are also transient pains in the chest, with a sense of tightness and some wheezing. The appetite from the first is impaired, and there may be entire distaste for food, and sometimes sickness and vomiting; not unfrequently there is some sense of weight in the right hypochondrium, and sallowness of the complexion; the bowels are usually confined, but there may be diarrhœa. The tongue is generally white, the pulse may be a little quickened, the skin may be dry, the temperature is raised, and the urine is scanty and somewhat high-coloured and deposits a little sediment. The pains in the head and face especially affect the forehead, the eyebrows, the root of the nose, the eye-balls, and the course of the dental and other nerves; they generally increase towards night, and may be so severe as entirely to prevent sleep. Not unfrequently there is more or less deafness, and usually loss of smell and taste. Herpetic spots often appear about the mouth, and the nostrils may become ulcerated from the discharge; the throat is more or less red and swollen, and often there is stiffness and pain of the neck, and tenderness on pressure over the larynx.

After these symptoms have continued for two or three days they generally gradually subside; but the cough may continue troublesome, and the patient be able to take very little food, and may still feel weak for a week or more. In persons of delicate constitution also, the weakness is often very persistent; and, if care be not taken, more serious inflammation of the bronchial mucous membrane or of the lungs may supervene, and may lapse into phthisis.

TREATMENT.—In the slighter forms of common cold, but little treatment is required except the use of the ordinary household remedies: the feet may be placed in hot water, some warm diluent beverage may be taken, and a light diet must be had recourse to for a day or two. In the more serious cases febrifuge medicines may be given, with an anodyne to relieve the cough, if troublesome, or to procure rest at night, if the neuralgic pains be very severe. When the attack has continued for two or three days a more stimulating diet may be given, and during convalescence tonics and stimulants may be required.

Dr. Ferrier recommends in catarrh the local application to the nose of the following powder in the form of a snuff—Hydrochlorate of morphia 2 grains, subnitrate of bismuth 6 drachms, gum-acacia in powder 2 drachms. From one-quarter to one-half of this may be taken in the course of twenty-four hours.

It not unfrequently happens that in delicate persons a cold is very difficult to get rid of, and the slightest exposure is followed by an aggravation or renewal of the symptoms. When this is the case the most effectual remedy is change of air, and the patient after leaving home often rapidly improves and soon gets well.

Thomas B. Peacock.

CATARRHAL (κατὰ, down, and ῥέω, I flow).—Pertaining to catarrh, both in its pathological and in its clinical signification—*e.g.*, catarrhal products, catarrhal pneumonia, catarrhal fever, catarrhal attack.

CATHARTICS (καθαίρω, I cleanse).—This word is sometimes used as a synonym for purgatives; but in a more limited signification it means purgatives of moderate activity. *See* Purgatives.

CAUSES of Disease. *See* Disease, Causes of.

CAUSTICS (καίω, I burn).—Definition.—Substances or measures which destroy organic tissues with which they may be brought in contact.

Enumeration.—The caustic substances in most common use are Potash, Soda, and Lime; Nitric, Hydrochloric, Sulphuric, and Glacial Acetic Acids; Red Oxide, Acid Nitrate, and Perchloride of Mercury; Carbolic Acid; Chromic Acid; Chloride of Zinc; Chloride of Antimony; and Arsenic. The ordinary caustic measures are the galvano-cautery; the red-hot iron; and moxæ. *See also* Poisons.

Uses.—Caustics are chiefly employed to destroy unhealthy, exuberant, or malignant growths; to establish issues for the purpose of counter-irritation (*see* Counter-irritation); and to destroy poisons when introduced into the body by breach of the external surface.

T. Lauder Brunton.

CAUTERETS, in the French Pyrenees. Sulphur Waters. *See* Mineral Waters.

CAVERNOUS.—A peculiar quality of sounds heard on auscultation of the lungs, indicative of the presence of a cavity. *See* Physical Examination.

CAVITY, Pulmonary.—As the result of certain morbid processes which terminate in the destruction of portions of the pulmonary tissues, abnormal spaces or excavations are frequently formed in the lungs, which are designated *cavities* or *vomicæ*. These are usually associated with, and are by far most important in that large class of cases which are grouped under the term Phthisis. They may, however, originate under other conditions, namely, as the result of abscess or gangrene of the lung; of the destruction of morbid growths or hydatid cysts; of dilatation of the bronchi; or of destruction of the pulmonary tissue from without, in connection with glandular disease, empyæma, and other lesions. The most recent observations on this subject are given in the article Vomica.

Pulmonary cavities present wide variations in different cases as regards their number, size, shape, condition of their walls, amount and nature of their contents, and other particulars. Usually they begin to form in the upper part of one lung, but subsequently they are produced in other parts, frequently both lungs becoming more or less involved, and any portion may be excavated in the first instance. A cavity frequently goes through certain stages, namely, those of formation and extension; of arrest; and of healing or contraction, which may terminate in ultimate closure and obliteration of the vomica. Enlargement of cavities is effected either by progressive implication of their walls, terminating in their disorganisation and removal; or by coalescence of adjacent spaces, the intervening lung-tissue becoming destroyed. During this process of destruction some of the tissues often escape more or less, especially the vessels, which may not uncommonly be seen traversing the spaces or running along their walls, their channel being obliterated. When an excavation is arrested in its progress, it becomes lined by a smooth membrane, and a more or less purulent fluid is secreted within it. This cessation of active mischief may not take place until a whole lobe, or even the greater part of the lung, is involved, a huge cavity being formed, which presents no tendency to contract. In other instances the progress of destruction is stayed, the formation of purulent matter is checked and finally ceases, a fibroid tissue forms, and the space undergoes a process of contraction or cicatrization, which may end in a complete cure, but more commonly merely diminishes the size of the vomica more or less. At a post-mortem examination in cases of phthisis it is common to find numerous cavities in the various conditions and stages indicated above. Occasionally a vomica gives way into the pleura, followed by pneumothorax and its consequences.

Clinically, the existence of cavities in the lungs can only be ascertained positively by physical examination of the chest, and as a rule not only their presence, but their conditions may by this means be determined with tolerable accuracy. The physical signs vary considerably in different cases, and are more conveniently described in other articles. *See* Phthisis; Physical Examination, and Vomica. Frederick T. Roberts.

CELL (*cella*, a closet or store-room).—The term 'cell' was for a long time applied, in anatomy, to various spaces in the body large enough to be recognised with the naked eye. In the *Anatomie Générale* of Bichat, for instance, it was used exclusively for the irregular spaces in areolar tissue (still often called *cellular tissue*). An entirely different sense of the word was introduced from botanical science. The microscope had shown that the structure of plants was largely made up of hollow bodies, called bladders, vesicles, or cells, in which various substances were enclosed or stored up. Schwann was the first to show the similarity in structure of many animal tissues, which were likewise made up of minute parts. These parts were assumed to be, as in plants, hollow; and in both cases, cells were defined as composed of a cell-wall, cell-contents, and a smaller included mass called the nucleus.

This conception of a cell still holds its ground in the anatomy of plants. It did so in animal histology till about the year 1861, when Beale, Brücke, and Max Schultze almost simultaneously showed that many so-called cells in animal tissues did not possess the typical structure of a cell, but were homogeneous masses of a substance resembling the bodies of many lower animals, which substance Schultze distinguished by the name of *protoplasm*. This was first shown to be true of certain special cells, such as the corpuscles of blood and lymph, but afterwards extended more widely, till now it is doubtful whether any minute elements in the higher animals, with the possible exception of the fat-cells when gorged with fat, and certain peculiar forms of cell on the mucous surfaces, come under the old definition of a cell. When the conception was altered, it would probably have been better to have introduced a new name. This, however, was not done, and hence the word cell as now used involves some inconsistency.

By 'cell,' we now understand a mass of contractile, colloid, living matter called *protoplasm*, containing at some period or other a smaller structure called the *nucleus*. It must remain uncertain whether the nucleus is or is not essential to the cell, till we know more about the nature and function of the former; and these points, in spite of the very numerous researches on the nucleus which have lately appeared, must be regarded as still obscure.. Sometimes the superficial portion of the cell-body may become hardened or otherwise altered, so as to form what is called a 'cell-wall,' but this is not to be regarded as a separate structure. In cells destined for special purposes the protoplasm becomes modified. *See* NUCLEUS in APPENDIX.

Protoplasm is a nitrogenous, albuminous, colloid substance, having certain properties called *vital*, that is, the power of altering its form under the influence of stimuli, or, apparently, spontaneously. This power may be lost, under the influence of too powerful stimulation or other causes. Protoplasm does not appear to exist in the higher animals otherwise than in the form of minute masses or cells, but it would be rash to say that it cannot exist in continuous masses, as in certain forms of plants.

Many of the properties of cells are the properties of protoplasm. Those cells which consist of unmodified or undifferentiated protoplasm possess contractility, the power of protruding their substance in the form of processes, of undergoing various changes of form, and even of locomotion. In these respects they resemble very simple animals—*amœbæ*, whose bodies are composed of homogeneous protoplasmic substance, and these movements are hence called *amœboid*, or simply vital. Cells which possess these properties may lose them, or die from excessive heat, cold, removal from the body, or other injurious influences. Hence the amœboid movements are especially characteristic of recently formed or young cells. They are seen in the white cells of the blood, lymph-corpuscles, the round or unfixed cells of connective tissue, the young cells which appear in inflamed parts, fresh pus-cells, and occasionally in the young cells of new growths, but are absent as a rule in cells highly differentiated and serving some special purpose, such as nerve-cells, secreting cells, and the fixed cells of connective tissue. Amœboid cells are sometimes found in tissues to the fixed elements of which they have no relation, and are then to be regarded as emigrant or migratory cells. They are very important in some pathological processes.

Cell-proliferation.—Cells increase in number by fission, and perhaps, as some think, by gemmation and by endogenous development. These processes collectively are called cell-proliferation, which is doubtless the source of many of the new cells found in pathological states. All cells are not equally capable of proliferation, which is chiefly seen in amœboid cells, and in all the elements of connective tissue. This tissue was regarded by Virchow as the *germinal* tissue, from which all others originate, but the balance of opinion is now in favour of a different view, namely, that each kind of tissue, by proliferation, produces only tissue of the same kind. Recent researches show that cell-division takes place in two distinct modes, the direct and the indirect. *See* NUCLEUS. The mode of proliferation in epithelial cells is still imperfectly understood. It was formerly held by Schwann and others, that cells originated spontaneously in a homogeneous blastema; but proof is quite wanting of this mode of origin, and it is in accordance with all experience to believe that new cells are always the descendants of pre-existing cells—a conclusion summarised by Virchow in the words *omnis cellula e cellulâ*. It does not follow that new cells are always descended from the cells of the tissues in which they are found, since they may have emigrated from the blood-vessels.

Shape of cells.—Amœboid cells have, strictly speaking, no fixed shape; but in a state of rest, and when dead, they are nearly spherical. Some cells of similar protoplasmic composition are very irregular in shape, and contain many nuclei, namely, myeloid or giant-cells. Other cells have various shapes, of which the commonest is an elongated form, with a process at each extremity, as in fibre-cells; some, as nerve-cells or fixed connective-tissue cells, are stellate, with several processes. Some cells in certain new growths, especially tubercle, also called giant-cells, have extremely complicated processes.

Wasting and Degeneration of cells.—The actual duration of life in cells is not in all cases precisely known; but in the blood and in large collections of amœboid cells we always find some with signs of decay and death, so that their life is probably measured by days. Epithelial and secreting cells have also a limited duration, while fixed cells of connective tissue and nerve cells are probably more permanent. Cells are also subject to the degenerations which affect tissues generally, especially the fatty, mucous, and colloid. The obvious pathological changes in organs are often due to the minute changes in the cells. Newly-formed cells are more subject to degeneration and decay than the original elements; and this is especially true of cells produced in inflammation. Some pathological processes consist essentially in the rapid production, followed by rapid degeneration, of new cells, for example, scrofulous inflammation.

Cellular Pathology.—This name is given to the system which explains morbid processes by reference to the independent life of cells, their active properties, their proliferation, and their degenerations, while it attaches less importance to derangements of the circulation, or to alterations in the composition of the blood. Its foundations were laid by Remak and Goodsir, but it was first reduced to a comprehensive system by Virchow, not only in his work thus named, but in memoirs published before and since. The cellular pathology explains many facts which were before obscure, and the important steps thus made are not likely to be retraced; but in several points modification of Virchow's views has become necessary. As to the origin of new-growths, it is not now held that all arise or can arise from the connective tissue; and in inflammation it is agreed that the changes of the tissues, however well-established, are only of subordinate importance, as compared with those depending upon the circulation.

J. F. Payne.

CELLULITIS.—Definition.—Cellulitis is the term applied to inflammation of the cellular or loose connective tissue, whether the subcutaneous areolar tissue, or that interposed between muscles and viscera, or surrounding various organs.

The areolar connective tissue is so universally distributed throughout the body that it is necessarily concerned in most inflammations—no matter of what structure—and in it, in fact, the chief changes generally take place.

To consider completely the pathology of inflamed connective tissue would be more or less to review the whole series of the acute diseases. We must limit our consideration to cases in which the cellular tissue is the chief or only tissue involved, or where changes in other parts are secondary to those primarily affecting the cellular tissue.

Beneath the skin, over the whole surface of the body, lies a layer of this tissue, containing within its meshes more or less adipose matter. It will be convenient to consider the changes which occur in it when inflamed, as they are identical with those in cellular tissue elsewhere.

Inflammation of the subcutaneous cellular tissue may be *diffuse* or *circumscribed*. The former is nearly always acute in type, and the latter often, but not invariably, so. A *chronic* form of cellulitis causing thickenings is observed in various regions, or it may be a sequel to the acute disease.

1. Circumscribed Cellulitis.—Ætiology.—Any injury to a part, whether of the nature of a wound or contusion; an impacted foreign body; or a fragment of bone, may cause cellulitis. Pyæmia or septicæmia, any decomposing secretion in a wound, altered blood, or infiltrated urine are prone to produce marked inflammatory changes in the connective tissue in different parts of the body. The poison introduced in a dissection- or *post-mortem* wound often occasions an acute cellular inflammation. Frostbite, burns, inflammation of muscles, arteries, veins, or periosteum may produce inflammation of the adjacent cellular tissue: thus, inflammation of the kidney may cause perinephritis; inflammation of the uterus may lead to pelvic cellulitis; or some mischief in the greater bowel or rectum may produce inflammation and abscess in the loose cellular tissue around them (*Perityphlitis*); the poison also of scarlatina causes cellulitis of the submucous areolar tissue of the throat; and *Angina Ludovici* is the name given to the cellulitis of the floor of the mouth and neck which is often associated with pyæmic symptoms. A *sympathetic bubo* is an irritated lymphatic gland causing inflammation of the cellular tissue around it.

Pathology.—Pathologically, connective tissue is of the greatest importance in the organism, being the most frequent seat of inflammatory and other changes. Areolar tissue mainly consists of loosely interlaced bundles of fibrous tissue, with flattened connective-tissue corpuscles adherent to them, and leucocytes, or amœboid corpuscles, in the intervals. The exact *rôle* played in inflammation by the cellular elements is not quite settled. Under ordinary circumstances the leucocytes doubtless proliferate, and the fixed corpuscles probably do so also. Even under the influence of a slight irritation the flattened corpuscles in a few hours become globular, and present many nuclei in their interior—changes certainly pointing towards proliferation; while the very rapid increase of cells which takes place points to their derivation from cells pre-existing in the part, although the immigration of leucocytes from the blood into the inflamed part adds considerably to their numbers. Whether the perversion of nutrition which forms the starting point of the disease first induces a local cell-proliferation, or an immigration of leucocytes, or what proportion these two processes bear to each other, is difficult to determine.

The disease consists essentially in a very active cell-proliferation and increase. Whether the cellulitis be circumscribed or diffuse, similar changes occur; the difference between them being that in the former there is formed a limiting zone of vascular tissue resembling granulation-material, which is absent when the inflammation is diffuse. There are otherwise no anatomical differences. When cellular tissue inflames, the part swells from the serofibrinous exudation poured out from the distended capillaries; its meshes are filled with young round cells, partly by proliferation of the connective-tissue corpuscles, in part by the accumulation of wandering leucocytes; the circulation is interfered with by the pressure of the effusion, complete stasis sometimes taking place. While the cell-increase is proceeding, the fibrillar intercellular substance gradually disappears, in part by necrosis, and in part by becoming liquefied; and the tissue is finally transformed into pus. When this has happened the deeper layers of the skin disintegrate; it becomes undermined and gradually thinner; necrosis in one or more places follows; and the pus mingled with shreds of dead cellular tissue escapes, the latter resembling nothing so much as soaked washleather. The pus, at first thin and serous, subsequently becomes laudable. There is always a great tendency to suppuration, the vitality of areolar tissue being very low; but resolution sometimes takes place without formation of pus. The cells then develop into fibrous material and the ordinary phenomena of a cicatrix result. The consequences of cicatrisation differ greatly, according to the tissue or organ involved and the extent of the disease; but essentially they are similar everywhere. A gradual contraction sets in. In external parts we can observe atrophic changes taking place, followed sometimes by deformity or loss of function, while in the viscera the condition is known as cirrhosis. The special tissue of an organ or of a muscle cannot be reproduced; it is replaced after an injury by connective-tissue cicatrix. In such tissues as bone, tendon, and nerve, however, the cicatrix will be converted into the normal tissue of the part.

Symptoms.—The amount of fever varies with the extent of the disease and the nature of the cause; when the cellulitis is quite limited there may be little or none, but deep-seated or extensive cellulitis produces considerable constitutional disturbance. Painful swelling of the inflamed part will first be observed; the skin soon becomes tense, red, and œdematous, although at the outset it is sometimes paler than normal. The redness is gradually lost towards the periphery of the swelling, and is darker, or of a bluish-red tint in the centre, from the obstruction to the exit of blood; the swelling is doughy, inelastic to the touch, and pits on pressure. The inflamed region feels hard, the induration ceasing by no well-defined border. If resolution occur all these symptoms subside. A greater or less amount of thickening of the tissue may, however, persist—often for a lengthened period—the parts gradually returning to their normal state. Suppuration is, however, the rule; and when it occurs the pain and tension diminish, fluctuation is felt,—obscure at first,—the pus by degrees approaching the surface, and escaping spontaneously, or by an artificial outlet which may be provided. When the inflammation is more deeply placed, especially when beneath strong fasciæ, there will at first be no perceptible redness or swelling of the skin, or only a slight pinkish hue, with some œdema, to indicate the changes taking place beneath; and fluctuation may be difficult or impossible to make out long after pus has formed; but the pain and fever are more considerable. This variety of the disease may also terminate in resolution—especially when early and appropriate treatment has been adopted; or in suppuration. It may also become chronic, or relapses may take place after temporary amendment. If the cause of irritation be a slight one, but repeatedly renewed, permanent thickenings or atrophic changes in the tissue may result; or the circumscribed may be converted into diffuse cellulitis. A very intense irritant sometimes induces gangrene. The same thing may happen if a previously diseased tissue be attacked, as an anasarcous limb; or pressure, associated with the cellulitis preceding bed-sores, may be sufficient to cause it.

2. Diffuse Cellulitis. Synon.: Diffuse phlegmon; Pseudo-erysipelas; Diphtheria of the cellular tissue. This is a severe disease attended by general symptoms of a marked character, frequently associated with septicæmia, of which it may be both a cause and an effect.

Ætiology.—The most frequent cause of diffuse cellulitis perhaps is some form of septic poisoning. In the extremities the disease may originate from some trifling cause, especially in those whose constitution is impaired by age, privation, or excess; in the hand and forearm of such persons it is especially common after wounds on the finger or an insignificant whitlow. In convalescence from acute febrile diseases, especially typhus or typhoid, a local phlegmon is sometimes transformed into a diffuse cellulitis.

Symptoms.—The local symptoms of diffuse cellulitis resemble those of the circumscribed form, but are more intense, and accompanied by severe constitutional disturbance.

A sudden chill with elevation of temperature often ushers in the attack; the rigor may recur at intervals, but sweating is unusual, and vomiting infrequent. In the affected region the patient experiences a sense of weight and great distension, with severe dragging pain. When the inflammation is deep-seated the redness of the skin may not be well marked, even after a considerable extent of the cellular tissue has sloughed. This character is a very dangerous one, because it leads to the nature of the affection being for a time overlooked and efficient aid postponed. When the skin participates, the redness is darker in hue, less sharply defined, and less easily dispersed by the pressure of the finger than in the cutaneous inflammation of erysipelas, while it soon becomes œdematous. The affected part feels brawny, hard, and swollen throughout, and extremely tender and painful; sleep is impossible; any movement causes great suffering; the fever is often very high; the secretions are diminished; and the appetite is lost. Sweating and rigor presently announce the formation of matter; the swelling becomes less prominent and more soft; the skin is mottled, thin, and yielding in places; and the fever and pain subside. Convalescence may take place on the evacuation of the pus; or the rigor may be renewed, the fever reappear or continue, and the patient sink with symptoms of blood-poisoning. The more deeply the inflammation extends the more tedious is recovery, and the more liable is the patient to relapse; or the muscles, tendons, and adjacent joints may become involved in the suppuration; or perforation of a dangerous character of neighbouring cavities or organs may take place. Suppuration consequent upon diffuse cellular inflammation will sometimes extend up the fore-arm to the elbow, undermine the skin, dissect the muscles, open into the finger- and wrist-joints, cause necrosis of tendons, and terminate in the loss of the limb by amputation, or perhaps in loss of life from septic poisoning; should recovery ensue, the limb is permanently crippled from the matting together of muscles and tendons, the immobilization of the joints, and the adhesions that take place between tissues which should freely glide over one another. Suppuration is the rule, but under favourable circumstances and with early and suitable treatment it may occasionally be prevented. Usually pus has already formed when the case comes under observation, and the surgeon has only to use his bistoury to limit the spread of the disease.

The irregular cavities and sinuses left after the evacuation of the dead tissue often suppurate for a long time, and may thus induce amyloid degeneration of the viscera. The thromboses which form of necessity in the smaller veins implicated in the inflamed area may break down and lead to septic embolism and pyæmia. The risk of this complication is a serious and ever-present one in these cases.

Diagnosis.—Cellulitis has chiefly to be diagnosed from erysipelas. Erysipelas may involve the subcutaneous tissues, and cause inflammation and suppuration of the connective tissue, but it always begins in the skin, which is more extensively affected. Inflammation of the cellular tissue begins beneath the skin, where the swelling and effusion first take place, the skin becoming involved later and usually to a less extent, while it may remain, at least for some time, almost entirely free; the redness, too, is less bright, and more diffused, not presenting the distinct margins of erysipelas, but fading into the surrounding parts.

In the later stages the two diseases are scarcely distinguishable. At first it may be difficult to decide whether the case is one of inflammation of the subcutaneous cellular tissue, of the perimuscular areolar tissue, or of that connected with the periosteum, or around a vein. The greater the general swelling of the limb, the more considerable the fever and the pain, and the less the redness of the skin, the more probable is it that the inflammation affects deeply seated structures.

Prognosis.—The prognosis depends on the extent of the disease and the constitution of the patient.

Treatment.—The local cause should be removed, so far as may be practicable. If the wound be in a foul condition it should be rendered aseptic. Absolute rest to the inflamed part is of great importance. So long as suppuration has not occurred, resolution is possible. Methodical pressure, once advocated, cannot usually be tolerated. Blistering is not employed in the acute form, but may be useful in removing more chronic changes. Cold applications and ice abate pain and inflammation, and limit the disease, even if they do not prevent suppuration. In the more advanced stages, especially when they tend to become chronic, they are useless or even dangerous, from their liability to cause gangrene in debilitated subjects. Local blood-letting does not prevent suppuration, and is usually contra-indicated by the weak state of the patient. When pus forms, or its presence is suspected, a sufficiently free outlet should be provided for it as soon as possible. Nothing so effectually checks the further spread of the disease. The incision should be made at the most prominent point. It is better to make a number of small incisions, from half an inch to an inch in length, than one long one, which is apt to be followed by dangerous bleeding, and does not relieve the strangulated tissues so efficiently. When suppuration is only suspected, incisions should nevertheless be practised without delay, without waiting for fluctuation. Pus and shreds of dead cellular tissue should be frequently washed out of the wound with an irrigator. No force should be used to remove portions of dead tissue: any dragging tends to rupture the small blood-vessels, and to destroy the remaining connexions of the skin with the deeper structures. Antiseptic precautions must be zealously carried out.

When a joint becomes involved, or when the patient is thoroughly exhausted by the quantity of discharge, and the tissues spoiled, amputation is often necessary. Excision may be practised if the condition of the soft parts admits of it.

The general treatment consists in giving nourishing food and stimulants, combined with opiates to relieve pain, and iron, quinine, and other tonic medicines. William MacCormac.

CEPHALALGIA (κεφαλὴ, the head, and ἄλγος, pain).—Pain in the head. *See* Headache.

CEPHALHÆMATOMA (κεφαλὴ, the head; αἷμα, blood; and ὁμὸς, like).—Definition.—An effusion of blood occurring in newly-born infants, forming a tumour upon the head; situated beneath the pericranium, upon the surface of the skull; or more rarely beneath the skull, between it and the dura mater.

Description.—This disease is of very rare occurrence, and must not be confounded with the *caput succedaneum*, which is an effusion of serum external to the pericranium, and is of common occurrence. The blood is generally extravasated immediately beneath the pericranium, over one of the parietal bones, most frequently the right, but it may occur over the frontal or occipital. Combined with this, or arising independently, but of extreme rarity, may be an effusion beneath the cranium. The origin of cephalhæmatoma has been attributed to a variety of causes, but is most probably due to the constriction of the margin of the os uteri during labour. It is generally observed some hours or a day after birth, as a circumscribed swelling, slightly tense and fluctuating: and its peculiarity consists in a bony circle surrounding and limiting it.

Diagnosis.—These tumours have been mistaken for hernia cerebri, but their situation over the bone away from the fontanelles, the absence of pulsation, and the existence of fluctuation in cephalhæmatoma should prevent confusion.

Prognosis.—Generally the blood becomes absorbed, but occasionally suppuration occurs, or the bone may become necrosed; if beneath the skull, serious consequences, including idiocy, may ensue.

Treatment.—As a rule, cephalhæmatoma is not to be interfered with. If suppuration take place the pus must be evacuated.

Clement Godson.

CERATITIS. *See* Keratitis.

CEREBELLUM, Lesions of.—The cerebellum is liable to the same diseases as the brain and nerve-centres generally, such as hæmorrhage, abscess, various forms of degeneration, tumours, &c. The nature of the pathological condition is to be determined by the symptoms peculiar to each, so far as this is possible. Its locality in the cerebellum is to be diagnosticated, first, by certain symptoms which are due to the cerebellar lesion as such, which may be termed the *direct* symptoms; and, secondly, by those symptoms which depend more on the influence exerted by the lesion on neighbouring or subjacent centres and structures. These latter may be termed the *indirect* symptoms.

It is by no means easy to separate these symptoms from each other, and to say how much is due to interference with the functions of the cerebellum, and how much to interference with the functions of other parts. There are few diseases which have a purely local organic or functional limitation. Hence, in order to arrive at the symptoms peculiar to cerebellar lesions, it is necessary to exclude all pathological affections which in their very nature affect the whole of the intracranial centres, *e.g.* tumours, meningitis, &c. The most satisfactory conclusions from a pathological point of view are to be drawn from cases of atrophy or degeneration of the cerebellum, and, from a physiological point of view, from the results of experimental lesions of this organ in the lower animals.

The evidence from these two sources is mutually supporting.

DIRECT SYMPTOMS.—The characteristic symptoms of cerebellar disease are disorders of equilibrium, shown, on attempts at locomotion, in a reeling or staggering gait (titubation), and a continual tendency to stumble or fall over the most trifling obstacle, or on hurried movements. These symptoms may be confounded with locomotor ataxy, but careful observation will show that in cerebellar disorders there is no true ataxy of co-ordination. The movements are quite co-ordinated with each other, and are such as would instinctively be made to prevent falling, or to preserve the equilibrium; and have none of the precipitate, irregular, and sprawling character seen in ataxy. They are not specially intensified on closure of the eyes, which is such a marked feature in ataxy. Nor are they accompanied by any of the sensory affections of ataxy, whether in the form of pains or anæsthesia.

There is no true motor paralysis in cerebellar disease as such, and the various volitional movements of the limbs can be carried out perfectly well in the recumbent posture. Sensation, general and special, is not directly affected in cerebellar disease. Nystagmus and strabismus have been observed, more particularly in connection with lesion of the cerebellar peduncles. Defects of articulation have been noticed, but it is very doubtful whether they should be regarded as direct symptoms.

It is to be noticed that in some cases of slowly progressive degeneration of the cerebellum, the disorders of equilibrium are not observed to any marked extent, an occurrence to be accounted for in all probability by compensatory action on the part of other centres.

INDIRECT SYMPTOMS.—*Pain in the head*, more particularly at the back, though not constantly situated there, is frequently associated with organic disease of the cerebellum.

Vomiting is also very frequently observed, perhaps more constantly than in connection with diseases of other parts of the brain. There is, however, no reason to regard this as due to cerebellar disease as such. It is probably due to indirect effects on the medulla. As a general rule, diseases tending to encroach on the space of the posterior fossa or to increase the pressure on this region, have a similar effect.

Hemiplegia is not uncommon in connection with cerebellar disease, and more particularly in cases of tumour or hæmorrhage into the lateral lobe of the cerebellum. The hemiplegia is on the side opposite the lesion. This does not prove that the hemiplegia is due to the destruction of the cerebellar lobe, or that the cerebellar lobes have cross relations with the limbs. Experimental physiology and anatomical investigations tend to show that the cerebellar lobes are functionally related to the motor tracts on the same side. This is also borne out by the fact that atrophy of the lateral lobe of the cerebellum follows disease and degeneration of the opposite cerebral hemisphere. The hemiplegia from cerebellar disease is, therefore, in all probability, due to compression or some affection of the subjacent motor tracts, which decussate at the pyramids. The fact that it occurs chiefly when the disease is limited to the lateral lobe is what might be expected on anatomical grounds.

Affections of sensation, common and special, have been observed in cases of cerebellar disease. Diminution of tactile sensation on the opposite side of the body, when the disease is situated in the lateral lobe, is to be accounted for in the same way as the motor paralysis. As regards the special senses, affections of sight have been most frequently noted. Sight is certainly not abolished by destruction of the cerebellum in the lower animals, and when blindness occurs in man in connection with diseases of this organ, it is either due to implication of the corpora quadrigemina, functionally or organically, or to secondary degeneration in the optic tracts, as the result of increased intracranial pressure or descending optic neuritis.

A special feature of *tumours* of the cerebellum, more especially of the middle lobe, is a tonic rigidity of the muscles of the back of the neck, with retraction of the head, associated frequently with flexion of the forearms and extension of the lower extremities and pointing of the toes. In these cases also, psychical affections, more particularly mental hebetude or stupor, occur as the result of secondary dropsy of the ventricles, caused by pressure on the veins of Galen. The symptoms then become those of hydrocephalus.

Hæmorrhage into the middle lobe of the cerebellum, in addition to the ordinary symptoms of apoplexy, has been frequently found to cause vascular excitement of the genital organs—in the male marked *priapism*. This symptom, of which several cases were first reported by Serres, led this observer to modify the view of Gall that the cerebellum, as a whole, was related to the sexual instinct, and to regard the middle lobe only as having any such function. The facts, however, are susceptible of a totally different interpretation, and one more in harmony with other data of physiology and pathology. It has been found experimentally by Segalas and by Eckhard that irritation of the posterior surface of the medulla and pons gives rise to vascular excitement of the generative organs, and hence the symptoms in cases of hæmorrhage into the middle lobe are to be ascribed to irritation of this region. This fact also explains the absence of the symptoms when the hæmorrhage occurs into the lateral lobes. There is absolutely no evidence of the slightest value in support of Gall's hypothesis. The facts of clinical medicine go a considerable way in diametrical opposition to it, if they are not themselves sufficient entirely to overthrow it.

Cerebellar Peduncles. — Respecting the effects of disease of the restiform tracts or inferior cerebellar peduncles we have no definite knowledge.

Cases, however, are on record in which lesions have been found involving principally either the superior or middle cerebellar peduncles. The symptoms, in the main, agree with those observed by Magendie on section of the middle peduncle in the lower animals. The chief effect of this lesion was to cause an irresistible tendency to roll over towards the side of lesion. Together with this rotatory disturbance of the equilibrium, a peculiar distortion of the optic axes was observed, the eye on the side of lesion being directed downwards and inwards, the other looking upwards and outwards.

In a case described by Curschmann (*Deutsch. Archiv f. Klin. Med.* xii. 356), along with appearances of basilar meningitis, which somewhat complicate the case, there was found a focus of softening, surrounded by capillary hæmorrhages in the right superior cerebellar peduncle. The symptoms observed in this case were a rotatory distortion to the right side, to which position the patient invariably returned when resistance to this movement was withdrawn. There was no motor paralysis, nor was there any distortion of the optic axes.

A case has been put on record by Nonat (*Comptes Rendus*, 181) of apoplectic extravasation into the right middle peduncle of the cerebellum and right cerebellar hemisphere. In this case the head and trunk were twisted towards the right side, and the ocular symptoms were also present, the eyes being immovable in a position of skew deviation. Other cases are on record in which the cerebellar peduncles have been involved in more extensive lesions; but the symptoms, though not opposed to those above related, are incapable of differential analysis. The special diagnostic symptoms, therefore, of lesion of the cerebellar peduncles are what are frequently termed 'forced movements' (*Zwangsbewegungen*), or distortions of the normal axis of the trunk. The exact direction of the distortion, in consequence of lesion specially limited to one or other peduncle on the right or left side respectively, is somewhat doubtful, though as a rule it has been found towards the side of lesion. Much, however, will depend on whether the lesion is of an irritative or inflammatory, or of a destructive character. A lesion of an irritative nature, though occupying the same position as a destructive lesion, would exactly reverse the direction of the distortion of the head and trunk. D. Ferrier.

CEREBRAL ABSCESS. *See* Brain, Abscess of.

CEREBRAL APOPLEXY. *See* Apoplexy, Cerebral.

CEREBRAL ARTERIES, Diseases of. *See* Brain, Vessels of, Diseases of.

CEREBRAL HÆMORRHAGE. *See* Brain, Hæmorrhage into.

CEREBRITIS.—Inflammation of the brain-substance. *See* Brain, Inflammation of.

CEREBRO-SPINAL FEVER.—Synon.: Epidemic Cerebro-spinal Meningitis; The Black Sickness (popular, Dublin); Fr. *Méningite cérébro-spinale épidémique*; Ger. *Cerebral-typhus; Epidemische-meningitis.*

Definition.—An acute epidemic febrile disease, characterised by sudden invasion, with extreme nervous shock, vomiting, excessive pain referred to the back of the neck and spine, spasmodic contraction of muscles, excessive sensibility of the skin, and frequently delirium; accompanied by purpuric eruptions, either circumscribed, raised, hard, and shotty to the feel, or extensive purpuric spots or patches, frequently accompanied by vesicular eruptions usually of herpetic but sometimes of a pemphigoid character, and frequently purulent inflammation of the eyes. *Post mortem* there are found: inflammation of the membranes of the brain and spinal cord, especially of the arachnoid, with deposit of white, yellow or greenish-yellow lymph upon the surface of the arachnoid, especially at the base of the brain and anterior portion of the medulla oblongata and spinal cord, and effusion of serum into the ventricles and sub-arachnoid spaces.

Ætiology.—*Age.*—The disease usually attacks those approaching the age of puberty or in early adult life; it is seldom met with after thirty-five years, and is very rare after the age of forty. It is not unfrequent in young children.

Sex.—It is much more frequent in males than females; robust males between the ages of fifteen and thirty are its favourite victims.

Occupation.—It seems specially to attack young recruits in the army, as was the case in the French epidemics. In Dublin it was specially severe among the recruits of the Royal Irish Constabulary stationed in the police barracks in the Phœnix Park. There does not seem to be any other occupation which predisposes to the disease. Excessive fatigue seems to predispose to the disease; it has arisen after a hard day's hunting, foot-racing, long walks, dancing, or in children exhausted from out-door play.

Season and Climate.—It is widely distributed in the temperate zone. It prevails more in cold than in hot weather; in Iceland it has usually prevailed in winter and early spring.

General Sanitary Conditions.—It seems to be less influenced than any other epidemic affection by general sanitary conditions.

Communicability.—It is generally believed not to be contagious; a few doubtful cases of contagion have been recorded; except, however, in cases where it has appeared as an epidemic among recruits, there are few instances of more than one case arising in any particular house or circumscribed locality.

Epidemic Influence.—The disease is undoubtedly epidemic.

Unwholesome Food.—It has been suggested that the disease owes its origin to the use of breadstuffs made from diseased grain.

ANATOMICAL CHARACTERS.—Cadaveric rigidity is well marked; large purpuric patches form after death even in cases where there were no purpuric symptoms during life; in some cases the whole body has turned black. On incision a large quantity of dark, tarry-looking blood exudes; the muscles are darker than usual, and in prolonged cases much weakened and wasted There is increased vascularity of the scalp; the cerebral sinuses are much distended with dark blood; serum is found in the sub-arachnoid spaces and ventricles; all the membranes of the brain may be more or less congested, the arachnoid being always extremely vascular and opaque from deposits of lymph—this opacity varies from slight milkiness to thick and dense deposits. The most marked intracranial lesion is the white-yellowish or yellowish-green 'fibrino-purulent' deposit found at the base of the brain. This deposit varies somewhat with the duration of the disease: in cases which die early the deposit is usually slight, whitish, and soft; in those which live for a week or so the deposit is yellowish or greenish; in prolonged cases the deposit is more white and pure, the effused serum greater in quantity, and the vascular fulness less. The origins of the nerves seem to be buried in and compressed by the deposit. The brain-substance itself is more vascular than normal, but not otherwise altered. In the *spinal cord* the lesions are similar to those found in the brain and its membranes. In some cases purulent infiltration of the eyeball and effusion into the joints have been met with. The lungs, liver, and spleen have been found much congested in many cases.

SYMPTOMS.—The patient is usually attacked suddenly when in apparently vigorous health by faintness, vomiting of greenish matter, and intense pain referred especially to the back of the head and neck; the extremities become cold; the patient becomes insensible and sometimes convulsed; the limbs become rigid. On recovering from the collapse, the patient complains of great pain in the head, back of neck, and along the spine; the head is drawn back, so as to be almost at a right angle with the spine; the whole back is sometimes arched, as in tetanus, the muscles become rigid, and the skin excessively sensitive; neuralgic pains are also complained of in all parts of the body. In most of the severe cases eruptions appear within the first twenty-four hours; the eruption usually appears first on the legs, and is frequently confined to the lower extremities; the spots are usually black, raised, about a line in breadth, and feel like a grain of shot under the skin; sometimes these raised spots are surrounded by a dark purplish areola; in most cases large purpuric patches of many inches in extent form on various parts and, sometimes coalescing, cover the entire body. Vesicular eruptions are also common; these usually have the character of herpes zoster, and are most frequent on the face, neck, and shoulders. The herpetic eruptions are met with as frequently in mild as in severe cases. Pemphigus sometimes appears in the advanced stages of the disease. When reaction sets in, the temperature is found to have risen to from 100° to 103° or 104° Fahr. In many cases the temperature never rises, and the patient dies in the collapse; the respiration becomes of a sighing character; the pulse rises to about 120, and has a peculiar jerking character, giving a sharp upstroke to a sphygmographic tracing. The foregoing symptoms are very variable; any one, or even a considerable number of them, may be absent throughout the whole course of the case.

COMPLICATIONS AND SEQUELÆ.—Complications connected with the nervous system are the most common; paralysis of one or more limbs is common, of a hemiplegic character, and most frequently attacking the arm; deafness is not very common, but has been met with in several cases, and sometimes becomes permanent. The eye-complications are among the most frequent and most serious. The eye is frequently attacked with a low form of inflammation, terminating in purulent infiltration of the whole or part of the organ; the cornea is more frequently attacked than any other portion; and this sometimes giving way, the whole contents of the globe escape, causing permanent loss of sight. The sight is also often permanently impaired by iritis, or opacity of the cornea. In many cases, however, the inflammation completely subsides. It is remarkable that it is the right eye which is usually attacked, seldom that both eyes are affected, and scarcely ever the left eye alone. Acute inflammation of the larger joints is a frequent complication in some epidemics; this often terminates in purulent effusion into the joints. Hæmorrhages are frequent in the more malignant forms, and are almost always present in cases where the purpuric blotches are of large extent: these hæmorrhages have occurred from the nose, uterus, bowels, kidneys, and ears in about the foregoing order of frequency. Gangrene is occasionally met with, and the cases in which it occurs are usually fatal. In some cases toes have been lost and the patient recovered; the purpuric patches have also sloughed without serious danger to the patient's life.

DIAGNOSIS.—The disease is liable to be confounded with typhus fever on account of the petechial rash, but is distinguished from typhus by the rash appearing suddenly without any previous mottling of the skin. The nervous symptoms also distinguish it from typhus, although in a case of typhus complicated with cerebrospinal meningitis the diagnosis is extremely difficult, and may be impossible. It is distinguished from *purpura hæmorrhagica* by the intensity of the fever and the localised nervous symptoms. The malignant cases are more likely to be mistaken for malignant scarlatina than for any other disease, and must be distinguished therefrom by the rash, sore throat, and nervous affections. In some cases it has been indistinguishable from malignant scarlatina, especially where death occurred within twenty-four hours, and both diseases were epidemic at the time.

PROGNOSIS, DURATION, TERMINATION, AND MORTALITY.—The prognosis, duration, etc., of the disease depend much upon the form the affection assumes, and for convenience we may divide the disease into the following forms:—

1st. Cases of a very mild form, terminating in recovery; the duration being usually from one to three weeks.

2nd. Cases of a very severe form, setting in suddenly; the symptoms being very violent and well marked, accompanied by purpuric spots and blotches, with a tendency to hæmorrhages, with deep collapse and coma; usually terminating fatally in from a few hours to three days.

3rd. Cases of medium severity, where all the nervous symptoms set in with less suddenness than in the second class of cases, purpuric blotches not being usually present, and no hæmorrhages. These usually yield to treatment, and terminate in recovery in from two to six weeks.

4th. Cases which set-in either in a mild or in a severe form, but in which on the subsidence of the fever the strength does not return, convalescence is retarded or ceases altogether, and the patient falls into a general atrophic condition, and usually dies in from three to six months of marasmus.

By deciding to which of the above classes the case belongs, the prognosis will be to a great extent determined. The chief indication of danger is the early appearance of purpuric and hæmorrhagic conditions.

The mortality in cerebro-spinal fever is very high—probably on an average about 60 per cent. In some of the American epidemics it is placed as high as 75 per cent. Among the Irish constabulary it reached 80 per cent. Like other epidemic diseases the mortality is highest at the commencement of the epidemic. It is most fatal about the age of twenty, and less so under fifteen years.

TREATMENT.—The treatment in the early stage must be directed to recovering the patient from the collapse. This is best done by the application of heat, the administration of small quantities of stimulants or stimulating enemata, and the application of sinapisms over chest and back. In the next stage of the disease attention must be almost altogether directed to allaying the spinal irritation, and promoting the absorption of the effused matters. The extreme irritation will be best diminished by the use of belladonna and bromide of potassium. The pain, which is extreme, will yield best to frequent and considerable doses of opium; indeed many physicians rely altogether on opium as the curative agent. With a view of promoting absorption of the effused matters, mercury and iodide of potassium have been chiefly relied upon. In the more sthenic cases calomel may be employed with benefit in small and repeated doses. The disease being usually of an asthenic type, mercury will seldom be well borne, and iodide of potassium should be preferred. Leeches applied to the back of the neck, behind the ears, or to the temples, produce great relief of the excessive pain in the head and upper part of the spine. The application of ice to the head and spine temporarily allays pain, but there is little evidence of permanent benefit being derived therefrom. In prolonged cases blisters applied along the spine have been favourably spoken of. The local complications must be treated as they arise, and according to general principles applicable in each case. Stimulants are required in considerable quantity in a very large number of the cases which present adynamic symptoms.

T. W. GRIMSHAW.

CHALAZION (χάλαζα, hail).—A small encysted tumour of the eyelids, colourless and transparent, and resembling a hailstone.

CHALK-STONES.—This name is applied to the deposits which are formed in connexion with the gouty diathesis, especially in the joints. They are thus denominated from their appearance and physical characters, in which they more or less resemble chalk; but in their chemical composition they are entirely different, consisting mainly of urate of soda. *See* GOUT.

CHALYBEATE WATERS (*chalybs*, steel).—Mineral waters which contain iron. *See* MINERAL WATERS.

CHANCRE (Fr. *chancre*).—Hard chancre is the initial manifestation of syphilis. *See* SYPHILIS. Soft chancre, *see* VENEREAL DISEASE.

CHANGE OF LIFE.—SYNON.: Climacteric epoch; Sexual involution; Fr. *Ménopause*. Ger. *Menstruationsende*.

DEFINITION.—The time of life in a woman when the functions of the uterus and ovaries cease, menstruation terminating,—a period when disease of these organs is especially prone to occur, and when various constitutional disturbances are almost certain to arise.

ANATOMICAL CHARACTERS.—Great changes occur in the sexual organs—the ovaries lose their smooth outline, and after a while become shrivelled up, occasionally only a trace of them remaining; the Fallopian tubes diminish in size, and sometimes become obliterated; the walls of the uterus atrophy, its cavity becomes much smaller, and the cervix disappears altogether.

SYMPTOMS.—The term 'change of life' is used among women very widely to signify everything which affects them at this critical time. It is so rare for the transition from activity to inactivity to take place without some disturbance locally, or constitutionally, that women are apt to neglect seeking advice for symptoms which should demand careful treatment, believing as they do that it is natural to suffer in such ways at 'the change.' There is no fixed period for the climacteric epoch, though roughly it may be said to occur between the ages of forty-five and fifty. Certain causes are apt to determine the time—amongst these are parturition and lactation, febrile attacks, such as typhus or acute rheumatism, profuse hæmorrhages, fright, &c.

The symptoms vary much. In some women the change is abrupt, menstruation ceasing all at once after perfect regularity; in others, and more frequently, the change is prolonged, the catamenia being irregular for many months, and varying as to periodicity and quantity. Frequently, after a long interval, a profuse flow with clots occurs, and this is very often attributed to a miscarriage. This loss is frequently beneficial, and if it do not take place, or relief be derived from vicarious discharges, such as bleedings from hæmorrhoids, the excess of blood gives rise to headaches, flushes, vertigo, and a host of other unpleasant symptoms. The balance between the nervous and circulatory systems is upset; irritability of temper, hypersensitiveness and all sorts of fancies arise, or depression sometimes amounting to melancholia ensues. If germs of disease exist, the uterus is especially prone at such time to develop them, so that carcinoma, fibroid disease, and polypus frequently present their first symptoms at this epoch. The importance, therefore, of an early examination cannot be too forcibly dwelt on, or the mischief of delay from considering the abnormal condition as typical of 'the change of life,' as a natural consequence, which will therefore right itself. At these times pruritus of the vulva, vascular growths at the orifice of the urethra, and cutaneous eruptions are especially likely to occur. There is a tendency to grow fat, and become coarse; frequently hairs appear on the face. The breasts often become very large and pendulous, and this with the increase in the size of the abdomen from flatus, and the deposition of fat in its walls, together with the cessation of menstruation, not infrequently gives rise to the supposition of pregnancy. To this imaginary state the term *Pseudocyesis* has been applied, and it is often almost impossible to set aside the opinion of the woman regarding her supposed condition. The headaches, neuralgia, loss of memory and nervous symptoms appear to be due to disturbance in the ganglionic system of nerves, with which the uterus and ovaries are largely supplied. If insanity arise the most common form it assumes is hypochondriasis or melancholia.

Treatment.—This must be directed to regulating the secretions. Generally constipation, previously troublesome, becomes aggravated; and portal congestion frequently occurs. Saline purgatives are especially beneficial, and these may be judiciously administered in the form of mineral waters, such as the Hunyadi János, or Friedrichshall. Blue pill with aloes is often very useful. The headaches and reflex nervous symptoms may be best combated by the administration of bromide of potassium, and this drug appears to act as a direct sedative to the sexual organs, besides diminishing the amount of blood determined to them. Occasionally, bleeding from the arm or cupping gives great relief. Attention must above all be paid to the diet. It should be plain and unstimulating; beer and spirits should be prohibited, and only light wines, if any, allowed. Tepid baths are useful. Late hours, heated rooms, and excitement of all kinds should be avoided. If local troubles arise, they must be treated according to their indications; as a rule, abstracting blood from the uterus does harm, but leeches to the anus are sometimes beneficial. It is clearly impossible to map out any empirical line of treatment for a condition in which the symptoms are so variable. Clement Godson.

CHAPPED NIPPLES. *See* Breast, Diseases of; and Nipple, Diseases of.

CHAPS.—Synon.: Rhagades.—Cracks or fissures of the skin occur where the integument has become hardened by infiltration, as in the erythema of the hands and wrists of cold weather, in chronic eczema, psoriasis and lepra vulgaris. The *treatment* for chaps consists in protection from the atmosphere; careful drying after the hands have been washed or wetted; and the use of zinc ointment and glycerine soap. Diluted glycerine, vaseline, and cold cream are also popular remedies. Erasmus Wilson.

CHELOID (χηλή, a claw).—Synon.: Cheloides, Cheloma; Fr. *Dartre de la graisse*; Ger. *Keloid.*

Definition.—A tumour of the skin resulting from over-growth of connective tissue within the corium.

Ætiology.—Cheloma may be idiopathic or accidental, and in both cases it is referrible to a diathesis. When of accidental origin it is commonly associated with a cicatrix, and is then developed in the midst of the cicatrix-tissue. This form of the tumour has been denominated *cheloides spuria* or *traumatica*, and, as such, has been seen scattered numerously over the chest and shoulders as a sequel of acne.

The cause of cheloma must be sought for in that vital source from which is derived aberration of nutrition in general. It is a consequence of feeble controlling power, and may be resident in the skin alone, or be dependent on a want of vigour of the constitution of the individual.

The traumatic cheloid may follow a light as well as a severe injury of the skin, such as a boil, a blister, a leech-bite, or even the irritation of a stimulating liniment; it is sometimes met with in the scars of strumous abscesses or ulcers, but is most common in the cicatrices of burns or scalds.

Anatomical Characters.—At its first development cheloma occupies the fibrous portion of the corium. As it increases in bulk it pushes the vascular layer outwards and stretches the corpus papillare, obliterating the capillary network, more or less completely. In its aggregate form when it presents itself as a flat plate, raised for a quarter of an inch above the level of the adjoining skin and sinking to a similar extent into the corium, it has the appearance of being tied down by strong cords or roots at either end, and frequently overlaps the healthy skin along its borders. In this state it is seen to be composed of strong fibrous bands closely interlaced with each other and enveloped by a smooth transparent pinkish layer, in which may be detected a scanty vascular plexus converging to venules which sink between the meshes of the fibrous structure.

Around the circumference of one of these larger flattened tumours, such as is commonly met with on the sternum, and measuring several inches in diameter, there will generally be observed a few scattered knots. These are developed in the fibrous sheath of the arteries at a short distance from the mass, and, being thus linked to the central growth, are subsequently drawn into the focus of the tumour. And the development of the so-called roots is explained by the propagation of the proliferating process by the coats and sheaths of the blood-vessels communicating with the central tumour.

Description.—Cheloid has received its name from its habit of throwing out spurs from its circumference, these spurs having been compared to crab's claws. It originates in a round, oval, or oblong tubercle or knot in the skin, and this may be followed by a second in its immediate neighbourhood, or sometimes by a cluster of three or four. When two of these knots are situated at a short distance apart they are apt to become connected by a cord of the same structure as themselves, and to give rise to what has been called a *cylindrical*, *club-shaped*, or *dumb-bell* cheloid. When three or four knots are grouped near together they are disposed to become blended by growth and produce an oval or square-shaped cheloid; and when the growth extends from these latter into the surrounding integument the appearance denominated *radiciformis* is established. Cheloma being due to a tendency to overgrowth or hyperplasia of connective tissue within the skin, it may appear on several parts of the integument at the same time, one of the most common seats of its development being the sternum, which it generally crosses transversely. It is often solitary; is more commonly composed of five or six tumours, discrete or confluent; but has been met with occasionally to the number of fifty or sixty tubercles or more.

Course and Prognosis.—Cheloid rarely gives rise to much inconvenience or attains any considerable magnitude, and when left to itself progresses very slowly or remains stationary for a number of years or for life; and we have known it to disappear spontaneously. Its subjective symptoms are of no great severity, being limited to itching, tingling, and smarting, and more or less uneasiness in moving the limbs, or from pressure when sitting or lying in bed. It has no tendency to desquamation or ulceration.

Treatment.—Being dependent on a diathesis, surgical manipulation has generally proved unavailing in cheloma. It might be expected to recur in the cicatrix of a wound made for its removal, or in the scars of a suture employed to hold the cut edges together, and such has proved to be the case. The most successful treatment consists in covering up the tumour with a mercurial or iodine plaster, or even with simple emplastrum plumbi. The writer's favourite treatment is to paint it with a spirituous solution of soap and iodide of potassium, and then cover it with an adhesive plaster spread on washleather, repeating the application as often as the plaster becomes loosened. We have seen a multiple cheloma cured in this way; aided by mild doses of the perchloride of mercury. The combination of warmth and moisture, such as is produced by a plaster, is an important element in the cure. But irritants, caustics, and the knife are all equally objectionable and valueless.

Erasmus Wilson.

CHELTENHAM, in Gloucestershire. Common salt waters. *See* Mineral Waters.

CHEMOSIS (χήμη, a hole).—A swollen condition of the conjunctiva, caused by effusion into its tissue around the cornea, which thus appears as if placed in a hole or hollow. *See* Eye and its Appendages, Diseases of.

CHEST, Diseases of the.—Following the plan adopted in the general article on the Abdomen, it is proposed in the first place to give an outline of the diseases of the chest; and then to indicate the principal points bearing on their clinical investigation.

General Summary.—The diseases of the thorax and its contents may be conveniently divided into certain groups, namely:—

I. Diseases of the chest-walls, or extending inwards from these walls.

II. Diseases of the respiratory apparatus contained within the thorax, namely:—1. Pleuræ. 2. Trachea. 3. Main Bronchi. 4. Lungs.

III. Diseases connected with the circulatory system, including:—1. Pericardium. 2. Heart. 3. Great vessels within the chest, both arteries and veins.

IV. Diseases originating in the mediastinal cellular tissue.

V. Diseases of the absorbent vessels or glands within the chest; of the thoracic duct; and of the thymus gland or its remains.

VI. Diseases of the œsophagus.

VII. Diseases of either of the important nerves traversing the chest.

VIII. Diseases of the diaphragm.

IX. Diseases encroaching upon the chest from the abdomen or from the neck.

The particular diseases comprehended within most of the groups just enumerated are very numerous, and they will be described under their respective articles. Affections connected with the chest constitute a large proportion of the cases which come under observation in practice. This will be readily understood when we remember that the thorax encloses organs essential to life, which are never at rest, and which are constantly more or less exposed to influences liable to injure them. They may be mere *functional disorders*, and to these the heart is especially prone; but serious *organic diseases* are also exceedingly common, and rank very high as causes of death. Moreover, they may either come under the category of *local* affections, though even then they frequently depend upon some cause acting through the general system, such as exposure to cold or wet; or they arise in the course of some *general* malady. For instance, pulmonary complications are of common occurrence in connexion with fevers and various other diseases; the heart is implicated in a large proportion of cases of rheumatic fever; and malignant disease is not infrequently manifested by a local development of cancer in connexion with certain of the thoracic contents. The structures within the chest have an important mutual influence upon each other; and they may also be affected, either directly or indirectly, by local diseases involving other parts of the body, such as the abdomen or the central nervous system.

Clinical Investigation.—It may be confidently affirmed, that the means which we now possess for investigating diseases connected with the chest are so adequate and precise, that any one possessing the requisite knowledge and skill, and who carries out the clinical examination properly, can, in the very large majority of cases, arrive at a diagnosis with certainty and accuracy. At the same time it must be remembered that every complaint referred to this region, however trivial it may appear to be, does require systematic and thorough investigation, otherwise very serious mistakes are constantly liable to be made. Of course, cases also do come under observation occasionally which are obscure, and which may call for repeated examination before a correct diagnosis can be formed; and exceptional instances occur in which no satisfactory conclusion can be arrived at. The previous general history of the patient, the hereditary history, and the account of the origin and progress of the illness, often afford signal aid in the investigation of chest-affections, and ought never to be overlooked. The symptoms to which these affections give rise are necessarily various. Pain or other morbid sensations are very commonly complained of, but only in a comparatively few instances are these at all significant, and they can never be positively relied upon in making a diagnosis, while they are often absent in diseases of the most serious character. The important organs, namely, the lungs and heart, usually present more or less disturbance of their functions when they are affected, but grave diseases may exist without any such disturbance. The different structures within the chest have a mutual influence upon each other, and thus other symptoms besides those connected with the structure actually diseased may be apparent. For instance, the lungs and heart are thus very intimately associated; while aneurisms or growths often disturb these organs seriously, or interfere with the air-tubes, nerves, veins, and other structures. In consequence of more or less interference with the circulation, various symptoms in parts remote from the chest are frequently originated; and distant organs may become the seat of organic lesions as the result of long-continued mechanical congestion, a new train of symptoms being thus set up. The general system may be in this manner affected; whilst pyrexia, wasting, and other general symptoms are often associated with chest-diseases. Lastly, morbid conditions within the thorax may directly affect the abdominal organs; or may make their way through the diaphragm into the abdominal cavity.

Physical Examination constitutes an essential and most important part of the clinical investigation of the chest and its contents. Indeed, without this examination no certain and exact diagnosis can ever be made. This subject is fully discussed in other appropriate articles, and here it need only be mentioned that the methods of examination which are usually required, and which should in every case be practised, are:—1. *Inspection.* 2. *Palpation.* 3. *Percussion.* 4. *Auscultation.* Other modes which may be called for include:—5. *Measurement* (not uncommonly). 6. *Succussion.* 7. The use of *special instruments*, directed to the investigation of particular organs, such as the spirometer, cardiograph, sphygmograph, aspirateur, œsophageal bougie, &c. *See* PHYSICAL EXAMINATION, and Diseases of the several organs. FREDERICK T. ROBERTS.

CHEST, Examination of. *See* PHYSICAL EXAMINATION.

CHEST-WALLS, Morbid Conditions of.—The walls of the chest may be the seat of various morbid conditions, and the affections of this portion of the framework of the body demand more attention than they are accustomed to receive. All that can be done within the limits of this article is to indicate their nature; to notice briefly such of them as are not described in other parts of this volume; and to point out the principles of treatment. They may be considered according to the following arrangement:—

1. **Superficial Affections.**—Under this group may be included morbid conditions of the skin and subcutaneous tissues. *a.* Cutaneous eruptions are of common occurrence over the chest. Among these may be specially mentioned the eruptions of the exanthemata, herpes zoster, and chloasma. *b.* The superficial vessels are liable to become enlarged under certain circumstances. This enlargement is usually seen in the veins over the front of the thorax, which may be distended on both sides, or only on one side, or in some particular region. The larger divisions may alone appear to be involved; or a more or less extensive network of smaller veins may be visible, and occasionally even the capillaries seem to be implicated. This condition generally arises from some obstruction interfering with the circulation through one or other of the principal veins which, either directly or indirectly, receive the blood from the veins of the thoracic wall. Thus the superior vena cava, or either innominate, subclavian, or axillary may be implicated, being, for example, pressed upon by new growths or enlarged glands, the distribution and extent of the venous distension varying accordingly. Occasionally one of the smaller veins is thus interfered with. The writer has met with cases in which considerable enlargement of the veins was visible over portions of the thorax, where the cause was by no means evident, the patients asserting that this condition had existed ever since they could remember, and being regarded by them as perfectly normal. Probably it has resulted from some local obstruction occurring during early life. It must be remembered that women who are suckling frequently present great enlargement of the superficial veins over the front of the chest, which usually subsides when the period of lactation is at an end. Again, more or less venous and capillary engorgement in this region may occasionally be observed in cases of cardiac or pulmonary disease, where the general circulation is much impeded, and due äeration of the blood is interfered with. Sometimes a ring of enlarged veins and capillaries is seen around the lower part of the chest. When the venous distension is due to obstruction of the vena cava superior, the skin may present a more or less marked cyanotic tint, and in cases of general cyanosis, the chest, in common with other parts, has a cyanotic appearance. Occasionally one or other of the small arteries which supply the thoracic walls is enlarged, and it may attain a considerable size. *c.* Subcutaneous œdema is sometimes observed over the chest. In most instances this is a local condition, being the result of venous obstruction; but it may be a part of general dropsy, particularly in connexion with renal disease. This morbid state is evident on inspection or to the touch, and the affected part pits on pressure. *d.* The subcutaneous tissue of the thorax is also liable to become the seat of

so-called emphysema, as the result of perforation or rupture of the lung and pleura, with the consequent escape of air into the cellular tissue under the skin, where it accumulates, and travels to a greater or less extent over the body. The lung may also give way into the mediastinum, the air which escapes subsequently making its way from this part into the subcutaneous tissue. This condition is generally due to direct injury, especially from fractured ribs, but it may also arise, in exceptional instances, from other causes, such as violent cough, powerful expiratory efforts, as in parturition, pulmonary disease—for instance, the giving way of a cavity in the lung—or in connexion with empyæma. Subcutaneous emphysema is attended with evident swelling of the part, which may be very great, all the normal anatomical outlines being obliterated; the peculiar sensation accompanying this condition is readily elicited on palpation and percussion; the percussion sound is tympanitic; and on auscultation a superficial crackling sound is heard. *e.* As belonging to the superficial affections connected with the chest may be just mentioned diseases of the mammary gland or nipple, which of course constitute a most important class of diseases in females (*see* BREAST, Diseases of).

2. **Muscular and Tendinous Affections.**—*a.* The muscles of the chest or their tendinous attachments may be the seat of certain painful affections. These are of the nature of so-called muscular rheumatism or myalgia, of inflammation, or of more or less injury or strain; being induced by cold, constitutional conditions such as gout, overwork, straining, violent coughing, fatigue from prolonged sitting, and other causes. The painful condition is usually localized, but different muscles are involved in different cases, sometimes those which are superficial being affected, in others the deeper muscles including the intercostals; or the complaint may be confined to a single muscle. Pleurodynia, dorsodynia, and scapulodynia are the terms applied to muscular rheumatism affecting the side of the chest, the upper part of the back, and the scapular regions respectively. As the result of severe coughing, muscular pains are very common around the lower part of the chest. The pain is usually more or less aching in character, and not severe, but it may be very intense, especially in acute cases. Whatever brings the affected muscles into play aggravates the suffering, such as moving the arms or shoulders when the superficial muscles are affected, coughing, sneezing, and similar actions. In some instances the pain is not felt when the affected structures are kept quite at rest. There may be local tenderness on pressure, or diffused pressure may give relief; while posture often influences the sensations experienced, such as whether the patient assumes the recumbent or sitting posture, or lies on one or other side. Fatigue generally increases the pain. Muscular affections connected with the chest are not necessarily accompanied with any other local symptoms; and physical examination reveals nothing, except that perhaps the act of breathing is voluntarily restrained, on account of the pain thus induced. *b.* The muscles of the chest may be affected, on the one hand, with spasm or cramp; on the other, with paralysis. The former is attended with more or less pain, which may be very severe; the latter is indicated by loss of power in the muscles involved. These disorders generally depend on some lesion of the central nervous system, but may result from local nerve-disease. In cases of hemiplegia from cerebral mischief, the muscles of the thorax on the affected side are often temporarily weakened, but they usually subsequently regain their power. When the upper part of the spinal cord is injured or diseased at a certain point, all the muscles of the chest become paralysed, which is a very serious matter, as respiration and the acts connected therewith cannot be carried on, except by the diaphragm, and consequently the blood is imperfectly aërated, secretions accumulate in the lungs, and the patient dies from suffocation. *c.* Atrophy or degeneration may involve the thoracic muscles. In cases of pulmonary phthisis either the whole of these muscles or certain of them are not uncommonly wasted out of proportion to the general emaciation. These muscles may also be more or less implicated in progressive muscular atrophy, and occasionally a single muscle undergoes marked wasting. The writer has seen a striking example of this local atrophy in connection with the pectoralis major, but the serratus magnus or other muscles may be implicated. The wasting is probably in most cases due to disease of the nerves supplying the affected muscles. It is quite evident on examination, and the movements which are usually performed by the involved structures cannot be executed properly. *d.* On the other hand, the chest-muscles may become hypertrophied. This may be a natural result of training; or it may occur in consequence of their being called upon, either habitually or at intervals, to act excessively, as in cases of emphysema or asthma. In exceptional instances the condition known as pseudo-hypertrophic muscular paralysis has extended up to the chest. *e.* The thoracic muscles occasionally present marked irritability under percussion or friction. This has been regarded as an important sign of phthisis; but the writer has only observed it in a comparatively few instances of this disease, and has found it equally if not more evident in cases where the lungs were perfectly healthy. *f.* As the result of injury and other causes, some portion of the muscular structures of the chest may be lacerated, ruptured, or perforated, either alone or along with other structures. This condition will be further alluded to presently.

3. **Nervous Affections.**—*a.* Neuralgia is very common in different parts of the chest, especially in the side, and particularly the left side—*intercostal neuralgia.* The pain is localised, being usually referred to a point where a branch of nerve becomes superficial. It is more or less constant, but subject to exacerbations, in some cases being very severe at times. It may be increased by deep breathing or coughing, but is not, as a rule, so much affected by these and similar actions as are other painful chest-affections. Shooting and darting sensations often radiate from the principal point, and certain spots of tenderness—*points douloureux*—may be recognised in many cases (*see* INTERCOSTAL

Neuralgia). *b.* Intercostal neuritis is occasionally met with, and this affection is attended with great pain, localised and radiating, with much tenderness, the suffering being aggravated by whatever causes any local disturbance. It is probable that the severe pains experienced in some instances where the complaint is supposed to be muscular, are due to branches of nerve being in an inflammatory condition. *c.* Some individuals, especially females, exhibit a remarkable superficial tenderness over the thorax or in parts of this region, especially the anterior and upper portions. The slightest touch is resented, and the most delicate percussion cannot be borne. This condition may exist without any actual disease, or it is sometimes observed in phthisical cases. *d.* Sensation may be more or less impaired over the chest, or in limited portions, either in connexion with central or local nervous disease, or in hysterical and nervous persons. Various paræsthesiæ are also frequently referred to this region by the class of individuals just mentioned.

4. Diseases of the Bones or Cartilages.—The morbid conditions which may be referred to the bony and cartilaginous framework of the thorax are as follows:—*a.* There may be undue rigidity and firmness of the chest-walls, owing to an excessive deposit of calcareous matter in the sternum and ribs, with ossification or petrifaction of the cartilages. This is a normal condition in old people, being one of the degenerative changes to which they are liable, but it may also occur in younger individuals, as the result of hard work, or in connexion with certain pulmonary diseases. This state of rigidity interferes more or less with the respiratory movements, and not infrequently causes serious embarrassment. *b.* On the other hand, the ribs and cartilages may be deficient in firmness, and consequently too yielding and elastic. This is observed in children and young persons who are ill-nourished, and it becomes a condition of great moment when any disease sets in which causes obstruction to the entrance of air into the lungs, such as bronchitis. The chest-walls are then liable to fall in more or less during the act of inspiration, and may become permanently deformed, the pigeon-breast and other abnormal forms of thorax being thus originated. In rickety children the vicinity of the junction of the ribs with their cartilages is the most yielding part of the chest, where nodular thickenings may often be felt, and in such subjects this is the portion of the thoracic wall which is most liable to fall in. *c.* Acute or chronic periostitis or perichondritis is sometimes observed in connexion, respectively, with the sternum or ribs, or with the cartilages. The acute affection gives rise to much pain and tenderness, which may be accompanied with superficial redness and swelling, and may simulate some more serious disease. The chronic complaint usually assumes the form of a node, being the result of syphilis. The writer has occasionally observed a small swelling at the junction of one of the ribs with its cartilage, painless, unaccompanied with redness, but presenting distinct fluctuation. *d.* The bony and cartilaginous structures themselves may be the seat of disease in some part of the chest, and here must be included the portion of the spinal column which limits this region posteriorly. Thus there may be acute inflammation, caries, necrosis, or so-called scrofulous disease. Among the more important causes which are liable to originate these conditions may be mentioned injury, syphilis, scrofula, empyæma opening externally, and thoracic tumours or aneurisms growing outwards. They may lead to serious consequences, both local and general, and frequently cause more or less deformity of the chest. *e.* Permanent thickening and distortion of portions of the ribs are sometimes observed after fractures which have united improperly.

5. Inflammation and Abscess.—It is expedient to make a separate group of those cases in which inflammation, resulting in the formation of one or more abscesses, occurs in some portion of the soft structures entering into the construction of the chest-walls. This may be of local origin, arising from injury, bone-disease, or other causes; or it may be due to the opening of an empyæma into the tissues; to suppuration extending and burrowing from the axilla or other parts; or to pyæmia. If deep-seated, an abscess may be difficult to detect with certainty, but usually the signs of this condition become sufficiently obvious. Sinuses or fistulæ may be left as a consequence of suppuration in the chest-wall, especially when pus makes its way outwards from within.

6. Tumours and New-Growths.—These morbid conditions also demand separate notice. They may be connected with any of the structures of the chest-walls, and are of various kinds; among those which have come under the writer's notice may be mentioned molluscum, fatty growths, cystic tumours, enlarged sebaceous glands, and infiltrated carcinoma. Tumours may make their way inwards from the chest-walls, encroaching upon the cavity of the thorax; or, on the other hand, the walls may be involved by growths from within. It need scarcely be mentioned that mammary tumours constitute a distinct, and by far the most important group associated with the structures covering the chest. *See* Breast, Diseases of.

7. Perforations and Ruptures.—The muscular structures of the thoracic wall may be more or less destroyed in some part either by sudden rupture or gradually, allowing a hernial protrusion of the lung to take place between the ribs. As already noticed, empyæma may make its way outwards through the chest-wall. Aneurisms and tumours extending outwards from within the thorax frequently cause serious destruction of the tissues, including the bony and cartilaginous, as well as the soft structures. This destructive process is often attended with severe pain and suffering, and leads to grave mischief.

8. Variations in Form and Size.—The chest often presents deviations from the normal shape and size, and these are so important that they demand separate consideration. *See* Deformities of Chest.

Treatment.—In many cases where the chest walls are in a morbid state, they either do not need any special treatment, or no treatment can be of avail. The chief circumstances under which the practitioner may be called upon to interfere, and the measures to be adopted, may be briefly indicated as follows:—

a. Painful affections of the chest-walls, depending upon conditions of the muscles or nerves, frequently demand local applications for their relief. Thus in different cases it may be requisite to employ hot fomentations, dry heat, or cold applications, in the form of wet rags frequently changed, ice, or evaporating lotions; or to use anodyne applications of various kinds, such as belladonna plaster or liniment, opium plaster or a liniment containing laudanum, oleate of morphia, tincture of aconite or ointment of aconitine, or veratria ointment. Anodynes may also sometimes be added to fomentations with advantage. Friction is often of much service, and at the same time stimulating liniments may be employed, such as one containing camphor, chloroform, or turpentine. For ill-defined muscular pains about the chest, which are frequently complained of, free douching with cold water every morning, followed by friction with a rough towel, is often highly efficacious. When pain is localised and obstinate, much benefit may be derived from the application of a sinapism, mustard-leaf, or even a small blister. In other cases the use of the ether-spray is serviceable, repeated more or less frequently; or sometimes much relief may be obtained from applying over a painful spot a mixture of equal parts of chloroform and belladonna liniment. Galvanism is another agent which may be of the greatest service in relieving painful sensations about the chest, whether connected with the muscles or nerves. Subcutaneous injections of hot water, morphia, or atropine may be demanded in some cases, and constitute a most valuable mode of treatment if pain cannot otherwise be assuaged.

In the treatment of many painful affections of the chest-walls much assistanse may be derived from attention to posture, especially in connection with certain occupations; from the avoidance of undue fatigue, or of any violent actions which are known to influence this part, such as cough; and from the adoption of measures tending to support the structures, or to keep them in a state of rest. The writer has found great benefit in a large number of instances from strapping the side more or less extensively, in the manner advocated by him for the treatment of pleurisy; and if there is any localised pain, some limited anodyne application, such as a piece of belladonna plaster, may be placed over this spot under the strapping.

b. In many affections of the chest-walls, treatment directed to the general system, or to some special constitutional condition, is often of the greatest service. Thus, in the painful complaints already noticed, there are frequently marked general debility and anæmia; and essential benefit is derived from the administration of quinine, preparations of iron, strychnine, cod-liver oil, preparations of phosphorus, and other tonic medicines, or such as improve nutrition. Some of these are also most useful when there is disease of bone and its consequences. Again, certain affections of the thoracic wall may be associated with rheumatism, gout, or syphilis, and then the particular treatment indicated for each of these several conditions is called for.

c. When disorders of the muscles of the chest-walls occur, such as paralysis or spasm, associated with some disease of the central nervous system, the treatment must usually be directed to this disease, and but little can be done for the local disturbance. In some instances, however, electrical or other modes of treatment may be of some service, by influencing the action of the muscles, but no definite rules can be laid down.

d. Local inflammations in connection with the thoracic walls must be treated as in other parts of the body, and it is unnecessary to discuss this subject in the present article.

e. Surgical treatment may be called for under certain circumstances. Of course this will be the case if the chest-walls are injured in any way. Among other conditions likely to demand surgical interference may be specially mentioned subcutaneous emphysema, abscesses, disease of the bones, and tumours.

FREDERICK T. ROBERTS.

CHEST-WALLS, Deformities of. *See* DEFORMITIES OF CHEST.

CHICKEN-POX.—SYNON.: Varicella; Fr. *La Varicelle*; Ger. *Wasserpocken.*

DEFINITION.—A specific infectious febrile disease, characterised by the appearance, in successive crops, of red spots, which in the course of about a week pass through the stages of pimple, vesicle, and scab.

ÆTIOLOGY.—The origin of this disorder is unknown. It is certain that it arises from contagion, and that childhood is its predisposing cause. It occurs in children at the breast, and is seen with increased frequency up to the fourth year, at which period it attains its maximum. It is less often found between four and twelve, and after twelve it may be said to disappear, although it is occasionally seen in adults.

SYMPTOMS.—The illness commences without any, or with but slightly-marked premonitories. There is usually, however, some feeling of lassitude, and the patient goes to bed earlier than usual. Within a few hours an eruption appears, usually on some part of the back or chest, but there are many exceptions to this rule. It may commence on the face, neck, chest, abdomen, or extremities, or upon several of these parts at the same time. The eruption consists of small, faintly papular rose-spots, varying in number from twenty to one or two hundred. These, in the course of eight, twelve, or, at the most, twenty-four hours from their appearance, change into vesicles, which, at first small in size and clear as to their contents, become quickly large; globular, or semi-ovoid in form; translucent, glistening, and opalescent in appearance; and surrounded with a faint areola. Towards the end of the second day of illness, the vesicles attain complete development, and about this time a few may be seen on the sides of the tongue, on the lips, cheeks, or palate, and sometimes upon the mucous membrane of the genitals. About the third day a few of the vesicles may have a pustular appearance, and sometimes a few pustules are seen; but, regarding the eruption as a whole, pustulation forms an incident rather than an essential feature in its progress. On the fourth day the vesicles begin to dry up, and by the sixth complete scabs are formed. These fall off in a few days, leaving in their place faintly red spots, and sometimes a few pits. A single crop of the eruption may be said to complete itself in five or six days; and, as two or three crops appear on as many successive days, the illness will last rather more than a week. In the event, however, of there being four or five crops, it may be prolonged for another week, but this is unusual. With the appearance of the eruption, the temperature rises two, three, or even more degrees, and this rise recurs with each successive crop of spots. The pulse is sometimes slightly increased in frequency; the tongue is moist, and sometimes covered with a light fur. As a rule, however, there is but little constitutional disturbance, although it is occasionally severe.

PATHOLOGY.—Chicken-pox is due to the reception of a specific poison, which after an incubation of about thirteen days, shows itself by an eruption upon the skin. What this poison is, how it enters the body, and what, if any, changes it produces upon the internal organs, the present state of our knowledge does not enable us to say. It affects the same individual once only, and it is perfectly distinct from modified small-pox, as the following considerations will show:—1. Chicken-pox is characterised by the *rapidity* with which it runs through its stages; modified small-pox, on the contrary, is characterised by an interruption in the course of the disease at one or other of three points—the papular, the vesicular, or the pustular. 2. The chicken-pox eruption attains complete development by the end of the third day; in modified small-pox, should the eruption attain complete development, this will not occur before the ninth day, however much the disease may be modified. 3. In modified small-pox the premonitory symptoms are usually well-marked, often quite as severe as in the natural disease, and these last forty-eight hours, after which there is an eruption of small hard papules on the forehead, face and wrists, followed by a *fall* of temperature. In chicken-pox the premonitories are most often wanting, and when present are slightly marked, and the eruption is followed by a *rise* in the temperature. It appears, moreover, upon any part of the body indiscriminately, and less frequently on the face than on other parts; and within a few hours—at the most within twenty-four—it has become vesicular; whereas in modified small-pox the vesicular stage is only reached forty-eight hours after the appearance of eruption. 4. The vesicles of chicken-pox are globular or ovoid in form, without any central depression; glistening or translucent in appearance; and unicellular in structure. They collapse on pricking, and attain their maximum development in from twelve to eighteen hours. Modified and natural small-pox vesicles are flat and circular in form, always depressed in the centre, and sometimes umbilicated, of an opaque dirty white colour, and multicellular in structure. They do not collapse on pricking, and attain their maximum development at the end of the third day from their origin. 5. Small-pox is an inoculable affection; chicken-pox, according to reliable authority, is not. 6. When cases arise which all recognise to be modified small-pox, they are always accompanied by others which are more severe; and in epidemics these latter gradually become more numerous up to a point of maximum intensity, when they decline and the modified forms reappear. In chicken-pox there is no such gradual increase in the intensity of illness, and neither serious nor fatal cases form part of its epidemics, which prevail independently of small-pox. 7. Small-pox and vaccinia are often early followed, in the same individual, say within two or three years, by chicken-pox, and *vice versâ*. 8. Chicken-pox, vaccinia, and small-pox have been known to follow in immediate succession in the same individual.

COURSE, TERMINATIONS, SEQUELÆ.—Varicella always runs a favourable course, invariably terminates in recovery, and has no sequelæ.

DIAGNOSIS.—It should be borne in mind that a sure diagnosis cannot be made in less than forty-eight hours. The appearance, however, of a crop of vesicles, followed on the next day by a second crop, points almost certainly to chicken-pox. Attention to this, and to the points noted under the head of pathology, ought to make the diagnosis easy.

PROGNOSIS.—This, as has been indicated above, is always favourable.

TREATMENT.—The treatment of chicken-pox consists in confining the patient to his room, or in the more marked cases to his bed, for one or two days; and in the administration of light, unstimulating food. Although no physician has recorded a fatal case of chicken-pox, a child whose temperature may be three, four, or six degrees above the normal, should be watched with care. ALEX. COLLIE.

CHIGOE.—DESCRIPTION.—The Chigoe is a minute parasitic insect, common in the West Indies and northern parts of South America. It is also popularly known as the *Jigger* or *Sandflea*. Though formerly regarded as an acarus or mite, it is now generally recognised as a true flea belonging to the genus Pulex (*P. penetrans*); but several entomologists have advanced solid reasons for separating it from the ordinary fleas. Thus Westwood terms it the flesh-flea, or *Sarcopsylla penetrans*, whilst Guérin formed the genus *Dermatophilus* for its reception. Practically, these distinctions are of little moment.

The Chigoe ordinarily lives in dry and sandy situations, where it multiplies to a prodigious extent. It attacks, however, the feet, chiefly underneath the nails and between the toes; the impregnated females burying themselves beneath the skin. Here the abdomen of the parasite swells to the size of a pea; and, unless removed by operation, gives rise to acute local inflammation, terminating in suppuration and sometimes in extensive ulceration, with even fatal results to the patient. Dogs also suffer excruciating torment from the bites and immigration of the *Bicho do Cachorro*, which, however Pohl and Kollar regard as distinct from the human jigger (*Bicho de pé*). Be that view correct or not, it would appear from the observations of Rodschild and Westwood that the larvæ of the human chigoe are hatched in the open wounds or ulcers, which sometimes extend inwards so as to involve the bones themselves. In bad cases amputation of the toes and adjacent parts becomes necessary. Left to themselves, the larvæ escape from their host, and probably, after the manner of bots and other parasitic insects, penetrate the soil for the purpose of acquiring the pupal stage of growth.

Treatment.—As regards treatment, the indications are simple. The parasite should be removed with the utmost care. Where this has not been done, and where, as a consequence, open sores exist, frequent washings with tepid water, followed by the application of carbolic acid lotions (twenty or thirty grains to the ounce), or of ointments (one drachm to one ounce of benzoated lard) will be found most suitable. Or, again, the carbolic acid putty, as sold in shops, or the application of one part of the acid previously mixed with ten or twelve parts of simple olive oil, will, in all likelihood, be sufficient to cause the destruction of any larvæ that might remain. In European practice cases of jigger are rarely seen; nevertheless the writer has recorded an instance in which strong mental delusions followed the torture produced by these creatures (*Worms*, p. 141). The patient, a middle-aged married lady, had suffered severely during her residence in the West Indies. Although she had got rid of the parasites, she constantly harpooned her own feet in the hope of destroying the young jiggers which she felt sure were still burrowing beneath the skin. Lastly, it seems almost needless to say that residents and travellers in Guiana, Brazil, and in the West Indies generally, should have their feet properly protected. T. S. Cobbold.

CHILBLAIN.—Synon.: Kibe; *Pernio*; Fr. *Engelure*; Ger. *Frostbeule.*

Definition.—A state of inflammation of a part of the skin induced by cold.

Ætiology.—Chilblains are common in children and young persons, and are more frequent in girls than in boys. They occur chiefly in those of a lymphatic constitution, and may be considered as an indication of debility and deficient vital power. In adult age they are rare, and are only met with when the powers of the constitution are reduced. Their occurrence is influenced more by the strength of the individual than by the degree of cold, and they continue in some persons throughout the entire year. Their tendency is to cease with the full development of the organism, and they reappear occasionally in advanced life.

Description.—The regions of the body usually affected with chilblain are the feet and hands, to which are sometimes added the ears and nose. A chilblain presents three stages or degrees of severity, namely, *erythematous*, *bullous*, and *gangrenous*; and it may be arrested at the first or second stage by the withdrawal of the cause. The *erythematous* stage is restricted to hyperæmia, swelling, and severe burning and itching, the itching being increased by heat, as by that of the fire or that induced by exercise. The congested spot is circular in figure, somewhat tumid, brightly red at first, but later on roseate crimson, purple, or livid in colour. The second or *bullous* stage exhibits the blain or blister resulting from effusion of serum beneath the cuticle; the permanent colour of the swelling is now purple or livid, and the contents of the blister a limpid serum, generally reddened with blood; sometimes, indeed, the fluid of the blister may be semi-purulent. In the *gangrenous* stage the blister is broken, the surface of the derma is in a state of gangrene, and the gangrenous layer is subsequently removed as a slough by ulceration.

Treatment.—The treatment of chilblain requires to be modified to suit its different degrees. In the first, the indication is to restore normal circulation by gentle friction, and, when the part is severely chilled, it is usual to rub it with snow; then some soothing liniment may be employed; and, finally, a stimulating liniment, covering the part afterwards with zinc ointment and cotton wool, or shielding it with lead or opium plaster spread on washleather. The liniments most in favour for this purpose are the soap liniment with chloroform, the compound camphor liniment, the turpentine liniment, and the linimentum iodi. In the bullous stage a similar treatment may be used to the erythematous portions, whilst the blister should be snipped and the broken surface pencilled with the compound tincture of benzoin, and afterwards dressed with unguentum resinæ or an ointment of Peruvian balsam. In the third stage the erythematous phenomena still require attention, and the ulcer should be dressed with unguentum resinæ, either alone, or in combination with spirits of turpentine.

To obviate constitutional debility, the diet should be nutritious and generous, and recourse may be had to tonic remedies, such as iron and quinine. Erasmus Wilson.

CHILL. — A subjective sensation of coldness, accompanied with shivering, and most frequently experienced in connexion with febrile or inflammatory diseases, in nervous individuals, and after exposure to cold and wet. In popular language 'taking a chill' is used as synonymous with 'catching a cold.' *See* Rigor.

CHIN-COUGH.—A synonym for whooping-cough. *See* Whooping Cough.

CHIRAGRA (χεὶρ, the hand, and ἄγρα, a seizure).—Gout in the hand. *See* Gout.

CHLOASMA (χλόα, a green herb). — Synon.: Liverspot. Fr. *Ephelide*; Ger. *Leberfleck.*

A pigmentary discolouration of the skin, of a yellowish brown or liver-colour tint, occurring in blotches, and due to constitutional causes. Its synonym, *ephelis gravidarum*, indicates its occasional association with pregnancy. *See* Pigmentary Skin Diseases.

Erasmus Wilson.

CHLORAL, Poisoning by. *See* Antidotes

CHLOROFORM, Use of. *See* Anæsthetics.

CHLOROSIS (χλωρὸς, green or sallow). Synon.: Green-sickness; Fr. *La chlorose*; Ger *Chlorose; Bleichsucht.*

Definition.—A variety of anæmia occurring in a peculiar diathesis or habit of body, which is characterised by deficient growth of the corpuscular elements of the blood, and of the vascular system.

The subjects of this diathesis are said to be *chlorotic*. They ordinarily enjoy good health, unless exposed to any of the causes of anæmia, when they speedily suffer from aglobulism; and this aglobulism may proceed to complete anæmia. The term *chlorosis* is properly applied to the first and simpler form of anæmia in these subjects; while the second and more complex condition is designated *chlor-anæmia*; or, more commonly, *anæmia* (*see* ANÆMIA).

ÆTIOLOGY.—Chlorosis occurs almost without exception in young women about the time of puberty, but is found occasionally in children and married women, and, very rarely, even in men. It is believed to be more common in the higher ranks of life. Beyond these predisposing causes, however, the very origin of the disease lies in a peculiar condition of the blood and blood-vessels, to be presently described, which is believed to be congenital, and perhaps hereditary. In such subjects, and under the preceding circumstances, any of the numerous causes of anæmia may be sufficient to excite the appearance of chlorotic symptoms, but those which do so most commonly are sexual development, the establishment of menstruation and its disorders, and an insufficient supply of light to the circulating blood.

ANATOMICAL AND CHEMICAL CHARACTERS.—The blood in chlorosis presents three definite and distinct imperfections. First, the total quantity of blood is below the normal, though there may be an excess in relation to the calibre of the vessels (*plethora ad vasa*). Secondly, both red and white corpuscles are deficient in numbers, and that proportionately. Thirdly, the individual red corpuscle contains less than the normal amount of hæmoglobin, and this deficiency may be so great that the total amount of hæmoglobin in the blood is reduced to one-fourth. It is an important negative fact that in pure chlorosis the quality of the liquor sanguinis is unchanged.

With this condition of blood there are associated remarkable abnormalities of the aorta and arterial system generally. The most striking of these is a hypoplasia, or dwarfed condition of the aorta, represented by small calibre, increased elasticity, anomalous origin of the branches, and unequal thickness of the intima. Along with these there may be found—probably as a consequence of the preceding—fatty metamorphosis of the intima, and enlargement of the heart, with traces of endocarditis. The blood-glands and lymphatic structures are not diseased. The condition of the ovaries and uterus has been carefully examined in chlorosis and found to vary extremely. In some cases the generative organs are described as 'infantile,' while in others they are either immoderately developed, or perfectly normal in every respect. Corresponding with the aglobulism, the subcutaneous fat is abundant; and the viscera present various degrees of fatty metamorphosis. When the cardio-vascular changes are marked and advanced, there may be extensive secondary disease throughout the body.

SYMPTOMS.—The symptoms of simple chlorosis are those of mild anæmia, with certain important differences, which become fewer and less marked and finally disappear as chlorosis advances to the more serious disease. The appearance of the chlorotic girl is peculiar, inasmuch as the pallor of her complexion is accompanied by natural or even increased fulness, from the excess of subcutaneous fat. At the same time the colour of the skin is so remarkable as to have given the name to the disease, the general hue being decidedly yellow. In blondes the transparency of the skin is increased; in brunettes it is diminished, and a dull yellowish-grey colour of skin is the result, which, in contrast with the greyish-blue of the eyelids, may appear of a sickly green.

The patient's usual complaint is of this alteration of colour, menstrual disorder, debility, great breathlessness, cardiac symptoms, and various pains. The menstrual symptoms are always prominent, namely amenorrhœa or menorrhagia, and leucorrhœa. Breathlessness on exertion is one of the most striking symptoms. The cardiac symptoms and the cardiac and vascular signs closely resemble those of anæmia. But there is this important difference in the phenomena connected with the heart, that in many cases of chlorosis they indicate enlargement, and especially hypertrophy of the left ventricle. The digestive and nervous systems are frequently very seriously deranged. The urine is abundant, watery, and pale. There is no dropsy in simple, uncomplicated chlorosis. Optic neuritis may occur.

The *chlorotic diathesis* may be recognized by the following characters, which are variously associated in different cases:—Diminutive stature; imperfect sexual development; a history of peculiar anæmia in childhood, of anæmia with menstrual irregularity at puberty, and of previous attacks of symptoms of chlorosis; evidence of cardiac enlargement or mitral disease in the absence of all the ordinary causes of these; the occurrence of endocarditis during pregnancy or *post partum*; and the presence of any of the diseases which will be referred to under the head of *complications*.

COURSE, DURATION, AND TERMINATIONS.—The commencement of chlorosis is generally gradual, but may be sudden. Its ordinary course is towards confirmed anæmia, in which it may terminate, the liquor sanguinis becoming affected, and wasting and œdema being added to the previous symptoms, which are also aggravated. It is for this reason that pure chlorosis is a rare disease, while anæmia associated with the chlorotic diathesis is comparatively common.—The duration of the disease is variable; it rarely declines until the determining circumstances have been removed, and the patient subjected to careful treatment. Chlorosis may reappear in the subject of the diathesis, and that more than once; but the probability of its return is small after the age of 25, especially in the married female. Death from chlorosis directly is excessively rare.

COMPLICATIONS AND SEQUELÆ.—According to Virchow, serious valvular disease and cardiac enlargement may be traced in some of the worst cases of chlorosis to the associated vascular condition; and the mitral valve is peculiarly liable to be attacked by endocarditis in rheumatic, puerperal, or septic fever. Hæmorrhages, gastric ulcer, and exophthalmic goitre are believed to occur with comparative frequency in persons of the chlorotic diathesis.

Pathology.—The deficiency of the blood in red and white corpuscles, and of the individual red corpuscle in hæmoglobin, described above, indicates an imperfect production of the cellular elements of the blood, and imperfect growth of the red corpuscles. With this blood-state there is undoubtedly associated a hypoplastic or dwarfish condition of the blood-vessels. In the embryo the blood and blood-vessels are developed from the same elements, the former making its appearance within the cells which produce the latter. It is highly probable, therefore, that the anomaly of blood and the anomaly of vessels are to be considered as together an expression of some congenital defect of the blood-vascular system, leading to imperfect growth both of blood and of vessels. Any individual possessing a blood-vascular system thus anomalous labours under a peculiar diathesis, or debility of the corpuscles and circulatory system, and is said to be a *chlorotic* subject.

If the other systems of the body are full-sized (which is not always the case) the dwarfish condition of the arteries of the chlorotic subject, and the scanty supply of hæmoglobin, will tend to fail to supply the ordinary demands for blood, and especially for oxygen; and at every period of extraordinary demand within the economy the blood-vascular system will be in danger of breaking down. Exposure to any of the causes referred to above will be sufficient to produce the symptoms of aglobulism, that is, chlorosis; and that when they would not affect the blood of an ordinary non-chlorotic individual. This effect is peculiarly striking when the exciting influence is one which is universally recognised as an important factor in the production of chlorosis, namely want of light; for light is essential in the formation of hæmoglobin, and to the health of the red corpuscle. Thus the special phenomena of uncomplicated chlorosis are those of aglobulism or deficiency of the oxygenating substance of the organism; and they furnish one of the purest examples in the whole range of pathology of the effects of want of oxygen in the system (*see* Blood, Morbid Conditions of). When chlorosis advances to anæmia, by the implication of the plasma, a new series of phenomena present themselves, prominent among which are loss of flesh and œdema of the extremities.

The relation of the cardiac enlargement and valvular disease to the vascular hypoplasia is a purely physical one. More complex is the connexion between the blood-vascular condition and that of the generative organs. The chlorotic diathesis, or actual chlorosis, will manifestly interfere with the development and activity of the ovaries and uterus; whilst, on the other hand, disorders of the sexual functions are amongst the most frequent exciting causes of aglobulism.

Diagnosis.—Chlorosis is to be distinguished from symptomatic and idiopathic anæmia; and the points by which the diagnosis may be accomplished have been sufficiently indicated above. Leukæmia may be readily recognised by a careful examination of the blood and spleen.

Prognosis.—The prognosis is highly favourable as regards life; and a speedy cure may be assured in uncomplicated cases subjected to careful treatment.

Treatment.—The success of a particular method of treatment of simple chlorosis is one of the strongest arguments in favour of the correctness of the preceding view of the pathology of the disease. The condition being one of aglobulism, the treatment employed will be so far simpler than that of anæmia, that the red corpuscles alone have to be restored. While the various measures recommended in the more serious blood-disorder are therefore to be employed, if necessary, it will generally be found that in chlorosis iron alone will be sufficient to effect a cure. The particular form in which the drug is to be presented must be carefully selected according to circumstances which need not be repeated in this article. A free supply of sunlight is essential, and must be insisted upon; and physiological rest of the blood and of the organs of circulation is equally necessary.

J. Mitchell Bruce.

CHOLAGOGUES (χολή, bile, and ἄγω, I move).—Definition.—Substances which lessen the amount of bile in the blood.

Enumeration.—The principal cholagogues are Mercury and its preparations—especially calomel and blue pill; Podophyllum and Podophyllin; Aloes; and Rhubarb.

Action and Uses.—The liver has a twofold action—it *forms* bile, which is poured into the duodenum; and it also *excretes* the bile which has been reabsorbed from the duodenum and carried back to the liver by the portal circulation. Much bile thus circulates continually between the liver and duodenum, while part is carried down the intestine with the fæces, and its place supplied by newly-formed bile. When the quantity circulating in this way is too great to be completely excreted by the liver, it enters the general circulation and produces symptoms of *biliousness.* These are removed by the so-called cholagogues, which probably act by stimulating the duodenum, and thus carrying the bile so far down the intestine as to interfere with re-absorption. Amongst the best cholagogues are the preparations of mercury, which do not increase the secreting power of the liver, nor augment the quantity of bile formed by it. Their utility is greatly increased by combination with a saline purgative, which still further clears out the intestine, and completely prevents any re-absorption of bile. Other cholagogues, such as podophyllin, rhubarb, and aloes, actually increase the secretion of bile by the liver. At the same time, they probably prevent its re-absorption, in a similar way to mercurials and salines.

T. Lauder Brunton.

CHOLELITHIASIS (χολή, bile, and λίθος, a stone).—The condition of system associated with gall-stones. *See* Gall-Stones.

CHOLERA, ASIATIC.—Synon.: Serous cholera, Spasmodic cholera, Malignant cholera; Fr. *Choléra asiatique*; Ger. *asiatische Cholera.*

Definition.—Asiatic cholera is a specific disease, characterized by violent vomiting and purging, with rice-water evacuations, cramps, prostration, collapse, and other striking symptoms; tending to run a rapidly fatal course; and capable of being communicated to persons otherwise in sound health, through the dejecta of patients suffering from the disease. These excreta are most commonly disseminated among a community, and taken into the system by means of drinking water, or in fact by anything swallowed which has been contaminated by the organic matter passed from cholera patients. In badly ventilated rooms, the atmosphere may become so fully charged with the exhalations from patients suffering from cholera as to poison persons employed in nursing the sick. In the same way people engaged in carrying the bodies of those who have died from cholera for burial, or in washing their soiled linen, may contract the malady. In a dried condition the organic poison contained in cholera excreta may retain its dangerous properties for a long time.

The disease is endemic in certain parts of British India, where from time to time it assumes a virulent type, and is apt then to spread, through the means above indicated, along the great lines of human intercourse, and so to extend over the world.

History.—Since the days of Hippocrates medical practitioners residing in various parts of Europe have described a disease which they called cholera. The nosology of this affection was hardly a matter of doubt with them, and it is only in modern times that the question has arisen as to whether the cholera commonly met with among us is identical in its nature with Asiatic cholera. Doubtless, if we compare isolated cases we may find that the symptoms which these affections induce are very similar; but those who have lived beyond the endemic area of Asiatic cholera, and watched the disease spread from India over Europe and America, can scarcely mistake this malignant malady for simple cholera. Asiatic cholera was unknown in Europe before the year 1829-30, although it has existed in India for many centuries. It is true we have no accounts of cholera extending throughout the whole of Hindustan prior to the year 1817, but this arises from the circumstance that it was only at the commencement of the present century that the British Government began to bind the heterogeneous principalities of India into union, and thus render it possible for us to gather together authentic details regarding the disease as it spreads from one province to another.

We cannot here fully consider the relations which unquestionably exist between the rapidity of the diffusion of cholera from the East over Europe, and the increased facilities of communication that have lately been established between India, and Persia, and Arabia, also from Hindustan to Russia, and the shores of the Mediterranean. For instance, forty years ago the passage from Bombay up the Arabian and Persian Gulfs could only be undertaken at certain seasons of the year when the winds were favourable, and even then the voyage was tedious and most difficult to accomplish; now large steamers run every week from Bombay to Bassorah and the intermediate ports along the Persian Gulf, and others pass with equal rapidity to the various towns bordering the Red Sea. But although we cannot enter further into this subject, we must, in order to appreciate the nature of cholera, glance at the chronological order of some of the principal outbursts of the disease which have been disseminated from British India over the world.

In 1817 cholera spread rapidly throughout Bengal; extending during the following year over the greater part of Hindustan, and from thence to Ceylon, Burmah, and China. The disease was communicated from Bombay *viâ* the Persian Gulf in 1820-21, and travelled northward, but did not extend into Europe.

During the year 1826 cholera again burst out over Bengal, and passing through the Punjaub, it entered Cabul in 1828, and from thence extended to Persia, and so to Russia during the years 1829-30, and over the whole of Europe and the greater part of America.

In 1840-41 cholera accompanied a British force despatched from Calcutta to China: it broke out among our troops on their voyage to that country, and having spread throughout the Chinese and Burmese empires, it passed in 1843-44 through Kashgar to Bokhara, and so to Cabul. From Afghanistan the disease extended south into Scinde, and westward in 1845-46 through Persia to Russia and Europe, reaching America in 1848.

In 1849 cholera was very fatal over Bengal, and during the season of 1851-52 it was communicated through the Punjaub and Bombay respectively to Persia and Arabia, and in 1853-54 it spread *viâ* Russia and Egypt with frightful virulence throughout Europe and America.

During the years 1860-61-62 cholera prevailed to an alarming extent throughout Bengal and the Central Provinces, and in 1864-65 in Bombay and along the shores of the Red Sea; thence it passed with pilgrims from Mecca to Egypt, and so to Europe, and for the fourth time to America.

These various outbursts of cholera were usually remarkably sudden in their advent, a considerable number of people in the affected locality being attacked by the disease within a few days after it appeared among them. The malady almost invariably died out from amongst the inhabitants of a country under its influence during the cold seasons of the year, to re-appear on the approach of summer. As a general rule the disease was most deadly during the first year of the epidemic; it decreased in violence the second season; and then gradually disappeared, seldom prevailing in any one locality for more than three consecutive years.

Ætiology.—The more we study the history of Asiatic cholera the better shall we understand that every outburst of the disease which has occurred beyond the confines of India might invariably be traced back through a series of cases to that country; the disease has never broken out spontaneously in any other part of the world—no amount of filth, bad food, or climatic influences have up to the present time induced a widespread epidemic of cholera. The inhabitants of countries far removed from Hindustan, and having limited communication with that empire, such as Australia, have not experienced the disease; whereas those states which have been brought into intimate relation with India have become frequently subject to outbreaks of cholera.

Many of the earliest Anglo-Indian authors declared their conviction that the disease was contagious; others disputed this idea; but all agreed that cholera when extending over a country often settled on the inhabitants of low-lying, ill-drained, and overcrowded localities, and that it frequently left unharmed people residing beyond the affected area, although they might have been employed in attending patients suffering from the disease. It remained for Dr. Snow, in 1854, to explain this apparent mystery, and to demonstrate, as he did by means of the Broad Street case, that the poison which causes cholera is contained in the excrements of those suffering from the disease, and 'that if by leakage, soakage from cesspools or drains, or through reckless casting out of slops and wash-water, any taint, however small, of the infective material gets access to wells and other sources of drinking water, it imparts to enormous volumes of water the power of propagating the disease' (Simon). Cholera patients cannot, in fact, communicate the affection to others, unless by means of the discharges which they pass. Persons attending them run no risk of contracting the disease provided they are protected from swallowing the organic poison passed by the sick; but in badly ventilated rooms, this organic matter having been disseminated in considerable quantities through the atmosphere, may be taken into the system by attendants, and so poison them.

Dr. W. Aitken observes that the evidence in favour of the communicability of cholera by means of water or food contaminated with cholera dejecta has since 1854 become almost overwhelming. A remarkable instance of the kind reported by Mr. N. Radcliffe took place in East London during the year 1866; and previous to this time the circumstances of a case came under the writer's notice, in which a small quantity of a fresh rice-water stool passed by a patient suffering from cholera was accidentally mixed with some four or five gallons of water, and the mixture exposed to the rays of the tropical sun for twelve hours. Early the following morning nineteen people each swallowed about an ounce of this contaminated water—they only partook of it once,—but within thirty-six hours five of these nineteen persons were seized with cholera. In this instance the choleraic evacuation did not touch the soil: as it was passed, so was it swallowed, but (and this is most important to remember) it had been largely diluted with impure water, and the mixture had been exposed to the light and heat of a tropical sun for twelve hours.

Doubtless we have much yet to learn regarding the nature of the organic substance which causes cholera. Professor Pettenkofer holds that if this material after leaving the human body happens to pass into the ground, it may there, under peculiar conditions of soil, moisture, and heat, undergo definite changes, and then, having risen as a miasma into the air, may poison those who are predisposed to the disease: the earth, according to this theory, seems called on to play the part in the *rôle* of cholera which has been assigned in former times to solar, lunar, electrical, or epidemic influences. The conclusions recently arrived at in Bengal by Drs. Lewis and Cunningham rather incline towards this view. The difficulty of working out these problems in relation to the infecting material of cholera is enhanced by the fact, that the human is the only animal which is incontestably subject to its influence. We must, however, refer our readers to some admirable papers by Dr. E. Parkes, published in the *Army Medical Department Reports*, for accurate knowledge on this subject.

Predisposing Causes.—Persons arriving in an infected area are predisposed to the disease. Beyond this fact nothing certain is known concerning the existence of predisposing causes of the disease.

ANATOMICAL CHARACTERS.—The external appearances of the bodies of those who have died of cholera present the mottled skin, shrunken and livid appearance of the limbs, and other features hereafter described as characteristic of the disease during the stage of collapse. The temperature of the body rises after death, and it remains warm for some time. Rigor mortis sets in speedily and is sometimes accompanied with muscular contractions, which displace the limbs of the corpse.

With regard to the internal lesions observed after death from Asiatic cholera, the writer's observations lead him to the conclusion, that almost the only alterations noticed in the tissues are due to the physical and chemical characters of the blood having been changed, consequent on its loss of water. The mucous surface of the stomach and small intestines is injected and swollen, and its epithelial cells contain micrococci; this epithelium drops off the surface of the mucous membrane in large patches within an hour and a half after death; and whatever may be the nature of the changes going on in the epithelial coat of the intestinal canal in cases of cholera, there can be no doubt as to its being extensively affected in this disease.

Anatomical changes of a specific nature, especially with reference to the amount of blood contained in the right side of the heart and lungs, have been described by pathologists as being characteristic of Asiatic cholera; and in many instances after death from this disease, if the post-mortem is delayed for a few hours, the right side of the heart will be found full of blood, together with the pulmonary artery and its divisions; while the lungs are collapsed and bloodless. But the writer holds that there are numerous exceptions to this state of the heart and lungs, and that the condition above described is not infrequently due to post-mortem changes; and if the bodies of those who have died of cholera be examined immediately after death, the left side of the heart will be found as full of blood as the right side, but as post-mortem rigidity sets in, the blood is forced from the left ventricle into the aorta, and in fact from the large arteries of the body into the capillaries and veins. He has less hesitation in expressing an opinion of this kind, because under similar circumstances he was misled into attributing an important place in the pathology of cholera to the shedding of the intestinal epithelium, as observed after death: more recent researches have, however, convinced him that the shedding of the epithelial cells, *en masse*, is also a post-mortem change, which takes place usually about an hour and a half or two hours after death.

Symptoms.—Asiatic cholera is most deadly at the commencement of an epidemic, and then usually begins without premonitory symptoms. The patient feels well up to within a few hours of the attack, or, it may be, goes to bed and sleeps soundly through the night, and immediately on rising in the morning is seized with violent purging and vomiting. After the first outburst of the disease, as a rule, cholera commences with diarrhœa, the stools being copious and watery, followed by great prostration of strength, with a peculiar feeling of exhaustion at the pit of the stomach; the sick person suffers from nausea, but seldom from actual vomiting or pain at the outset of the attack. If judiciously treated, many patients recover from this, the *first stage* of cholera, but if neglected the tendency of the disease is to grow rapidly worse. The stools become very frequent, and resemble in appearance and consistency the water in which rice has been boiled: these liquid evacuations flow away from the sick person with a sense of relief rather than otherwise; but the patient now commences to vomit, first throwing up the contents of his stomach, and subsequently all the water he drinks, mixed with mucus and disintegrated epithelium; the fluid is ejected from his mouth with considerable force, and this adds to the increasing prostration which is one of the most urgent and marked features of the disease. The patient complains of intense thirst, and a burning heat at the pit of his stomach; he suffers also excruciating pain from cramps in the muscles of the extremities; he is terribly restless; and his urgent cry is for water to quench his thirst, and that some one might rub his limbs, and thus relieve the muscular spasm. Although the temperature of the sick person's body falls below the normal standard, he complains of feeling hot, and throws off the bed-clothes in order that he may keep himself cool. The pulse is rapid and very weak, the respirations are hurried, and the patient's voice becomes husky. His countenance is pinched, and the integument of his body feels inelastic and doughy, while the skin of his hands and feet becomes wrinkled and purplish in colour. The duration of this, the *second stage* of cholera, is very uncertain; it may last for two or three hours only, or may continue for twelve or fifteen hours; but so long as the pulse can be felt at the wrist, there are still good hopes of the sick person's recovery. The weaker the pulse becomes, the nearer the patient is to the *third*, or *collapse-stage* of cholera, from which probably not more than thirty-five per cent. recover. This, however, depends much on the condition of the patient's heart; it is quite possible, although the cases must be rare, that a sudden outpouring of fluid into the intestinal canal has been sufficient to cause syncope and death, among persons suffering from a weak heart, before the liquid contents of the bowels have had time to be rejected either by the mouth or anus. In the third stage of the disease the vomiting and purging continue, although in a mitigated form; and the skin is covered with a clammy perspiration, especially if the cramps are still severe. We now cease to be able to feel the pulse at the wrist, the lividity of the extremities and surface of the body increases, the patient cannot speak above a low whisper, his breathing is very rapid, his eyeballs are deeply sunk in their sockets, and his features are marvellously changed within a few hours. The urine is suppressed. The temperature of his body may fall as low as 94° Fahr. The patient remains terribly restless, longing only for sleep, and that he may be supplied with water. His intellect is clear, but he seldom expresses any anxiety regarding worldly affairs, although fully conscious of the dangerous condition he is in; sleep, and a plentiful supply of drinking water, are the sole desires of a person passing through the collapse stage of cholera. This condition seldom lasts for more than twenty-four hours, and reaction either commences within that period, or the patient dies in collapse, or passes on into the *tepid stage*, which in ninety-nine cases out of a hundred ends speedily in death. In the tepid stage of the disease the sick person's body feels cold to the touch, but the temperature, as shown by the thermometer, begins to rise very rapidly, sometimes marking 99° or 100° F. The purging and vomiting cease, and the patient lies in a semi-comatose state, his eyes half open, the ocular conjunctiva being deeply congested, the cornea hazy, and the pupils fixed; the pulse can be felt at the wrist, but the respiration is very hurried, suppression of urine continues, the patient's body is bathed in a cold clammy perspiration, the skin becomes of a dusky red hue, and death too frequently closes the scene within a few hours.

On the other hand, the sick person having been in the collapse-stage of cholera some twenty-four hours (it may be a longer or shorter period), the temperature of his body may begin to rise, gradually creeping up to the normal standard; the respiration diminishes in frequency; the pulse returns; the patient can sleep, and after some thirty-six hours may pass a little urine; in fact, the functions of animal life are slowly restored, and the sick person recovers his health. This desirable result, however, is not infrequently thwarted by various complications which arise during the stage of reaction. Of these complications the following are the most important:—suppression of urine; gastritis and enteritis; pulmonary congestion; meningitis; sloughing of the cornea; abscesses over the body; the formation of coagula in the right side of the heart or pulmonary arteries; hæmorrhage from the bowels; and roseola-choleraica.

Diagnosis.—The question of the diagnosis of Asiatic cholera is discussed in the article on Choleraic Diarrhœa.

Prognosis.—The means of forming a prognosis in cholera will be gathered from the preceding account of the disease. Speaking generally, the prognosis depends chiefly upon the stage of the disease, and upon the time of the epidemic—

that is, according as the patient has been seized at the outbreak, at the height, or towards the end of an epidemic.

TREATMENT.—In the first stage of Asiatic cholera we should endeavour to stop the purging, and without doubt opium is the drug upon which we may with the greatest confidence rely for effecting this purpose. When practising in the endemic area of cholera the writer was in the habit of carrying about pills containing one grain of opium and four of acetate of lead, so that, if called to see a patient suffering from the disease in its early stage, no time was lost in administering one of these pills dissolved in water. The next thing done was to make a large mustard poultice, and apply it over the whole surface of the patient's abdomen. The sick person was ordered to remain in bed, and to be allowed nothing in the shape of food or water; but he might suck as much ice as he felt inclined for.

If, after the first pill, the patient was again purged, a second was given, and a third (but not more) after each loose motion. It often happened that the first or second pill, together with the mustard poultice, ice, and rest, was sufficient to check the progress of the disease, and the patient recovered. Supposing this treatment not to succeed, or that on first seeing the patient it be found that he has passed into the second stage of the disease, we should still prescribe the pill, as above directed, dissolving it in water, because in the solid form it might be rejected entire, and under any circumstances it would take time to be dissolved by the fluid contained in the stomach; the mustard poultice also should be applied, and the sick person kept warm and in bed. Ice is invaluable in this stage of the disease, and unless a person has passed through an attack of cholera, it is impossible to realise the immense relief it affords; it should be given in small lumps, the sick person eating and swallowing as much as he chooses; he will frequently devour a pound or two of ice in the course of an hour, and he cannot take too much of it. In the treatment of cholera there can be no question as to the value of ice. The patient should be prohibited from drinking water or any other fluid beyond that which he gets from the ice. The practitioner must be firm on this point, turning a deaf ear to the entreaties of the sick man or his friends, that he may be permitted to swallow even a small quantity of water, for if they once break through this rule, it will be impossible to limit the amount of liquid the patient will consume. If this treatment does not check the progress of the malady, we may prescribe three grains of acetate of lead and fifteen drops of diluted acetic acid in water every second hour, and fifteen drops of diluted sulphuric acid in water every alternate hour, so that the patient should take a draught, first of one mixture then of the other, every hour. The writer often combines five drops of spirit of camphor with each dose of the medicine, but this drug requires care in its administration, and should seldom be continued beyond five or six doses of from five to ten drops each. Should the vomiting be very severe, in spite of the free administration of ice, a second mustard poultice should be applied over the abdomen; all medicine must then be omitted for an hour and a half, after which time a scruple of calomel may be sprinkled on the patient's tongue, and he should be made to wash it down with a little iced water. The cramps are best relieved by hand-friction, and if very severe, ease may from time to time be given by allowing the patient to inhale some ether. The writer prefers this practice to administering hydrate of chloral, either by the mouth or by subcutaneous injection. Hot water bottles should be applied to the soles of the patient's feet, and also to his legs and abdomen.

Should the disease have reached the collapse-stage there is but little we can do for the patient. Ice must still be given, and, if the purging is frequent, the sulphuric acid draught (but no opium) may be administered every hour; heat and friction may with advantage be applied to the surface of the body; and the patient may now be permitted to drink iced water in moderation, provided it does not increase the vomiting. According to the writer's experience, wine and stimulants, if given by the mouth, do harm in this stage of cholera; but, if the purging has abated, enemas of warm beef-tea and brandy may be administered by the rectum every third hour. When reaction comes on, we must guard against doing too much—it is very rare indeed to see a patient in this condition sink from exhaustion, but probably many lives are lost by endeavours erroneously made, under the idea of keeping up the patient's strength. Iced milk or arrowroot is all that should be allowed to be given by the mouth for some time after reaction has set in; but enemas such as those above-mentioned, administered per rectum every five or six hours, are often beneficial, especially if the stomach remains irritable; and under these circumstances we not unfrequently find that a small quantity of solid food is easily digested, when soup and liquids are rejected. In each case, however, the dictates of common sense and experience must guide the medical practitioner in his treatment of the sick person through the convalescent stage of the disease.

With reference to the treatment of suppression of urine after cholera, we should get the patient to drink about half a pint of water every second hour, so as to add fluid to his blood. Dry-cupping over the loins should be employed; and ten drops of the tincture of cantharides in water administered every hour, until a drachm of the drug has been given It need hardly be remarked that suppression of urine after cholera is a most dangerous complication, and there is very little that can be done to restore the suspended functions of the kidneys.

PREVENTIVE TREATMENT.—Among persons predisposed to its influence, the infecting material of Asiatic cholera will manifest its effects on the system within five days of having been swallowed, but the poison does not always engender symptoms of virulent cholera. Nevertheless, in milder cases of the disease the evacuations passed by the patient may contain the germs of cholera, and these evacuations are therefore capable, under certain circumstances, of developing a deadly type of the malady; consequently, the following remarks are applicable to instances of so-called *cholerine*, as well as to the severer forms of cholera. If the disease has appeared within a neighbourhood, a searching examination must be made into the condition and source of the local water-supply, not overlooking that of the milk, which is too often diluted with water before being sold. All surface and doubtful wells (especially those in the proximity of drains and cesspools) should be immediately closed; and it is desirable that the drinking water before being consumed should be carefully filtered. All accumulations of house refuse and filth must be removed; and dirty places, both within and without uncleanly premises, must be freely disinfected and cleansed. There is no necessity when the disease is prevalent for making any alteration in the usual diet; but in times of cholera we cannot too strongly insist on at once checking any tendency to diarrhœa, especially if it be of a watery nature. Many cases of incipient cholera have been prevented from running on into dangerous disease, by the early administration of pills containing four grains of acetate of lead and one of opium, one pill to be taken after each loose motion, to the extent of three pills.

If called to treat a case of Asiatic cholera, care should be taken that the rice-water stools, and the matters vomited, are disinfected by means of bichromate of potash or Macdougall's mixture, which should be poured over the bottom of the vessel into which the evacuations are received from the patient; and directly the dejecta are passed from the sick person, a solution of one part of carbolic acid to twenty of water should be sprinkled over them, and they must be immediately taken from the patient's room, and disposed of as follows:—If the sewage of the locality is conveyed away by means of a constant water supply, the disinfected cholera evacuation should be thrown at once into the sewer. Drains used for a purpose of this kind must, however, be flushed with a mixture containing about an ounce of ferro-sulphate to a pint of water. But if the drainage of the place passes into a cesspool, the disinfected cholera stools should be buried in a deep hole in the ground, removed from wells, and, if possible, from human habitations; it is a dangerous practice, however carefully cholera-stools have been disinfected, to allow them to gain access to a cesspool. The room in which the patient has been treated must be freely disinfected, and his bedding subsequently burnt. If the sick person should die, the corpse is at once to be placed in a coffin containing a mixture of lime, charcoal, and carbolic acid; in fact, the body should immediately be buried in a mixture of this kind, and the coffin with its contents committed to the grave within twenty-four hours of the patient's death.

But after all, as Mr. Simon remarks, infinitely the most important preventive measures to be adopted against cholera are to provide a pure supply of drinking water, good drainage, ventilation, and cleanliness; for these means, if rightly enforced, must prevent the cholera contagion, whether disinfected or not, from acting to any great extent on the population.

The Vienna Cholera Conference has decided that quarantine is inapplicable to the circumstances of cholera; but this subject, together with the duties incumbent on sanitary and port authorities with reference to the preventive treatment of the disease, hardly falls within the scope of this article. C. MACNAMARA.

CHOLERAIC DIARRHŒA. SYNON.: Simple Cholera; Sporadic Cholera; Fr. *Choléra sporadique*; Ger. *sporadische Cholera*.

DEFINITION.—An acute catarrhal affection of the mucous membrane of the stomach and small intestines, attended with vomiting and diarrhœa. The stools consist of a serous fluid, containing a little albumin. The whole system is implicated to a greater or less extent, through the rapid loss of water from the body.

ÆTIOLOGY.—As has already been remarked, it is only of late years that the question has arisen as to whether Asiatic cholera and simple cholera are identical diseases; but it seems probable that any obscurity which may exist on the subject occurs from the impression that similar symptoms are necessarily produced from precisely the same causes. It appears reasonable, however, to believe that, if the infecting matter of Asiatic cholera, when introduced into the intestinal canal, induces changes such as we have described, decomposing animal or vegetable substances, under certain conditions, may excite analogous changes in the mucous membrane of the alimentary canal, the consequence being that in both diseases a drain of serous fluid takes place from the bowels, followed by symptoms of cholera. In the case of Asiatic cholera, however, we believe that the discharges have the power, under favouring conditions, of propagating the disease, whereas the evacuations in simple cholera are in this respect barren. Doubtless climatic and meteorological influences very materially affect the susceptibility of the human subject to disease, and consequently we find that simple cholera, like the malignant form of the malady, is apt to prevail as an epidemic in moist or wet seasons of the year, and especially among people whose bodies are predisposed to pass into a diseased condition, from their having habitually breathed impure air, and consumed unwholesome food and water, or become debilitated from other causes.

In a hot and moist climate like that of lower Bengal, choleraic diarrhœa is an affection which we meet with at all seasons of the year, and it is especially prevalent among infants who are being reared on cow's milk, or on other kinds of food prone to undergo putrefaction. Among the fish-eating Hindoos the writer has frequently seen several members of the same family who have been seized with symptoms of simple cholera, attributable to the patients having partaken of fish which was slightly tainted. In fact, according to his experience, there are few more certain sources of this form of cholera than fish which has gone bad; and it is very evident that whatever the deleterious influence may be which food of this description contains, the mere fact of keeping it in boiling water for some time does not destroy its pernicious qualities.

It occasionally happens that cases of choleraic diarrhœa occur among people residing in malarious districts, the diarrhœa taking the place of the cold stage of a fit of ague; patients under these circumstances have been seized with all the symptoms of severe cholera, but they have, almost invariably, recovered from the attack.

Symptoms.—Choleraic diarrhœa begins suddenly; that is, the patient, whether an infant or an adult, has probably up to the commencement of the attack been in good health; there are in fact seldom any premonitory symptoms. A child may perhaps look somewhat paler than usual, and has a dark ring under his eyes, but beyond this appears to be perfectly well. Shortly after taking food, the infant vomits up a quantity of uncoagulated milk, the evacuation not being curdled like that from an overloaded stomach, the gastric secretion no longer having the power of coagulating the casein of milk. Soon after vomiting, or it may be before, the child commences to pass from the bowels an acid greenish-yellow fluid, containing flakes and often lumps of undigested food. The little patient becomes very thirsty, restless, and is evidently in considerable pain, crying, and drawing his legs up towards the abdomen. If these symptoms continue the evacuations become colourless, resembling in appearance the rice-water stools of Asiatic cholera. The temperature of the body falls, the face becomes of a dusky hue, the features are contracted, and the eyeballs deeply sunk in their sockets; the fontanelles are depressed, the child is evidently terribly prostrated, his pulse can no longer be felt at the wrist, and his crying passes into a weak whimpering, he eagerly drinks water when offered him; and, as the exhaustion increases, convulsions supervene, and the child dies within a few days or even hours. On the other hand, the symptoms may abate at any stage of the disease, and the little patient gradually recovers his health.

In the adult the symptoms induced by choleraic diarrhœa are much the same as those above detailed. There are seldom any premonitory symptoms, and the attack begins with nausea and vomiting, together with a sensation of exhaustion referrible to the pit of the stomach; the vomiting is speedily followed, or it may be preceded, by purging; copious watery discharges are thus passed out of the body, and the larger and more rapid the evacuations, the more they come to resemble the serum of the blood, which, in fact, drains into the intestinal canal, and passes away from the stomach and bowels. The patient naturally complains under the circumstances of intense thirst: he is very restless, and at the commencement of the attack suffers from colicky pains in the abdomen, and subsequently from spasms and cramps which often seize the muscles of the extremities. The pulse becomes small and weak, the respiration is hurried, the voice feeble, and the countenance pale and shrunken. The urine is scanty or suppressed, and the temperature of the body falls one or two degrees below the usual standard. These symptoms, as a rule, gradually subside, the purging and vomiting cease, and the patient falls off to sleep, waking more or less exhausted in proportion to the severity of the attack, but he usually recovers his health rapidly.

Diagnosis.—The question naturally arises, are there any means by which we can distinguish a case of choleraic diarrhœa from one of Asiatic cholera? and in reply it may be affirmed that there is no characteristic symptom by which these affections can be diagnosed from one another. But, taking all the circumstances of any particular case into consideration, it is difficult, except on paper, to confound the two diseases; for unless a patient has recently imbibed the poison which produces Asiatic cholera, he cannot be suffering from that malady. Should the sick person reside in a neighbourhood affected by Asiatic cholera, we must, in forming an opinion as to the nature of the affection, be guided by the previous history of the case, the nature of the food consumed, and so on, and, above all, by the severity of the symptoms. Choleraic diarrhœa, even in the tropics, rarely passes on within a few hours from the commencement of the attack into collapse, such as is commonly seen in cases of Asiatic cholera; and, in the early stages of the former disease, there is seldom that complete loss of voice and pulse so characteristic of the malignant form of this affection. An experienced medical practitioner, placed at the bedside of a person suffering from Asiatic cholera, even in its earliest stages, feels no doubt whatever as to the nature of the affection, and is at once impressed with the grave responsibility of the charge which rests upon him; his anxiety is infinitely less when he meets with an instance of choleraic diarrhœa, although he is unable to lay down any hard and fast rules by means of which he could define the difference that exists between the symptoms present, and those occurring in a case of Asiatic cholera.

Prognosis.—Although choleraic diarrhœa in its more severe forms resembles mild cases of Asiatic cholera, it is a comparatively harmless disease. Unless among young infants, or old and sickly people, no matter how threatening the symptoms may be, however great the collapse and depression of the patient may seem, a previously healthy adult seldom dies of choleraic diarrhœa.

Treatment.—In cases of simple cholera occurring among children, the important point we must enforce in our treatment is that the affected organ shall have rest. In practice, however, it is often difficult to persuade parents and nurses that an infant can exist uninjured for ten or fourteen hours on iced water; nevertheless, we must insist on a plan of this kind being carried out. The little patient will eagerly swallow cold water, either from a bottle or spoon, and the child may be allowed to take as much cold water as he requires, and to suck ice, which may be wrapped up in the corner of a handkerchief and put into his mouth. A poultice made of equal parts of mustard and flour, applied over the abdomen, is often very useful in this form of disease. With reference to drugs, should the treatment above indicated not relieve the symptoms, or should the vomiting be very constant, four grains of calomel may be given, and repeated if necessary in an hour's time; but if the diarrhœa is the more prominent symptom, calomel is not required, but a teaspoonful of castor oil should be administered, and after the bowels have been cleared out, if the serous discharge continues, we should order astringents, in the form of $\frac{1}{8}$ of a grain of acetate of lead every hour, or $\frac{1}{16}$ of a grain of nitrate of silver, until the purging subsides. Tannic acid, in combination with dilute sulphuric acid and sugar, is frequently a useful combination to administer to children in cases of this description. With reference to opium, much as the writer dislikes prescribing it for infants, it may be necessary in cases of simple cholera, but it should hardly be given in a mixture to be administered from time to time by a nurse; opium under these circumstances can only be admissible when given by the medical attendant himself, in doses of two or three drops of laudanum in a little weak brandy and water, carefully watching its effects. If the drug causes the child to sleep for a few hours it may act almost like a charm; the infant awakes comparatively well; but if the opium has no such effect, we may be tempted to repeat the dose, but can scarcely give it a third time, at any rate until some hours have elapsed since the administration of the second dose. The symptoms having subsided, the child's diet must be strictly attended to, a good healthy wet-nurse as a rule being an urgent necessity in the case of infants. Lime-water may with advantage be mixed with the child's food.

With reference to the treatment of adults suffering from choleraic diarrhœa, we must bear in mind the fact that, unless among old and debilitated persons, the patient will, as a rule, get well without medicine. If therefore called to prescribe for a case of this complaint, we may order fifteen drops of laudanum, or a drachm of the compound tincture of camphor in water, to be taken (supposing the patient is very sick) immediately after vomiting; half the above dose may be given at the expiration of one hour, and again after another hour, unless the symptoms have in the meantime subsided. A large mustard poultice should be applied over the abdomen, and the patient must be confined to bed, and kept on ice and iced water; he should not, however, be permitted to swallow too much liquid. Among old or weakly persons, and also in the case of infants, it is often very necessary to administer brandy and water from time to time, according to the state of the pulse. If the vomiting is severe, a scruple of calomel may be given to an adult, or in the first instance the effervescing mixture with hydrocyanic acid may be employed to allay the sickness; on the other hand, should the serous diarrhœa be excessive, we may with advantage prescribe four grains of the acetate of lead and ten drops of diluted acetic acid every second hour; or pills containing a drop of creasote, a quarter of a grain of nitrate of silver, a grain of camphor, and two grains of Dover's powder, to be repeated after each loose motion. C. Macnamara.

CHOLERINE.—A term applied to a class of cases which occur during the prevalence of cholera, in which the milder symptoms of the disease are present. It has also been used to designate the poison on which cholera is supposed to depend. *See* Cholera; and Choleraic Diarrhœa.

CHOLESTEATOMA (χολή, bile; στέαρ, suet; and ὁμὸς, like).—An encysted tumour, consisting chiefly of cholesterine. *See* Cysts.

CHOLESTERINE. *See* Appendix.

CHORDEE (χορδή, a harpstring).—Definition.—Painful imperfect erection of the penis during gonorrhœa.

Ætiology and Pathology.—Chordee is most common in the second and third weeks, and rarely attacks the patient after the third week of gonorrhœa. In exceptional cases, on the contrary, chordee, absent in the acute stage, is violently developed after the inflammation has become chronic and very slight. The bulbous part of the urethra is generally intensely inflamed when chordee happens; and, further, chordee is very uncommon when the urethritis is limited to the anterior or posterior portions of the canal.

The *mechanism* of chordee is imperfectly understood. Two explanations have been put forward:—(*a*) That the corpus spongiosum surrounding the urethra being affected by inflammation through the effusion of lymph into its substance, proper distension of its spongy tissue and elongation during erection cannot take place. Hence it is drawn tight like a bowstring by the arching of the distended corpora cavernosa. (*b*) That the inflammatory condition of the mucous membrane and submucous tissue at the bulbous part excites reflex spasm of the muscles surrounding that part of the corpus spongiosum. This prevents distension of the parts compressed; while the corpora cavernosa, being untrammelled, continue to expand in the ordinary manner. The first explanation is insufficient to account for some cases where the inflammatory action is very slight and there is no evidence that lymph has been effused into the erectile tissue; for example, after a plastic operation on the penis. Again, natural erection has been known to take place very shortly after the subsidence of gonorrhœal irritation, and, it is fair to suppose, before effused lymph can have been absorbed. The second explanation is unsatisfactory, because spasm of other muscles of the perinæum is often absent. Probably both methods may be active in producing chordee.

The causes of chordee are *indirect* or *direct*. The most common indirect cause is urethritis or urethral congestion. Direct causes are the reflex irritants which usually produce erection during sleep, such as stimulating food and drink, strongly acid urine, great superficial warmth of the body, distended bladder, lascivious dreams, &c.

Symptoms.—The organ grows suddenly turgid and assumes a bowed or crooked form, causing acute pain, which is felt at the part and towards the perinæum. In severe cases the strain causes rupture of the mucous membrane and spongy tissue, with hæmorrhage. The loss of blood is usually limited to a few drops, and gives relief to the pain. Rarely the hæmorrhage is rapid and prolonged.

Treatment.—Abstinence from stimulants of all kinds and late suppers; light clothing; and a hard mattress at night are the best means of preventing chordee. Micturition at short intervals during the night must be enjoined. Of medicines the best is a suppository at bed-time of one grain of crude opium in ten grains of cocoa butter. The subcutaneous injection into

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the perinæum of one-sixth grain of acetate of morphia is also an effectual remedy. Both these applications should be followed by an aperient saline draught the next morning. A drachm of spirit of camphor thrown just before it is swallowed into an ounce of water, and taken on lying down at night is also useful, and it may be repeated once if chordee awaken the patient, but it is a very uncertain remedy. More trustworthy are twenty or twenty-five grains of chloral-hydrate in syrup and water at bed-time, and repeated in four or six hours if needed. Bathing the genitals and perinæum with very hot water for ten minutes before going to bed sometimes proves successful. The application of a spiral coil of narrow india-rubber tubing round the penis and scrotum, through which a continuous current of ice-cold water flows, is also an excellent preventive.—To disperse an attack of chordee the best remedies are voiding urine; the application of cold to the perinæum by evaporating lotion or by ice; and the upright posture.

BERKELEY HILL.

CHOREA (χορεία, a dance).—SYNON.: Chorea Minor; St. Vitus's Dance; Fr. *Danse de St.-Guy*; *la Chorée*; Ger. *Veitstanz*.

DEFINITION.—A disease of the nervous system, characterised by a succession of irregular, clonic, involuntary movements of limited range, occurring in almost all parts of the body.

The distinctive features of the movements are the entire absence of either rhythm or method in their recurrence; that not individual muscles but co-ordinated groups are affected; and not one or more groups only, but almost all the muscles in turn. There is not actual loss of command over the muscles, but voluntary movements are interfered with by superaddition of involuntary movements. As a rule the movements cease during sleep.

ÆTIOLOGY.—Chorea is a disease of childhood; it is most common between the ages of eight and twelve, very rare before six, and rare after sixteen; it is more than twice as frequent in girls as in boys, especially after the age of nine. It occurs more frequently in families in which nervous diseases are hereditary than in others. It is more common in large towns than in the country; and far more frequent among the poor than among those in comfortable circumstances. Want of proper food, neglect, ill-usage, with the weakness and anæmia induced by these means, are very common antecedents. Children well-nourished and with a good colour, exposed to none of these causes, may however suffer. An intimate association between chorea and rheumatism has long been recognised. A large proportion of the children suffering from chorea are found to have had acute or subacute rheumatism, and some of the most terrible cases met with, especially after the age of puberty, are those in which the chorea comes on during or just after acute rheumatism. Whether traceable to rheumatism or not, there is very frequently found in chorea a cardiac murmur, usually mitral systolic, sometimes aortic. This may or may not disappear after recovery. In almost all the fatal cases of chorea which have been examined after death, endocarditis with fibrinous vegetations on the valves has been present. In adults, pregnancy divides with rheumatism the causation of this affection; recovery generally speedily follows delivery, and can rarely be brought about till this has taken place. Bad habits, and disorders of menstruation, are also said to be capable of inducing chorea. Intestinal worms again have appeared to set up the disease, and instances are on record in which the expulsion of worms has been followed at once by cessation of the movements, but this must be extremely rare. Fright or some powerful emotion is very frequently assigned as a cause; and it is seldom that parents are not prepared with the instance required. But, making allowance for this, and notwithstanding the fact that endocarditis may be present in cases said to have originated in fright, it does not seem possible to exclude fright as a cause of chorea. The influence of imitation is less certain. The disease is said to be far less common in negroes.

ANATOMICAL CHARACTERS AND PATHOLOGY.—The study of chorea, as of epilepsy and many other affections of the nervous system, has been hampered by its being regarded as a morbid unity. The view here maintained is that it is a sympton rather than a disease, and that the characteristic movements are in relation not with the *nature* of the morbid change but with its *seat*. The seat of the disturbance is the corpus striatum, its character probably different in different cases; but the anatomical condition cannot amount to actual breach of structure, since that is known to give rise to hemiplegia, while it must obviously be of a kind to impair the functional vigour of the ganglia. Chorea, as the writer has said elsewhere, has been called 'insanity of the muscles'—a better phrase would be 'delirium of the sensori-motor ganglia.' In delirium there is loss of control over the mental processes with rapid succession of incoherent and imperfect ideas; in chorea loss of control over the motor apparatus, with movements excessive in point of number and extent, but wanting in vigour and precision.

In some cases of chorea nothing abnormal has been detected after death, but usually the minute methods of investigation now pursued yield positive results. The largest series of examinations published is contained in a communication to the Medico-Chirurgical Society, in the session 1875–6, by Dr. Dickinson. He describes dilatations of the minute arteries as existing throughout the brain and cord, more especially, however, in the corpus striatum and thalamus, with small hæmorrhages; and considers the disease to be due to a widely-spread hyperæmia of the nerve-centres. He did not find capillary embolisms, but does not appear to have drawn out the arterioles to look for them. The appearances he describes are very much those producible by impaction of microscopic particles of fibrin in the minute vessels. Capillary embolisms have been found by Dr. Tuckwell and other observers, predominantly in the central ganglia, but also in the convolutions and cord, accompanied by patches of softening and minute hæmorrhages. In almost all fatal cases of chorea there is endocarditis with deposit of beads of lymph on the mitral or aortic valves or both, whether a murmur has been audible during life or not.

The post-mortem appearances consequently do not indicate any localisation of the morbid change in the central ganglia. But it is to be remembered that the fatal cases are those in which there is not only extreme violence in the choreic movements but usually also delirium and other symptoms. There are in fact multiple symptoms just as there are multiple lesions, and we are called upon to distribute the symptoms and assign them to their respective sources by such knowledge of the functions of the different nerve-centres as physiology affords us. The delirium or comparative dementia is thus attributed to the lesions in the convolutions; the loss of speech to lesions in convolutions or in lower centres, according to its character; the impairment of sensation to lesions in the thalami; the chorea to lesions in the corpora striata. The grounds upon which this last localisation—that in which we are immediately concerned—is decided, are as follows. We exclude the cerebral hemispheres and cerebellum, rather arbitrarily perhaps, since there is much to be said in favour of their contributing to excite the movement, now especially that convolutional motor areas have been demonstrated by Hitzig and Ferrier. The important point to be made clear, however, is that chorea has not its seat in the cord. The arguments and evidences against this are (1) That *tonic* and not *clonic* spasm is characteristic of persistent spinal irritation; (2) The degree of control over the movements retained by the will; (3) Their increase under emotion; (4) Their cessation during sleep. To those which were originally advanced by Dr. Russell Reynolds may be added: (5) The diminished reflex action on tickling; and (6) The phenomena of hemichorea and its relations with hemiplegia. The evidence afforded by hemichorea is so conclusive that other considerations have been merely alluded to. It cannot be supposed, for example, that one lateral half of the entire length of pons, medulla, and cord can be affected without implication of the other half, which would be the case with hemichorea of spinal origin; and still more conclusive is the fact that when in hemichorea there is impairment of sensation it is on the same side with the movements, and not, as in hemiparaplegia (due to division of one half of the cord), on the opposite side to the motor paralysis. The parallelism between hemichorea and hemiplegia is so perfect as to suggest at once that the two affections represent different conditions of the same nerve-centres, and is made more complete by the very discrepancies, as they may at first sight appear, which have been considered to be objections. In hemiplegia there are certain muscles which more or less completely escape paralysis: the motores oculorum, orbiculares palpebrarum and other facial muscles, the muscles of the neck, chest, back, and abdomen. In hemichorea the irregular movements cross the median line and invade the opposite side in these same muscles. This has been explained (rightly or wrongly) by the hypothesis that all these muscles acting in compulsory concert with the corresponding (or other) muscles of the opposite side, the nerve-nuclei of the bilaterally associated muscles will be commissurally associated in the cord, so as to become in effect a single nucleus, and this single nucleus for muscles on each side of the body being connected with both corpora striata is thrown into action by the sound corpus striatum when its fellow of the opposite side is damaged, as in hemiplegia, thus preventing paralysis; and, on the other hand, is reached by the irregular impulses from the corpus striatum affected in hemichorea, thus causing bilateral chorea in the parts enumerated.

In addition to the correspondence between hemichorea and hemiplegia just described, there are transitions from one to the other, and combinations of the two to be mentioned below, under the head of complications. Hemiplegia may be succeeded by hemichorea (the *post-hemiplegic chorea* of various observers); or chorea may deepen into paralysis; or, as in a case reported by the writer, there may be with chorea of the limbs on one side, first chorea, then paralysis (hemiplegiform), and then again chorea of the same side of the face. The conclusion is obvious, that hemiplegia and hemichorea in these cases are indicative of different degrees of damage in the same centre. Hemichorea and hemianæsthesia have been found very constantly associated with structural lesions in the white fibres just outside the posterior extremity of the thalamus, usually involving also the ganglion itself at this part.

The well-known embolic theory of chorea originated by Kirkes, and improved and ably maintained by Dr. Hughlings Jackson, at once finds its place here. Capillary embolism is of all others the condition which might be expected to induce the instability without abolition of function which exists in chorea, and in almost all cases a fertile source of fibrinous shreds is present, in the form of vegetations on the valves of the heart; the fact of embolism, again, has repeatedly been demonstrated. While, however, giving to capillary embolism a prominent place among the causes of chorea, it cannot be considered as the only cause. The clinical differences between ordinary chorea and the acute and fatal form are of themselves suggestive of a different pathology; and the speedy recovery after delivery in the chorea of pregnancy, or (as in one or two cases on record) after expulsion of intestinal worms, is inconsistent with the existence of embolism. What the precise anatomical condition is can only be matter of conjecture, but it will be some form of innutrition, irritability, and debility, as Dr. C. B. Radcliffe has abundantly demonstrated, going together. Hyperæmia, with capillary blood-stasis, or capillary thrombosis by cohering leucocytes, has been suggested as the cause. Prolonged arterial spasm from persistent reflex irritation, uterine or intestinal, or the more brief contraction of the cerebral vessels from fright, may perhaps lower the functional vigour of the ganglia to the degree required. A very important consideration is the remarkable limitation of chorea to the period of childhood—the period between infancy and puberty. This is a limitation, if not without parallel, certainly unequalled, and it points to a condition of nerve centres in childhood which specially favours the occurrence of the disease. This condition may be said with confidence to be the fact that childhood is the period of special activity of the sensori-motor ganglia.

SYMPTOMS.—In a slight case the patient, usually a child, may be perfectly quiet when lying down, and for a short time even when sitting or standing, if not conscious of being under observation; but when walking or while under examination there will be various fidgety actions, abrupt flexion of the fingers, a sudden pronation of the forearm, or hitching up of one shoulder, or twist of the body, or there is shuffling of a foot on the floor, or again a jerk of the head or twitch of the mouth or eyes. If the patient be told to do anything, the movements will be multiplied and exaggerated in the muscles employed. A small object will be picked up and held, but the hand is brought down upon it hastily and after various irregular excursions. In a more severe case the grimaces, contortions, and jerkings succeed each other without intermission. The gait is now very peculiar, being slow, shuffling, and uneven; the steps of irregular length and unequal time; and the line of progress deviating. In the worst forms of this disease every muscle appears to be thrown in turn into violent contraction, the face is distorted this way and that, the eyes roll to and fro, the teeth are snapped or ground together, the whole body writhes, and the limbs are in unceasing motion. It is to be remarked that, even in extreme cases, the movements, violent as they may be, are in some degree circumscribed; the arms, for example, are not thrown up over the head, nor do the legs go to the full extent of their range of motion; the tongue is rarely bitten, though the lips may be. Deglutition is greatly interfered with in a severe attack, and the evacuations may be discharged involuntarily. In the mildest forms, the diaphragm and muscles of the chest and abdomen are affected, causing irregularity in respiration. The action of the heart may also be irregular, but this is probably secondary to the respiratory variations in frequency and depth, and is not attributable to chorea of the heart. There is generally impairment of motor power, and frequently diminution of sensation. This is most readily ascertained in hemichorea, *i.e.* chorea affecting one half of the body only, when the sound side can be employed for comparison; but in the violent forms of the disease, when the skin is gradually worn through by incessant friction, there is often so little complaint of pain that sensibility must, it would seem, be blunted. Reflex sensibility is also, commonly, dull.

It has already been stated that the movements cease during sleep; this is a rule to which exceptions are rare though not unknown, even in mild cases, and especially in hemichorea.

Chorea is usually gradual in access, even in the cases which ultimately become severe; it is very commonly one-sided for a time, and occasionally throughout, when the name hemichorea is given. It is not, however, strictly unilateral in these cases, as the movements transgress the median line and affect the corresponding muscles of both sides of the body at those parts where these are bilaterally associated, and where in hemiplegia there is immunity from the paralysis, as for instance the oculo-motor muscles, the muscles of the neck, chest, and abdomen.

COMPLICATIONS.—The foregoing description applies more or less to all cases of chorea, but there are often additional symptoms, and it will conduce to clearness if these are considered apart and called complications. Mention has been made of impairment of motor power; at times this amounts to complete paralysis, and the relations and combinations of chorea and paralysis, and especially of hemichorea and hemiplegia, throw much light on the disease. Chorea sometimes succeeds hemiplegia in the paralysed parts; more rarely chorea deepens into paralysis. Cases again occur in which with facial hemiplegia there is chorea of the limbs of the same side. Speech is very commonly more or less affected and occasionally completely lost for a time. The difficulty is usually articulatory, chorea of the muscles of respiration, phonation, and articulation interfering with utterance of words; but there is in some cases true aphasia, and when this is so, there is the same tendency to the association of aphasia with right hemichorea as with right hemiplegia. The intellect may suffer in various degrees: the face has often an idiotic expression in chorea, usually no doubt from the muscular contortion or atony, but sometimes truly indicative of temporary imbecility. In the violent and fatal forms of chorea there is almost always delirium. Impairment of sensation is common, and hemianæsthesia is almost always associated with hemichorea.

DURATION, TERMINATIONS, AND PROGNOSIS.—The average duration of chorea is about two months; if prolonged beyond three months it may be exceedingly chronic and go on better and worse for one or two years. There is a tendency to spontaneous recovery, but on the other hand relapses are common. Chorea is rarely fatal in children; when it is so the case is usually acute and violent from a very early period of the attack, and it is rare for a case to run the usual course for a time and then take on a very severe character. After puberty and especially when it supervenes on acute rheumatism, it is very dangerous, but less so when associated with menstrual disorders and pregnancy than in youths or men.

DIAGNOSIS.—It is only necessary under this head to warn against the mistake of confounding with the movements of chorea the tremor or jactitation of disseminated sclerosis of the nerve-centres, which, though most common in adults, is not unknown in childhood.

TREATMENT.—In a large proportion of cases of chorea, especially such as come into the hospitals of London, rest and food, with perhaps aperients, are all that are required for recovery. But it can scarcely be denied that medicinal treatment often renders important services, especially in cases of a lingering character. The causation and pathological condition being various, it is to be expected that the remedies required will be different, and the attempt should be made to adapt the treatment to the special features of the case, the basis of all being the endeavour to improve the nutrition of the body generally, and of the nervous system, by good food, rest, and warmth. The food may be supplemented by cod-liver oil, and Dr. C. B. Radcliffe attaches importance to the free administration of wine or other stimulants. Any recognised cause should be removed, such as constipation or worms; irregularities or suspension of the catamenia should receive attention; when there is pregnancy it may perhaps be necessary to induce premature labour. When the chorea is accompanied by rheumatoid pains and feverishness, iodide of potassium with ammonia may have a remarkably good effect. Iron in some form or other is very generally useful, but especially when the patient is anæmic. Another remedy is sulphate of zinc, given in doses gradually increasing from one or two grains three times a day, to six, eight, or ten, till sickness is induced, when in some cases the disease appears to be cut short. The remedy which in the writer's experience has been found most generally useful is arsenic. Trousseau sometimes gave strychnine in gradually increasing doses till its physiological effects manifested themselves. On the other hand, conium, recommended by Dr. John Harley, has been extensively employed; the only reliable preparation is the juice, which should again be given in gradually increasing doses, beginning with a drachm and going up to one or two ounces if necessary, till its depressing effect on the muscles becomes evident. It has not, in the writer's hands, given satisfactory results; the same may be said of the application of ether-spray along the spine, which has recently been strongly recommended, except in acute cases in which the freezing of the skin here has in two cases been followed at once by sleep, and in a few days by alleviation of the violence of the chorea. Baths, warm and cold, especially shower-baths, spinal douches, spinal ice-bags, gymnastics, musical gymnastics, *i.e.* movements timed by music, have advocates and may no doubt be useful in suitable cases.

In the terrible cases of acute chorea the great indication is to procure rest for the poor sufferer and keep up the strength. Milk, eggs, beef-tea and other forms of concentrated fluid nourishment, should be given freely, together with wine or brandy. Conium, hyoscyamus, bromide of potassium or ammonium, and chloral, have been tried separately or in combination, with more or less appearance of success; chloroform, again, may be administered; chloral by the mouth or rectum, and hypodermic injection of morphia with free administration of brandy have in the writer's judgment appeared to do much good. It is in these cases that tartar emetic in full doses has been recommended; it is certainly tolerated in an astonishing degree. Restraint of the violent movements is often a great comfort to the patient; the limbs should be carefully bandaged with flannel and bound, the legs together, the arms to the sides, a folded blanket, across the abdomen and hips, keeping down the body. If half-done it only adds to the suffering, but when properly carried out it gives a feeling of relief and favours sleep. W. H. Broadbent.

CHOROIDITIS.—Inflammation of the choroid. *See* Eye, Diseases of.

CHROMIDROSIS (*χρῶμα*, colour, and *ἱδρώς*, sweat), coloured perspiration. *See* Perspiration, Disorders of.

CHRONIC (*χρόνος*, time).—This word is applied to a disease when its progress is slow and its duration prolonged. *See* Disease, Duration of.

CHYLOUS URINE.—*See* Chyluria.

CHYLURIA (*χυλὸς*, chyle; and *οὖρον*, urine).—Synon.: Galacturia; Chylous urine; Fr. *Urine laiteuse*; Ger. *Die Chylurie*; *milchsaftiger Harnabgang*.

Definition.—A diseased condition, occurring in tropical and sub-tropical climates, which manifests itself by a milky appearance of the urine, accompanied usually with more or less distinct traces of blood. On standing, the fluid coagulates, so as to present the appearance of size. A microscopic nematoid entozoon (*Filaria sanguinis hominis*) is generally found in the blood and urine of persons affected with the disease.

General Description.—The affection known as chylous or chyloid urine has long remained a puzzle to physicians, not only on account of the very remarkable character assumed by the secretion, but also on account of the very erratic course which the disease runs. Scarcely any two persons affected with this malady give a similar account of its mode of onset, of the duration of the attack, or of the symptoms and seasons of its occurrence. The writer has had the opportunity of studying from thirty to forty cases of the disease in Calcutta, and the variety of symptoms presented, and the numerous causes, of the most opposite character, to which the disease has been attributed, are very perplexing. The histories of the cases published by various observers present a like uncertainty, and Dr William Roberts very aptly describes the course which the disease runs as marked by an irregularity and capriciousness which baffles explanation. It would seem as though the one symptom which may be looked upon as constant is the condition of the urine implied by the designation which was applied to the disorder by Prout.

This symptom, however, although very applicable to the generality of cases met with in India, does not appear to be so generally applicable to the disease as it occurs in Egypt, the Brazils, and the West Indies. In these countries the term *hæmaturia* is adopted as being a more correct description of the malady, whereas in India the designation 'hæmaturia,' though generally more or less applicable at some period or other of the disease, is, nevertheless, not so appropriate in the great majority of the cases, and, indeed, in some instances is wholly inappropriate, as occasionally no marked traces of red colouring matter can be detected in the urine from the beginning to the close of the attack. It is of importance that this feature in connection with the disease should be borne in mind, as it may hereafter be found that what at present are generally considered as merely two phases of one malady may each have a distinctive ætiology.

History and Geographical Distribution.—The phase which chyluria usually presents in India is, in this article, taken as the typical one, and its history may be thus briefly epitomised. To Dr. Vandyke Carter belongs the credit of having observed systematically, and seriously attempted to clear up the pathology of the disease. His researches, published in 1861-62 tended to show that a direct admixture of chyle and urine occurred—a leak from the lymphatic tract into the urinary.[1] In March 1870, when examining a specimen of milky urine passed by a man under the charge of Dr. R. T. Lyons in Calcutta, the writer found that it contained numerous microscopic nematoid worms in a living condition. These were described and figured in a report published in 1870 by the Indian Government.[1] Under the impression that no nematoid parasites had previously been found in the urine, specimens were forwarded to the late Dr. Parkes, and by him shown to Professor Busk, who suggested that probably they belonged to the Filaridæ. Similar entozoa were detected in the urine of chyluria patients in Calcutta by Dr. W. J. Palmer and Dr. Charles in the course of the next few months. Towards the beginning of July 1872 the writer found nine minute nematoid worms in a state of great activity on a slide containing a drop of blood from the finger of a Hindoo. These were identical in character with those above referred to. Unfortunately the man could not be found after the observation had been made, so as to be questioned as to his past history, so that the pathological conditions which might have been associated with this the first recorded instance of the existence of nematoid hæmatozoa in man must continue to remain in obscurity. However, since this period the writer has traced the helminth (named *Filaria sanguinis hominis*) to the blood *direct* in about fifteen, and to one or other of the various tissues and secretions of the body in about thirty-five individuals. All with the exception of the person just referred to were known to suffer or to have suffered from chyluria or some closely allied pathological condition.[2] These observations have, moreover, been confirmed by others in numerous instances.

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[1] *Transactions Med. and Phys. Soc. Bombay*, vol. vii, 1861. *Medico-chir. Trans.*, vol. xlv., 1862.

The more recent history of the variety of the disease usually referred to as 'hématurie graisseuse,' 'hæmaturia Braziliensis,' 'hæmaturia Egyptica,' is also associated with an entozoon—or rather with two distinct kinds of entozoa—a fluke and a nematode. The former was discovered in 1851 by Bilharz. His observation was followed up, and now it is estimated that about a third of the inhabitants of Brazil harbour this parasite in their bodies. In 1868 Dr. Otto Wucherer, of Bahia, discovered a microscopic entozoon, which he forwarded to Leuckart to be identified.[4] The latter writer suggested that it might be the embryo of some round worm, probably belonging to the strongylidæ. Dr. Jules Crevaux, a French naval surgeon, succeeded in confirming Wucherer's observation by finding (July 27, 1870) similar helminths in the urine of a young creole affected with 'hematurie chyleuse.'[5] The next link in the chain appears to have been furnished by Dr. Sonsino, who, in January 1874 (having no knowledge of previous observations of a like character), found similar parasites in the blood and in the urine of a Jew lad at Cairo affected with hæmaturia. In the latter fluid distomata also were found. This observer, however, considers that these parasites, though bearing a very close resemblance, differ in some respects from those found in chyluria, and has accordingly added the word *Egyptica* to the original designation for the purpose of distinguishing it. It is possible that the microscopic nematode which was discovered by Wucherer in Bahia may also be traced to the blood eventually, and that the slight differences in the recorded characters in the worm as found in Egypt and in the Brazils from that found in India may be shown to be sufficient to indicate a specific difference in the parasites, and thus offer a satisfactory explanation of the discrepancies observed in the character of the urinary disorder in the different countries.

In Europe the disease has been investigated by several observers. The cases which have come under their care have occurred with very rare exceptions in persons who have at some time or other resided in countries situated between about 30° north and 30° south latitude. Of the four or five cases which have been recorded as having originally occurred in Europe, one is furnished by Dr. William Roberts, the patient never having been out of Lancashire; and another by Dr. Beale, in a person who had never resided out of Norfolk.[1]

SYMPTOMS.—So far as is at present known, there are no premonitory symptoms of chyluria. Sometimes the only symptom is the milky condition of the urine—a condition which usually comes on very suddenly; generally, however, the patient complains of uneasiness, scarcely amounting to pain, across the loins, along the ureters, over the bladder, or along the course of the urethra—especially towards the perinæum in the male. There is generally marked debility, with mental depression. Occasionally chylo-serous discharges take place from various parts of the body—the axilla, the surface of the abdomen, the groin, and especially from the scrotum, in that condition of it which is known as Elephantiasis lymphangiectodes (Bristowe), Nævoid elephantiasis, or Varix lymphaticus. The disease is also sometimes observed associated with true elephantiasis of the limbs and scrotum. It occurs at all ages, from childhood to extreme old age, and in about equal proportion among the sexes—perhaps more frequently in the female than in the male.

With regard to the *urine*, it presents, as already mentioned, a milky appearance, and frequently emits a strong milky or whey-like odour, which is made more evident by warmth. After standing a short time the fluid coagulates, so as to form a more or less semi-solid mass resembling blancmange. In the course of a few hours the clot breaks down, and the urine becomes rapidly decomposed. In some cases the fluid presents a pink colour, from the admixture of blood, but more commonly—at least, in India—the blood, when present, is seen forming a shreddy adherent coagulum at the bottom of the vessel. Not unfrequently the flow of urine is suddenly stopped during micturition by the blocking up temporarily of the urethra with one of the clots. Sometimes in India, but apparently almost always in the West Indies, South America, and Egypt, the presence of blood in the urine forms, as already mentioned, the most pronounced feature. The specific gravity varies greatly—may range in the same individual from 1007 to over 1020. Shaken up with ether the urine loses its milky aspect; and when nitric acid or heat is applied a precipitate almost invariably results. These characters, and the fact of the coagulability of the fluid, indicate the presence of fat, albumen, and fibrin, all of which are to be considered as abnormal constituents. The proportion, however, in which they exist in different individuals, and even in the same individual at different times, varies greatly. Dr. Beale's analyses show, that though a specimen of urine may contain at one time 1·39 per cent. of fat, another specimen, obtained a few hours later, from the same person, may contain none. In the majority of cases the fatty element is usually scanty in the morning before meals, and so are the other abnormal elements, unless exercise have been taken or the circulation otherwise accelerated. Under the latter circumstance, as Dr. Bence-Jones has shown, the albumen is increased, without, however, a corresponding increase of the fat.[1] It is evident, therefore, that in order to institute a comparison between the character of the urine and the character of the various nutritive fluids for the purpose of ascertaining from which of them the abnormal constituents of the urine are derived, the results of analyses of the latter fluids at different times of the day and at different stages of the disease should be taken. Further, as the nutritive fluids themselves undergo constant changes dependent on the quality of the nourishment supplied and the time which has elapsed since partaking of it, it is equally evident that any single analysis would be insufficient. An attempt has been made to bring together in the following table all of what appeared to be the most trustworthy analyses of these fluids which have been published. In order to simplify the table, only the estimates of the albuminoid and fatty matters have been given, these being the most pronounced of the more readily estimated abnormal constituents in the urine:—

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[1] *Vide* abstract of this description in *British Medical Journal*, Nov. 19, 1870.

[2] 'On a Hæmatozoon in human blood; its connection with Chyluria and other diseases.' *Vide Eighth Ann. Rep. of Sanitary Commiss. with Govt. of India*, 1872; also *Indian Ann. Med. Science*, vol. xvi.

[3] 'On the Pathological Significance of Nematode Hæmatozoa.' *Tenth Report of Sanitary Commiss.*, 1874; also *Indian Ann. Med. Science*, vol. xvii.

[4] *Gazetta da Bahia*, Dec. 1868.

[5] *Journ. de l'Anat. et de la Physiol.* T. xi., 1875; and Leuckart's '*Parasiten*,' Band ii. S. 628 *et seq.*

[1] Dr. S. Mackenzie exhibited to the Pathological Society (October 1881) living specimens of filaria from a soldier who had served in India. He noticed the daily periodicity of the filaria, which had previously been determined by Dr. Manson of Amoy, and further showed that the periodicity could be inverted from day to night by changing the habits of the individual.

Constituents selected.	URINE in chyluria. [Mean of 15 analyses].	BLOOD in chyluria. [Hoppe-Seyler.]	BLOOD — Normal human. [Becquerel and Rodier.]	CHYLE [Mean of 6 analyses: man, cow, horse, ass, dog, cat.	LYMPH —human [Mean of 4 analyses].
Albuminoids	0·54%	3·35%	7·00%	7·08%	2·26%
Fatty matters.	0·80%	0·67%	0·06%	0·92%	0·56%

A glance at this table reveals the fact that the relative proportion of the albuminoids to the fatty matters in chylous urine does not correspond with the proportion in which they are found in any one of the nutritive fluids of the body. In normal blood, for example, the fatty matter is as 1 to 116 of the albuminoid, whereas in the urine the former exceeds the latter to a very considerable extent. The same discrepancy, but to a less degree, is found to exist when the urine and chyle are compared—the quantity of albumen in the latter being more than seven times greater than that of fat. The proportion of these substances in lymph approaches more closely to what is encountered in the urine—the fat being to the albumen as 1 to 4 very nearly. The specimen of chyluria-blood recently analysed by Hoppe-Seyler[1] approaches very closely to the average composition of human lymph—the fatty matters being as 1 to 5 of the albuminoid, thus differing in this respect very considerably from Dr. Bence-Jones' analyses of similar blood where the quantity of fat given is that of normal blood. On the other hand, the urine of the man from whom this blood was obtained yielded a proportion of fat almost identical with what Hoppe-Seyler obtained in the urine of the person whose blood he examined—the figures given by the former writer being 0·74 and by the latter 0·72 per cent. The composition of the blood in this affection must be regarded as hitherto unsettled. Guibort found in a clot of it almost twice, and Hoppe-Seyler about eleven times as much fat as is found in normal blood; on the other hand, Rayer, Bence-Jones, and Crevaux could detect no change in its composition. It is possible that the discrepancy in the results of these analyses and macroscopic examinations of the blood may be due in part to the particular moment when the blood was abstracted. According to M. Claude Bernard, 'Les urines chyleuses ressemblent au sang d'un animal en digestion, ou plutot à celui des oies que l'engraisse.'[2]

With regard to the *microscopic examination of the blood*, the writer has not observed that the corpuscles or serum presented any abnormality indicative of the presence of fatty matter in any form—the serum has seemed as clear and as free from molecular matter as normal blood. So far as his experience goes, the only feature worthy of special note in connection with microscopical examination of the blood in chyluria, is the presence of the hæmatozoon already referred to. In searching for it, it will be advisable to abstract by means of a needle a drop of blood from several fingers, and to submit each slide to a thorough examination, which may have to be very prolonged, employing for this purpose a comparatively low power—⅔" or ½" objective—a higher power being resorted to when the entozoon has been detected. It must not be expected that the blood will present any peculiarity to the naked eye, even though every ounce may contain thousands of these microscopic worms. The accompanying wood-cut, traced from a micro-photograph, accurately represents the size and form of the parasite. Its average length is $\frac{1}{75}''$ (=0·34mm.); its breadth $\frac{1}{3500}''$ (=0·007mm.), or about equal to the diameter of a red blood-corpuscle. It is enclosed in a transparent tubular sac, within which it can be seen to alternately contract and elongate itself. This sac is extremely delicate and translucent, and may sometimes, when the worm has shortened itself more than usual, be seen collapsed and folded like a ribbon, and the next moment be instantaneously straightened again, by the extension of the filaria to its ordinary length. After death the worm may occupy either the entire length of the tubular sac, or be so contracted as to leave the tube empty at one or both ends, as may be observed in the wood-cut.[1] The internal organs are not sufficiently differentiated to be recognised with anything like certainty, although when carefully scrutinised from time to time during the twenty-four or forty-eight hours that the parasites may continue to live, something like differentiation of an alimentary canal may be recognised.

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[1] *Phil. Trans. of Royal Soc.*, cxl., 1850, p. 651.

[1] *Med.-chem. Untersuchungen*, 1871, s. 551–56. Abstract by Dr. Ferrier in *Journ. Chem. Soc.*, vol. ix., 1871; page 740.

[2] Quoted by Crevaux, *op. cit.*

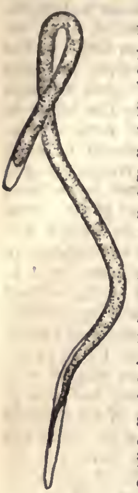

FIG. 11.
Filaria Sanguinis Hominis.
× 300.
(Traced from a micro-photograph.)

Microscopical Characters of the Urine.—The filaria may likewise be detected in the urine. One day it may be readily obtained in the blood but not in the urine, and *vice versâ*; but, as a rule, the parasite will be found equally readily in both fluids. In making a search in the urine, it is advisable to pick out one of the coagulated shreds generally found in it, transfer it to the glass slide by means of a forceps or pipette, and carefully tease the fragment before applying the cover-glass.

The other leading microscopical character of the urine is the minutely molecular matter—fat in an emulsified condition—to which the fluid owes its opaline or milky aspect. There are also numerous white, lymphoid corpuscles, together with red corpuscles, numerous or the reverse according to the degree of sanguinolence of the urine. Casts of the tubular structure of the kidney—indicative of organic disease of these organs—are seldom to be seen; they were absent in all the cases that have come under the writer's observation.

ANATOMICAL CHARACTERS.—The post-mortem examinations of persons who have died whilst affected with chyluria, also testify to the freedom of the kidneys from disease. This was the case in two autopsies conducted recently by Dr. McConnell in Calcutta. The writer had the opportunity of examining the kidneys of the first case, and of all the organs of the body of the other case, but could find nothing in any of the organs or tissues suggestive of being a cause of the urinary derangement, except the fact that all the vessels—arteries as well as veins—contained the filaria in their minutest ramifications. It may be further mentioned that the entozoon is present in the chylo-lymphous discharges which have already been referred to as sometimes accompanying chyluria. Of this the writer was able to satisfy himself in 1872, and repeatedly on subsequent occasions. In one of the instances the secretion flowed from the inner corner of the eye, several ounces of which escaped daily; the others were cases of elephantiasis lymphangiectodes, or nævoid elephantiasis of the scrotum. For a summary of what is known of the latter affection, the reader is referred to a carefully-written paper by Dr. Kenneth McLeod.[1]

ÆTIOLOGY AND PATHOLOGY.—Having considered in detail what seem to be the leading pathological features of chyluria, a brief reference may be made to the views which at present prevail regarding its ætiology. These may be comprised under three heads:—(1) Dr. Vandyke Carter advocates the view that a direct communication exists between the chyle-carrying vessels and the urinary tracts. (2) MM. Claude Bernard and Ch. Robin believe that the condition of the urine is but a symptom of piarrhæmia—fatty blood; the latter condition being but the normal condition of the blood for some time after the partaking of food, aggravated and made permanent by derangement of the digestive organs—notably the liver. One of these distinguished authors (M. Robin) suggests, further, that this derangement is probably induced in the liver and elsewhere by the filaria sanguinis hominis.[2] (3) The third view to be noticed is that advanced by Dr. W. Roberts. This view appears to be based mainly on the history of a very remarkable case, published by him in 1868. It was one in which a coagulable chylo-lymphous discharge escaped from open vesicles which had formed over the surface of the abdomen: the patient's urine was, moreover, chylous for two days. Dr. Roberts suggests that a condition somewhat similar to that on the surface of the abdomen existed in the urinary tract,—a sort of eczema—probably on the front of the bladder. Post-mortem examination did not however confirm this view, nor could anything be detected in any of the organs suggestive of a cause, but Dr. Roberts infers that this was probably due 'to the fact that in the last few weeks of life the morbid process had retrograded and had consequently left no appreciable marks on the surface of the bladder.' The examination of the skin in the diseased part showed that the *cutis vera* and the subcutaneous tissue were traversed by short channels or lacunæ from the width of a crow-quill to that of a hair. A careful study of this and other cases suggested to Dr. Roberts the view that one, at least, of the forms of chyluria may be due to hypertrophy of the lymphatic channels and subsequent acquisition by them of gland properties.

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[1] The microscopic worms detected by the writer (in July 1874) in the blood of dogs in India—presumably the same species as those discovered by MM. Grube and Delafond, in France, about 1843—are not enclosed in an envelope of this kind, although in every other way they appear to be identical; and Dr. Sonsino states that the hæmatozoon found in Egypt is also destitute of this enveloping tube, as is likewise the urinary parasite discovered by Wucherer.

[1] *Indian Medical Gazette*, August 1874.

[2] 'Leçons sur les humeurs'; 2nd edit. 1874, p. 845.

Trinity Medical College.

In the present state of our knowledge, however, it cannot be said that any of these ingenious explanations meet all the objections that might be raised. For example, before the explanation suggested of the direct leakage of the chyle into the urine can be accepted as sufficient, it must be shown that such a leakage is anatomically possible, and, secondly, that the relative proportion of the leading constituents of the two fluids agree more closely than is suggested by the greater number of the analyses hitherto published. M. Robin's view does not suggest any special anatomical difficulty, but it remains to be demonstrated more conclusively than has hitherto been done that the blood in man ever contains a sufficient quantity of fatty matter to produce such extreme milkiness by admixture with the urine as is observed in chyluria. Dr. Roberts' theory is certainly not open to these particular objections, as, given a certain agent to start the formation of these glandular tissues, there does not appear to be any special anatomical or physiological difficulty to be got over; but the result of all the autopsies as yet recorded do not warrant the inference of the existence of such pathological conditions. Future observation, however, may show that they really do exist.

Of the ætiological significance of the presence of the filaria in the circulation there can, the writer thinks, scarcely be much doubt—more especially when the number of observations recorded within the short period that has elapsed since attention has been drawn to its existence therein, is taken into consideration. These suggest more than a fortuitous connection; indeed it might rather be said that chylo-serous effusions may be considered as symptomatic of the parasitism. Filariæ have even been detected shortly *before* chyluria had manifested itself. Whether they act injuriously by giving rise to rupture of the walls of the delicate channels in which they circulate and thus cause the escape of the different nutritive fluids into the urinary tract; or whether, as M. Robin suggests, they produce derangements of the liver and other organs which give rise to piarrhæmia (and, probably M. Robin would add, to rupture of the capillaries, so as to permit of the escape of the abnormally fatty blood), it would be premature to express a definite opinion. It is possible that both Carter and Robin may be correct to some extent, for the disease presents many phases; and the writer would suggest further, that it may also be possible that, in addition to giving rise to the escape of fluid in a purely mechanical manner by causing ruptures, local congestions, and so forth, the entozoon may in some way tend to the production of minute secreting structures (analogous to those described by Roberts as having been formed in the subcutaneous tissues) along the urinary tract, or in other situations, which might permit of the filtration of the ordinary nutritive fluids of the body in a more or less modified condition.—Analyses tend to show that the constituents of these fluids do not reach the urine in the proportions in which they are normally found in the body.

It is also possible that chyluria may occasionally occur unassociated with any parasite, but this remains to be demonstrated.

PROGNOSIS.—Persons have been known to suffer off and on from this affection for from one to fifty years. This would suggest that the malady usually runs a chronic course, which as a rule it doubtless does; on the other hand patients apparently in fair health otherwise have been known to die very unexpectedly from no recognised acute disorder. With regard to the prospect of a cure a very guarded opinion should be given, as the probability is that the complaint will return again and again so long as life lasts—even when the disease commences at a very early age, and often after a complete change of climate and avocation.

TREATMENT.—This has proved extremely unsatisfactory in almost all the cases recorded; in fact it cannot be distinctly stated that the course of the disease has been materially modified, much less cured, by any known remedy. Iodide of potassium has been tried in large doses, and in some cases appears to have been beneficial; in others the tincture of the perchloride of iron has seemed to be more successful. A decoction of the bark of Rhizophora racemosa (mangrove) has a reputation in Guiana, just as a decoction of the seed of Nigella sativa (used also as a condiment in curries) has in India. The latter remedy has, however, been known to be powerless in mitigating the malady even in cases where on former occasions it had been resorted to with apparent success. Perhaps the most satisfactory results which have been published are those which have followed the administration of large doses of gallic acid—one or two drachms a day. *See* FILARIA SANGUINIS-HOMINIS. TIMOTHY LEWIS.

CICATRIZATION (*cicatrix*, a scar) is the process by which solutions of continuity in an organ or tissue are repaired. These solutions of continuity may be due to injury, ulceration, extravasation, or the effusion of inflammatory products. The result of the process is the formation of a cicatrix or scar.

PATHOLOGY.—Cicatrization, as it occurs in superficial parts in surgical practice, may be selected as affording a typical illustration of the process. It is most frequently and easily observed, and it corresponds to what is met with in deeper tissues.

Repair may take place either with or without the occurrence of granulation, and the process of granulation may or may not be accompanied by suppuration: the existence both of granulation and of suppuration depending on the degrees of abnormal stimulation to which the injured tissues are subjected.

In an incised wound favourably circumstanced as to vascularity of tissue, absence of tension, and apposition of edges, epidermic continuity may be re-established in thirty-six to seventy-two hours. The lips of such a wound are temporarily united by a thin layer of lymph and white corpuscles of the blood, and perhaps soon afterwards by cells proliferated from connective-tissue corpuscles. These cells become spindle-shaped, and are ultimately converted into ordinary connective-tissue corpuscles, whilst offsets from the neighbouring capillaries re-establish the circulation throughout the new tissue. Coincidently with these changes the surface becomes covered with epidermic scales.

The resulting scar at first appears as a red line, which subsequently becomes white from the disappearance of many of its blood-vessels.

When an open wound heals by scabbing, the epidermis spreads over the tissues without the intervention of the process of granulation, owing to the protection afforded them by the crust of blood and lymph which has formed upon the wound.

Recent antiseptic surgery has shown that even large hollow wounds filled with blood-clot, such as are caused, say, by operation for ununited fracture of the femur, may cicatrize completely without suppuration or granulation, if protected from the stimulation of the antiseptic used. In these cases the white corpuscles of the clot become organized directly into fibro-plastic cells and connective-tissue corpuscles, and the new epidermis will probably be formed beneath a thin upper layer of the clot.

If a recent wound, too large for scabbing, be simply left exposed to the air or treated with water dressing, or with an ordinary antiseptic, there will be a discharge at first of serum tinged with blood, then of pale serum, and latterly of cloudy yellowish serum, replaced in about three days by fully-formed pus. By this time the wound will be studded over with little bright red elevations, termed granulations, which ultimately cover the whole surface. Granulation-tissue consists of nucleated cells, amongst which pass vascular loops with thin walls. After an interval the edges of the skin are seen to be on a level with the granulating surface, and as it were continuous with it. Perhaps already the wound is much smaller, owing to the shrinking of the granulations as their cells assume the spindle-cell type. Then, extending from the cutaneous margin there may be observed a narrow red line, brighter than the rest of the granulating surface, owing to the presence of a layer of transparent epidermis. Next day this zone will be bluish, owing to the growing opacity of the epidermic cells, and there will be a new red line of newest epithelium. A day later the outer layer will have become so opaque as to be whitish, and the second to be bluish; and there will again be a fresh inner red line, which will gradually advance until the scar is complete. The new epidermis quickly separates into a horny and a mucous layer.

The healing of an evacuated abscess-cavity depends partly upon the contraction, and partly upon the coalescence of the granulations of which its pyogenic membrane consists.

Many cases of disease of joints (caries, &c.), and the behaviour of abscesses treated antiseptically and with adequate drainage, may be referred to as instances of the existence of non-suppurating granulations. JOHN BISHOP.

CINCHONISM.—A condition induced by the administration of quinine, the chief active principle of cinchona. *See* QUININISM.

CINCLISIS (κιγκλίζω, I move).—This word signifies agitation or motion, and was formerly applied to involuntary winking or movements of the eyelids; and also to the movements of the chest in dyspnœa.

CIRCULATION, Disorders of.—Abnormal excess and deficiency of blood are known as *Hyperæmia* and *Anæmia* respectively. Each of these may be *general* or *local*.

I. **Hyperæmia.**—*General* hyperæmia signifies excess of blood in the body, and is also called *plethora*. *Local* hyperæmia means excess of blood in a part. Such excess may be caused either by superabundant supply, or by deficient removal of blood through the agency of the blood-vessels. Dilatation of the arteries, however produced, causes more copious afflux of blood, which fills the capillaries and veins in a corresponding degree, so that there is excess of blood in all the vessels of the part. This condition is called *arterial* or *active hyperæmia*, *active congestion*, or *determination of blood*. If, on the other hand, blood is imperfectly removed by the veins, these vessels, as well as the capillaries, become gorged, and the condition called *venous* or *passive hyperæmia*, or *venous congestion*, results. There cannot be *capillary hyperæmia*, except as the result of one of these conditions.

A. *Arterial or Active Hyperæmia.*—An excessive amount of blood can be conveyed by the arteries only under two conditions:—(1) Enlargement of these vessels by relaxation of their muscular walls; (2) Increased pressure within them, from obstruction of collateral channels with which they communicate, *i.e.* collateral hyperæmia.

(1) Relaxation of the muscular walls may be caused *directly* by violence or by warmth, as is illustrated in the redness of the skin produced by a blow, by heat, or by the reaction after intense cold. Sudden withdrawal of pressure has the same effect, as is sometimes seen on evacuating a hydrocele or fluid-collection in a serous cavity. Dry-cupping produces similar but more complex results, the veins being acted upon as much as the arteries. Relaxation of the muscle-fibres is produced also *indirectly* through the vaso-motor nerves. If these are paralysed, relaxation of the fibres occurs, and the arteries dilate. Experimental section of the cervical sympathetic in animals shows this most clearly; but the same result follows less constantly if other nerves containing vaso-motor fibres are divided or injured, such as the mixed nerves of the limbs, or branches of the trigeminus. Wounds of the brachial plexus have been found to cause hyperæmia of the fingers (*glossy fingers* of Paget). When the section is complete, hyperæmia is only transitory, and is soon followed by a return to the normal condition, or even by undue anæmia, which is permanent. In irritative lesions, on the other hand, such as gunshot wounds, hyperæmia continues as long as the irritation. In such cases it is possible that the lesion is not paralytic, but depends upon stimulation of the actively-dilating vaso-motor fibres which physiologists have now shown to exist in many parts of the body, since stimulation of these produces the same result as paralysis of the inhibitory fibres. Hyperæmia often accompanies neuralgia, both depending upon some morbid condition of the nerve. The starting point of the neurosis in all these cases may be, and often is, in the central nervous system, and hence chronic diseases of the spinal cord or brain are often accompanied by general

paralytic hyperæmia—that is, flushing, or by congestion of special parts. The same result may come from reflex nervous action, set up by disturbances of the digestive organs, the organs of generation, or of other parts.

(2) Collateral hyperæmia is a consequence of the rise of pressure produced by the blocking-up of arterial channels in the adjoining parts. It is usually effected by the enlargement of existing vessels, and the conversion of small, almost capillary, vessels into pulsating arteries. It occurs not only in the familiar instances of surgical ligature, and the sudden blocking of an artery by a plug (*see* EMBOLISM); but in the gradual obstruction which accompanies atrophic and sclerotic processes. When the chief arterial channels to an organ become obstructed, its peripheral parts are very liable to become hyperæmic, a principle which when applied to such cases as cirrhosis of the liver, granular kidney, and sclerosis of the brain, will be found fruitful in practical deductions.

SIGNS AND RESULTS.—The colour of parts in a state of active hyperæmia is, during life, bright red, the arteries, large and small, being visibly injected, while the capillaries, filled with arterial blood, produce a diffuse red colour. In experimental hyperæmia the blood may remain bright red even in the veins. The temperature of external parts becomes elevated, though not above that of internal parts. Sometimes there is obvious pulsation or throbbing. There may be swelling, which is due to simple enlargement of the vessels, not to exudation of fluid, since this does not occur from arterial hyperæmia alone. The nerves, both those of common sensation and those of special sense, are more excitable than they are normally. There is usually a subjective sensation of warmth, and there may be pain or itching.

Arterial hyperæmia may last for a long time without producing any change whatever in the part affected, but may, under conditions little understood, give rise to hypertrophy, which sometimes, though rarely, results from section of the cervical sympathetic. Transitory but repeated hyperæmic conditions more regularly produce this result, as is seen in hypertrophy from pressure; in thickening of the skull from excessive exposure of the head to the sun; in hypertrophy of the skin and its glands from frequently recurring hyperæmia of the face (*acne rosacea*). This kind of hyperæmia constantly precedes, but can hardly be said to produce, inflammation. It does, however, render the tissues more vulnerable, bringing them into a condition in which a slight cause will set up inflammation. Unless the vessels are unsound simple arterial hyperæmia does not lead to hæmorrhage.

B. *Passive Hyperæmia or Venous Congestion.*—This may be due to—(1) Feeble circulation; or (2) Obstruction in the veins.

(1) Blood may be imperfectly removed from a part, owing to the imperfect action of the forces which normally maintain the flow of blood in the veins. These are, besides the action of the heart, the pressure of muscles (combined with the arrangement of the valves in the veins), and the movement of the thorax in inspiration. If these are deficient, the venous current will be everywhere delayed, but notably in those parts where it has to overcome the action of gravity. In the erect posture this will be the case in the lower limbs, and hence venous congestion is common in the legs, ankles, and feet. In decumbent patients, for analogous reasons, the nates, sacrum, shoulder-blades, and the bases of the lungs behind become the seat of what is called *hypostatic congestion.* Very general obstruction, such as results from imperfection of the heart itself, may lead to the condition called cyanosis, which is essentially venous congestion, and to similar congestion of the lungs, liver, kidneys, and other internal organs, with very serious results.

(2) Obstruction of the veins is rarely produced by a morbid condition of the walls of these vessels, but may result from coagulation of blood within them. Another cause is external pressure, such as that of tumours, of the gravid uterus, or of the intestinal contents, as in the case of the hæmorrhoidal veins. Finally, indurative changes in the solid viscera lead to venous obstruction, as is seen in cirrhosis of the liver, which produces congestion of the whole portal system.

SIGNS AND RESULTS.—The colour of parts in a state of passive hyperæmia is bluish rather than red, the veins, large and small, being injected with venous blood, and the capillaries, in which the blood is also venous, producing a uniform purple colour. If the congestion is extreme, collateral venous channels are likely to be established, which are sometimes the only evident sign of internal venous obstruction. The surface is usually cooler rather than hotter when compared with corresponding parts of the body; and there is no unusual nervous sensibility or sense of throbbing. Swelling very frequently occurs, and depends on actual serous effusion from the vessels, so that the parts are often anasarcous, pitting on pressure; while in cavities there is an accumulation of fluid.

Venous congestion produces more important and permanent results than arterial. In experimental venous obstruction, besides engorgement of the vessels, two nearly constant phenomena are seen—copious transudation of serum, and migration of a number of red blood-disks through the walls of the capillaries and smaller veins. Few or no white corpuscles emigrate, and the arterial circulation is unaltered. The absence or occurrence of dropsy depends upon the adequacy or inadequacy of the lymphatics to carry off the superfluous serum. In ordinary pathological venous congestion all these changes are seen to some extent; extravasation of red blood-disks being shown by the pigmentation of parts in chronic congestion, though this is not evident in the acute condition. Chronic venous congestion increases the hardness and density of organs, a change which may, in the first instance, result from simple œdema, but in the end is due to fibroid change (*see* DEGENERATIONS). Such organs are at first enlarged, but ultimately diminish in size, and suffer fatty atrophy, not only through the general law of fibroid change, but because venous blood is inadequate to the proper nutrition of tissues. These changes are seen in the liver and kidneys in cases of obstructive heart-disease. External parts, as the skin of the lower part of the leg, show by a tendency to ulceration that they are imperfectly nourished, and are also liable to become inflamed from slight causes (varicose eczema).

Post-mortem Characters.—The appearance of hyperæmic parts after death is not necessarily the same as during life. The colour of the blood does not enable us to say whether the hyperæmia was arterial or venous. All blood contained in the body after death, excluded from the air, is dark or venous, but becomes florid when exposed to the air, unless it have previously undergone some *post-mortem* change, or some morbid alteration during life. This change may be watched in the lungs when the chest is opened, especially in the case of children whose lungs have little local colour. The only important point after death is the fulness of the three kinds of vessels. Arteries are usually empty, unless diseased; the larger veins almost always full. If the smaller veins and arteries are conspicuously and brightly injected, the part may be described simply as congested; a uniform colour indicates fulness of the capillaries, which may be confirmed by the microscope. Uncomplicated arterial hyperæmia leaves no trace after death; the appearance of it is produced by inflammation. Simple venous hyperæmia can only be recognised as such after death by comparison, that is, with the same part under normal conditions. Chronic venous congestion is indicated by many of the same characters as during life. Care should be taken not to mistake for arterial hyperæmia mere staining with blood-pigment of the walls of the vessels; nor for venous congestion mere *post-mortem* hypostasis, or the settling down of the blood, if fluid, after death.

II. **Anæmia.**—*General* anæmia is a morbid condition in which there is a deficiency of blood, or, more correctly, a deficiency of the red corpuscles of the blood, throughout the whole body. It is also called *oligæmia*, or *oligocythæmia* (*see* Anæmia). *Local* anæmia, with which we are here concerned, signifies deficiency of blood in a part. It may be complete or partial. Complete local anæmia can only occur when the blood-supply of a part is totally cut off by obstruction of its arteries. The conditions and consequences of such obstruction are discussed elsewhere (*see* Embolism.) Partial anæmia or *ischæmia* may be produced by direct pressure, or else by arterial obstruction, permanent or transitory. Permanent anæmia of many parts results from gradual obstruction of arteries by atheromatous change, or, still more strikingly, by a form of endarteritis (*endarteritis obliterans*) attributed to syphilis; or, again, from deposition of fibrin on the diseased vascular wall. Temporary anæmia results from spasmodic contraction of the annular fibre-cells in the muscular coat of the artery. Such a contraction may be produced experimentally by direct electrical stimulation, or by stimulation of the sympathetic branches distributed to the vessel; and in pathological conditions we find such contraction occurring in consequence of some derangement of the nerve-centres, or from reflex irritation, or even, as it would seem, idiopathically. Neuralgia and migraine are often accompanied or caused by spasm of the arteries, and epilepsy has, with less certainty, been attributed to the same cause. In these cases it is possible, as is held by some authorities, that anæmia of the nerve-tissue is the cause of the disturbed innervation. Hysterical blindness, and probably other hysterical affections, may be explained in the same way.

Signs and Results.—An anæmic part is pale, its temperature in the case of external parts is diminished, and there is weakened or arrested arterial pulsation. A permanent condition of anæmia, even if only partial, produces degeneration, ending in atrophy of the affected part. The wasting of the skin, and possibly that of the kidneys in old age, is due to this cause. Transitory anæmia causes necessarily a cessation of functional activity in the part, as is obvious in the nerve-centres and the muscles: but does not, so far as we know, produce any permanent change. Compression or obstruction of the abdominal aorta produces symptoms of temporary paraplegia. J. F. Payne.

CIRCULATION, Diseases of Organs of. The organs of circulation comprehend the heart, the arteries, the veins, and the intervening capillaries. The diseases affecting each of these structures will be found described under their respective headings. It has, however, been thought desirable to give in this place a general sketch of the different ways in which the intimate relations that exist between the parts of the circulatory apparatus may be disturbed by disease. While the heart, the arteries, the veins, and the capillaries have each special diseases, related to their differences of structure and of function, the effect of such diseases is rarely or never purely local. The other parts of the circulation on either side of the lesion and the regions to which the vessels are distributed suffer more or less from the local disease. This is true whether the disease be structural or only functional; and whether, in the latter case, the nervous system or the blood be the primary seat of the disorder. Viewed thus, the subject will be best considered under three heads:—1 The *structural changes* of the several organs of circulation, and the diseases and disorders to which they give rise in other parts of the system, whether general or local. 2. The *functional disorders* of the organs of circulation due to *nervous* disturbance, both local and general. 3. The *functional disorders* of the circulation due to changes in the *blood*. We shall discuss these divisions in the order in which they have been named.

(A)—Structural Changes in the Organs of Circulation.—The *heart* is liable to organic disease either in its propelling muscular walls, its regulating valves, or its controlling nervous system; and it will be found that diseases of each of these parts of the cardiac apparatus affect respectively its several functions. Thus disease of the walls of the heart affects the force or pressure; valvular disease primarily disturbs the distribution or quantity of blood in the several parts of the circulation; while nervous disorder especially interferes with the rate and regularity of its movements. Diseases of the *arteries* interfere with the quantity of blood transmitted through them, and produce secondary disturbances of distribution or of pressure. When the *capillary* walls are degenerated or ruptured, or when their canals are blocked as a result of embolism or thrombosis in arteries or veins, nutrition is disturbed in various ways. Lastly, the *veins* may be the seat of a variety of lesions, which prevent the return of blood, and lead to hæmorrhage or to dropsy. We shall consider the diseases that have been above indicated from a common point of view, viz. their effects upon the circulation.

1. The *pressure* of blood within the circulation may be either increased, diminished, or irregularly distributed. The most marked instance of *increased* pressure is seen in simple hypertrophy of the left ventricle without valvular disease, especially if the hypertrophy be associated with increased peripheral resistance, as observed in chronic Bright's disease. The effects of increased pressure on the *heart* are cardiac enlargement with its consequences, and valvular disease; in the *arteries*, they are fulness, elongation, thickening, and atheroma with its results. The *pulse* is strong and full, and may possess the various characters of the vessel-wall just enumerated. The *capillaries* are over-distended, and may be ruptured, hæmorrhage being the result. The functions of the several organs are, under favourable circumstances, more active; and the *venous* circulation is more free.

Diminished pressure of the circulation is more common, and is seen in dilatation with thinning of the cardiac walls, in atrophy, in fatty degeneration, and in fibroid hypertrophy or degeneration. The effects of diminished pressure within the circulation generally are the reverse of those of increased pressure. The *arteries* are comparatively empty and small, and the pulse is weak, small, and often irregular. The *capillaries* are insufficiently supplied with blood; the visible surfaces are anæmic, or passively congested; and the various functions are feebly discharged. The backward pressure within the *veins* is, on the contrary, increased; the blood tends to accumulate within them; the walls are dilated; the valves are disorganised; and passive congestion, thrombosis, dropsy, and chronic inflammation are frequent results.

2. *The Quantity of blood distributed.*—What has just been said concerning the pressure of the blood applies, in a great measure, to the quantity distributed through the circulatory system. In hypertrophy of the heart, a larger amount of blood passes through it in a given time, and the arteries and pulse are full; while in atrophy and dilatation the quantity is less, and the pulse is empty and contracted.

3. The most frequent disturbance observed is *irregularity of distribution.* This condition generally affects the pressure and quantity together, but may affect one more than the other. Irregular distribution of blood and of pressure is most markedly present in valvular imperfection, and especially in aortic and mitral regurgitation. It is also seen in obstruction and other allied conditions of the arteries, especially of the aorta. In the parts of the circulation and in the organs situated behind the seat of disease, irregularity of distribution of blood and of pressure is manifested in the form of dilatation, such as enlargement and engorgement of the heart, of congestion and associated changes in the lungs and abdominal viscera, of hæmorrhage, and of various exudations and effusions whether as œdema, dropsy, or catarrh. On the other hand, the portions of the circulatory apparatus beyond the seat of disease are underfilled and undersized; the organs are deprived of their sufficient supply of blood: and anæmia, with its further consequences, is the result.

4. *Frequency and Rhythm.*—Among the most common forms of cardiac disturbance are alteration of frequency and irregularity of rhythm. Alteration in frequency is generally in the direction of increase; but unnatural slowing may also occur as a symptom of fatty degeneration and other morbid conditions. The essential causes of modifications in the rate of the heart's action are very complex and obscure, for the muscular tissue, the intrinsic nervous apparatus, and the extra-cardiac nerves and centre in the medulla oblongata, may, in different instances, be all more or less concerned. As a rule, increased frequency is associated with, and proportionate to, weakness of ventricular contraction. Unnatural slowing is believed to be generally nervous in its origin; but it may sometimes be due to inertness of the muscular substance from fatty degeneration of the walls of the heart. The remarks that have just been made respecting frequency apply equally to disturbance of rhythm and irregularity of contraction. Frequency and irregularity of pulse in organic disease of the heart are generally indications of serious cardiac weakness, and are often found in the later stages of heart-disease, whether its original seat has been valvular or parietal.

(B.) FUNCTIONAL NERVOUS DISORDERS OF THE CIRCULATION.—When the distribution and functions of the nervous structures associated with the organs of circulation are considered, the variety and complexity of the disorders of the heart and vessels due to nervous influences will be readily appreciated.

Through the medium of the nervous system the action of the heart is affected by every sensory impression received by the brain; specially by influences proceeding from the following parts:—the respiratory centre, the respiratory organs, the blood-vessels, the abdominal viscera, the surface of the body, and the cerebrum itself with the organs of sense. Many of the disturbances of the circulation with which the reader is familiar in diseases of the *lungs* are occasioned through nervous channels, especially such respiratory diseases as are attended with imperfect oxygenation of the blood. In the *blood-vessels*, the most marked example of nervous association between them and the heart is afforded by the relaxation of the arteries in cardiac over-distension and embarrassment through the operation of the depressor nerve, which, passing from the heart to the vaso-motor centre in the medulla, inhibits or controls the constricting influences constantly exerted by this centre on the walls of the vessels, and thus effects the relaxation of these vessels and 'depresses' the circulation or lowers the blood-pressure. Cardiac disturbance referable to *abdominal* causes is so familiar that it needs scarcely to be mentioned; and such disturbance, though frequently direct, is more frequently indirect or reflex through the nervous centres. The condition of the blood-vessels within the abdomen has the greatest influence on the heart and circulation generally, as may be seen in cases of shock, injury, and inflammation of the peritoneum and great viscera. The *surface* of the body, as the seat of impressions of touch, of temperature, and of common sensibility, may prove to be the source of cardio-vascular nervous disturbance. It is through impressions on the nerves of the surface that the circulation may be disturbed until seriously embarrassed, and even paralysed, as in shock, exposure to cold, &c.; or, on the other hand, roused to activity, by blistering, flagellation, douching, &c. Lastly, the more extreme and frequent, as well as the more irregular and varied nervous disturbances of the circulatory organs are due to conditions of the *brain*. The most common of all forms of circulatory disturbance is seen in emotional excitement, as palpitation, with vascular throbbing, and as in blushing or in pallor.

The general phenomena of functional disorders of the circulation due to nervous disturbance are—(1) Alteration in the force, frequency, and rhythm of the cardiac movements; and (2) Disturbances of sensibility referable to the condition of the nerves, to distension of the cavities, and to irregular muscular contraction. In certain cases the cardio-vascular disorder may be extensive, complex, and serious, and may involve the neighbouring nerves, as is seen in angina pectoris. The remote effects of these attacks of functional failure are fully described elsewhere. *See* HEART, Functional Disorders of. Other disorders of a complex character occur, such as Graves's disease, which is probably referable to a nervous origin.

(C.) FUNCTIONAL DISORDERS OF THE CIRCULATION, DEPENDING ON THE CONDITION OF THE BLOOD.—The blood is so essentially associated with the organs of circulation, that any alteration either in its quantity or in its composition speedily manifests itself in disorders of the heart or vessels. Besides the effect on the general intravascular pressure that follows directly any change in the blood, there are two ways in which any morbid state of this fluid reacts upon the circulation—namely, first, by affecting the nutrition of the cardiac and vascular walls; and, secondly, through the agency of the nervous centres. Thus, when the *amount* of blood is below the normal, not only is the circulation comparatively depressed, but the myocardium is ill-nourished and feeble, the tone of the vessels is low, and the excitability of the nervous centres, which directly or indirectly control the heart, is greatly increased. The opposite condition—of plethora, high blood-pressure, enlarged and powerful heart, and energetic nervous system cannot, within definite limits, be considered morbid, but rather an evidence of too robust health. The most frequent changes in the *quality* of the blood are those which are associated with anæmia, as first described. The next most important group of cases is that in which the blood contains some poison, whether generated within the body or introduced from without. The disturbances of the circulation by poisons of all kinds are very numerous and complex. When the poisoning of the blood is of long duration, and moderate in degree, chronic disease may be set up throughout the organs of circulation; and this is probably the mode of origin of the cardio-vascular disease so often found accompanying chronic Bright's disease.

R. QUAIN, M.D.

CIRRHOSIS (κιῤῥὸς, yellow).—SYNON.: Sclerosis; Fibroid Substitution; Fibroid Degeneration; Chronic Interstitial Inflammation; Fr. *Cirrhose*; Ger. *Cirrhose*.

The term cirrhosis, which was originally invented to describe a particular state of the liver has now acquired a more extended meaning, and is applied to similar morbid processes affecting other organs, though the name itself, derived as it is from the yellow colour of the liver in this disease, ceases to be properly applicable. Cirrhosis may be regarded as a chronic non-suppurative inflammation affecting the interstitial, connective, and supporting tissues of the different organs, and not those by which the proper physiological function is performed. The process begins, after a more or less protracted hyperæmia, by the appearance in the interstitial tissues, between the proper functional elements, of small lymphoid corpuscles or leucocytes, which are arranged in lines or tracts interpenetrating the affected organ. These corpuscles crowd the tunica adventitia of the small vessels, the lymph-spaces, and the cavities in which the connective-tissue corpuscles lie; and when present in considerable amount appear to the naked eye as narrow lines of a slightly translucent greyish material. This condition was formerly termed cellular hyperplasia of the connective tissue, and the corpuscles themselves were supposed to originate from proliferation of the connective-tissue corpuscles. More recent researches have, however, shown that in inflammation the connective-tissue corpuscles remain quite passive and take no part in the formation of new cells. The early stage of cirrhosis is therefore more correctly described as cellular infiltration of the connective tissue. The cells themselves are white blood-globules, which have emigrated from the vessels, and their descendants. The amount of this cellular exudation varies very much in different organs in the different forms of the disease. In many cases of cirrhosis of the liver, and in the fibroid induration of the left ventricle of the heart, and of the pylorus, it is very considerable, and causes much increase in the bulk of the affected organ. In other instances, as in some forms of granular kidney, it may be very small. Many pathologists consequently regard the process in these cases as essentially one of atrophy of the true physiological tissue, and the indurated fibrous tissue which results as consisting of the withered remains of the vessels ducts, &c. of the organ.

The later stages of the process consist in the conversion of these tracts, which may be looked upon as closely analogous to ordinary granulation-tissue, into fibrous tissue. A more or less fibrillated intercellular substance appears; the corpuscles diminish in number; the remaining ones become in part elongated and oar-shaped, and some may pass into true spindle-cells, or become stellate: in cirrhosis of the lung tracts of true spindle-cell tissue are often met with. In the liver, where much of this new tissue is often formed, numerous blood-vessels become developed in it: they are devoid of distinct walls and consist merely of channels lined by endothelium. The fibrous tissue which is the final result of the whole process, closely resembles ordinary cicatricial tissue; it is usually tough, dense, and imperfectly fibrillated, with a strong tendency to contract. Sometimes, especially in the suprarenal capsules, and less frequently in the liver, portions of it consist of a reticulated connective tissue.

The *effect* of this series of changes on the proper physiological tissue of the organ is to cause its atrophy. This is partly due to the direct pressure of the new growth, when it is formed in large quantities, but chiefly to the constriction of the contracting fibrous tissue and the consequent obliteration of the blood-vessels; for even where, as in the liver, new vessels are developed, the original vessels of the organ become obliterated. The atrophy of the proper tissue of the organs appears to take place by a gradual process of granular and fatty degeneration followed by absorption. Sometimes, particularly in the lungs and suprarenal capsules, this change is less gradual, and portions of the original tissue together with the new growth lose their vitality *en masse*, pass at once into a state of fatty degeneration, and ultimately become caseous and even calcareous, giving rise to the formation of opaque yellow nodules surrounded by the semi-translucent grey fibrous tracts. In these cases it becomes difficult to draw a strict line of demarcation between cirrhosis and true tuberculosis, and the difficulty is rendered greater from the fact that chronic tuberculosis in itself sets up the cirrhotic process. In the lung the caseous transformation is no doubt most commonly caused by the filling up of the air-vesicles with large epithelioid catarrhal cells coincidently with the cirrhotic change in the walls of the vessels. These catarrhal cells not being in immediate relation with the blood-vessels, are especially prone to caseous change. So, too, in the suprarenal capsules the caseous nodules, if examined early enough, will be found to consist of the tubular spaces of the organ filled with their cells in a state of fatty degeneration. In the liver, on the other hand, the secretory cells, being in intimate relation with the blood-vessels, are not liable to this caseous transformation. Again, it is impossible to make a strict demarcation between syphilitic affections of the viscera and true cirrhosis. Even the typical gummata of syphilis originate in and are surrounded by tracts of cirrhotic induration; and in other cases where true gummata are not found, the only difference between cirrhosis and syphilis is that in the latter there is a greater accumulation of the new growth at particular points and a less general diffusion of it through the organ. Lastly, in some cases, as in the cirrhotic liver of hereditary syphilis, the two processes are identical.

If we now proceed to inquire into the *causes* of cirrhosis, we find that it is generally preceded by a protracted hyperæmia of the affected organ produced by some chronic irritation, whether functional or mechanical. As examples of this may be mentioned cirrhosis of the liver which results from the congestion produced by spirit-drinking; sclerosis of the grey matter of the cerebral convolutions after protracted maniacal excitement; cirrhosis of the lung, the result of prolonged inhalation of irritating dust in the various forms of grinders' and miners' phthisis; the cirrhotic thickening of the pylorus in chronic catarrh of the stomach; and cirrhotic affections of the lungs and heart extending to those organs in chronic inflammation of their serous coverings. A more passive congestion, however, if long continued, may cause a simple hypertrophy or overgrowth of the interstitial connective tissue, and more or less induration in consequence. It does not, however, appear to have the same tendency to excite active proliferation and the formation of the contracting fibrous tissue characteristic of true cirrhosis. The exception to this rule is that we usually meet with a slight degree of the cirrhotic change in cases of 'nutmeg' atrophy of the liver due to prolonged passive congestion of the hepatic venous system. W. CAYLEY.

CIRRHOSIS OF LIVER, LUNG, &c. *See* LIVER, LUNG, &c., Diseases of.

CIVIL INCAPACITY.—One of the causes of this condition is mental weakness or disease, and it is one of the duties of the physician to aid in determining the existence and nature of such conditions. There is a kind of incapacity which is implied in the restriction of a person's liberty when he is placed under care in an asylum or other special place of treatment. The necessary information regarding this will be found in the article LUNACY, Laws of. But the question of incapacity is more directly raised when it is proposed that a person should be declared unfit to exercise his civil rights, to require the shield of the law to prevent his being imposed on, and to obtain special protection for his property. Medical evidence will require to be taken if it becomes necessary for a Commission of Lunacy to be issued by the Lord Chancellor. This is a proceeding which ought not to be adopted if it can properly be avoided. But it must be remembered that till a person is found lunatic by inquisition he may, though placed in an asylum under regular certificates, exercise his rights unrestricted in the disposal of his property. The acts of any person either in or out of an asylum may, however, be declared invalid if it can be shown that at the time they were performed the person laboured under such an insanity as rendered him incapable of performing them rationally and without injurious consequences. On this principle any person may be found to have been incapable of contracting marriage, of executing a deed, contracting a debt, making a will, or giving credible evidence. The principle, it must be carefully noted, is not that the mere existence of insanity in the person performing them invalidates such actions, but that if the insanity has materially affected the character and quality of the actions they may be thereby invalidated. This is one of the most important principles that a medical jurist has to keep in mind, as it is not an unfrequent mistake to suppose that a person is necessarily incapacitated for the performance of every civil act the moment he can be proved to labour under any condition to which the term insanity may be applied. Perhaps the case in which the validity of a civil act is most easily endangered by the existence of any form of insanity is the contract of marriage. This proceeding is supposed so to affect the whole relations of life that almost any form of unsoundness of mind may be sufficient to interfere with that intelligent and deliberate consideration which is essential to the giving of rational consent.

The different kinds of mental disease will be found described elsewhere (*see* INSANITY), and it is necessary that the practitioner, when dealing with medico-legal questions, should be fully acquainted with them. But it is chiefly important that he should distinguish the two following classes: (1) diseased perversion of the mental faculties, and (2) weakness or enfeeblement of the mental faculties resulting either from defective development, disease, or decay. The first class includes all kinds of insanity which are the result of active disease. These would be the simple forms of delirium, mania, melancholia, and monomania; as well as the similar primary conditions which are found in general paralysis, and other diseases which present maniacal, melancholic, or monomaniacal symptoms. It is in this class that the special knowledge of the physician can be most successfully applied in aiding the administration of justice. In order to establish the incapacity of a person said to labour under any of these forms of disease, it must be necessary that an experienced physician should not only be able to detect their characteristic symptoms, but also to show that the performance of the duties or the exercise of the rights under consideration would be modified or obstructed by the existence of such disease. The second class includes congenital imbecility, and all the forms of what is called chronic dementia—all those enfeeblements of mind which are sometimes the remaining effects of acute disease, sometimes the concomitants of chronic disease, and sometimes only the mental phase of senile decay. Here, again, the information which may be communicated by the physician must be of great importance. But in estimating the extent to which a condition of mere mental weakness will disable a person from the performance of a certain class of actions there is not so much special medical knowledge required as is necessary in the consideration of active disease.

Marriage.—As has been already stated, the mere existence of any form of insanity in one of the parties may render a contract of marriage void. In one case which terminated in this manner, a man who had been insane and when in that state had voluntarily contracted marriage instituted the suit himself.

Civil Contracts may be held binding although made by lunatics. If the person with whom a contract is made had no knowledge that the person contracting was insane, and if no attempt was made to take undue advantage of him, the contract would be held good.

Wills.—A person is considered to be of a disposing mind, that is, capable of making a valid will, if he knows the nature of the act which he is performing, and is fully aware of its consequences. It is in regard to the making of wills that the law has carried out most thoroughly the principle that the validity of an act ought to be maintained in cases of insanity unless at the time the act is performed the state of mind of the agent can be shown to render him unfit to perform that particular act in a rational manner. Persons have made valid wills while inmates of lunatic asylums. And one will was held to be good though the testator had committed suicide within three days after its execution. The existence of delusion which has been regarded by lawyers as of such importance in cases of alleged insanity does not invalidate a will; for it has been declared to be 'compatible with the retention of the general powers of the faculties of the mind,' and to be 'insufficient to overthrow the will unless it was calculated to influence the testator in making it.' On the other hand, a will may be invalidated on account of the existence of mental states which would not be regarded as insanity from either a legal or medical point of view. Drowsiness and stupor resulting from erysipelas or fever, extreme weakness from cholera, and failure of memory in old age, have all been found sufficient to render wills void. It frequently happens that a medical man is called on to be witness to a will. On such an occasion it is his duty to satisfy himself as to the testamentary capacity of the testator. His subsequent evidence in regard to this, will, in case of dispute, be of almost decisive influence if he has taken proper means of forming an opinion. In all cases, therefore, where there may be a possibility of doubt it is well to require the testator to show that without extraneous aid, and without referring to the document itself, he remembers and understands all the provisions of the deed.

Evidence of the Insane.—Lunacy was, till a recent date, regarded by the law as incapacitating a patient from giving evidence in court. But according to the much more extended signification which the term lunacy has received it now includes states of mind which are looked on as compatible with testimonial capacity. Where the judge is satisfied that the lunatic understands the obligation of an oath, and can give a rational account of such things as happen before his eyes, the evidence may be admitted. But the weight to be attached to such evidence will still depend on the extent to which it fulfils the conditions commonly required to constitute credibility. It has been held, however, that when a person has suffered from an attack of insanity between the occurrence of the transaction and the time he tenders his testimony, his evidence cannot be admitted.

Management of Property.—Where persons are supposed to be unable from unsoundness of mind to undertake the management of their own property, it may be necessary that they should be placed under the protection of the Court of Chancery; but this proceeding is not usually had recourse to unless there is urgent necessity or a strong probability that the person's incapacity will be permanent. It is consequently resorted to chiefly in chronic or congenital cases where there is no room for doubt as to the mental condition of the individual; and in cases of recent insanity where it is necessary to have recourse to an asylum for the protection of the individual it may also be necessary to obtain protection for his property by the aid of the Court of Chancery. In giving evidence or framing a statement in such a case it is important, if incapacity is to be proved, to show that the individual has been found, when placed in circumstances requiring such capacity, unable to perform the acts which the management of property necessitates. In cases of active insanity it is especially required to show, not merely that there is delusion or other symptoms of insanity, but that the insanity is of such a nature as specially to disable the person from duly performing the duties which would be required of him. Difficulties most frequently occur in cases of imbecility and dementia; but the verdicts in such cases when disputed will generally be found to rest rather upon the impression produced by evidence of the actual behaviour of the individual than upon the mere medical view of his mental condition. The most effectual aid that the medical witness can render in such cases is to show whether there are or are not such peculiarities in the conduct of the person under inquisition as are known to be characteristic of imbeciles or demented persons. In undisputed cases, where the duty of the medical man consists merely in making an affidavit, there is no special difficulty to be encountered. Brevity, scrupulous accuracy, and attention to the fact that such unsoundness of mind as involves incompetency to manage property must be established, are the most important requirements. A person found by the court to be incapable is placed under the control of a 'committee of the person,' and the property under a 'committee of the estate.' In Scotland an application to the Court of Session for the appointment of a *Curator bonis* takes the place of the English inquisition. The chief peculiarities of the Scotch process are that it is cheaper, more easily effected and more easily annulled, and that it does not affect the person of the lunatic. The functions of the curator correspond to those of the committee of the estate in the English court. The Scotch procedure for the appointment of a guardian of the person was virtually in desuetude until the passing of a recent statute (31 and 32 Vict., cap. 100). Under this act a brieve for the cognition of an alleged lunatic is issued from Chancery and tried before a judge of the Court of Session and a special jury. The procedure is similar to that of jury trials in other civil causes in Scotland, and both medical and other evidence must be produced. If the person so cognosced be found 'furious, fatuous, or labouring under such unsoundness of mind as to render him incapable of managing his affairs,' his person is placed under the guardianship of the nearest male relative found competent.

Drunkenness.—This condition is not held to deprive a man of civil capacity unless it has at the time rendered the individual unconscious of what he was doing. J. SIBBALD.

CLAP.—A popular name for gonorrhœa. *See* GONORRHŒA.

CLAVUS HYSTERICUS (*clavus*, a nail).—An acute pain often associated with hysteria, but occurring also in other conditions, which is felt in a localised point in the head, and is compared by the sufferer to the sensation that might be produced by a nail being driven into the part. *See* HYSTERIA.

CLIMACTERIC (*κλιμακτὴρ*, a step, *κλιμάζω*, I proceed by degrees, or step by step).—This word, which properly signifies 'by degrees,' was originally employed to indicate certain epochs or periods in the life of an individual, which were looked upon as critical, and at which the body was supposed to have undergone a complete change, so that it had become entirely renewed in its structural elements. The years in which these epochs terminated were called climacteric years—*anni climacterici*, and their number was variously estimated. Thus, some only recognised three climacterics; the Greek physiologists held that there were five, ending at the seventh year, the twenty-first (7 × 3), the forty-ninth (7 × 7), the sixty-third (7 × 9), and the eighty-first (9 × 9); others made them multiples of seven or nine, or multiples of seven by an odd number. Most regarded the sixty-third year as the *grand climacteric*, but the Greeks recognised two grand climacterics, terminating respectively at the sixty-third and eighty-first years, and this special denomination was given because there was little, if any, prospect of life being extended beyond these periods. At the present day the word climacteric has lost much of its original meaning, and is generally applied to certain times of life, without any reference to numbers of years, at which marked physiological or developmental changes occur, such as the period of puberty, or that of the cessation of menstruation.

A particular *climacteric disease* has been described, which is said to occur either about or subsequent to the sixty-third year or grand climacteric, and supposed to be distinct from the natural decay and degeneration which takes place in advanced life, inasmuch as recovery often ensues. It is stated that the complaint comes on suddenly, but advances insidiously, the symptoms being at first loss of flesh and weakness, followed by loss of appetite and dyspeptic symptoms with a white tongue, which are regarded as sympathetic, sleeplessness or disturbed and unrefreshing sleep, constipation, pains in the head and chest, a frequent pulse, swelling of the legs, and an emaciated or bloated appearance of the face. The urine does not present any abnormal characters, and most of the viscera seem to perform their functions properly. Whether there is any independent disease deserving this special denomination seems to the writer to be more than doubtful.

FREDERICK T. ROBERTS.

CLIMATE, Ætiology of. *See* DISEASE, Causes of.

CLIMATE.—Formerly the word climate (from the Greek word *κλίνω*, I incline) was a term of astronomical or mathematical geography, which implied a portion or zone of the earth's surface comprised between two lines parallel to the equator, and measured by the length of time during which the sun there appears during the summer solstice, that is, by the sun's inclination. The space between the equator and the pole was divided into half-hour climates, in which the length of each day increased by half-an-hour, and also into monthly climates. This unequal division of each hemisphere is now replaced by a division of the interval between the equator and the poles into ninety degrees, which constitute what are called degrees of latitude, and the word climate has received a more extended application.

By climate is now understood those conditions of heat, moisture, atmosphere, wind, soil, and electricity, which impress certain conditions, uniform even when apparently irregular, on given portions of the earth's surface, and which modify, also in a uniform manner, vegetable and animal life.

Climate, when thus interpreted, is still principally dependent on astronomical facts, on the sun's position or inclination with regard to the earth, and on the amount of heat it supplies to different portions of the surface of the latter. Climate may be studied generally and locally. The division of the earth's climates is necessarily arbitrary, and many different classifications have been proposed. The most simple is that which recognises three principal kinds of climate, each susceptible of subdivision, viz.: warm climates from the equator to 35° lat., temperate climates from 35° to 50° or 55° lat., cold climates from 50° or 55° to the pole. As subdivisions we may recognise equatorial, tropical, sub-tropical, subpolar, and polar climates; and also insular and maritime, or moist climates—continental and mountain, or dry climates.

1. *Warm climates*, extending from the equator to 35° lat., that is, 12½° beyond the tropics, comprise nearly all Africa and its islands, South Asia, most of the islands of Polynesia, and the portions of North and South America comprised between California and the north of the La Plata territory. In the equatorial regions the medium temperature for the year is from 80° to 84° F., the min. being 54°, the max. 118°. Near the equator the annual mean temperature decreases slowly as we recede from it, the decrease not amounting to more than 2° F. for the first 10° lat. The difference of temperature during the day is slight, but much greater during the night, owing to radiation. The general variations of the barometer are slight, but the periodical or diurnal variations are very marked. It ascends and descends regularly twice in the twenty-four hours. It ascends from 4.13 a.m. to 9.23 a.m., and descends until 4.8 p.m., ascending again until 10.23. Electrical phenomena are very decided. The rainfall is variable, but 40 inches may be given as a mean. It is generally supposed that heat is greatest at the equator and diminishes as we recede from it; but both observation and astronomical induction lead to the conclusion that not only the maximum of temperature in warm climates is attained at or near the tropics, but also the highest annual mean. The countries in which the highest degree of heat is known to be attained are near the tropic of Cancer, as, for instance, the banks of the Senegal, the Tehama of Arabia, and Mehran in Beloochistan. Moreover, the snow-line, or the line of perpetual snow, is higher at the tropics than at the equator. In the Bolivian Andes, near the tropic, it is 17,000 feet, whereas in the Ecuador Andes, on the equator, it is only 16,000 feet. These facts are partly explained by the unequal progress of the sun after the equinox in its course towards the tropic. In the first month it passes through 12° of latitude, in the second month through 8°. At the end of the second month, therefore, it is 20° from the equator, and there remain only 3½° to be traversed in the third month. The sun receding from the tropic at the same rate at all places between 20° and 23½° of latitude, the solar rays during two months fall at noon either perpendicularly or at an angle which deviates from a right only by 3½° at most.

Another cause which tends to diminish heat in the regions near the equator is the prevalence of rain. For about five degrees north and south of the equator, in the region of the equatorial calms, there are few consecutive days in the year without rain. The principal cause both of the calms and of the rains has been attributed to the meeting in the upper atmospheric regions of the trade winds, north and south. They neutralise each other and precipitate the vapour they hold in solution.

Regions that lie between 5° and 10° of latitude have usually two rainy and two dry seasons. The greater rainy season occurs when the sun in its passage to the nearest tropic passes over the zenith, lasting from three to four months. The lesser rainy season occurs when the sun on its return from the nearest tropic approaches the parallel of the place. The rains then only last from six weeks to two months, and are much less abundant and continual. Countries more than 10° or 12° from the equator have only one rainy and one dry season; the first begins when the sun approaches the nearest tropic, and ends some time after, when in its course from the tropic it has passed the parallel of the place. It lasts from four to six months. Local conditions may modify the course of the dry and wet seasons, as is the case in India, where the dry and rainy seasons depend principally on the monsoons. The amount of rain that falls in a short time within the tropics is very great, much more so than in more northern regions, but these heavy rains do not last continuously as is supposed. Days of continued rain, even in the rainy season, are rarer than in the north. Still, heavy rains are apt to cause great inundations, and to cover large extents of low or level country with water, causing swamps and marshes, very injurious to health.

In the vicinity of the tropics there is a belt, extending over several degrees of latitude, where it seldom rains. This rainless tract is precisely the region which has been already mentioned as that of greatest heat. These belts of rainless regions, extending around the globe on each side of the equator, may be said to separate the countries which lie on each side of the equator from the temperate zones. Thus in Africa the rains cease on the southern border of the desert of Sahara at about 16° N., and begin again at 28° N. On the banks of the Nile the rain ceases about 18° or 19°, to begin again between 28° and 29°. The Tehama, or low coast of Arabia, is all but rainless. This rainless tract crosses Asia as far as China, where there is no rainless region, owing, probably, to the fact, that all parts of China between 22° and 30° N. lat. are traversed by high mountain chains.

The influence of warm climates impresses certain peculiarities on the peoples who inhabit them. They are the abode of the Ethiopian and Mongolian races of mankind, and appear to have impressed the same characteristics, in a minor degree, on the Caucasian races that inhabit them: a dark complexion and black hair. The inhabitants of these countries are indolent and apathetic. The functions of the skin and liver are peculiarly active, a circumstance which exposes them to severe disease of these organs. The digestive functions are sluggish, and the nervous system is alternately excited and depressed. Remittent and intermittent fevers, dysentery and yellow fever are common. During the dry season disease tends to assume the ataxic, during the rainy season the adynamic form. Pulmonary consumption is frequently met with in the towns, in contradiction to received opinions.

2. *Temperate climates* may be said to occupy the zones of the earth's surface comprised between 35° and 50° or 55° lat. They comprise southern and central Europe, with its islands; the parts of Asia which extend between the Black Sea and the Mediterranean, and Japan; the greater part of North America; a part of Chili and La Plata and Patagonia, in South America. The mean temperature may be stated at from 60° to 50°. The climates in which the mean temperature is from 60° to 68° are often spoken of as temperate, but in reality they approximate closely to warm climates. The four seasons, winter, spring, summer, and autumn, are well marked, but very variable both as to barometrical and thermometrical conditions. The mean temperature in the central regions is, for winter 38°, for spring 51°, for summer 68°, and for autumn 53°. The regions which are near the south and north limits of the temperate zones approximate to the meteorological characters of the warm and cold climates respectively. The periods of the year when storms, rain, and general versatility of meteorological phenomena are principally observed correspond with the vernal and autumnal equinoxes. *The influence* of a temperate climate on the human organisation is salutary, extremes of heat and cold being both trying. Thus the healthiest climates of the world's surface are found in this zone. Intense heat, or even moderate heat if persistent, throws a physiological strain on the liver, skin, and digestive system, and renders mankind prone to severe and fatal diseases of these organs. Intense cold throws a physiological strain on the lungs and kidneys, and exposes them also to severe and fatal disease. The healthiest temperate climates are those in which the winter is not very cold and the summer is not very warm, and in which, consequently, there is no great or continued strain on any one class of organs. The diseases of temperate regions are those that are the best known, as their study and description constitute the foundation of pathological science, ancient and modern.

The climate which, perhaps, the best deserves the appellation of temperate is that of the Mediterranean basin. The winters are not severe on any part of its north shores, and the summers are not intensely hot on its south shores; at least the heat falls short of that of the tropics. There are many conditions of physical geography which conduce to this result. The north shores are protected from north winds by the ranges of high mountains of Southern Europe which skirt them, and the south shores are in close proximity to the hot, rainless tract of Northern Africa—the desert of Sahara, which favourably modifies winter temperature. Moreover, the Mediterranean is a warm sea, but few cold rivers of considerable size flowing into it from the north, a fact which increases the temperature on its shores and islands.

3. *Cold climates* comprise the regions which extend from 50° or 55° lat. to the poles. They may be subdivided into *cold*, with a mean of from 50° to 40°; *very cold*, with a mean of from 40° to 32°; *glacial*, with a mean below the freezing point. In the austral hemisphere the zone contains but little known land, although the existence of an antarctic continent is suspected; in the northern hemisphere it comprises, in Europe, the north of Scotland, Denmark, Sweden, Norway, Iceland, Finland, Lapland, Northern Russia, Spitzbergen, Nova Zembla; Northern Asia, and some of its large plains below 50° lat., Siberia, and Kamtschatka; in America, Canada, including some regions below 50°, the northern lands and islands of Hudson's and Baffin's Bays, and Greenland. In this zone the decrease of the mean temperature is much more rapid as we recede from the equator, than it is in the tropical regions. Thus from the equator to 20° lat. the variation of the mean temperature is not more than 7° or 8°, whereas the variation between 55° and 75° lat. amounts to from 22° to 27°. The coldest region of the globe is not, it would appear, at or near the pole, but at about 80° lat., or 10° from the pole, north of Behring's Straits: the cold of the glacial climates has been exaggerated. At the latitudes of from 70° to 78°, the extreme limit of human habitation, the mean annual temperature is between 19° and 17°, *i.e.* 13° to 15° below the freezing point. The extreme of cold registered, however, reaches a hundred degrees or more below the freezing point. Owing to astronomical conditions there is great disproportion between the length of the nights and of the days at different seasons of the year. In the more northern regions, for several months in the winter the sun never appears above the horizon, and in the summer for several months the sun never disappears below it. Spring, during which the extreme cold is mitigated, lasts but a very short time, and is succeeded by summer, which is in its full strength in June and July. Temperature rises rapidly from 35° to 55° and 60°. In some northern localities it rises to 86° or 90°. Under the influence of the prolonged or persistent days, and of the increased temperature, the vegetation peculiar to each locality passes through all its phases with extreme rapidity. Towards the end of July rain and fog reappear, and are followed by snow and intense cold, the highest expression of which is in January and February. The barometrical changes are the reverse of what obtains in the tropics. Above 60° lat. the diurnal or periodical changes are scarcely perceptible, whereas general or occasional variations become

more marked as we approach the pole. Electrical phenomena become less marked, and above 68° lat. they are scarcely perceptible, with the exception of the aurora borealis. The winds which predominate are the N.E and S.W., and they change rapidly from one point of the horizon to the other, and thus frequently occasion tempests which extend over considerable areas. The quantity of rain that falls in cold climates is much less than in the tropical and temperate, with some exceptions. Between 60° and 90° lat. it only amounts to a few inches, and falls principally in the form of snow. *The influence* of cold climates is shown on the inhabitants of these countries, who vary much in stature, and possess a vigorous constitution, a sanguineous temperament, great muscular development, active digestive functions, and sluggish nervous powers. Notwithstanding the severity of the climate they generally succeed in protecting life, and live to old age, presenting few diseases peculiar to climatic influences. They are, however, subject to opththalmia and amaurosis, owing to the reflexion of light from the snow in the polar regions, and to scrofula and scurvy, the result of a poor and incomplete dietary. Agues, and intermittent fevers from marsh influences, are rare, and not severe, and disappear entirely as we approach the pole. Continued fevers are met with, but seldom if ever epidemically.

4. *Insular climates* present important peculiarities. The temperature of the sea is more equable than that of the land. Owing to the action of currents, and to the circulation of its waters under the influence of heat, its superficial temperature is warmer in winter and cooler in summer—more equable—than that of the land. It has thus a tendency to warm in winter and to cool in summer the island which it surrounds. Moreover, there is constantly watery vapour arising from the sea which extends to island atmospheres, veils the sky more or less, shields their surface from the ardour of the sun in summer, and prevents great radiation both in summer and in winter. Thus it is that the climate of all islands is more equable than that of continents. This fact is more especially recognisable in the climate of the British Isles, which is also modified—rendered warmer and moister, by the waters of the Gulf Stream impinging on their shores. The warm Gulf Stream, commencing in the tropics, in the Gulf of Mexico, passes northwards along the shores of North America, crosses the Atlantic to the south of Newfoundland, and strikes the shores of the British Islands, of Norway up to Cape North, of Holland, and of France; everywhere raising temperature and the annual mean.

5. *Maritime climates* participate in these influences; temperature is more equable, warmer in winter and cooler in summer, on the shores of seas and oceans than it is inland. Owing to this cause most of the winter sanitaria have been chosen in islands or on the coasts of oceans and seas: such as Hastings, Ventnor, Bournemouth, Torquay, Funchal, Malaga, Cannes, Nice, Mentone, Naples, Salerno, and Algiers.

6. *Continental climates* exhibit conditions the reverse of those which obtain in maritime climates. The tendency is to cold winters and warm summers, owing principally to the absence of the equalizing influence on temperature of large masses of water. A very short distance from the sea is sufficient to establish this difference. Thus the central parts of France are very much warmer in summer and colder in winter than the coasts of Normandy and Brittany. But it is when we reach the centre of continents—Russia, central Asia, central America—that the difference is the most marked.

7. *Mountain climates.*—As we rise above the level of the sea, we meet with two important meteorological conditions. The air becomes more and more rarefied, and the heat diminishes, independently of the more or less obliquity of the sun's rays. The higher we rise above the sea level the more the air is rarefied, and the more the degree of heat due to the solar rays diminishes. We arrive at last, even at the tropics or the equator, at a height, variable according to latitude, where the sun's heat is insufficient to melt the snow. This is termed the snow-line. Mountains attract clouds and watery vapour, and the coolness of their atmosphere causes the precipitation of the vapour in the form of rain or snow. Thus, mountains, mountain-ranges, and the glaciers they contain, are the principal cause and origin of rivers. *The influence* of mountain climates, notwithstanding the clouds, fogs, and rain which characterise them, is proverbially a healthy one, owing to the purity of the air, and, perhaps, to the sparseness of population. They have of late been much recommended for phthisis. The two conditions above mentioned, however, namely, purity of the atmosphere and sparseness of human habitations, are quite sufficient to account for the rarity of phthisis amongst their inhabitants, and for the improvement of the phthisical who resort to them.

Soil modifies climate considerably. Wet and marshy soils are cold, engendering fog and mist. Sandy, dry, well-drained soils are comparatively warm. All sandy plains are warm in summer and cold in winter.

Such are the features which characterise the climates of the terrestrial globe, generally. Each locality, however, each mountain, plain, and valley, each city, village, and house, has a climate of its own, modified by all the meteorological elements which we have successively considered. To discover what each climate is, we must study carefully the meteorological conditions and influences which we have rapidly surveyed in their application to it.

8. *Isothermal climates.*—Owing to the unequal influence of the different elements that constitute climate, the annual mean temperature of regions occupying the same latitude on the earth's surface is very variable. Hence the above name has been given to the regions in which the annual mean is the same. The study of a map on which the isothermal lines are marked is an instructive illustration of the facts above described. Thus it will be seen at a glance that the limit of constantly frozen ground in the central plains of Asia and in the northern plains of America is below 54° F.; which is the latitude of York!

The general influence of climate.—The vegetable and animal worlds, including man himself, have been modified in essential characters by climatic conditions. The study of its influence on their vitality and organisation opens out a wide field to the observer. This study leads to the conclusion that geological periods of time have been necessary to impress on terrestrial life, be it vegetable or animal, the characteristics observed now or formerly in the climates of different regions of the earth. The current of modern research is strongly directed to the elucidation of the influence of climate on life during such geological periods. The investigations of Darwin and his followers may be named as the most remarkable and important illustration of this fact. We may also mention the researches of modern philologists, which have proved, by the study of languages and their roots, that most of the nations of modern Europe have descended from the same Aryan parents as the inhabitants of the Indian peninsula. Climate, in the course of time, has so modified them as apparently to produce different races. For such a change to take place geological lapses of time are certainly required. Our earliest records, dating back several thousand years, show these races such as they are now, quite as distinct. In these days the Aryan races of Europe cannot rear their children in the climate of India, where their Hindoo relatives thrive and propagate their species. In Palestine and Egypt the biblical records, those of the Pharaohs, and those of Nineveh and Babylon, show these regions to have been inhabited, several thousand years ago, by nations and tribes presenting precisely the same race characteristics as those that now inhabit them. During the historical period, the races of Europe have in vain endeavoured to colonise the valley of the Nile; but they have not been able to propagate their species, and have died away, leaving the valley of the Nile to its ancient inhabitants. Their children cannot withstand the heat of summer. On the north-eastern shore of Africa the Algeria of the present, history presents the same record. The Romans and the Visigoths occupied its plains for centuries, continually recruiting their colonies from the mother-countries; and yet, except in the mountains, all traces of their presence has disappeared. They could not rear their children so as to occupy the land of the Arabs. What lengthened periods of time must have elapsed to so profoundly modify races deriving their origin from a common parentage, that they can no longer live and propagate their species in the same climates!

Therapeutical Applications.—The therapeutical application of many of the above facts is contained in the facts themselves. Reasoning suffices to deduce the therapeutical law, and experience proves the correctness of the deduction. A very brief summary only can here be given. *See also* CLIMATE, The Treatment of Disease by.

Firstly, it is clear that if a local climate produces injurious effects on the health of its inhabitants, or of visitors, the latter should leave it, and the regular inhabitants, who cannot leave it, should endeavour by every possible means to modify the pernicious climatic influence to which they are exposed, and to partially escape from its action. This rule may be illustrated by the influence of confined mountain valleys in producing goitre, and of marshy districts in producing intermittent fevers. The principle applies to all local climates which exercise a pernicious influence of any kind on the human organisation. When possible the climate should be abandoned; if that is impossible its pernicious influence must be combated by every possible hygienic and therapeutical means.

The injurious effects which extreme climates exercise on the human economy—warm climates on the abdominal and cerebral organs, cold climates on the thoracic—point to change of residence as an important therapeutical agent, the value of which is only beginning to be understood. Our naval and military surgeons have done much to clear up this branch of therapeutics, as regards the diseases of tropical regions. Thus chronic affections of the liver and intestines, incurable in a warm climate, often become quite curable if the patient is transferred to a temperate region or to a mountain elevation in the tropics, which reproduces a temperate climate.

Inversely, persons suffering from diseases of the respiratory organs, so common in damp temperate climates like those of France, England, and Holland, find relief by migrating, especially during winter, to warmer regions of the earth's surface, where they escape from the influences which have proved so detrimental to them. Thence the yearly increasing exodus of persons suffering from chronic laryngitis and bronchitis, from bronchial asthma and from phthisis, from the north of Europe to the south.

The increased facilities of locomotion, by rail and by steam, have thus opened out, as it were, a new and important branch of therapeutics, that of the application of climate to the treatment of disease. J. HENRY BENNET.

CLIMATE, The Treatment of Disease by.—Though we can scarcely say with accuracy that change of climate is a specific for disease, yet much can be effected by it in relieving symptoms, and in assisting the reparative powers of the organism by thus improving the general health. The diseases in which change of climate has been found of value will be enumerated below, with a short notice of various climates. Here we may notice the *rationale* of the benefit to be derived from such change.

Change of climate, we must premise, is only a relative term. It does not necessarily involve the idea of removal to a great distance from the patient's home. A few miles' journey from the town to the country, from inland to the seashore, from the plain to the mountain, often suffices to produce marked results. One use of climate being to expose the organism to the effects of *contrast*, the element of distance comes in most when we wish to make the contrast greater; for instance, in ordering change from a cold to a warm climate or *vice versâ*.

The therapeutic elements of most importance in any climate are (1) pure air free from dust and organic particles; (2) abundance of sunshine, without excessive heat, so that much time can be spent in the open air; (3) a temperature without extremes, so that the body is not exposed to the risk of great variations of heat and cold—equability; (4) absence of violent, very cold, or very hot winds, at any rate of long duration (in this is involved the element of local shelter).

These four elements should be present in each of the subdivisions of climate which a therapeutic classification renders necessary, namely climate of (*a*) the seashore; (*b*) mountains; (*c*) inland wooded districts; (*d*) the open sea.

The epithets 'moist' and 'dry,' which are applied to climates, are merely relative, and depend on local peculiarities of rainfall, soil, &c., as well as to some extent on season; and the essential differences between the climate of the seashore, the woodland, and the mountain remain everywhere the same. We shall say a few words about each of these, with the indications for their use. The climate of the open sea will be referred to in speaking of sea voyages.

(*a*) *Climate of the Seashore.*—The special peculiarities of this variety of climate are that—the air is saturated with moisture, except when dry land winds prevail; it is dense, and, as a rule, therefore, bulk for bulk, contains more oxygen than air of any higher level; its density is liable to great and frequent but regular variations, which increase the activity of the circulatory and respiratory organs, and thus favour their functional activity; it is more equable; and, lastly, it contains saline particles in suspension.

According to Beneke, sea air cools the body relatively quicker than mountain air, and thus quickens the processes of tissue-change the most. Hence the seaside should be ordered where we wish for a highly stimulating effect, as in persons of scrofulous tendency, in chronic diseases succeeding acute ones, or in the later stages of convalescence from the latter, in convalescence from surgical operations, or in some surgical diseases where we wish to accelerate tissue-change, without exertion on the patient's part. On account of the equability of the climate, some patients who cannot bear great changes of temperature do well at the seaside. Persons suffering from overstrain, mental or bodily, with a fair digestive power, and not liable to nervous irritability, may also be sent there.

(*b*) *Mountain Climates* are distinguished from sea-side climates by the lower density of their atmosphere; their lower and less equable temperature; by less humidity, though, owing to local winds, mist and cloud often form; and by relatively lower night-temperatures in clear weather, owing to the dryness of the air, and consequent great radiation. They are cooler also than the inland climates of level districts, and this coolness tends to some extent to diminish the rarefaction and increase the density of their air.

The general action of mountain air is to produce a freer circulation of the blood and greater vascularity of the lungs, owing to deeper and more frequent inspirations and greater ease of bodily movement. Owing to the cooling of the body by the lowered temperature more food is required, the appetite improves, and the body becomes better nourished and gains weight.

The intensity of the effect is, roughly speaking, directly as the height. The term 'mountain climate' is applied in medical parlance to elevations in Europe of from 1,500 to 6,000 feet, though in South America patients have been sent as high as 10,000 feet, or higher.

Mountain Climates are indicated (1) in cases of hereditary tendency to phthisis in young persons with narrow, shallow chests, and who are growing too fast; also in young scrofulous patients. (2) In chronic phthisis and pneumonia; remembering, however, that phthisis occurs at all elevations. The coolness of the mountain air in the height of summer is an important element in phthisical cases, which always suffer from great heat. (3) As a tonic and restorative in persons suffering from over-work in business or literary pursuits, and who have no real organic disease. (4) Generally to complete the convalescence from acute diseases of individuals not past middle life, with a fair amount of muscular power and bodily activity. (5) As a prophylactic against hay-fever, cholera, and other infectious diseases. Mountain climates are not advisable in cases of chronic bronchitis, heart-disease, emphysema, Bright's disease, chronic rheumatism, or for aged persons.

(*c*) *The Climate of Wooded Districts* (elevations above 1,500 feet are not here referred to) is peculiar in the following points:—(1) It has a temperature lower than that of the surrounding country—on the average 3° Fahr.—during the hours of daylight; the temperature is also more equable. (2) The relative humidity is higher (9·3 per cent) in summer than in the less wooded country, and hence there is greater liability to rain and mist. (3) It affords greater protection and shelter against winds than other climates.

The general effect of woodland climates, as may be deduced from the above, is sedative and tonic. They may be advised in chronic bronchitis, emphysema, heart-disease, and in hypochondriasis, hysteria, and other nervous affections where tranquillity and subdued light are of importance; also in the earlier stages of convalescence from acute disease when sea or mountain air is too stimulating. In bronchitis pine woods should be selected, and in heart-disease level walks are essential.

(*d*) *Ocean Climates.—Sea Voyages* have of late years been much recommended in the treatment of phthisis in its early stages, with a view to enable the invalid to spend much time in an exceedingly pure and fairly equable atmosphere, and to secure a sufficient amount of bodily movement without great fatigue.

The main drawbacks to the sea are the impossibility of escape from bad weather and the confinement to close, ill-ventilated cabins, if such occurs; the absence of sufficient light and air below decks, the latter being felt very much at night; want of variety in the diet after a certain time, and at all times (except in short cruises, or coasting trips) of fresh food, milk, &c.; monotony in society and occupations; and, lastly, the inconveniences arising from crowding of the maindeck with hen-coops, sheep-pens, &c., and in steamers from the smoke of the engines, and the smell and vibration of the machinery.

The routes generally recommended to invalids are either to (1) Australia, 90 days; (2) the Cape of Good Hope, 30 days; (3) the West Indies, 14 days; (4) the United States or Canada (in summer), 10 days. Short cruises in the Mediterranean, or to the latitudes of the Canaries and Azores are suitable for certain

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cases where expense is no object. Of routes (3) and (4) we may say that they are too short for the full benefit of the sea to be obtained, as improvement does not generally begin for a week or two after sea-sickness has subsided and the patient can remain comfortably on deck. Route (2) does not allow him to get the bracing effect of high South latitudes. Hence where a long sea voyage is indicated, route (1) is decidedly the best. England is quitted in the beginning of October, Australia (Sydney or Melbourne), or New Zealand (Wellington), is reached early in January, and the return voyage is begun not later than the end of February.

Patients should not remain in the coast-towns of Australia in summer on account of the heat. They should go to the table-land of New South Wales, or to Darling Downs in Queensland, or else they should cruise from port to port, or run over to New Zealand or Tasmania.

In returning, the route round Cape Horn should be *avoided* on account of the great risk of the climate of the South Pacific Ocean and the chance of encountering icebergs, fogs, and unfavourable winds. Either the patient should come back round the Cape of Good Hope; or if his strength permits he may cross to California, travel overland to New York and thence by steamer; or, lastly, he may come by the Red Sea, Suez Canal, and Mediterranean.

The invalid must expect about 20 wet days on the voyage out. The temperatures met with range from 40° to 80° Fahr., the coldest and most uncertain weather occurring in the North Atlantic and South Pacific Oceans.

Choice of Vessel.—The following considerations may be useful in deciding between steam and sailing vessels:—

For a steamer there is the greater certainty in predicting the length of the voyage, and the calms of the tropics are sooner passed.

Against steamers, there is the nuisance of steam and smoke on deck; much space is taken up by the engines, stokers' rooms, &c., and hence other parts of the ship are more crowded; the bilge water is tainted with the engine grease; there is the wearying grind of the screw by day and by night; while more seas are shipped, because a steamer can run against a head-wind.

For sailing vessels there are the advantages of more room, light, and air in the cabins, and the absence of the above-mentioned disagreeable conditions.

Against them there is the longer and more uncertain duration of the voyage, and the necessity of shaping their course by the prevailing winds.

A word must be added as to the comparative merits of wooden and iron vessels. Briefly stated, iron ships are cleaner, drier, freer from smell of bilge water, and hence healthier than wooden; but on the other hand they are less equable in temperature (hotter in hot and colder in cold latitudes), and less aërated by natural ventilation through their sides than the latter. They are also noisier.

The vessel chosen should not be under 1,000 tons, and her age, class of passengers, the character, temper, and standing of her captain, as well as the size of her cabins, should be carefully ascertained. Of course it is a *sine quâ non* that she should carry a duly qualified surgeon.

The cabin for the outward voyage to Australia should be on the port side, so as to get the breeze in hot weather, and *vice versâ* in returning.

The cabin outfit should include a spring mattress, with hair (not wool) mattress over, a folding easy chair, chest of drawers, carpet, curtains, and sponge bath (Faber). Clothes of various degrees of thickness are essential, both for body and head, and a waterproof suit is necessary for bad weather.

Plenty of linen must be taken, as washing is difficult on board, and there should be a supply of preserved milk, meat or essence of meat, fruit, and light wines.

The *indications* for a sea voyage are hereditary tendency to phthisis, or the presence of actual but uncomplicated disease in a very early stage, in persons not past middle life, with a fair digestion, absence of severe pyrexia, and general health not much impaired. Patients with a tendency to hæmoptysis should not be sent, nor should those of a desponding disposition, who would thus be likely to suffer by the long absence from home, or from fears of their personal safety. Of course a tendency to protracted sea-sickness is a distinct contra-indication.

The invalid should be careful not to overtax his digestion too much; he should take regular daily exercise on deck to the extent of his strength, have some definite occupation to beguile the time, and, if possible, be accompanied by a personal friend (Faber).

Choice of a Climate—General Hints.—It is a good plan, if possible, to order a patient a climate with that mean temperature and relative humidity which he is known to tolerate well (Sigmund). The patient's disposition must be considered, and a lively or a quiet place chosen according to his temperament. We should not send a poor man to a place beyond his means, otherwise he has to grudge himself many comforts, and loses much, if not all, the benefit of the change. In sending patients to the South of Europe this rule is too often neglected.

The special indications for the climates of particular places can only be understood by studying their local aspect. Generally speaking, as far as Great Britain is concerned, the climate of the east coast is colder and drier than that of the west and south coasts. In Europe the north and west coasts are moister and cooler than the shores of the Mediterranean. As to season, mountain and woodland climates are almost exclusively indicated in summer from May to September. Certain parts of the sea-coast are adapted for invalids at all seasons of the year; but as a rule the northern coasts of Europe and the eastern or south-eastern coasts of Great Britain are best suited for summer, and the south, west, and south-western for winter residence. The Mediterranean coast is only to be recommended from mid-October to the middle or end of May, and Egypt should be quitted not later than April. A word may be added as to the advantages of wintering in the South of Europe. It is incontestable that the invalid gets a milder winter, a longer autumn, and an earlier spring. Although there is no place where some days of bad weather do not occur, or where uninterrupted calms are met with, yet the number of rainy days is fewer, there is more sun, little or no fog, and, except in the neighbourhood of the Pyrenees, little or no snow or ice. The scenery is picturesque and attractive, and the invalid is able to spend much time in the open air, and to sit out of doors on many days, even in mid-winter. The drawbacks to the South are the risk of chills, owing to the difference between sun and shade temperatures, especially at first, when persons are unaccustomed to the climate, and fail to take sufficient care; the occasional occurrence of high winds, especially in spring; the more limited accommodation, owing to the expense of rooms and living; and the absence of many so-called 'home comforts.'

Those who visit the South must remember that the curative value of the climate consists in its *allowing much time to be spent in the open air*, and in its milder temperature and drier air, which protect the respiratory organs from fresh inflammatory attacks. A south room and warm clothing of the texture usually worn in England in autumn are essential, and a coat or wrap should always be carried out of doors in midwinter to put on in passing from sun to shade. The invalid should strictly avoid the hot atmosphere of gaslit *salons* at night.

Patients with acute diseases of the respiratory organs should not be sent to the South; and high fever, excessive weakness, or the necessity of remaining in bed, are also contra-indications, owing to the fatigue and risks of the journey and the need of home comforts. Cases of mental disease with excitement, where rest and protection of the mind and body is of primary importance, should not be sent.

In the convalescence from acute diseases occurring in autumn, where a cold northern winter would prevent open-air exercise, and probably set up fresh exacerbations, southern winter climates are of great value.

In ordering change of climate the accommodation, food and water supply, soil and drainage of the locality chosen should be carefully considered, especially if the distance is a long one. The best climate may be unavailable for the invalid, owing to defects in one or more of these particulars.

Lastly, the patient's own feelings should be carefully consulted before he is sent far away from home. In some cases all the benefits of climate are counteracted by 'home sickness.' *Cælum non animum mutant qui trans mare currunt.*

Enumeration of Climates.—We shall now enumerate various climates and regions suitable for the treatment of cases that can be benefited.

1. **Of the Nervous System.**—In neuralgia, Arcachon (for the calm, sedative, yet tonic atmosphere of the pinewoods), Cannes (the districts away from the sea), Upper Egypt (Cairo, Luxor, Helwan), Hastings, Hyères, the Engadine, the Bernese Oberland, Pau, Pisa, Rome, the Salzkammergut (Ischl, Berchtesgaden). Some of the above climates will also be found suitable to cases of hemicrania and sciatica.

In hysteria, hypochondriasis, spinal irritation, and in some cases of protracted chorea, Brighton, Cannes, Ischl, Malta, Mentone, Montpellier, Morocco (Tangiers), Nice, Naples, the Bernese Oberland (Grindelwald, Mürren), Palermo, Pau, Seville, Spezia, and Valencia; the effect produced being chiefly due to diversion of the attention by the change of scene, although the bracing influence exerted on the system at large must be taken into account.

In chronic softening of the brain and spinal cord, in paralysis of cerebral origin, and in some cases of locomotor ataxy the South of France may be advantageously ordered in winter, and Alpine climates of moderate height in summer. As a rule hot climates, or those where the sun has considerable power, are contra-indicated where there is a tendency to apoplexy or hyperæmia of the brain.

Temperate and bracing climates are, as a rule, to be recommended in nervous diseases, to restore the general tone of the system.

The immediate neighbourhood of the sea not unfrequently causes nervous excitement, neuralgia, and sleeplessness.

2. **Of the Respiratory and Circulatory Systems.**—In chronic bronchitis, emphysema, bronchial and spasmodic asthma, as well as in chronic pharyngeal and laryngeal catarrh and laryngeal ulceration the following climates may be recommended:—Algiers, Australia, the Azores, Bordighera, Bournemouth, the Canaries, the Cape of Good Hope (?), Upper Egypt, Glengarriff, Hastings, Hyères, Lisbon, Madeira, Malaga, Malta (?), Mentone, Naples (?), Nervi, Nice, Palermo, Pau, Pisa, Queenstown, Rome, San Remo, Torquay, and Ventnor.

Change of climate is of great value in convalescence from the acute, and as a prophylactic and curative measure in the chronic forms of bronchitis; but we must remember that where there is copious expectoration a dry climate is indicated, while in the irritative forms with scanty sputa (*bronchitis sicca*) a moderately moist mild climate is generally suitable. In emphysema we should choose a mild and not too dry climate, if possible in the neighbourhood of pine-woods, such as Arcachon, on the west coast of France. In spasmodic asthma the choice of climate must be partly a matter of personal experience.

In the early active, and in the quiescent forms of the later stages of phthisis, as well as in chronic pleurisy, and in convalescence from pneumonia, the following (chiefly winter) health resorts and climates have been favourably spoken of:—Algiers (?), Australia, Bordighera, Bournemouth, Cannes, Davos, Upper Egypt, Upper Engadine (in summer), South of France, Hastings, Hyères, Queenstown, Ischl (in summer), Madeira, Malaga, Mentone, Natal (?), Nervi, Nice (?), the Oberland (in summer), Palermo, Pau, Pisa, San Remo, Sicily, Spezia, Torquay, Glengarriff, and the Undercliff (Isle of Wight).

In chronic endocarditis, pericarditis, and in heart-disease generally, a rather bracing climate, without extremes and of the character suited to chronic bronchitis, is usually indicated. Here both the tonic effects of climatic change and the prevention of pulmonary complications and fresh rheumatic attacks must be taken into account.

Mountain resorts of *moderate* height, well protected from sudden changes of temperature, may be prescribed in summer (von Dusch).

In the neuroses of the heart, including (1) angina pectoris, (2) palpitation associated with chlorosis, hysteria or hypochondriasis, and (3) exophthalmic gôitre, bracing climates are indicated. In angina pectoris long journeys involving great exertion must be rigorously forbidden, as must also sightseeing or exciting amusements.

3. **Of the Abdominal Organs.**—In the various forms of chronic dyspepsia and intestinal catarrh, in chronic hepatic disease, in chronic dysentery (after removal from a malarial district or tropical climate), in diabetes, and in chronic endometritis, pelvic cellulitis, and other diseases of the uterus and its surroundings, the following climates may be selected from:—Cannes, The Engadine, Hastings, Hyères, Lisbon, Malta, Mentone, Montpellier, Morocco, Naples, Nice, the Nile, the Bernese Oberland, Pontresina, the Pyrenees (in summer), Queenstown, the Salzkammergut, Seville, Spezia, St. Moritz, Valencia, and Ventnor.

In convalescence from acute nephritis, and in all forms of chronic Bright's-disease, but especially *catarrhal* nephritis, warm dry climates are indicated. Among the best are Upper Egypt, the Riviera, the Cape of Good Hope (inland), Bombay; and in England: Brighton, Folkestone, and Ventnor.

In renal calculus removal from particular districts in which stone is known to be prevalent may possibly be of use in some cases.

4. **Of the System at large.**—Change of climate is here nearly always indicated:—

(1) In convalescence from typhus and typhoid fevers, scarlet fever (at the end of the desquamative stage), measles, diphtheria, and acute rheumatism; also in the third stage of protracted hooping cough.

(2) As a prophylactic against all infectious diseases, and especially cholera, yellow fever, hay fever, influenza, and malaria; also against rheumatism and phthisis by withdrawal from damp districts, and goitre and cretinism by removal from the *ensemble* of conditions to which the latter are due.

(3) In rickets, scrofula, chlorosis, general anæmia, and functional debility. Here, where a pure air and a bracing sunny atmosphere are the chief indications, the climates enumerated in section 1, page 268, are suitable, as are also Algiers, Biarritz (in autumn), the Cape of Good Hope, Ischl, Malaga, Rome, Sicily, St. Moritz; and in Great Britain a number of inland and seaside places (Malvern, Scarborough, &c.) which we have not space to mention.

Edward I. Sparks.

CLINICAL (κλίνη, a bed).—This word literally signifies 'of or belonging to a bed'; but it has been particularly applied to the practical study and teaching of disease at the bedside; and has more recently been extended to all that relates to the practical study of disease in the living subject generally.

CLONIC (κλόνος, commotion).—This word is applied to spasmodic movements which are of short duration, and alternate with periods of relaxation. *See* Convulsions, and Spasm.

CLOT.—A clot, or coagulum, is the product of the formation of fibrin. The separation or formation of fibrin is attributed to the union, under the influence of a ferment, of the fibrinogenetic substance or fibrinogen which is contained in the liquor sanguinis, the juice of the flesh and most of the serous fluids, with the fibrinoplastic substance which is contained in the blood-globules, the lymph-corpuscles, and the cells of the body generally. Coagulation of the blood within the blood-vessels is described under Thrombosis; the coagulation of extravasated blood under Hæmorrhage and Brain, Hæmorrhage into; and the coagulation of inflammatory exudations under Inflammation and Exudation. *See* also Blood, Morbid Conditions of.

CLOTHING. *See* Disease, Causes of; and Health, Personal.

COAGULUM (*coagulo*, I curdle). *See* Clot.

COAL GAS, Poisoning by.—Coal gas, so largely employed for illuminating purposes, is a compound, containing—in addition to olefiant gas and analogous hydrocarbons, on which the luminosity principally depends—certain so-called diluents which burn with a non-luminous flame, viz., hydrogen, marsh gas, and carbonic oxide along with what are termed impurities, of which the chief are carbonic acid, sulphuretted hydrogen, and bisulphide of carbon. On these impurities the characteristic odour mainly depends. This odour, which is perceptible even to the extent of 1 in 10,000, is a valuable safeguard against accidents from escape of gas.

A mixture of coal gas with the air inhaled exerts a deleterious effect on the system, and proves fatal when it reaches a certain percentage. In addition to the danger from inhalation, fatal accidents frequently occur from the explosive nature of the compound which is formed when the gas reaches the proportion of 1 to 10 of the atmosphere. Much less than this, however (a non-explosive mixture, therefore), proves fatal if long inhaled.

It is difficult to determine the exact proportion of the gas present in atmospheres in which fatal accidents have occurred, but we derive important information on this point from experiments on animals. Many such have been made. M. Tourdes, who has carefully investigated the subject, finds that pure gas is almost instantaneously fatal; $\frac{1}{8}$th kills rabbits in five minutes, and dogs in twelve minutes; $\frac{1}{15}$th kills rabbits in from ten to fifteen minutes; $\frac{1}{30}$th still proves fatal after a longer period; and evident signs of distress are caused in rabbits by an atmosphere containing only $\frac{1}{50}$th of the gas. Dr. Taylor (*Edin. Med. Jour.*, July, 1874) has estimated the proportion of gas existing in a room in which a fatal case occurred at three per cent.

Sources of Poisoning.—Poisoning by coal gas is only known of as an accident. Occasionally suddenly fatal consequences ensue among workmen from exposure to a sudden rush of undiluted gas from gasometers and mains. More commonly slowly fatal cases result from the gas-tap in a bed-room being left open carelessly, from accidental extinction of the light, or from leakage of gas-pipes in a house or at a distance; the gas gaining access to the house in the latter case through cellars, walls, and more especially by means of drains and sewer-pipes.

Symptoms.—Gas, even when in comparatively small proportion and just sufficient to cause an unpleasant odour, acts deleteriously if long breathed, and gives rise to headache and general depression of health.

In severe and fatal cases the symptoms which have been noted are headache; nausea or vomiting; vertigo; and loss of consciousness, passing into deep coma and muscular prostration, which resembles the apoplectic state, the individual lying insensible and incapable of being roused, with livid features, stertorous breathing, and froth at the mouth. Death usually occurs quietly, in this state of coma, but occasionally with convulsions.

The state of the pupils does not seem to be constant, though they are generally dilated before death.

In Dr. Taylor's case the teeth were firmly clenched, and the eyes were in a constant state of lateral oscillation.

Fatal Period.—The fatal period of poisoning by coal gas is extremely variable, and a remittent character of the symptoms sometimes gives rise to fallacious hopes of recovery in cases which ultimately prove fatal.

Diagnosis.—The smell of gas in the clothes, breath, and perspiration, which continues for a considerable time after removal from the infected atmosphere, is the best indication of the cause of the coma.

Anatomical Characters.—The smell of gas is often very marked. M. Tourdes has found, as the most constant appearances, a dark colour of the blood, which, however, coagulates; a bright coloration of the pulmonary tissue; froth in the air-passages; congestion of the mucous membrane at the base of the tongue more particularly; engorgement of the cerebral and spinal venous system; and rose-coloured patches on the thighs.

Mode of Action.— It is obviously impossible to differentiate between the effects of the various constituents of coal-gas, but we have good reason for believing that the most active agent is the carbonic oxide, which exists in the proportion of from five per cent. (English gas) to twenty-five per cent.

The symptoms in the main agree with those caused by carbonic oxide (*see* Carbonic Oxide, Poisoning by), and the effects, therefore, would be chiefly due to the action of the carbonic oxide on hæmoglobin.

Treatment.—Instant removal from the infected atmosphere is the first thing to be attended to. Attempts must then be made to cause oxygenation of the blood by artificial respiration and excitation of the respiratory centres by reflex stimulation of the face, chest, &c.

Pure oxygen gas may be administered. As, however, the compound which carbonic oxide makes with the blood-colouring matter is a very stable one, and not easily broken up by the introduction of atmospheric air or oxygen, it not unfrequently happens that these measures prove of no avail. In such cases it would be highly advisable to perform venesection, and then transfuse fresh blood, a plan of treatment which has been found successful in poisoning by carbonic oxide. D. Ferrier.

COARCTATION (*coarcto*, I straiten).—A pressing together, narrowing, or stricture of any hollow tube, such as the aorta, intestine, or urethra.

COLD, A.—A popular name for Catarrh. *See* Catarrh.

COLD, Ætiology of. *See* Disease, Causes of.

COLD, Effects of Severe or Extreme.—The general effect of exposure to severe or extreme cold is to lower, even to extinction, all vital activity. The blood-vessels, especially the smaller arteries and capillaries, after a brief period of congestion, become contracted, the latter to such an extent as no longer to permit the passage of the red corpuscles; the normal condition, composition, and structural integrity of the various tissues are more or less impaired, or altogether destroyed; and those processes of chemical and physiological change which are essential to every manifestation of life, being only possible within certain very narrow limits of temperature, are hindered or absolutely prevented.

Effects and Symptoms.—The more special effects vary in degree and kind:—1stly, with the degree of cold, the duration of the exposure, and the medium or manner of application; 2ndly, with the part, and extent of surface exposed; and, 3rdly, with the general constitution and physiological condition of the sufferer. Moderate cold, acting during a short time, or even severe cold during a still shorter time, followed by the glow of speedy reaction, exercises a tonic and stimulating influence. But if the cold is too severe, or the exposure too long, no glow of reaction occurs, but a sense of depression is experienced, from which, at best, recovery takes place but slowly. Continued exposure to such degree of cold as is yet not incompatible with the maintenance of life, nevertheless keeps at low ebb activity of nutrition and function alike. Extreme cold and long exposure lead to congelation and consolidation of the various tissues of the body. After complete congelation recovery is impossible. Dry cold is much less readily injurious in its influence than cold associated with wet. The better conductor of heat the medium is, the more speedily and completely does it reduce the temperature of the part with which it is in contact. Immersion in water cools more rapidly than exposure to air of the same temperature: and contact with wool, wood, or metal, of the same degree of coldness, excites in each case a different sensation, and leads to a different result, or to the same result with very different rapidity. Constant renewal of the medium in contact hastens the cooling effect; and a continuous draught of only moderately cold air may do more to chill than temporary exposure to an intensely cold, but still atmosphere. If some external part, and a comparatively small extent of surface only, be acted upon, the effect may be simply local, and the general disturbance of the system scarcely appreciable. But if the whole body, or a considerable extent of surface, or any important internal organs be acted upon, a proportionately serious general effect is produced. The young (infants especially) and the aged alike ill sustain exposure to cold, and are most liable to suffer, not only from its direct effects, but also from the various maladies to which it gives rise. The feeble, ill-nourished, and broken in health, especially the subjects of organic disease, or of degeneration due to habitual intemperance, readily succumb, or only slowly and imperfectly recover. Among the healthy and otherwise vigorous, hunger, fatigue, sleep, anxiety of mind, fear and mental depression of whatever kind, lower—too often even to fatal issue—the power of resistance to the deadly influence of cold.

For *local effects* of exposure to cold *see* CHILBLAIN, FROST-BITE, and GANGRENE.

The *General Effects* produced by exposure to severe or extreme cold vary somewhat in different cases. Temporary exposure produces, first, a sense of coldness or chilliness, associated with paleness and corrugation of the skin (the so-called *cutis anserina*), then shivering and tingling sensations, followed by numbness and diminution of muscular activity and power. Healthy reaction restores more or less quickly the normal condition. Prolonged exposure to extreme cold gives rise to a series of symptoms, graphically described by Beaupré somewhat as follows:—Reaction has a limit, and a moment arrives when the powers are exhausted. Shiverings, puckerings, paleness and coldness of the skin, livid spots, muscular flutterings, are symptoms of the shock given to the vital forces; syncope approaches; the stiff muscles contract irregularly; the body bends and shrinks; the limbs are half-bent; lassitude and languor invite to repose; a feeling of weight and numbness retards the steps; the knees bend; the sufferer sinks down or falls; the propensity to sleep becomes irresistible; everything grows strange; the senses are confused; the mind grows dull, the ideas incoherent, and the speech stammering or raving; respiration, at first interrupted, becomes slow; the heart's action is feeble, quick, hard, irregular, and sometimes painful, and the pulse progressively smaller; the pupils dilate; the brain becomes stupified; and finally deep coma indicates the approach of inevitable death.

Other, and somewhat different effects and symptoms, attributable to differences of circumstances and condition, have been from time to time observed. Distressing and almost intolerable thirst, with loss of appetite for food, is often experienced; and the attempt to obtain relief, by sucking snow or ice, only adds to the suffering. Somnolence is by no means so constant an effect as is commonly supposed—at any rate, in the earlier stages, and less extreme cases. On the other hand, inability to sleep has proved a common cause of suffering and consequent loss of strength. The manifestations of brain-disturbance due to exposure to cold, varying as they do from dullness, incoherence, wandering and thickness of speech to even raving delirium, are especially worthy of note, inasmuch as they resemble, and are liable to be mistaken for, the effects of alcoholic intoxication.

Death from the direct and immediate effects of cold is rare in our country; but it is estimated that in the Russian Empire, on an average, 694 deaths occur annually from this cause. The length of time during which exposure can be sustained varies greatly with the condition of the individual and with surrounding circumstances, as well as with the degree of cold. Under ordinary circumstances, an hour's exposure to intense cold often suffices to determine a fatal result. At the same time, well-authenticated cases are on record, in which persons buried, for days even, in the snow, have nevertheless survived and ultimately recovered with little permanent damage.

Mode of Death.—The immediate cause or mode of death from cold seems in some cases to be principally shock; in some, syncope; in others, asphyxia; and in others, again, coma. In most cases it is probable that these several conditions, with others less readily specified, combine to produce the fatal issue.

ANATOMICAL CHARACTERS.—The appearances presented on post-mortem examination are somewhat differently described and estimated by different observers; but none of them are absolutely pathognomonic, and some are as likely to be produced by exposure of the body after death as during the process of extinction of life. Among the more noteworthy are the following:—strong cadaveric rigidity; paleness or waxy whiteness of skin, with patches of more or less bright redness about the face, neck, and limbs, especially on exposed or prominent parts; a contracted and shrunken condition of the male genital organs; comparative bloodlessness of superficial and external parts; accumulation of blood in and about the thoracic and abdominal viscera; great distension of all the cavities of the heart, with more or less clotted and often bright-coloured blood; the blood in other parts also sometimes of brighter colour than usually seen on post-mortem inspection; hyperæmia and congestion of the lungs; hyperæmia of the brain, overfulness of the sinuses, and excess of serous fluid in the ventricles, and at the base, in some cases; in others, comparative bloodlessness of the surface of the brain, and no distension of the sinuses; excessive fullness of the urinary bladder; and, lastly, separation of the cranial bones along the coronal and sagittal sutures. The lines of reddish or brownish staining along the course of the superficial blood-vessels, relied on by some as pathognomonic, are certainly not so, inasmuch as they depend upon exosmosis of the blood colouring-matter set free by disruption of the corpuscles, which may be effected by freezing after death, as well as before.

TREATMENT.—The treatment of sufferers from the effects of cold, consists in the restoration of warmth, and the rekindling of those processes by which the natural heat of the body is maintained. But this must be done gradually, and with great care. As in the treatment of a frostbitten part, so in the treatment of the body generally—all sudden or rapid elevation of temperature must be avoided. The sufferer, divested of the clothing previously worn, and wrapped in blankets, should be placed in the recumbent position in a room, the air of which is dry, still, and cold, but capable of being gradually warmed. Gentle, but continuous friction should be made over the trunk and limbs, care being taken that rigid or frozen parts be not damaged by rough manipulation. At first, ice or ice-cold water may be used; afterwards dry rubbing with flannel or with the hands is better; later still some stimulating liniment may be employed. Some recommend immersion of the body in a bath of cold—at first ice-cold—water, the temperature of which can be gradually raised. This method would seem easy and advantageous, if means are at command. When the sufferer can swallow, warm, gently stimulating, drinks—as tea, coffee, aromatic infusions, beef-tea, or soup—may be given, at first without, but later with some wine or spirit. Alcohol, though useless or injurious if taken to fortify against cold, is useful and beneficial when judiciously administered as a restorative after exposure. In all cases of insensibility, and even apparent death from cold, every effort must be made to restore animation; and the attempt must be persevered in for a considerable time before being given up as hopeless. It is often difficult, sometimes impossible, to judge whether life is absolutely extinct or not. And while, on the one hand, it is important that the temperature be not raised too quickly, lest reaction should be too strong or dangerously irregular; on the other hand, it is equally, if not more important, that the needful measures be adopted without delay, and carried out not too slowly, lest the chance of revival should be lost. In the less severe cases, restoration of warmth may be comparatively quickly accomplished. The state of the bladder should always be examined, and relief afforded, if needful, by aid of the catheter. Attention to the general health is often requisite for long after recovery from the more immediate effects of exposure has taken place. Rest, good nourishment, and tonics are indicated.

Cold as a Cause of Disease.—As a predisposing and exciting cause of disease, cold proves, in this country, year by year, more fatal in its effects probably than any other single condition or influence. Any considerable fall in the thermometer below the average standard during the colder months of the year is constantly followed by a corresponding rise in the death-rate, and an increase in still greater proportion in the amount and extent of sickness and suffering. The Reports of the Registrar-General clearly prove this, so far as the death-rate is concerned. A striking instance may be quoted. In the week ending December 19, 1863, in the London district 1,291 deaths were registered. Severe frost set in, and in the week ending January 9, 1864, the number rose to 1,798. The week following, ending January 16, no fewer than 2,427 deaths were registered. This enormous increase could be attributed to no other cause than the effects of the severe cold which prevailed. The Registrar-General also shows that after the age of from twenty to forty the mortality from cold increases in something like a definite ratio with increasing years.

General depression of the vital powers, congestion and functional derangement of various internal organs—the lungs, liver, and kidneys—catarrhal and other forms of inflammation of the mucous membranes, especially of the respiratory tract, but also of the intestinal canal and bladder, paralysis from central or peripheral lesion, together with rheumatism, chilblain, frost-bite, and gangrene, constitute the list of maladies most commonly caused and fostered by exposure to the influence of cold. ARTHUR E. DURHAM.

COLD, Therapeutics of.—The therapeutic uses of cold are various and extensive. Cold may be applied as moist cold, by means of wet compresses and cold lotions or baths; and it may also be used as dry cold in the form of ice enclosed in a receptacle of metal or india-rubber. Each of these methods has its special advantages and adaptations. Furthermore, cold may be made use of by the mouth, and by injection into the mucous canals of the body.

GENERAL PRINCIPLES.—The general effect of cold, however applied, is to lower temperature, to diminish sensibility and fluidity, to contract the tissues and vessels, and so to reduce the volume of parts. The cold bath and cold sponging alike have the effect of lowering the temperature of the body. The fall of temperature sometimes is but transient, reaction setting in and heat of surface returning when the body is withdrawn from the cooling medium. At other times the temperature continues to fall after the individual is removed from the bath. If the action of the cold bath be prolonged, then a thermometer, introduced within the rectum, shows a great depression of temperature, and much pain is experienced, similar to the severe pain which is felt in the hand and arm when the former is held for some time in water at a temperature of 41° Fahr., and which soon compels the withdrawal of the hand from the vessel. Cold baths and their uses are treated of in another article, but attention may here be drawn to the practice of cold sponging over the surface as an efficacious means of lowering preternatural heat and relieving acridity and dryness of the skin during fever. Reduction of hyperpyrexia by means of cold is now a well-established therapeutic method. *See* TEMPERATURE; and Special Diseases.

METHODS OF APPLICATION AND USES.—1. **Cold Affusion and Wet Packing.**—In the practice of cold affusion, introduced by Dr. Currie, in 1797, the patient is unclothed, seated in a tub, and four or five gallons of cold water thrown over him. Thus, Dr. Currie said, a commencing fever might be 'extinguished.' In cases where the skin was burning hot and dry, it was observed that after the cold affusion, temperature fell, perspiration broke out, and the patient usually dropped into a refreshing sleep. If the body-heat did not exceed 98·5° Fahr., or if the patient was damp and chilly, with or without delirium, the cold affusion was regarded as dangerous and by all means to be avoided. In fevers complicated with any visceral inflammation, the cold affusion is prejudicial. Drs. Strauss and Hirtz speak most highly of the marvellous effect of cold affusion in cases of collapse during fever. This kind of collapse appears due to a paralysis of the nervous centres: the heart's action fails, as does also the respiration; but while the surface of the body is cold, the temperature, taken in the rectum, still remains abnormally high. The affusion is applied by pouring a pitcherful of water, at a temperature of, or a little above 10° C. (50° Fahr.), over the patient seated on a waterproof cloth. The patient, plunged in stupor, is suddenly roused by the shock: he draws a long breath, the respiration becomes fuller; the cardiac ataxy ceases, and the pulse, which, traced by the sphygmograph during the collapse, presented a scarcely broken horizontal line, now regains its normal line of ascension: heat of surface returns, and the temperature in the rectum falls. The action of the cold affusion, as thus applied, is to excite immediate and energetic reflex action.

In many nervous affections, such as chorea and hysteria, cold douches, shower baths, and affusions are valuable as restorative and curative agents. In the convulsions of robust children, a stream of cold water directed over the head from a height of two or three feet often has a speedily beneficial effect. Cold affusion has been tried in tetanus, but it has in some instances killed the patient (Elliotson).

Other cases in which cold affusions are of service are those where respiration fails, and it is necessary to appeal powerfully to the reflex excitability of the nervous centres. To resuscitate those who are in danger of death from a narcotic such as chloroform or opium, slapping the patient severely with a cold wet towel is an efficient method. In sun stroke cold affusion over the head and neck may be resorted to, provided the skin be not cold and clammy and the patient in a very syncopal state. In conditions of nervous spasm, of the larynx for example, cold douches over the neck may prove useful. Cold affusion to the feet was much commended by Cullen as a means of promoting action of the bowels in cases of obstinate constipation. Spasmodic retention of urine has been relieved by cold douche over perineum and thighs (Currie); and Mr. Erichsen mentions the case of an old man who found his power of micturition increased by sitting on the cold marble top of his commode.

In cases of extreme debility, with damp, cool skin, low muttering delirium, and very feeble pulse, cold affusions are dangerous.

In some cases of fever, where for any cause a cold bath is objectionable, the patient may be wrapped in a wet sheet and then covered with a few blankets. The sheet as it becomes heated may be changed for one fresh and cold, or very cold water may be squeezed from a sponge over the sheet as the patient lies rolled up in it on a waterproof cloth. In scarlet fever of malignant type, where the rash does not readily appear, this form of cooling pack has been found most valuable. Drs. Hillier and Gee have both added their testimony to its utility. In Dr. Gee's cases the patient remained packed in the wet sheet for one hour and was then removed to bed. The cases best suited for treatment by the wet pack are those where the skin is very dry and hot, and the patient exceedingly restless and delirious.

2. Cold Compresses, Irrigations, Lotions, and Injections.—Cold may be continuously applied with a view to abating undue heat of a part of the body. Thus iced-water rags or *compresses* may be placed over an inflamed throat, or on the head in inflammation of the brain. In acute pneumonia Niemeyer has commended strongly the use of cloths dipped in cold water, well wrung, and then applied so as to cover the chest and especially the affected side. These compresses are repeated every five minutes. Pain and dyspnœa are much relieved; sometimes the temperature falls an entire degree; and if the cold appliances do not arrest the actual attack of pneumonia, they shorten its duration and promote speedy convalescence. The necessity of so often having to change the compress, and thus disturb the patient, is a great objection to this mode of applying cold.

A powerful sedative and antiphlogistic effect of cold can be obtained by *irrigation*; i.e. allowing cold water to fall drop by drop on a cloth, so as to keep it continually wet with fresh supplies of water. This may be done by suspending over the part to be irrigated a bottle of water, in which a few pieces of ice may be put; one end of a skein of cotton, well wetted, is then allowed to hang in the water, while the other end is brought over the side of the bottle. This, acting as a syphon, causes a continual dropping upon the part to be irrigated. In injuries of joints, where it is of much consequence to check inflammation, this process, which abstracts heat gradually, and without disturbance of the part, is most valuable. Irrigation of the shaven scalp in cases of meningitis is a very powerful, cooling, and sedative appliance, requiring care and watchfulness. A cap of india-rubber over the head and back of neck, so arranged that a current of cooled water may flow continuously through it, will act as a general reducer of temperature. Where pounded ice is applied to the head in a bladder, this should be suspended by a string from the bedstead, so that the head of the patient may not have to sustain the weight of the bag and its contents. Five ounces of sal ammoniac and five ounces of nitre in a pint of water will form a frigorific mixture, which can be applied in a bladder when ice is not at hand. The ice-bag, and cold water compresses renewed every three minutes, have been used as an appliance to strangulated hernia, and to prolapsed rectum, to reduce the volume of the part and so facilitate reduction. Care must be taken that the cold application be not continued so long as to cause gangrene. Cold wet compresses should not be applied over dry bandages, with which wounded or broken parts are secured. Several cases are recorded where a hand or arm has become gangrenous, in consequence of having been bound up with dry bandages, and then treated with cold water compresses. The dry bandages, as they become wet, contract tightly on the limb, thus stopping circulation and causing gangrene.

A mixture made of spirit of wine and water, or of eau de cologne with water, is a simple form of *cooling lotion*. The spirit evaporates and so carries off heat from the surface. 1 oz. of rectified spirit to 15 of water makes a good spirit lotion, and the addition of 4 drachms of nitrate of potash, or chloride of ammonium, will add to its cooling and sedative effect. 4 drachms of the chloride of ammonium with half an ounce of diluted acetic acid, and the same quantity of rectified spirit in 15 ozs. of camphor water, is another form for a very serviceable lotion. These lotions, applied by means of a piece of soft rag or lint over the skin, act as refrigerants, cooling the head when it is hot or painful; reducing heat and arterial excitement in tumours or contusions; and tending in the latter to promote the absorption of effused blood. Cold water, and cold lotions of vinegar and water, are familiar means for trying to stop hæmorrhage.

In cases of severe uterine hæmorrhage, *injections* of ice-cold water into the vagina, or into the rectum, frequently succeed in checking the bleeding. In cases of bleeding internal piles an injection of cold water, after the action of the bowels, braces the parts and constringes the bleeding vessels.

3. **Dry Cold. Uses of Ice.**—Heat may be continuously abstracted from an inflamed part in a safe way, and without undue risk, by applying dry cold by means of a waterproof bag of vulcanised india-rubber filled with ice, snow, or a freezing mixture made of equal parts of salt, nitrate of potash, and chloride of ammonium. Moisture from the air will condense on the exterior of the cold bag, but a piece of lint interposed will protect the skin from damp. The india-rubber is a bad conductor, and too great abstraction of heat need not be feared. The walls of an animal bladder conduct heat much better than the india-rubber, and it is necessary to watch carefully over the application of ice-bladders, for when continuously applied they have been known to cause severe frost-bite of the part. If, when cold is being applied, the patient persists in complaining of severe pain, it is right carefully to examine and see how the part is affected by the cold. Professor Esmarch, in cases of fracture, and in various forms of traumatic inflammation, has applied ice for periods of twenty or thirty days with the best results. In cases of commencing disease of the vertebræ this surgeon has used cold water placed in a tin vessel, so made as to adapt itself to the part to be treated. Minor cases of bruise with inflammation may be treated by cold employed in the form of a common bottle filled with cold water and kept pressed against the part. After operations upon the eye, the extraction of cataract for example, a small ice-bag is very useful in relieving pain and keeping down inflammation.

Ice-bags placed along the course of the spine have been found effectual remedies in many forms of nervous disorder. In cases of epilepsy, where the circulation is sluggish, the hands and feet being always clammy and cold, an india-rubber bag of ice applied along the spine has been found to restore warmth, at the same time relieving headache and symptoms of incipient paralysis. Cold to the spine is asserted by Dr. Chapman to lessen the excito-motor power of the cord. In the severe pain of an inflamed ovary or testicle ice in a bag may often be employed beneficially as an anodyne.

Lumps of ice swallowed are invaluable in arresting hæmorrhage from the throat and stomach. In tonsillitis and diphtheria this same treatment tends to reduce inflammation and cool the throat of the patient. Obstinate vomiting can often be checked by swallowing fragments of ice.

4. **Cold as an Anæsthetic.**—Dr. James Arnott, in 1849, brought forward the use of a freezing mixture of ice and salt as a means of producing local anæsthesia, by freezing the part to which the mixture was applied, either in a bag or in a metallic spoon. For small superficial operations this method of anæsthesia by congelation answers very well. The part becomes white and hardened to the cut of the surgeon's knife, there is very little hæmorrhage, and the wound made usually heals well by primary adhesion.

More recently, Dr. Richardson has indicated a very convenient way of inducing local anæsthesia, by the volatilization of ether in the form of spray, by means of the hand-ball spray atomizer. Ether sprayed on the bulb of a thermometer, held about an inch from the jet, brought down the mercury to within 10° Fahr. of zero. When the jet was turned on to the skin, a marked degree of local anæsthesia was produced, but not enough for surgical purposes. By driving over the ether under atmospheric pressure, instead of trusting simply to capillary action—or to suction, as in Siegle's apparatus—one may bring the thermometer within thirty seconds to 4° below zero. By the use of this apparatus, at any season or temperature, the surgeon can produce cold even 6° below zero; and by directing the spray upon a half-inch test-tube containing water, he can produce a column of ice in two minutes. For local anæsthesia by cold, the ether spray answers well. Such operations as the removal of small tumours, opening abscesses, and inserting sutures, may be painlessly performed. JOHN C. THOROWGOOD.

COLIC (κῶλον, the large intestine).—Originally colic signified a painful affection due to spasm of the bowel, but though still retaining this application, it has now come to be further associated with other complaints which are attended with severe pain of a spasmodic character, a qualifying adjective indicating the nature and seat of each particular form. Thus *renal colic* is applied to the group of symptoms due to the passage of a stone from the kidney to the bladder; *hepatic colic* to those accompanying the escape of a gall-stone. *See* COLIC, Intestinal.

COLIC, INTESTINAL.—SYNON.: Fr. *Colique*; Ger. *Die Kolik*.

DEFINITION.—Painful and irregular contraction of the muscular fibres of the intestines, without fever.

ÆTIOLOGY.—*Predisposing causes.*—These include the nervous (as hysteria, hypochondriasis), lymphatic, and bilious temperaments; sedentary occupations; the female sex; and the period of youth or adult age. *Exciting causes.*—These may be grouped as follows:—1. Irritation from lodgment of gas due to fermentation of undigested food and decomposition of fæces long retained within the large intestine; from fæces, or intestinal concretions, undigested or partly digested food, such as pork, shell-fish, salt meats, unripe fruit or septic game; from cold drinks or ices; from excessive or morbid secretions, especially bile; from gall-stones; or from worms—a bundle of round worms or coiled up tape-worms. 2. Morbid states of the bowel, including obstruction from intussusception, twisting, strangulation, &c.; ulceration (typhoid, tubercular, dysenteric); inflammation (enteritis, typhlitis, &c.) 3. Reflex nervous disturbance, due to anxiety, fright, anger, or other emotional disorder; to disease of the ovaries or uterus; to calculus (hepatic or renal); to dentition; or to exposure, especially of the feet and abdomen, to cold. 4. Blood-poisoning, as from lead, copper, gout, rheumatism.

SYMPTOMS.—The characteristic or essential symptom of intestinal colic is pain in the abdomen, without febrile disturbance. It usually begins, and is most severe, in the umbilical region, then spreads to other parts, or to the whole abdomen, and is apt to travel from one part to another. It is almost always relieved by firm pressure and by expulsion of flatus, and is paroxysmal in character, remitting, or exacerbating, or completely subsiding at intervals. The suffering is usually severe, often agonising, and to relieve it the patient bends forwards, pressing the abdomen firmly with his hands or against some hard surface, or rolls about. As a rule the abdomen is distended by flatus; in lead colic it is, however, firmly retracted towards the spine, and the movements of the inflated intestines affected by spasmodic contraction, producing loud borborygmi, may frequently be seen and may be felt by the hand applied to the abdomen. The muscles of the abdominal wall and the bladder usually participate in the internal spasm: the abdomen becomes rigid or knotted, and the recti muscles become contracted into round balls, while frequently the navel is retracted; micturition is frequent or suppressed. Usually there is constipation, and the pain disappears when the bowels are freely relieved; sometimes, however, it persists for a time. Constipation stands in a twofold relation to colic, either as cause or effect of the spasm.

The countenance expresses great suffering, anxiety, and depression, and the features may be pinched. The surface of the body is cold, especially the feet, and the pale skin is covered by a cold perspiration. The pulse is commonly of normal frequency, or is infrequent and feeble.

The symptoms vary somewhat with the cause. When due to irritating ingesta the prominent symptoms are vomiting and diarrhœa, sometimes ending in catarrhal dysentery. In children the legs are drawn up upon the abdomen, the bowels are often at first confined, and the evacuations greenish, offensive, and very acid, afterwards becoming loose.

In nervous and hypochondriacal subjects, and especially females, severe pain in the intestines, resembling that of spasmodic colic, is apt to occur (*see* ENTERALGIA). Flatulence plays a varying part in different cases; it is often a prominent symptom, and the form of colic thus characterised has been termed Colica flatulenta.

Vomiting is generally in proportion to the severeness of spasm, and the degree of intestinal obstruction.

DURATION.—The duration of the attack varies greatly, from a few minutes to several days. The spasm usually ceases abruptly, leaving a feeling of soreness in the abdomen, while there is enjoyable relief from suffering. Colic, when violent or intractable, may terminate in enteritis, in peritonitis, and, especially in children, in intussusception.

DIAGNOSIS.—A pain moving from place to place, relieved by firm pressure and unattended by fever, separates colic from other affections, more particularly from those due to inflammation, in which pain is always aggravated by pressure.

Distension with spasm of the stomach may be distinguished from a similar condition of the colon, by the pain occupying a higher position in the abdomen (at or around the ensiform cartilage instead of—as in colic—the umbilical or hypochondriac regions), and by the percussion note elicited being deeper-toned and more prolonged than that which is produced by a distended colon; besides in colic the spasmodic contraction of the colon, producing borborygmi, may be traced by the hand, or may be even seen, and there is tenesmus.

It should be borne in mind that enteritis or peritonitis may follow colic, when the pulse, previously unaltered, may become frequent, hard and small, or frequent and soft, and the seat of inflammation becomes tender.

PROGNOSIS.—Colic almost always ends in recovery, preceded by free evacuation from the bowels. Unfavourable signs are those arising from inflammation or intestinal obstruction.

TREATMENT.—In the first place the ætiological indications should be met. The irritating contents of the bowels should be dislodged by purgatives combined with sedatives, such as calomel (five or eight grains) or rhubarb (twenty grains) with opium (one grain), followed by repeated doses of some saline aperient, such as magnesiæ vel potassæ sulph., with tinct. of henbane or opium, and spirits of chloroform, until free action of the bowels is obtained.

A suppository containing half a grain each of hydrochlorate of morphia and extract of belladonna, or a subcutaneous injection of morphia, may secure immediate relief from pain before aperients have time to act. Large warm enemata often relieve quickly. Other suitable measures are—the warm bath, friction with warm oil or stimulating liniments, hot-water fomentations, steamed flannels, mustard or turpentine stupes, flannel bags containing hot chamomile flowers or heated sand, the stomach-warmer filled with hot water, large linseed and mustard poultice. The diet should be liquid.

In the prophylactic treatment the diet should be strictly regulated, lodgment of irritating solids and gases within the bowels should be prevented (*see* CONSTIPATION; FÆCES, Retention of; and FLATULENCE), and the abdomen and feet should be kept warm by a flannel roller or belt and thick woollen stockings. GEORGE OLIVER.

COLLAPSE.—DEFINITION.—Collapse is a state of nervous prostration. When it is extreme, the vital functions are in a condition of partial, and sometimes nearly complete, abeyance. It may terminate in death, or be followed by gradual reaction and complete recovery.

Collapse and shock have usually been classed together, but it is not accurate to do so. It is true that the ganglionic centres of the medulla oblongata are more or less profoundly involved in both, and that both possess many symptoms in common, dependent upon the derangement of function of one or more of these centres. Some confusion is attributable to the fact that shock is a term applied not only to a state or morbid condition, but to the cause which most frequently produces that condition—a violent impression or 'shock' to the nervous centres. *See* SHOCK. Collapse arises from many different causes, shock being one, of which collapse may be regarded as a final and extreme degree, and into which it often imperceptibly passes. Collapse, on the other hand, may occur under conditions where there has been no antecedent state of shock. Collapse presupposes previous nervous exhaustion, while shock may instantly appear in a healthy individual.

ÆTIOLOGY.—Any severe injury, especially if attended by profuse and sudden hæmorrhage, may terminate in collapse, such, for instance, as the rupture of one of the abdominal viscera, a penetrating wound of the chest or abdomen, or a wound of the heart or of a large artery. Extensive burns or scalds frequently give rise to typical collapse; and severe and prolonged pain is capable of causing it. Rupture of the heart or of an internal aneurism, if the patient do not immediately die, causes extreme collapse. Certain poisons, as tobacco and arsenic, will also produce this condition. It is the terminal stage of some diseases, as, for instance, of Asiatic cholera; severe drastic purgation also, or prolonged vomiting, from whatever cause, may occasion it. The pernicious malarious fevers and yellow fever often end in collapse. In the acute yellow atrophy of the liver symptoms of severe nervous disturbance, resulting in a species of collapse, sometimes suddenly supervene. Pyæmia, septicæmia, prolonged narcosis, frequently terminate in collapse.

SYMPTOMS.—The severity of collapse depends on the nature of the cause and the physical and mental vigour of the individual. It may vary from a moderate to an extreme degree. A moderate amount is seen in the course of fever and some other diseases, but this neither modifies the progress of the malady nor attracts the notice of the patient, causing chiefly peripheral coldness. From this trifling amount collapse may pass to the most intense form, where the patient scarcely differs in outward semblance from a dead body. A superficial inspection will fail to detect the existence of the functions of respiration and circulation. Vitality may be said to have reached its minimum. In well-marked collapse from severe injury or loss of blood the pulse at the wrist may be almost or wholly imperceptible, the heart's action scarcely audible, very rapid, fluttering, and irregular; the surface of the body, the face especially, is deadly pale and cold, and the skin moist with clammy sweat; the respiration is very feeble, slow, and irregular, accompanied by sighing or gasping inspirations at intervals; the expression and character of the face are lost; the features are sunken and relaxed; the eye is dull, glassy, staring, or languidly rolling about, and the conjunctiva perhaps insensible to the touch; the nostrils are dilated; the sensibility of the whole body is diminished; and the muscular debility is extreme. The patient lies on his back, without a trace of voluntary effort. If a limb is lifted it falls back again as if dead. Yet the consciousness and senses may be almost unimpaired; if roused by repeated questions the sufferer will with visible effort make a coherent though, probably, inadequate reply.

If relief be not given, the respiration may become slower and slower till each one appears the last, when a sudden sigh shows that life is still present; finally, the pulse and heart's action become more and more faint, and death results from pure asthenia. A condition closely resembling traumatic collapse is often witnessed in the last stage of cholera, when in an extreme degree the patient almost resembles a corpse save for the convulsive motions induced from time to time by the painful cramps. The surface is pale or bluish, covered with profuse sweat, but is at the same time cold to the touch. The hands and extremities are icy cold, the tongue is cold, and so also is the breath, which is gasping and paroxysmal; no pulse can be felt at the wrist; the eyes and features are sunken; the mind is apathetic, but nevertheless the consciousness may be perfect, and the patient able to respond to questions with a strong voice. Severe purging and tobacco-poisoning produce a condition extremely like that described as traumatic collapse.

Some cases of malignant fever terminate in collapse, which is characterised by extreme anxiety, pallor or lividity of the face and surface, coldness of the skin, sweating, and a small, frequent, and irregular pulse.

A decrease of animal heat, especially in the external parts, is characteristic of collapse. The temperature of the internal organs varies; and there may be collapse with high internal temperature. This occurs in cholera, intense fevers, and some forms of septicæmia; or the converse may obtain, as is frequently witnessed in the collapse of dissolution. Collapse from loss of blood differs from syncope, although the latter may be described as an acute and transient form of collapse. In syncope the prominent symptom is loss of consciousness, which in collapse may be almost or quite perfect.

For the PATHOLOGY and TREATMENT of collapse *see* SHOCK. WILLIAM MACCORMAC.

COLLAPSE, Pulmonary.—A condition in which the lung is simply more or less devoid of air. *See* LUNG, Collapse of.

COLLIQUATIVE (*colliqueo*, I melt).—A term which originated in the belief that in certain conditions the solid parts melted away, and were carried off as *liquid* discharges. The word is now generally applied to the copious sweats and diarrhœa which occur in certain wasting diseases, such as phthisis.

COLLOID (*κόλλα*, glue, and *εἶδος*, like).—A peculiar morbid product resembling in its characters glue or jelly, and found associated with cancer and other forms of new-growth. *See* CANCER and DEGENERATION.

COLON, Diseases of.—The colon participates to a varying extent in the lesions and derangements of dysentery, typhoid fever, enteritis, peritonitis, and other affections. The special disorders to which it is most liable are intimately connected with its anatomical and physiological peculiarities. The colon is a distensible membranous tube, of large capacity, with chiefly solid contents, which are propelled slowly onwards by the muscular contractions of the walls. The moving force and the resistance offered to it are often too finely balanced, so that whenever the energy of the former is somewhat reduced, an accumulation of excretory products is apt to be determined. Hence arise retention of fæces and gases, constipation and consecutive evils, such as colic, colo-enteritis, or ulceration of the colon.

I. **Atony.**—DEFINITION.—Loss of contractility of the walls of the colon, leading to accumulations and other sequelæ.

ÆTIOLOGY.—The causes of torpor or atony of the colon are mainly those of constipation—sedentariness, indolent and luxurious habits, a sluggish and lymphatic temperament, old age, and general debility or exhaustion, as after a long and tedious illness. Whenever the walls of the colon are distended by solid or gaseous accumulations, the contractile power is apt to be enfeebled, leading to further retention and loss of tone.

Atony of the colon is an essential element in the pathogeny of constipation not depending on mechanical obstruction. Tympanitic distension of the colon from paralysis of the sympathetic nerve occurs in peritonitis and in fevers, *e.g.* typhus fever.

SYMPTOMS.—Torpor of the colon may be indicated only by constipation. There are usually the ordinary signs of retention of flatus or fæces. In hysteria, and in inflammation of the bowels or peritoneum, flatus is apt to accumulate rapidly, and to produce great distension of the colon. Fæces may collect and form large tumours in any part of the large intestines, but especially in the cæcum and sigmoid flexure.

Fæcal and gaseous accumulations in the colon resulting from atony may produce the following effects, directly or remotely connected with them:—

(*a.*) *Local.*—1, Colic. 2, Inflammation of the walls of the colon, or of the mucous and submucous coats, and ulceration. 3, Disturbances from pressure: thus flatulent distension, and large fæcal accumulation encroaching on the cavity of the thorax and impeding the descent of the diaphragm, may cause dyspnœa or short and rapid respiration, palpitation and irregular action of the heart, with remote effects arising from a disturbed circulation in the brain, such as giddiness and headache; a distended cæcum or sigmoid flexure pressing on veins and nerves may induce œdema, numbness, and cramps of the right or left lower extremity. 4, Retarded digestion, derangement of the stomach and liver, and intestinal obstruction.

(*b.*) *General.*—The absorption of excrementitious matter is said to lead to wide-spread general effects, such as a sallow, earthy, or dirty complexion, lassitude, debility, offensive breath, loaded urine, &c.

TREATMENT.—Atony of the colon is usually a chronic disorder demanding prolonged treatment. The hygienic and dietetic rules laid down in the article CONSTIPATION require in most cases to be supplemented by medicines. The most satisfactory results follow a course of tonics, combined with aperients, such as iron, quinine, strychnia, belladonna, with aloes, colocynth, or rhubarb.

The purgative should be adjusted to each case, so as to secure no more and no less than a regular and efficient evacuation; and while the loaded colon continues to be thus relieved, the dose should be very gradually reduced.

This tonic-aperient course may be greatly aided by local stimulation of the colon, as by friction, kneading, electricity, cold-water compresses, or douches. The abdomen should be supported by a belt or roller. Bretonneau and Trousseau strongly advised a course of belladonna, giving gr. ⅙ of the extract or of the powdered leaf as a pill in the early morning,—the stomach being empty,—then two such pills if in four or five days the bowels do not respond, and increasing the dose, but not beyond that contained in four or five pills, in twenty-four hours. A teaspoonful of castor oil may be given twice a week to aid this course of treatment. Flatulent distension of the colon in the elderly and in females at the climacteric period is often greatly relieved by the prolonged use of a pill containing compound assafœtida pill and nux vomica after meals. Electricity is sometimes used with benefit.

Tympanitic distension of the colon in peritonitis and in fevers is best treated by free doses of opium.

II. **Inflammation.**—SYNON.: Colitis, colonitis, colo-enteritis; Fr. *colite*; Ger. *Entzundung des Schleimhautes des Kolons.*

An inflammation with ulceration of the mucous membrane and submucous connective tissue of the colon, producing lesions undistinguishable from those of dysentery, has been pointed out by Copland and Parkes. Colitis is said to be a non-specific local affection, commencing in the submucous tissue, and subsequently attacking the mucous membrane with its glandular structures—the primary seat of dysenteric inflammation. As in dysentery the inflammation induces gangrenous destruction and ulceration of the mucous membrane and underlying cellular tissue.

A *catarrhal* form of colitis is apt to occur in measles. 'It often happens that the morbillous catarrh of the intestines exhausts itself by attacking the large intestine, producing that special form of colitis characterised by tenesmus and glairy bloody stools.'[1] Inflammatory diarrhœa, particularly in children, often terminates similarly.

Colitis arising from *retained excreta* may involve the entire wall of a circumscribed portion of the colon, commonly the ascending colon and sigmoid flexure, or may be confined to the mucous and submucous tissues. In inflammation of the cæcum (typhlitis) the walls of the ascending colon are more or less implicated. In fæcal retention the mucous follicles of the colon may become obstructed, and the distension resulting therefrom may lead to inflammation and ulceration. Irritation of the mucous lining of the colon from the lodgment of fæces may extend to the lymphatic vessels and glands. The glan-

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[1] Trousseau, *Clinique Medicale.*

Trinity Medical College.

dular enlargement cannot, however, usually be recognised during life. While the symptoms of tabes mesenterica may be traced to enlargement and obstruction of the mesenteric glands, set up by irritation of the intestinal tract, it is doubtful whether such results can follow a similar cause limited to the colon only.

TREATMENT.—The treatment of colitis consists in the local application of fomentations, poultices, opium enemata, or morphia suppositories; and in the use of gentle laxatives, such as castor oil, combined with sedatives, such as opium or henbane. The catarrhal form generally terminates in spontaneous recovery. Trousseau advises the use of albuminous injections, or of injections containing about half an ounce of water and nitrate of silver—from ¾ to 1½ grains,—or sulphate of copper or sulphate of zinc—from 3½ to 4½ grains.

III **Displacements.**—The parts of the colon most liable to displacement are the transverse colon and sigmoid flexure—the former may descend as low as the pubes, and the latter may occupy any position between the left iliac region and the right side of the abdomen. Usually the meso-colon is elongated; there is adhesion between the displaced part and the new site; and, the longitudinal bands being elongated, the loculi are obliterated. Displacements are most apt to occur in those who have long suffered from constipation, retention of fæces, chronic dysentery, hernia, or from encysted or other tumours. They may lead to complete obstruction, and cannot usually be recognised with certainty during life.

IV. **Diverticula.**—A loculus of the colon from repeated accumulation may become so distended as to form a lateral appendix. Such a diverticulum when loaded with fæces may be felt through the abdominal wall as a distinct tumour, which may collapse when pressed between the fingers.

GEORGE OLIVER.

COLOUR-BLINDNESS. — A defect of vision, the subject of which is unable to distinguish certain colours. *See* VISION, Disorders of.

COMA (κῶμα, deep sleep).—A condition of profound insensibility. *See* CONSCIOUSNESS, Disorders of.

COMA-VIGIL (κῶμα, insensibility, and *vigil*, wakeful).

DEFINITION.—A symptom, or set of symptoms, where continuous sleeplessness is associated with partial unconsciousness.

Coma-vigil occurs towards the end of diseases in which the nervous system is involved either directly or indirectly, especially where sleeplessness has been a symptom in the earlier part of the disease. Thus it frequently appears towards the end of an attack of typhus or of delirium tremens, when these are about to terminate fatally.

SYMPTOMS.—The patient lies quiet with his eyes half-closed, inattentive to everything around, but not absolutely unconscious. If the eyelids are touched, they are closed, and perhaps the head is slowly turned away. The eyes have a dull, half-glazed look, and slowly follow any moving object near them. The pupils are neither much dilated nor contracted, and they more under the influence of light, but very sluggishly. The mouth is generally somewhat open and dry, as are also the lips. The power of swallowing is much impaired; if a small quantity of fluid be put into the mouth, an effort is made after a short time to swallow it, and this effort is for a time successful; but after the symptoms have been present for some time, the effort is so feeble that no result follows. The patient lies mostly on the back; if turned on the side, he either remains as placed, or often slowly turns to the former position on the back. The limbs are occasionally moved a little, and if the hand or arm be raised, a slight resistance is offered. If the bladder, or the rectum be emptied, there is slight consciousness of the act, as if a feeling of discomfort preceded it. The pulse is quick and weak. The respiration is weak, but otherwise normal. The symptoms continue unbroken throughout, nothing like natural sleep occurring.

DIAGNOSIS.—Coma-vigil is distinguished from coma by the presence of a certain amount of consciousness, by the quick pulse, and by the absence of stertorous breathing. It is distinguished from concussion of the brain by the pupil not being contracted, by the history of the case, and by the absence of coldness of the skin, and of any sign of shock.

PROGNOSIS.—The prognosis is unfavourable; coma-vigil is almost invariably a fatal symptom. It may last from a few hours to three or four days; from twenty-four to forty-eight hours being the most common duration. It may deepen into actual coma; but more usually the symptoms change but little, save that the pulse becomes quicker and weaker, and the respiration more feeble, and death by asthenia then results.

PATHOLOGY.—As being little but a symptom, coma-vigil has strictly speaking no pathology. It seems to coincide with the gradual suspension through exhaustion of the functions of the nervous centres; the cerebral hemispheres being nearly if not quite inactive, while the action of the rest of the centres is kept up weakly but continuously, till the little remaining nervous power is exhausted, when death ensues. It differs from coma, inasmuch as in the latter, the medulla oblongata is the only centre left active, the functions of the rest being entirely suspended. It differs from concussion, inasmuch as the symptoms attending the temporary unconsciousness of the latter are more those of irritation than of pure suspension of function.

R. BEVERIDGE.

COMEDONES (*comedo*, I consume).—SYNON.: Grubs.—This is the name applied to the little cylinders of sebaceous and epithelial substance which are apt to accumulate in the follicles of the skin, and to appear on the surface as small round black spots. When squeezed out they have the appearance of minute maggots or grubs with black heads, and thence have derived their name. They may occur in all parts of the body where sebaceous follicles exist, but are most common on the face, the nose, the neck and shoulders, the breast, and within the concha of the ears, in the latter situation often attaining a considerable size. The accumulation of this substance is due to want of expulsory power of the skin, and to the slight impediment which is afforded by the aperture of the follicle to its exit; and when squeezed out it is found to vary in colour, in figure, and in density, according to the period of its detention. When recent, the comedones are soft and white, and modelled into an exact cylinder by compression through the mouth of the follicle; when impacted for a considerable time they acquire the yellow tint, the transparency and hardness of horn; and assume a bulbous figure from the dilatation of the follicle below the constricted orifice of the epidermis; and by their bulk they sometimes stretch the hair-follicle so far as to obliterate it completely. Besides their usual composition of sebaceous substance and epithelial cells, they frequently contain lanuginous hairs, and not rarely the entozoon folliculorum in its different phases of development. When they raise the pore into a minute pimple they have a similitude to acne punctata, and might be mistaken for that affection; whilst the black spot on the summit of conical acne is due to a comedo.

Treatment.—Comedones are generally associated with a weak state of the skin as well as of the individual; they are most frequently met with in young persons in whom the powers of the constitution are not yet established, and will be benefited by generous diet and tonic treatment. Locally, soap and water with plentiful friction and ablution will be found of great service; and, as an astringent to invigorate a debilitated skin, a lotion of perchloride of mercury, in emulsion of bitter almonds (two grains to an ounce) and spirits of wine.

Erasmus Wilson.

COMPLICATION (*con*, with, and *plico*, I fold).—It is difficult to give a strict definition of what ought to be included under the term *complication*, but the word signifies the occurrence during the course of a disease of some other affection, or of some symptom or group of symptoms not usually observed, by which its progress is therefore complicated, and not uncommonly more or less seriously modified. The difficulty lies in determining what should be looked upon as essentially part of the original disease, and what as a mere accidental occurrence. For instance, many regard the cardiac affections which so often arise during the progress of acute rheumatism as a part of the complaint, others as complications. The same remark applies to the relationship of renal disease to scarlatina, as well as to numerous other cases.

Complications arise in different ways. They may, as just indicated, be considered as developments of the original morbid condition, resulting from the same cause and being more or less allied; or they are independent and accidental, of which an illustration is to be found in the association of ague with scurvy or dysentery, or in the co-existence of two or more of the exanthemata. The most important class of complications, however, are those which follow the primary disease as more or less direct consequences. These may further be induced in various ways. Thus, for example, in febrile diseases secondary lesions are liable to arise as a result of changes in the blood; a mechanical act, such as cough, may lead to complications in the course of phthisis and other pulmonary affections; cardiac diseases frequently bring about consecutive changes in other organs, by inducing obstruction of the venous circulation, or emboli may originate under certain conditions and produce their usual consequences. It is of great practical importance to be acquainted with the complications which are liable to be met with in the various diseases, and especially in those which are of an acute nature, in order that measures may be taken to prevent them, and that they may be recognized and treated at the earliest possible period, if they should occur.

Frederick T. Roberts.

COMPOUND GRANULAR CORPUSCLES.—Formerly these microscopic objects were regarded as of inflammatory origin, and as affording positive evidence of the occurrence of inflammation. Hence they were termed 'compound inflammation globules' (Gluge.) Almost all pathologists now, however, recognize the fact that they are not products of an inflammatory process, but result either from the degeneration of pre-existing cells, in which protein and fatty granules accumulate, or, perhaps, from the aggregation of granules originally distinct, which are present in abundance in degenerating tissues. They may even be formed out of the cells of morbid products, such as cancer. These compound granular corpuscles derive their name from the fact that they consist of a large number of minute granules aggregated together, and they either present a delicate cell-wall, or this cannot be detected. Occasionally there is an appearance of a nucleus in the centre.

Frederick T. Roberts.

COMPRESS.—Folds of lint or other material, which are used for the purpose of producing pressure, or as a pad by which hot or cold water or medicinal agents may be applied to the surface. In the latter case the compress may be rendered waterproof by being covered by a piece of gutta-percha tissue or mackintosh-cloth. *See* Hydropathy.

COMPRESSIBLE.—A term implying comparatively slight resistance, and applied specially to the pulse when it yields readily under the finger. *See* Pulse, The.

COMPRESSION of Brain. *See* Brain, Compression of.

COMPRESSION of Lung. *See* Lung, Compression of.

CONCRETION (*con*, together, and *cresco*, I grow).—Synon.: Calculus; Fr. *Concrétion*, *Calcul*; Ger. *Concrement*.

Definition.—An unorganised body, formed either in one of the natural cavities or canals, or in the substance of an organ, by the deposit of certain solid constituents of the fluids of the part. In the widest sense of the term, Concretions comprehend Calculi.

Enumeration and Classification.—The following classified list includes the principal varieties of concretions:—

1. In *glandular structures*: lachrymal, sali-

vary, pancreatic, prostatic, seminal, urinary, hepatic, sebaceous, and mammary.

2. In the *circulatory system*: cardiac, and venous (*phleboliths*).

3. In *closed sacs*: peritoneal, and articular.

4. In *culs-de-sac*: bronchial, pulmonary, nasal, tonsillar, laryngeal, gastric, intestinal, præputial, uterine, and vaginal.

5. In the *substance of tissues* and new formations, especially in the nervous system—Corpora amylacea.

6. *Various*, such as the concretions on the teeth known as *tartar*.

General Characters and Number.—Concretions are generally firm or even of stony hardness; but they may be soft and friable. Their colour varies from white to black through shades of yellow and red. Concretions occur either singly or in groups; and their shape and size, as well as the character of their surface, vary considerably with their number; single concretions being more frequently rounded, larger, and less smooth than multiple specimens, which often present facets and polished surfaces. Many concretions are composed of concentric laminæ.

Composition.—The chief constituents of concretions are inorganic, that is, mineral salts, in a basis of organic matter. The bulk of the salts are carbonate and phosphate of lime and magnesia, with smaller quantities of alkaline compounds. The organic basis is composed of albuminous substances, mucus, cholesterin, and colouring matters.

Mode of Formation.—Concretions are generally derived from the solid constituents of vital fluids, whether physiological or pathological. In most instances the fluids are delayed in the natural passages by some abnormal obstruction or dilatation; and under such circumstances a chronic inflammatory condition of the walls contributes greatly to the probability of mineral deposit. Most frequently—as in the formation of the salivary and biliary concretions—the fluid portions of the secretion escape by the natural outlet or are absorbed, while the solid constituents are deposited; the particles being either agglomerated around a nucleus, or deposited in centripetal layers upon the surface of the cavity. In other instances—intracardiac, peritoneal, and articular, a nucleus is furnished by a portion of fibrin, blood-clot, or growth, on which fresh deposits take place, while calcification proceeds in the interior. In a third series, examples of which are found in the alimentary canal, the basis of the concretion consists of foreign or indigestible matter, such as hair, inspissated fæces, and masses of magnesia.

Effects and Symptoms.—The functions of a part occupied by a concretion are generally more or less impaired; the neighbouring tissues frequently atrophy; and inflammation and ulceration are common results, ending probably in the escape of the body. The concretion may be passed along a duct, and this process is generally attended with great pain; but concretions may remain where formed without causing symptoms. Occasionally they are spontaneously disintegrated or dissolved.

Treatment.—The treatment of concretions will be found discussed under the heads of the diseases of the organs where they respectively occur.

J. Mitchell Bruce.

CONCUSSION (*concutio*, I shake together). This term is used to indicate a condition induced by a more or less violent shaking or physical commotion of the general system, or of some particular organ, whereby serious symptoms may be induced, but no definite lesion can be detected to account for them. The nerve-centres are the parts most liable to be thus affected, concussion of the brain or spinal cord being of considerable moment, giving rise to more or less complete abolition of their functions, though this effect is usually only temporary. *See* Brain, and Spinal Cord, Concussion of. General concussion of the body is highly important at the present day, in connexion with railway accidents, after which persons seem to be uninjured, or only to be slightly shaken, but subsequently grave symptoms, associated with the nervous system, set in. *See* Railway Accidents, Results of.

Frederick T. Roberts.

CONCUSSION OF BRAIN, SPINE, &c. *See* Brain; and Spinal Cord, Diseases of.

CONDYLOMA (Lat).—Definition.—Excrescences often found about the anus and organs of generation in both sexes. The term has been applied to simple cutaneous growths as well as to those of syphilitic origin; but since these latter are altogether due to a constitutional taint, and require a different treatment, they will be described separately under the heading of Mucous Tubercles, whilst the term *Condyloma* will be restricted to non-specific growths.

Symptoms.—Condylomata are generally situated in the neighbourhood of the anus and genital organs; and they result from the irritation produced by acrid vaginal or rectal discharges, or by the natural secretions in dirty persons. They consist in hypertrophy of the tegumentary tissues, and generally form smooth pendulous growths, but they may be flattened, irregular, and ulcerated on the surface. They are vascular, liable to become inflamed and painful from friction, and, as their position favours development, they may attain considerable size.

Treatment.—When all inflammation has been allayed, these excrescences should be removed with a pair of scissors; and to prevent their recurrence thorough cleanliness must be practised, and any discharge from the rectum or vagina stopped. If the parts be damp and perspiring they should be kept dry, and frequently dusted with zinc or bismuth powder, or bathed with some astringent lotion. No general treatment is of the slightest service.

George G. Gascoyen.

CONFLUENT (*confluo*, I run together).—Applied chiefly to a variety of smallpox and of other exanthemata, in which the eruption runs together or coalesces.

CONGENITAL (*con*, together, and *genitus*, begotten).—Existing at birth: a term generally applied to diseases or malformations, such as *Congenital Syphilis*, and *Congenital Clubfoot*.

CONGESTION (*congero*, I accumulate).—Overfulness of vessels caused by accumulation of their contents: generally applied to blood-vessels. *See* CIRCULATION, Disorders of.

CONIUM, Poisoning by. *See* APPENDIX.

CONJUNCTIVITIS.—Inflammation of the conjunctiva. *See* EYE AND ITS APPENDAGES, Diseases of.

CONSCIOUSNESS, Disorders of.—The disorders of consciousness are so numerous as to make it desirable briefly to consider them in one article, with a view to their classification and the better comprehension of their mutual relations. We shall, therefore, here group and arrange the various morbid conscious states, not aiming to produce a strictly scientific classification so much as one which will be practically useful.

1. **Exaltation of.**—Under this head may be ranged certain states of consciousness more or less distinctly bordering upon the unnatural, to be met with in persons under the influence of 'mental excitement' from various causes, as from sudden good news, or generally pleasant surroundings; also from a slight degree of poisoning by alcohol, opium, hashish, or other drugs; or from an early stage of some forms of insanity, or of delirium. In this state of mental exaltation the individual's powers of perception, apprehension recollection, thought, emotion, and volition, would seem to be all more or less intensified, just as in that of hebetude or dementia they are diminished and consciousness is proportionately dwarfed.

2. **Perversions of.**—Many of the various defects here to be referred to are very partial in the extent to which they implicate consciousness, though others are general. In what is known as an *illusion* some object of sense is not correctly perceived; or, in other words, some sensorial impression is quite wrongly interpreted, as when a feverish or a maniacal patient, looking at some inanimate object, declares that it is a cat or a dog about to fly at him, or hearing even the slightest noise in any part of his room, interprets it to be the voice of some friend or imagined enemy. In the case of an *hallucination*, however, forms are declared to be seen, or voices heard (by a patient suffering from delirium tremens, for instance), where no appreciable external realities could have started the notion. And in these cases, it is not that the patient sees or hears without believing; he implicitly believes that the visions or voices which have been conjured up subjectively by the working of his own brain, have a real existence in the outside world. It is necessary to make this distinction because it is by no means uncommon in regard to the olfactory sense (especially in some epileptics), for odours or smells to be perceived which the patient soon comes to know are purely subjective or devoid of any external correlative.

Hallucinations and illusions, though occasionally existing alone, are quite commonly associated with a very important and more general derangement of consciousness, viz., *delirium*. This is a symptom very common in many fevers, in certain low states of the system, after severe frights, in inflammatory or other lesions of the brain and its membranes, as a result of some narcotico-irritant poison, or occasionally in a person who is recovering from an epileptic attack, or from the stupor sequential to a series of convulsive attacks. The state itself varies much in intensity. Three fairly distinct types exist. In (*a*) *low* or *muttering* delirium the patient lies still and more or less heedless of what is occurring around; or if heeding at all, the impressions which he receives give rise to erroneous perceptions (illusions) which are woven into the incoherent fabric of his rambling thought. In (*b*) *delirium tremens* the patient is more restless, tremors of the limbs and of the muscles of the face are often easily induced, hallucinations of sight and hearing are common, and the character of the delirium reveals that the patient is, to an unusual extent, possessed by fears, terrors, and other emotions of a depressing type. In (*c*) *wild* or *raving* delirium we have to do with a much more active state. The patient raves loudly and incoherently, more in regard to his fleeting dream-like thoughts than in connection with external impressions, of which he is more or less heedless. He is often violent in demeanour, and difficult to be restrained, persons in this state being capable of great and prolonged muscular exertion. The bodily activity accompanying this form of delirium is, in fact, just as characteristic as the great intensity of the mental processes. It is met with occasionally in some fevers, but more commonly in meningitis and in acute mania.

In its early stages delirium is principally noticed during the transition-period between waking and sleeping—at times, that is, when the nervous system most needs the reinvigorating influence of sleep. It is in these cases, too, that beef-tea or stimulants may for a time dispel all traces of the wandering thought. Whilst illusions and hallucinations enter largely into the mental activity of a delirious patient, *delusions* also are generally well-marked components. That is to say, the person becomes for a time possessed by an idea, notion, or fancy, for which there is no real warranty, though he believes and wishes to act as though it were true.

Somewhat allied to delirium in nature, though much lower in intensity as a mental process, is that *incoherence* of thought which is met with in many chronic maniacs, or in non-febrile patients suffering from various organic brain-diseases. In its slighter degrees this incoherence displays itself as mere 'rambling' talk; the patient has not sufficient brain power to follow up the main subject of thought, and is frequently diverted into collateral channels. This, which is a natural state with some persons, may be distinctly indicative of disease in others whose mental power has previously been of a more vigorous type. At times the incoherence is seen to be governed principally by mere verbal suggestion, the patient being led away from point to point in new directions, owing to the associations of some word which has been used becoming for the time dominant. This state is often well seen in the sub-acute exacerbations of chronic mania, though it may occur also where multiple softenings or indurations of the brain exist. At other times the incoherence is more absolute—wayward transitions from subject to subject, connected by no discoverable bond, rapidly following one another. The result in such a case is a mere unmeaning jumble of words, interspersed here and there with brief propositions having a limited significance of their own, though often wholly unrelated to that which precedes or follows.

Hypochondriasis is a perverted state of consciousness, having some resemblance to that of illusion, but in which some internal or visceral state becomes the starting-point of impressions (possibly not actually painful) which, when magnified and perverted as they are in the mind of the patient, fill him with false and gloomy apprehensions of various kinds. This perversion of consciousness is more generalised than that which exists in the case of illusion; and also instead of being a more or less temporary defect, it is one that may last for weeks, months, or even years. The state of mind of an hysterical patient is often not altogether different from that of the hypochondriac.

3. **Partial Loss of.**—Defects of this order are numerous and may exist in great variety. They may implicate almost equally nearly all the varieties of conscious mental activity, or some more than others. They may be either congenital, or acquired during the life of the individual.

In *idiotcy* we may have from birth defect in the power of concentrating the attention, a defective power of apprehension and of thinking, and a defective volition, shown alike by an inability to guide or control thought, and by a deficient vigour of bodily movement. Again, as a result of epilepsy, of organic brain-disease, or of injuries to the head, the patient may gradually lapse into such a condition from one of health, so as to become, as it is termed, 'demented.' Whilst this state of *dementia* may supervene at any age, it is much more common as a consequence of the brain-diseases frequent in advanced life. There is, moreover, a form known as *senile dementia*, in which without any typical disease, but as a consequence of impaired tissue-vitality and diffused degenerative changes throughout the nervous system, the mental faculties undergo a more marked degradation than is usually met with in old age. This condition in its minor degrees goes by the name of *hebetude*. In all such states or grades of idiotcy and dementia, we meet with an undue tendency to sleep in the day-time as a result of the listless and languid mental condition. This is but another sign of the general lowering of conscious vigour.

Here we must include, also, a peculiar group of conditions, having some alliance to one another, and which are all characterised by loss of consciousness to some extent, either partial in range or general. They are—*reverie*, *somnambulism*, *ecstasy*, *coma-vigil*, *catalepsy*, *hypnotism*, and *trance*. They are merely enumerated here, but are defined or described in their several places. In the latter of these conditions the loss of consciousness, in the ordinary acceptation of the term (viz. loss of perceptive power) is so absolute, that some may think it ought rather to be included in the next section. Loss of perceptive power, however, would not seem to be absolutely synonymous with loss of consciousness. There is good reason to believe, for instance, that where the influence of chloroform and other anæsthetics is not pushed to the fullest extent, a condition of *anæsthesia* intermediate between slight and profound is produced, in which, whilst there is absolutely no consciousness for external impressions, so that pain is altogether unfelt, there is still a certain amount of cerebral activity—as evidenced by rambling and indistinct speech on subjects altogether apart from what the surgeon may be doing. There is mental activity clearly, though the nature of this, as revealed by the patient's speech, may preclude the notion that pain is at the time being felt. Sensorial consciousness is blotted out, whilst a kind of ideational consciousness remains. We have an approximation to such a condition, also, in the case of *sleep* when dreams are rife. But here sensorial consciousness is not completely in abeyance. Again, in certain rare and anomalous epileptiform attacks we may find the patients, after the first paroxysms, bereft of some senses, though not of others. They may hear what is said by those around them, though they continue for a time quite unable to see or speak.

4. **Complete Loss of.**—In very profound sleep (*sopor*), in that prolonged form of it in which the person, if he can be momentarily roused, drops off again immediately (*lethargy*), and also in profound *anæsthesia*, there is complete loss of consciousness. The terms sopor and lethargy are now rarely used, and authors are not even agreed as to the precise state which should be designated by the latter word.

In *syncope* we have insensibility resulting from a cutting off of the proper supply of blood to the brain; whilst in *asphyxia* we have a like result following upon an interference with respiration.

A condition of *narcosis* or profound insensibility may result from opium or other drugs and poisons, amongst which alcohol is to be included as one of the most common producers of such a state. Or it may also be due to the deficient elimination of urinary products by the kidneys, when uræmic coma is produced.

Complete loss of consciousness exists for some time during the ordinary form of *epileptic fit*, or during an attack of convulsions; though in other epileptiform fits, not unfrequently met with—having some of the characters of hysterical convulsions—there seems to be a loss of sensorial consciousness only (loss of perception), whilst a certain amount of ideational consciousness remains. In *apoplexy* also there may be for hours or days a more or less profound loss of consciousness. In the less profound attacks, as well as after an epileptic fit or an attack of convulsions, the loss of consciousness is not complete, and we have a condition now commonly known as *stupor*. This state is also frequent as a result of concussion or other injuries of the brain, and it occasionally follows a severe fit of hysterical convulsions.

It may last for hours, days, or even weeks in some cases. In it the patient lies with his eyes closed, taking no heed of what is passing around, though he may show obvious signs of feeling when touched or pinched, and may be capable of being momentarily roused, so as to give a short monosyllabic answer, if slightly shaken or spoken to in a loud voice. On these occasions, signs of impatience are often shown. Though such a patient will not ask for food, he will often drink freely when it is offered. He will of his own accord, when his bladder is full, sometimes get out of bed, find the chamber-pot, use it, and return to bed without saying a word—and then speedily relapse into his previous state of stupor. When the insensibility is more profound, both urine and fæces are passed incontinently

The state just spoken of is referred to in this section because it is so intimately allied to and connected by all sorts of transition conditions with another, known as *coma*, in which the loss of consciousness is more complete and absolute. There are different degrees of stupor and there are different degrees of coma; the former is commonly spoken of as slight or deep, whilst a comatose condition, coma, and profound coma (the latter being what the older writers termed *carus*) are the phrases ordinarily used to denote the increasing insensibility of the graver state, which is more especially characteristic of the apoplectic condition. Coma may result from long-continued exposure to cold, from sun-stroke, from poisons of various kinds, from erysipelas of the head and face, from inflammations of the meninges, multiple embolisms, the effects of hyperpyrexia, or from cerebral hæmorrhage. The most common cause of very profound coma is cerebral hæmorrhage (apoplexy). In this condition the breathing is often loud and stertorous, and consciousness is entirely obliterated, so that there is an utter absence of reflex movements when a limb is pinched or when the conjunctiva is touched. The patient in the deeper forms of coma often cannot be roused at all, even for a moment, and if this state does not terminate in one way or another before the expiration of twenty-four hours, or if it does not gradually pass into one of mere stupor, a fatal result may be considered imminent.

H. CHARLTON BASTIAN.

CONSTIPATION (*con*, together, and *stipo*, I cram).—DEFINITION.—Infrequent or incomplete alvine evacuation, leading to retention of fæces.

ÆTIOLOGY.—The causes of constipation may be *local*—an impediment to the onward movement of the fæces in the large intestine or from the rectum: or *general*—pertaining to habits, diet, and other conditions.

Local.—These include:—(*a*) Lesions inducing narrowing of some part of the large intestine. (*b*) Collections of scybala, intestinal concretions, &c. in the cæcum, sigmoid flexure, or rectum. (*c*) Pressure on the rectum, by uterine fibroid or ovarian tumours, uterine displacement, the gravid uterus, or an enlarged prostate. (*d*) Defæcation thwarted, as when the expiratory abdominal muscles are enfeebled, as in pregnancy, especially when repeated or after twins, obesity, old age, or in some painful affection of the abdomen, such as rheumatism of the abdominal walls and diaphragm, chronic dysentery, piles, anal fissure. (*e*) Feeble contraction of the intestinal muscular fibres, as in distension of the large intestine or a portion of it by gas, fæces, or lumbrici, inflammatory affections, lead-poisoning, senile atrophy, or in delicate females with lax muscular fibre (*see* COLON, Diseases of). (*f*) Pain in the pelvic viscera and probably elsewhere may induce paralysis of the sympathetic nerves supplied to the intestinal walls; thus may be explained obstinate constipation in painful uterine and ovarian diseases, which cannot be accounted for by pressure on the bowels or otherwise.

General.—The general causes of constipation are:—(*a*) Sluggishness of function—lymphatic temperament, anæmia, especially with amenorrhœa; or disposition to great activity of the muscular and nervous system. (*b*) Certain habits, namely, sedentariness; too great muscular activity: mental application, especially when excessive or prolonged; the continued use of aperients or enemata after the relief of temporary constipation; habitual disregard of, or hurry in the act of defecation; prolonged hours of sleep; the excessive or even moderate use of alcohol, tea, tobacco, or opiates. (*c*) Dietetic errors.—Diet too nutritious—leaving little intestinal residue—or poor and insufficient; improper feeding, especially in infants and children; the use of indigestible substances, such as cheese, nuts, or cucumber.

Constipation is frequently a prominent symptom in diseases of the stomach; of the liver; of the heart, inducing congestion of the portal system and of the nervous system: as well as in connexion with diabetes, excessive perspiration, prolonged lactation, and discharges.

The causes of constipation are such as evidently induce one or both of the following conditions.—1. Dryness and hardness of the contents of the large intestine from deficient secretion, or too active absorption of fluid from the intestinal tract. 2. Impaired contraction of the muscular fibres of the large intestine.

DESCRIPTION.—In constipation the evacuations are infrequent, solid, deficient in quantity, and sometimes unusually offensive; they often consist of dry, hard, dark or clay-coloured masses or scybala. Defæcation is generally difficult or even painful. As a rule the depth of colour, and the scybalous character of the motions, are in proportion to the duration of the lodgment of fæces in the large intestine. Infrequency of defæcation regarded alone is an untrustworthy sign of constipation, or constipation demanding medicinal or other treatment, inasmuch as it often depends on individual peculiarity. Good health is consistent with wide departures from the ordinary rule—a daily evacuation; not unfrequently there is no relief from the bowels for several days or even for a week, and yet without inconvenience, so long as the infrequent defæcation is habitual, or can be ascribed to idiosyncrasy.

The disturbances of function usually associated with constipation may be local, or extend to distant parts.

The *immediate* or *local* effects are such as may arise from retention of fæces:—signs of fæcal collections in the cæcum, colon, sigmoid flexure, or rectum; irritation of portions of the intestine, indicated by colic, inflammation, ulceration, and perforation of the intestines; intestinal obstruction; pressure of fæcal accumulations on the intra-pelvic vessels and nerves, inducing menorrhagia, uterine catarrh, seminal emissions, hæmorrhoids, cold feet, neuralgia and numbness of the legs (Niemeyer). Constipation frequently exerts a pernicious influence on primary digestion, indicated by foul tongue, fœtid breath, anorexia, acidity, flatulence, biliary disturbance—even jaundice, and urine loaded with lithates.

The *remote* or *general* effects of constipation are lassitude of body and mind; headache, flushing and heat of head, vertigo; anæmia and wasting.

TREATMENT.—Constipation depending on individual peculiarity is rarely relieved permanently by treatment. The bowels, having acquired from early life the habit of infrequent evacuation, may be stimulated for a time, and are then apt to become more sluggish than before. In all cases the habit of the patient in this respect from childhood should first be determined, either as a warning against active or prolonged treatment, which may prove injurious, or as a guide to the adjustment of directions and remedies—affording as it does a limit which should not be over-stepped.

1. *Ætiological, Dietetic, and Hygienic Treatment.*—In treating constipation the causes should be met. Local causes—such as those inducing contraction of or pressure on some part of the large intestine, or feeble or ineffectual contraction of the intestinal muscular fibres or of the expiratory muscles, should first be eliminated. Habits disposing to constipation should also be corrected. Persons who are much preoccupied or careless are apt either to disregard the call to stool, or to perform the act of defæcation hurriedly, incompletely, and at irregular intervals. The sensibility of the nerves of the rectum becomes blunted by the constant contact of fæces. Hence the periodical removal of collections in the lower part of the large intestine is an essential element of the treatment. It is best when this can be done by well-timed natural efforts. The patient should be told to attempt defæcation every day after breakfast, and to persevere in so doing even when the result is occasionally or frequently unsuccessful. While straining to relieve the bowels, he may facilitate evacuation by pressing firmly the fingers in front and on each side of the coccyx, thus supporting the levator ani during contraction. Failing to obtain relief on the second day, a small cold water enema should be used to prevent further accumulation of fæces in the rectum, and to restore tone and sensibility to the blunted nerves. The enema should never be larger than is required to dislodge the motion from the pouch of the rectum—nor should it be warm; at first it may be tepid, afterwards cold. When evacuation is obstructed by the lower part of the fæcal mass becoming dry, relief may be obtained from emollient enemata and suppositories, such as infusion of linseed, decoction of marsh-mallow, solution of white of eggs, olive oil alone or in oatmeal gruel, or glycerine injected in small quantity into the rectum, and allowed to remain there for some hours; or by the use of suppositories at bed-time, consisting of cocoa-butter, soap, or honey hardened by heat, either alone or combined with a stimulant to excite the flow of mucus into the rectum, or with extract of belladonna or of stramonium. Sedentary habits should be broken into. Exercise on foot or on horseback is specially to be commended, and carriage exercise to be avoided. While studying or reading the patient should walk about, and stand rather than sit at the desk. Gymnastics and out-of-door games are useful when a limited time only can be devoted to exercise. Excessive and exhausting exertion should be avoided. It is generally advisable to recommend early rising and cold bathing in the morning. In different cases one or other of the following may be found serviceable: a shower- or sponge-bath containing vinegar, baysalt, or consisting of sea-water, or a cold sitz bath; douches directed to the abdomen; a cold water compress applied to the abdomen during the day or night or for three or four hours in the morning; friction or kneading in the course of the colon every morning and when at stool; an abdominal belt (flannel or elastic)—especially if the abdomen be pendulous. The interrupted current of electricity has been successfully employed as a special excitor of the muscular fibres of the intestines or of the abdominal wall.

Diet.—Vegetable should predominate over animal food. Greens (cabbage, lettuce, &c.) are useful, as well as fruits, which should be ripe, and taken on an empty stomach. Prunes or figs stewed in olive oil, or infusion of senna, prune-pulp, oils and fats, such as cod oil or olive oil, are also serviceable when they do not disturb the digestion. Bread made of bran (or three parts flour and one part coarse bran), of corn-meal, or of cracked wheat; oatmeal porridge; or wheat ground in a coffee-mill, boiled and salted and served like rice, only less thick, may assist in preventing constipation; if there be acidity and other symptoms of dyspepsia, however, these indigestible articles of diet should be avoided. Tobacco-smoking after meals in moderation sometimes relieves constipation. Cold water or carbonic acid water—a tumblerful at bed-time, or preferably on rising in the morning, may be useful. Much must be left to individual experience; sometimes coffee, or beer, or cider answers best. As a rule farinacea, astringent wines, and tea increase constipation.

2. *Medicinal Treatment.*—When dietetic and hygienic directions fail, they require to be assisted by medicinal agents. The ends to be secured are threefold:—1. To evacuate fæces and gases which, distending the large intestine, thwart peristaltic action. 2. To tone the walls of the bowel, and thus prevent reaccumulation of fæces and the products of their decomposition. 3. To increase the flow of intestinal mucus. Remedies are usually variously combined for these purposes, and should be carefully adjusted to the requirements of each case, so as to meet the leading indications. Among the most useful aperients are aloes or its watery extract, rhubarb, colocynth, gamboge, and podophyllin, and either of these may be variously combined with extract of hyoscyamus or belladonna, extract of gentian,

extract of nux vomica, quinine, sulphate of iron, or ipecacuanha. The dose of the aperient should not exceed that required to secure gentle evacuation, and it varies with individuals. Purging exhausts torpid bowels, and perpetuates constipation. The bowels should not be pushed to more frequent relief than has been habitual with the patient from early life. The aperient, which should be varied in a prolonged course of treatment, should be very gradually dropped, while the intestinal tonics (belladonna, quinine, nux vomica, iron) are continued. The duration of treatment is prolonged until the aperient is almost entirely withdrawn. The remedies should be taken immediately or two or three hours after the principal meal. The treatment by belladonna, introduced by Bretonneau, was greatly prized by Trousseau (*see* COLON, Diseases of).

In anæmic subjects a firm and prolonged course of iron should be aided by aloes, nux vomica, and arsenic. In hæmorrhoidal complications aloes should as a rule be avoided, and laxative electuaries should be prescribed; in some cases, however, it tones without irritating the rectum. Flatulent dyspepsia and tympanites are indications for the prescription of nux vomica, which, however, will not radically cure constipation. In obstinate cases the most useful remedies are colocynth — tincture (Prussian Pharm.) 5 minims or more on sugar or in water three or four times a day, or 10 to 20 minims an hour before breakfast; extract or compound pill with small doses of croton oil, or with gamboge, elaterium, or other combinations; podophyllin with belladonna (Trousseau), ipecacuanha, and colocynth or aloes. A full dose of opium may liberate the bowels after the failure of the strongest purgatives, and constipation depending on inhibition of the sympathetic nerve from pain, will be relieved by opium with belladonna. Enemata, when frequently required, should be small in quantity, and at first tepid, then cold; for occasional use for the purpose of clearing away fæces loading the large bowel, they should be large (from two to six pints) and warm (*see* FÆCES, Retention of). The frequent use of large warm injections is injurious. Purgative waters, such as the Friedrichshall, Pullna, Hunyadi, or Carlsbad waters, given occasionally in small doses with warm water in the early morning, are often valuable adjuvants to a well-organised course of treatment. Constipation cannot, however, be cured by a course of saline purgatives, and may be greatly aggravated by it.

Numerous other drugs have been recommended in the treatment of habitual constipation, among which are nitric acid; arsenic with food in debilitated anæmic females, in the sedentary, or the old; tincture of benzoin—20 minims thrice daily; tincture of colchicum—a few drops after each meal; carbonate of iron; compound liquorice powder with sulphur—a teaspoonful at bedtime in water; tincture of veratrum viride—3 minims four or five times a day; or ox-gall dried, in pills.

GEORGE OLIVER.

CONSTITUTION. — SYNON.: Diathesis, Habit, Conformation of body. Fr. *Constitution*; Ger. *Leibesbeschaffenheit*.

The constitution may be *sound* or *unsound*. A sound constitution may be defined as the harmonious development and maintenance of the tissues and organs of which the body is made up. It originates with the union of a healthy sperm and germ cell, continues with the growth of the product under the most favourable conditions to adult life, and becomes gradually enfeebled with advancing age by the process of natural decay.

The constitution may be unsound in consequence of *deficient vitality*. This deficient vitality may be general, as is sometimes observed in the children of parents one or both of whom are in advanced life, or whose vitality on one side or the other has been reduced by excesses, such as alcoholic or venereal. Exhausted vitality from prolonged disease, *e.g.* phthisis or tertiary syphilis, affecting either parent, may determine the death of the offspring at an early period from mere failure of nutrition, or may cause it to succumb to acute disease not not necessarily associated with any inherited tendency of a special kind. The deficient vitality may be restricted to certain tissues or organs, viz., those concerned in the nervous, vascular, respiratory, or digestive systems. Thus amongst the most strikingly hereditary of diseases are those of degeneracy, such as emphysema, structural heart-diseases, atheroma of vessels, certain kidney-diseases, &c. Rightly interpreted, these diseases are of the nature of premature senility, attacking certain tissues or organs—as it may be seen to attack the hair or the cornea —from some inherent defect in their vitality.

The constitution may, in the second place, be unsound from some definite *inherited* form of disease. Although the constitution of an individual begins with his life, it is nevertheless the resultant of the constitutional peculiarities of many antecedents. This being so, tendencies to disease may date far back in the pedigree, to be called forth from time to time by favouring circumstances. We need, however, practically only go back a few generations in inquiring for those diseases which are well recognised as being hereditary. These form one section of the group of *constitutional diseases*.—Congenital syphilis, gout, scrophulosis, tuberculosis, cancer, asthma, and certain neuroses are all diseases which are apt to appear at certain periods of the life of the offspring, in consequence of some specific inherent defect of blood or tissue derived from his progenitors.

The constitution may, thirdly, become unsound at any period *subsequent to birth*. (*a*) This may be due to the surrounding conditions of life being evil. Deficient or impure air, insufficient or improper food, defective sunlight, over-work, intemperance, &c., may injure the constitution and give rise to diseases whose constitutional nature is sometimes strikingly shown in the tendency of some of them to become hereditary. Rickets, phthisis, and scrofula are examples. (*b*) The introduction of certain poisons into the system affects the constitution profoundly, and in some cases permanently, after the more obvious effects of the poisons have passed away. All the acute specific zymotic diseases, including vaccinia, would come under this category. They render the organism, for a long period or for life, proof against subsequent attacks of the same disease. Only in certain cases, however, can the soundness of the constitution be said to be *impaired* by such diseases, and then it is usually through the occurrence of sequelæ.

R. Douglas Powell.

CONSTITUTIONAL DISEASES.—These may be regarded as diseases generated from within, in the course of the wear and tear, nutrition and waste of the body, in consequence of inherent or acquired weakness in its construction.

The applicability of the term 'constitutional' to disease is sufficiently explained in the preceding remarks on 'constitution.' The term may, however, be associated with a group of so-called 'general' diseases, in opposition to that which includes 'zymotic' or 'specific' diseases, which are generated by the introduction of some definite poison from without.

In our present state of knowledge, however, no very rigid lines can be drawn to separate local, general, constitutional, and specific diseases from one another. *See* Disease, Causes of.

R. Douglas Powell.

CONSTRICTION (*constringo*, I bind together).—A narrowing, to a limited extent, of a canal or hollow organ, due either to a textural change in its walls, or to the pressure of a band surrounding it.

CONSUMPTION (*consumo*, I waste).—This is a term for any wasting disease, but it is generally applied to pulmonary phthisis. *See* Phthisis.

CONTAGION.—The word *contagion* is applied in pathology to the property and process by which, in certain sorts of disease, the affected body or part causes a disease like its own to arise in other bodies or other parts; and the Latin word *contagium* is conveniently used to denote in each such case the specific material, shown or presumed, in which the infective power ultimately resides. *See* Zyme and Zymosis.

The property of contagiousness belongs to a very large number of the diseases which affect the *human* body. And in more than this direct way the property is of great interest to mankind. Contagiousness of disease is a fact not only for man, but apparently for all living nature; and the influence of contagion in spreading destructive diseases among *domestic animals*, and among those parts of the *vegetable kingdom* which contribute to the nourishment of man, is such as to make it of immense social importance that the laws of contagion should be well studied and understood. Further, just as contagion in the case of *living* bodies and their parts spreads disease from one to another, so, to an immense extent, in the case of certain matters which, though of organic origin, are *not living*, it spreads various processes of decay. The so-called 'fermentations' which yield alcohol and vinegar, as well as that in which putrefaction consists, are contagious affections of the respective matters in which they occur: every cheesemonger knows that moulds of different kinds spread by inoculation, each in its own kind, from cheese to cheese; and if the Greek proverb 'grape mellows to grape' is true of the living fruit, the apple-loft gives analogous experiences of contagion among the fruit which is garnered.

The rationale of the word 'contagion,' as now used, is that the property is understood to attach itself essentially to a material *contact*; not necessarily that, when infection is spread from individual to individual, the contact of the individuals must have been *immediate*; but that in all cases there must have been such passage of material from the one to the other, as was in itself at least a *mediate contact* between them. And similarly, in those very instructive illustrations of the process of contagion which are furnished within the limits of a single diseased body by the propagations of disease from part to part of it, we can in general easily see that infection advances from part to part, either in proportion as part touches part, or in proportion as the one receives from the other the outflow of lymph or blood or secretion.

The various specific matters which effect contagion in the living body, the respective 'contagia' of the given diseases, seem all to have in common this one characteristic: that in appropriate media (among which must evidently be counted any living bodily texture or fluid which they can infect) they show themselves capable of *self-multiplication*; and it is in virtue of this property that, although at the moment of their entering the body they in general do not attract notice, either as objects of sense or as causes of bodily change, they gradually get to be recognisable in both of these respects. Now, the faculty of self-multiplication is eminently one of the characters which we call *vital*; and when it is said that all contagia are self-multiplying things, this is at least very strongly to suggest that perhaps all contagia are things endowed with life.

In order to any general consideration of the question thus suggested, contagia may conveniently (even if but provisionally) be distinguished as of two main classes, differing, or at present seeming to differ, from each other in their mode of action on the organisms which they infect: one class, namely, that of *Parasites*; and the other class, that of the true or *Metabolic Contagia*. Of this separation, so far as present knowledge seems to justify it, the assumed grounds are: that each true Contagium, in proportion as it multiplies in the body, *transforms*, in a way which is specific to itself and is different from the ways of other contagia, the bodily material with which it has contact; while, on the contrary, the Parasite, however much it may grow or multiply in the body, produces no qualitative effects specific to itself, but only such effects as are of common kind to it and all other parasites—indications, namely, of its *mechanical intrusiveness* in the parts which it occupies, and sometimes of the *drain* which it makes on its host's general nutritive resources.

A.—Of Parasites, in relation to processes of contagion, little needs be said in the present article. When an organism or part of it is, in greater or less amount, inhabited by other organisms, animal or vegetable, which subsist on it, or its food or refuse, it of course may be a centre of infection to other (if susceptible) bodies or parts, to which it can transmit live parasites or their germs or seeds: for, when this transmission takes place, growth and self-multiplication, as in a colony, are the natural results which have to be expected; and in proportion as these occur, the newly-infected body or part gradually gets to suffer, like the old, from those particular derangements which make the type of parasitic disease. Some parasitic diseases, especially some of those of the skin, spread actively by direct contagion in ordinary intercourse; as for instance, scabies by the migration of its acari, and porrigo (among children) by the spores of its microphyte; and the spreading of such diseases where they exist may of course be to any extent facilitated by aggregation of persons and uncleanliness of personal habits. There are cases in which parasitic disease spreads from animal to animal only in proportion as the one feeds on the other, and eats it with parasites still living in it; or in proportion as live parasite-eggs or larvæ, discharged from the body of one animal, get conveyed with food (especially on raw herbage and in water) into the bowels of another. Considerable epidemics of trichiniasis in the human subject have been traced, chiefly in Germany, to infection from the pig; in cases where pork, abounding with trichinæ, has been eaten, as sausage-meat or otherwise, in a raw or imperfectly-cooked state: and in Iceland the very great sufferings of the human subject and the cattle from echinococcus have been traced to the influence of the dogs in spreading contagion from the slaughter-house, where they eat hydatidised offal, to the kitchen-gardens and water-sources and pastures, where they discharge tape-worm eggs from their bowels. *See* PORRIGO, SCABIES, TRICHINA, HYDATID, &c.

The **DISEASED STATES** which consist in being colonised by parasites are diseases of indefinite duration, tending in some cases to indefinite increase. In cases where the disease consists in the presence of swarms of blood-sucking or otherwise exhausting animal parasites, symptoms of the blood-drain will of course gradually arise; but otherwise the parasite, whether animal or vegetable, operates only as a mechanical presence. Skin and mucous membrane will be irritated in their superficial layers, and in some cases more deeply, by the animal or vegetable parasites which breed on or in them, just as they might be by dead mechanical irritants: solid organs having cystic entozoa in them will in like manner show evidence of irritation by encapsulating the colonists; and the surrounding tissue will of course suffer compression and displacement in proportion as the colonisation (*e.g.* in case of echinococcus) is compact and massive. In the case of trichiniasis—but, in our ordinary experience, in no other—the multiplication of the parasites, the burrowing of their young, and the general diffusion of these in the body, are processes of such extreme activity that, if the quantity of contagium taken into the stomach has been large, the innumerable local irritations suffice to make a very acute fever; but even in this extreme case, the merely irritative type, though exaggerated, is essentially preserved.

As different sorts of animals are notoriously liable to different sorts of parasites, so, even among animals of one sort, as for instance in the human kind, the **LIABILITY** of different bodies to receive particular parasite-infections, does not seem to be quite equal for all. Especially, the vegetable parasites seem to have their affinities determined or modified by the general state of health of the recipient; and there are cases in which it looks as if there ran in particular family-lines (perhaps with some slight chemical idiosyncrasy) a special liability to particular intestinal worms. There, however, is no reason to believe that in regard of the more important animal parasites, as particularly of trichina and the tæniadæ, the susceptibility of individuals to attacks is other than universal and practically equal.

B.—The true or **METABOLIC CONTAGIA** (to which the rest of the present article will exclusively refer)—the contagia which, in their respective and specific ways, operate *transformingly* on the live bodily material which they affect, are perhaps the most important of all the incidental physical influences which concern mankind. Whether they may all, at some time hereafter, admit of being named, like the parasitic contagia, in terms of biological classification, is a question which needs not in the first instance be raised; for meanwhile the identity of each separate true contagium is settled in experimental and clinical observation by the uniformity of the operation of each on any given animal body which it affects. Each of the diseases propagates itself in its own form in as exact identity, as if it were a species in zoology or botany; and in each such repetition of the disease there is a multiplication—always a large, and sometimes an inconceivably immense multiplication, of material which has the same infective property. Evidences innumerable to that effect are under daily clinical observation in this climate in instances of smallpox, measles, scarlatina, whooping cough, enteric fever, mumps, typhus, syphilis, cowpox, diphtheria, erysipelas, hospital gangrene, purulent ophthalmia and gonorrhœa, venereal soft-chancre and phagedæna, &c.: for, barring fallacies, no man ever sees any one of those diseases produced by the contagium of any other of them; and any man who has before him a case of any of them can see that, however minute may have been the quantity of contagium by which the disease was started, the patient's diseased body (part or whole) yields for the time an indefinitely large supply of the specific agent. It is more or less habitual to some of the diseases that the infectedness of the patient is first made known to the observer by such *general pyrexia* as tells of change already far advanced in the circulating mass of blood; and it is only after this has shown itself, that other symptoms, adding themselves to the fever, complete the more or less complex type which establishes the identity of the disease. But in many of the diseases it may be the case (either naturally or as result of experimental infection) that the first, and in some diseases the main or even the only, effects of the contagion are *local changes*, passing where we can from the first observe them; and the broad facts of metabolic infection, as regards waste of bodily material with concurrent increase of contagium, are, in many such cases, among our most familiar experiences. Most instructive, too, are the facts of contagion which are to be learnt in the study of tubercle: the contagium, introducible either by tubercular and certain septic inoculations through the skin, or internally by the infective action of the milk or diseased organs of tubercular animals if taken as food; and the contagium, when introduced, gradually spreading as it multiplies, and as lymph and blood carry it from the first infection-spot to other organs which now will repeat the process. And similarly in cancer (though the primary disease is at present of unknown origin and cannot be created by experiment) the repetition of the primary disease in secondary and tertiary propagations in the body of the sufferer is one of the most striking of all evidences of contagion; because of the great number of structural types which pass under the name of cancer, and the fidelity with which each of them is reproduced in the organ to which the contagion extends. A further fact of contagion, deserving notice in the present context, is the local spread of certain of these processes by continuity of tissue; as, for instance, in the continuous extension of phagedæna or hospital-gangrene from any centre of first inoculation, or of tubercular softening or cancer at the place where it begins: a mode of extension which indicates successive infective actions of matter on matter in spheres of ever-widening circumference;[1] and the like of which, but in rudimentary degree, may be traced in the areola of any acute inflammation.

In the physiology of the metabolic contagia no facts are more characteristic or more important than those which show the RELATIVENESS of particular contagia to PARTICULAR RECEPTIVITIES of body. First, and in intimate connexion, as would seem, with a *chemical electiveness* of action which will presently be imputed to contagia, there is the preference which some particular contagia (however introduced into the system) show for particular *organs* of the body; so that, by the exercise of this preference, there is given to each of the diseases its own set of clinical and anatomical characters. Compare, as instances in this point of view, the respective local affinities of smallpox, enteric fever, mumps, syphilis, hydrophobia, &c.—Secondly, it may be noted that, in regard to some of the contagia, different *persons*, and particularly persons of different *family-stocks*, show original differences of susceptibility; original, namely, as distinguished from others, hereafter to be mentioned, which are acquired; so that, for instance, the severity with which scarlatina or diphtheria will strike in particular families contrasts with a comparative mildness of the same disease in other families, or perhaps even with cases of apparently complete personal immunity under exposure to the particular danger: and recent researches have seemed to suggest as possible that, in the very wide differences of degree with which tubercular disease prevails in different families, an essential condition may be, that the families have widely different degrees of original predisposition towards some of the septic contagia.—Thirdly, there is the extremely suggestive fact with regard to many of our best-known febrilising contagia, that they run a course of *definite duration*, and that in this course, provided the patient do not die, all present, perhaps all future, *susceptibility to the particular contagium is utterly exhausted from the patient*; so that re-introduction of the same contagium will no more renew that patient's disease than yeast will excite a new alcoholic fermentation in any previously well-fermented bread or wine. The inference from this fact seems unavoidable, that each such contagium operates with a chemical distinctiveness of elective affinity on some special ingredient or ingredients of the body; and that exhausting this particular material in febrile process, which necessarily ends when the exhaustion is complete, is the bodily change which the contagium 'specifically' performs.—Of not all metabolic contagia, however, can it be said that their operation runs so definite and self-completing a course. For, first, there are particular *acute infections* which, as a rule, kill; either (as appears to be the case in splenic fever when affecting man) because of the extreme magnitude of the transforming process which the contagium sets up, or else (as appears to be the case in hydrophobia) because the elective incidence of the contagium is on an organ indispensable to life; so that in such cases there is in fact hardly such an event as passing alive through the whole process of the disease. And secondly, there are the *contagious dyscrasies* which are clearly characterised by their tendency to indefinite duration: syphilis, which oftener than not relapses in successive outbreaks, and often as years pass invades the body more and more deeply, and may after all never during life be ended; and tubercle and cancer, which, with almost invariable persistence, will in general steadily advance month by month to infect more and more of the body till the process eventuates in death.

The transmission of various contagious diseases IN COMMUNITIES is of course greatly influenced, both in detail and in aggregate, by such differences of individual receptivity as were mentioned in the last section. Notably, as regards communities through which particular acute infections have had full run, fresh sparks of the contagium may find little or no fuel on which to act; and much new diffusion of the disease may not again be possible, till immigration, or births, or lapse of time operating in other ways, shall have reconstituted a susceptible population. And, given the susceptible population, circumstances of time and place are infinitely various (especially as regards quantity and quickness of personal or quasi-personal intercourse) in determining how far this population shall have particular contagia thrown in its way.

Also there are conditions, not primarily of a personal kind, which operate on a very large scale in determining the spread of some of the metabolic infections: giving to them respectively *at certain times*, in ways not hitherto understood, a *special increment of spreading-power*, and in some instances also *special malignity*: and thus enabling them respectively from time to time to come into comparative prominence in national life, and perhaps at once or successively in many different countries, in the form of so-called EPIDEMICS. Thus, it is matter of familiar

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[1] Compare Tennyson's

'little pitted speck in garnered fruit,
Which, rotting inward, slowly moulders all.'

THE PROPERTY OF
Trinity Medical College.

knowledge that the fevers which are most habitual to this country, scarlatina, measles, smallpox, enteric fever, are of nothing like uniform prevalence,—that scarlatina, for instance, will be three times as fatal in one year as in another, and that smallpox is liable to even greater exacerbations: and it is known that temporary differences of this kind are not exclusively local,—that, for instance (to quote a late official report) 'the epidemic of smallpox which began in England towards the close of 1870 and terminated in the second quarter of 1873 was part of a general epidemic outbreak of that disease, of world-wide diffusion, marked wherever it occurred by an intensity and malignity unequalled by any previous epidemic of the disease within living memory.' The wider the survey which we take of epidemiology, the more certain it becomes to us, that, outside the conditions which are independently personal or local, there are *cosmical conditions* which have to be considered. Doubtless there are great epidemiological facts—such, for instance, as the first spreading of smallpox to America, or in our own times the increasing frequency of Asiatic cholera in Europe, which may be ascribed to novel conditions of international intercourse: but there are others, equally great, to which apparently no such explanation can be applied. For what reason it is that cholera every few years has its definite fit of extension in India,—or why diphtheria, which scarcely had a place in history till it overran Europe in the 16th century, and which since then had been rarely spoken of, began again some twenty-odd years ago to be comparatively important in England,—or why the plague of the Levant has for the last two centuries been so unfamiliar to us,—or why the yellow fever of the Mississippi has in particular years raged furiously in parts of Europe,—or why our black-death of the 14th century, though apparently still surviving in India, has never but that once been in Europe,—or whither has gone our sweating-sickness of three centuries ago,—or whence have come the modern epidemics of cerebro-spinal meningitis: these, and many like questions, which cannot at present be answered, seem to be evidence enough that, in the making of epidemics, contagion and personal susceptibility may be factors in a partly *conditional* sense. Influences which are called 'atmospheric'—the various direct and indirect influences which attach to the normal succession and occasional abnormality of seasons, in respect of the insolation of our planet, and of the temperature and humidity of air and earth—are in general far too vaguely regarded as elements of interest in the present question, but are possible factors which no epidemiologist should omit from scientific consideration. For any definite knowledge which exists on the relation of particular conditions of season to the prevalence of particular epidemics, the reader is referred to the article EPIDEMICS, and to articles on the respective diseases.

In the PASSAGE of the metabolic contagia FROM PERSON TO PERSON various agencies may be instrumental,—bedding or clothing or towels which have been used by the sick, dirty hands, dirty instruments or other utensils, the washerwoman's basket, foul water-supply, stinking house-drains, contaminated milk or other food, the common atmosphere, &c.; but differences of that sort are only differences as to the *means by which such communication is established with a diseased body* as brings its products into relation with healthy persons; and the disengagement of *infectious products* from the bodies of the sick is pathologically the one influential fact. As regards the products which ought to be deemed infectious, the specially-diseased surfaces and organs of the patient, and the discharges and exhalations which they respectively yield, must always be regarded with chief suspicion; but suspicion, however much it may insist on them, must never disregard other sources of danger. Of some of the metabolic contagia we practically know, and of many of the others we may by analogy feel sure, that, when a given body is possessed by one of them, no product of that body can be warranted as safe not to convey the infection. Presumption against every part and product of the diseased body is by everyone readily admitted where there are vehement general symptoms of disease: but it is important to know that not only in such febrile states, but even in states of chronic dyscrasy, and even at times when the dyscrasy may be giving no outward sign, the infected body may be variously infective. Thus, in regard to constitutional syphilis, it is certain that the mere utero-catarrhal discharge of the syphilitic woman, or the sperm of the syphilitic man, or the vaccine lymph of the syphilitic infant, may possibly contain the syphilitic contagium in full vigour, even at moments when the patient, who thus shows himself infective, has not on his own person any outward activity of syphilis. Similarly, in regard to tubercular disease, experiment has proved beyond question that the milk of animals suffering from tubercle will, if taken as food by other animals, infect them through the intestinal mucous membrane: and there are independent reasons for believing that the tubercular contagium (like the syphilitic) will at times during the dyscrasy be contained in the seminal fluid, and that men, tubercular perhaps only in some degree which is not immediately important to themselves, may by that secretion convey fatal infection to women with whom they have conjugal relations.[1] Regarding many of the metabolic contagia, conclusive evidence exists that, when they are in operation in pregnant women, the fœtus will in general be infected by them; and this though the diseases (*e.g.* smallpox, cholera, syphilis) be of the most different pathological types: but with regard to pregnant animals affected with splenic fever it is noticeable that Brauell, in his extensive researches, found the blood of the fœtus not to be infective.

In general, each contagium has its own favourite WAY OR WAYS OF ENTERING THE BODY; and these preferences are not only of speculative interest, as attaching to varieties of nature and natural habits among the contagia, but are of obvious practical importance as measures of the widely different degrees in which the different contagia are qualified to spread in communities. Thus, *inoculation at broken surfaces* of skin or mucous membrane has long been known as the ordinary mode by which the infections of syphilis, hydrophobia, splenic fever, cowpox, and farcy or glanders, get admission to the body; and our best knowledge of some other infectious diseases (notably of tubercle) has been derived from inoculations intentionally made with their contagia for purposes of study. While probably all infections which tend to be of general action on the body can be brought into action in that way, and while some infections are not known to pass by any other mode of transmission, there are many infections which spread freely from subject to subject by *atmospheric and dietetic communication*; and the meaning of these preferences is hitherto not fully known. It seems that some contagia are so acted upon by air and water, that they seldom or never reach the body in an effective state by those common means of communication,—some hardly, if at all, by water, and some not by air except with very close intercourse; and further, that, of contagia which reach the body in an effective state, some require, while others do not require, that an abnormal breach of surface shall give them special opportunity for taking hold. In some of the cases where a disease can be propagated in both ways,—i.e., certainly in smallpox, and apparently also in bovine pleuro-pneumonia, the artificially-inoculated disease tends to be much milder than the disease otherwise contracted; but pathologically it is difficult to conceive any essential difference between those different modes of contagion. It may be presumed that, in the modes which are not by true inoculation, acts which are comparable to inoculation take place on internal surfaces; that, for instance, when particles of scarlatina-contagium are caught in the tonsils, or inhaled into the bronchi, or swallowed into the stomach, they begin by penetrating the texture of the mucous membrane, and by thus effecting as real an inoculation, with regard to the blood, as that which art or accident provides in other cases through the punctured skin. That previous abnormal breach of surface by artificial puncture or otherwise is not necessary to allow the infection of mucous surfaces is illustrated in ophthalmia and gonorrhœa; where apparently no other condition has to be fulfilled than that a particle of the blennorrhagic contagium shall be deposited on the natural surface of the mucous membrane. It deserves notice that, while a considerable number of the worst diseases of the domestic animals admit of being communicated to man by artificial inoculation atmospheric communication seems to be very inapt, if not absolutely unable, to infect man with any one of them; and in this connection it may be of interest to remember that syphilis, one of the most familiar of human infections, but hitherto not traced to any brute ancestry, differs from our other current infections in requiring inoculation to transmit it.

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[1] See Dr. Weber, in *Clin. Soc. Trans.*, 1874.

When any metabolic contagium enters the animal body, it requires an INTERVAL OF TIME, and in most cases a considerable interval, before its morbific effects can become manifest even to skilled observation. The period of latency or so-called INCUBATION varies greatly in different cases. In hydrophobia it is very rarely less than of one month, is certainly often of several months, and is said to be sometimes of years. In syphilis the inoculated spot remains generally for at least a fortnight, and may remain even as much as five weeks, without any ostensible change; and the roseola of the general infection will not be seen till some weeks later, when generally at least three months will have elapsed since the first inoculation. In the acute eruptive fevers, when their contagium is transmitted by air, the first changes which ensue on infection are not external, and we cannot be sure what early internal changes may take place; but in smallpox, the fever (which is the first overt sign) does not attract notice till about the twelfth day after infection, nor the eruption till two days later; and in measles the incubation-time, though perhaps less uniform, seems to be little (if any) shorter than that of smallpox. The septic contagia and the contagium of splenic fever seem to be of particularly quick operation; but even the most virulent septic contagium, when without admixtures which tend to complicate its action, will not begin sensibly to derange the infected animal till at least several hours after it has been inoculated. As regards the contagia last referred to, it is conceivable that the self-multiplication of the contagium in the form in which it proves fatal to life is a process which goes on continuously and uniformly from the moment of inoculation to the moment of death, and that the moment when signs of general derangement become manifest is the moment when this uniformly advancing process has accumulated in the system a certain quantity of result:—but it does not seem easy to apply this explanation to the diseases of long incubatory period; and we can hardly conjecture what may be the latent processes—for instance of smallpox, during the first ten or more days after contagium has been received.

It is not yet possible to say, in any universal sense, with regard to the metabolic contagia, what is the ESSENTIAL CONSTITUTION of 'contagious matter,' or what the INTIMATE NATURE of the 'transforming power' which the particle of such matter exercises on the particles which it infects.—As regards the question of the FORCE, chemists, when they refer in general terms to the various acts which they designate *acts of fermentation*, allege that certain processes of change in certain sorts of organic matter induce characteristic changes in certain other sorts of organic matter, not by the common chemical way of double decomposition with reciprocally new combinations, but (so to speak) as a mere by-play or collateral vibration-effect of the chemical force which is in movement; and though language can hardly be more vague than this for any scientific purpose, it expresses clearly enough the conviction of experts that a certain great force in nature lies beyond their power even of definite nomenclature, much more of exact identification and measurement. In that most interesting, but most difficult and hitherto almost uninvestigated, branch of chemical dynamics, we are supposed to have our nearest clue to the scientific problems of the present subject-matter. It may be conceded that the 'contact-influences' which are dimly recognised as causing the fermentatory changes of dead organic matter have apparent analogues in many of the morbific influences of contagion: for the changes which chemists call 'fermentatory' are all catalytic or disintegrative of the organic compounds which they affect; and when living protoplasm is brought by contagion into processes of *characteristic decay*, the analogy seems sufficiently close to justify the word *zymotic* in the naming of the nature of the process. But it must not be forgotten that, among immediate effects of contagion in the living body, are cases wherein the process (so far as we can yet see) is primarily not *catalytic* or *disintegrative*, but, on the contrary, *anaplastic* or *con-structive*. Thus, when tubercle gives rise to tubercle, whether by secondary and tertiary infection in a single diseased body, or by infection from the sick to the healthy, each new tubercle which the contagion brings into being is a *growth-product* of the texture which bears it. And similarly, when the innumerable varieties of cancerous tumour propagate themselves by contagion, each after its special type, in the bodies of the respective sufferers, it is growth, not disintegration, which we first see. It would seem that in those cases of anaplastic 'contact-influence' something far beyond the analogy of chemical fermentations must be involved; and, in view of some of them, the physiologist has to bethink himself of the analogy of that 'contact-influence' which becomes the mainspring of all normal growth and development, when the ovum receives spermatic impregnation.—As regards the ultimate ORGANIC CONSTITUTION of the several metabolic contagia—(each of them of course abstracted from accidental admixtures, and seen or conceived in the smallest and simplest units of quantity and quality in which its specific force can be embodied)—modern research seems more and more tending to show that the true unit of each metabolic contagium must either be, or must essentially include, a *specific living organism, able to multiply its kind*. For with regard to those other contagia (as we may properly call them) which spread fermentatory processes in common external nature, and of which it is as clear as of the morbific contagia that they multiply themselves in proportion as they act, it seems to be established beyond reasonable doubt that the 'self-multiplication' of each of them as it acts is the infinite multiplication of a specific microphyte; and that this microphyte (acting apparently by means of a matter which it produces and from which it can be mechanically separated) is the essential originator of the fermentation.[1] This being the case in regard of those fermentations, it seems probable that the same is in substance true of the specific morbific changes which extrinsic contagia produce in the materials of the living body: probable, namely, that low, self-multiplying organic forms, specific in each case for the particular disease which is in question, are essential to each morbid poison; that the increase of each contagium as it acts is the characteristic self-multiplication of a *living thing*; and that *this* (however obscure may yet remain its mode of operation) is the *essential originator of change* in the affected materials of the diseased body. The fact that low organic forms of the sorts now spoken of have often, or generally, been seen in the morbid products and tissues of persons with zymotic disease, would not by itself be a proof, or nearly a proof, that the forms are causative of the morbid change: for obviously they might be mere attendants on the necrosis and decomposition of bodily material, availing themselves of the process (just as certain insects would) to feed and multiply: and in many of the cases in which micrococci have been seen in morbid material, no direct proof could be given that the meaning of their presence was more than that. There are, however, some cases in which this proof has been completely established; and though such cases are at present but few, the significance of each of them in aid of the interpretation of other cases is of the highest importance. The researches of successive able observers in regard of the splenic fever of farm-stock, and those of Dr. Klein in regard of the 'pneumo-enteritis' (as he names it) of swine, have shown that in each of these cases the microphyte which attends the disease is botanically specific; that it and its progeny can be conducted through a series of artificial cultivations apart from the animal body; and that germs thus remotely descended from a first contagium will, if living animals be inoculated with them, breed in these animals the specific disease. It is equally well known that the organisms (spirilla) which are found multiplying in the blood during the accesses of relapsing fever are botanically specific; but in regard to this disease, experimental proof has not hitherto been given that the spirilla, if separately inoculated, will infect with relapsing fever. Studies as complete as those which have been made in splenic fever and pneumo-enteritis will no doubt sooner or later be made in regard to many other of the diseases, but their progress will necessarily be slow; partly because the objects which have to be scrutinised, and to which specific characters have to be assigned, are so extremely minute, and often so similar among themselves, that none but very skilled and very patient microscopical observers are competent to pronounce on them; and partly again because the conditions of the case are such as to limit very closely the field within which the essential experimental observations can be made. Meanwhile, however, the two diseases, regarding which the larger knowledge has been obtained, must be regarded as highly suggestive in regard of other diseases of the same pathological group, and particularly as giving importance to fragments of evidence (not by themselves conclusive) which have been gathered of late years in studies of some of these other diseases. Eminently this is true of the large family of the septic infections—including on the one hand erysipelas and pyæmia with its congeners, and having on the other hand tuberculosis intimately associated with it; and almost equally it is true of enteric fever and cholera and diphtheria, and of the smallpox of man and beast. Thus, though it would be at least premature to say of these diseases that they certainly have as their contagia *microphytes respectively specific* to them, it seems at present not too much to say that probably such will be found the case; and if as much may not yet be said of many other diseases which are due to metabolic contagia, it must be remembered that the right lines of study relating to contagia in this point of view have not till within very recent times been opened.

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[1] The doctrine to which the words in parenthesis refer (that the microphyte is not itself the ferment, but the producer and evolver of the ferment) tends to bring the case of these ferments into parallelism with that of the chylopoietic and other functional ferments which more highly organised creatures produce for the purposes of their own economy. In the latter case the distinction between the ferment-yielding live bodies (say certain gastric cells) and their not-live product (say pepsin) is already familiar.

Of the NATURAL HISTORY of the contagia, considered independently of the part which they play in the living body, there are hitherto only the beginnings of knowledge. The absolutely first origin of contagia may perhaps not be more within reach of scientific research than the absolutely first origin of dog or cat; but their nearer antecedents—the states out of which they come when first about to act on the living body, and generally the variations which they and the common ferments exhibit under natural and artificial changes of circumstance, are within easy reach of investigation; and those humbler studies are likely to give very useful results. For some of our cases we seem to have an instructive analogy in the facts which Professor Mosler has put together in explanation of the blue-milk contagium of dairies: facts showing that the omnipresent penicillium glaucum, if its spores happen to alight in particular (morbid) sorts of milk, will operate distinctively on their casein as an anilin-making ferment, rendering the milk blue and poisonous, and imparting to each drop of it the power to infect with a like zymosis any normal milk to which it may be added.[1] In our own more special field, pathologists have already learnt that certain of the so-called 'morbid poisons'—the contagia of erysipelas, pyæmia and tuberculosis, are intimately related to the common ferment or ferments of *putrefaction*; and that the most vehement of these contagia can be developed by the artificial culture of successive transmissions in the living body from the comparatively mild contagium of any *common inflammatory* process.[2]

Two other directions suggest themselves as likely to lead to fields of useful observation and experiment. On the one hand, in *comparative pathology*, and with the tracing of contagion from animal to animal, there is the possibility that at last some lower and relatively worthless order of animals may be found the starting-ground of fatal infections for higher orders; and this, perhaps, by contagia which in their former relations are of mere inflammatory significance. On the other hand, in *geographical pathology*, and with the tracing of contagion from place to place, local centres of contagium-origination may possibly be found, in which the contagium, before it enters the animal body, will show itself an independent microphyte of the earth, first operating on the animal body as the essential force in a local malaria. Some of the worst pestilences known to the human race—yellow fever, cholera, perhaps plague, and also some of the diseases of cattle, have in their history facts which suggest that sort of interpretation: the supposition, namely, that certain microphytes are capable of thriving equally (though perhaps in different forms) either without or within the animal body; now fructifying in soil or water of appropriate quality, and now the self-multiplying contagium of a bodily disease. In regard to our own common ague-poison there seems every reason to suspect that its relation to soil is that of a microphyte; and though we know ague only as practically a non-contagious disease, we do not know that any little transfusion of blood from sick to healthy would not show it to be (in that way) communicable from person to person.

It needs hardly be said that exact scientific knowledge of the contagia, and of their respective modes of operation, is of supreme importance to the PREVENTION OF DISEASE. With even such knowledge of them as already exists, diseases which have in past times been most murderous of mankind and the domestic animals can, if the knowledge be duly applied, be kept comparatively, or absolutely, in subjection; and the fact that at the present time fully a fifth part of the annual mortality of the population of England is due to epidemics of contagious disease is only because of the very imperfect application hitherto made of that knowledge. In the present article it is not necessary to state in detail the practice which ought to be adopted in the various different cases of infectious disease; but briefly it may be said that one principle is at the root of all such practice, whatever the disease to which it relates. This principle, which of course becomes more and more important in proportion as the infection is dangerous, and as the persons whom it would endanger are many, is the principle of *thoroughly effective separation* between the sick and the healthy: a separation, which, so far as the nature of the disease requires, must regard not only the personal presence of the sick, but equally all the various ways, direct and indirect, by which infective matters from that presence may pass into operation on others. Especially as regards the diseases which make serious epidemics, the principle of isolation is not carried into effect unless due care be taken to thoroughly disinfect in detail all infective discharges from the sick, and all clothing and bedding and towels and like things which such discharges may have imbued, and finally, as regards certain contagia, the rooms in which the cases have been treated; and in order to secure these objects, it is essential in all grave cases to make such nursing-arrangements and such arrangements of the sick-room (whether private or in hospital) that no retention or dissemination of infectious matters will escape notice. It is likewise essential that all who attend on the sick should be careful not to carry contagion to other persons; as they may but too easily do, particularly in scarlatina and

[1] Virch. *Arch.*, vol. 43.

[2] See particularly Professor Sanderson's papers in successive yearly volumes of *Reports of the Medical Officer of the Privy Council* from 1868 to 1877. It concerns the second fact mentioned in the text to remember that apparently every 'common inflammatory process' includes more or less of textural changes which are necrotic and of septic tendency. See *Holmes's System of Surgery*, first edition, article 'Inflammation.'

in certain traumatic and puerperal infections, if they omit to take special precautions against the danger. *See* articles QUARANTINE, DISINFECTION, and PUBLIC HEALTH, and those on the special diseases.

The SOCIAL CONDITIONS through which, in our own country at the present time, the more fatal infectious diseases are enabled to acquire *epidemic diffusion* are chiefly such as the following:—that persons first sick in families and districts, instead of being isolated from the healthy, and treated with special regard to their powers of spreading infection, are often left to take their chance in all such respects; so that, especially in poor neighbourhoods, where houses are often in several holdings, and where always there is much intermingling of population, a first case, if not at once removed to a special establishment, will almost of necessity give occasion to many other cases to follow:—that persons with infectious disease, especially in cases of slight or incipient attack, and of incomplete recovery, mingle freely with others in work-places and amusement-places of common resort, and, if children, especially in day-schools; and that such persons travel freely with other persons from place to place in public conveyances;—that often, on occasions when boarding-schools have infectious disease getting the ascendant in them, the schools are broken up for the time, and scholars, incubating or perhaps beginning to show infection, are sent away to their respective, perhaps distant, homes;—that keepers of lodging-houses often receive lodgers into rooms and beds which have recently been occupied by persons with infectious disease and have not been disinfected;—that persons in various branches of business relating to dress (male and female) and to furniture, if they happen to have infectious disease, such as scarlatina or smallpox, on their premises, probably often spread infection to their customers by previous carelessness as to the articles which they send home to them; and that laundries further illustrate this sort of danger by carelessness in regard to infected things which they receive to wash;—that purveyors of certain sorts of food, if they happen to have infectious disease on their premises, by carelessness spread infection to their customers;—that streams and wells with sewage and other filth escaping into them are most dangerous means of infection, especially as regards enteric fever and cholera; and that great purveyors of public water-supplies, so far as they use insufficient precautions to ensure the freedom of their water from such risks of infectious pollution, represent in this respect an enormous public danger;—that ill-conditioned sewers and house drains, and cesspools receiving infectious matters, greatly contribute to disseminate contagia, often into houses in the same system of drainage, and often by leakage into wells. Of the dangers here enumerated, there is perhaps none against which the law of England does not purport in some degree to provide. At present, however, they all are, to an immense extent, left in uncontrolled operation; partly because the law is inadequate, and partly because local administrators of the law often give little care to the matter; but chiefly because that strong influence of national opinion which controls both law and administration cannot really be effective until the time when right knowledge of the subject shall be generally distributed among the people, and when the masses whom epidemics affect shall appreciate their own great interest in preventing them.

Whenever that time shall come, probably the public good will be seen to require, with regard to every serious infectious disease which is apt to become epidemic, that the PRINCIPLES which ought to be accepted in a really practical sense, and to be embodied in effective LAW, are somewhat as follows:—(1) that each case of such disease is a public danger, against which the public, as represented by its local sanitary authorities, is entitled to be warned by proper information; (2) that every man who in his own person, or in that of anyone under his charge, is the subject of such disease, or is in control of circumstances relating to it, is, in common duty towards his neighbours, bound to take every care which he can against the spreading of the infection; that so far as he would not of his own accord do this duty, his neighbours ought to have ample and ready means of compelling him; and that he should be responsible for giving to the local sanitary authority proper notification of his case, in order that the authority may, as far as needful, satisfy itself as to the sufficiency of his precautions; (3) that so far as he may from ignorance not understand the scope of his precautionary duties, or may from poverty or other circumstances be unable to fulfil them, the common interest is to give him liberally out of the common stock such guidance and such effectual help as may be wanting; (4) that so far as he is voluntarily in default of his duty, he should not only be punishable by penalty as for an act of nuisance, but should be liable to pay pecuniary damages for whatever harm he occasions to others; (5) that the various commercial undertakings which in certain contingencies may be specially instrumental in the spreading of infection—water-companies, dairies, laundries, boarding-schools, lodging-houses, inns, &c., should respectively be subject to special rule and visitation in regard of the special dangers which they may occasion; and that the persons in authority in them should be held to strict account for whatever injury may be caused through neglect of rule; (6) finally, that every local sanitary authority should always have at command, for the use of its district, such hospital-accommodation for the sick, such means for their conveyance, such mortuary, such disinfection-establishment, and generally such planned arrangements and skilled service, as may, in case of need, suffice for all probable requirements of the district.

Persons who are imperfectly acquainted with the scientific and social facts relating to the present subject-matter, or who have never seriously considered them, may think it would be over-sanguine to expect any general recognition of principles so peremptory as the above may at first appear to them; but, if so thinking, they would perhaps have under-estimated the rapidity with which knowledge is now increasing as to the common interests and mutual duties of mankind in respect of dangerous infectious disease. Fourteen years ago, when the so-called cattle-plague or steppe-murrain was imported afresh, as a long-forgotten disease, into this country, and was found to affect very large pecuniary interests, primarily of the chief landowners of the United Kingdom, and secondarily of other classes, an immensely valuable stimulus was given to the education of the country, and especially of its Legislature, in regard to the preventability of the infectious diseases. And the remarkable zeal and ability which have been shown, in providing adequate laws and admirable administrative arrangements against the diffusion of steppe-murrain and other infectious diseases of Farm-Stock, are not likely to be found permanently absent in relation to the interests of Human Life, when once the true bearings of the subject shall have got to be popularly understood. JOHN SIMON.

CONTINUED FEVERS.—CHARACTERS.—Under the name of Continued Fevers is included a group of diseases which have the following characters in common:—

1. They are attended with *pyrexia*, or a febrile condition sustained for a more or less definite period of considerable duration, without intermission or very decided remission, and not due to any local inflammation. That is, the fever is *essential*, and not merely *symptomatic*. The distinguishing feature of pyrexia is unnatural elevation of the temperature of the body, but there are other symptoms scarcely less constant—increased frequency of the pulse, thirst, loss of appetite, furred tongue, headache, chilliness, and —if the temperature is high—various manifestations of disturbance of the nervous system.

2. They are clearly due to the introduction into the body of a *poison from without*, and this poison is *reproduced in the system*, so that continued fevers are communicable directly or indirectly from the sufferer to others. This statement would not apply to simple continued fever so called; but simple continued fever, when not a mild or abortive attack of one or other of the specific fevers, has scarcely anything in common with them.

3. The continued fevers rarely affect the same individual twice. An attack is *protective against subsequent attacks* of the same fever. This is much less manifest in relapsing than in typhus and enteric fever.

4. The continued fevers have a more or less *definite duration*. A certain time intervenes between the exposure to the poison and the onset of the disease, which is called the period of incubation; and the disease is divisible into the stages of invasion, dominance, and decline.

5. In two out of the three continued fevers there is a characteristic *cutaneous eruption*.

ENUMERATION.—The continued fevers are typhus, enteric, and relapsing fever. Common continued fever, or febricula, often associated with them for the sake of convenience, resembles them only as consisting in pyrexia not traceable to any known local inflammation. It does not conform to the characteristics enumerated, and cannot be brought within any definition which applies to the true fevers.

DIAGNOSIS.—The continued fevers have to be distinguished from the intermittent and remittent fevers on the one hand, and from the eruptive fevers and some other diseases on the other.

1. From *intermittent* and *remittent* fevers they are distinguished clinically by the comparatively sustained high temperature; but were this all, the continuous character sometimes assumed by intermittents and the remittent type occasionally seen in enteric fever—especially in children—would bring them close together. The essential distinction is that indicated under the second head, and is mainly ætiological. Both kinds of fever are due to a poison received from without; but while in continued fevers the source of the poison is for the most part a previous case of fever of the same kind, and the poison is generated anew in the subject of the disease, remittents and intermittents are of malarious origin, and the poison is never reproduced in the system, and therefore never communicated by the sufferer.

The formation of the specific contagium of continued fevers within the system during the disease is of course the cause of their spread by contagion. The mode of this spread is different for the different fevers. Typhus and relapsing fever are directly contagious in an eminent degree; the poison is contained in the emanations from the skin or lungs, and is capable of entering the blood of healthy persons by being breathed or swallowed; it may also be carried by fomites. Enteric fever, if directly contagious at all, is very slightly so; the contagium is apparently not given off in the breath or perspiration, but chiefly or exclusively from the bowels, and the disease is spread mainly by the contamination of drinking water, or, more rarely, by sewer gases or by the emanations from typhoid excreta, especially after long residence in sewers.

2. The distinctions between the continued and the *eruptive fevers* remain to be pointed out. They are of a very slight character. All the characters given of the continued fevers, including the occurrence of a cutaneous eruption, are common to them and the eruptive fevers. The differences are as follows:—

a. The liability to the eruptive fevers is almost universal in the absence of protection by a previous attack, and is little affected by the state of health of the individual, while the liability to continued fever is very variable in different persons, and even races, and is greatly influenced by external conditions. There is no parallel in the eruptive fevers to the predisposition to typhus and relapsing fever generated by overcrowding and famine.

b. The protective influence of a previous attack is more marked in the eruptive fevers, though not to such a degree as would constitute an important distinction. Instances of small-pox after a previous attack, or after vaccination, and second attacks of measles and scarlet fever, are not very uncommon.

c. While in the eruptive fevers the specific poison is considered to be invariably derived from a previous case, this cannot be said with the same confidence with regard to the continued fevers. It is true that in by far the largest proportion of attacks of typhus, enteric, and relapsing fevers the source of the poison can be traced, and that as the experience and trained skill brought to bear on the search increase, the fewer are the examples in which it fails; but it cannot yet be said definitely that these fevers are not generated anew under certain conditions. The constancy with which typhus and relapsing fever follow in the track of overcrowding and starvation is suggestive of spontaneous origin; but in this country typhus is never so completely extinct that foci of infection are wanting, and epidemics of relapsing fever may be imported. Enteric fever, again, appears from time to time under circumstances which appear to exclude the possibility of the poison having been derived from a previous case, though in most instances of epidemic prevalence of the disease, there is conclusive evidence of specific and not merely general contamination of the air or water. It is not, however, necessary to enter upon this controversy here, or to do more than allude to the question whether or not their contagia are of the nature of organic germs. *See* CONTAGION; and ZYME.

The fevers will be fully described under their respective names. WILLIAM H. BROADBENT.

CONTRACTION, Muscular (*contraho*, I draw together).—A term applied to the action or to the shortening of a muscle from any cause, whether in health or in disease. *See* SPASM.

CONTRA-INDICATION.—Any circumstance which forbids the employment of therapeutic measures otherwise indicated.

CONTRE-COUP (Fr.), Counter-stroke.—An injury of a part opposite to and distant from that to which force is applied, as by a fall or direct blow. Contre-coup is chiefly observed in injuries of the skull.

CONTUSION (*contundo*, I bruise).—A bruise or injury of the soft parts without breach of surface.

CONVALESCENCE (*con* and *valesco*, I grow well.)—The *period of convalescence* signifies that period during which a patient is progressing towards recovery, and is returning to a state of health after having suffered from an illness. When the health has been completely restored, convalescence is said to be established, and the patient is regarded as convalescent. The word is used most commonly in association with fevers, inflammatory diseases, and other acute affections. Convalescence may be ushered in by a crisis, and become speedily established; or it may be very slow and protracted in its progress, which is also often interrupted by relapses, complications, or sequelæ. Patients frequently require careful watching and judicious treatment while becoming convalescent, as they are apt to retard or even prevent their recovery, and to lay the foundation for permanent disease by neglect of due precautions, especially as regards their diet. Much injury is not uncommonly inflicted by the injudicious administration of medicines, and the employment of other means which are supposed to hasten convalescence.

FREDERICK T. ROBERTS.

CONVOLUTIONS OF THE BRAIN and CORTEX CEREBRI, Lesions of.—The pathology of the cortex cerebri is a subject which, notwithstanding the extensive literature relating to cerebral disease, is still comparatively in its infancy. The older records and observations made while the idea was still prevalent, that the convolutions of the brain had no definite dispositions and relations, and that the various parts of the hemispheres were functionally equivalent, are not sufficiently exact to be made the basis of trustworthy clinical and physiological conclusions. Recent anatomical investigation into the topography and homologies of the cerebral convolutions, and the experimental researches of Hitzig, the writer, and others in reference to the results of electrical irritation of the brain, have directed greater attention to accurate topographical descriptions of the lesions of the cortex in connexion with observed clinical symptoms. As yet, however, the reliable pathological material is not very extensive, though it is every day accumulating, more particularly by the labours of Charcot and his followers in France, and Hughlings Jackson and others in this country. Up to a comparatively recent date physicians and physiologists generally held by the views of Flourens, based on experimental investigation of the brains of the lower classes of animals. According to Flourens the hemispheres were concerned purely with intelligence—a faculty one and indivisible; and each part of the hemisphere possessed the functions of the whole, so that, if part were destroyed, functional compensation might be effected by the parts which remained. These views seemed satisfactorily to explain the cases, not uncommon, in which, notwithstanding the existence of extensive lesions in the hemispheres, no symptoms were observed during life. The frequent association of aphasia with a limited lesion of the cortex cerebri, vaguely indicated by Bouillaud and Dax, and definitely fixed by Broca at the posterior extremity of the third left frontal convolution, was a step towards localisation of function in the brain, which, however, met with much opposition and counter-facts. The clinical and pathological observations of Hughlings Jackson in reference to the causation of limited and unilateral epileptiform convulsions were an important contribution to the physiology and pathology of the cortex. These convulsions he attributed to irritative or discharging lesions of the grey matter in the neighbourhood of the corpus striatum in the opposite hemisphere.

Physiological experiment has demonstrated the correctness of the views advanced by Hughlings Jackson, and shown that, not only can movements be excited by electrical irritation of certain regions of the cortex, but also that definite combinations of muscular movements uniformly result from stimulation of certain specialised areas within this region. The interpretation of these facts, now no longer disputed, has been much debated, but the views the writer has elsewhere expressed at length (*Functions of the Brain*) seem in accordance with the most recent and careful pathological and clinical research, viz. that the brain is divided into a motor and a sensory region, and that in each there are definite centres with definite functions, and that the symptoms of cortical lesions depend on the locality of the lesion, and on whether it is unilateral or bilateral.

Physiological experiment is, as to precision in its results, considerably in advance of clinical observation, and, from the nature of the two methods, this is what might be expected.

The investigation of diseases of the brain is surrounded by special difficulties. Though, as shown by physiological experiment, the brain is capable of being mapped out into different regions possessing different functions, yet the brain acts as a whole, and it is not always easy to analyse the facts of disease, and to distinguish with certainty between the effects directly dependent on the locality of the brain and those due to the indirect influence exerted on the functions of neighbouring regions and on the brain as a whole. And when, moreover, we take into account the vague manner in which it has been the custom to define the locality of the lesion, it is not surprising that so little has as yet been accomplished in reference to the localisation of cerebral disease.

But, besides these difficulties there are others, of greater magnitude and less easy to overcome, inherent in the subject itself. For the brain, besides being concerned with certain functions which we can investigate objectively, viz. sensation and voluntary motion, is the organ of mental operations, and as the same parts have an objective and subjective function, it is obvious that cerebral diseases may manifest themselves mentally as well as bodily. These two sides of brain-function and their disordered manifestations have been in a great measure artificially separated for convenience in treatment, and the relation between the physiological and the psychological has not been duly recognised. And yet it is obvious that until psychological phenomena have been reduced in ultimate analysis to their anatomical and physiological substrata we can have no rational medical psychology, as distinguished from empiricism or mere speculation, available as a guide to the diagnosis and treatment of cerebral disease in its subjective or mental manifestations.

That the brain is diseased in insanity, functionally or organically, is a fact now universally admitted; but it is also true that the lesions which cause objective symptoms in the domain of motion and sensation need not cause mental derangement, and also that lesions which cause mental derangement need not manifest themselves in any discoverable disorders of sensation or motion. In fact, for purposes of ideation we have practically two brains; for, though motion and sensation will be paralysed on the opposite side by destruction of one hemisphere, yet intelligence and thought are possible through the hemisphere which remains.

Various forms of lesion have been found in the brains of the insane, such as morbid conditions as to vascularity, degeneration of the blood-vessels, degeneration of the nerve-cells, neuroglia, membranes, &c.; but no constant relation has as yet been established between any one form of degeneration and any one form of mental alienation, or between the latter and any localised lesion. Nor has it been clearly established whether the forms of degeneration found in the brains of the chronically insane are the result or the cause of the mental disorders. An exception, however, is to be made in favour of general paralysis of the insane, where there seems to be a definite connexion between the anatomical lesion and the symptoms manifested. In this disease we find as a constant, if not the only factor, a form of chronic encephalitis, affecting chiefly the cortical regions which physiological experiment has shown to be the motor zone of the hemispheres. This lesion is associated with progressive motor paralysis, varied with intercurrent epileptiform and apoplectiform seizures, and with mental symptoms characterised generally by exalted ideas and delusion as to wealth, power, and grandeur. The motor symptoms are readily accounted for by the locality and character of the cerebral lesion, but the relation between this and the mental symptoms is a subject which psychological analysis has yet to elucidate.

Another link between the physiological and psychological aspects of brain-function is furnished by aphasia, in which, with a definite anatomical lesion, there is a definite psychological defect (*see* APHASIA). But beyond these the relation between morbid mental manifestations and morbid conditions of the brain, and their joint relation to the bodily symptoms, remain involved in great obscurity.

The objective symptoms of cortical lesions depend on their locality, and on whether they exercise an irritative or destructive influence on the parts they invade. From the localisation point of view alone the intimate nature of the morbid process is unimportant, except in so far as its irritative or destructive character is concerned. Lesions, such as tumours, which from their very nature exercise important indirect effects on the encephalon as a whole, apart from their effects on the regions which they directly invade, can rarely be exactly localised, owing to the difficulty of separating the direct and indirect symptoms from each other and referring each to its exact cause. Also no rigid conclusions as regards localisation can be drawn from morbid affections of the hemispheres which extend over a large area, such as the various forms of meningitis and meningo-encephalitis. In all these cases the nature of the affection must be diagnosed from its own general and special characters; its position and extent in the brain being arrived at approximately from a consideration of the effects of accurately circumscribed lesions, as determined by careful clinical and pathological observation and physiological experiment.

The brain may be considered as divided into a *motor* and a *sensory* zone.

Motor Zone.—The motor zone includes the convolutions bounding the fissure of Rolando, viz. the ascending frontal and the bases of the three frontal convolutions, the ascending parietal and postero-parietal lobule, and the internal surface of the same convolutions or paracentral lobule. In this zone are differentiated centres for the movements of the limbs, head, and eyes, the muscles of expression, and those of the mouth and tongue. The centres of the leg and foot are situated in the postero-parietal lobule, those for the arm in the upper third of the ascending frontal, those for the hand and wrist in the ascending parietal, those of the facial muscles in the middle third of the ascending frontal and base of the second frontal, those for the mouth and tongue at the lower third of the ascending frontal at the base of the third frontal, and for the platysma at the lower extremity of the ascending parietal, just posterior to the mouth-centre. The posterior third of the upper frontal convolution and corresponding part of the second frontal, contain the centre for the lateral movement of the head and eyes.

The frontal regions in advance of this centre, though anatomically related to the motor division of the internal capsule, do not seem directly connected with motor manifestations as judged by the negative effects either of irritation or extirpation.

Irritative lesions of the motor zone proper, such as may be induced by syphilitic lesions, tumours, spicula of bone, depressed fractures, thickening of the membranes, &c., cause convulsions, which may remain limited to one limb or one group of muscles without loss of consciousness, or affect the whole of the opposite side with loss of consciousness, or become more or less bilateral with all the symptoms usually observed in so-called idiopathic epilepsy.

If the convulsive phenomena begin always in the same way, and if they frequently remain localised in one limb or one group of muscles, and especially if paralytic symptoms manifest themselves, the exact position of the lesion in the opposite hemisphere may be accurately diagnosed. (*See* cases by Hughlings Jackson, *Clinical and Physiological Researches on the Nervous System* (reprints), 1873; Dr. Dreschfeld, *Lancet*, Feb. 24, 1877; Dr. Bramwell, *Brit. Med. Journ.*, Aug. 28, 1875; MM. Charcot and Pitres, *Revue Mensuelle*, 1877.)

Destructive lesions of the motor zone cause general or limited paralysis of voluntary motion in the opposite side of the body, according as the lesion affects the whole of the motor zone or is limited to special centres within this area. The causes of destructive lesions of the cortex may be various—hæmorrhage, laceration by wounds, &c. One of the most common causes is embolism or thrombosis of the arteries supplying the cortical motor area. These are derived from the Sylvian artery of the middle cerebral. The cortical branches may be occluded without interfering with the circulation in the corpus striatum, which is supplied by special branches, as shown by the researches of Duret and Heubner.

When the motor zone is affected by general destructive lesion, complete hemiplegia of the opposite side results, in all respects like that resulting from destructive lesion of the corpus striatum and anterior portion of the internal capsule. In this form of paralysis the loss of motion is most marked in those movements which are most independent, hence the arm is more paralysed than the leg or face, and the hand more paralysed than the shoulder movements of the arm. This has been accounted for by the fact, that the centres for bilateral movements are intimately associated in the lower ganglia; hence the stimulus from one hemisphere can to a certain extent call forth the action of

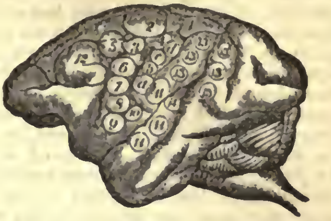

FIG. 12.—Side view of the Left Hemisphere of the Monkey. The areas have the same signification as in the next figure.

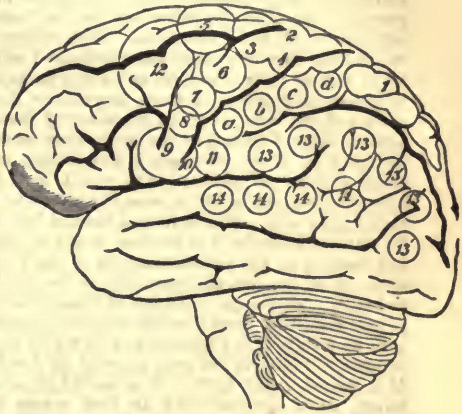

FIG. 13.—Side view of the Left Hemisphere in Man, with the areas of the cerebral convolutions. The effects of stimulation of each area, as ascertained by experiments on the brain of the monkey, are subjoined.

1. Postero-parietal lobule. Advance of the opposite hind limb, as in walking.

2, 3, and 4. Around the upper extremity of the fissure of Rolando. Complex movements of the opposite leg and arm, and of the trunk, as in swimming.

a, b, c, d. Ascending parietal convolution. Individual and combined movements of the fingers and wrist of the opposite hand. Prehensile movements.

5. Posterior extremity of the superior frontal convolution. Extension forward of the opposite arm and hand.

6. Upper part of ascending frontal convolution. Supination and flexion of the opposite forearm.

7. Median portion of ascending frontal convolution. Retraction and elevation of the opposite angle of the mouth.

8. Lower part of the ascending frontal convolution. Elevation of *ala nasi* and upper lip, with depression of lower lip.

9 and 10. Inferior extremity of ascending frontal convolution (Broca's convolution). Opening of the mouth with (9) protrusion and (10) retraction of the tongue. Region of aphasia. Action bilateral.

11. Between the inferior extremities of the ascending frontal and the ascending parietal convolutions. Retraction of the opposite angle of the mouth; and the head turned slightly to one side.

12. Posterior portions of superior and middle frontal convolutions. Eyes opened widely; pupils dilated; head and eyes turned towards opposite side.

13 and 13'. Supra-marginal lobule, and angular gyrus. Eyes moved towards the opposite side, with an upward (13) or a downward (13') deviation. The pupils generally contracted. (Centre of vision.)

14. Infra-marginal (superior temporo-sphenoidal) convolution. Pricking of opposite ear; head and eyes turned to opposite side; pupils largely dilated. (Centre of hearing.)

the conjoint motor nuclei. The electrical contractility and nutrition of the muscles is not affected by paralysis of cerebral origin. The nutrition of the muscles may, however, suffer from disuse, and frequently paralyses of cortical origin are followed after a time by rigidity and contraction, accompanied with descending secondary sclerosis of the motor tracts of the crura, pons, and lateral tracts of the spinal cord. In some cases the descending degeneration invades the anterior cornua of the spinal cord, and atrophy of the paralysed muscles ensues. Occasionally from limited lesions of the cortical motor area complete hemiplegia may occur on the opposite side for the time at least. This is to be explained by the fact that sudden establishment of a destructive lesion may cause such commotion or perturbation of the centres in general, that their functions are for the time suspended. But in such cases those centres which have been only functionally suspended will again resume their functions, and the paralysis will disappear except of those movements the centres of which have become permanently damaged. Limited lesions of the motor zone cause paralysis of those movements the centres of which the lesion invades. The result is not complete hemiplegia, but a *monoplegia* or *dissociated* paralysis. Hence, from a cortical lesion we may get a paralysis of the arm, or of the arm and face, or of the leg and arm, or of the face alone, or of the lateral movements of the head and eyes. Numerous examples of these monoplegiæ resulting from limited cortical lesions have been collected by Charcot and Pitres (*Revue Mensuelle*, Jan. 1877, *et seq.*; abstract in *Lond. Med. Record*, April, 1877). The morbid process which, while circumscribed at first, causes a monoplegia, may advance to other centres, and after a time produce general hemiplegia of the opposite side. Hemiplegia so resulting is a succession of monoplegiæ, and is a sure indication of cortical disease. It is to be noted that destructive lesion of the mouth-centre (Broca's region) on one side does not cause paralysis of articulation, owing to the fact that each centre has a more or less complete bilateral influence over the movements of the mouth and tongue. Destructive lesion of this centre in the left hemisphere generally gives rise to aphasia without paralysis of articulation (*see* APHASIA). In bilateral lesions there is both aphasia and paralysis of articulation (*see* Dr. Barlow's case, *Brit. Med. Jour.* 1877, vol. ii. p. 103). Limited cortical motor lesions are frequently associated with transitory rigidity of the opposite side of the body; and if the lesion is complete, the local paralysis or monoplegia will remain permanently, and may be accompanied by late rigidity and descending sclerosis of the motor tracts, as has been shown by Charcot (*op. cit.*). These monoplegiæ frequently alternate with unilateral convulsions, owing to the morbid process occasionally inducing irritation of the neighbouring centres.

Destructive lesions of the frontal and orbital regions cause no motor paralysis or any very evident physiological symptoms. In the recorded cases of bilateral lesions symptoms of dementia to a greater or less extent have been noted.

Sensory Zone.—From experiments on the brain of monkeys by means of the complemental methods of excitation by the electric current, and destruction of the grey matter of the cortex, the writer has arrived at the conclusion that in the regions lying posterior to the motor zone there are differentiated centres of sight, hearing, touch, smell, and taste. The sight-centre is situated in the angular gyrus, and embraces also the occipital lobe—the occipito-angular region; the centre of hearing is localised in the superior temporo-sphenoidal convolution; the tactile centre is situated in the hippocampal region; while the centres of smell and taste are situated together at the lower parts of the temporo-sphenoidal lobe.

Destructive Lesions.—Unilateral destruction of these sensory centres does not, however, appear to permanently abolish sensation on the opposite side of the body. It is only when the lesion is bilateral and in corresponding points that the loss of sensation is thorough and permanent. Hence the fact is to be accounted for, that in man, as a rule, unilateral destructive lesions of the regions indicated are latent, or not, so far as at present known, accompanied by any objective symptoms. Numerous cases of this kind are on record. No secondary descending degeneration of the spinal cord has been observed in these cases.

Until evidence is increased from human pathology of the occurrence of loss of sensation from lesion of the cortex—and this the writer holds is to be looked for in bilateral destructive lesions—pathologists in general reserve their opinion as to the explanation of the latency of the lesions in question.

But though the pathological evidence in favour of the localisation of distinct sensory centres is as yet comparatively slender, it is daily increasing. Though numerous cases are on record of lesions in the angular gyri and occipital lobes without symptoms as regards vision, there are others, more particularly of lesions of the medullary fibres of this region, in which hemiopia towards the side opposite the lesion has been observed. Some of these cases may perhaps be explained by direct or indirect lesion of the optic tract, but others cannot be so accounted for. For other facts bearing on this question the reader is referred to a paper by the writer on Cerebral Amblyopia and Hemiopia, *Brain*, xii. 1881.

It has been established by the researches of Türck, Charcot, &c., that destructive lesions of the posterior third of the internal capsule, external to the optic thalamus, cause hemianæsthesia of the opposite side of the body. The hemianæsthesia of organic origin exhibits the same symptoms as are observed in what is termed hysterical hemianæsthesia. In this condition there is loss of tactile sensation and more or less complete loss of sight, hearing, smell, and taste, on the side opposite the lesion. The affection of sight, which is not accompanied by any changes in the eye discoverable by the ophthalmoscope, is characterised by dyschromatopsy, and a remarkable contraction of the field of vision. The loss of hearing is very marked, if not absolute, and similarly as regards smell and taste. It is evident that the lesion situated in the medullary fibres is not an affection of sensory centres, and that it is simply a solution of continuity of the centripetal paths which radiate out into the differentiated sensory centres of the cortex. The exact destination of the special sensory paths the writer has indicated above, and to this the special attention of physicians and pathologists should be directed. The writer is likewise of opinion that the loss of smell and taste, which is occasionally observed to result from a blow on the occiput or vertex is in many cases due to injury by counterstroke to the centres of smell and taste, which are situated in such a position as to be specially affected by violence so directed. There is no doubt that in some cases the loss of taste might be accounted for by rupture of the olfactory tracts or nerves, such as those in which taste is lost only for flavours, which are compounds of smell and taste. But there are others in which there has been clear loss both of smell and taste independently of each other; cases which can only be satisfactorily accounted for, in the writer's opinion, in the manner which he has indicated.

Irritative Lesions.—Though the pathological evidence in reference to the localisation of sensory centres is as yet but deficient, at least as regards paralysis of the special senses from destructive lesions of the cortex, there is good reason for believing that in cases of insanity, accompanied by sensory hallucinations, as also in certain cases of epilepsy ushered in by subjective sensations, such as flashes of light and colour, loud sounds, disagreeable tastes and smells, &c., the phenomena are the result of some morbid irritation of the cortical sensory centres, the anatomical substrata of ideation.

D. Ferrier.

CONVULSIONS.—Definition.—This term is commonly given to more or less general, purposeless muscular contractions, occurring simultaneously and successively for a variable time. It is also, however, applied at times to certain more localized purposeless contractions, though these would be more appropriately (and are in the majority of cases) termed Spasms. The latter, like Convulsions, are of two kinds, *tonic* and *clonic*.

Classifications.—Convulsions have been variously classified by different authors according to the different points of view from which they have been regarded. Looking to their causation, there is both a clinical and a physiological division into classes. From the former standpoint we have (1) primary or essential convulsions; (2) sympathetic convulsions; and (3) symptomatic convulsions; whilst from the physiological point of view they have been divided into (1) centric and (2) excentric. These classifications are arbitrary and will not stand the test of a critical examination, though the first of them is to a certain extent useful. Again, looking to the distribution of the convulsions, or to the parts involved, their classification by different writers may be summarized as follows:—(1) *External*—*a*, general; *b*, unilateral; *c*, partial; (2) *Internal*.

These various terms need little explanation, though something requires to be said in regard to them.

Convulsions are termed *primary* or *essential* when they occur either without assignable cause, from mental or moral perturbations, or as a result of some local irritation. They are called *sympathetic* when the convulsions declare themselves as a prelude to, or in the course of, any of the specific fevers, as a consequence of acute pulmonary or renal affections, or in association with disordered states or structural diseases of any of the organs of the body other than those of the nervous system; whilst the name *symptomatic* has been applied to the convulsions which occur as a result of injury or structural disease of the nervous system itself. The unilateral convulsions which affect one half of the body only, as well as other more partial convulsions, are almost entirely confined to this latter group, though general convulsions of the symptomatic type are perhaps just as frequently met with. The so-called *internal convulsions* constitute an ill-defined group, the members of which are scarcely worthy of the name of convulsions at all. They are rather tonic or clonic spasms of particular parts. The best known member of this group is laryngismus stridulus (*see* separate article thereon), though we may also include another much less grave, though often obstinate malady, viz. a spasmodic and frequently recurring hiccup. Some would include angina pectoris also in this group.

Convulsions, either tonic or clonic, or both, enter into or form the semeiological basis of five principal diseases having separate places in our nosology. These are *Eclampsia*, *Epilepsy*, *Tetanus*, *Hydrophobia*, and *Chorea*. All but the first of these diseases will be fully considered in their respective places, so that Eclampsia alone would remain. But Eclampsia and Convulsions are convertible terms, meaning almost absolutely the same thing. The former term, indeed, is useless except for the mere purpose of literary precision. In epilepsy and in eclampsia we have equally to do with convulsions, which are now admitted by almost all modern writers to be quite indistinguishable from one another. The former name, however, is given to convulsions which have a known tendency to recur at variable intervals; whilst the latter has been commonly applied to convulsions which are either solitary or, if not exactly so, which occur as a closely successive cluster or group, more or less distinctly sympathetic with some general or local bodily condition. Seeing that there is, in a very large number of cases, almost nothing in the nature of the attack itself to enable a medical man, called to a patient in convulsions for the first time to say whether he has to do with an attack which will be repeated or not, it is easy to understand that eclampsia is a word more frequently to be seen in books than to be heard at the bedside. In books we may read of eclampsia neonatorum, the eclampsia of parturient women, and uræmic eclampsia; though the more common clinical equivalents are infantile convulsions, puerperal convulsions, and uræmic convulsions. The distinction between epilepsy and eclampsia is, therefore, one which is to a very great extent purely artificial.

Convulsions have a frequent though less constant relationship also with many other affections, such as general paralysis of the insane, tubercular meningitis, chronic hydrocephalus, hemiplegia, and hysteria.

ÆTIOLOGY.—The causes of convulsions are oftentimes more than usually complex, constituting a web of causal conditions partly made up of (*a*) predisposing, partly (*b*) of exciting, and partly (*c*) of proximate elements. It is often the fashion to pick out some one of the most prominent or easily recognizable of these factors, and speak of it as 'the cause' of the attack. It must never be forgotten, however, that this so-called cause, in any given case, may be able to act as such only when in conjunction with certain other more obscure, though perhaps not less potent, co-operating conditions. Without the conjoint influence of the latter it might have been quite powerless to produce any such results. Hence the proverbial uncertainty in regard to the action of any of the more important factors, or so-called 'causes,' upon different individuals whose age, state of health, predisposition, or surrounding conditions are not similar.

The question of the causation of convulsions resolves itself, however, into two distinct departments, one of which is strictly clinical in character, whilst the other is more strictly physiological. It is one thing for the medical man to ascertain what are the particular individual states, conditions of life, and occurrences, physical or moral, which have contributed to induce an attack of convulsions (to ascertain which he studies the 'predisposing' and 'exciting' causes of the disease); but it is quite a different problem when he endeavours to unravel, by anatomico-physiological data, the actual mode of production of the convulsions. In this latter part of the inquiry he has to do with what are called 'proximate' causes, and is brought face to face with a problem still involved in great obscurity, and concerning which the most opposite views are held by leading pathologists and physiologists. This second part of the problem of causation, for the present, concerns us less than the more strictly clinical side of the inquiry, and it will be only incidentally referred to in the present article. It will be fully considered in the article EPILEPSY.

Predisposing Causes.—The most important of these is the existence of an unduly excitable nervous system—one in which there is an exaltation of the tendency to produce reflex movements —an 'undue mobility of the nervous system,' as it is sometimes called. This is a state of things which is naturally more marked in women than in men, and is also notably prominent in young children of both sexes. It is, moreover, much exaggerated in some children of nervous habit, who, besides being unduly emotional or excitable, are very prone to start or tremble on the least noise, and are subject to muscular twitchings in various parts of the body. With increasing age, and more especially in the male sex, we find the sensorial and emotional nerve-centres becoming less excitable, owing, in great part at least, to their more complete subordination to the controlling or inhibitive influence of the developing cerebral hemispheres.

The predisposing groundwork being of this nature, how is it caused, or to be accounted for? (1) It may be inherited from one or both parents, or from grandparents, who may themselves have possessed a nervous system of this type, and may, morever, have been subject to fits or other well-marked disease of the nervous system. But though not inherited in the strict sense of the term it may (2) be connate; the patient may always (*i.e.* from birth) have possessed a nervous system of this type, as an accompaniment of the mere low vitality which is often seen in children born from parents who are simply weak and debilitated, or in those whose parents have been advanced in life. (3) At other times the nervous system may have acquired such predisposing characters some time during the life of the individual (especially during childhood or adolescence) owing to the action of various sets of conditions, some of the best established of which are these:—(*a*) The cachexia sometimes following measles, pertussis, &c.; (*b*) insufficient or improper food; (*c*) chronic diarrhœa; (*d*) hæmorrhages or exhausting discharges.

If we turn now to the various *exciting causes* we find these so powerfully influenced by the age of the patient, as to make it desirable to consider them in reference to different periods of life, which we may artificially though conveniently mark off from one another.

Infancy (from birth to end of 2nd year).—In certain cases convulsive attacks are congenital; and here perhaps the most frequent exciting cause is a meningeal effusion of blood which presses upon and irritates the surface of the brain—the extravasation having in some cases been occasioned during parturition where it has been prolonged or unnatural. These congenital attacks are most frequently associated either with more or less marked hemiplegia, or with a subsequent partial or distinct condition of amentia or idiotcy. Such unfortunate infants may continue quite unable to stand or even sit up; they remain unable to speak, and, as in a case which I have recently seen, the child may be quite blind. Meningeal or superficial hæmorrhages may also occur in young infants, under the strain of the mechanical congestion produced by violent fits of coughing in pertussis or bronchitis, and in some of these cases such effusion may be followed by convulsions. Fits in infancy may also follow falls or blows upon the head, though at this early age such occurrences are comparatively rare.

In infancy, again, convulsions may usher in or subsequently supervene in almost any acute disease, this being especially the case with measles, scarlet fever, and other of the exanthemata; in pneumonia or bronchitis; and also in tubercular meningitis.

But, still more frequently, convulsions in infancy are excited by mere peripheral irritations, as during the process of teething, from an overloaded stomach, or from indigestible food. Diarrhœa, worms, &c., also take their place as more or less frequent excitants of convulsive paroxysms in infants—though worms only begin to appear towards the end of this period. But though irritations in the field of distribution of the 5th and pneumogastric nerves are especially potent in exciting convulsions, irritations of other parts of the body may also lead to similar results, whether they are occasioned by the injudicious disposition of pins, by tight strings wounding or irritating the skin of the body, or by any other means. The more distinctly predisposing conditions exist, the more frequently will any or all of these exciting causes give rise to an attack of convulsions.

Lastly, an infant which has taken the breast of a woman who has shortly before been much perturbed by violent anger, grief, or any other strong emotion, may thereafter, if predisposed, be seized with convulsions—probably owing to the milk of the nurse having been so altered in quality as to have led to gastric trouble and irritation in the infant.

Childhood (from the 2nd to the 13th year).—Most of those exciting causes which are influential during the last period continue to be occasionally operative in this—especially during the first half of it. Meningeal hæmorrhages are now rarer, though they may still occur during violent paroxysms of coughing, and also from falls or blows upon the head. The latter causes of hæmorrhage may, however, act in producing fits in other ways, *e.g.* by concussion, shock, &c., and they now come to be more frequently operative. The exanthemata are still apt to be preceded or associated with convulsive attacks; and irritations, especially from teething or irritants (undigested food or worms) in the intestinal canal, are also still apt to be followed by such a sequence.

During this period another cause of considerable potency comes into operation with great frequency, and this is fright. The first fit either follows the fright more or less immediately, or it may not take place for days—perhaps for weeks—after the sudden emotional disturbance. During the interval, however, the health and mental condition of the child is generally obviously disturbed. Proper treatment at this stage may prevent the occurrence of fits. Scrofulous tumours in the brain sometimes help to determine convulsions in children.

Adolescence (from the 13th to the 20th year).—Fright or other sudden emotions, falls upon or blows about the head, still appear as frequent excitors of convulsive attacks which recur (epilepsy) at this period of life, though meningeal hæmorrhages, acute diseases, and peripheral irritations are much less frequently operative than at earlier periods, since the special irritability of the nervous system characteristic of childhood decidedly abates as the cerebral hemispheres develop and begin to exercise a more powerfully controlling influence over the lower centres.

Other and new causes, however, come into play at this epoch. The establishment of puberty is a kind of crisis during which, independently of all other causes, convulsions or fits may be initiated in those whose nervous systems are at all predisposed towards such an occurrence. This is more especially so in the case of the female, partly because of the existence of a more frequent predisposition in persons of this sex, and partly because of extra excitations in association with the establishment of the catamenia—whether this be brought about imperfectly or in a natural manner. Ovarian or uterine irritation, or irregularity of the functions of these organs at any part of this period, may help to occasion fits which may or may not take an hysterical type. Masturbation may also be added as an occasional provocative of epilepsy at this critical period of life, though I am inclined to think too much stress is often laid upon this as a cause. When operative this mode of causation occurs more frequently with the male than with the female sex.

Excessive study and mental application, as well as worry or anxiety, must also undoubtedly be enumerated amongst the causes of epilepsy at this period of life.

Neither must we forget the possible existence of aneurysms of the arteries or of morbid growths in connection with some portion of the brain or its meninges, either of which may act as occasional excitants of epileptic paroxysms. This cause also figures in earlier periods of life—more especially in those of a scrofulous type. And in some of such cases the new-growth may lead to the supervention of chronic hydrocephalus, and thus render the occurrence of convulsions even still more likely.

Early Adult Age (20–40 years)—Fits originate much less frequently during this period of life than in adolescence or childhood. They are, however, apt to supervene more especially when the general health is lowered under the influence of various exciting causes. Grief and mental worry, more especially when combined with long-continued bad sleep, and the labours or cares of business, are then apt to induce them.

Blows or falls upon the head may still be followed by attacks of this kind, though perhaps with less frequency than in the earlier periods of life.

Syphilitic indurations or growths from the meninges may now occur; and other attacks (often of one-sided convulsion) may be determined by various pathological changes or accidents taking place in regions of the brain where more severe lesions would give rise to hemiplegia. The primary change in these cases may be minute hæmorrhages into the brain-substance, or minute and slight softenings produced by stopping of small vessels (embolism or thrombosis). From lesions of this kind hemiplegia and epilepsy are often more or less associated. Occasionally the cause may be a non-syphilitic tumour, occupying the side or base of the brain.

Puerperal convulsions in the female, and uræmic convulsions in both sexes, are most frequently met with during this period of life. During pregnancy the reflex excitability of the nervous system is often greatly increased, and in the production of puerperal convulsions some amount of uræmia also intervenes not unfrequently. Intemperate habits, carried to excess, frequently produce fits, and so also may venereal excesses.

After Middle Age (40 years and onwards).—The mobility of the nervous system gradually diminishes during this period, so that epileptic attacks commence now with still less frequency. There is, however, one period (the climacteric) in the female sex in which this mobility is temporarily increased, and in which fits again become more frequent, under the influence of apparently slight exciting causes.

Although fits are only very rarely liable to be induced by the sequelæ of hæmorrhages or of softenings of the brain, yet these events now grow more common as age advances, and are therefore to an almost corresponding extent more liable to figure as causes of epileptic attacks. An attack of hæmorrhage or of softening may be ushered in by epileptiform convulsions (especially when the lesion occurs in certain parts of the brain), and in some cases such attacks may thereafter recur at irregular intervals. Exposure to great heat, or sunstroke, may also at this period, or earlier in life, act as the exciting cause of convulsions.

Mental overwork, worry, fright, and such-like influences, are much less likely to operate in persons over 40 than in earlier life; and the same is to be said of blows or injuries of the head, short of the most severe causing actual lesions of the brain. But the malnutrition and degeneration induced by intemperate habits may predispose to symptoms of this kind; and so also may blood-poisoning from renal disease, which is now not unfrequently present.

Various organic diseases of the brain, whether principally characterized by degenerations with a process of more or less general atrophy, or with localized overgrowth of connective tissue, are also not unfrequently productive of convulsions, either in persons of middle or of advanced age. A well-marked instance of the former of these associations is to be met with in general paralysis of the insane. Cysticerci on the surface of the brain have also in some recorded instances been the cause of most obstinately recurring convulsions.

Lastly, it should always be borne in mind that convulsions are sometimes the result of the action of poisons of various kinds upon persons of any age. Occasionally such poisoning may be brought about by articles of diet, such as mussels or fish in certain states, or from poisonous mushrooms; whilst at other times it results from some of the well-known narcotico-irritant poisons, taken either inadvertently or purposely.

ANATOMICAL CHARACTERS.—These may be said, so far as our present knowledge goes, to be absent. It is true that general or partial congestion of the brain may frequently be encountered in those who die during an attack of convulsions. But this congestion is to be regarded as a result rather than as a cause of the fit. The convulsions are due to mere molecular changes in the brain, inappreciable to, or at all events unappreciated as yet by, the most skilled microscopists. When fits occur in association with actual organic growths or other lesions of the cerebral cortex or elsewhere, such lesions may form merely the starting points for nervous impressions which travel downwards so as to upset the equilibrium of certain unstable or highly charged motor centres; just as a similar disturbance of nervous equilibrium with discharge of motor energy may result in another case from abnormal visceral impressions (induced it may be by indigestible matters in the intestine or by an acute disease of the lungs), or from some surface-irritation. In accordance with this point of view, such organic growths or other lesions need receive no further mention here. Those who may be inclined to think otherwise, should bear in mind the fact that convulsive attacks are easy to be produced in animals from whom the cerebral hemispheres have been removed.

SYMPTOMS.—The varied nature of the causes make it impossible to say anything of moderate compass concerning the premonitory signs or symptoms which may precede an outbreak of convulsions. These must necessarily vary immensely in different cases. Some of the characters of the predisposing state have been already alluded to (p. 300). The onset is, however, often abrupt and without any distinct premonitory symptoms.

With regard to the actual characters of the attack it will be sufficient to say here that they also vary immensely in different cases; and as notwithstanding this great variability it is impossible in any individual case to tell, from the nature of a first convulsive fit, whether it will form a more or less isolated attack, or whether it will constitute one of a subsequently recurring series, the reader may, for this part of the subject, be referred to the description of the attacks given under EPILEPSY. All that is there said concerning the actual phenomena and mechanism of the attack, holds good for occasional convulsions as well as for those which are habitual. In each we have to do with (1) a more or less distinct stage of tonic spasms, followed (2) by one of clonic spasms, and (3) succeeded by a state of stupor. One or other of such stages is, however, not unfrequently more or less abortive. These attacks may, at times, so rapidly follow one another as to be merged into one long series or *status convulsivus*, differing in no respect from the analogous *status epilepticus*.

COMPLICATIONS AND SEQUELÆ.—The complications are most various, seeing that in different cases we may have to do with irritated gums, repletion, diarrhœa, worms, or an acute specific disease; whilst in other cases it may be with general debility and sleeplessness, with mental anxiety, puberty, or the climacteric period. Again pneumonia, renal disease, pregnancy, ovaritis, or some organic brain-disease may be the accompanying condition.

The nature of the sequelæ will depend principally upon the frequency of the attacks and the duration of the period during which the patient has been subject to the recurrence of them, so that for this part of the subject the reader may refer to the article EPILEPSY.

DIAGNOSIS.—There is very little difficulty in regard to the diagnosis of the affection. The differential characters of Laryngismus Stridulus are given elsewhere, and the absence of any real distinction between a fit of Eclampsia and a fit of Epilepsy has already been insisted upon. Neither of these affections can be easily confounded with certain forms of Chorea, which occasionally present themselves in adults, with movements not unlike those of ordinary convulsions. The more continuous nature of the movements, and the fact that consciousness is not impaired, suffices to distinguish all forms of Chorea. The spasms of Tetanus and Hydrophobia are also easily distinguishable from an ordinary attack of convulsions.

The characteristics of hysterical convulsions will be pointed out in the article on HYSTERIA.

The real difficulties from this point of view of diagnosis have reference to the cause of the attack. To arrive at a decision in regard to this is often very difficult and occasionally impossible, at all events when a patient first comes under observation. At other times, however, the indications are so plain that there can be little or no difficulty. It is a question which should always be considered with the utmost care, since on the correctness of our conclusions in regard to this point the efficacy of the particular line of treatment which we adopt must necessarily depend. Nothing is more to be deprecated than hasty jumping at conclusions, from mere routine and superficial considerations. The condition of the patient must be carefully examined, and the nurse, attendants, or relatives must be closely questioned in order that we may learn as much as possible as to the previous state of health of the patient, and more especially as to the time and events which immediately preceded the first outbreak of an attack of convulsions. Examination and enquiries combined may convince us that the convulsions are (1) of the primary or idiopathic variety, immediately occasioned perhaps by fright, anxiety, overwork, overmuch or indigestible food, &c.; or we may come to the conclusion that the convulsions are (2) of the sympathetic order dependent upon pregnancy, renal disease, the onset of an acute specific fever or of pneumonia, or due to the existence of hooping cough, scarlet fever, &c. Or, in the absence of reasons for placing them in either of these categories, we may be forced to conclude that they are (3) symptomatic of some organic brain-disease, the nature of which must then be determined as nearly as possible, judging from the age of the patient, the mode of onset, his present state and associated conditions.

In any case we may have to enquire more closely as to hereditary tendencies, or acquired predisposing causes, which sometimes reduce the nervous system to such a degree of irritability as to lead to an attack of convulsions without the aid of any obvious exciting cause. In infants or very young children such a condition of the nervous system may display itself by great restlessness and startings at night, by the child's sleeping with half-open eyes, by drawing in of the thumbs across the palms, by twitchings of the limbs, of the angles of the mouth, or of the facial muscles generally. In older children and in young adults the signs which most easily mark a similar below-par condition of the nervous system are twitchings of the muscles about the angle of the mouth and of the tongue (the former being especially well seen when the latter organ is tremulously protruded for inspection) associated with debility, anorexia, partial insomnia, and general nervousness. In nervous girls fits are induced by very slight causes about the time when the catamenia become first established. The indications for treatment must in fact vary immensely in any five consecutive cases of convulsions to which the practitioner may be summoned.

Prognosis.—The possibilities under this head are at least six in number in regard to any case of convulsions:—(1) The patient may recover after having a single fit or a batch of them within a few hours or days, and may never have another attack. (2) The patient may recover, and though he or she may not have fits habitually thereafter, they may recur at prolonged intervals, when predisposing circumstances chance to be strong or are supplemented by an exciting cause of unusual potency. Thus convulsions during teething may cease, and may not recur till the constitution has been lowered by some illness years after, or when the nervous system has been rendered more irritable, as at the time when the catamenia are about to commence, especially if some slight fright should also come into operation as an exciting cause. (3) The patient may recover, though he subsequently continues to have fits either at irregular or regular intervals; he becomes, in short, a confirmed epileptic. (4) The convulsions may come to be followed by temporary delirium or a more or less marked maniacal condition, recurring after all or some seizures. (5) The patient may recover from the convulsive attack and may or may not have another fit, though he may remain hemiplegic. (6) The patient may die during the attack or almost immediately afterwards, (*a*) from the effects of it, or (*b*) by reason of some organic lesion by which the fit itself has been determined.

Recoveries are fortunately common, but death, especially in infants, is by no means uncommon. We possess no accurate data to enable us to assign the numerical proportion of these terminations to one another and to the other above-mentioned sequences.

Treatment.—During the convulsion itself, whether we have to do with an infant or an adult, we must see that all clothes are thoroughly loose about the neck and chest, and the patient should be placed in the supine position with the head slightly raised. Beyond seeing that the patient does not knock or injure himself, owing to the violence of his movements, these should not be much restrained; although efforts should always be made to prevent the tongue being bitten, by slipping the most suitable thing at hand between the molar teeth on one side, when the age of the patient or the character of the fit renders it likely that this event might otherwise occur. Beyond such simple measures as this, the less we do during the actual continuance of the fit the better it will probably be for the patient. We know of no rational or successful means of cutting short an ordinary attack of convulsions, and in the face of such an attack we should be cautious lest evil might be done.

Where we have to do with a succession of attacks quickly following one another, and which have already lasted some time, the careful administration of chloroform may be tried, as it is very serviceable in many cases when a *status convulsivus* occurs in children or in adults—though it would not be desirable to have recourse to it in infants. Under similar circumstances, for the latter the warm bath may be substituted, and sometimes seems to do good. On the cessation of the convulsions, or during the intervals, the treatment to be adopted to prevent their recurrence must necessarily vary immensely according to the age of the patient, and according to the predisposing and exciting causes which appear to have been operative in inducing the attack.

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An overloaded stomach will call for the speedy administration of an emetic, and where indigestible food has already passed into the intestine an enema or brisk purgative should be given. Diarrhœa must be checked, or anthelmintics administered when worms are suspected. Gums may be lanced if they seem really to need it. In many of these cases an acquired or hereditary predisposition will have to be combated by the careful regulation of the diet, so that nutritious and easily digested food are given in place of their opposites, whilst at the same time the most suitable nervine tonics and antispasmodics are administered. For general usefulness in such cases no remedies can compare with the bromides of potassium and ammonium. As part of the specific influence which they exercise over nerve-tissue, they fortunately establish a tendency to quieter and sounder sleep, of which such patients often stand much in need. Ten-grain doses three times a day should be given at the commencement to youths or adults, and afterwards increased if necessary. Or a larger dose may be given once a day, either in the morning or at night, according to the indications in each case. Quinine or belladonna may be often given simultaneously with great advantage. To young children or infants, the dose of the bromide must, of course, vary with their age. Valerianate of zinc and oxide of zinc are remedies of less power, though these and other drugs may be tried where bromides appear to fail. This general treatment is applicable to a large proportion of cases also in which in debilitated or 'nervous' patients fits have been brought on by fright, worry, or anxiety, or by no assignable cause. Fatigue of mind and body is always to be avoided, and in those instances in which over-attention to business or over-study have been in part operative in bringing on the fits, absolute rest must form an essential part of the treatment. In girls or young women in whom fits occur at the time of the establishment of the catamenia, or where they recur in association with an irregular menstrual function, the general health often requires our most careful attention.

The convulsions which belong to the class known as *sympathetic* have to be carefully considered in relation to the malady of which they are the forerunners or associates. When convulsions precede an attack of scarlet fever or of small-pox they usually subside of themselves as the disease develops. They are, however, of much more significance when occurring during the course or towards the close of one of these maladies or during an attack of hooping cough or of croup. Our indications for treatment must then be derived in the main from the general state of the patient, and this is also eminently the case where we have to do with uræmic convulsions.

The treatment of *symptomatic* convulsions, dependent upon actual organic brain-disease, must also necessarily be subordinated to that appropriate for the affection itself upon which such symptoms depend. No drug will be found more generally useful, however, than bromide of potassium in ten to fifteen-grain doses for an adult (administered three times a day), in checking or diminishing the repetition of convulsions in these cases. Sometimes the action of the bromide seems to be favoured by combining it with moderate doses of digitalis, especially in those cases in which there is great general nervousness in association with a disordered cardiac rhythm. Where sounder sleep is urgently necessary, chloral, either alone or in combination with bromide of potassium, should be given at bed-time. Tinctures of sumbul or of henbane are also at times useful adjuvants. Where we have to do with tumours of the brain, and especially with syphilitic growths in the meninges, much better results are to be hoped for from large and increasing doses of iodide of potassium, either alone or in combination with small doses of bichloride of mercury, with the administration of nutritious food and attention to the improvement of the general health. *See* BRAIN; and SPINAL CORD, Diseases of. H. CHARLTON BASTIAN.

CO-ORDINATION.—This term is used in reference to muscular movements principally. Certain parts of the nervous system have more especially to do with the calling into activity, and therefore with combining, the contractions of different muscles, both simultaneously and in succession, in the precise order in which they occur in the several motor acts of which we are capable. The nervous arrangements upon which these actions depend have come into being, both in the race and in the individual, by processes of organic growth and development *pari passu* with the possibility of executing these several movements. It would be wrong to expect, therefore, that an isolated organ should exist solely for co-ordinating muscular movements. The execution of the most habitual of these must depend, to a large extent, upon the activity of the ordinary motor tracts of the spinal cord and brain. The extent or precise mode in which the cerebellum intervenes in certain higher forms of co-ordination is still involved in much obscurity. That it has some share in such functions may be regarded as certain, though it probably intervenes far less than some would have us believe, who regard the cerebellum as *the* organ for the co-ordination of muscular movements.

Many nervous affections exist in which the co-ordination of muscular movements is more or less impaired. One of the most familiar of these is locomotor ataxy, a disease dependent upon a morbid process in the posterior columns of the cord. Sclerosis of the antero-lateral columns of the cord also not unfrequently disturbs the execution of muscular movements, especially those of the upper extremities. Chorea gives rise to very similar uncertainties in the execution of muscular acts. Spasms of all kinds, in short, tend to interfere with the harmony of the muscular movements in the course of which they intervene. Stammering is an affection of this kind, implicating the muscles of articulation, and certain disturbed cardiac actions characterised by disordered rhythm can only be regarded as belonging to the same category.

The above-mentioned are common instances of impaired co-ordination of muscular movements dependent upon structural or functional changes in parts of the nervous system other than the cerebellum. Certain diseases of this organ, however, are known to give rise to a distinct form of inco-ordination. It is characterised by a reeling, unsteady gait in walking, with legs straggling, and mostly wide apart, to which the term 'titubation' is commonly applied. Other kinds of inco-ordination may hereafter be proved to depend upon diseases of the cerebellum. These are still very imperfectly recognised, and this is especially true in regard to its merely functional perturbations.

Certain inco-ordinations in speech and writing are common. Instances are to be found in that use of wrong words or misapplication of terms which we meet with in aphasic and amnesic persons; also in the substitution of wrong words in the act of writing, or of wrong letters in the writing of words, when such substitution is mechanical and unintentional—when it is wholly distinct, therefore, from mere inability to spell. These defects are inco-ordinations of a complex kind, dependent upon the perverted action of higher cerebral centres, in the same way that incoherent speech generally is dependent upon incoherent thought. There is reason to believe, indeed, that the same kind of ultimate defective nervous action which leads to inco-ordinations of movements when certain motor regions of the nervous system are affected, may, on the other hand, give rise to perverted perceptions (*illusions*) or to perverted thought (*incoherence*) when the disturbed nervous action occurs in other and in higher parts of the central nervous system.

H. CHARLTON BASTIAN.

COPHOSIS (κωφός, deaf).—Deafness. *See* HEARING, Disorders of.

COPPER, Poisoning by.—*Metallic copper* may be regarded as innocuous when swallowed, and the recent researches of Hirt show that those who are engaged in the metallurgy and manufacture of copper utensils are not specially liable to any diseases which can be attributed to copper as such. It is, indeed, stated that workers in copper enjoy an immunity from cholera, a conclusion which is based on very insufficient premisses. It is contradicted by the occurrence of cholera among coppersmiths in Buscau in 1866, and by certain other cases of a like nature reported by Hirt. That the disease is seldom found among workers in copper is true, but that the copper has anything to do with this result is not proved.

Though pure copper may be regarded as innocuous, it is otherwise with *alloys of copper*, more particularly with the alloys of copper with zinc and tin, known under the names of brass and bronze respectively, and with compounds of copper with lead or arsenic. In these the injurious agent would appear to be the alloy, and not the copper itself. An affection of a febrile character, and known as 'brass-founder's ague,' occasionally occurs on fusing days, and is attributable to the zinc fumes which are generated by the melting process.

The *salts of copper*, on the other hand, are capable of causing injurious and fatal results. The more important salts, from a medico-legal point of view, are the sulphate, blue vitriol, or bluestone; the acetates (basic and neutral) constituting artificial verdigris; and the carbonate or natural verdigris. The manufacture of verdigris is carried on to a large extent in the south of France. Plates of copper are acted on by the skins of grapes which are allowed to undergo the acetous fermentation. Those engaged in this industry on the whole enjoy good health, and it is only rarely that symptoms can be directly traced to the work; and then only when through sheer carelessness and uncleanliness quantities of the salt have been ingested. It is even said that dogs eat the refuse grape-skins without appearing to suffer from poisonous symptoms.

1. Acute poisoning by copper.—SYMPTOMS.—The salts of copper, when taken in sufficient quantity, cause symptoms of acute poisoning, frequently terminating fatally. Twelve to fifteen grains of the acetate have been sufficient to kill a dog within an hour. The fatal dose in man is not quite determined; but doses above the usual emetic dose of the sulphate (ten to fifteen grains) have caused serious symptoms, and death has resulted within four hours after swallowing some pieces of the sulphate. Half an ounce would probably cause a fatal result. The symptoms are essentially those of irritant poisoning, viz., styptic or coppery taste, constriction of the fauces, epigastric pain, violent vomiting and purging, followed by collapse and death, usually with tetanic or convulsive symptoms. That which characterises copper-poisoning more especially, as compared with other irritants, is the frequent occurrence of jaundice. In dogs copper usually causes death with symptoms of paralysis of the hinder extremities, in addition to the usual irritant symptoms. It is said also to have a paralysing action on the heart.

2. Chronic poisoning by copper.—It is generally stated that the long-continued introduction of copper into the system in small doses gives rise to a form of chronic poisoning known under the name of 'copper colic.'

SYMPTOMS.—The symptoms are essentially those of gastro-intestinal irritation, with nausea or sickness and diarrhœa. They have none of the characters of colic in the sense in which the term is usually employed. The hair and the cutaneous secretions of workers in copper and brass are sometimes found of a green colour, and a line is sometimes found at the margin of the gums and teeth, variously described by authors,—Corrigan calling it purple, while Clapton calls it green.

Though symptoms of gastro-intestinal irritation, as above described, have been found among workers in copper, the question is whether they are in reality due to the copper, or merely symptoms of a not uncommon affection showing themselves among copper-workers. That copper does gain access into the system, and may be detected in the urine during life, and found in the bones after death, without the individual showing any manifest symptoms during life, seems pretty well established. But though we may regard it as certain that symptoms of copper-poisoning are more rarely found than those of lead-poisoning among those who have to deal with these metals, yet it would be a very unwarrantable conclusion, and contrary to all that we know of the action of poisons, to assert that a substance which is undoubtedly poisonous can be taken freely into the system with impunity.

This is a point of considerable interest in reference to the accidental or wilful adulteration of articles of food with copper salts. Many cases are on record of severe symptoms resulting from the use of copper utensils in cooking, or more frequently from the storage of water or articles of food in copper vessels, especially if the food contains oil—which, on turning rancid, dissolves the copper—or vegetable acids, or even large quantities of ordinary salt.

Copper salts are also employed intentionally to impart a green, fresh colour to pickles and preserved vegetables, such as peas. It is asserted that the quantity of copper necessary to produce this effect is infinitesimal, and that no poisonous effects can be proved to have resulted even from long-continued employment of these vegetables as articles of food. This is strongly maintained by M. Galippe, who has tried them on himself and family. Assuming the impossibility of proving the injurious effects of copper-tinted vegetables, the question comes to be principally a social and economic one, as to the propriety or legality of adulteration of food at all, and especially with a substance undoubtedly poisonous. Copper is said by some to be a natural constituent of the human body, but Boutigny furnishes strong grounds for attributing the minute quantity which may be found in the liver to accidental introduction into the system from cooking utensils, or from fruits raised on manure containing copper.

Diagnosis.—The greenish or bluish colour of the vomited matters, which turn bright blue on the addition of ammonia, renders the diagnosis comparatively easy.

Treatment.—In *acute* cases the stomach should be evacuated by encouraging vomiting, or by the stomach-pump. Albumen in some form, as milk or white-of-egg, should be given in order to precipitate the copper. Iron filings may be given for a similar purpose.

In *chronic* poisoning the cause should be discovered and removed, or the individual removed from the cause.

D. Ferrier.

CORN.—Synon.: *clavus*; Fr. *Clou, cor*; Ger. *Leichdorn, die Hühnerauge.*

A corn is a thickening of the epidermis, caused by undue pressure and friction, as by boots, shoes, or implements of occupation. It is usually situated on a prominence, such as that of a joint, where the skin is subjected to double pressure, and is therefore unable to yield, or between the toes. Corns are most common on the feet.

A corn usually begins as a general and uniform thickening of the epidermis, which is termed a *callosity*, (*tyloma*, *tylosis*, *Schwielen*). Callosities may occur on any part of the integument. Thus they may occupy the prominence of a joint, or spread over the heel or the metatarsal cushion of the foot from pressure in walking, or occupy the metacarpal prominences of the hand as in boatmen.

The callosity is composed of laminated epidermis; is thickest in the centre, becoming thin towards the circumference; and is more or less hard and condensed, smooth and hornlike in appearance, and yellowish in colour. When the irritation which gives rise to a callosity is prolonged, effusion is apt to take place beneath it, and it is raised like a blister, the effused fluid being sometimes serous and sometimes seropurulent. Whenever this happens, the subsequent separation of the horny layer results in spontaneous cure.

When the pressure giving rise to a callosity, instead of being diffused, is concentrated on a central point, the epidermis corresponding with that point increases in thickness, by its under surface, and forms a conical prominence; further pressure increases the length and breadth of the cone, and in this way a corn is established. Continued irritation enlarges the corn by hyperplasia of epidermic cells, and its pressure produces absorption of the derma, sometimes extending to the bone itself. Not unfrequently effusions of serum or blood take place beneath the conical prominence, and, in rare instances, a bursa is found between the corium and the joint.

At a late stage of its growth the corn has the appearance of a central core—technically, *the eye of the corn*—surrounded by a collar of smooth epidermis in the state of callosity. The core is a lamellated ovoid mass, corresponding in external figure with the cup by which it is produced; and consisting in substance of vertical cup-shaped lamellæ closely packed one within the other. In an old corn the shape of the entire core is conical, the point resting on the sensitive skin, and the signification of the term *clou* or nail applied to it by the French is made manifest. The substance of the corn resembles horn both in colour and density, but between the toes, where moisture is generally present, it remains white and soft, like soddened cuticle, and is thence named *soft-corn*. Effusion at its base is more common in the soft than in the hard corn.

Treatment.—The treatment of a corn is to remove its cause, namely, pressure and friction; but when this is impracticable, to equalize pressure, by which the corn will revert to the state of callosity. The second indication is best effected by some simple unirritating application, such as soap- or lead-plaster spread on wash-leather. As a preliminary to this application, as much of the hard epidermis as possible should be removed by soaking and scraping, and the core turned out with a blunt-pointed instrument. The soft corn may be removed as the hard one, or by snipping with scissors. When there is much pain and inflammation about the corn it should be treated by means of water-dressing. Chronic corns and callosities are much benefited by painting with iodine liniment, and the use of an unirritating protective plaster.

Erasmus Wilson.

CORNEITIS.—Inflammation of the cornea. *See* Eye and its Appendages, Diseases of.

CORNUA (*cornu*, a horn).—A synonym for horns. *See* Horns.

CORONARY ARTERIES, Diseases of. The diseases of the coronary arteries may be classified as follows: (*a*) atheroma and calcification; (*b*) aneurism; (*c*) occlusion of the orifice; (*d*) thrombosis; and (*e*) syphilitic disease.

a. **Atheroma and calcification** of the coronary arteries are ordinary, but by no means constant sequelæ of similar changes in the root of the aorta. The disease may be general, affecting both vessels equally or unequally; or it may be limited to one of them, or even to a primary branch of either; and may lead to fatty degeneration or fibroid change of the corresponding substance of the heart. The experiments of Mr. Erichsen and M. Schiff have proved that the nutrition of the heart in health depends upon a free coronary circulation, and pathology has confirmed this conclusion. Dr. Quain found the coronary arteries diseased or obstructed in 13 out of 33 cases of fatty degeneration of the heart, and in one of these cases, the trunks of both vessels being healthy, a calcified coronary branch led to the only portion of the heart exhibiting fatty change. Of 55 cases of fatty degeneration of the heart collated by the author from the *Transactions* of the London Pathological Society, 21 exhibited atheromatous or calcific change of the coronary arteries. In 10 of these death occurred by rupture of the left ventricle, in 1 by rupture of the right ventricle, and in 2 by rupture of the septum ventriculorum, the coronary branch leading to the seat of rupture having been, in every instance, in a more advanced state of disease than the other portions of the vessel. From the foregoing statistics it would appear, that whilst fatty degeneration of the heart may exist independently of disease of the coronary arteries, the latter condition may be regarded as the *immediate* cause of fatty change in the heart, in the proportion of about 38 per cent. of all cases.

SYMPTOMS AND SIGNS.—There are none which are peculiar to this disease; those which exist being due to the consecutive changes in the substance of the heart. The doctrine formerly held, that calcification of the coronary arteries was the cause of angina pectoris, is no longer tenable. In an example of this disease in its most typical form, eventuating in death, which recently came under the writer's notice, the coronary arteries were found, on examination, to be perfectly sound.

b. **Aneurism** of the coronary arteries is of rare occurrence. It is usually preceded by atheromatous or calcific changes in the coats of the vessels, and may, therefore, be regarded as a disease of middle or advanced age. Dr. Gee has, however, published an example of coronary aneurism in which the patient was a boy of only seven years.

SYMPTOMS AND SIGNS.—There is no positive indication of coronary aneurism during life. When the termination is fatal, as it usually is, death occurs by hæmorrhage into the pericardium from rupture of the sac.

c. **Occlusion** of the orifices of the coronary arteries has been met with only in connection with calcific changes in the root of the aorta, a partially detached calcareous plate overlying the orifice of either vessel (both are rarely affected), and partially or completely shutting off the circulation. There are no *symptoms* distinct from those of the principal disease.

d. **Thrombosis** of the coronary arteries is a frequent result of disease in the coats of these vessels; and, owing to their small size, complete blocking and arrest of circulation through them are the ordinary consequences of this accident. The heart-substance, depending upon the occluded vessel for its vascular supply, quickly undergoes the atrophic changes of fibroid or fatty degeneration. Special *symptoms* are entirely wanting.

Disease or obstruction of the coronary arteries, with the ordinary consequences—fatty degeneration of the heart, and anæmia with white softening of the brain—are the conditions usually found in cases of permanently slow pulse.

e. **Syphilitic disease** of the coronary arteries has been recorded in a few instances, but its identification depended entirely upon the history and the concomitant symptoms, the deposit being histologically indistinguishable from ordinary atheroma.

THOMAS HAYDEN.

CORPORA AMYLACEA (*corpus*, a body; and *amylum*, starch).—These minute bodies, which were described in this country by Dr. Quain and Dr. Hughes Bennett in the 2nd and 3rd vols. of the *Transactions* of the Pathological Society, were thus named by Virchow. They are generally only visible with the aid of the microscope, but sometimes are large enough to be seen by the naked eye, and now and then attain some size. Usually they are round or oval, and present a concentric, laminated arrangement, which is made more apparent by the action of acetic acid. They often have a yellowish tinge. In appearance corpora amylacea somewhat resemble starch-granules, and they are tinged brown or bluish by the action of iodine upon them. These bodies were formerly supposed to be composed of starch, and hence their name. This is not the case, however, and their actual chemical composition is not clearly known; it probably differs in different structures. Bodies resembling corpora amylacea in appearance and arrangement have been found in various parts, but they have attracted most attention in connexion with the nerve-centres, being particularly observed when these are the seat of atrophy or degeneration; they are also seen in the choroid plexus.

FREDERICK T. ROBERTS.

CORPORA QUADRIGEMINA, Lesions of.—The facts of comparative anatomy and experimental physiology tend to show that the corpora quadrigemina (*corpora bigemina* or *optic lobes* of the lower vertebrates) are in relation not only with vision and irido-motor co-ordination, but also with those functions which are, to a large extent, independent of the cerebral hemispheres, viz., equilibration and locomotor co-ordination.

The facts of human pathology, though not opposed to these data, cannot be made the basis of very precise conclusions as to the diagnostic indications of disease of these ganglia, as it is exceedingly rare to find disease limited to this region anatomically or functionally.

The corpora quadrigemina are, however, not unfrequently involved in lesions which invade neighbouring parts, such as meningitis—simple and tubercular, tumours, especially of the pineal gland and middle lobe of the cerebellum, &c.; but disease strictly limited to the corpora quadrigemina, such as local softening, is extremely rare, and hæmorrhage is unknown.

It is a fact agreed on by all experimenters that when the anterior tubercles, which are more especially connected with the optic tracts, are destroyed, vision is abolished, and that if the lesion is unilateral. the blindness occurs on the side opposite the lesion.

These phenomena in animals are in accordance with what has been observed in man. Dr. Bastian has recorded a case of total blindness, in which the cause proved to be softening limited to the anterior tubercles of the corpora quadrigemina (*Paralysis from Brain Disease*, p. 116).

It has been found experimentally in animals, and also in man, that atrophy of the opposite tubercle ensues when the eye has been destroyed. Irido-motor action is also paralysed by destruction of the corpora quadrigemina a result which, however, is stated not to occur unless the injury is more than superficial and implicates the oculomotor nuclei.

Disturbances of equilibration and co-ordination also result from lesion of the corpora quadrigemina. These are attributed to lesion of the subjacent tracts, and, according to Lussana and Lemoigne, more particularly to lesion of the subjacent superior cerebellar peduncle. For his own part, the writer thinks that all attempts at differentiation are pure hypotheses, and from the nature of the question must remain so. But, from whatever cause, there is no doubt that the disturbances alluded to do occur.

Irritation of the corpora quadrigemina on one side causes dilatation of the pupils and a hemi-opisthotonus of the opposite side, which becomes general if the irritation is prolonged or bilateral, the head being retracted and the legs extended, trismus also being very marked. According to Lussana and Lemoigne unilateral lesion of the corpora quadrigemima causes an incurvation of the trunk and gyration to the side of lesion. This would agree with the effects of irritation, being naturally a reversal of the phenomena. Clinical illustrations of these facts in the lower animals are difficult to find, for the reasons above mentioned; but a case reported by Dr. Duffin (*Clin. Soc. Trans.*, vol. ix., p. 187) which the writer had an opportunity of seeing and examining *post mortem*, is important in this relation. This was a case of tumour of the pineal gland, which, besides passing forward into the third ventricle, pushed underneath the aqueduct of Sylvius, stretching and causing atrophy of the corpora quadrigemina. The symptoms, in addition to those of cerebral tumour, viz., violent occipital headache and double optic neuritis, were double vision followed by loss of sight, vertigo, specially marked when the eyes were open, staggering gait, and tendency to retraction of the head and rigidity of the dorsal muscles. The pupils were large and sluggish. These symptoms, to a certain extent, resemble those caused by tumour in the middle lobe of the cerebellum, and it is a question how far these latter may be due to mechanical irritation of these ganglia. But we may infer that such a combination of symptoms as the above points to lesion of the corpora quadrigemina, or of the middle lobe of the cerebellum, though we cannot be certain of absolute limitation of the lesion.

Naturally the same secondary affection of the functions of the cerebral hemispheres occurs from tumours situated in this region, as in cases of tumours of the middle cerebellar lobe.

Pressure on the veins of Galen leads to dropsy of the cerebral ventricles, and its consequences on the cerebral circulation and functions.

D. Ferrier.

CORPULENCE (*corpus*, a body, and *lentus*, thick).—An undue accumulation of fat in the body. *See* Obesity.

CORPUSCLE (*corpusculum*, a little body).—In physiology and pathology this word is generally used as synonymous with cell. *See* Cell.

CORPUS STRIATUM, Lesions of.—The corpus striatum of English anatomy and pathology comprises various structures which have received special names, viz.: the *nucleus caudatus*, or intra-ventricular nucleus, which is exposed to view by laying open the lateral ventricle; the *nucleus lenticularis*, or extra-ventricular nucleus, consisting of three divisions, and subjacent to the convolutions of the Island of Reil; together with part of the *internal capsule*, or peduncular expansion, which forms part of the 'projection system' between the cortex and crus cerebri.

This differentiation is considered necessary, as it is believed that the effects of lesion of the corpus striatum will differ according to the part involved, although up to the present it cannot be said that this has been conclusively established. This is not to be wondered at considering the excessive rarity of lesions which have an exact anatomical and functional circumscription.

Physiological experiment, while thoroughly in harmony with clinical and pathological observations respecting the effects of lesion of the corpus striatum, has not succeeded in defining the functions of its several parts, if such differentiation exists, with any degree of precision. The statements made by some physiologists on the point, do not seem to the writer to rest on any satisfactory basis.

The corpus striatum is especially liable to lesion from embolism or rupture of its bloodvessels. These are furnished principally by the middle cerebral artery, which in the first part of its course sends off numerous straight twigs, which sink into the anterior perforated space, and supply this ganglion and the adjacent part of the optic thalamus. Owing to their position, and direction as regards the main current, they are easily ruptured or blocked up, and owing to their being of the nature of 'end arteries,' and almost destitute of anastomoses with other cerebral arteries, embolism rapidly leads to softening of the regions which they nourish.

Symptoms.—The symptoms of lesion of the corpus striatum may be divided into three groups or stages.

First stage.—This includes certain symptoms which are more or less transient, and depend chiefly on the suddenness of the lesion and functional disturbance of other parts.

To the latter belong the symptoms usually accompanying an apoplectic seizure (apoplexy), as also the loss or diminution of sensation on the opposite side of the body, which sometimes occurs in consequence of pressure on, or functional interference with, the sensory tracts of the internal capsule by effusion into the corpus striatum. The symptoms due to the suddenness of the lesion of the corpus striatum as such, are complete paralysis of every voluntary movement on the opposite side of the body, occasionally varied by convulsive spasms of the paralysed side, and conjugate deviation of the head and eyes towards the sound side. This latter symptom is due to the centres for the head and eyes of the opposite hemisphere suddenly losing their antagonists. The temperature of the paralysed side is as a rule higher than that of the sound side. The total paralysis and flaccidity of the opposite side of the body, and conjugate deviation of the head and eyes, are transient symptoms, lasting from a few hours to a day or two.

Second stage.—This stage includes those symptoms which continue for a variable period, after those depending on the suddenness and disturbing effect of the lesion have passed off. They constitute the common type of hemiplegia or paralysis of voluntary motion on the side opposite the lesion. The face, arm, and leg, and to a certain extent the thoracic and abdominal muscles on the one side of the body, are affected. The paralysis does not affect all these parts equally. As a general rule it may be stated that those movements are most affected which are most independent of those of the opposite side, and which are most complex and delicate.

Hence the movements of the hand and arm are more affected than those of the face or leg owing to the fact that these latter are more commonly exercised in associated or alternating action with those of the other side. The facial paralysis is most marked in the lower facial region. The orbicularis palpebrarum is more or less paretic, but never paralysed to the extent which occurs in Bell's or true facial paralysis, depending on lesion of the portio dura. The angle of the mouth on the paralysed side hangs lower, and the tongue deviates slightly to the paralysed side. The weakness of the facial muscles is best brought out when the patient smiles or tries to whistle. The face then becomes drawn to the sound side. While some volitional control may have been acquired over the leg, the hand and arm remain perfectly motionless.

In the process of recovery, the leg recovers before the arm, and as a rule the recovery proceeds from the proximal to the distal end of the limb, the shoulder and hip movements being regained before those of the hand or foot. The flexors regain their power before the extensors.

The sensibility of the paralysed parts is unimpaired; the superficial reflexes are diminished, the deep (tendon) reflexes increased.

The faradic contractility of the muscles is unimpaired, occasionally rather increased than diminished.

The muscles do not undergo atrophy except by disuse.

The temperature of the paralysed limbs, which at first is usually increased, is generally found to be lower than that of the sound side, to the extent of a degree, more or less.

Recovery may take place from all the symptoms of this stage, within a period varying from weeks to months, or the patient may pass into the third stage.

Third stage.—The special symptoms of this stage are the occurrence of what is termed 'late rigidity' in the paralysed limbs, a condition of evil import. This rigidity shows itself most frequently in the arm, but it is common enough in both limbs. The rigidity affects the flexors more particularly, and causes the limb to assume a position in which the flexors predominate. It is variable in degree and at first is capable of being overcome. At first also, it is remittent, tending to give way when the patient abstains from volitional efforts or from excitement, and seems almost gone on waking from sleep or when the patient yawns or stretches himself.

Gradually it assumes a more intense form, and the limb becomes permanently fixed and rigid.

After death, this condition is found to coincide with descending sclerosis of the motor tracts of the brain and spinal cord. The degeneration proceeds from the seat of lesion downwards through the crus, pons, pyramid of the same side, and then across to the posterior part of the lateral column of the spinal cord on the paralysed side. Frequently also, a similar track of degeneration is found on the inner aspect of the anterior column of the spinal cord, on the same side as the brain-lesion (Charcot, Türck, &c).

Even during the rigid stage, there is, as a rule, no trophic degeneration of the muscles or annihilation of faradic contractility, though the muscles waste from disuse unless artificially stimulated. But in some rare instances as Charcot has shown, the secondary degeneration invades the anterior cornua of the spinal cord, in which case amyotrophy or trophic degeneration of the muscles ensues.

There is no recovery from this condition.

Variations and complications.—Though general hemiplegia of the opposite side, without affection of sensation, is the type of disease of the corpus striatum, certain variations and complications have been observed, some of which still require elucidation.

When sensation is permanently affected along with voluntary motion, we have reason to regard the lesion as not confined to the corpus striatum, but as implicating also the posterior part of the internal capsule and the thalamus, an occurrence by no means rare. When the lesion affects only the grey matter of the nucleus caudatus, it is said that the hemiplegia is as a rule comparatively slight and transitory.

Similar affection of the nucleus lenticularis is said to produce more marked paralysis than that caused by affection of the nucleus caudatus, but also not of a permanent kind. When, however, the lesion causes rupture of the anterior two-thirds of the internal capsule, the hemiplegia is most marked and most enduring. It is this lesion only which gives rise to secondary degeneration of the motor tracts and permanent rigidity.

Cases are on record in which lesions of the corpus striatum have given rise, not to general hemiplegia of the opposite side, but to monoplegia, such as paralysis of the face or of one or other limb. We cannot yet say whether the lesions in these cases affected specially differentiated centres or medullary fibres, but that such may be the case is not impossible, though the subject requires investigation.

Cases are also on record of paralysis occurring on the same side of the body as the lesion. The real existence and explanation of such exceptional occurrences are still *sub judice*, and though various explanations may be suggested, it is well to wait for further instances, carefully investigated by accurate modern methods, before pronouncing definitively on the question.

Treatment.—It is unnecessary to discuss the treatment of lesions of the corpus striatum, as this is considered under the head of the various diseases of the Brain. D. Ferrier.

CORRELATION.—This term is used in medicine almost exclusively in reference to the ætiology of disease, and in this relation principally in regard to the zymotic diseases. The term 'correlation of the physical forces' may be taken as implying that the several forces are capable of being converted into or of giving place to one another when they are permitted to act under certain conditions, and that they are all related to a common cause. It is very much the same idea that is implied by the term 'Correlation of the Zymotic Diseases,' a subject which has recently been discussed in a separate work by A. Wolff.

It is contended that the several contagious diseases of a general type (the exanthemata) do not, necessarily and in all cases, reproduce their like; but that occasionally, the contagious particles thrown off from the same sick person suffering from some one of the diseases (*e.g.* scarlatina) may suffice to engender one or more different kinds of disease, according to the mode in which this matter operates—that is according as it may be swallowed, taken into the system through the pulmonary surface, or through some other mucous-membrane or skin abrasion. These diseases are said to be correlated, therefore, on account of this assumed relation to a common cause—a specific contagium. According to this notion the seat of primary action and the constitutional condition of the patient are factors which largely influence the form of disease which will ultimately manifest itself as a result of the contact of any given contagium. This view has at present scarcely passed beyond the stage of an ingenious speculation—though it is one which is by no means unworthy of further attention.

Diseases may be said to be correlated also when they are severally related to the same cause acting with different degrees of intensity. Thus it is held by some epidemiologists that the plague is only a malignant form of typhus; that yellow fever is due to a more intense form or action of the same poison as suffices at other times to engender intermittent or remittent fever; and that summer diarrhœa, cholerine, and cholera are also but different manifestations of one common though variable cause.

Similarly it is held by many surgeons that ordinary surgical fever, pyæmia, and septicæmia are correlated effects. They maintain that the appearance of one or other of these morbid states after a surgical operation is dependent in the main upon differences in the constitutional condition of their patients, and, moreover, that these forms of disease are further linked to one another by numerous intermediate states. This point of view has been both strengthened and extended of late, by some of the experimental researches of Dr. Burdon Sanderson. He found that the subcutaneous injection of different portions of the same inflammatory product, executed at the same time, would often produce quite different effects upon different animals of the same species. At one time a typical septicæmia proved rapidly fatal, at another a slower pyæmic process was established, whilst in a third animal the still more chronic process of so-called tuberculosis was set up. Here we get out of the region of speculation into that of fact.

The term correlation is only applicable to communicable diseases, otherwise its leading signification, viz. convertibility, could not be fulfilled. Hence it is that though very many diseases may arise from the operation upon different individuals of some common cause (such as exposure to cold), the maladies which may result from such a cause no one would think of speaking of as correlated.

H. Charlton Bastian.

CORROSIVE SUBLIMATE, Poisoning by. *See* Mercury, Poisoning by.

CORYZA (*κόρυζα*, a running from the head).—A synonym for nasal catarrh. *See* Catarrh.

COUGH.—Synon.: *Tussis*; Fr. *Toux*; Ger. *Husten.*

Description.—The *act of coughing* consists in one or more abrupt forcible expirations, accompanied by contraction of the glottis. First a deep inspiration is taken, the glottis is closed for a moment, and then it is opened by the pressure of the air forced out by the combined action of the thoracic and abdominal expiratory muscles. With the air thus suddenly expelled, any foreign matter that may be in the larynx or bronchi is driven into the pharynx or the mouth.

Ætiology.—The immediate cause of cough is the presence of an irritant, mechanical or sympathetic, affecting the surface of the air-tubes or the nerves that supply them, and it is the object of the cough to remove this source of irritation.

The sensibility of the respiratory surfaces is greatest at the commencement—the glottis being an ever-watchful janitor. It may be increased by congestion or inflammation, or by the continued act of coughing. Even the mere inhalation of cool or dry air may, in asthma or bronchial congestion, be sufficient to excite cough. The result of the irritation is to increase the natural secretion, and to alter its characters (*see* Expectoration).

Cough may be due to numerous reflex causes, such as gastric irritation, ear-disorder, or aneurismal or other pressure on the vagus, recurrent, or sympathetic nerves. The act may also be caused by a long uvula or enlarged tonsil; a granular state of the pharyngeal or laryngeal mucous membrane; polypi or other foreign

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bodies in the larynx, trachea, or even in the external auditory meatus; various affections of the bronchial tubes—*e.g.*, undue dryness, hyperæmia, alteration in the quality or quantity of the bronchial secretion, or inflammatory affections; inflammation of the lung or pleura: or tubercle, cancer, or other growths in or near the lung.

Diagnosis.—Cough is not a disease to be treated, but a symptom to be traced to its source. An inspection of the pharynx and larynx and a physical examination of the chest will generally suffice to detect the cause.

The character of the cough is often quite pathognomonic—*e.g.*, the 'whoop' of whooping cough; the 'bark' of hysteria; the catching, painful cough of pleurisy; the slight 'hack' of early phthisis, and the equally distinctive cough of advanced phthisis with laryngeal ulceration; the loud clanging cough due to pressure on the trachea or laryngeal nerves; the spasmodic, suffocative cough of asthma.

The 'tightness' or 'looseness' of cough, indicating the absence or presence of secretion, is a valuable guide in diagnosis and treatment.

The *absence of cough* is no proof of the absence of serious lesion: while the presence of a few granulations in the lung is often productive of incessant and uncontrollable cough, long-continued destructive disease may exist without it.

Treatment.—Before prescribing for a cough it is of course essential to ascertain its cause; and the simplest and most innocuous remedies should be first used. The routine treatment of cough by sedatives is as injurious as is their use in diarrhœa. The secretions which ought to be removed are thus, in either case, locked up, and the irritation, which would have been transient, becomes established.

If the tonsils are found much enlarged, or the uvula pendulous and irritating the epiglottis, caustics or the guillotine will remove the evil. If a granular state of the pharyngeal membrane, dependent on torpid or engorged abdominal viscera, gout, or hepatic obstruction, exists, it may be treated by local astringents and general deobstruents.

A lax or congested state of the laryngeal membrane, due to overwork of voice, or the undue direction of attention to the vocal apparatus (clergyman's sore-throat), is best treated, according to the writer's experience, by the local application of iodine dissolved in spirit and olive oil. Undue dryness, simple hyperæmia, or hyperæsthesia of the respiratory mucous tract, may often be relieved by the act of sipping and slowly swallowing cold water, or the decoction of Iceland moss, fruit lozenges, gum arabic, liquorice, or linseed tea. Sucking ice or inhaling steam is very often all that is needed. In the early stage of catarrhal sore-throat, chlorate of potash in crystal, or in the form of lozenge, should not be neglected. The use of glycerine of tannin, or nitrate of silver dissolved in glycerine (half a drachm to one ounce) is of more service in relaxed throat than alum or tannin gargle; indeed, the free use of well-selected lozenges has rendered the employment of gargles well-nigh obsolete. The former can be constantly, the latter but seldom applied.

Medicinal treatment.—If it is desired to increase the fluidity of the secretion, squill or ipecacuanha may be used, or better still, tartar emetic in small doses, which is best given in effervescence with ammonia and citric acid. It must not be forgotten that syrups and nauseating expectorants are apt to do harm by enfeebling or disturbing digestion. Tincture of aconite in three-drop doses is often of value in allaying irritable cough, especially when fever is present. Gelseminum is the novel remedy for the same purpose. Of the direct sedatives, morphia is the most valuable; it proves of service in very small doses, $\frac{1}{12}$-gr. in a lozenge being often adequate. Conium, with or without morphia, suits some persons; hydrocyanic acid still more; and Indian hemp is also of value. The bromides, in combination with chloral, have recently gained great repute; the latter should be given with caution. The power of the bromide of ammonium in allaying spasmodic cough is remarkable. An emetic of ipecacuanha, sulphate of zinc, or mustard may be useful in relieving cough, by expelling secretion when this has accumulated in large quantity. If cough causes vomiting, food should be taken in small quantities, fluids should be limited, and a little capsicum or spiced brandy 'stays the stomach.'

External applications.—The use of counter-irritants must not be neglected. In the inflammatory stage of bronchitis, for instance, linseed and mustard poultices, and in the later stages, iodine or croton oil are of great use. The application of a small blister or vesicating fluid is a remedy not to be forgotten in some cases.

Inhalations.—Infusion of hops as an inhalation is a useful calmative; iodine is indicated in relaxed conditions in strumous subjects. Chloroform (10 to 15 minims) mixed with Eau de Cologne, and inhaled from a handkerchief, is useful in other cases. By means of the spray-inhaler, many non-volatile preparations may be applied to the respiratory passages. A solution of carbonate of soda is very useful in liquefying tenacious secretion. Tannic acid, alum, perchloride of iron, and nitrate of silver, are all valuable. Of sedatives, henbane, conium, camphor; and of antiseptics, sulphurous and carbolic acids are serviceable as inhalants. In chronic granular disease of the pharyngeal and laryngeal mucous membranes, the sulphurous waters of Aix-la-Chapelle, Aix-les-Bains, and St. Saveur in the Pyrenees, when inhaled in an atomised state, are of distinct service.

Patients may be thus *taught how to cough*:—Try to suppress the inclination, until the secretion that causes the cough is within reach, then take a deep and deliberate inspiration, and the accumulated phlegm is removed at a single effort. By inhaling steam from a hot sponge or basin of boiling water on first waking from sleep, the inspissated secretion, which is apt to be difficult to move, may be easily loosened and expelled. An ipecacuanha lozenge may serve a similar purpose.

E. Symes Thompson.

COUNTER-INDICATION. *See* Contra-indication.

COUNTER-IRRITANTS.—The term counter-irritation implies any irritation artificially established with a view to diminish counteract or remove certain morbid processes which may be going on in a more or less remote part of the system. The substances employed in establishing this state are called counter-irritants, and may be classified as follows, according to degree of action:—1. Rubefacients; 2. Epispastics, vesicants, or blistering agents; 3. Pustulants.

Although some therapeutists have of late been disposed to question the value of counter-irritants, on the theoretical ground of inability to explain their mode of action, yet there is not wanting evidence, both from clinical observation and physiological experiment, that irritation in one part of the body may affect the functions and nutrition of other parts. That stimulation of the vessels of the surface can influence decidedly the circulation of deeper parts has been demonstrated by Dr. Brown-Séquard: for he found that irritation of the skin of the back, over the kidneys, caused a contraction of the arteries supplying those organs. From this experiment we can understand how a blister may relieve a sudden internal congestion in the lungs or brain, and how it may act in restoring tone to dilated and paralysed capillaries.

Revulsion and *derivation* are both examples of counter-irritation. In the first, the induced morbid action is set up in a part remote from the primary disease, as when mustard poultices are applied to the feet in an attack of apoplexy; in the second, derivative action is set up in the neighbourhood of the primary malady, as when a blister is placed on the back of the neck for the relief of cerebral disorder.

Rubefacients. — *Action.* — These remedies, applied to the skin, produce local warmth and redness from increased flow of blood in the cutaneous vessels. The local hyperæmia thus induced subsides gradually on ceasing to employ the rubefacient; but sometimes, when the action of this has been prolonged, the epidermis may peel off, and more or less local soreness remain. Rubefacients are usually quick in action; their local after-effects are trifling; and they may, therefore, be applied without injury over a large extent of surface.

Enumeration and Application.—Examples of rubefacients are found in Ammonia and Ammoniacal Liniments or Embrocations; Mustard Plasters and Liniment; Volatile Oil of Mustard; Oils of Turpentine and Cajuput; and Iodine. Hot water is at times applied on a sponge or flannel to produce a speedy counter-irritant and derivative effect in relieving sudden internal congestion and spasm, as in the early stage of croup, laryngitis, and laryngismus stridulus. The Cataplasma Sinapis, or mustard poultice, is a useful and rapidly-acting rubefacient in inflammation, spasm, and neuralgic pain. Dr. Garrod recommends a very useful sinapism, made by mixing 10 minims of volatile oil of mustard with 1 oz. of spirit of camphor, and sprinkling this on impermeable piline. Rigollot's mustard leaves, and the Charta Sinapis or mustard-paper of the Pharmacopœia, applied to the skin, produce a speedy rubefaction of the surface. Vinegar should not be added to mustard poultices; but by mixing some oil of turpentine or a little powdered capsicum in a mustard poultice, its rapidity of action as a stimulant and rubefacient can be greatly increased. Where, on the other hand, a gentle stimulation with warmth and moisture to the surface are desired, as in some cases of pneumonia, a linseed-meal poultice may be used, with its surface sprinkled lightly over with mustard-meal. Generally twenty minutes is as long as an ordinary mustard poultice can be safely borne on the skin. In persons who have a very delicate skin, a layer or two of muslin should be placed between the mustard application and the surface of the body. In applying mustard poultices to those who are unconscious of pain, caution is necessary, for it has happened that the poultice being left on for a long time has produced dangerous ulceration and sloughing of the surface. A mustard foot-bath is at times employed with a view to a revulsive and counter-irritant effect. To prepare a mustard bath, two table-spoonfuls or more of mustard should be tied in a cloth, and agitated well with cold water; then hot water may be added to make the bath. It is found by experiment that cold water extracts the active principle or volatile oil of mustard far better than very hot water does.

Uses.—Rubefacients are used in chronic inflammation and irritation of the mucous surfaces, as in bronchitis, and irritation about the air-passages. Troublesome cough, in cases of phthisis, is often relieved by applying tincture of iodine, or acetic acid and turpentine liniment, to the chest. Rubefacients are of service in removing lingering irritation about a joint, their use also tending to promote the absorption of chronic thickening or effusion in the joint; but friction with a rubefacient liniment over a joint must not be employed till all active inflammatory action has entirely ceased. Various degrees of persistent counter-irritation may be maintained by applying, after the skin has been well cleansed with soap and water, the Emplastrum Picis or Emplastrum Calefaciens of the Pharmacopœia. A mustard plaster applied to the nape of the neck has proved useful in cases of irritable brain with sleeplessness. The same application made to the foot or great toe is a valuable revulsive where gout attacks more important organs. A mustard plaster has the advantage over a blister in rapidity of rubefacient action; and, from the sharp pain caused, the mustard plaster is preferable when it is a matter of moment to rouse one who is in a state of lethargy or torpor from narcotic poisoning by opium, or alcohol, or from coma in the course of a fever. Where we wish to exercise a prolonged action over chronic inflammation in an organ, we should use a blister rather than a sinapism.

Vesicants, Epispastics, or Blistering Agents.—*Action.*—A blister acts primarily as a rubefacient and powerful stimulant to the cutaneous vessels. The papillæ of the skin become reddened and raised; minute vesicles soon appear on these elevations; and these, gradually coalescing, form a bleb, or large vesicle, containing an albumino-fibrinous fluid.

Enumeration and Application.—The agent most commonly employed for blistering purposes is Cantharis or Spanish fly, in the several preparations to be found in the Pharmacopœia; but there are other agents that have been used for a similar object. Glacial Acetic Acid applied to the skin produces intense redness and pain, with rapid vesication, but its action may extend deeply as a caustic, and cause a troublesome sore. Liquor Ammoniæ dropped on a piece of lint, applied to the skin, and covered with a watch-glass, very soon causes redness and rapid vesication in most persons. This is a good way of raising a blister when it is desired to apply powdered morphia endermically to relieve severe pain.

The application of blisters should not be made directly over an inflamed part. There is some evidence to show that a strong stimulus applied very near an inflamed organ may increase the paralytic dilatation of its capillaries, and so add to the disease. Blisters should not be applied where the skin is loose, nor over any prominence of bone, nor to the breast during pregnancy. It should moreover be borne in mind that the cantharidine of a blister may be absorbed by the skin, and act on the kidneys, producing strangury and bloody urine. This accident may be obviated by sprinkling powdered camphor over the blister before placing it on the skin, or a thin piece of silver paper may be interposed. In persons of feeble vitality, a blister left on too long time has been known to induce dangerous sloughing.

When vesication is specially desired, there is no need to leave the blister on for twelve hours or more, for it may be removed at the end of six or eight hours, and a warm linseed poultice applied. If the blister be opened, which is best done by pricking the most dependent part with a needle, sweet oil and cotton wool is the best dressing. The practice of maintaining a blister as a running sore or *exutoire*, by applying irritating ointments, is not often resorted to now. The process causes great pain and exhaustion of the system, and is one rather of depletion than of counter-irritation. In the case of children, blisters should be used with caution, being kept on till the skin is well reddened, when they should be replaced by a poultice. It is also a good plan not to open the blister, as the effused serum forms the best dressing for the excoriated surface, and by following this plan the child is saved much worry and pain.

Uses.—In its primary action a blister acts as a local stimulant, but when it remains on long enough to produce extensive vesication and discharge of serum, it acts as a depletive and depressing agent. This primary and secondary action of blisters has been much insisted on by the late Dr. Graves of Dublin, who found great benefit in cases of fever with apathy and prostration from the application of *flying blisters* to various parts of the surface. Thus a blister over the præcordial region, kept on for about one hour, and then removed, was observed to rouse and stimulate a flagging heart. In other cases the flying blister might be placed at the chest or back, or else behind the head on the neck. Care should be taken not to leave the blister on long enough to cause vesication, and the size of the blister should be fairly large.

Vesication by a blister is of service in many brain-affections attended with congestion and tendency to serous effusion, such as in the chronic stages of hydrocephalus, and non-tubercular meningitis. In hysterical paralysis narrow strips of blister placed completely round the affected limb have proved curative. A strip round the throat may cure nervous aphonia. A strip of blister one inch wide will sometimes stay the spread of erysipelas along a surface. In cases of pleuritic or pericarditic effusion the repeated application of blisters to the chest-wall is of manifest advantage. In effusions into joints (hydrarthrosis) blisters aid absorption; and it has seemed to the writer that absorbent remedies, such as iodide of potassium, often begin to do good as soon as a blister appears to have once set the absorptive process in action. In the joint-affections of acute rheumatism, 'the blister treatment' has attracted notice. Armlets and wristlets of blister-plaster are applied close to the inflamed joints during the fever, and the serous discharge from the blister is kept up by means of linseed-meal poultices.

In the obstinate acid vomiting of gouty patients, a blister over the epigastrium often gives relief. Some forms of neuralgia, as for example pleurodynia, may yield to a blister over the seat of the pain. At times obstinate pleurodynia, or mastodynia, can be relieved by flying blisters applied in the vertebral groove on the affected side, where a tender spot can often be detected on pressure. Blisters should be avoided in cases of renal and vesical inflammation, as the absorption of the cantharidine may increase the mischief.

Counter-irritation by heat.—The skin can be rapidly blistered by applying a hammer or a small flat iron heated in a spirit-lamp or boiling water. The skin is tapped for a few seconds with the hammer, just to induce redness of the part. In some forms of rheumatism, neuralgia, and spinal weakness, this practice has been followed by satisfactory results. Vesication of the skin by the *ferrum candens*, or hot iron, has been used in chronic joint-disease.

Moxas are used for the purpose of causing severe counter-irritation. European moxas are made either with cotton wool soaked in solution of nitrate of potash, or of the pith of the sunflower, which naturally contains this salt. A wet rag is placed on the skin; in the centre of this is a hole in which the lighted moxa is placed, which gradually burns down to the skin and produces an eschar which in due time separates by suppuration. In spinal affections, and in some forms of paralysis of the sensory and motor nerves, moxas are said to have done good; but their application is very painful, and now they are seldom employed.

Pustulants.—*Action.*—The agents belonging to this class of counter-irritants produce a pustular eruption on the part of the skin to which they are applied.

Enumeration and Application.—Among pustulants may be placed croton oil, tartarated antimony, and strong solution of nitrate of silver. When croton oil is applied to the skin, it acts as an intense irritant, producing an eruption which is at first papular but very soon becomes pustular. Tartarated antimony in the form of ointment, or in hot aqueous solution, is a powerful counter irritant, producing pustules which resemble those of variola. When applied thus it may, by becoming absorbed, induce symptoms of gastro-enteritis. It should not be applied to parts usually uncovered, as the pustules leave marks behind them; and under all circumstances the remedy, being a painful one, must be used with caution. Strong solution of nitrate of silver will produce pustulation, but it is seldom employed for this purpose.

Issues have long been used as counter-irritants. An issue is formed by placing on the skin a piece of adhesive plaster, in a hole in the centre of which a fragment of caustic potash is inserted. The caustic causes an eschar, and when this has come away an issue-pea is placed in the cavity left by the eschar; this pea acts as a foreign body, and keeps up suppuration. One drachm of pus may be discharged daily by an issue; more than this is too great a drain on the system. An issue requires to be dressed daily, and when it has been long open and running it must not be healed too suddenly. Issues over the spine have been found useful in chronic spinal disease; and in some chronic brain-affections, with hyperæmia and congestive tendency, an issue in the back of the neck or in the arm is frequently of service.

Setons.—A seton is made by passing a narrow-bladed knife under a fold of skin and then carrying a few silk threads through the incision by means of a probe or long needle. The threads remaining in the wound prevent it from healing, and maintain a free purulent discharge. Setons are used for the same purposes as issues, and they have proved useful in certain intractable forms of headache—the seton being inserted in the skin of the neck. Setons have been used in cases of cystic bronchocele with thickened walls; in chronic inflammation of the bladder; in many chronic affections of the uterus; in various chronic skin-diseases of an obstinate character; in chronic inflammations of the eye, and ulcerations of the cornea; and in the early stages of pulmonary phthisis.

In acute affections issues and setons are never employed, and they should not be placed over any part where there is much movement, as a troublesome sore may be the result. It is necessary to bear in mind that issues, setons, and pustulants are, like blisters, when kept on long enough to induce serous discharge, of the nature of evacuants. They carry off nutrient material from the blood, and therefore are more or less depressing and exhausting to the system, and their repeated or protracted employment will tend to induce the irritative fever of debility.

John C. Thorowgood.

COUP DE SOLEIL (Fr.).—A synonym for sunstroke. *See* Sunstroke.

COW-POX. *See* Vaccinia.

COXALGIA (*coxa*, the hip, and ἄλγος, pain).—Pain in the hip-joint. *See* Joints, Diseases of.

CRACKED-METAL or CRACKED-POT SOUND (*Bruit de pot fêlé*). A peculiar sound elicited by percussion, and resembling that emitted on striking a broken jar or a metallic vessel. *See* Physical Examination.

CRAMP.—This name is applied to certain painful varieties of tonic spasm. In its most familiar form it affects the calves of the legs, coming on principally at night, on the occasion of some slight movement of these parts. The affected muscles, mostly on one side, contract with such energy as to give rise to a board-like rigidity, together with sensations of an agonising character. The attack rarely lasts more than a minute or two, though it may more or less speedily recur. It is perhaps best cut short by a vigorous but steady voluntary contraction of the opposing extensor muscles of the foot. Where it is more obstinate than usual, firm pressure around the thigh or upon the great sciatic nerve, sometimes gives relief. Cramp is often associated with some irritation of the stomach or of the intestines, especially in children or delicate nervous persons. In this way it is produced not infrequently when arsenic in medicinal doses has been continued for some time, and is beginning to exert a slightly poisonous effect upon the system. In a more general form it often occurs, to a marked extent, in cholera. Other forms of painful spasm are by no means common, if we except colic. *See* also Spasm.

H. Charlton Bastian.

CRANIOTABES.—*See* Skull, Diseases of.

CREPITANT (*crepito*, I make a noise).—When applied to a body, this word signifies that it is capable of yielding the sensation or sound of crepitation. It is also associated with a râle, to indicate a peculiar character which it possesses. *See* Physical Examination.

CREPITATION (*crepito*, I make a noise).—A sensation or sound of crackling. It may be observed in morbid states of the bones, joints, or subcutaneous tissue; but the term is more frequently applied to a physical sign connected with the lungs. *See* Physical Examination.

CRETINISM (*creta*, chalk).—Synon.: Lat. *Cretinismus*; Fr. *Crétinisme*; Ger. *Cretinismus*; Ital. *Cretinismo*.

Definition.—A condition of idiocy arising from endemic causes, associated with imperfect development and deformity of the whole body, varying however in degree.

This condition of physical and mental degeneracy is not limited to any nationality. It obtains in the great mountain chains of Europe, Asia, and America. In Europe it is met with in the valleys of Switzerland, Savoy, and Piedmont; and it abounds in the neighbourhood of Salzburg, Styria, and the Tyrol. It is less frequently met with in the Pyrenees and in the valleys of the Auvergne in France. Even in England it has been met with in various parts, among others in the dales between Lancashire and Yorkshire. Although more frequently met with in valleys, it is not unknown on plains which are subject to inundations.

Description.—The degrees of cretinism are numerous. A residence in one of the valleys where this affection exists, enables one to trace the various steps of degeneracy commencing with those who are taking part in the industrial life of the valley, down to the helpless individuals who are leading only a vegetative existence.

The typical cretin presents a marked physical conformation. He is stunted in growth, rarely reaching five feet in height. His skin is of a tawny yellowish hue, thickened and wrinkled; and looks as if too large for the body. There is also a great increase of subcutaneous areolar tissue. His tongue, large and thick, with hypertrophied papillæ, always displays lessened power of co-ordination; and often hangs from the mouth. The mouth is partly open, margined by thick fissured lips, and with the saliva running over the chin. The face is large; the lower jaw is drooping, and its angle obtuse. The eyes are often affected by strabismus, obliquely placed, and small; and the lids are commonly puffy. The belly is pendulous from the laxness of the skin. The lower limbs are generally short and deformed, and the gait is waddling. The head is deformed, the forehead retreating, the top flat, and the occipital region ill-developed. The cranium is brachycephalic. The nose is broad and flattened. Puberty is often delayed to the twentieth year. The mammæ in the female are large and pendulous; the same remark applies to the genitals in the male. The intellectual faculties are imperfectly developed. The cretin is often unable to speak, and his hearing is frequently defective. The affection is usually associated with more or less enlargement of the thyroid gland. His viability is low, few living beyond thirty years of age. The sexual functions are abnormal; masturbation is frequent; and the subjects of cretinism are often impotent.

ÆTIOLOGY.—The conditions for the development of cretinism are hereditary predisposition; the action of deteriorating influences on the parents, such as unwholesome dwellings and non-nutritious diet; and accidental causes operating on the infant during the period when its physical and intellectual life are developing. The last-named causes are atmospheric and possibly geological conditions, peculiar to special localities. Humidity of the soil and air in valleys where there is little interchange of the atmosphere, and the existence of magnesian limestone in the soil, are probably the most potent factors. Cretinism is not met with as an endemic disease on elevated plateaux, nor in cold countries where sudden changes of temperature are uncommon. Goitre is a frequent accompaniment of cretinism, and would appear to be developed under the same conditions. The cases of cretinism met with in England present features which are indicative of a scrofulous origin. There is a condition of idiocy associated with arrest of growth and development at the period of first dentition, not unfrequently met with in England, which has been termed *Sporadic Cretinism*. Some of these cases have been traced to alcoholism on the part of the progenitors, and are usually associated with an absence or atrophy of the thyroid body. There is reason to believe that children become cretinoid when taken to reside, at the period of their early development, in localities where the disease is markedly endemic. There are numerous, well-attested instances of healthy women living during their pregnancy in cretinic districts bringing forth cretinoid children, who removing from such localities, propagate healthy children. By far, however, the greater number of cretins arrive at their helpless condition by successive steps of degeneracy in their ancestors. It has been thought that cretinism was due to premature ossification of the cranial sutures, especially of the spheno-basilar suture; and that this was caused by drinking water largely charged with lime. It is impossible, however, to regard this premature ossification, when it does occur, as other than one of the outcomes of the malady and not its cause. Moreover there are numerous examples where the synostosis is deferred instead of being premature.

ANATOMICAL CHARACTERS.—Pathological anatomy shows that the bones of the cranial vault are thickened and without diploë. The basilar groove is generally wanting. The foramina for the passage of arteries and nerves are somewhat smaller than natural. The occipital fossæ are flatter than usual, as if the flattening had resulted from a compression of the cranium from above downwards. Every variety of deformity of the cranium is met with of the brachycephalic type. The brain is usually small, unsymmetrical, pale, and infiltrated with serum. Premature synostosis is occasionally met with at the spheno-basilar suture, and with it a rectangular form of the base of the skull; this, however, cannot be regarded as a constant condition.

DIAGNOSIS.—The diagnosis of cretinism may be made in childhood, from the slowness of the development of the body, the stupid expression, the postponement in the evolution of the teeth, and of the ossification of the fontanelles and sutures, the tawny yellow colour of the skin, the thick and goitrous neck, the slavering, and the delay of speech and of walking.

TREATMENT.—This consists in removing the child as early as possible from the circumstances which have produced the disease. He should be taken to a locality where the soil is dry and porous, and should have frequent baths with friction to the surface of the body. The diet should be of the most nutritious kind—a diet into which animal food largely enters. The administration of cod-liver oil and of the lacto-phosphate of lime and iron is indicated. Early education should be commenced as to habits of cleanliness, followed by systematic physical exercise of the various muscles. All intellectual advancement must be sought for through the improvement in every way of his physical condition. The lower animal life may thus be supplemented, if earnest efforts are used, by increased capacity for rational enjoyment, and a more or less useful existence.

J. LANGDON DOWN.

CRIMINAL IRRESPONSIBILITY.—HISTORICAL SUMMARY.—A medical opinion as to the condition of an accused person is often necessary in order to determine whether he or she can be held accountable for criminal acts. Such an opinion generally depends on the presence or absence of insanity, or on the connection which may be traced between this mental condition and the act in question. In the article on Legal Insanity it is explained that it is only within a comparatively recent period that insanity has been admitted as an excuse for crime, except in those comparatively rare cases in which, as Justice Tracey expressed it in 1723, a person does not know what he is doing, 'no more than an infant, a brute, or a wild beast.' *See* INSANITY, LEGAL. This view fairly represents the state of public and of legal opinion until the later years of the eighteenth century. The subsequent enlightenment of the public mind did not receive juristic expression until the trial of Hadfield in 1800, when Erskine first enunciated the doctrine, that 'delusion where there is no frenzy or raving madness is the true character' of such insanity as implies irresponsibility. The most important case in the history of this question was that of Bellingham, who was executed in 1812 for shooting Mr. Spencer Perceval. In this case Lord Chief Justice Mansfield said, that if a person labouring under mental derangement were capable in other respects of distinguishing right from wrong, 'he could not be excused for any act of atrocity which he might commit.' 'It must be proved beyond all doubt,' he added, 'that at the time he committed the atrocious act he did not consider that murder was a crime against the laws of God and nature.' The trial of MacNaughton in 1843 for the murder of Mr. Drummond led to the most authoritative statement of the law which has ever been obtained in this country. MacNaughton was acquitted on Chief Justice Tindal's direction that the point for the jury to consider was whether 'at the time the act was committed' the accused 'had that competent use of his understanding as that he knew that he was doing by the very act itself a wicked and a wrong thing.' The general application of this doctrine would have greatly enlarged the area of irresponsibility, and its enunciation at that time produced considerable surprise and even consternation. The matter was indeed regarded as so urgent that the House of Lords immediately ordered a series of questions to be laid before the fifteen judges with the view of settling the state of the law. In the answers to these questions it was in substance laid down, that to entitle an accused party to acquittal on the ground of insanity it is necessary that he be of diseased mind, and at the time he committed the act not conscious of right or wrong; or, that he be under some delusion which made him regard the act as right. But this statement has been far from effecting a final settlement of the question.

Most writers on medical jurisprudence have insisted that the real criterion of responsibility is the freedom of the will, or the power of the individual to control his actions. This has been more or less advocated by Esquirol, Marc, Ray, Pagan, Jamieson, Mittermaier, and Von Krafft-Ebing. Esquirol dwells strongly on the importance of the freedom of the will. Ray includes it in the comprehensive statement which has received the approval of so many medical jurists. 'Liberty of will and action,' he says, 'is absolutely essential to criminal responsibility, unless the constraint upon either is the natural and well-known result of immoral or illegal conduct. Culpability supposes not only a clear perception of the consequences of criminal acts, but the liberty unembarrassed by disease of the active powers which nature has given us, of pursuing that course which is the result of the free choice of the intellectual faculties.' Pagan observes that the 'loss of control over our actions, which insanity implies, is that which renders the acts which are committed during its continuance undeserving of punishment.' Jamieson puts the question: 'Had the lunatic at the time of committing the deed a knowledge that it was criminal, and such a control over his actions as ought, if it existed, to have hindered him from committing it.' Dr. Taylor says: 'The power which is most manifestly deficient in the insane is generally the controlling power of the will'; and he expresses the opinion that 'we have here a fair criterion on which responsibility or irresponsibility may be tested.' Dr. Bucknill's view is substantially the same. 'Responsibility,' he says, 'depends upon power, not upon knowledge, still less upon feeling. A man is responsible to do that which he can do, not that which he feels or knows it right to do. If a man is reduced under thraldom to passion by disease of the brain he loses moral freedom and responsibility, although his knowledge of right and wrong may remain intact.' The latest German code puts responsibility upon the same basis. 'An act is not punishable,' according to it, 'when the person at the time of doing it was in a state of unconsciousness; or of disease of the mind, whereby free volition was prevented.' Mittermaier and Von Krafft-Ebing sanction the attempt to render the meaning of 'free volition' more definite by describing it as made up of *libertas judicii* and *libertas consilii*, freedom of judgment and freedom of choice. Casper somewhat obscurely defines criminal responsibility as 'the psychological possibility of the efficacy of the penal code.' Mr. Balfour Browne, a recent writer, gives as the best definition 'a knowledge that certain acts are permitted by law, and that certain acts are contrary to law, and, combined with this knowledge, the power to appreciate and be moved by the ordinary motives which influence the actions of mankind.' Dr. Guy thinks that every person who is insane must be regarded as wholly irresponsible, and that the law of England ought to be assimilated to that of France in the declaration that: 'Il n'y a ni crime ni délit lorsque le prévenu était en état de démence au temps de l'action.' Mr. Warren, on the other hand, suggests that a person should not be held irresponsible unless he were as 'unconscious of his act as a baby.' Dr. Maudsley and others hold that the determination of responsibility in cases where insanity is alleged depends on whether a connection can or cannot be traced between existing disease and the act.

Insanity has been pleaded as an excuse for acts of theft; but such cases are rare, and never occur except where the social position of the accused adds importance to the decision. Indeed it may almost be said that the plea is never raised, except in order to avoid capital punishment. Hence it is, that in the discussions which have arisen the question has been intimately associated with the law of murder and homicide. A special inquiry into the state of this law by a committee of the House of Commons[1] has consequently given occasion to the enunciation of important views as to the legal relations of insanity and responsibility. Evidence was furnished to the Committee by Lord Chief Justice Cockburn, Baron Bramwell, Mr. Justice (now Lord) Blackburn, and Sir James Fitz-James Stephen. The immediate object of the Committee was to examine a bill drawn by Sir James Stephen for the codification of the law of homicide. In the clause of the bill which deals with the relations of disease and responsibility, homicide is stated to be 'not criminal if the person by whom it is committed is at the time when he commits it prevented by any disease affecting his mind—(*a*) from knowing the nature of the act done by him, (*b*) from knowing that it is forbidden by law, (*c*) from knowing that it is morally wrong, or (*d*) from controlling his own conduct.' But it is stated to be 'criminal, although the mind of the person committing it is affected by disease, if such disease does not in fact produce one of the effects aforesaid in reference to the act by which death is caused, or if the inability to control his conduct is not produced exclusively by such disease.' It was, however, proposed in the bill that, 'if a person is proved to have been labouring under any insane delusion at the time when he committed the homicide, it shall be presumed, unless the contrary appears or is proved, that he did not possess the degree of knowledge or self-control hereinbefore specified.' That is to say, where delusion exists, the burden of proving moral capacity would be shifted, the prosecutor having to prove its existence, instead of the accused having to prove its absence. The opinions elicited during the enquiry showed that the law is regarded by legal authorities as being at present too uncertain in its operation, and as failing to recognise some of the most important elements in the question. The divergent character of the recommendations which were made showed, however, that legal opinion is much divided not only as to the proper relations of insanity and crime, but also as to the essential elements of responsibility. In the meantime, therefore, the statements of the fifteen judges after the MacNaughton case remain the chief exposition of the English law where insanity is pleaded in excuse for crime.

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[1] Report of Select Committee of the House of Commons on the Homicide Law Amendment Bill, July 21, 1874.

Present state of the question.—It is necessary, in order to justly appreciate the present aspect of the subject, thus to trace its more recent history, and it would be useful, did space permit, to present an estimate of the comparative value of the several tests or criteria which have been proposed for the determination of cases in which insanity has been alleged. These criteria may be broadly summarised in the following six propositions. According to one view a person should be held irresponsible for an act if at the time of committing it (1) he laboured under insanity of any kind or degree; according to another, if (2) he laboured under delusion; or (3) if he was ignorant of right and wrong; or (4) had not power to appreciate and be moved by ordinary motives; or (5) had lost the controlling power of the will; or (6) if the act is traceable to, or its nature has been determined by mental disease affecting the agent. The last of these views is the only one to which fatal objection may not be raised both on the theoretical and practical sides. The others are all too vague to be of much advantage; and they rather tend to introduce new difficulties than to remove those already existing. The proposition therefore which seems to approach nearest to a solution of the difficulty is that irresponsibility must be admitted whenever the act is traceable to, or its nature is determined by mental disease affecting the agent. It will of course be understood that under such a rule the term 'mental disease' must be held to include both congenital and acquired disorders: arrest of development being as much a morbid condition as functional or structural change. This view of the subject may not be ultimately accepted in the precise terms of the proposition here given; but the principle on which it rests seems to afford the only safe basis upon which we can go. As has already been shown, it has not hitherto been regarded in this light by the majority of the judges; but there have been indications of late years that judicial views are tending in that direction. The late Lord Wensleydale and others have given sanction to the principle in their judicial statements. And the present Lord Justice-General of Scotland (Inglis) gave definite expression to it in one case (*Brown*, Sept. 1866). He told the jury that the main question was 'whether the prisoner was in such a state of insanity at the time, as not to be responsible for the act which he had committed'; and in order to constitute such insanity he said that 'it must be clearly made out that at the time of committing the act the prisoner was labouring under mental disease in the proper sense of the term, and that that mental disease was the cause of the act.' In America the doctrine has been frequently acknowledged, but never more fully and tersely than by Judge Doe, of New Hampshire (*State v. Pike*), who comprehensively defined the medical relations of both criminal irresponsibility and civil incapacity, when he stated that 'a product of mental disease is neither a contract, a will, nor a crime.' One important point is to prevent persons from being punished for actions which are the direct outcome of pathological processes. But it is of equal importance to avoid the adoption of a principle which would make the existence of slight mental irregularities incompatible with responsibility. There does not appear to be any danger of this in acting on the principle which is here enunciated. For it lies in the very nature of the cases in which the doctrine could be applied, that the condition to which it is proposed that irresponsibility should be attached must be one which is known to exhibit itself in acts of serious and even criminal character. If the trained observer of disease is able to recognise in an act—which is ordinarily followed by severe punishment—a direct result or a characteristic feature of a morbid process, of the existence of which there may otherwise be sufficient proof, the question of responsibility cannot present any serious difficulty. It may admit of doubt whether a person is responsible for not controlling his actions, or for not knowing right from wrong, or even in some cases for the harbouring of a delusion. But once let it be proved that an act is the natural result of a disease under which a person is known to labour, and the question must be practically removed from the field of discussion. Before, however, the principle can be accepted as fully satisfactory, it is necessary to enquire whether its application would permit insane persons to be held responsible who ought not to be so considered. In other words, are there states of insanity in which a person is irresponsible for acts to which he has not been predisposed or impelled by the insanity? It is perhaps impossible to give such an answer to this question as would be both definite and complete; but for practical purposes we think it may be answered in the negative. Where the insanity is of such a nature that it does not modify the whole conduct, we believe it will be found in practice necessary to admit the existence of responsibility for acts where there is no demonstrable connection between them and the mental disease. The insane persons who on this principle might be held responsible, would be found solely among those whose irresponsibility could only be admitted after very searching enquiry, and whose insanity was of that kind and degree which has often been declared by medical writers to be consistent with responsibility. It is not to be supposed that under this rule difficulties would cease. It would often be hard to show in cases of actual disease that there was good reason for believing in its existence, or that it was really contributory to the act committed. This, however, would not result from any defect in the principle, but from that imperfection of our knowledge which renders the perfect application of any principle impossible. Let the task of the medical witness be limited to the demonstration of facts indicative of disease and its consequences, and he will at least be acting quite within his special province and might expect that reasonable weight would be attached to his opinion. And if juries were instructed that the law does not hold a person responsible for acts committed under the influence of disease, it is scarcely conceivable that anyone would be found guilty where good cause had been shown even for the reasonable supposition of such an influence. Whatever may be the view ultimately adopted, it would seem to be in every way desirable that the attention of the medical expert should be confined to the elucidation of the medical facts, and that he should not be required to deal with questions which are legal and abstract, and in no way specially medical. The condition known as *diminished responsibility* has not been alluded to in this article. It is only indirectly recognised by British law, and therefore, though much is to be said in favour of its recognition, it is unnecessary to deal with the subject here. JOHN SIBBALD.

CRISIS (*κρίσις*, a decision, a turn).—Crisis is a term applied to the rapid defervescence of an acute febrile disease. It has wandered somewhat from its original meaning, which was 'judgment,'—primarily an operation in the mind of the observer, but reflected upon the phenomena observed. The converse term, employed to designate a gradual subsidence of fever, is *lysis*.

Crisis formed at one time the basis of an important medical doctrine. Certain days from the onset of the disease on which the crisis commonly occurred were considered to be propitious. The seventh day was especially favourable, while the sixth was the most unfavourable; speaking generally, the odd numbers or the multiples of 7 were propitious, and even numbers and such odd numbers as stood near multiples of 7, such as 19, were unpropitious. The preparation also for a crisis was indicated and the critical day foretold by remissions perceptible some days previously. The whole morbid process of fever was represented as a process of elaboration by which a *materies morbi* was prepared for expulsion, and an essential feature of the crisis was a critical evacuation, by means of which this was eliminated.

The doctrine of crisis and even of critical days was not pure imagination or superstition, but was founded originally on careful observation. In times when nothing was known of the organic lesions which give rise to fever, and in countries where a large proportion of the diseases were of a malarious origin, it would afford data for prognosis and conduce to appropriate treatment; and at the present day in hot climates a crisis is anxiously looked for in febrile attacks on a given day, and, as is well known, a critical fall of temperature and improvement in the general symptoms precede in pneumonia improvement in the physical signs.

In order to constitute a true crisis the defervescence should occupy less than forty-eight hours, and it often takes place in a much shorter time. The fall of temperature should be accompanied by a corresponding reduction in the frequency of the pulse, and should coincide with a feeling of relief and a return of strength, the skin will be warm and soft, the tongue moist, and there will be indications of reviving appetite; there may or may not be a critical evacuation, but the secretions will become more natural in amount and character.

This favourable mode of termination of an acute febrile disease is more common than is usually supposed. The circumstances under which it is most likely to occur are when the attack begins abruptly and the temperature rises rapidly, the natural course of the disease being short and not attended with organic lesions, such as will of themselves keep up fever. After twenty-one days, termination by crisis is not to be expected. The more marked the onset, as, for example, by a definite rigor, the more rapid the rise of temperature and the greater the height to which it reaches, the greater the probability of an early critical termination.

OCCURRENCE.—The diseases in which the conditions favouring a crisis are realised, and in which this mode of termination is observed, belong to various classes.

Among the *specific fevers*, eruptive and continued, it occurs frequently in variola, but in severe cases it is interfered with by the febrile disturbance excited by the eruption. In measles it is very common: in scarlet-fever a true crisis is seen only in mild cases, though the onset of this disease is peculiarly abrupt. The mode of termination of typhus is essentially critical, but as a rule the crisis is not sharp. Relapsing fever affords the best examples of crisis, which is moreover attended by a critical evacuation in the form of profuse perspiration, the temperature sometimes falling 10° F. in as many hours, and the patient passing from a state of extreme suffering and oppression to almost perfect ease and comfort. In enteric fever *lysis* is the mode of termination.

Remittent fevers often present crises, which may be true and curative, or false and illusive; and the sun-fever and common continued fever of hot climates, and tropical diseases generally, have a tendency to fever running high very early and breaking abruptly at a critical period.

In this country *feverish colds*, attacking the throat or taking the form of influenza or catarrh, often terminate critically in three or four days. Erysipelas may so end, but at a later and less definite period. The sharp *febrile attacks* which sometimes occur *after childbirth* often exhibit a very decided crisis. In *pneumonia* the natural termination is by a well-marked crisis, which may take place as early as the fifth day, or be deferred to the ninth, after which a critical termination is not to be expected, and the suspicion may be entertained that the case is not one of frank pneumonia, the prognosis becoming grave. As has been already stated, the general improvement precedes the indications by physical signs of resolution in the inflamed lung. Pleurisy is said also to terminate critically, but it is not in the same definite way as pneumonia.

The *critical evacuations* which entered into the original notion of a crisis are really a common attendant. The most common is a profuse warm perspiration, which may occur whatever the disease may be. Occasionally the evacuation is a copious flow of urine, or it may take the form of diarrhœa. Epistaxis or hæmorrhoidal flux is a more rare and doubtful critical evacuation. A common critical phenomenon is a prolonged, sound, and refreshing sleep.

The question whether or not a favourable crisis affects the odd rather than the even days has been a frequent subject of dispute, and it still remains undecided. It is not, however, of any importance; but another point handed down with the doctrine is worthy of attention, namely, that indications of an approaching crisis are often given two or three days beforehand in slight remissions of fever. By the presence or absence of such remissions at a certain period of the attack, or by a continuous rise of temperature where a remission might be expected, important prognostic information may be afforded and indications for treatment obtained.

THERAPEUTIC INDICATIONS.—The main therapeutic deduction from a study of crisis as a termination of acute disease is, that we should not hastily interfere with the reactions by which the system adjusts itself to altered conditions or meets the incidence of the causes of such disease, but contribute to their completion. We do not assume the existence of a *vis medicatrix* tending invariably to the restoration of health; but we must recognise the power inherent in a living organism to respond by internal changes to external influences, and to regain the balance when this has been disturbed. In this process a certain cycle of changes must be gone through, and the great opportunity for treatment of an active kind, should any be required, arises when the course, direction, and probable duration of these changes are known, and when agencies can be brought to bear at a given moment, which will contribute to bring about the appropriate critical evacuation or a critical sleep, through which a return to a normal condition would naturally be effected.

WILLIAM H. BROADBENT.

CRITICAL.—Having relation to a crisis. *See* CRISIS.

CROUP.—DEFINITION.—Croup is a word which, in accordance with its etymology, originally meant *stridulous breathing*, a symptom, therefore, of laryngitis stridulosa, laryngismus stridulus, œdema of the glottis, laryngo-tracheal diphtheria, and other affections which permanently or spasmodically contract the chink of the glottis. It was imported from the Scottish vernacular into medical nomenclature by Dr. Francis Home, of Edinburgh, in 1765, when he published a tract of 60 sparsely printed pages, entitled *An Inquiry into the Nature, Cause, and Cure of the Croup.* It has since drifted into very strange and very different meanings. 'In France,' to quote the Dictionary of Littré and Robin, 'it is a term now generally reserved for *tracheal diphtheria*:' in Germany, it is applied to *membranous deposits on the internal surface of organs*, such expressions as 'croup of the uterus' and 'croup of the intestine' being in current use: in Great Britain it is used, as employed by Home, Cheyne, and their followers, to designate a disease which they believe to be distinctive and separate, but which is declared by an increasing number of British physicians, the followers of Bretonneau, to be a mere literary composite of diseases pathologically different from one another. In a general way, the question—What is croup?—has now been answered. It is necessary, however, still further to explain the position which 'croup' at present holds in the literature and science of British medicine.

In 1826 Bretonneau of Tours, by the publication of his work entitled *Recherches sur l'Inflammation Spéciale du Tissu Muqueux, en particulier sur la Diphthérite*, created the name, and first pointed out, in that and subsequent writings, the true pathology of diphtheria. He did not, however, describe a new disease. He only disentangled it from other diseases in which it had been mixed up in description. Modern literary research has shown that diphtheria has at intervals prevailed, under various names, in many countries, from the earliest medico-historical times. Home, in his little monograph, describes only eight cases; and of these, all of which he calls by the name of 'croup,' five are manifestly tracheal diphtheria, and three are cases of laryngitis. As no false membrane was seen in the three cases of laryngitis, he concluded that it had been absorbed, or that the treatment had prevented its formation! For a long period his successors, British and foreign, continued to make similar mistakes; and indeed till Bretonneau published the result of his clinical study, the error now adverted to was universally accepted as the truth. In 1801, Dr John Cheyne of Edinburgh published his *Essay on Cynanche*

Trachealis, or Croup, a pamphlet of 80 pages illustrated by five excellent plates, the work of the illustrious Charles Bell. Cheyne, like Home, has confounded together infantile laryngitis and infantile tracheal diphtheria in one disease, which he calls 'cynanche trachealis or croup.' He attributes the recoveries from the former to the energy of the bleeding and purging; and the deaths from the latter to the imperfect adoption of that treatment. Dr. Cheyne's essay contains only ten cases. In the history of the five which terminated in recovery, nothing is said of false-membranes having been seen; and in four of the five which terminated in death, there was found false-membrane, which is well depicted by Charles Bell in the coloured plates. If the account now given of the constantly quoted, and often misquoted, little tracts be correct, where is the foundation for the statement reiterated up to the hour at which we write by a succession of British authors, that the said writings of Home and Cheyne contain the description of an individual disease—croup—possessing essentially different features from the laryngeal and tracheal diphtheria of Bretonneau?

It must be admitted that, while the inference to which the preceding remarks are intended to lead is in accordance with the views of some eminent British physicians, it is at variance with the teaching of others who claim respectful attention. Dr. Charles West, in the edition of his *Lectures on the Diseases of Infancy and Childhood*, published in 1874, when discussing 'Diphtheria or Angina Maligna,' says:—'I have come to the conclusion which I long hesitated to adopt, that what differences soever exist between croup and diphtheria, they must be sought elsewhere than in the pathological changes observable in the respiratory organs. The mere extent of false-membrane in the air-passages certainly affords no ground for a distinction between the two affections, though I think it is more common to find the false-membrane reaching to the tertiary bronchi in diphtheria than in primary croup.' In these sentences he intimates his belief in a non-diphtheritic membranous croup—a disease which many maintain has no existence, except in books. In the same work, in the lecture on croup, he says:—'It can scarcely be necessary to tell any of you that *croup* is the English name for the disease designated by scientific writers *cynanche trachealis* or *cynanche laryngea*. It consists in inflammation, generally of a highly acute character, of the trachea or larynx, or both, which terminates in the majority of cases in the exudation of false-membrane, more or less abundantly, upon the affected surface.'—(Lecture xxiii. p. 390, 6th edition, London, 1874.) The only case of croup given by Dr. West in the lecture is one which, if Bretonneau's teaching be correct, is a typical case of diphtheria affecting the air-passages. The case and the sentence by which it is introduced, are subjoined:—

'The danger,' says Dr. West, 'of being lulled into security by the apparent improvement of a child who has been attacked by croup, is so serious that before proceeding to consider the treatment of the disease, I will relate to you a case by way of caution. On June 25, a little girl, four years old, became hoarse and lost her appetite, though she did not appear otherwise ill. On the 27th, she seemed less well, and in the night was very restless, and had difficulty of breathing. On the 28th, respiration was more difficult, and though she had but little cough, she seemed sometimes in danger of choking. In the night a croupy sound accompanied her breathing, and violent attacks of dyspnœa were of frequent occurrence. On the 29th, she was taken to a surgeon, who gave her some medicine, after each dose of which she was sick; and this sickness was followed by much relief, and by an almost complete cessation of the croupy sound. This improvement was thought to have continued during the 30th; the child slept quietly during the night, and was considered so much better by her parents that she was brought by them to the Children's Hospital at 9 a.m. on July 1. As she lay in the lap in a sitting position, her countenance was pale and livid, her respiration was sibilant, her surface cool, her pulse very frequent and feeble; but she did not appear to be in any of the distress usual in the advanced stages of croup. At 9 a.m. she was admitted; at 6 p.m. she died, though no great distress nor violent struggle for breath preceded her death. The extensive deposit of false-membrane in the trachea and bronchi showed that in spite of her apparent amendment for a season, disease must all the time have been advancing, unsuspected by her friends, overlooked even by her medical attendants.'

This case, given by Dr. West as a case of the disease which he calls croup *in contradistinction to diphtheria*, will be regarded by the medical profession in France, and by all other followers of Bretonneau, as a typical and graphically described example of diphtheria implicating the air-passages. They will say that it was typical in its manner of invasion, in its course and duration, in its being relieved by emetics, in the anæsthesia and asphyxia proclaimed by quietude and the pale lividity of countenance observed nine hours before death; and finally, that it was typical in the extensive deposit of false-membrane in the trachea and bronchi.

In illustration of the remarks made at the beginning of this article on the meanings of the term *croup*, it is well to remind the reader that Dr. West's case, now quoted, will be called *croup* by French physicians, for they reserve that name for the manifestation of diphtheria in the air-passages.

ÆTIOLOGY.—The disease which Home, Cheyne, West, Sansom, and many other older and recent British authors of repute call *croup*, is an acute inflammation of the larynx or trachea, or of both, which, when it runs its natural course, generally, they say, terminates in membranous exudation on the inflamed mucous surface. The affection which Bretonneau, Trousseau, Peter, Barthez, Sanné, and the entire modern school of French physicians, call *croup*, is the membranous manifestation in the larynx and trachea, or in both, of diphtheria, a general asthenic disease. The French physicians, with whom agree George Johnson, Semple, and other British physicians, including the writer, hold that membranous exudation is never a result of simple acute inflammation, or, in other words, that there is no such disease as the croup of Home, Cheyne, West, and

Sansom, these authors having blended two essentially different diseases in one description.

No statement could have been written intelligibly in respect to the ætiology of 'croup,' without these prefatory remarks. The subject now admits of being very briefly disposed of. Diphtheritic croup, that is to say, the croup of French authors, is considered in the article DIPHTHERIA. The common exciting causes of inflammations of the larynx and trachea are exposure to chilly winds and cold damp air; and the sudden transitions from mild to cold wet weather. Cold wet places are those in which inflammations of the larynx, trachea, bronchi, and pulmonary parenchyma are most prevalent. The much greater frequency of these affections among children in the northern and eastern coasts of Great Britain than in the southern is attributable to the greater rigour of the climate in the former regions. In some localities in northern Europe inflammation of the air-passages is said to prevail at times among children as an epidemic. Perhaps a somewhat exaggerated impression exists as to the greater proportion of cases of inflammation of the larynx and trachea in young children, because in them it generally causes stridulous breathing. The chink of the glottis being very small in young children does not admit of being narrowed by turgidity of the mucous membrane without the causation of stridulous breathing to a greater or less extent. Even a slight catarrhal affection of the larynx and trachea, by exciting spasm, causes stridulous or 'croupy' breathing in a very young child, whereas a somewhat acute inflammation accompanied by considerable swelling of the same parts often runs its course in the adult without producing noisy breathing or alarm.

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TREATMENT.—The treatment of diphtheritic croup is described in the article DIPHTHERIA.

Inflammation of the larynx and trachea, like inflammatory affections of the other parts of the air-passages and lungs, requires to be treated by antiphlogistic measures. When the inflammation is acute, active remedies are called for. Some physicians do not hesitate in such cases to bleed from the jugular vein, taking as much as three ounces of blood from a child two or three years of age. Others, including the writer, abstain from this heroic proceeding, under the conviction that although it often produces apparent temporary benefit, it is a benefit always fraught with evil. The strength is dangerously reduced; a fatal issue may be precipitated; and when recovery does take place, the course of convalescence is slow and difficult. It seems safer, and every way better, to subdue the inflammation by blisters and carefully watched doses of ipecacuan and tartar-emetic. If the affection be only moderately sthenic, it is prudent first to use the ipecacuan by itself; there are many cases, however, in which the antimonial must not be withheld. Too large a dose of tartar-emetic may give rise to alarming depression. Should such a state be induced, the best means of averting danger is watchfully to administer a little brandy, and apply a small blister—say an inch and a half square—over the sternum about two inches below the manubrium, a warm moist linseed poultice being placed over it for three or four hours. Even when no depression has been occasioned by drugs, a succession of small blisters to the chest is of great use. Signal benefit is often obtained by a short and smart purging with calomel and scammony. In all cases, the legs must be kept enveloped in warm wrappings, moist warmth being preferred if it can be unflaggingly maintained.

In most cases, the breathing is subject to dyspnœal paroxysms arising from spasm of the glottis. The muscular relaxation which follows the emetic action of ipecacuan or tartar-emetic generally relieves this spasm with rapidity and for some hours. The vomitive effort is also useful in another way—in clearing the air-passages from dangerously accumulating mucus, and so admitting more air into the lungs. When bronchitis and broncho-pneumonia are associated, as frequently happens, with the laryngeal and tracheal inflammation, the treatment is the same as that which has been already described. In protracted cases, and in weak children, it is nearly always necessary to give, for a longer or shorter period, brandy or some other alcoholic stimulant. Ammonia too is generally indicated. The extent to which stimulants are demanded varies with each case, and also with the varying circumstances of each case. Milk ought to be the principal aliment. Beef-tea, and arrowroot made with milk or with brandy, may also be given from time to time.

Should diphtheria be prevalent when we have under treatment cases of common inflammatory sore-throat, we must be specially on the outlook for the supervention of the former. Not in cases of simple inflammatory sore-throat only, but still more in the sore-throat of scarlatina and measles, diphtheria frequently supervenes as a secondary disease, suddenly declaring itself by an exudation of false-membrane in the air-passages. A new principle of treatment must be adopted when diphtheria engrafts itself on the original inflammation. We have then to treat an asthenic general disease as well as the throat-affection.

The possibility of the supervention of diphtheria, with its accompanying prostration of strength and dyscrasia of the blood, is another argument in addition to those already mentioned against the abstraction of blood in the common laryngo-tracheal inflammations of young children.

[The article on DIPHTHERIA should be read in connection with this article.]

JOHN ROSE CORMACK.

CROUP, FALSE.—A term commonly applied to laryngismus stridulus. *See* LARYNX, Diseases of.

CROUPOUS, CROUPY (Scot. *croup*, to croak).—These terms were originally employed with reference to the peculiar crowing or stridulous character of the respiration, cough, and voice in certain affections of the larynx, and signified 'belonging to croup' in its clinical relations; for example, 'croupy cough,' 'croupous symptoms.' When morbid anatomy demonstrated the occurrence of a fibrinous exudation or false membrane upon the affected surface in a special form of croup, the word 'croupous' was used also to designate this false membrane; thus, 'croupous exudation' and 'croupy membranes.' The application of the term was afterwards further extended; and it is now employed to indicate the process that leads to a fibrinous exudation in any situation whatever; such as 'croupous inflammation,' and 'croupous pneumonia.' Thus the words "croupous' and 'croupy,' which were originally associated with peculiar sounds, have come in a remarkable manner to express certain physical, chemical, and microscopical characters in the products of inflammation. *See* CROUP, DIPHTHERIA, and INFLAMMATION.

CROWING CONVULSION.—A popular synonym for laryngismus stridulus. *See* LARYNX, Diseases of.

CRURA CEREBRI, Lesions of.—From anatomical and physiological considerations we should be prepared to find that a solution of continuity of the crus cerebri would interrupt the sensory and motor tracts for the opposite side of the body. And, further, as the roots of the third nerve pass through the inner aspect of the crus to their nucleus underneath the aqueduct of Sylvius, there is considerable danger of their being implicated in a lesion of the crus.

Hence we should expect, in consequence of such a lesion, a form of alternate paralysis, viz., oculo-motor paralysis on the side of lesion, and paralysis of voluntary motion and sensation on the opposite side. A typical instance of this form of paralysis has been put on record by Weber (*Med. Clin. Trans.* 1863). In this case there was oculo-motor paralysis on the side of lesion, and complete paralysis of voluntary motion and partial paralysis of sensation on the opposite side. The partial escape of the sensory tracts is accounted for by the fact that the sensory tracts are situated more to the outer and back part of the crus, and hence tend to escape destruction from a lesion situated in such a position as specially to endanger the continuity of the third nerve.

Vaso-motor paralysis on the hemiplegic side also occurs in a marked degree, and the temperature of the paralysed side may be two or three degrees above that of the other.

D. FERRIER.

CRUSTA LACTEA (*crusta*, a crust, and *lactea*, milk-like); milk-crust—A synonym for eczema pustulosum of the face and head, met with in infants at the breast. *See* ECZEMA.

CRUVEILHIER'S PARALYSIS.—A synonym for progressive muscular atrophy. *See* MUSCULAR ATROPHY, Progressive.

CUPPING.—This is a mode of treatment sometimes employed to relieve congestion or inflammation of internal parts by drawing blood to the surface of the body. When the blood thus attracted to the superficial parts is actually abstracted from the body by means of incisions, the operation is called *wet*-cupping, and this has been described in the article BLOOD, Abstraction of. We shall here describe *dry*-cupping, in which no scarifications are made, the blood being simply drawn towards the surface by atmospheric exhaustion, hyperæmia of the subcutaneous parts or organs being thereby relieved.

Formerly cupping was extensively practised, but of late years it has fallen into disuse. In some respects it serves the purpose of, but has a more powerful effect than, counter-irritants; rapid and marked results being sometimes produced upon the circulation of inflamed or congested tissues.

MODES OF APPLICATION.—Dry cupping is performed as follows:—The flame of a spirit-lamp, being allowed to burn for an instant in the dome of a cupping-glass, is quickly withdrawn, and the cup is then rapidly and evenly applied to the skin over the affected part. The heat expands the air contained in the glass cupola, and, owing to the contraction which ensues on cooling, the skin is forcibly sucked up into the cup. It is well first to sponge the skin of the selected spot with hot water, so as to render it more supple and vascular; slightly moistening the rim of the cupping-glass helps to increase the degree of exhaustion.

An excellent modification of cupping, which has been demonstrated to the writer by Dr. Quain, is practised in the following way:—Instead of allowing the cup to remain stationary after its application to the skin, as is usual, the operator dexterously slides it to and fro along the surface. When the operation is to be thus performed the amount of surface drawn into the glass must not be considerable. In this way a large tract of skin may be quickly rendered hyperæmic without effusion of blood into its meshes, as happens when the cups are stationary.

PRECAUTIONS.—Cupping-glasses should be applied where the skin is thick and cushiony, as over the loins, nape of the neck, pectoral region of the chest, &c., and not where bony prominences, or other irregularities, are likely to interfere with complete exhaustion. The edges of the glasses should not be so hot as to burn the skin.

USES.—Cupping may be advantageously employed in sthenic cases of cerebral congestion, the cups being applied to the nape of the neck; in hyperæmia of the spinal cord; and in inflammation or congestion of the lungs, kidneys, or other viscera. In renal ischæmia it is eminently serviceable. This may be owing to the fact that the blood supply of the skin of the loins is in intimate relation with that of the kidneys; the vascular supply to those organs being thus directly and immediately influenced.

ALFRED WILTSHIRE.

CUTIS, Diseases of. *See* SKIN, Diseases of.

CUTIS ANSERINA (*cutis*, the skin, and *anser*, a goose). A state of roughness of the skin, resembling that of a goose when plucked, produced by prominence of the pores or follicles. It is due to contraction of the muscular structure of the corium, and is commonly occasioned by cold.

CYANIDES, Poisoning by.—*See* ANTIDOTE; and PRUSSIC ACID, Poisoning by.

CYANOSIS (κυανὸς, blue).—This which is really not a disease, refers to the peculiar blue or more or less livid colour of the surface of the body, especially in certain parts, which is observed in several affections that interfere with the circulation and oxygenation of the blood. The condition is most commonly associated with, and reaches its highest development in certain forms of congenital malformation of the heart, for which consequently cyanosis is not uncommonly used as a synonym. Lesser degrees of similar discolouration are, however, not infrequently noticed in cases of cardiac disease developed after birth, and they may also accompany pulmonary affections which materially obstruct the circulation; a cyanotic appearance is also one of the obvious effects resulting from all modes of suffocation, and it is observed in the collapse-stage of cholera. The upper half of the body may become extremely cyanotic as the result of obstruction of the superior vena cava. For the pathology of cyanosis, *see* HEART, Malformations of.

CYNANCHE (κύων, a dog, and ἄγχω, I strangle). SYNON.: Fr. *Angine*; Ger. *die Bräune*.

This word is used to express an inflammatory condition of the throat, or contiguous parts, in which difficulty of breathing or of swallowing exists, accompanied by a sense or feeling of choking. The term is used synonymously, more frequently on the Continent than in England, with *Angina*; an affix, indicative of the seat or nature of the affection, being employed as a designation for each of the several forms or varieties of disease affecting the throat or adjacent parts. Such, for example, are the terms Cynanche *laryngea*, or croup; Cynanche *maligna*, or malignant sore-throat; Cynanche *parotidea*, or mumps; Cynanche *pharyngea*, or inflammation of the pharynx; and Cynanche *tonsillaris*, or quinsy. *See* these several diseases.

CYRTOMETER (κύρτος, a curve, and μέτρον, a measure).—An instrument for measuring the absolute and relative dimensions of the chest-wall. *See* PHYSICAL EXAMINATION.

CYSTICERCUS (κύστις, a bladder, and κέρκος, a tail).—DESCRIPTION.—Cysticercus is a bladderworm furnished with a head which is distinctly visible to the naked eye. The form usually found in man is specifically identical with the so-called pork-measle, or *Cysticercus* (*telæ*) *cellulosæ*. According to Dr. Giacomini, however, the human measle commonly displays 32 cephalic hooks, whilst the pork-measle carries 24; moreover, in the human variety there is a greater adherence of the measle to its investing capsule. The only other form of cysticercus at present known to infest the human body is the slender-necked bladder-worm, or *Cysticercus tenuicollis*. An alleged example is preserved in the anatomical museum attached to King's College, London. This parasite is of frequent occurrence in the sheep.

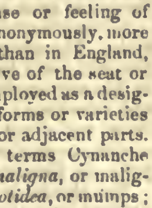

FIG. 14.—*Cysticercus* (*telæ*) *cellulosæ*, removed from the human eye by Mackenzie. × 5 diameters. After Allen Thomson.

SITUATIONS AND SYMPTOMS.—The clinical importance of the human measle is chiefly due to the circumstance that it is apt to take up its residence in the brain and eye; those parasites occupying the cerebrum being for the most part situated in the grey or cortical substance. The only serious attempt that has been made to establish diagnostic signs by which brain-cysticerci might be detected during life is that initiated by Griesinger, who based his conclusions on data supplied by the histories of upwards of fifty cases. Symptoms are exceedingly variable. In some cases they are altogether wanting; in a second set, epilepsy exists, without mental disturbance; in a third set, epilepsy is accompanied with mania or imbecility; in a fourth set, mental disturbance may occur without epilepsy; whilst in another group there is neither epilepsy nor mental disturbance, until shortly before death, when symptoms of irritation or torpor gradually supervene. Since Griesinger has himself remarked that the epileptiform seizures due to cysticercus are in all respects like ordinary cerebral epilepsy, and since also 'the psychical disturbances have nothing characteristic about them,' the practical physician is naturally tempted to conclude that diagnosis and curative treatment are alike impracticable. The writer, however, objects to that inference, on grounds too wide for discussion here; but, as one source of encouragement calls attention to the fact that cysticerci are not very long-lived. He has demonstrated that a period of eight months is amply sufficient for the setting in of calcareous degeneration, a process which involves the speedy death of the measle. If therefore the presence of cysticerci be so much as suspected in the brain, the prospect of a natural cure is by no means hopeless. Rest, both mental and corporal, would of course tend to assist nature's efforts.

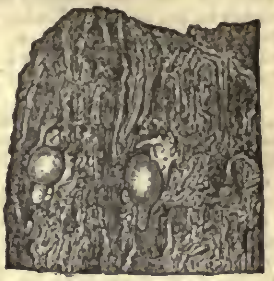

FIG. 15.—Portion of measled pork, showing *Cysticerci*. Nat. size. After Lewis.

Cysticerci may develop in any part of the human body; their most frequent situation being the subcutaneous, areolar, and intermuscular connective tissues. Amongst the more remarkable cases are five recorded by Heller, and one by Greenhalgh, where they occupied the lip; by Fournier, where several occurred in a boil; and one by Dupuytren, where the parasite lodged in the great peroneus muscle. Mr. R. Davy lately recorded a case in which several were present in the arm; but the well-known multiple cases given by Giacomini, Hodges, Delore, and others, show that hundreds of measles may co-exist in the same human host. In Delore's case there were about 2,000, of which no less than 84 were found in the cerebrum! Of instances where the cysticercus occupied the eye we may particularise the cases by Windsor, Logan, Estlin, Rose, and Mackenzie of Glasgow; whilst of additional brain-cases, those given by J. Harley, Hulke, Burton, Bouvier, Frèdault, and Toynbee are particularly noteworthy.

Amongst the most recent contributions to our knowledge of cysticerci are the memoirs of Perroncito (*Della panicatura negli animali*, in *Annali del. R. Accad. d'Agricolt. di Torino*, 1872); of Bécoulet and Giraud (*Bull. de la Soc. Méd. de Gand*, 1872), of Giacomini (Sul. *Cyst. cell. hominis* e sulla *Tænia med.* &c., 1874), of Lewis (*Report on Bladderworms*, &c., 1872), and of Pellizzari, as reported by Dr. Tommasi in his Italian edition of the writer's manual of the parasites of our domesticated animals (*Appendice Parasiti*, &c. *Vermi*, 1874). A summary of these last-mentioned researches was given by the writer in the *Lond. Med. Record* for 1874 (p. 641). Lastly, it is important to bear in mind that small hydatids, which are also liable to take up their abode in the brain, may very readily be mistaken for cysticerci, after death; and during life they are apt to give rise to precisely similar symptoms. The writer has collected records of more than thirty cases where bladderworms occurred in the human brain. References to most of these are given in the *Bibliography* of his Introduction to the study of Helminthology (*Entozoa*, 1864; and *Supplement*, 1869). *See* Bladderworms.

T. S. Cobbold.

CYSTINE or CYSTIC OXIDE (κύστις, the bladder).—A peculiar substance occurring either in solution or in the form of small crystals in the urine, or as calculi in the urinary passages. *See* Urine and Calculi.

CYSTITIS (κύστις, the bladder).—Inflammation of the bladder. *See* Bladder, Diseases of.

CYSTS.—Definition.—The word cyst (κύστις, the urinary bladder) is used in pathology for a closed cavity containing fluid or soft matter. The nature of the wall is unimportant; it may be newly formed or a pre-existent structure. The objects thus defined differ much among themselves, and are associated together rather from convenience than on account of any real pathological similarity.

Classification.—Cysts may be classified according to their structure, as simple or compound; according to their contents, as serous, mucous, fatty, etc.; or according to their mode of origin. The latter, though not free from objection, is the basis of description which will be here adopted. Cysts may originate (1) from *dilatation* of previously existing closed cavities; (2) from *retention* of products of secretion; (3) from *exudation*, or the metamorphosis of exuded products; (4) as a part of *new-growth*; (5) by a vice of *development*; and, finally, (6) from the growth of *parasites*.

1. **Cysts from Dilatation.**—Spaces, normal or newly formed, in connective tissue may, by irritation and consequent excessive exudation, be converted into cysts; or the same result may happen from the confluence of several such spaces. In proportion as the wall becomes smooth, and the shape uniform, they may be called cysts. Bursæ, whether normal or pathological, are cysts. Ganglion in the sheath of tendon is clearly a pathological cyst. To these and like structures the name *Hygroma* has been given. They all contain clear serous fluid, and are lined by an endothelium. Hydrocele, or dilatation of the tunica vaginalis testis—an affection probably always due to a low form of inflammation—is another instance. One class of ovarian cysts comes under this head, those, namely, which are due to simple dropsy of the Graafian vesicle. Tubo-ovarian dropsy has the same explanation; and cysts of the broad ligament are enlargements of normal structures which are left as relics of the development of the ovary. The thyroid gland seems from its structure, containing, as it does, so many closed follicles, particularly disposed to this kind of cyst-formation, and this is doubtless the explanation of bronchocele.

2. **Cysts from Retention.**—Cystic formations may result from the obstruction of the natural outlet of a secreting organ, and the consequent retention of secretion. It is necessary that the walls of the secreting cavity should admit of enlargement, and that the tension should not become so great as to check secretion.

All secreting glands present instances of such cysts. The sebaceous glands of the skin are particularly liable to obstruction of their duct, and in this way are formed sebaceous cysts, miliaria, and comedones; the contents of which are sometimes epithelium and the products of normal secretion, sometimes abnormal products, such as pus. *See* Follicular Diseases.

The glands or mucous surfaces are liable to similar obstructions, and *mucous cysts* result, such as are sometimes seen in the mouth. Larger cysts in the mouth (*ranula*) result from the obstruction of the ducts of the salivary glands, or are perhaps connected with an abnormal production of gland-substance. The stomach very frequently, other parts of the intestinal canal more rarely, show similar cysts, which, when they project and become complicated in structure, are called polypi. They are occasionally seen on the larynx and trachea. In no part are mucous cysts more frequent than in the uterus, where indeed, similar formations, the *ovula Nabothi*, must be regarded as normal. The varieties here met with have, as Virchow has pointed out, a close analogy with the various forms of retention-cysts in the skin.

In the mamma, cysts may result from the cutting off of portions of the gland-follicles, but the cysts contained in mammary tumours are not always formed in this way, some being part of new growths. In the testicle obstruction and cutting off of seminiferous tubes may lead to small cysts, but these are more often connected with new-growths. The curious cysts known as *spermatocele*, containing spermatozoa, appear to arise from a similar distension of detached portions of testicle-substance, which, by an error of development, have failed to become connected with the excretory ducts. The testicle is also liable to a general cystic degeneration, usually called cysto-sarcoma. Cysts of the kidney are of various kinds, but many, no doubt, both large and small, result from the dilatation of uriniferous tubules and capsules of glomeruli when their outlet is obstructed, as occurs in the cirrhotic form of Bright's disease. The origin of the very numerous microscopic cysts has been much disputed. The writer inclines to the belief that they arise from moniliform contraction of the uriniferous tubes, especially such as contain the hyaline cylinders, known as fibrinous casts. Another form of cystic disease of the kidney is developmental. In this the whole of the organ is converted into a mass of cysts, and is usually much enlarged. This condition may be congenital, and the organ may be so large as to obstruct parturition. It is attributed by Virchow to inflammation of the calyces during intra-uterine life.

To guard against a common error of language, it should be pointed out that the condition of the kidney which results from the obstruction of the ureter, or of the urinary passages lower down, though sometimes called cystic dilatation of the kidney, is not properly a case of cyst-formation, and is better called *hydronephrosis*.

3. **Cysts from Exudation.**—Exuded materials, such as blood and inflammatory products, may, by a process of degeneration, central softening, and external fibrous formation, become converted into imperfect cysts, as is seen in the metamorphosis of a blood-clot in the brain, and in the termination of some abscesses. But since the accumulation of fluid does not go on continually, the tension in such cavities is slight, and they do not approximate to a globular shape.

4. **Cysts from New-Growth.**—In many forms of new-growth cysts are produced, but not always in the same way. Sometimes, as in myxoma and enchondroma, they result from softening of portions of new-growth already formed. In many sarcomata, the production of new tissue goes hand in hand with that of cysts, and is sometimes effected as in glandular organs, by the formation of new follicular structures without an outlet, sometimes by new-growth into the dilated cavities. Polypoid or pedunculated growths on a free surface may sometimes, by the fusion of their extremities, enclose spaces which become converted into cysts. We do not, however, find cysts forming by themselves a new-growth of so definite a character as to deserve a separate name.

5. **Developmental Cysts.**—These include (*a*) *compound ovarian cysts*; (*b*) *dermoid cysts*. Cysts are met with in the ovary which come under none of the definitions just given, viz., the so-called *compound multilocular cysts*, which constitute the well-known formidable cystic disease of the ovary, and sometimes produce tumours of immense size. In these the originally simple primary cyst appears to become complicated by the formation in its walls of secondary cysts, which may encroach upon or project into the primary. Again there may be papillary growths starting from the inner wall of the primary cyst, which either fill it up, or by fusion enclose spaces, which become secondary cysts. Very complicated structures thus result. The contents may vary in consistence and colour, from clear, pale, albuminous liquid to gelatinous matter, and may be stained through hæmorrhage, or purulent through inflammation. The origin of these structures, which have no precise parallel in other parts of the body, is extremely obscure. It is not even certain whether the primary cysts commence, as might seem *primâ facie* highly probable, in the Graafian follicles; but they are plainly due to an error of development, possibly beginning in early intra-uterine life, and are not set up by any external causes. The presence of a tubular gland-tissue, such as is found in the rudimentary, but not in the perfect ovary, confirms this view, by throwing cyst-formation back into an early stage in the development of the organ.

In another, but rarer form of cystic disease of the ovary, equally due to an error of development, and sometimes congenital, the whole organ is found converted into a mass of small cysts, with no striking inequality of size. This variety resembles one form of cystic disease in the testicle and kidney.

Dermoid cysts are those containing sebaceous matter, and which are lined by a layer of flat cells resembling epidermis. The wall may be complicated with connective tissue, forming papillæ resembling those of true skin, and may contain hairs, sebaceous glands, either in connection with them or unattached, and sudoriparous glands. The accumulation of fatty matter within the cysts is doubtless the result of the continuous activity of the sebaceous glands, the products of which cannot escape. Large masses of hair may also be found, from continuous growth, and there are often numerous detached epidermic scales. Such a cyst has only the characters of a portion of skin, which might be imagined invested and included by the growth of the surrounding parts in an early stage of development—an explanation formerly entertained.

These simple dermoid cysts are sometimes complicated by containing teeth, it may be in very large numbers (*dentigerous cysts*), but since teeth may also be regarded as cutaneous products, the cyst may still have originated in the skin. This explanation no longer holds, however, when masses of bone are found, sometimes serving for the attachment of teeth, sometimes separate; as well as other tissues, *e.g.* nervous tissue and striated muscle. Cysts with this variety of contents have been called *proliferative*. Dermoid, dentigerous, and proliferative cysts appear to be always congenital structures, but may show further growth and development in after-life. At least two-thirds of the known cases have occurred in the ovaries. Next to these organs, the testicles are the most frequent seat, but these cysts have been also found in other parts of the body-cavity, in the mediastinum, lung, and even within the skull. The origin of these growths is extremely obscure; but it is desirable to reject entirely the hypothesis that a mixed tumour of this kind can be the remains of an undeveloped fœtus included in the perfect individual; a hypothesis rendered improbable by the extreme irregularity of the tissues produced, the teeth, for instance, sometimes numbering one hundred or more. It would rather appear as if a portion of embryonic tissue, from the upper and middle germinal layers, became misplaced at an early period of development.

6. **Parasitic Cysts.**—Several parasitic animals infesting the human body may appear in an encysted form, and may resemble in appearance true pathological cysts. The commonest, the larval form of *Tænia echinococcus*, or *hydatid cyst*, is known by its laminated wall, and by containing a fluid which is not albuminous, but holds in solution sodium chloride. *Cysticercus cellulosæ* has a transparent wall and clear contents. The other encysted parasites are either very small, as *Trichina spiralis*, or unimportant.

Contents of Cysts.—The serous cysts and hygromata contain an albuminous fluid like that of serous cavities, which may hold enough fibrinogenous material to coagulate spontaneously. Leucocytes may also be present. If inflammation be set up the proportion of albumin and of leucocytes becomes greatly increased. In the fluid of mucous cysts mucin is contained; in that of colloid cysts, little-known substances which are allied to gelatin. Sebaceous cysts contain neutral fats—sometimes hard, sometimes fluid, and cholesterin. Both mucous and sebaceous products may harden into concretions, and even become calcareous. In renal cysts urea has been found; in biliary cysts, bile-pigment; and in general the products of special secretion may be found in cases of retention, at least in early stages, but if retention last too long, special secretion may cease. Various exceptional contents have been already enumerated.

J. F. Payne.

D

DACTYLITIS (δάκτυλος, a finger).—A term meaning inflammation of the finger. It is applied to syphilis and struma of that organ, as in the terms dactylitis syphilitica, and dactylitis strumosa.

DANDRIFF, or Dandruff (from two Saxon words signifying *itchiness* and *foulness*).—Synon.: Furfur; Scurf of the Head.—Dandriff is met with in pityriasis, chronic eczema, and lepra vulgaris or psoriasis of the scalp.

DANDY FEVER.—A synonym for Dengue. *See* Dengue.

DARTRE (Fr.).—This term is the French equivalent of the word *tetter*, and is applied to a variety of cutaneous diseases, without strict limitation.

DAVOS, in North Engadine, Switzerland. A dry, cold, bracing, winter-climate. Altitude, 5,177 feet. Season, October to March. Winds, N.E. and S. *See* Climate, Treatment of Disease by.

DAY-BLINDNESS.—A disorder of vision, characterised by the patient being unable to see during the day: also called Nyctalopia. *See* Vision, Disorders of.

DEAFNESS.—Loss of the sense of hearing. *See* Ear, Diseases of, and Hearing, Disorders of.

DEATH, Modes of.—The proximate causes of death, whether resulting from natural decay, disease, or violence, may be reduced in ultimate analysis to two, namely, first, cessation of the circulation; and, second, cessation of respiration. On the continuance of these functions, and particularly of the former (if specialisation is possible where all are essential) life of the body as a whole, or of the individual tissues and organs, depends. These functions may cease from causes directly operating on their mechanism, but they may also be brought to a standstill by causes operating indirectly through the nerve-centres which regulate them. Hence it is usual, in accordance with Bichat's classification, to describe this as a third mode of death; so that we speak of death beginning at the *heart*, death beginning at the *lungs*, and death beginning at the *head*. This classification is convenient; for though death beginning at the head is, in reality, death from failure of the respiration or circulation, or of both, through paralysis of the vital nerve-centres, yet the affection of the nervous system is the primary fact, and the phenomena are sufficiently distinct and characteristic to require separate consideration. It must, however, always be borne in mind that, owing to the interdependence of all the vital functions, there is no such sharp line of demarcation, in reality, as we, for convenience' sake, make in theory between the various modes of death.

I. **Death from failure of the Circulation.**—This may be (1) sudden, as in *syncope* and *shock*; or (2) gradual, as in *asthenia*.

(1) *Sudden failure of the Circulation.*—As the circulation of the blood depends on the difference in the pressure in the arteries and veins, the circulation will be brought to a standstill by any cause which annihilates, or very greatly lowers, this differential pressure. The cause may be in the heart, or in the vessels, or in both.

(*a*) In the *heart*. As the action of the heart is the chief factor in the maintenance of arterial tension, any organic or structural disease of the heart, rendering it incapable of propelling its contents into the arterial system, will naturally result in cessation of the circulation and death. Under this general head are to be classed all diseases of the heart and its annexes.

But apart from structural disease, the heart may suddenly be made to cease through nervous influence. The heart may be inhibited, or be made to cease finally and for ever either by central causes, such as violent emotion, or a blow on the head; or by reflex inhibition, as in the case of a violent blow on the epigastrium, or sudden irritation of the sensory nerves of the stomach, as in corrosive poisoning, and even in the ingestion of a large draught of cold water when the system is overheated.

Death from sudden cessation of the heart's action is death from *syncope*. Momentary cessation of the heart's action is transient syncope or fainting. There is sudden loss of consciousness, due mainly to the cessation of pressure in, and anæmia of the cerebral centres.

(*b*) In the *vessels*. Rapid fall of the blood-pressure, and cessation of the circulation, will naturally be brought about by rupture of the vessels, either from injury or disease, causing death by hæmorrhage. But besides actual rupture of the vessels, the vascular area may in certain conditions become so enlarged or dilated that we may practically have death from hæmorrhage without any loss of blood externally. This is what we observe in death from *shock* or *collapse*. In certain conditions, such as that resulting from blows on the abdomen, the vascular area of the abdomen and viscera may become so dilated as practically to retain almost the entire volume of blood in the body. Hence, even though the heart may be acting, yet the circulation throughout the body generally, and especially in the extremities and superficially, is practically *nil*.

The individual may, however, retain his consciousness, and thus he differs from a patient in a state of syncope. But very frequently in cases of blows on the abdomen, there is not merely reflex dilatation of the abdominal vessels, but also reflex inhibition, for a time at least, of the heart, so that we have syncope and shock co-existing. But the symptoms of syncope may pass off, leaving those of shock still remaining. Shock, like syncope, may be transient or fatal.

(2) *Gradual failure of the Circulation.*—This constitutes death from *asthenia*. This is the natural termination of life, and it is also the mode of death after wasting and exhausting diseases, cold, starvation, &c. The vital powers fade gradually, while consciousness may be retained up to the last moment.

II. **Death from failure of the Respiration.**—The various ways in which the function of respiration may be interrupted, and the phenomena consequent thereon, have been described under the head of ASPHYXIA, to which article reference may be made.

III. **Death from paralysis of the vital nerve-centres—Coma.**—As already remarked, death beginning at the head ends by paralysing respiration and circulation. The nerve-centres situated above the medulla and pons are not essential to life except in so far as animal life is concerned, and the possibility of adaptation to surroundings. Diseases of the brain, however, are liable to prove fatal by indirect action on the medulla and pons through pressure, extension of inflammation, and the like. Certain poisons also, whether introduced from without,—such as opium and narcotics generally,—or arising within, owing to the non-elimination of waste products, as in uræmia, affect the nerve-centres, both cerebral and spinal, and not only produce unconsciousness or coma, but also paralyse the respiratory and cardiac centres.

In death arising in this manner, the individual lies unconscious, reflex action becomes abolished, and the breathing becomes stertorous and ultimately ceases, death occurring quietly or in convulsions. In death from coma, in addition to the usual phenomena of asphyxia, there is, as a rule, more or less marked congestion of the cerebral and spinal centres.

D. FERRIER.

DEATH, Signs of.—It is not always easy to determine when the spark of life has become finally extinguished. From the fear of being buried alive, which prevails more abroad than in this country, some infallible criterion of death, capable of being applied by unskilled persons, has been considered a desideratum, and valuable prizes have been offered for such a discovery. The conditions most resembling actual death are syncope, asphyxia, and trance, particularly the last. We cannot, however, say that any infallible criterion applicable by the vulgar has been discovered, and we do not rely exclusively on any one sign, but combine several.

The most reliable sign of death is proof of *cessation of the heart's action*. This, however, is not to be inferred from mere pulselessness, for the heart may still be beating, and resuscitation may be possible, when no pulse is to be felt in the arteries by ordinary manipulation. The use of the stethoscope is necessary, implying, of course, technical skill. Though, according to Rayer, the heart cannot cease to beat for more than seven seconds without death, yet, considering the very slow and feeble action of the heart (8 to 10 beats per minute) in hybernating animals, which normally have a pulse of 80 to 90 per minute, it is well to regard a similar condition as possible in man, and to spend in doubtful cases some minutes, up to half an hour, in auscultation. The so-called cases of life continuing notwithstanding cessation of the circulation, as that of Colonel Townsend, or of the Indian Fakirs, are to be set down as altogether apocryphal, and not scientifically investigated.

To enable unskilled persons to determine whether the circulation continues or not, Magnus recommends the application of a tight ligature on a finger or toe. If the circulation has quite ceased, no change in colour is produced; but if circulation continues, however feebly, the extremity, in course of a longer or shorter period, assumes a livid tint from strangulation of the venous flow, while a ring of arterial anæmia is observable at the point ligatured.

Cessation of the heart's action, if absolutely established, renders other indications unnecessary. As accessories they are useful, but the following signs are none of them individually conclusive taken alone. The first is *cessation of respiration*. Respiration may not be very obvious, and yet it may be going on. The popular methods of holding a cold mirror before the mouth and nostrils, and looking for indications of moisture; placing a flock of cotton wool on the lips to ascertain whether air-currents exist;

and placing a cup of water on the chest, and observing whether the reflection on its surface moves or remains still, are all well adapted for the purpose in view.

With the cessation of the circulation and vital turgor, the skin becomes ashy pale, and the tissues lose their elasticity. The eyeball becomes less tense, and the cornea becomes opaque. The pupils cease to react to light; and there is no vital reaction on the application of irritants to the skin. Though the body is dead as a whole, certain parts may continue to retain their independent vitality after somatic death. This is seen in the muscles, which may retain their electrical contractility from two to three hours after death. The existence of electrical contractility of the muscles in a body supposed to be dead indicates life, or death within two or three hours, according to M. Rosenthal.

The subsequent changes which occur in the dead body not only indicate the fact of death, but aid in fixing the probable period at which death occurred. These are the following:—

(1) *The cooling of the body.*—The body after death, except under certain special circumstances, as in fatal cases of cholera and yellow fever, ceases to be a source of heat-production, and therefore is to be looked upon as an inert mass possessed of a higher temperature than the average medium, which parts with its heat according to certain physical laws. The superficial coldness of collapse, which is due to cessation of the peripheral circulation, must not be mistaken for the cadaveric coldness, for there is still an amount of internal heat which has to be parted with, and the body, cold to the touch before death, may after death rise in temperature, as the internal heat radiates. It is impossible to describe here in detail all the circumstances which modify the rate of cooling of the body, but it may be said in general that all circumstances which favour radiation, convection, and conduction of heat in inorganic bodies are equally applicable here, while the opposite conditions retard. Therefore a thick coating of adipose tissue, clothing, &c., retard cooling. The exact thermometric observations of Drs. Wilks and Taylor show that at an average temperature, and without clothing, a dead body cools at the rate of about 1° Fahr. per hour.

(2) *Hypostasis.*—After death the blood gravitates to the most dependent parts, both externally and internally, giving rise to livid discolourations, termed *hypostases.* These are liable to be confounded with ecchymoses or extravasations externally, and with the results of congestion and inflammation in the internal viscera. They differ from ecchymoses in the fact that the blood is not extravasated into the tissues, but still contained in the vessels, as may be shown by an incision into the skin. So long as the blood remains fluid, these discolourations may be caused to disappear if the position of the body be reversed; they will again form in the parts which are now the most dependent. They usually occur in from eight to ten hours after death.

(3) *Rigor mortis.*—After death the muscles become stiff, giving rise to *rigor mortis* or cadaveric rigidity. It is due to coagulation of the muscle-plasma. This rigidity attacks the muscles usually in a certain definite order, beginning in the muscles of the neck and face, and gradually extending from above downwards. It gives way to putrefaction in the same order, so that while the upper parts of the body may be flaccid, the legs may be found rigid. It can only be overcome by tearing the tissues, and if overcome it does not return. In this it differs from cataleptic rigidity. A certain amount of mobility is still observable at the joints. In this it is unlike the stiffness of freezing, in which all the parts are equally rigid, and crackle if bent.

The period of the occurrence of rigidity, and the length of its endurance, are extremely variable, so that no definite practical rules can be laid down. It may be said generally, however, that the greater the store of muscular energy at the time of death, the longer it is before rigidity sets in, and the longer it lasts. On the contrary, the greater the exhaustion, the sooner rigidity sets in, and the sooner it disappears. Hence rigidity is longer in appearing in subjects dying suddenly in full muscular vigour, than in those dying from exhaustion. As a rule, a period of relaxation intervenes between death and the occurrence of rigidity, but in certain cases the last muscular contraction seems to pass directly into the rigidity of death. This is seen more particularly in death during great nervous excitement, as in soldiers in the field of battle, or in suicides. The same is said to occur also in death from strychnia-poisoning and in death by lightning.

Rigidity may therefore occur immediately on death or within a few hours. It has never been observed to be delayed beyond a day after death. It may last from so short a time as scarcely to be perceptible, up to a week or more.

(4) *Putrefaction.*—After death the tissues undergo changes in colour, consistence, &c., by which they are ultimately resolved into their simple elements, included under the general term *putrefaction.* Putrefaction, however, may occur locally during life, and general septic changes may occur to some extent before death. The term, however, is not generally applied until the changes are clearly perceptible in alteration of colour, consistence, and smell. The first external sign is a greenish discolouration of the abdomen. Internally the mucous membrane of the larynx and trachea is the first to exhibit change in colour and consistence. The less compact tissues putrefy first, the fibrous tissues resist longer, and the compact tissue of the uterus resists longest of all. In process of time, however, the soft tissues become entirely disintegrated and the skeleton is exposed and gradually falls to pieces.

The rate of putrefaction is very variable, depending partly on the state of the body itself, but mainly on external conditions as to temperature, moisture, and exposure. A combination of high temperature, moisture, and free exposure, are the most favourable conditions for rapid putrefaction. A high temperature alone without moisture tends to dry the tissues, and thus to produce mummification, instead of colliquative putrefaction. Moisture alone, as when a body lies in water or moist earth, tends to produce a saponification of the tissues, more particularly the fatty, with the formation of a substance termed adipocere (*see* ADIPOCERE). The course of putrefaction can be stopped by antiseptics, as in embalming, and in certain cases of poisoning, as with arsenic, as also by freezing. Putrefaction is more rapid in air than in water, and least rapid in earth. Under ordinary circumstances and average temperatures, signs of putrefaction are clearly visible on the third day after death, commencing with the green hue of the abdomen. Many months elapse before the soft tissues become entirely disintegrated. The uterus has been found fit for judicial examination as long as nine months after death, where no antiseptics had been employed. When such has been the case, however, there is practically no limit to the period of preservation—witness the Egyptian mummies.

There is still much to be learnt respecting putrefaction, and it is unsafe to lay down dogmatic rules as to how far putrefactive changes shall have advanced at a given time, for even under apparently similar conditions the most extraordinary divergences have been recorded.

D. FERRIER.

DEBILITY (*debilis*, feeble). SYNON.: Feebleness; Weakness; Asthenia; Fr. *Faiblesse*; Ger. *Schwäche*.

DEFINITION.—The body or any of its organs are said to be in a state of debility when their vital functions are discharged with less than the normal vigour, being reduced in the amount of activity that they display, and of work that they can accomplish. The term debility is also employed in a somewhat different sense in the case of constitutional weakness of an organ, to convey the notion of vulnerability or predisposition to disease. In this acceptation, 'pulmonary debility,' for example, signifies a peculiarly delicate 'build' of the lungs, which renders them more than ordinarily liable to succumb to the causes of disease.

ÆTIOLOGY.—Debility is frequently constitutional and inherited; but it is more often developed after birth. It is most commonly due to impaired nutrition, whether this be prolonged and moderate, as in defective hygiene or chronic illness, or, on the other hand, rapid and extreme, as in acute disease. Another frequent cause of debility is abuse of the affected organ. Overuse of any part leads to fatigue, and if frequently repeated to exhaustion, the chief feature of which is extreme debility, as in cases of sustained mental exertion or of repeated strain of the heart. On the contrary, an organ may become feeble from want of exercise. Paralysed muscles furnish the best examples of this condition, but the same may be seen in all organs after unnatural rest.

SYMPTOMS.—The natural ability of the organs to perform their functions varies extremely with sex, age, previous exercise, and many other circumstances. Debility, or the loss of this functional power, is therefore frequently ill-defined; and, when unquestionably present, may vary greatly in different cases, from a condition in which fatigue comes on only somewhat earlier than usual, as in muscular debility, to a state in which the slightest exertion may exhaust the whole of the vital energy and the functional life of the part may cease—as is seen in the cardiac asthenia of acute fevers, and less markedly in certain chronic diseases, such as idiopathic anæmia and Addison's Disease.

Debility may be *general*, affecting the whole body; or *local*, individual organs only being involved. Speaking generally, the symptoms of debility of an organ may be said to be chiefly two. These are, first, increased irritability, or an unnatural readiness of the part to respond to stimulation; and, secondly, a tendency to untimely exhaustion. The phenomena of irritability and exhaustion naturally vary with the organ involved. The symptoms of muscular asthenia are few and simple; those of digestive feebleness are more complex; and in debility of the nervous system the whole of the mental processes, as well as the functions of organic life, may be involved. For a specific account of the phenomena of each of these cases, and of debility of other parts, the reader is referred to the articles upon diseases of the several organs.

DIAGNOSIS.—Debility pure and simple is as a rule easily distinguished from *disease* by the absence of all evidence of organic alteration, and especially of physical signs of anatomical change. It is more difficult to separate debility from *disorder* or *derangement*, but careful observation will generally determine in the case of pure debility that the functions are normally discharged as long as the demands made upon them are not excessive.

PROGNOSIS.—Debility due to acute disease may, in the absence of complications, be expected to disappear during convalescence. If the cause have been more chronic, and be less easily removed, recovery will certainly be more slow and less satisfactory. The prognosis of inherited constitutional debility, as regards its disappearance, is nearly always unfavourable.

TREATMENT.—Debility must be treated according to its cause. If nutrition have failed, it must be restored as far as possible; and until this can be done, stimulants and suitable tonics are indicated—especially in the case of acute disease. Rest is of the first importance in most instances; and it is frequently alone sufficient to restore the vital force. In a few cases, however, the opposite line of treatment must be followed, as in muscular debility from indolence or in some forms of paralysis. Where the vital activity is low from constitutional defect, age, or sex, the condition may not be remediable; and the treatment of such cases is chiefly prophylactic. The principal indication then is to secure the subject of debility against exposure to damaging influences.

J. MITCHELL BRUCE.

DECLINE (*declino*, I decline).—A popular name for any wasting disease; it is especially associated with pulmonary consumption. The word is also applied to the period in the course of a disease when the symptoms are abating; and likewise to the time of life when the physical and mental powers are failing.

DECUBITUS (*de*, down, and *cumbo*, I lie).—The lying posture. *See* POSTURE.

DEFÆCATION, Disorders of.—On the descent of the fæces, which accumulate in the sigmoid flexure of the colon, into the rectum, the associated movements necessary for their expulsion are excited. These movements are chiefly involuntary, though influenced and controlled by the will.

Some of the more important difficulties interfering with the actions of defæcation arise from disorders in the *nervous system*, by which the movements are excited and directed. In injuries and diseases of the brain or cord, the control of volition, especially its influence over the sphincters, is annihilated, whilst the excito-motory movements depending on the spinal cord continue. In these cases the actions of defæcation take place only when the need of expulsion arises without any power of the patient to induce or restrain them. In injuries destroying the lower part of the spinal cord, the fæces escape involuntarily in varying quantities and at all times.

Serious troubles in defæcation may also arise from excessive as well as from weakened action of the *muscles* concerned in this function. The sphincter may be irritable or subject to spasm, and resist too forcibly the expulsive actions of defæcation (*see* ANUS, Diseases of); or the muscular fibres of the rectum may lose their tone, be defective in power, and incapable of properly extruding the fæces. Patients thus situated are often obliged, when at stool, to use the finger to dislodge masses retained in the weakened bowel. An atonic condition of the rectum usually arises from over-distension. It may be produced by too free and frequent use of enemata, the quantity injected being so large as to dilate the bowel and impair the power of its muscular coat. This atonic state of the bowel is apt to give rise to fæcal accumulations. Cases of this kind are not uncommon, yet the nature of the affection is liable to be overlooked. The rectum may become gradually dilated and blocked up by a collection of hard dry fæces, which the patient has not the power to expel, being unable from loss of tone in the distended bowel to overcome the resistance of the sphincter to the passage of so great a body. Some indurated lumps from the sacs of the colon, on reaching the rectum, perhaps coalesce so as to form a large mass; or a quantity accumulated in the sigmoid flexure, on descending into the lower bowel, becomes impacted there. In several instances a plum-stone has been found in the centre of the mass. Such a collection gives rise to considerable distress, producing constipation, a sensation of weight and fulness in the rectum, tenesmus, and forcing pains which women liken to those of labour. In cases of some duration, where the hardened fæces do not quite obstruct the passage, they excite irritation and a mucous discharge, which, mixing with recent feculent matter passing over the lump, causes the case to be mistaken for diarrhœa. Injections have no effect in softening the indurated mass: they act only on the surface, and return immediately, there being no room for their lodgment in the bowel. The practitioner on passing his finger finds the rectum blocked up with a large lump, which feels almost as hard as a stone. In such cases, the only mode of giving relief is by mechanical interference. The mass requires to be broken up and scooped out. After the breaking up and extraction of the larger portions, injections of soap and water will be sufficient for the removal of the remainder. The persons most subject to these troubles are those enfeebled by age or disease, especially women. They may also occur in infants who have been operated on for imperforate anus, when the artificial aperture contracts or is left too small for the free passage of the fæces. In these cases the distension of the bowel is sometimes excessive, and its expulsive functions are seriously impaired and weakened. *See* FÆCES and CONSTIPATION. T. B. CURLING.

DEFERVESCENCE (*de*, down, and *fervesco*, I grow hot).—The decline of fever, characterised by a fall of temperature and of pulse, and by other phenomena. *See* FEVER.

DEFORMITIES.—*See* MALFORMATIONS.

DEFORMITIES OF THE CHEST.—Under this head are included all deviations in shape from the normal chest.

Deviations from the shape of the typical thorax are appreciable by careful physical examination. Of the various methods employed for this purpose, by far the most valuable are inspection and mensuration. Although in some few cases it may be important to determine the exact amount of deformity by mensuration, there are very few deviations in shape or size of the thorax, the degree of which cannot be sufficiently estimated for clinical purposes by the eye and hand, without the aid of any special instruments for measuring.

Deformities of the chest may be due either to abnormity of the parietes; or to disease of internal structures.

DESCRIPTION.—Deviations from the form or size of the typical thorax may be either *general* or *local*; *i.e.* the abnormity may involve the whole thorax, or a part only.

I. General Deformities.—1. *General Diminution.*—The chest may be too small—that is, diminished in all its diameters without being in other respects deformed. Diminution of the thorax simultaneously and uniformly in its antero-posterior and lateral diameters is effected mechanically by an increase in the obliquity of the ribs. The smaller the chest (having regard to the height of the person) the more obliquely are the ribs arranged, and the more acute the angle formed between each of the true ribs (excepting the first) and its cartilage. The intercostal spaces of the true ribs are widened about the junction of the ribs with their cartilages, and at the same time the ribs posteriorly are approximated more closely to each other, the closeness of the approximation being in proportion to the diminution in the size of the thorax. The vertical diameter of the thorax is lessened by an increase in the height of the arch of the diaphragm. The very oblique position of the false ribs, and the height to which the diaphragm rises into the chest, cause several of the false ribs to lie in contact with the diaphragm, and thus no portion of lung is under these ribs. They are, practically speaking, no longer part of the chest-walls.

The costal angles are diminished in proportion to the diminution of the size of the thorax, *i.e.* to the obliquity of the ribs. The obliquity of the ribs also causes the shoulders and the sternal ends of the clavicles to droop, and at the same time to incline forwards; the upper part of the scapula is carried by the shoulder forward, the inferior tilted backward. General and symmetrical diminution in the size of the thorax has one and only one cause, namely, small size of the lungs. Small lungs may be congenital, *i.e.* due to original conformation; or the consequence of atrophic degenerative changes incident to age. In both these cases the lungs are, in relation to the length of the ribs, disproportionately small, and as a necessary consequence, the relatively too long ribs are arranged more obliquely than they are in a well-formed chest, and the diaphragm is pushed by the abdominal organs higher into the thorax. When the small size of the lungs is due to atrophy, the supra-clavicular fossæ are deepened and the vertical diameter of the chest proportionately diminished. In advanced life the congenitally small lungs are frequently reduced still further in size by the supervention of atrophous emphysema. The congenitally small lungs and the consequently small chest is one of the characteristics of tuberculosis, *i.e.* of that congenital organization in which tubercle is likely in subsequent periods of life to occur. Atrophous emphysema is especially common in those who have either manifested symptoms of tubercle in their youth, or belong to tubercular families. It is the congenitally small lungs of childhood which are prone to become the seat of tubercle in youth, and the subjects of atrophous emphysema in old age.

2. *General Enlargement.*—The thorax may be too large, increased in all its diameters, without being otherwise deformed. It is simply bigger than it should be, having regard to the height of the subject.

When the thorax is abnormally large, the ribs, instead of being more obliquely situated than natural, as they are in the small thorax, are placed more horizontally than they are in the normal thorax. The angle formed between each rib and its cartilage is greater than in health; while the intercostal spaces, especially the lower, are widened, and the ribs less closely approximated, the arch of the diaphragm is lessened in depth, and a considerable mass of lung lies under the lower false ribs, between them and the diaphragm. The chest is increased in all its diameters. The shoulders are raised. The costal angles are greater than natural.

Increase in the size of the whole thorax has but one cause, viz., increase in the size of the lungs. Increase in the size of the lungs generally, and pretty uniformly, is the consequence of disease, and of one disease only, viz., large-lunged or hypertrophous emphysema. When the increase in size of the thorax attending large-lunged or hypertrophous emphysema is moderate in degree, the increase in its size is effected by the altered position of the ribs; but when the lung-disease is extreme, then a certain amount of the enlargement is caused by pressure on the inside of the chest during the violent expiratory efforts of severe cough.

3. *Irregular General Deformities.*—In the deformities above described the antero-posterior and the lateral diameters retain more or less perfectly their normal proportion—both are increased or both are diminished; in the former case the chest is on the whole more barrel-shaped than natural, but the deviation from the normal form is not considerable. If, however, the chest-walls are from any cause unduly soft or unduly rigid, then the actually or relatively soft portions will recede during each inspiratory act, and local deformity of the chest follows. The diameter of the chest at the part where the absolutely or relatively soft portion of the parietes is placed will be diminished. The special deformities of the chest which result are due, therefore, primarily to the state of the parietes, and are not, as those previously described, secondary to conditions of the lungs themselves.

a. Diminution in the antero-posterior diameter of the thorax.—The antero-posterior diameter of the thorax is frequently less than that of the normal thorax, the lateral diameter being proportionately increased. The chest has an oval form—it is flattened from before backwards.

The thorax flattened from before backwards is usually associated with small lungs, but the mechanical cause of the flattened form is the want of full resisting power in the ribs and considerable strength in the cartilages. These conditions of thorax are common in the subjects of tuberculosis.

The flattening of the thorax is increased by all impediments to the free passage of air through the air-tubes. In some children suffering from even slight bronchial catarrh, the flattening of the chest is seen to be increased at each inspiration; and if the impediment to the entrance of the air to the pulmonary tissue be constant or extreme, not only is the flattening increased at each inspiration, but the sternum is also depressed, especially at its lower half below the level of the costal cartilages, and thus the antero-posterior diameter of the thorax is still further diminished in the median line.

b. Increase in the antero-posterior diameter of the thorax.—In rickets the cartilages of the ribs are very firm, whilst the ribs themselves are softer than natural, and especially so near to their enlarged growing ends—the softest part of the ribs; that is to say, just outside the nodule formed at the spot where cartilage is in the process of growing into bone. The consequence of the extreme softness of the ribs at this part is that at each inspiration the weight of the atmosphere presses inward the softest part of the ribs, while the sternum is borne forward by the firm cartilages. The result is great increase in the antero-posterior diameter of the thorax, and diminution of the lateral diameter at the part corresponding to the softest part of the ribs. The depression of the softest part of each rib is increased by the want of resilience of the softened structures.

A groove is thus formed in the thoracic walls just posterior to the rickety nodules; and this groove being deepened at each inspiration, the part of the lung adjacent is compressed in place of being expanded during the inspiratory act. At the same time, in consequence of the cartilages and sternum being thrust forward at each inspiration, air enters with undue force into the lung-tissue subjacent to these parts. The consequence of the excessive expansion of the anterior part of the lung is vesicular emphysema, and the recession during inspiration of the softened and imperfectly resilient and therefore deeply grooved part of the chest-wall leads to collapse of the subjacent pulmonary tissue; and, as the effect of these two conditions, the lungs, when the chest is opened, present a vertical groove corresponding to the groove in the chest-walls. The antero-posterior diameter of the thorax in rickets is still further increased by the curvation of the spine. The muscles are weak, the child is unable to sit upright, that is to say it is unable, in consequence of the weakness of its muscles, to support the weight of the upper part of its body, the bones of the spine are, in common with the other bones of the body, softened, and the result of the weakness of the muscles and the softness of the vertebræ is the dorsal bow.

When deformity of the chest is the result of undue softness of the chest-walls, the position of the solid organs subjacent to the parietes is frequently perceptible to the eye. The liver supports the lower ribs on the right side, the heart supports the ribs and cartilages over it on the left side, and thus these organs cause local prominence of the chest-walls without being themselves in any way abnormal.

In the so-called *pigeon-breast*, the antero-posterior diameter of the thorax is increased in the middle line, the lungs are small, the ribs and cartilages are firm, the ribs are placed obliquely and the chest-walls are flattened laterally, and the sternum as a consequence is thrust forwards; thus the chest in the pigeon-breasted has a triangular form, the apex of the triangle being the sternum. Impediment to the free entrance of air into the lower lobes of the lungs will favour the production of and increase the deformity. The chests of children who suffer from repeated attacks of bronchitis, but are otherwise healthy, are commonly the subjects of this deformity, while there is increased expansion and subsequent enlargement of the upper part of the chest, the lungs being more or less collapsed below and emphysematous above.

c. Transverse anterior constriction of the lower part of the thorax is the consequence of small size of the lung, or of imperfect inspiratory expansion, permanent or frequently recurring in youth. In these cases the lower ribs are little used in respiration, while below they are borne outwards or supported by the liver, stomach, and spleen, and thus an imperfectly formed transverse depression is produced in the front of the chest on a level with the base of the ensiform cartilage.

The deviations from the type of the normal thorax hitherto described are bilateral, and more or less symmetrical.

II.—Local, unsymmetrical, and unilateral deformities.—1. *Fulness of the supraclavicular region.*—The supraclavicular region, corresponding to the portion of the thoracic cavity above the clavicle, may be fuller than natural. The causes of this local bulging are—*a.* Development of adipose and cellular tissue. *b.* Distension of the deep-seated veins. *c.* Large-lung emphysema, in which disease there is occasionally distension of that part of the cavity of the thorax which lies above the level of the clavicle; the distension is due to pressure on the inside of this part of the thoracic cavity; air being forced violently into this part of the lung during the powerful expiratory effort of cough.

2. *Depression of one supraclavicular fossa* is caused by any pathological condition of the apex of the lung which produces diminution of its bulk, *e.g.* atrophous emphysema, or chronic consolidation of the apex.

3. *Elevation of one shoulder.*—Occupation is a common cause of elevation of one shoulder; thus in clerks, who sit much at the desk, the left shoulder is permanently a little higher than the right, and the upper portion of the spine is slightly curved, the convexity being to the left; so in those who carry heavy weights on one arm, the opposite shoulder is elevated and the spine curved. Whatever necessitates an increase in the capacity of one side of the thorax causes elevation of the shoulder on the same side: thus, considerable dilatation of the heart, fluid in the pericardium, fluid in the pleura, aneurism of the arch of the aorta or of the innominate, all lead to elevation of the shoulder. The shoulder is depressed and carried forward when, from any cause, the whole or upper part of one side of the chest is diminished in size, *e.g.* when the apex of the lung is the seat of chronic pneumonia or chronic phthisis.

4. *Uniform dilatation of one side* of the thorax is due, with one exception, to fluid or air in the pleura; the exception is those rare cases of encephaloid cancer of the lung, in which the formation of cancer is uniformly diffused through the lung-tissue, and in amount so great that the lung 'infiltrated' with cancer very decidedly exceeds in bulk the healthy lung inflated with air by inspiration.

In uniform dilatation of one side of the thorax, the shoulder is raised, the ribs are placed more horizontally than on the healthy side, the intercostal spaces are widened, and the spine slightly curved. When the enlargement is moderate in amount, the increase in capacity is effected by the altered position of the ribs; but when the increase in size is very considerable, then it is due in part to the pressure exercised by the air, fluid, or cancer-loaded lung on the inner side of the chest-wall.

5. *Uniform contraction of one side* of the thorax is the consequence of any pathological condition which leads to general and uniform reduction in the size of the lung, *e.g.* cirrhosis of the lung, infiltrated cancer of the lung, chronic tubercular disease of the lung, chronic pneumonia, or the change in the texture of the lung which follows long-continued compression by fluid in the pleura. When the whole of one side of the thorax is reduced in size, the shoulder on that side is depressed, the ribs are placed more obliquely and are more closely approximated than on the opposite side, the intercostal spaces are narrowed, and the spine is curved, often considerably, the concavity of the curve being towards the contracted side.

6. *Lateral curvature of the spine*, instead of being the consequence, may be the cause of deformity of the thorax: the ribs are then approximated on the side and at the part where the concavity of the curvature is placed, while they are separated and the shoulder raised on the side of the convexity.

7. In *angular curvature of the spine* the deformity of the thorax varies with the seat and the extent of the vertebral disease; but, speaking generally, it may be said that in angular curvature of the spine the antero-posterior diameter of the thorax is increased in proportion to the amount of destruction of the bodies of the vertebræ, and that the ribs are in a corresponding degree approximated.

8. *Extreme depression of the lower part of the sternum* is the consequence of softness of the cartilages of the ribs and impediment to the free passage of the air to the pulmonary tissue. This deformity is never congenital, although the subjects of it often affirm it to be so; it may, however, commence to be formed directly after birth if there be a congenital impediment to the entrance of air into the lungs, *e.g.* atelectasis.

The deformity may be the result of direct pressure. In certain occupations pressure has to be exerted on the lower part of the sternum—thus, some shoemakers use a wooden instrument which has to be kept in its place by pressure against the lower part of the sternum. For direct pressure to produce this deformity it must have been applied in early youth, while the parts are still flexible, and have been exerted frequently over a long period of time.

9. *Congenital deformities* of the thorax are few in number and are due to arrest of development—for example, cleft sternum, and defective formation of one or more ribs or cartilages.

10. *Unsymmetrical diminution in size of a part* of the thorax is produced by any pathological change which reduces the size of the subjacent part of the lung. All chronic inflammatory or congestive conditions of the apex of the lung, whether primary or the consequence or the concomitant of the formation of tubercle, are attended by diminution of the bulk of the part of the lung which is the seat of the lesion. Considerable loss of pulmonary tissue is usually accompanied by falling inwards of the chest-wall over the cavity.[1] The formation of a cavity is almost invariably attended by chronic inflammatory condensation, and this increases the local depression of the chest-wall. In chronic thickening of the pleura, the chest-wall at the part is, by the contraction of the fibrin, drawn inwards, and the lung subjacent to the thickened pleura being condensed, the chest-wall is also forced in during inspiration by atmospheric pressure. Hence, after pleurisy limited in extent it is common to find permanent flattening of the thoracic parietes at the base of the chest on the side affected.

In cancerous infiltration of the lung, limited in extent, the lung-tissue is sometimes so much condensed that the bulk of the cancer and lung are less than that of the healthy lung, and the chest-walls as a consequence are flattened over the seat of disease.

11. *Unsymmetrical localised bulging.* If the ribs are, in relation to the size of the lungs, disproportionately long, and their cartilages soft, then one or more of the cartilages may be knuckled forwards; the cartilage, being compressed between the end of the rib and the sternum, bends in an angle outwards. Although the prominence is trifling, it often causes anxiety to parents and its subject. Local deformity of this kind is occasionally the result of repeated lateral compression of the chest-wall in the athletic sports of young boys, *e.g.* cricket.

All the diseases of the chest which are accompanied by general enlargement of both or one side of the chest, when localised, are attended by local bulging; thus a common cause of abnormal fulness of the lower part of the left side of the thorax, posteriorly, is emphysema of the corresponding part of the lung; a moderate amount of fluid in the pleura is attended by fulness of the lower part of the chest on the same side. In both these cases the ribs are raised into an abnormally horizontal position; the chest-walls are not pushed outwards, but the ribs are raised, and the intercostal spaces are to that extent widened. The ribs are put into the position which gives the greatest capacity to the thoracic cavities containing the fluid or the enlarged lung. Local bulging may be produced by aneurism of the arch of the aorta or of the innominate artery; by growths, malignant or other, within the chest; by chronic pleurisy with effusion circumscribed by dense false membrane; by hydatids; or by abscess; and in all these cases the prominence is due to direct pressure on the inner side of the chest-wall, and to changes in the chest-wall itself.

Hypertrophy and dilatation of the heart and fluid in the pericardium are attended by fulness of the præcordial region. The bulging from these diseases is much greater in the child than in the adult. In these cases a little of the fulness is produced by a more horizontal arrangement of the ribs; but when the prominence of the præcordial region is at all considerable, it is the result of the pressure exercised by the fluid or by the large and powerfully acting heart on the inner surface of the corresponding part of the chest-wall.

At the part corresponding to the junction of the first and second bones of the sternum, opposite the cartilage of the second rib, the sternum projects forward. This prominence is called the angle of Ludovicus. Any impediment to the free entrance of air into the lungs may cause depression of the lower part of the sternum; if the ossification of the sternum is not complete at the junction of the first and second bones, undue prominence of this part is the result. Subsequently a formation of bone takes place at this spot, and increases the prominence.

WILLIAM JENNER.

DEGENERATION (*degener*, unlike one's race; out of kind).

DEFINITION.—The word 'degeneration,' meaning etymologically change or deterioration of kind, is used in pathology for any process by which a tissue or substance becomes replaced by some other, regarded as less highly organised, less complex in composition, of inferior physiological rank, or less suited for the performance of its original functions. While some change for the worse is thus the essence of degeneration, it is of secondary importance by what steps this change is effected. It may be by direct chemical *metamorphosis*, as of albuminous into fatty material; by *infiltration* of the tissues with some new material, as in albuminoid degeneration; or even by *substitution* of a newly-formed tissue, inferior to the original in organisation or in functional efficiency, as in what is called fibroid degeneration. Degeneration is very closely connected with atrophy, since on the one hand it is often caused by imperfect nourishment, and on the other hand may be a stage in progressive wasting; so that it may be difficult to draw the line between the two.

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[1] It is said that a very large air-containing cavity may give rise to local bulging.

Summary.—The following kinds of degeneration may be recognised:—*Albuminoid*, *Fatty*, *Mucoid* or *Colloid*, *Parenchymatous*, *Calcareous*, *Pigmentary*, and *Fibroid*, with possibly one or two minor varieties of less moment. The two first-mentioned are described elsewhere (*see* Albuminoid Disease, and Fatty Degeneration).

1. **Mucoid or Colloid** degeneration is in one sense a physiological process, since it is probably by a partial transformation of the protoplasm of epithelial cells into mucin that the secretion of mucus is effected.

Mucoid and colloid degeneration are sometimes distinguished. We are unable to recognise any difference except in situation, and this distinction is better expressed in other words. The process consists in the transformation of portions, usually albuminous, of the tissues into a semi-transparent homogeneous material, varying in consistency from fluid to a gelatinous solid, and consisting of altered albuminates with variable proportions of mucin, a substance allied to albumin, but differing in its entire insolubility in acetic acid, and solubility in alkalies. All masses of gelatinous appearance have not this composition, since the colloid material which fills some ovarian cysts, that of renal cysts, and probably that found in some other cases, is said to contain no mucin. The thyroid gland when enlarged and cystic, as in one form of bronchocele, is a striking instance of colloid degeneration. The enlarged cystic vesicles become filled with colloid material, which plainly results from a transformation of the epithelial elements, and possibly also of some albuminous exudation in the original vesicles. Small masses of colloid material first appear in the cells, which become confluent into homogeneous masses. In colloid cancer a similar process appears to take place, but is rather synchronous with, than subsequent to, the growth of the tumour. The alveolar spaces which in other forms of cancer are filled with cells, here contain colloid material resulting from the metamorphosis of cells, and every transitional stage, from the epithelioid cancer-cell to a homogeneous translucent mass, may often be met with. The stroma is unaffected, and remains fibrous. The gelatinous material of colloid cancer is stated to contain more mucin than that of the enlarged thyroid. It is instructive to notice that this form of cancer usually occurs or commences in parts where epithelium is present, which undergoes the mucous transformation and secretes mucus, as in the stomach and intestines. When colloid or mucoid transformation affects tissues of the connective tissue group, it is the intercellular substance which appears to be chiefly affected. This change is seen in the mucoid softening of cartilage which sometimes occurs in old age, where the chondrin undergoes chemical change, and the intercellular substance softens into a diffluent or liquid substance containing mucin. The so-called mucous tissue which forms the umbilical cord, and the vitreous body of the eye, as well as certain fœtal structures, consists essentially of a reticulated connective tissue with mucous intercellular substance, and the same tissue forms the new growth called myxoma, which may therefore be regarded as formed by mucous transformation of connective tissue. Its cells are quite unaffected by this change, being either fixed stellate connective tissue cells, or migratory lymphoid corpuscles. This view explains how portions of other tumours, as sarcoma, enchondroma, and lipoma, are often found to have undergone myxomatous degeneration. All these mucoid or colloid substances contain mucin with albuminates.

2. **Parenchymatous or Granular** degeneration, also called *cloudy swelling*, is a peculiar change met with in some epithelial structures, especially liver- and kidney-cells, and muscular tissue, occurring only in the course of some infective febrile diseases, especially typhus, enteric fever, scarlatina, diphtheria, pyæmia, etc. The histological elements are found after death to have lost their transparency, and to be filled with minute granules, so that the general appearance is not unlike that of fatty degeneration. The naked-eye appearance of the organs is also not dissimilar; they are pale, dull, and opaque-looking. This change has been thought to be the precursor of fatty change: but whether this be so or not, it is at once distinguished by the solubility of the granules in acetic acid, and their insolubility in ether. The cause of this degeneration has been asserted to be simply high temperature; still it is not found in all febrile diseases. It has also been regarded as a post-mortem change, which is possible, but still this implies some abnormality in the tissues during life.

Another change also occurring in febrile diseases is *waxy* or *vitreous* degeneration of the voluntary muscles. They are found after death with little or no striation, and the myosin irregularly coagulated in lumps. That this is a change occurring after death there can be no doubt; while it is equally clear that this abnormal coagulation shows some abnormality of composition to have existed during life.

3. **Calcareous** degeneration consists in the deposition of calcareous particles in the elements of a tissue, or in some inflammatory products previously formed. It is more appropriately called *calcareous infiltration* or *deposit*. When the normal tissues are thus infiltrated, there is not of necessity any other alteration in the tissues themselves, though the process generally indi-

cates retardation of the circulation or arrest of tissue-metamorphosis. In the case of inflammatory products, new-growths, and parasites, as well as in other cases, the calcareous deposit follows on partial necrosis or local death. It is, therefore, if not a degeneration, the consequence or accompaniment of degeneration. *See* DEPOSITS, Calcareous.

4. **Pigmentary** degeneration is a name which has been given to the changes produced in a tissue or organ by the deposition or formation of pigment. It is very doubtful whether this should always be described as a degeneration, since this change does not necessarily diminish the vital activity of the part, lower its physiological rank, or involve a simpler chemical or anatomical composition. Pigmented tumours do not show less vitality than others, nor is excessive pigmentation of the skin or any organ where pigment normally occurs, necessarily an accompaniment of degeneration. On the other hand, the pigmentation of the spleen and liver from intermittent fever, and that which is the consequence of chronic venous congestion, are often the accompaniment of fibroid induration, and thus form part of a degenerative process. Pigmentation in general must not, therefore, be identified with pigmentary degeneration.

5. **Fibroid** degeneration is the name given to a process in which the original tissue becomes replaced by a form of connective tissue. It is also called *fibroid substitution* or *fibroid change*. In the early stages of this process we find the tissues penetrated with numerous cells of the lymphoid type, which become slowly organised into connective tissue—at first of the cytogenous form, and rarely very vascular. The infiltrated lymphoid cells are probably chiefly derived from the blood-vessels; but some may be, as theory teaches, the descendants of tissue-cells. The process is essentially chronic interstitial inflammation (*see* INFLAMMATION). Since the final result of the process is that tissue of less physiological value is substituted for the original, the process may be described in general terms as a degeneration, though it is not an actual metamorphosis of tissue. It finally leads to induration, contraction, and partial atrophy.

J. F. PAYNE.

DEGLUTITION, Disorders of.—Before describing the disorders of deglutition or swallowing, it is necessary to state briefly in what this physiological act consists, and how the process is performed.

PHYSIOLOGY OF DEGLUTITION.—The act of deglutition is commonly divided into three stages. The first is a voluntary effort, accomplished by means of the tongue and the muscles of the cheeks and mouth, as far back as the anterior arch of the fauces. The second stage is an involuntary act, though certain voluntary muscles are engaged in effecting it; and it is accomplished by the action of those muscles whose duty it is to retract the tongue, to raise the larynx and close the glottis, to lift the soft palate, to contract the fauces and bring the tonsils in contact with the bolus of food, to close the posterior nares, and to raise and contract the pharynx. Then the food passes into the œsophagus or gullet, when the third stage is entered upon; and as the morsel passes into this tube, a progressive undulatory or peristaltic movement of the gullet is produced, by which the bolus is propelled into the stomach.

DEFINITION.—Any condition which interferes with the perfect integrity of this physiological process constitutes a disorder of deglutition. The general term which is commonly applied to this condition is Dysphagia or Deglutitio Impedita, as it is sometimes termed. But, in actual fact, such conditions will be found to be dependent for the most part on some other morbid state of the structures immediately concerned in the act of swallowing, or of those in close proximity to them. Yet, although dysphagia must, as a rule, be regarded merely as a symptom of some more or less serious disorder, still it may be convenient and useful to examine the subject somewhat more in detail than can be done in the consideration of those affections in which it frequently plays so prominent a part.

ÆTIOLOGY.—All affections of the throat modify in some way the power of swallowing, and render the act of deglutition painful and difficult. Thus:—1. We meet with it as one of the symptoms in acute catarrh of the pharynx, in tonsillitis, and in ulceration of the throat, which disturbances are dependent upon some alteration in the mucous membrane, the submucous cellular tissue, or the muscular tissue. 2. Similarly, diseases of the larynx may give rise to disorders of deglutition; such as laryngitis, inflammation of the perichondrium of the cartilages, and laryngeal polypi. 3. Specific diseases, for example, phthisis, syphilis, cancer, scarlatina, measles, and croup, are another fertile cause of difficulty of swallowing, owing to their affecting the throat in various ways. 4. So also are nervous affections, for instance, post-diphtheritic paralysis, hysterical affections, general paralysis of the insane, progressive muscular atrophy, and glosso-laryngeal paralysis. 5. Affections of the salivary glands, such as parotitis, may interfere with deglutition. 6. Œsophageal disorders, whether functional, or causing organic obstruction, are important causes of dysphagia. 7. Difficulty of deglutition may result from pressure upon some part of the passage, as by an aneurism of the thoracic aorta, a solid tumour, whether malignant or benign, or a retro-pharyngeal abscess. All these causes, though in different degree, offer some impediment to the act of deglutition.

SYMPTOMS.—Although difficulty in the act of swallowing is the essential symptom in many and various affections, yet this differs greatly in degree, as well as in the attendant phenomena, according to the pathological condition of the parts involved. Thus, when irritation of any kind is met with in any part of the track through which the bolus of food has to pass, then the act of deglutition is attended merely with more or less pain, which in such cases constitutes the sole difficulty in the process. When, however, the calibre of this portion of the alimentary canal is reduced by disease affecting its own structure, or when it is encroached upon by morbid growths or other disease in its immediate vicinity, a mechanical impediment is set up, which necessitates a certain amount of voluntary effort to accomplish the act. This supplementary aid is usually sufficient to propel the bolus onwards, and deglutition, though slower than in health, and usually attended with pain, may be successfully performed. It occasionally happens, however, that the obstruction is so great as to prevent the passage of at least the larger portion of the food downwards, and regurgitation takes place through the mouth or nostrils.

A similar result is brought about when paralysis affects any portion of the muscular structures concerned in the act of swallowing, but obviously in a different manner. For example, in post-diphtheritic paralysis, in consequence of the implication of the soft palate and neighbouring structures in this loss of power, the food, instead of passing into the gullet, returns through the posterior nares.

The dysphagia occasionally observed in hysterical persons, and which appears to partake of the nature of spasm, differs essentially from those forms already described, in the fact that it is not a constant phenomenon.

In addition to those varieties of dysphagia dependent upon morbid conditions of the apparatus concerned in the act of swallowing, another kind may also be induced by the nature and form of the articles partaken of. Thus, irritant, corrosive, and very hot substances may readily give rise to difficulty in swallowing. In like manner dysphagia of an urgent character is often caused by the impaction of a large bolus of unmasticated food in the œsophagus.

Treatment.—This will manifestly depend upon the recognition of the cause which gives rise to the impediment in swallowing. Cases of simple catarrh of the mucous membrane of the throat, and those produced by the action of irritant substances generally, yield, after a short interval, to the use of bland articles of diet and demulcents, such as olive oil, milk, linseed tea, &c. It must, however, be borne in mind that permanent stricture of the œsophagus may be the result of causes such as those last mentioned. Of course, when abscess is the cause of the dysphagia, the evacuation of its contents will give immediate relief. In that form of dysphagia dependent upon diminution of the calibre of the œsophagus, the question of its treatment by the use of bougies or stomach-tubes should be considered. *See* Œsophagus, Diseases of.

The dysphagia dependent upon specific disorders of the larynx, such as that occasioned by phthisis, syphilis, cancer, &c., may often be greatly mitigated by the use of warm medicated sprays of a sedative character, such as bromide of ammonium, chlorine water, or other agents. In cases acknowledging a nervous origin, the treatment must bear reference to the general nervous disorder of which the dysphagia is but a symptom. Thus hysterical dysphagia may be speedily removed by the application of galvanism in the neighbourhood of the œsophagus. Post-diphtheritic dysphagia usually disappears as the health of the patient improves, and is to be treated by the administration of nervine tonics, such as strychnia, iron, and quinine.

C. Muirhead.

DELHI SORE OR BOIL.—Synon. Aleppo Evil; Mycosis Cutis Chronica (V. Carter); Lupus Endemicus (Lewis and Cunningham); Oriental Sore (Fox). Fr. *Bouton d'Alep*; Ger. *Beule von Alep*.

Definition.—An indurated, indolent, and very intractable sore; papular in the early, encrusted or fungating in the advanced stages; spreading by ulceration of skin; single or multiple; and often occupying extensive surfaces of the exposed parts of the body, such as the face, neck, and extremities. It is capable, if inoculated, of reproducing the disease; and it also affects dogs and horses.

Geographical Distribution.—This disease occurs in India, especially the North-west Provinces, Punjab, Cabul and Scinde, Persia, Arabia, Crete, the Sahara of Africa, perhaps China, and doubtless wherever certain peculiar conditions of soil and hot climate co-exist. Though called Delhi boil, it is neither a furunculus, nor is it peculiar to that city. The Scinde boil, the sores of Roorkie, Moultan, Lahore, Meerut, other crowded Indian cities, and Aden, are probably only varieties, if not identical. The same may be said of the Bouton d'Alep, of Biskra, Bussorah, Baghdad, and Crete. Slight differences may exist, but essentially they are the same disease. The Yeman and Cochin China sores are probably varieties, as are other indolent indurated and intractable sores occurring in persons of impaired health, residing in hot and malarious climates, who use certain hard waters, and in whom there is neither syphilitic nor strumous taint.

Ætiology and Pathology.—Drs. Fleming and Smith, V. Carter, and Lewis and Cunningham give the best account of the disease. Though called a local disease, it is probable that the state of the health has much to do with its production, certain conditions of climate, soil, and especially of drinking water being concerned. Furunculi of a severe and painful though different character are prevalent in hot climates at certain seasons of the year, in enervating and malarious climates like India, especially after the rains, *i.e.* towards the termination of the most exhausting season, when the vital powers have been depressed during the preceding months, and the functions of the liver and spleen are impaired. The blood, imperfectly elaborated, and not freed from excrementitious matter, is then in a condition in which it not only ministers imperfectly to nutrition, but is prone to fibrinous coagulations, which cause capillary embolism, giving rise to local starvation and death of minute portions of areolar tissue in or under the integument. These result in suppuration, which is set up for the purpose of getting rid of the dead fragment or core. An analogous, though perhaps not precisely similar pathological condition may be concerned in the causation of the Delhi sore, and is not incompatible with an otherwise fairly good condition of the general health. Water, soil, food, bites or stings of insects, parasites, insanitary conditions, such as exist in crowded native cities, have all been charged with causing the disease. Improved hygiene, planting of trees, and change of water, food, and locality, have all been credited with benefit in the treatment of it. The fact that this peculiar form of sore manifests itself under similar climatic conditions in other parts of the world, which, it is to be noted, are generally those of the more arid regions, and that it occurs most frequently at the most exhausting season, seems to point to a constitutional state as a predisposing cause.

The disease is not confined to human beings; in Delhi it has been observed that dogs are very liable to be affected, especially in the nose, and this, from the position of the sore, has been adduced as strong evidence in favour of the theory that it is due to the presence of a parasitic ovum which finds its way there from the water. In some districts other animals are affected; and it seems probable that the indolent, indurated, and intractable sore that horses are liable to in India, called *Bursattie* (Rain Sore) is of the same character. Further investigation into the causation and pathology of Delhi boil is needed, especially with reference to the action of drinking water, and the nature of the structures that form the essential constituents of the disease.

Anatomical Characters.—When the Delhi sore is cut into, yellowish points are seen, consisting of minute cellular growths, which have been described by Dr. Smith as the ova of a parasite (*Distoma*), and by others as of vegetable origin, but are probably the result of cell-growth, connected with the hair- and gland-follicles, perhaps an abnormal development of connective-tissue corpuscles, or an imperfect form of granulation. After ulceration has disintegrated the surface, mycelium or other low forms of organism may be present; but it is a question if these be the essential cause, and not rather an accident of the disease, introduced from without. Dr. V. Carter refers Delhi boil to a parasitic organism, consisting of spheroids and mycelium, which occupies the distended lymphatic vessels in and around the sore, arranged in open and angular meshes, the free ends giving off conidia which multiply and reproduce. Pale, round or stellate granulation-cells are found; numerous bright orange-tinted particles, arranged as spherical or ovoid groups disseminated throughout the tissues of the tumour. These, it is considered, are the fructification-stage of the fungus. Lewis and Cunningham describe lymphoid nucleated cells, the products of a condition which they consider as identical with that of lupus, and which they ascribe to the action of the chemical constituents of certain hard waters.

Symptoms.—Delhi sore commences as a small pink and reddish papule, like a mosquito bite, which gradually extends, generally around a hair-follicle as its centre. This is elevated, and after a time desquamates. There is itching and a stinging sense of pain; on pressure it is somewhat boggy. The progress of the disease is slow, often occupying several weeks, during which time it assumes a semi-transparent appearance, with blood-vessels ramifying near the surface. A vesicle then rises, bursts, and gives exit to an ichor which forms a crust; under this, suppuration and ulceration take place and advance until, by the coalescence of several papules and destruction of skin, an indurated sore is formed, which is either crusted over or fungates. The sore gradually invades the surrounding parts, and destroying the integument, may give rise, especially on the face, to deformity from cicatricial contraction; and from the irritation and the pain it causes, may, when the number and extent of the sores are large, seriously compromise the health. An ordinary boil or abrasion may assume these specific characters. The disease is regarded as contagious, and apparently may be produced by inoculation of the specific cell-matter, though not by the pus which forms on the surface.

Treatment.—*Preventive.*—Cleanliness of person, clothing, and habitation, good food, the use of pure drinking water, and careful attention to the sanitary condition of the locality,—avoiding overcrowding and contact with the disease in men or animals,—are the best means of preventing Delhi sore.

Curative.—Change of locality, when practicable; in some cases early destruction of the sore by the potential or actual cautery; the application of metallic astringents, iodine, carbolic acid lotion; pressure; attention to the state of the health, and any ailment that may be present; tonics and nutritive diet, and especially change of drinking water; and change to another climate,—are the most effective measures.

In the advanced conditions of the disease similar measures are indicated. The sore, if too extensive to be destroyed, should be dressed with stimulating and astringent applications. Soothing measures are indicated if there is pain. Black wash, sulphate and carbolate of zinc, copper, Gurjon oil, and lime water, with change of climate, and the use of tonics, will generally prove efficient.

Joseph Fayrer.

DELIRIUM (*deliro*, I rave).—A derangement of consciousness, characterised by incoherence of thought, and evidenced by various expressions and actions. *See* Consciousness, Disorders of.

DELIRIUM TREMENS (*delirium tremens*, trembling delirium).—A form of acute alcoholism, chiefly characterised by delirium and tremors. *See* Alcoholism.

DELUSION (*deludo*, I deceive).—A false belief in some fact which almost invariably concerns the patient, of the falsity of which he cannot be persuaded, either by his own knowledge and experience, by the evidence of his senses, or by the declarations of others. Such delusions, when distinguished from merely erroneous judgments upon abstract questions, generally indicate insanity. *See* Consciousness, Disorders of.

DEMENTIA (*de*, without, and *mens*, a mind).—Synon.: Fr. *Démence*; Ger. *Blödsinn.*

Definition.—A mental weakness, or a deficiency rather than an aberration of intellect, depending for the most part on some antecedent brain-disorder, such as apoplexy or epilepsy, or being the sequel and termination of various forms of insanity. It may also be congenital, deserving rather the name of idiocy; or may be due to senile decay.

Trinity Medical College.

1. Acute Primary Dementia.—There is a form of insanity known as primary or acute dementia, which comes on rapidly without any preceding disorder, is accompanied by the most profound vacuity and abeyance of all the mental faculties, yet yields to treatment and disappears, leaving the patients sane.

ÆTIOLOGY.—The patients are young persons, boys and girls,—more frequently girls. The complaint is seldom seen in any case beyond the age of 30, and chiefly in those under 20. It seems to be a collapse of all mental power, due to great physical weakness and deficient nerve-force. Owing to imperfect development, to bad food and living, or to the patients having outgrown their strength, the mental condition becomes so weakened that, with or without some moral cause, as a fright or a scolding or something apparently more trivial, or after some illness slight or severe, they suddenly or gradually present that condition which is now to be described. If the immediate exciting cause is some mental shock or fright, the symptoms may come on rapidly. If they are due to ill-health or some protracted exhausting occupation, the access may be gradual; and if it is set down to sulkiness, temper, or idleness, the measures adopted for the correction of the latter may quickly indicate the real state of things.

SYMPTOMS.—Nothing can appear more hopeless than the appearance many of these patients present. The face is vacant, with a fatuous grin, and often the saliva dribbles continuously. The sufferer sits motionless and lost, or automatically wags the head, snaps the jaws, or moves the limbs for hours together unconscious of fatigue. Or if a limb is placed in any position, it is retained there for a time in a way that no effort of will could accomplish. There may be a repetition of some word or sentence, but all conversation is abolished, and the patient has to be fed, washed, and tended like a baby.

The physical condition of these patients is peculiar, and corresponds closely to the mental. The heart's action and the circulation are so reduced in strength that the blood in the extremities is stagnant. Hands and feet are blue with cold even in the heat of summer. In cold weather they are covered with chilblains, and great care must be taken, otherwise these will give rise to obstinate sores. The tongue is pale and flabby, the pupils are dilated. There is no rapid emaciation, for the waste here is not great; neither is sleep absent, as in mania, but it is irregular and uncertain.

PATHOLOGY.—The external physical manifestations sufficiently indicate the condition of the brain in these patients. It is the very opposite of that in acute sthenic delirious mania. In the latter there is an excessive discharge of nervous force, an hyperæmic state of brain, and rapid brain-circulation, the whole leading in a short time to death by exhaustion if relief does not come. In acute dementia we see the very opposite. The brain-action is reduced to the lowest point, and the circulation is stagnant, as in the extremities, giving rise to passive congestion and œdema.

COURSE, TERMINATIONS, AND PROGNOSIS.—In acute dementia there is no sudden exhaustion; but death, if it occurs, is caused, not by the brain-disease, but by a general failure of the bodily strength, or by some low form of lung-disease — phthisis, pneumonia, or gangrene. Death, however, in this disorder is the exception. When taken in time and properly treated, the majority of these seemingly hopeless cases recover, and recover perfectly.

TREATMENT.—The treatment of acute dementia may be carried out in a family, or even at home, if means are ample, and if the necessary measures are strictly enforced. But it may be necessary to feed the patient by force, and that for a considerable time, and relations do not always care to enforce this to the extent required. Abundant nutrition is imperatively demanded in order to restore the force that is so greatly in defect, and unless abundant nutrition is administered, there will be no recovery, but the patient will die, or sink into permanent dementia. There is not as a rule violent resistance to food, but it may be kept in the mouth without being swallowed, and care must be taken in feeding, even if a stomach-tube be not necessary. Food should be given frequently, and so a habit of taking it engendered. Stimulants, wine and brandy, will be necessary, especially in the early stages. Equally necessary is warmth; an amount of heat is required which to those in health would be oppressive, for the greatest heat of summer fails to warm the hands and feet. Warm clothing must be provided, and the circulation aided by a short sharp shower-bath, cold or tepid, and plenty of friction afterwards. Exercise is useful for the same purpose, but this is to be taken under proper supervision, for it must not be fatiguing, and due regard ought to be had to the debilitated state of the individual. In addition to the stimulus of the shower-bath, that of electricity is of great use in acute dementia. Here, and in certain cases of melancholia, marked benefit follows the application of the constant current. Of drugs the most useful appear to be steel and quinine. The former, in this as in almost every form of insanity, is a most valuable tonic: the choice of the particular preparation should depend upon the state of the patient at the time.

2. Chronic Primary Dementia.—Dementia, however, may be primary, yet may not be that just described. It may come on gradually; or suddenly without previous mental affection, but is in such cases connected almost invariably with disease of the brain. Its first and most prominent symptom is loss of memory. In connexion with apoplectic or epileptic attacks, or after years of drinking, the memory is found defective. This may appear quite suddenly, or may be noticed to come on gradually, being at first so slight as to cause little alarm. It may vary at different times. If a patient is kept from alcohol, the memory may gain strength, and if epileptic attacks are reduced in frequency, the same thing may happen. The prognosis in all such cases is unfavourable, for loss of memory points to decided deterioration of brain. Apart from loss of memory, symptoms of dementia or weakness of mind are occasionally found as the first indication of mental unsoundness, following a fright or shock or some severe illness. If they assume the form of acute dementia, we may have hopes that they will pass away, but if with little disturbance of the bodily health the mind becomes weaker and weaker, the hopes of recovery are small.

3. **Secondary Dementia.**—Of dementia which is the sequel to prior mental disorder, such as mania and melancholia, little need be said. It varies in degree, but it is not in our power to remove it. It may be in our power, however, to ameliorate in a great degree the condition of such patients when, as is frequently the case, they are found in a very neglected state. Their friends think that nothing can be done or need be done, and they are allowed to lie in bed, often in a filthy condition, or roam about and get into mischief for want of care and skilled attendance. Many demented patients have far more mind than is generally imagined by the uninitiated, and can be taught to be cleanly, to take their meals in an orderly fashion, and to keep themselves tolerably neat. They are susceptible of amusement, and open to reward for good behaviour. The vital powers of demented patients are low, and they suffer much from cold. In winter their minds like their bodies are enfeebled, and with warm weather they recover somewhat of their energy. There is a tendency in many of these patients, especially women, to become very fat, and in this condition they are subject to bronchitis, and many succumb to acute attacks of this disorder. They require warmth and good diet, for it is difficult to make them take sufficient exercise.

Females, in the writer's experience, are more prone to drift into dementia than males. The latter present various types of chronic mania, with well-marked delusions; but, among private patients at any rate, there are fewer of the hopelessly demented than among the female inmates of private asylums. One cause of this may be that the mortality amongst males is greater, and thus fewer are left to reach the demented stage.

G. F. Blandford.

DEMODEX (δέμας, a body; and δήξ, a timber-worm).—A genus of acarine parasites, established by Owen for the reception of the human pimple mite (*D. folliculorum*), which is sometimes spoken of as the *Simonia* or *Entozoon folliculorum*. It infests the sebaceous follicles, especially those situated upon the sides and alæ of the nose. The body is vermiform, owing to the great length of the abdomen, but the entire animal rarely exceeds the $\frac{1}{50}$ of an inch from head to tail. Gruby and others have succeeded in inoculating dogs with this parasite, which has also been found in mange-affected animals not previously subjected to experiment. In man, when occurring in large numbers, they cause the formation of prominent pimples, which often present an unsightly appearance. Each whitish spot or enlarged follicle presents to the naked eye a terminal black point, and it contains not only full-grown animals (having their tails directed towards the opening) but also eggs, larvæ, and exuviæ. Their presence rarely gives rise to inconvenience other than that resulting from unsightliness. Infected persons, however, are extremely glad to get rid of them, and this may be done by the application of mercurial ointments, by the frequent use of a corrosive sublimate lotion (2 grains to 1 ounce of water), or, as the writer has found, by rubbing-in glycerine of carbolic acid after warm water fomentations. A coarser method of treatment consists in evacuating the pustular contents by small incisions and pressure. By forcibly bursting the follicles and squeezing out the contents small ugly scars are apt to be subsequently formed. *See* Acarus.

T. S. Cobbold.

DEMULCENTS (*demulceo*, I stroke softly).

Definition.—Substances which soften, protect, and soothe mucous membranes. They are generally of a mucilaginous character; and when applied to the skin are termed *emollients*.

Enumeration.—The demulcents in ordinary use are—Linseed-tea, Gum, Starch, Bread, Honey, Figs; Linseed, Almond, and Olive Oil; Glycerine, White-of-Egg, Gelatine, and Isinglass.

Action.—The chief action of demulcents is a mechanical one, in forming a smooth, soft coating for an inflamed mucous membrane, and thus protecting it from external irritation.

T. Lauder Brunton.

DENGUE.—Synon.: Dandy fever (West Indies); Three-day fever; Break-bone fever; Fr. and Ger. *Dengue*.

Definition.—An infectious, eruptive fever, commencing suddenly, and characterised by severe pain in the head and eyeballs; swelling and pain in the muscles and joints, prone to shift suddenly from joint to joint; catarrhal symptoms; sore-throat; congested conjunctivæ; and affection of the submaxillary glands. The disease may remit, and is liable to relapse.

Natural History and Geographical Distribution.—Dengue occurs epidemically and sporadically in India, Burmah, Persia, Egypt and other parts of Africa, North and South America, and the West Indies. It is not known in Britain. Epidemic visitations of dengue, extending over wide tracts of country, occur at considerable intervals, and probably depend on certain unknown atmospheric and cosmic conditions that favour its development.

Ætiology.—Dengue attacks persons of all ages, from infancy to extreme old age. It certainly is infectious, as has been proved by many cases in which the disease has been conveyed from person to person.

Symptoms.—Those characteristic of dengue are the presence of severe continuous arthritic and muscular pains; great debility and prostration; the occurrence of an initial and a terminal rubeoloid or scarlet rash; fever, which is subject to remissions and relapses; the possibility that convalescence may be tedious and painful, and complicated by the continuance of general cachexia, pain and swelling of joints, enlargement of glands, orchitis, weakness of eyes, deafness, visceral disease (such as diarrhœa or dysentery of a chronic and intractable character, and hepatic derangement) boils, carbuncles, and perhaps insanity. In the female, uterine hæmorrhage and miscarriage may occur.

The *invasion* of dengue is usually sudden, the patient feeling well up to the period of attack. The earliest symptom is severe pain in some joint, probably of a finger, which rapidly extends to all the other joints and bones; and this pain during the progress of the disease often passes from one joint to the other by a sort of metastasis. Sometimes there is a period of preliminary malaise, of one or more days' duration, marked by anorexia, a sense of weariness and languor, giddiness, nausea, chilliness or rigor, severe pain in the head—localised or in the eyeballs, and pains in the body, limbs, and joints, notably of the fingers and toes. The attack is often, however, strikingly sudden, as was frequently seen in the last Calcutta epidemic, commencing with violent pains and swelling of the joints, or severe pains in the head, eyeballs, neck, and back. In some epidemics certain phenomena are more prominently marked than others.

The eruption commences on the third day. The fever is accompanied by redness of the face, which is puffy and swollen; sore-throat; congested conjunctivæ; and a general redness, like the scarlatinal rash, extending over the whole body. The tongue is red at the tip and edges, and loaded with white fur, through which the red papillæ protrude. The pulse is rapid, ranging from 102 to 120, or even 140; respiration is hurried; and the temperature rises to 103° or even 105°. These symptoms mark the occurrence of the initial fever and rash, and endure for a period varying from one day to forty-eight hours. After this the rash disappears, the fever subsides, and the remission lasts for a period of two, three, or four days. A recurrence of febrile symptoms then takes place, accompanied by a second, or terminal rash. This differs in character from the first, resembling a rubeoloid or even an urticarial eruption, often showing itself first on the palms of the hands, and in some cases resulting in profuse desquamation of the cuticle, though it may sometimes be so slight as to be barely perceptible. These symptoms gradually subside, leaving the patient weak, exhausted, and often still tortured by swelling and pain of the joints, especially the smaller ones, which may continue in this state for weeks, making convalescence tedious and painful. Or there may be repeated relapses, prolonging the suffering and protracting recovery.

Varieties.—The symptoms vary in different cases, as to the character of the rash, the temperature, and the muscular or osseous pains.

The *rash* not only varies considerably in colour, character, and duration, but it is sometimes almost absent; in other cases it is attended with so much hyperæmia and action of the skin that excessive desquamation results. This hyperæmia also sometimes expresses itself by hæmorrhage from the mouth, nose, bowels, and uterus.

The *fever* is sometimes accompanied by delirium, or in children by convulsions; in the latter, indeed, these occasionally initiate the disease.

Dengue occasionally assumes a *malignant* form, where the amount of poison received has been overwhelmingly large. Dr. Charles says: 'Drowsiness may have passed into coma; the temperature verges on the hyperpyretic; the heart fails, and the lungs are œdematous: while the whole surface is highly cyanotic. These cases have been popularly termed "black fever," and are justly much dreaded.' Happily such cases are rare. Again, there are very mild forms of the disease, in which the patients are scarcely ill, and where it is not easy to decide as to their exact nature; 'A trifling sore throat and slight malaise may be all you can lay hold of till the terminal rash appears to show you what you have had to deal with; and even this may not be seen.'

Course, Duration, and Complications.—The period of *incubation* of dengue is probably from five to six days; it may be a day or two more or less in some cases.

In simple and uncomplicated cases the average period for the *duration* of the disease may be taken as about eight days; but it is frequently prolonged over weeks, and recovery is slow and painful; the constitution often being so much shattered that complete restoration to strength and vigour does not occur for months. It is rarely fatal. *Relapses* are liable to be frequent, and the patient may suffer more than even a second or a third relapse before recovery.

Some of the *sequelæ* already mentioned may remain to torture the patient and retard his recovery. Albumen is occasionally present in the urine; but it is not, as in scarlatina, especially in the cases of children, a frequent or dangerous result of the disease.

Diagnosis.—The distinction betwixt scarlatina and dengue is well marked; though during the outset there is considerable resemblance between the two diseases. There is a high temperature at first in both, but it is more quickly attained, and is transient in dengue; in scarlatina it endures for several days, whilst in dengue the fastigium gives a temperature of 103°, or even up to 105° or 107°, and this being attained it rapidly declines. It is exceptional to find a temperature above 102° maintained in dengue. In scarlatina the period of decline extends over several days, and is marked by slight exacerbations in the evening. In dengue it occupies a few hours, and the temperature may even fall below the normal standard. The severe muscular and arthritic pains of dengue do not occur in scarlatina; and the pulse in the latter is much more rapid in the early stages than in the former. The initial rash in dengue occurs sooner than the eruption in scarlatina.

Prognosis.—An attack of dengue does not confer absolute protection from a recurrence of the disease, though it does so to a great extent.

Treatment.—This is a specific fever, and has to run a certain course. The treatment is simple, and if judiciously directed mitigates the sufferings, and materially aids recovery.

Neither emetics nor active purgatives are necessary. They do no good, but increase the weakness and aggravate the suffering by the muscular movements necessarily induced. Moderate action of the bowels is advisable, followed by a warm carminative aperient, or an occasional dose of calomel, rhubarb, or colocynth, especially if the bowels remain confined, to which there does not appear to be any peculiar tendency, though the evacuations may be dark and often slimy, and confined at the outset. Salines, such as the acetate of ammonia, or citrate of potash, with nitric ether, combined with aconite, are good during the pyrexia. In cases of very high temperature (105° to 107°) Dr. Charles suggests cold-sponging as beneficial; he recommends it when 105° is reached. The danger to life of such a high temperature during the intense heat of the hot months in India is great; and it is then that cold sponging or the cold bath is indicated.

Belladonna seems to confer great relief in this disease; ten to fifteen drops of the tincture may be given, and two or three such doses at intervals of an hour will sometimes produce excellent effects, and afford much relief. The extract may be given if preferred, in doses of one-third of a grain; or the juice in similar doses to those of the tincture. For the pains and nocturnal restlessness, morphia or Dover's powder may be given. Liniments containing opium, belladonna, and chloroform are serviceable as external applications to the spine, back, and joints.

Tonics, and a carefully-regulated nutritious diet, are also indicated, and depletive measures must be avoided. The tonics should be of the bitter vegetable kind, such as gentian and calumba; with these may be combined a small quantity of quinine, with a mineral acid; or, in some cases, the dilute phosphoric acid, combined with nux vomica or small doses of strychnine.

Quinine is given more for its tonic than for its antiperiodic effects; though, where there is a tendency to relapses, the judicious administration of five- or even ten-grain doses may be beneficial in arresting them. Bromide of potassium is recommended by some authorities, and especially when convulsions occur in children. Alkalies, colchicum, and other remedies in use in rheumatism have been found to have little, if any, effect in relieving the pains of dengue.

As to wines, claret is probably the best, but others may be given.

For the irritation of the skin, which is sometimes very troublesome, the application of camphorated oil, and the use of warm baths have been suggested.

As in so many other diseases, especially those that occur to Europeans in tropical climates, complete restoration to health is likely to be expedited and promoted by change of air; and if the cachexia be severe after a prolonged attack of the disease, return to the patient's native climate for a season is desirable.

JOSEPH FAYRER.

DENTITION, Disorders of. — SYNON.: Teething; Fr. *Troubles de la dentition*; Ger. *Zahnen*.

GENERAL REMARKS.—The period of cutting the teeth has been always recognised as a critical time, during which the health of young children is especially liable to become disturbed; and it has been a common practice amongst mothers to attribute every illness occurring in early life, from the irritation of scabies to the distortions of rickets, to the same baneful influence. The evolution of the milk-teeth is no doubt attended with some irritation, especially as at this period the follicular apparatus of the intestines is undergoing considerable development and we know that, on account of the impressibility of the nervous system in young children, any irritation is apt to be followed by general disturbance. It is no doubt also the case that local functional derangements are frequent at this period, but it is often unfair to attribute these *directly* to the irritation of an advancing tooth. One of the most common direct results of teething is pyrexia, which may be intense; and a feverish child is particularly susceptible to impressions of cold, and to the irritation of unsuitable food. Catarrhal attacks coming on at this time need not be therefore the immediate result of the condition of the gum. It is at least equally admissible to attribute them to the ordinary causes of such derangements acting upon a body rendered for the time peculiarly susceptible to injurious influences. This view is supported by the fact that diarrhœa, which is a very common complication of dentition, is especially frequent during the warmer months, when the temperature is apt to undergo rapid variations, while the dress of the child remains unchanged; and is far less common during the winter, when the temperature is more uniform, and the child is more carefully guarded against the cold.

As a rule, the first milk-tooth appears in the seventh month after birth; but dentition may begin at an earlier period. It is not rare for an infant to cut a tooth at the age of four months, and occasionally at the time of birth one tooth is found to be already through the gum. In cases where the ordinary time of weaning is anticipated, a pause generally ensues after the appearance of one or two teeth, and further dentition is delayed until the usual age. Constitutional conditions influence the time of teething. Thus tuberculous and syphilitic children cut their teeth early, while in rickety children the teeth are very slow to appear.

In the majority of cases the teeth pierce the gum in the following order—lower central incisors, upper central incisors, upper lateral incisors, lower lateral incisors, first molars, canines, back molars. A child of twelve months old should have eight teeth and be cutting his first molars, and the whole number (twenty) should be through the gum soon after the end of the second year. The order given above is not adhered to invariably. The incisors are often cut irregularly, and the first molars may precede the lateral incisors. The canines seldom or never precede the first molars.

Some infants suffer more than others from the cutting of a tooth, and it is not always in cases where the eruption of the teeth has been delayed that dentition, when it occurs, is attended with special inconvenience. On the contrary, in severe rickets, where the delay is great, the teeth are often cut with remarkable ease.

SYMPTOMS.—The phenomena which may be looked upon as natural to the process of dentition are salivation; swelling of the gum, which becomes more and more tense, hot, and painful; slight general pyrexia, with flushing of one or both cheeks; irritability of temper; and some degree of restlessness at night. These all subside when the point of the tooth appears through the gum. The complications not necessarily attendant upon the process are high fever; inflammation of the mouth and aphthæ; vomiting (gastric catarrh); diarrhœa (intestinal catarrh); cough (pulmonary catarrh); various eruptions of the skin, with, sometimes, swelling, and even suppuration of lymphatic glands; and certain troubles of the nervous system, such as convulsions, squinting, &c.

The peculiarity of the pyrexia of dentition is its irregular character. It is often higher in the morning than at night, and varies in intensity in a remarkable manner from day to day. A temperature of 104° Fah. at 8 A.M. is not at all uncommon in a teething infant; indeed such an amount of fever in the morning should alone lead us to inspect the mouth, as few diseases are marked by so much pyrexia at that hour of the day. It is important in practice to bear in mind this simple cause of elevation of temperature, for any disease in a child is apt to be complicated by teething, and much needless anxiety may be occasioned by overlooking the condition of the gum. We must not, however, in every case where the gums are swollen and tense, rush to the conclusion that they are the sole cause of the symptoms, for the most serious cerebral disease may co-exist with the eruption of a tooth. Thus, to take an example:—if we find cerebral symptoms to supervene in the course of dentition, we must most narrowly scrutinize their character, before passing them over as merely harmless indications of the general disturbance. Headache, delirium, vertigo, startings, twitchings, and convulsive attacks, may merely indicate functional disturbance of the brain such as is common to many disorders, and these phenomena are not necessarily symptomatic of cerebral disease; but if the bowels become obstinately confined, the pulse slow and irregular, and the respiration unequal and sighing; and if in addition there be photophobia, with sullenness and tendency to drowsiness, we may conclude that something more than mere functional derangement is present, and that there is every reason to suspect the existence of tubercular meningitis.

Treatment.—The treatment of the complications which occur during dentition must be conducted upon ordinary principles. Aphthæ of the mouth are readily cured by the administration of rhubarb and soda, and the application to the mouth of a solution of chlorate of potash or borax in glycerine (ten grains to the ounce). Perfect cleanliness is, however, necessary, and the child's mouth should be washed out each time after taking food with a piece of soft rag dipped in warm water.

Vomiting is best checked by clearing out the stomach with an emetic of ipecacuanha wine, giving a tea-spoonful every ten minutes until sickness is produced. Afterwards a few grains of carbonate of soda may be given with one drop of liquor arsenicalis in a tea-spoonful of water three times a day. Diarrhœa should be treated on the same principle:—first a dose of castor oil to remove irritating secretions from the bowels, then a mixture containing chalk and catechu, or oxide of zinc (one grain to the dose). If afterwards the motions continue large, pasty-looking, and offensive, and are passed too frequently in the day, one drop of tincture of opium may be added to the mixture, as there is usually in such cases too rapid peristaltic action of the intestines. In the case of either of these derangements (vomiting or diarrhœa) it is of great importance to keep the body warm, and this is most effectually done by applying a broad flannel bandage to the abdomen. The diet also should be temporarily modified, reducing the quantity of farinaceous matter that is being taken, on account of the tendency to acid fermentation of food which is set up by such a condition of the alimentary canal.

Looseness of the bowels during dentition has been looked upon by some writers as a natural method of relief to the system, and fears have been held out of grave troubles which might ensue if the looseness were too suddenly arrested. Such fears are, however, quite groundless. A catarrhal condition of the bowels should be cured as quickly as possible, especially during dentition, for it is at this time that the susceptibility to chills is so great, and the danger of severe choleraic diarrhœa being set up is therefore correspondingly threatening. In some cases of teething, where the lungs as well as the bowels are the seat of catarrh and there is a risk of bronchitis, Trousseau recommends that the intestinal derangement should not be suddenly put an end to: but even in these cases a dose of castor oil may be safely given to remove irritating matters from the canal, for, according to the writer's experience, any irritation of the bowels is apt rather to increase than to diminish pulmonary mischief.

The favourite remedy for all disorders occurring at the time of dentition is lancing the gums, but the practice is one which ought not to be pursued indiscriminately. Unless the gum be actually swollen and tense, incising it has no object whatever, for to cut the top of the gum can have no influence in promoting the development of the tooth below. If, however, there be very much inflammation and swelling, and the child seem to be in pain, relief may be obtained by lancing, but in this case the object is merely to relieve tension. Excitement of the nervous system dependent upon the condition of the mouth can perhaps be allayed by the same means; but in the case of convulsions more benefit is to be gained by the use of warm baths, cold applications to the head, and the gentle action of a mild aperient.

Eustace Smith.

DEODORANTS (*de*, from, and *odoro*, I cause to smell).

Definition.—The term deodorant, although it has a more extended signification, is generally used to signify a substance that destroys offensive odours.

General Principles.—Odorous bodies are essentially volatile, and those which are offensive frequently contain sulphur in some state of combination. Deodorants usually produce the effect for which they are used by causing a chemical change in bodies to which they are applied; but sometimes their action consists in absorbing and condensing odorous substances, and thus destroying or counteracting their volatility. Substances which, like charcoal, possess this latter property may, however, indirectly produce chemical changes by bringing the odorous substances into contact with oxygen in a condensed and active condition.

Deodorants may be classed as *volatile* and *non-volatile*.

1. **Volatile Deodorants.**—These all consist of substances the action of which is immediately and exclusively chemical. Being intended to act on bodies which are themselves volatile they admit of more generally useful application than those which are not volatile.

Enumeration.—Chlorine and its lower oxides, Sulphurous Acid, Nitrous Acid and other oxides of nitrogen, Ozone and Peroxide of Hydrogen are the most important members of this class.

Application.—In the selection and use of volatile deodorants, it is necessary to distinguish between bodies which possess the power of destroying or removing a noxious smell, and those which merely cover one smell by another. Carbolic acid, for instance, which is a valuable disinfectant, is of little use as a deodorant, although its powerful odour may render other weaker but more objectionable odours imperceptible or indistinguisable. On the other hand, the so-called chloride of lime (chlorinated lime of the Pharmacopœia), while it possesses a strong and characteristic smell itself, is capable of destroying other noxious odours, and is an excellent deodorant.

The chemical action by which noxious odours are destroyed is principally one of oxidation, and therefore this class of deodorants are generally oxidising agents. Ozone, or active oxygen, is the natural deodorant contained in the atmosphere, which no doubt largely contributes to the destruction of noxious vapours in the air. Volatile oils, which emanate from the flowers and other parts of plants, in contact with atmospheric oxygen produce peroxide of hydrogen, and this as an oxidising agent possesses deodorising as well as disinfecting properties. The moderate and judicious use of perfumes may thus produce a beneficial effect, although their undue employment, by hiding more than removing what is objectionable and may be injurious to health, cannot be recommended. The preparation called 'Sanitas' is principally a solution of peroxide of hydrogen.

2. **Non-volatile Deodorants.**— Enumeration.—Among this class of deodorants are included Charcoal, Earth, Lime, Oxide of Iron, Sulphate of Iron, Chloride of Zinc, Nitrate of Lead, and Permanganate of Potash.

Application.—Although very efficient when brought into contact with the class of odorous substances referred to as noxious gases, these deodorants are less generally useful than they would otherwise be on account of their non-volatile character. Charcoal owes much of its efficacy as a deodorant to the surface-attraction and power of condensation which it possesses, by virtue of which it brings noxious gases such as sulphuretted hydrogen into contact with oxygen in a condensed and active state, so that they are burnt up and resolved into innocuous compounds, or compounds less noxious than those from which they are produced. Earth and oxide of iron, which, like charcoal, are used in the solid and dry, or nearly dry state, absorb and combine with, or promote the combination of, noxious gases, producing innocuous products. Lime may be used either dry or in the state of milk of lime. The other substances named are used in the form of solution in water. Where large quantities of decomposing animal or vegetable matter are required to be deodorised, dry lime or solution of sulphate of iron (green vitriol) may be economically and advantageously used. T. Redwood.

DEPILATORIES (*depilis*, without hair). Synon.: *Psilothron*, *Rusma*.

Definition.—Depilatories are agents used for destroying the hair by means of their chemical properties.

Enumeration and Action. — Depilatories usually consist of powders, of which the chief constituents are quicklime (three parts), and sulphuret of sodium (one part), diluted with (four parts of) starch. The powder is mixed with water to the consistence of a thin paste, and laid on the part to be operated on by means of an ivory paper-knife. In from five to fifteen minutes the paste should be carefully scraped off, when the hair, shrivelled and burnt, will come with it. The skin must then be washed with fresh water, and dried, and anointed with cold cream. A strong solution of sulphuret of barium, made into a thin paste with starch, is a powerful depilatory.

Erasmus Wilson.

DEPLETION (*depleo*, I empty). Synon.: Fr. *déplétion*.

Definition.—By depletion is understood (*a*) the unloading, or rendering less full, of that which is over-burdened or over-full, for example, portions of the turgid vascular system —as the portal vessels; or (*b*) excessive evacuation causing exhaustion—as in choleraic or other severe diarrhœa.

Uses.—Depletion, local or general, as a therapeutic agent, may be practised in a variety of affections, such as cerebral congestion, venous turgescence, engorgement of the portal system, pulmonary congestion, renal ischæmia, or general plethora.

Methods.—The agencies whereby depletion may be produced are blood-letting, general or local, purging, sweating, vomiting, and abstinence from food and drink.

1. **General Blood-letting.**—There is no more powerful or prompt depleting agent than general blood-letting by venesection or arteriotomy; indeed, the chief indications for bleeding are to be found where it serves a depleting purpose—as in engorgement of the right heart and venous system, visceral congestion and arterial turgescence. (*See* Blood, Abstraction of.) It is seldom, however, that abstraction of blood needs to be carried to such an extent as to exert a marked depleting effect on the whole system; it is required, rather, for the relief of limited vaso-motor disturbances.

2. **Local Bleeding.**—Bleeding by means of leeches, scarifications, or cupping, may serve a very valuable depleting purpose in limited congestions, as in those of the pericardium, pleura, peritonæum, lungs, eyes, kidneys, tongue, uterus, and hæmorrhoidal vessels.

3. **Purgation.**—For general depleting purposes free purging by means of hydragogue

cathartics is the most efficacious agent. In cerebral, cardiac, and hepatic congestions, when it is required to give relief to turgid vessels without abstracting blood, nothing depletes so readily, efficiently, and safely as watery purges. The best purgatives are:—Elaterium, jalap, senna, scammony, sulphate of magnesia or soda, tartrate of soda, bitartrate of potash, croton oil, and gamboge; to which may be added, podophyllin, calomel, and antimony. Watery purges have the great advantage of depleting by removing serosity from the blood-vessels without the loss of red corpuscles. In cerebral congestion depletion by means of such purges is of cardinal service. In congestion of the intestinal tract arising from hepatic, cardiac, or pulmonary disease, a mercurial followed by a saline purge is of great service. Antimony has been mentioned in the above list because of its usefulness in combination with sulphate of magnesia and other saline purges. It should be remembered that it also acts as a depressant, and should only be used when such action is permissible.

4. Vomiting.—When used as an emetic, antimony has a powerfully depressant, as well as evacuant or depletory effect; but depression and depletion are not synonymous. The lowering effect of free purging is pronounced, and ordinarily, sufficient. Emetics may act as depletants by evacuating the contents of, or producing a flux from, the stomach; but their depressant action is always to be borne in mind when used with this object.

5. Sweating.—This is a less effectual mode of depletion. It may serve a good purpose, when freely induced, in lowering arterial tension, as in cases of renal disease, especially if there be pyrexia. Active exercise, the hot air (or Turkish) bath, the vapour bath, wet packing, jaborandi, antimony, and Dover's powder are the usual modes of exciting diaphoresis. Diaphoretics are often aided by copious draughts of hot fluids. The evacuant action of sweating and purging may be advantageously combined when speedy depletion is desired. The combination is valuable in certain dropsies.

6. Abstinence.—General depletion may be produced by abstinence from food and drink, and is sometimes employed in the treatment of aneurism, and of strangulated hernia containing omentum, the absorption of the fat of which is the object aimed at by starvation.

Alfred Wiltshire.

DEPOSITS.—The term deposit had at one time a much wider extension in pathology than it has now. In accordance with the doctrine of morbid *crases* or *dyscrasiæ*, it was customary to regard cancers and all new-growths, the products of tubercular and scrofulous diseases, as well as those of the specific fevers and ordinary inflammation—in fact almost every kind of morbid product in the body—as 'deposited' from the blood in consequence of some alteration in its composition. In many of these cases the term deposit is still often used, even though an entirely different view may be taken of the processes leading to these morbid changes. The name remains, though the idea has departed; and this is also true of other morbid products called deposits. The term *secondary deposits* was formerly used for what are now called pyæmic or secondary abscesses, from a belief that pus was removed from the original seat of disease, and deposited in distant parts. The term *atheromatous deposit* is due to Rokitansky, who described this change as due to the deposition upon the arterial wall of material precipitated from the blood. In both these cases the term seems now misleading. Again, several processes which we now call degenerations or infiltrations were formerly spoken of as deposits; for example, lardaceous, fatty, and pigmentary deposit; and although these processes may now be better described by another name, it cannot be doubted that in some of them an extraneous substance is actually deposited in the tissues. The term *fibrinous deposits* was also used for the masses now known as infarctions or blocks (as for example in the spleen or kidneys) where the appearance of a mass of extraneous material is produced by the degeneration as a mass of tissue, mixed with products of hæmorrhage, inflammation, and exudation. In quite another sense the various substances precipitated from urine are spoken of as *urinary deposits*, with which we are not here concerned.

When these exceptions are made, the present use of the word *deposit* is a limited one, but is appropriate in those cases where something different from the elements of the tissue, and especially if it be an inorganic material, is found in their substance, and when it may reasonably be supposed that this material has been brought to the tissues by the circulating fluid and there deposited. The term is clearly inappropriate when the foreign matter is formed by some chemical change in the substance of the tissue-elements, but between such cases and those just mentioned it is very difficult to draw the line. We shall speak, in the sense just defined, of *calcareous*, *metallic*, and *pigmentary* deposits.

1. Calcareous Deposits.—All calcification of the tissues of the body, whether normal or degenerated, of inflammatory products, of new growths, or of any morbid products, appears to depend upon the deposition of lime-salts in the form of granules, this deposition taking place either within the substance of the elements, or more rarely in the intercellular substance, or, possibly, sometimes in the interstices of the tissue. Calcareous deposit takes place towards the close of life in several parts of the body, as in the walls of arteries, in cartilages and tendons, in the valves of the heart, the crystalline lens of the eye, and other parts; though in most of these cases, if not in all, some other pathological change precedes the deposition of lime. Still more frequently this change occurs in masses of dead or degenerated materials, as, for instance, in organs which have partially or wholly lost their vitality, in new-growths which have reached the stage of retrogressive change, in old blood-clots, or in products of bygone inflammation. A wasted eyeball always becomes partly calcified (sometimes ossified); tumours, such as myoma and fibroma, are especially subject to calcification; venous clots which remain long undisturbed, as in the deep veins of the pelvis, undergo the same change, and become phlebolithes. Old inflammatory products, as pus and lymph, seem to become necessarily calcified if they are not absorbed; so do especially the products of chronic degenerative inflammations which have become necrotic, as seen in scrofulous lymphatic glands, and in tubercular masses in the lungs. A similar explanation applies to calcareous deposit in the walls of arteries, where the lime is generally deposited in new products which result from chronic arteritis or the atheromatous process, though lime may also be deposited in the muscular walls independently of atheroma. Necrotic masses resulting from embolic infarction are frequently calcified. Parasites of all kinds, occurring in solid organs, are liable to become surrounded by a calcified wall: a change frequently seen in hydatid cysts.

From all this it appears that calcareous deposit rarely occurs in normal healthy tissues, but is common in such parts as are dead or of deficient vitality. Its deposition must be attributed to some chemical reaction between the tissues thus altered and the lime-salts in the blood, and it is possible that the presence of an excessive quantity of lime-salts in the blood sometimes favours the change, since deposition of lime in one part sometimes coincides with removal of it from another part. In senile decay the wasting of bones goes on simultaneously with the calcifying processes just mentioned, and in some rare cases rapid absorption of bone from special disease has appeared to be the determining cause of its deposit elsewhere by a sort of *calcareous metastasis.*

2. **Metallic Deposits.**—Other minerals besides lime-salts are rarely found deposited in the tissues, although in cases of chronic metallic poisoning, compounds of lead, silver, and copper may be found thus deposited. Zinc and mercury are less clearly traced, but probably follow the same law. The state of chemical combination in which the metals occur is not positively known, but appears to be some combination with albumen.

3. **Pigmentary Deposits.**—Pigmentation as a process is discussed in the article Degenerations, and has been shown to depend very frequently upon the occurrence of hæmorrhage and transformation of the extravasated blood. But pigment is deposited in many parts of the body, both normally and pathologically, quite independently of hæmorrhage. Normally this is seen in the skin, the choroid coat of the eye, &c.: pathologically in the same situations, but in excessive quantity; and also in abnormal situations, as on the mucous membrane of the mouth. The arrangement of the pigment is in every case the same, forming minute black granules in the protoplasm of the cells around the nucleus. Its deposition and removal are regulated by causes as yet very imperfectly known, but are probably in some way dependent upon the nervous system.

The deposit of such substances as fat, lardaceous material, colloid, &c., is not a simple process, but depends either upon chemical metamorphosis of the cell, or on general pathological changes, which are dealt with in other parts of this work. J. F. Payne.

DERBYSHIRE NECK.—A synonym for goitre, which is thus called from the prevalence of the disease in that county.

DERIVATIVES (*derivo*, I drain).

Definition.—Medical appliances or remedies which lessen a morbid process, such as inflammation, in one part of the body, by producing a flow of blood or lymph to another part.

Enumeration.—Derivatives include—Local bleeding, Cupping, Leeches, Blisters, Sinapisms, and Setons.

Action.—The name 'derivative' was applied in ancient times under the belief that diseases were caused by morbid humours, which might be drawn away from the part which they were affecting. It is now used chiefly to signify the diminution of blood in an inflamed part, by increased circulation in some other vascular district, either adjoining or remote from it.

T. Lauder Brunton.

DERMATALGIA (δέρμα, the skin, and ἄλγος, pain).—Pain and aching in the skin. *See* Neuralgia.

DERMATITIS (δέρμα, the skin).—Inflammation of the skin, a term applicable to every variety of inflammation of the integument, but especially to an acute inflammation attended with exfoliation of the cuticle and copious desquamation, for example, *Dermatitis Exfoliativa*, the *Pityriasis rubra* of Devergie.

DERMATOLYSIS (δέρμα, the skin, and λύσις, a loosening).—Looseness or relaxation of the skin. *See* Cutis pendula and Molluscum.

DESQUAMATION (*de*, from, and *squama*, a scale).—The process of separation or shedding of the epithelium of any surface. It is of most importance in connection with the skin in scarlatina, where the epidermis usually desquamates extensively.

DESQUAMATIVE NEPHRITIS.—A synonym for certain forms of Bright's Disease, applied on account of the shedding of the epithelium lining the tubules, which is characteristic of the disease. *See* Bright's Disease.

DETERGENTS (*detergo*, I cleanse).

Definition.—Substances which cleanse the skin.

Enumeration.—The principal detergents are—Water, Soap, Alkalies, Ox-gall, Milk, Vinegar, Charcoal, Sand, Oatmeal, Sawdust, Pumice-stone, Oil, and Borax.

Uses.—Detergents are used either to remove extraneous dirt adherent to, or epidermal scales which may have accumulated upon the skin, and interfere with its function. The chief detergent is warm water, but its action is greatly aided by such substances as soap, alkalies, borax, or vinegar, which act chemically in the removal of dirt or epidermis; or by such substances as oatmeal, sawdust, charcoal, pumice-stone, and sand, which act mechanically. Oil removes the resinous deposit left on the skin by plasters. Where the skin is tender, as in the case of the scalp, and where at the same time the detergent employed cannot very readily be removed, borax with elder-flower water may be found preferable to the more irritating soaps as a means of removing scurf.

T. Lauder Brunton.

DETERMINATION OF BLOOD.—Increased flow of blood to a part or organ, synonymous with *active hyperæmia* or *active congestion*. *See* Circulation, Disorders of.

DEVELOPMENT, Arrest of.—The causes of arrest of development are in most cases still very doubtful, and for the most important theories and observations on the subject the reader is referred to the article on Malformations. Such arrests may take place at any stage in the development of the embryo and of its organs; but only the most important of them, and the mode in which some typical examples are brought about, will be mentioned here.

Varieties.—Those which occur very early in fœtal life are complex and, for the most part, incompatible with viability; whilst those which occur later often affect only one organ or a set of organs, and in some cases form no barrier to a prolonged existence. Not only must the fœtus be considered, but also the placenta and membranes in which it is enclosed *in utero*; for diseases of these lead to many forms of monstrosity, either by interference with the nutrition and respiration of the embryo, as in the case of many so-called 'true moles'; or the normal changes may be checked by adhesions between them and the fœtus. Persistence of the umbilical vesicle is excessively rare, but a patent vitelline duct is very common, and explains many of the diverticula in connection with the small intestines. A want of closure of the visceral laminæ is the source of many deformities, from a simple fissure in the sternum, or a ventral hernia, to a complete anterior cleft, with the thoracic and abdominal viscera lying bare out of the body-cavity. In other cases the skin and muscles only may cover the viscera, or the muscles may not be developed. The thorax is closed before the abdomen, so that ectopia of the abdominal is more common than of the thoracic viscera. The abdomen, however, is sometimes closed in, whilst the thorax remains open, and varying degrees of ectopia cordis result; but this is rarely complete. Epispadias and hypospadias to varying extents are further examples of imperfect fusion of the ventral laminæ. These may or may not be attended with displacement or deficiency of the urinary and genital organs. Similarly from an incomplete fusion of the dorsal laminæ the various forms of spina bifida occur, and these are generally accompanied with an excess of fluid in the spinal canal, or hydrorachis.

The arrests in the development of the cerebrospinal centres and of the organs of special sense are very numerous. The whole brain may be wanting, or the medulla oblongata developed and the remaining portions missing, or any given part of it may be absent or quite rudimentary. From incomplete fusion of the bones of the skull hernia cerebri or encephalocele occurs, and this is generally complicated with hydrocephalus, though the latter is frequently found as an independent and solitary affection. Coloboma and deficiency of the olfactory, optic, or auditory nerves are well-known examples of arrested development of the organs of special sense. The special malformations of the heart and vascular system, the digestive, respiratory, and urino-genital systems, will be described under the various organs; but reference must here be made to congenital fissures leading into the pharynx (persistent branchial clefts), to the various fissures of the face and palate, to persistent cloacæ, to the numerous forms of hermaphroditism, and to imperforate anus, as all coming under this head. Varying degrees of ill-developed extremities are common, from a diminution of number in the fingers or toes, or their coalescence, to a complete absence of one or all the limbs. Finally, ducts, vessels, and openings—such as the urachus, ductus arteriosus, umbilical vessels, and foramen ovale—which normally close soon after birth, may remain patent throughout life. John Curnow.

DEVONSHIRE COLIC.—A synonym for lead colic, which has arisen from the frequency of lead-poisoning in that county, supposed to be due to the contamination of cider by lead. *See* Lead, Poisoning by.

DIABETES INSIPIDUS (*διά*, through, *βαίνω*, I flow; and *insipidus*, tasteless).—Synon.: Polyuria; Fr. *Diabète insipide* or *non sucré*; Ger. *Polyurie*. A synonym for Polyuria. *See* Polyuria.

DIABETES MELLITUS (*διά*, through, *βαίνω*, I flow; and *μέλιττα*, a bee).—Synon.: Glycosuria; Fr. *Diabète*; Ger. *Harnzuckerruhr*.

Definition.—The term Diabetes, meaning an excessive flow of something, has been applied to the pathological condition indicated by an excessive flow of urine. It has, moreover, been almost wholly limited to the kind of malady characterised by the presence of a notable quantity of sugar in the urine—a condition more strictly described by the term Diabetes Mellitus. Another condition is sometimes seen where no sugar is to be found in the urine, which is, however, excessive in quantity. This is designated as Diabetes Insipidus, or better, Polyuria.

Diabetes is a malady more or less chronic, characterised by the persistent presence of a notable quantity of sugar in the urine, which is in most cases markedly abundant. It is accompanied by thirst, hunger, and bodily wasting. If unrelieved it invariably tends to death. The ordinary form of Diabetes is thus to be distinguished from certain other conditions, where, for instance, a small or hardly perceptible trace of sugar may be detected in the urine; or where, yet again, considerable quantities of that substance may be detected occasionally, and for a short time only. To this abnormal condition the term *Glycosuria* (*γλυκύς*, sweet, and *οὖρον*, urine), which is often also employed to describe artificial diabetes, best applies.

General Considerations.—Three important facts lie at the bottom of our knowledge of the pathology of Diabetes.[1]

These are:—

I. That grape sugar is found in the healthy human body.

II. That glycogen, a substance closely allied in chemical composition to grape sugar, is also found in the healthy human body.

III. That both of these may be formed in the healthy human body.

Beyond these, certain other fairly definite propositions may be made.

[1] The discussion at length of the subject Glycogenesis, which formed part of the original article, has for want of space been here omitted.—Ed.

1. Glycogen is found most abundantly in the liver, insomuch that, with due precautions, it can always be detected there: after a certain time sugar takes the place of glycogen, but the exact mode and time of this conversion are not known.

2. Nevertheless, it is fairly certain that the sugar called glucose can always be detected in the liver; still more certain that it is to be found in the blood; but

3. This sugar never appears in any notable quantity during a state of health in the urine.

4. As sugar is not to be found in any appreciable quantity in any other of the excretions, it follows:

5. That this sugar must disappear in the body.

6. It is commonly asserted, and, upon the whole, believed, that sugar is less plentiful in venous than in arterial blood.

7. From this, if true, it follows that sugar must be used up in the course of the circulation.

8. Where the combustion, or oxidation, occurs is not quite clear.

9. But it is plain that, from a fault in either direction, sugar may become over-abundant in the blood, namely:—

a. By over-production, or

b. By diminished consumption.

10. The over-production and the diminished consumption of sugar in the body may depend on various causes. The most notable of these are (*a*) an increased ingestion of saccharine material into the stomach and bowels, without a corresponding destruction; and (*b*) such an alteration of nerve-influence as will completely modify the relative proportions of the sugar produced and the sugar destroyed.

11. With an excess of sugar in the blood, only one easy road of egress from the body is available, that is, by way of the kidneys; but this is not a sufficient outlet when there is great superabundance in the blood. Sugar may then be found in almost every one of the secretions or excretions.

12. With this unnatural discharge of sugar there is usually a corresponding discharge of urine, but not always.

13. Thus there may be no greatly increased flow of urine, yet the urine may be rich in sugar.

14. And yet, again, there may be a copious flow of urine without any sugar, as in *Polyuria.*

15. Hence the over-production or the diminished consumption of sugar in the system has no necessary connection with increased flow of urine.

16. Both the abnormal action of the liver and that of the kidneys seem in the main to depend on similar but not identical causes.

17. Both seem to be under the control of the sympathetic, but the special fibres are not the same as regards the two organs.

(*a*) In the case of the liver the fibres seem to originate in the medulla oblongata, to descend in the spinal cord to the lower cervical or upper dorsal vertebræ, thence to leave the cord to join the gangliated sympathetic, and so ultimately to reach the liver.

(*b*) In the case of the kidneys the active fibres proceed further down the spinal cord, but are ultimately connected with the great abdominal plexus, for such it may well be called, whence the fibres proceed to the kidneys.

Ætiology.—The classification of cases of diabetes according to causation is in very many cases practically impossible.

As to the circumstances that call the morbid processes into play, we know very little. It is certain, however, that the disease is much more frequent among men than among women, and among the middle-aged than among the very young or the very old. The disease is very much more fatal in young adults than in those over, say, forty-five. That the disease is more rife in certain districts than in others may probably be best explained by its undoubted tendency to heredity. This heredity, as in many other maladies, is peculiar; the diabetic tendency in one branch of a family being represented in another branch by various nervous disorders, especially epilepsy and imbecility.

Of the so-called *exciting* causes there are two of the first rank, namely, injury, or disease of the brain; and mental excitement, or, perhaps still more, worry. Tumours and other local brain-mischiefs sometimes give rise to a fatal diabetes. Certain mental emotions, at once powerful and prolonged, which may be epitomised in the single word strain, apparently act as exciting causes of diabetes, such as continuous anxiety, long-lasting grief, or excitement followed by reaction. Certain errors of diet—such as excessive use of hydrocarbons, especially sugar—or other interference with the laws of health, may originate a fatal diabetes, especially in those who have any hereditary tendency to the disease. It is possible that the frequency of the malady among the Jews (as noted by Seegen) may be accounted for on dietetic grounds.

Anatomical Characters.—Many pathological conditions have been recorded as occurring in those who had been the subjects of diabetes, but we know little of its real pathology. In many cases nothing which can be directly connected with the diabetes has been found *post mortem*. Latterly attention has been mainly directed to the investigation of certain parts of the nervous system and of the liver itself. Perhaps the most reliable data for the ordinary anatomical appearances are to be found in Seegen's analysis of Rokitansky's experience, embracing 30 necropsies.

Connected with the *brain and spinal cord* various lesions have been found, such as tumours of different kinds pressing on the medulla, and softening, with or without the marks of extravasated blood. In some cases extravasation has been the only morbid change discovered. In two cases under the writer's care there were extravasations of blood in the spinal canal in the cervical and upper dorsal regions, and the same was observed in another case under the care of a colleague. In one of these there was very marked softening of the cord in the regions named. In these three cases death took place suddenly. Dr. Dickinson's theory of the origin of diabetes in lesions of the nervous system, represented by enlarged perivascular spaces, the sites of existent or pre-existent extravasations of blood with destruction of the surrounding nerve tissue, is hardly tenable. The exploration of the sympathetic system has not been more satisfactory.

Rokitansky found (in 15 out of 30 cases) that the *liver* was enlarged, hyperæmic and hard, of a dark-brown colour, with its acini imperfectly defined. The same conditions were present in the cases examined by the writer. When the disease has lasted a long time, the liver may be smaller than natural. The same would appear to hold good with regard to the cells themselves. Early in the disease, the cells, especially in the outer portions of the acini, are large, plump, and rounded, instead of angular, with large and distinct nuclei. They tend to assume a wine-red colour with solution of iodine, from the presence of unchanged glycogen. There are also sometimes found signs of active cell-growth at this early stage. Later the cells seem smaller, and as if undergoing pigmentary degeneration.

The condition of the *pancreas* in diabetes is highly interesting. In 13 out of Rokitansky's 30 cases, it was strikingly small, hard, and bloodless; and in many cases it has been found so shrunken and altered as to be hardly recognisable save by its connections. Such was the case in one instance the writer has seen, and in all his other cases the pancreas has been abnormal, usually contracted here and there, hard and knotty. In one case, however, the organ was enlarged and more succulent than usual, probably the first stage of the mischief. The occurrence of so important pancreatic changes in about one-half the cases of diabetes would seem to indicate more than a casual connection with the disease. What this connection really is remains unascertained. Klebs has associated the changes with disease of the cœliac plexus. One result from the pancreatic mischief is inability to digest fat. This was seen in one of the cases referred to above.

The *kidneys* Rokitansky found diseased in 20 instances, but the changes were not uniform. Usually they presented the ordinary indications of hyperæmia, being enlarged, dark red, and full of blood. Occasionally there were signs of more extensive mischief, the substance of the kidney as well as its vessels and epithelium being involved, and the organ harder than natural. Often fatty changes occur. In one case of the writer's amyloid changes had begun in the Malpighian bodies.

The *lungs* are frequently diseased: in only 7 of his cases did Rokitansky find them normal; Dickinson only twice out of 27 instances. The changes included all stages, from acute or chronic pneumonia, to the formation of numerous cavities, or even to gangrene. In one of the writer's cases the whole of the upper lobe of one lung was converted into a huge cavity filled with solid and semi-fluid detritus, having no gangrenous odour. There had been no expectoration, and no hæmorrhage, though vessels were exposed.

The *stomach* and *intestinal canal* present little beyond the ordinary signs of recurrent or chronic catarrh—thickening, mammillation, and slaty pigmentation; erosions and ulcerations may, however, occur.

SYMPTOMS.—The following sketch comprehends the more characteristic clinical features of diabetes; but there are often important variations in individual cases, though a certain number of features are common to all:—The patient, most likely a male between twenty and forty-five, when he comes before the physician has in all probability been suffering from the disease for some time; for it usually comes on insidiously. He may say that he has been in failing health for a varying period; that he has been very thirsty, and has passed much water, having to get up repeatedly for this purpose during the night. His appetite has been more than hearty; but his food seems to do him no good, for he has been constantly growing thinner, and he feels weak and ill. On closer examination it is found that he is daily passing as much perhaps as eight, ten, or more pints of urine, light in colour and of a peculiar sweetish odour, of a high specific gravity, perhaps 1040, and containing an abundance of sugar. The skin is dry and harsh; the tongue red and glazed or slightly furred; the mouth dry and clammy; the lips, teeth, and gums are covered with scanty, sticky mucus; the breath is often sweetish, or it may be unpleasant from the state of the mouth; the bowels are confined; and the countenance wears an expression of weariness and fatigue.

From this point the malady may progress in one or other of two directions. Under judicious management the symptoms may ameliorate. Often the first indication of improvement is a copious perspiration; the thirst diminishes; less urine is passed; the appetite is not so ravenous; the sugar decreases in quantity; and with it the specific gravity is lessened. Emaciation ceases, and the patient begins to regain weight. This auspicious commencement may, with time and care, end in a more or less complete return to health. Unfortunately there is another side to the picture, for notwithstanding all our efforts the patient often goes from bad to worse. We fail to reduce the quantity of sugar beyond a certain point. The appetite gets more and more voracious, especially for starchy articles of food, for which the patient will sometimes lie, steal, do anything, and yet there is often no feeling of satiety. Sometimes the appetite fails, and then emaciation goes on still more rapidly. All sexual power and feeling have long ago been lost, the testes sometimes undergoing almost complete atrophy. The harsh, dry, and itchy skin becomes the seat of boils, or even of carbuncles. Often the sight is injured by cloudiness of the refractive media, especially of the lens, or by other and more anomalous changes. All this time the temperature is low, perhaps sub-normal; but towards the later stages of the malady it often rises. Such a rise indicates the accession of a formidable complication which might almost be said to be the natural termination of diabetes. This superadded mischief is a peculiar insidious kind of pneumonia, resembling acute pneumonic phthisis, and giving rise to local signs resembling those characteristic of that malady. The progress of this lung-mischief is rapid, the fever increases, and often there is irrepressible diarrhœa, sometimes of fatty-looking matter. As the end approaches, the sugar usually disappears from the urine, which may become albuminous and scanty. There may even be some œdema of the extremities. The end often comes swiftly, and without warning, by acute pneumonia, or by what, for want of a better name, we call diabetic coma, or more slowly by gradual exhaustion. After the onset of pulmonary symptoms it is never very long delayed. Such may be said to be the ordinary course of a well-marked case of diabetes. There are cases slighter, where the history is different; but in both sets of cases there are certain symptoms, which demand further consideration than has been given them above.

The Urine.—The characteristic of the urine in diabetes is the presence in it of sugar in notable quantity, though this varies greatly in different cases. In the earliest and slightest forms of diabetes, small quantities of sugar may be passed now and again, as after a meal or the consumption of an unusual quantity of starchy or saccharine food; but the sugar may completely disappear in the interval, or may do so finally by the use of an animal diet. The sugar thus excreted is glycose of the kind called dextrose, from turning polarised light to the right, is readily soluble in water and alcohol, and easily ferments. When diabetic urine is allowed to stand in a warm place, fermentation soon sets in, gas being disengaged, and yeast deposited at the bottom of the vessel. The proportion of sugar to urine is usually from 8 to 12 per cent., but varies; the total quantity passed amounting to 20 or 25 ounces, or even more. Its presence in such proportion causes an increased specific gravity, though this is not invariably the case, inasmuch as it may vary from 1,008 to 1,060 or 1,070. Along with the presence of sugar, we almost invariably find an increase in the quantity of the urine. But neither is this an invariable feature of diabetes, for sugar may exist with a normal quantity of urine, constituting the so-called *Diabetes decipiens.* But in most cases, there is a marked increase, the quantity passed amounting to 8, 10, or 15 pints daily; and even the highest of these rates has been greatly exceeded. With an excessive amount of urine, its colour becomes lighter; sometimes it has a faint greenish tint, and when passed is quite clear. On standing there is no ordinary sediment, though, as already said, sporules of yeast may be deposited after a time. There is on the whole an excess—sometimes a large excess—of urea, and if the quantity of urine passed be small, urates or other urinary ingredients, as sulphates and phosphates, may appear. Very great inconvenience may arise in diabetic females, or even in males, by the arrest of saccharine urine about the external genitals, producing a raw or eczematous condition of the inside of the thighs and groins. The urine being also almost invariably acid, is highly irritating to the raw and swollen parts. Enuresis is common, especially at night, and among diabetic children. Albumen makes its appearance sometimes in the progress of, or in the later stages of the disease.

The Digestive Organs.—As the correlative of the unusual flow of urine we have also, as a marked and early symptom of diabetes, extreme thirst, a thirst too which cannot be satisfied, for apparently the more the patient drinks the greater is the thirst. This sensation is in some part due to the dry and clammy condition of the mouth, which it is difficult to relieve. Hunger, or even a voracious desire for food, is usually a prominent feature in diabetes, but is not invariably present, and in the later stages there may be complete loss of appetite, amounting to a loathing, especially for a restricted diet. It is often impossible to satisfy the intense craving for food, and should satiety be attained the sensation lasts but for a little time. The mouth is usually dry and parched, the saliva being scanty and tenacious. Often particles of food are retained about the teeth, and there putrefy, giving rise to unpleasant odours. The buccal fluid is almost always acid instead of alkaline, probably from the formation of lactic acid. The tongue is rarely perfectly natural. Seegen describes it as usually thickened and increased in volume, with fissures and glazed blood-red islands on its surface, which, however, may present a general coating. The teeth often fall out without pain from the retraction of the gums, and are singularly liable to caries. Digestion is usually good, except during catarrh of the stomach, which is a rather frequent condition. Constipation is the rule in diabetes, often to a troublesome extent. This arises partly from the deficiency of water in the bowel; partly also from the small quantity of fæcal residue from an exclusively meat diet. Diarrhœa, on the other hand, is not uncommon, and rapidly deteriorates the patient's strength.

General Symptoms.—Emaciation is an early and marked symptom of diabetes, but not invariably so, for diabetes often occurs and persists in stout persons, without removing the obesity. These are cases of the more tractable kind, the patients being usually somewhat advanced in life. Their complete cure is seldom effected, but they do not seem to suffer greatly from the malady. Though the emaciation is in great part due to the removal of fat, and in part to the abstraction of water from the tissues, there seems to be also an actual waste of muscular substance, especially in the advanced stages of the disease. With this emaciation are associated weakness, weariness, and disinclination to exertion. These are often among the earliest symptoms of the disease, often occurring long before wasting is noticed, and increasing markedly towards the close of the malady. From various causes, one being, doubtless, weakening of the heart, œdema of the lower extremities may occur, with or without albuminuria. Gangrene of the extremities, of the senile kind, has been observed.

Respiratory apparatus.—With regard to the respiratory organs, a peculiar apple- or hay-like odour of the breath is sometimes observed, probably arising from the production of acetone mixed with alcohol. But the most serious pulmonary symptoms are those of phthisis, resulting from a more or less chronic pneumonia. This mischief is usually indicated by a nightly rise in the temperature, but otherwise may remain for a time almost latent. It is most common in the young, and towards the end of the disease. The expectorated matters may contain sugar. Gangrene of the lung, or a form of necrosis of the lung-tissues, has been noticed. With this form of gangrene the sputum may be odourless.

Skin.—The skin is usually dry and scurfy, often extremely itchy; wounds inflicted by scratching heal with difficulty. Copious saccharine sweat is observed in a certain number of instances. There is a marked tendency to the formation of boils and carbuncles. Boils often occur early in the disease, and may give the clue to the existence of diabetes. Carbuncles occurring late in the disease may be the immediate cause of death.

Nervous System and Special Senses.—The sight is often affected in diabetes, most frequently by the formation of diabetic cataract. Operations in such cases do badly till the disease is cured, and are seldom tried, for the cataract occurs late in the disease, and advances rapidly. A form of retinitis not unlike that of albuminuria is sometimes found. Other forms of imperfect vision of uncertain origin occur in diabetes. They go by the general term of diabetic amblyopia.

Along with the physical, the mental powers fail, and all moral sentiments become blunted, which, to the friends of the patient, is not the least distressing feature in the malady.

Genital organs.—Early in the history of the disease, all sexual appetite disappears, and sexual power soon fails in the male—but with improvement this may return. In the advanced stages amenorrhœa is not unusual amongst females.

COMPLICATIONS.—Several of the symptoms just described are regarded by some authorities as complications of diabetes rather than as belonging essentially to the disease. Such are especially diabetic cataract and amblyopia, boils and carbuncles, and the chronic pneumonia or phthisis in which diabetes so frequently ends. Gangrene of the extremities has also been occasionally observed. Amongst the intercurrent diseases that are specially to be watched for and seriously regarded, one of the most important is albuminuria, the appearance of which may encourage a false prognosis, from the fall in specific gravity of the urine that attends it.

DIAGNOSIS.—The diagnosis of Diabetes depends on the discovery of sugar, in notable quantity, in the urine of the patient. But before the investigation for sugar is undertaken, there have usually been observed by the patient some of the early indications of diabetes, of which the following are the most frequent, though no one definite symptom invariably heralds the disease:—1. dryness of the mouth and thirst; 2. bodily weakness and gradual emaciation; 3. dryness of skin, with itching and a tendency to successive crops of boils; 4. urination in increased quantity, the urine being of a greenish yellow tint, with the odour described; 5. defects of vision. Occasionally the attention of the patient is drawn to the state of his urine by the attraction it presents to ants, flies, and other insects; or by the formation of white spots of sugar on his dress or boots left by the urine on evaporation.

We must not forget that in true diabetes we find sugar in notable quantity. There are often present in the urine other reducing agents (such as uric acid and colouring matters), so that the amount of sugar detected must be such as to admit of no doubt whatever. Again, the presence of the sugar must be persistent, hence a single examination will not suffice for diagnosis unless sugar be found in large quantity. It may so happen that the patient when seen is not passing sugar, from the influence of restricted diet, or from some other cause, such as pneumonia or other feverish condition. It is then best to examine the urine passed an hour or two after a meal, or even to permit the use of starchy food for a day or two, so that the constitutional proclivities of the patient may be the better ascertained. To determine the existence of sugar is not enough; it is always necessary to determine the quantity passed, so as to obtain a clue to the intensity of the disease, and to judge of the effects of treatment.

Qualitative testing for sugar.—1. *Specific gravity.*—This almost invariably exceeds that of the healthy secretion. If a large quantity of urine is being passed daily, the specific gravity of which is upwards of 1030, we have good *primâ facie* grounds for concluding that sugar is present. But as urinometers are often inaccurate, this criterion is of doubtful value.

2. *Formation of torulæ.*—When saccharine urine is allowed to stand for a time in a warm place, sooner or later fermentation is set up, with the formation of yeast-fungus (*Torula cerevisiæ*). The detection of the fungus by means of the microscope has been proposed as a test of the saccharinity of the urine. Such a test is of little use, for the spores of the ordinary mildew fungus (*Penicillium glaucum*) can hardly be distinguished from those of the yeast-fungus, and penicillium will grow on any decomposing organic matter.

3. *Fermentation.*—The fermentation of saccharine urine may be greatly accelerated by adding to it some fragments of dry German yeast, and placing it in a moderately warm place. The production of alcohol and carbonic acid which results is a certain test of the presence of sugar in the urine. This procedure, however, takes some time and is not very delicate, requiring about five parts of sugar in a thousand, or two and a half grains to the ounce, to give any satisfactory result. It is best managed as follows. Take a large test-tube, or ordinary medicine-bottle, place in it some fragments of yeast, and fill up with urine. Fit a cork with a hole bored through it with a bent glass tube, one end of which will reach nearly to the bottom of the bottle that is to contain the urine. Fix the cork firmly in the mouth of the bottle, so that the bent end of the tube shall turn away from its side, and over a wine-glass or similar collector. When fermentation begins, the carbonic acid collecting in the top of the bottle will press downwards on the fluid, which will thus be forced up through the bent tube, and fall into the wine-glass or other receiver. An important and valuable modification of this test will be noted hereafter.

4. *Moore's test* or *Heller's test.*—When saccharine urine is boiled with liquor potassæ the sugar is decomposed, and a compound is formed, giving its colour, black or brown, to the fluid. A convenient test-tube is filled one-third full with the urine, and an equal quantity of liquor potassæ is added. The two should then be well mixed by shaking, and the heat of a spirit lamp applied to the upper portion of the mixed fluids. If sugar be present this portion will gradually darken, the tint assumed varying in depth according to the quantity of sugar present. This test is very convenient, but it is liable to several objections,

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notably these:—(*a*) It is far from delicate, requiring as much as three parts in a thousand, or a grain and a half of sugar to the ounce, to afford any satisfactory indication. (*b*) It is practically useless for quantitative purposes, though the plan has been tried of comparing the colour produced with the colours of solutions containing known quantities of sugar, as is done in the Nessler process for substances producing ammonia and its allies. (*c*) It is liable to two notable fallacies. (1) High-coloured urine is always darkened in tint, sometimes blackened, by boiling with liquor potassæ. (2) Liquor potassæ very often contains lead, which is liable to be converted into black sulphide, when boiled with caustic potass, if albumen or any organic matter be present in the urine. The former of these risks cannot well be obviated. The latter may, by first testing the purity of the liquor potassæ, and keeping it in green glass instead of white glass bottles.

5. *Boettger's test* consists in the action of sugar as a reducing agent on bismuth. A small quantity of urine having been poured into a test-tube, an equal bulk of a solution of carbonate of soda (one part of crystallised carbonate of soda to three of water) is to be added, and a small quantity of the ordinary basic nitrate of bismuth introduced. The whole is to be heated, when the appearance of a grey or black colour will indicate the reduction of the bismuth, and the presence of sugar. Albumen in the urine gives rise to a similar fallacy as in the last test, by the formation of a black sulphide of bismuth. Other metals, as silver, chromium, and tin, may be reduced in like manner, but by far the most convenient practically is copper, which is now almost universally employed for this purpose, as in

6. *Trommer's test.*—The usual mode of procedure is to take a drachm or two of urine in a test-tube, to add to it a few drops of solution of sulphate of copper, then to add liquor potassæ in excess, and to boil. When sugar is present a red or orange-coloured deposit of suboxide of copper should be thrown down. To this simple mode of testing there are several objections. If excess of copper be used some of the blue hydrated oxide of copper may remain unchanged, and so give rise to confusion. If too much liquor potassæ be used it may blacken the sugar. Hence it is better to add the liquor potassæ first, then to add the copper solution drop by drop. A bluish-white precipitate forms, which dissolves on shaking. In this way a splendid blue fluid is produced. When the precipitate ceases to dissolve, neither reagent can be in excess, and heat may be applied. This solution of the blue precipitate is due to the presence of sugar, but many other organic substances have the same effect. Among the substances which possess this property, yet do not reduce the copper by boiling, is tartaric acid, and advantage of this has been taken for the production of a test-fluid not open to the above objections. The employment of this is known as

7 *Fehling's test or method.*—This testing fluid may be procured ready-made, but the following is the formula for it, as slightly modified by Pavy, and fitted for daily use:—Five grains of sulphate of copper, ten grains of neutral tartrate of potash, and two drachms of liquor potassæ. A more exact formula will be given farther on. The fluid thus formed is of an intense blue colour, clear and bright. When the test-fluid is to be used, a small quantity of it should first be raised to the boiling point, because by prolonged keeping the tartaric acid undergoes change, a substance being formed from it which is capable of reducing copper, and might give rise to confusion. But if on boiling the test-fluid no copper is thrown down, the suspected urine should be added drop by drop, the mixed fluid being at the boiling point. If sugar be present in quantity it will throw down the copper in the form of a red or orange precipitate. The quantity of urine added must never exceed the bulk of the test-fluid, and the upper portion of the fluid should be heated, so as to contrast with the lower portion. Should suboxide of copper be thrown down when the test-fluid is boiled, the fluid must be filtered before adding the suspected urine, or, still better, a new fluid be prepared. To obviate as far as possible such inconveniences, the cupric and alkaline fluids should be kept in separate bottles until about to be used.

When the quantity of sugar in the urine is very small, as may occur in ordinary diabetes after long fasting or the use of a rigidly restricted diet, or during an access of fever, still more minute precautions must be taken. When, from any cause, the sugar present is less than three parts in a thousand, various anomalies may occur in the reaction. It is in such cases that the reducing power of uric acid and the urinary colouring matters assumes importance. With this small quantity of sugar the copper deposit is never red, but yellow; and we may have apparently any intermediate shade of colour from the deep blue of the copper solution through all varieties of green to yellow, with or without deposit after standing. Again, if the urine contains much phosphates, boiling with the alkaline solution may throw them down, and if at the same time the normal urinary constituents reduce some of the copper, the precipitate may roughly resemble a deposit of copper produced by sugar. It may thus be necessary to decolorise the urine, which may be done by passing it repeatedly through a filter of animal charcoal. Another difficulty is the presence of albumen in the urine, which renders the test nugatory. Accordingly in all cases, before applying any kind of test, the albumen must be removed by boiling and filtration.

Quantitative Testing for Sugar. 1. *Fehling's volumetric method.*—This method, now in common use, is founded on the fact that the proportion in which sugar reduces copper is constant. One equivalent of grape sugar decomposes exactly ten of sulphate of copper, or 180 parts by weight of grape sugar decompose 1246 8 parts by weight of sulphate of copper. This being borne in mind, and a copper solution of known strength being used, it is easy to determine the quantity of sugar in any given specimen of urine. The quantities may be calculated according to the metric system or by grains and minims. If we adopt the metric system, our fluid will consist of the following ingredients:—

Sulphate of Copper (crystals) 40 grammes.
Tartrate of Potass (neutral) 160 grammes.
Liquor Sodæ (Sp. gr. 1·12) 750 grammes.
Water to 1154·5 cubic centimetres.

These should be carefully mixed, or, what is better, the copper and alkaline solutions made separately, so that five cubic centimetres of each, or ten of the mixed fluids, will exactly decompose ·05 gramme or 50 milligrammes of sugar.

According to the English system of measurement, Dr. Pavy's solution is the most convenient. It consists of sulphate of copper, 320 grains, dissolved in ten ounces of distilled water; and tartrate of potash (neutral), 640 grains, with caustic potash 1280 grains, also dissolved in ten ounces of distilled water. These fluids may be kept separately or mixed. In mixing, the copper should be added to the alkaline solution, not *vice versâ*, to prevent the formation of any precipitate. One hundred minims of this mixed fluid are decomposed by half a grain of sugar. Only a minim measure and a porcelain capsule or other vessel, which will stand heat, are required for Pavy's solution in the procedure which is as follows:—Most specimens of diabetic urine, containing too much sugar for accurate testing, first require dilution with water, and the most convenient degree of dilution is when one-tenth of the fluid is urine. Next put ten cubic centimetres of the metric copper solution, or one hundred minims of Pavy's solution, carefully measured, in a small porcelain capsule. The fluid being deep blue is better for dilution, so as to diminish the intensity of tint. Of course this does not alter the quantity of copper present in it. The porcelain capsule with its contents is to be placed on an iron retort-stand, at such a level that the flame of a spirit lamp will easily play on the capsule. Meanwhile a pipette, graduated from above downwards, either in minims or cubic centimetres, is filled up exactly to the 0 in the graduated scale with the diluted urine. When the solution of copper is boiling, the urine is added to it from the pipette, drop by drop, stirring carefully the while, until signs are shown of a decoloration of the cupric solution. The moment all the copper has been thrown down as suboxide, and all shade of blue or green has disappeared, the addition of the diluted urine is stopped, and the quantity already used read off on the graduated pipette. To ascertain the quantity of sugar in the urine is now a simple calculation. We know how much urine has been employed in reducing the 10 cubic centimetres, or 100 minims of the cupric fluid, but these measures represent exactly 50 milligrammes and half a grain of sugar respectively. The quantity contained in the diluted urine being hence deduced, multiply this by ten, to get the quantity contained in the urine as passed. Next multiply by the total quantity of urine passed in twenty-four hours, to ascertain the full amount of sugar passed in this period. In all such analyses the sample examined should be taken from the mixed urine passed during the whole twenty-four hours. That passed at night is the richest, that passed in the morning poorest in sugar.

2. *Roberts' fermentation method.*—We have already noticed the fermentation method for demonstrating the existence of sugar in urine. Dr. William Roberts, of Manchester, has also devised from it a highly accurate quantitative process. It is as follows:—

Put about four ounces of the suspected urine into a clean eight- or twelve-ounce glass bottle. Introduce a piece of dry German yeast, about the size of the point of the forefinger, but divided into small pieces. Cork the bottle with a grooved cork to allow the escape of gas. Fill a companion bottle *quite full* with the urine. Cork quite tightly, and set both aside for twenty-four hours in a warm place—the mantelpiece will do. By the end of that time fermentation will probably have ceased, and the yeast fallen to the bottom; but if not, being suspended it will not affect the specific gravity of the fluid. The specific gravity of the two specimens must now be carefully taken with an accurate urinometer, that of the unfermented bottle being taken as the standard. The fermented urine will have lost weight from two causes. 1st, the sugar which gave the increased specific gravity has been destroyed; and, 2nd, in its place have been formed alcohol, which is lighter than water, and carbonic acid, which has escaped. *Every degree of specific gravity thus lost represents a grain of sugar in the ounce of urine.* Thus, if there is a loss of twenty-five degrees of specific gravity, the urine would contain twenty-five grains of sugar in each ounce. Multiply this by the total number of ounces passed, to get the amount of sugar discharged per diem. This plan is especially useful for noting the quantity of sugar passed day by day, and can be easily undertaken by the patient or his friends.

3. *Estimation by the polariscope.*—A plan of estimating sugar employed a good deal abroad, depends on the power of diabetic sugar to turn the plane of polarisation to the right. The degree of rotation is in proportion to the quantity of sugar contained in the urine. The apparatus used commonly goes by the name of the Ventske-Soleil apparatus, from its inventors. It is best adapted for light-coloured urines. If the urine be deep in colour it requires to be diluted.

4. *Estimation by specific gravity.*—The rudest mode of estimating sugar is by the specific gravity of the urine. Since the methods described above were introduced, there is no excuse for its employment save as a preliminary test, which may suggest the idea of sugar in the urine. To facilitate its use tables were drawn out, but the great increase of urea often found in diabetes renders the test of but little accuracy.

PROGNOSIS, COURSE, AND TERMINATION.—The prognosis of confirmed diabetes is ever unfavourable. Amelioration is common, but a perfect cure, save in exceptional cases, is rare. Diabetes coming on suddenly and from special causes, such as injury to the head, is more likely to do well than when more gradually developed. The younger the patient, the more sugar passed, the greater the emaciation and debility, the worse the prognosis. Diabetes persistent with pure flesh diet is worse than if persistent only with a free starchy or saccharine diet. Loss of appetite and of digestive power, as indicated by the condition of the fæces, is of evil omen. When albumen appears in the urine in the course of diabetes, the specific gravity of the fluid diminishes, often giving rise to a false impression to the effect that, as the specific gravity has decreased, the diabetic state must be improved. The only true test of recovery is the power of consuming ordinary mixed food with impunity; but Seegen says that out of two hundred cases he had never seen this result. But by rigid or limited dieting, the patient may live, and even enjoy life, for many years. Heredity, directly or collaterally, adds to the blackness of the out-look. Cases resulting from injury to the brain or other parts of the nervous system are often the most hopeful with which we have to deal, though by no means always so. The course of diabetes is on the whole chronic. Most frequently it develops gradually, though in some cases suddenly, and it generally lasts from six months to three or four years. In stout elderly persons it may exist much longer, especially with good digestion and a limited dietary. On the other hand, Dr. Roberts records a case which proved fatal, after a well-marked onset, in eight days—the shortest period known to the writer. Another case was fatal in three weeks, the patient being three years old. Some cases are recorded of death at still earlier periods, but these were most probably cases of long duration in an unnoticed shape suddenly developed into an aggravated form. A fatal termination of diabetes may be brought about, as already indicated, in various ways. One is by diabetic coma, not unlike the first stages of uræmia. This may prove suddenly fatal, and has been described as due to fat embolism, or to acetone in the system. In the advanced stages of diabetes, the strength being very low, comparatively slight causes may produce fatal effects.

TREATMENT.—Though we are ignorant on many points as regards diabetes, yet when we come to its treatment, we have these undoubted facts—that sugar cannot be formed out of nothing; and that the series of substances out of which it may be formed is limited. And though we cannot absolutely succeed in feeding the patient on substances which will not yield sugar, we can supply a nourishing diet furnishing sugar-forming materials in the scantiest proportion—an end best attained by a pure meat diet. But besides dietetic measures, other, though subsidiary, means may be taken to limit the formation of sugar by suitable hygienic and medicinal treatment. It is convenient to treat of these separately, though they should be employed in conjunction.

Dietetic treatment.—All authorities agree that meat should be the main constituent of the patient's food, and that starch, and cane and grape sugar, should be avoided, as well as the substances containing them. The use of fats and oils, of fruit-sugar (levulose), and of milk-sugar, is not so definitely settled. Three of the ordinary constituents of meat—gelatine, glycogen, and glycerine—being sugar-formers, the parts of animals containing these should as far as possible be avoided. It is very important in constructing a diet scale to give the patient as much variety of form as possible, the basis remaining the same. As the diet of the patient is the main factor in his treatment, it is worth the practitioner's while to study the various changes and combinations of food which may be given with impunity. (See a long list of available dishes in the Appendix of Bouchardat's work on Diabetes.) As regards vegetables, the rule is that all green vegetables, or the green parts of vegetables, may be eaten; for where chlorophyll is abundant, starch and sugar are commonly scanty; but this rule has important exceptions, which will readily occur to the reader. Thus the green parts of asparagus and celery may be used, whilst the white portion is highly saccharine. Green artichokes may be used. Jerusalem artichokes are objectionable. Cabbage should be used before it forms a white heart. Cauliflower and brocoli are rather questionable. Scottish kale and spinach may always be used. Sea-kale is forbidden. Most fruits are forbidden, but nuts may be used if they can be digested. French beans may be used when quite green; when older the beans themselves must be removed. Haricot beans, peas, and all cereals; tapioca, sago, arrowroot, all forms of macaroni, potatoes, carrots, turnips, parsnips, and beetroot are in the forbidden list. Water-cress, lettuce, and all kinds of green salad may be freely used. Cheese, especially of the poorer kinds, may be used. Cream, butter, and other fatty articles may be used in moderation, as they are only sugar-formers by virtue of the glycerine they contain. Some kinds of green pickle are useful; mustard pickle should not be used. Most mustard contains starch, but it may easily be got quite pure. To sweeten tea or coffee, mannite has been suggested; but both will soon be found more refreshing without sugar. Cocoa made from the nibs can be used. Small quantities of cold tea without milk or sugar, with slices of lemon in it, will often be found palatable, cleaning the mouth and relieving thirst. Rinsing the mouth with iced water will often give more relief than a hearty draught. Slowly sucking ice is a very good plan for relieving thirst. All sweet drinks are in the forbidden list, including most sherries and ports, though some of the former may be found nearly sugar-free. Nearly all brandies contain sugar. Light French and German wines contain little or no sugar. Gingerbeer and lemonade are very objectionable; so are champagne, sweet beer, cider, porter and stout, rum and gin. Whisky is probably the best form of spirits. The use of alcohol in these cases has been gravely questioned. Where alcohol has not been used before the onset of the disease, the patient is probably better without it; but it is quite clear that in many cases it may be taken in moderation with advantage.

There is difficulty in procuring a substitute for bread and potatoes. Three imperfect substitutes are employed, viz:—gluten bread, bran bread, and almond bread. Gluten bread as introduced by Bouchardat consists of flour out of which nearly, but not quite, all the starch has been washed. It is tough, and patients tire of it; a better form of gluten bread is made by Bonthron (Regent Street, London). This last is palatable and nearly starch-free, but does not keep well. Bran bread is now often made, in the form of biscuits or cakes; the bran should always be washed nearly free of flour. Bran bread is hardly admissible when there is a tendency to diarrhœa, but may be useful in constipation

Almond cakes were first introduced by Dr. Pavy. They are rather rich to be eaten with meat, but used by themselves or with wine are excellent. Almond flour may now be obtained from which much of the oil has been expressed.

We pass over Dr. Donkin's skim-milk treatment of diabetes with the remark that in the hands of Dr. Donkin and some others the method has been successful; in the hands of many eminent physicians, both at home and abroad, it has done unmitigated harm. Probably the explanation of any successful cases may be found in the fact, that in certain conditions of diabetes, milk sugar, as well as certain other substances, does not give rise to grape sugar. If milk is to be used, butter-milk or sour milk will be best. The treatment by sugar or glycerine is self-condemned.

Hygienic treatment.—In this the first and most important point is regular exercise, especially walking, not carried out to fatigue. Bouchardat has strongly advocated gymnastic exercises. These would be useful in moderation, especially in bad weather. Nothing is more grateful or beneficial to the skin after such exercise, or even without it, than a warm bath, temp. 80° to 90°, with a little common washing soda in it. In all cases, the avoidance of wet and cold is important. Flannels, frequently changed, should be worn; and it is always safer to change the clothes after the slightest exposure to damp. Little may suffice to give rise to a fatal pneumonia.

Medicinal Treatment.—This must be considered as subsidiary to dieting, but there are many cases where undoubted benefit results from drugs. Of those which have been found of real value, the foremost is opium. Yet there is no unanimity of opinion as to the mode in which opium acts, and its apparent effects are most discordant—in some cases reducing both sugar and urine without sleepiness, in others speedily giving rise to drowsiness and even apparently to coma. The varied susceptibility of different patients to this drug is very striking. Some will take 20 or even 50 or 60 grains a day with no apparent physiological effect beyond slight contraction of the pupil; others again cannot endure even a few grains. The writer's experience is decidedly in favour of opium. Codeia has been strongly recommended by Dr. Pavy as being the influential ingredient in the raw opium. He begins with doses of half a grain. Next to opium come alkalies, and especially some alkaline waters. Alkalies themselves may be given in various forms—as cream of tartar to relieve thirst, as citrate or bicarbonate of potash, or, if there is a tendency to gastro-intestinal catarrh, as liquor potassæ, with or without a bitter. The waters in most repute in diabetes are those of Carlsbad, Vichy, and Vals. An annual visit to Carlsbad, with the rigid system of regimen and dietary carried out under the resident physicians, often suffices, with due care, to keep the patient fairly well for many years.

Lactic acid has been strongly advocated by Cantani. His results seem good, but he also makes use of a most rigid dietary. Dr. B. Foster records a case where acute rheumatism seemed to arise from the use of lactic acid. Pepsine and rennet have been used, but without real advantage.

Of secondary remedial agents, the three most important are strychnine, iron, and cod-liver oil, these favour nutrition, and the cod-liver oil seems to improve the temperature somewhat. Laxatives, not purgatives, should be used for the troublesome costiveness. Mineral waters, castor-oil, or alkaline purgatives suit best.

Management of a Case of Diabetes.—By way of recapitulation we may say a few words here on the management of a case of diabetes. When a patient comes under the care of the practitioner he must first ascertain the general state of the patient as a basis for future comparison. The patient's weight must be carefully taken, and the state of his bowels noted. The quantity and characters of urine passed should be noted daily for a short time, the patient still consuming ordinary diet. After a day or two the restricted diet should be gradually commenced, sugar and potatoes being first cut off. Next the bread should go, being first of all cut down and used toasted hard or torrefied, and this should merge into the use of bran cakes or gluten bread. Above all things, the patient must not be disgusted with his food, for this favours the secret consumption of forbidden dainties. Week by week the weight should be taken; day by day the sugar estimated, as may easily be done by Roberts' method, and the whole arranged on a card so as to be seen at a glance. Warm baths, exercise, and the other adjuvants must be assiduously employed, and as soon as the effects of the limited diet are clearly marked, opium may be tried. If well borne it should be used determinedly, and pushed to its physiological effects, as indicated by the contracted pupil. If the patient is seen daily his diet should be regulated each day; if only at intervals certain available changes should be indicated. When convalescence begins, and the urine has for some time been free from sugar, the diet may be gradually relaxed, beginning with substances containing little starch or sugar, gradually extending to bread in small quantity; potatoes should come last, sugar itself never. When, with every care, restriction of diet effects no diminution of sugar, or, if that be limited, emaciation and weakness rapidly go on, it will be a question whether it may not be best, as it often is, to return to a practically unrestricted diet.

Alexander Silver.

DIAGNOSIS of Disease. *See* Disease, Diagnosis of.

DIAPHORESIS (διὰ, through, and φορέω, I convey).—The act of perspiring. The term is more generally applied to perspiration artificially induced.

DIAPHORETICS (διὰ, through, and φορέω, I convey).

Definition.—Remedies which increase the secretion of sweat. When the increase is so great as to cause the perspiration to stand in beads upon the surface, they are usually termed *sudorifics*.

Enumeration. — The principal diaphoretic measures are—The Vapour Bath, Turkish Bath, and Wet Pack; Warm Drinks; Warm Clothing; Jaborandi, Pilocarpin; preparations of Antimony; Ipecacuanha; Opium and Morphia with their preparations; Sarsaparilla, Guaiacum, Serpentary, Sassafras, Senega, Mezereon, Camphor; Sulphur; Ammonia and its Carbonate, Acetate, and Citrate; Alcohol; Ethers (especially Nitrous Ether); and Chloroform.

Action.—The secretion of sweat usually consists of two parts, namely, a free supply of blood to the sweat-glands, and the abstraction from it of the materials for sweat by the cells of the gland. These two processes sometimes occur independently of each other. In fevers the supply of blood to the glands is abundant, but they do not secrete; and a similar condition is observed in belladonna-poisoning. Belladonna or atropia possesses the power of paralysing the secreting nerves of the sweat-glands, just as it does those of the salivary glands, and thus the skin remains dry, although the cutaneous vessels are much dilated. In collapse the cutaneous glands secrete a cold sweat profusely, although the supply of blood to them is deficient.

The secreting cells appear to be under the influence of nerves, by exciting which secretion occurs. The centres for the secreting nerves of the sweat-glands appear to be situated in the spinal cord, and in the medulla oblongata. The fibres seem to run in the same path as the vaso-motor nerves. The secretory nerves of the sweat-glands may be excited directly by a stimulation of the nervous trunks in which they run; and the sweat-centres may also be reflexly excited by irritation of various sensory nerves. Certain substances, such as nicotine and carbonic acid, seem to stimulate the sweat-centres; whilst other drugs, such as pilocarpin, appear to act upon the peripheral terminations of the secretory nerves in the sweat-glands themselves. Several remedies, at the same time that they excite secretion, likewise increase the flow of blood through the skin, rendering it redder, warmer, and more vascular. Others, again, excite the secretion at the same time that they diminish the cutaneous circulation. Diaphoretics have therefore been divided into two classes, the former kind being termed *stimulant*, and the latter *sedative* diaphoretics. The exact mode in which each drug already enumerated produces diaphoresis has not yet been ascertained, but antimony, ipecacuanha, and jaborandi are classed as sedative diaphoretics, and all the others as stimulating ones. The supply of blood and the secretion are both increased by the application of warmth, by the ingestion of warm fluids, and by the action of jaborandi.

Uses.—Diaphoretics are employed to increase the flow of blood to the surface, and possibly to aid the elimination of excrementitious products in internal congestion, such as catarrh of the respiratory passages or digestive tract, and in febrile conditions generally. In fevers, the cutaneous circulation is generally active, and the so-called sedative diaphoretics are then most useful. Diaphoretics are also used to increase the elimination of water by the skin, and thus lessen the accumulation of fluid in dropsy, or to relieve other excreting organs, such as the kidneys in albuminuria and diabetes insipidus, or the intestines in diarrhœa. In these cases stimulant diaphoretics are indicated.

T. Lauder Brunton.

DIAPHRAGM, Diseases of.—The diaphragm may itself be the seat of *functional disturbance*, or of *organic lesions*; or it may be affected by *neighbouring morbid conditions*. For practical purposes its affections may be conveniently discussed according to the following arrangement:—

1. Mechanical Interference.

2. Functional Disorders. (*a*) **Paralysis.** (*b*) **Spasm.**

3. Organic Lesions. (*a*) **Injuries, including Ruptures and Perforations.** (*b*) **Inflammation, acute or chronic.** (*c*) **Muscular Rheumatism.** (*d*) **Atrophy and Degeneration.** (*e*) **Morbid formations.**

1. Mechanical Interference.—The diaphragm is frequently interfered with by morbid conditions within the chest or abdomen, which impede its action, displace it more or less, either upwards or downwards, or render it tense and stretched. The entire structure may be thus affected, or only a portion of it, such as one lateral half or its central part. The chief thoracic conditions by which the diaphragm may be thus affected are pleuritic effusion or pneumothorax, emphysema of the lungs, abundant pericardial effusion, enlargements of the heart, and tumours within the chest. The principal abdominal conditions deserving notice as being liable to produce this effect are a distended stomach, tympanites, ascites, peritonitis, pregnancy, large fæcal accumulations, and tumours or enlarged organs which attain considerable dimensions, especially ovarian, hepatic, splenic or renal tumours. It sometimes happens that the diaphragm is interfered with both from its thoracic and its abdominal aspects.

The symptoms induced by this mechanical interference are readily explained by its effects. A sense of uneasiness and discomfort is often experienced around the lower part of the chest, amounting sometimes to considerable tension and tightness. There is not any actual pain, but in some instances, where the diaphragm is much pushed down, the patient complains of a painful sensation referred to the ensiform cartilage, as if the attachment of the diaphragm at this point were being severely dragged upon. The act of respiration is more or less impeded, and this often seems to be the cause of the discomfort experienced. A sensation frequently complained of by patients is that they cannot take a full breath. Respiration may be much hurried, or oppressed and laboured, and not uncommonly the normal relation between the thoracic and abdominal movements is markedly altered, as observed on physical examination, and the diaphragm may so act as to draw in the lower part of the chest-walls in inspiration. Occasionally a kind of spasmodic cough seems to be excited by the tension of the diaphragm produced by certain conditions. The act of coughing is also frequently rendered more or less difficult and ineffectual.

2. Functional Disorders.—The affections of the diaphragm included within this group are (*a*) **Paralysis**; (*b*) **Spasm.**

a. **Paralysis.**—The diaphragm is completely paralysed when the upper part of the spinal cord is destroyed, whether as the result of injury or disease. If one or both phrenic nerves should be cut across, or destroyed by disease, or even severely compressed, the same effect will be produced, either one lateral half or the whole of the diaphragm being paralysed, according as one or both nerves are involved. This structure may also be implicated in the course of diphtheritic paralysis.

Where paralysis of the whole diaphragm is suddenly produced, death speedily ensues from the grave impediment to the respiratory function resulting therefrom. If it is brought about gradually, or if only part of the structure is involved, the effects are seen in more or less interference with this function, and with the acts in which respiration is concerned. Thus there will be a subjective sensation of dyspnœa, and of a want of power to breathe; while the respiratory movements will be hurried, shallow, and superior-thoracic. Coughing cannot be performed efficiently, and sputa cannot be expelled, while the abdominal acts for which a tense diaphragm is required, such as defæcation or vomiting, are also ineffectual or impracticable. The lower parts of the lungs become more and more congested, fluids accumulate in the air-tubes and pulmonary vesicles, which become by degrees filled up, and the patient ultimately dies of asphyxia.

b. **Spasm.**—The diaphragm may be the seat either of clonic or tonic spasm or cramp. The disorder may depend upon disease of the nerve-centre at the origin of the phrenic nerves; irritation of these nerves in their course; direct excitation of the diaphragm; or reflex causes. Tonic spasm is most strikingly observed in cases of tetanus; of poisoning by strychnia, or of hydrophobia; but a form of asthmatic attack has also been attributed to this condition of the diaphragm.

The symptoms will vary in different cases. Tonic contraction of the diaphragm gives rise to severe pain, and a sense of constriction in the corresponding region, which may come on in paroxysms; clonic spasms also originate painful sensations after a time, which may become very considerable. Hiccup is probably due mainly to a clonic spasm of the diaphragm. If this structure should become rigidly fixed, respiration is gravely interfered with, and the patient soon presents the phenomena of suffocation, which will end fatally if the spasm is not relieved. In the form of asthma supposed to be due to diaphragmatic spasm, expiration is very difficult and greatly prolonged, inspiration being short and abrupt; the lungs are distended; great distress is felt; and there may be signs of impending death from suffocation. A spasmodic cough may be due to clonic spasm of the diaphragm.

3. Organic Lesions.—These may be briefly considered in the order in which they were enumerated at the commencement of this article.

a **Injury, Perforation, and Rupture.**—The diaphragm may be perforated, lacerated, or ruptured in connection with various forms of injury, such as crushing accidents, fractured ribs, penetrating wounds, or gun-shot injuries. Should the patient recover, a permanent perforation may be left. In medical practice perforation of this structure may be met with as a congenital condition; as the result of the bursting of some fluid-collection through it, such as an empyæma, a hepatic, renal, or other abscess, or a hydatid-cyst; or from its destruction in the progress of some organic lesion, such as malignant disease or an aneurism. It may occasionally occur, independently of these causes, owing to the yielding of a weak portion of the diaphragm, especially between the attachment to the ensiform cartilage and the seventh rib. In rare instances the perforation is congenital, or a considerable portion of the diaphragm may be deficient. The size and other characters of the perforation differ much in different cases. If it is produced by the opening through the diaphragm of a fluid-accumulation, this fluid escapes from the abdominal into the thoracic cavity, or *vice versâ*; in other instances the portions of the thoracic or abdominal organs pass through the perforation, constituting forms of *diaphragmatic hernia.* The writer had the opportunity of observing a remarkable instance in which the entire stomach had passed through an opening in the diaphragm into the cavity of the chest. In a case reported by Dr. Little, of Dublin, the diaphragm presented an almost circular opening, well-defined, sharp, with somewhat thick edges, and through this opening passed a hernia consisting of peritoneum containing some omentum, and about fifteen inches of the transverse and descending colon.

To recognise clinically a perforation or rupture of the diaphragm is generally no easy matter. Often there are no symptoms referable to this structure, though there may be signs indicating that its functions are more or less impeded. The occurrence of sudden perforation may be known from the previous existence of some condition likely to cause this event, such as empyæma, or an abdominal abscess; the supervention of acute pain, accompanied with indications of shock or collapse, and the disappearance of the signs of the original morbid condition; and followed by the development of phenomena revealing that fluid has passed through the diaphragm, and accumulated in the thoracic or abdominal cavity, as the case may be, or that some secondary affection has been set up as the result of the perforation, such as peritonitis or pleurisy. A fluid collection may, however, penetrate the diaphragm without giving rise to any very evident disturbance. When an organ passes through the diaphragm, the symptoms present, if any, are more likely to be associated with this organ than with the diaphragm, and physical examination may possibly detect the displacement. In the case of hernia of the stomach, already referred to, the chief symptom was vomiting, which occurred immediately after taking any food or drink.

b. **Inflammation.**—The serous covering of the diaphragm, either on its thoracic or abdominal aspect, is not uncommonly involved in cases of acute pleurisy or peritonitis respectively, and the inflammatory process may penetrate its structure. It may also be involved by extension from pericarditis. Inflammation of the substance of the diaphragm may further arise from injury, direct irritation, pyæmia, or without any evident cause. The anatomical conditions observed are increased vascularity; the formation of lymph upon its surfaces; softening and degeneration of its muscular tissue; or, in rare instances, suppuration, an abscess forming in the substance of the diaphragm, or pus collecting under one or other of its serous coverings. Chronic inflammation of the diaphragm may occur, leading to a fibroid change in its muscular portions, either by extension from neighbouring structures, or as the result of chronic local irritation.

The symptoms of acute inflammation of the diaphragm are generally very obscure and ill-defined. The condition may be indicated by severe pain in the region of this structure, obviously increased by breathing, so that the respiration becomes instinctively thoracic, as well as hurried and shallow; and also much aggravated by coughing, defæcation, or any other act which disturbs the diaphragm. The patient will probably be much distressed. More or less pyrexia will probably be observed. If an abscess should form, this might burst either into the chest or abdomen, and thus lead to secondary pleurisy or peritonitis. Chronic inflammation and its consequences may possibly be suspected from a want of free movement in the diaphragm, associated with conditions likely to originate this change; but it could scarcely be recognised with any certainty.

c. **Muscular Rheumatism.**—The diaphragm may be involved in this complaint, whatever its nature may be; probably it is attended with structural changes in its tissues. The affection is characterised by pain referred to the diaphragm, which may be very acute when it is in any way brought into play. So long as it is kept at rest, there may be no discomfort, but deep breathing causes considerable pain, so that the respiration is carried on in a shallow manner, and may be entirely thoracic. Such acts as coughing or defæcation cause much pain and a sense of aching.

d. **Atrophy and Degeneration.**—The diaphragm may be involved in the course of progressive muscular atrophy; it may also be atrophied from causes which produce general wasting; or undergo senile atrophy and degeneration; or be similarly affected from local causes, such as interference with its blood-supply from vascular degeneration, want of action, or after chronic inflammation. These conditions might give rise to more or less evident interference with the functions of the diaphragm, which in extreme cases would amount to their total cessation, diaphragmatic breathing being rendered impossible, the symptoms being then the same as when the diaphragm is paralysed. In cases of progressive muscular atrophy the fatal termination may arise from this cause. There would not be any pain, but uncomfortable sensations might arise from the impeded respiration.

e. **Morbid Formations.**—The diaphragm is occasionally the seat of malignant disease, being usually involved by extension from some neighbouring structure. Non-malignant solid growths have in rare instances been found in it. Parasitic formations may also occur in it, namely, hydatids, cysticercus, and trichina spiralis. Tubercle is occasionally found in the diaphragm. Possibly malignant disease might be indicated by signs of impeded diaphragmatic movements, with localised pain, accompanying indications of cancer in other parts. The implication of the diaphragm in trichinosis may also be recognised in some instances by severe pains, spasmodic contractions, and serious interference with diaphragmatic respiration. In most cases, however, the presence of any morbid growth in connection with the diaphragm cannot be diagnosed during life, and is only discovered at the post-mortem examination.

Treatment.—But little can be done in most cases in the way of direct treatment in connection with affections of the diaphragm. The most obvious indication is to get rid, if possible, of any condition which is mechanically impeding its movements, and preventing it from performing its functions. In the next place, any disease of which the condition of the diaphragm is but a part must receive due attention, such as progressive muscular atrophy, centric nervous disease, or trichinosis. Painful affections might be relieved by local applications of dry heat, fomentations, or anodynes; and if acute inflammation is suspected, a few leeches might be applied. Electricity might prove of service in the treatment of some cases of spasm or paralysis of the diaphragm, the continuous current in the one case, the interrupted current in the other.

Frederick T. Roberts.

DIARRHŒA (*διαρρέω*, I flow away).—Synon.: *Defluxio; Alvi Fluxus; Purging*; Fr. *Cours de Ventre; Dévoyement*; Ger. *Der Durchfall; Bauchfluss; Durchlauf.*

Definition.—A frequent and profuse discharge of loose or of fluid alvine evacuations, without tenesmus.

Ætiology.—The causes *predisposing* to diarrhœa are individual peculiarity; childhood—especially the period of first dentition; the climacteric period; and hereditary or acquired weakness of the digestive organs.—The *exciting* causes may be thus classified:—1. *Direct irritation of the intestines* by (*a*) *Food* in excess, or of improper quality—for example, salted meat, shell-fish, sour unripe fruit and vegetables—diseased, decomposed, or imperfectly masticated; the products of faulty digestion prematurely passing the pylorus; imperfectly elaborated and fermenting chyme; impure water, such as that containing from 3 to 10 grains of putrescent animal matter per gallon (Parkes); or imperfectly fermented malt liquors. (*b*) *Purgative medicines and irritant poisons.* (*c*) *Bile*, excessive or acrid. (*d*) *Fæces*, retained. (*e*) *Entozoa*—lumbrici, tænia, trichinæ, and *entophyta*—mycosis enteralis (Buhl and others). (*f*) The contents of a ruptured abscess or hydatid cyst. (*g*) *Intestinal lesion*—such as tubercular or other ulceration. 2. *Defective hygiene.*—Diarrhœa may arise from the dwelling being damp, cold, dark, and unventilated; or from foul emanations from decaying organic, especially animal matter, sewage, or fæcal collections. 3. *Chills, climatic variations*, &c. Diarrhœa has been attributed to insufficient clothing; sudden exposure to cold and damp; chills, as from wet feet, and damp bed or clothing; over-heating, as by excess of bed-clothing; and rapid variations of temperature, such as hot days and cold nights. 4. *Nervous disturbances*, for example, depressing emotions—fright, grief; neuralgia, hepatalgia (Trousseau), dentition, and other causes of reflex disorder. 5. *Defective absorption with augmented peristalsis*, so that the food is passed unaltered—*Lienteric diarrhœa.* 6. *Symptomatic* in various morbid states, for instance, in passive congestion of the portal vein from disease of the liver, heart, or lungs; peritonitis, especially puerperal; organic disease of the intestines—ulceration (simple, typhoid, tubercular, cancerous), lardaceous degeneration, enteritis, acute or chronic; cholera; typhoid fever; dysentery; occasionally in pyæmia, measles, scarlatina, confluent small-pox, malaria, gout, Bright's disease (its later stages), and in anæmia and exhaustion, as from over-lactation, phthisis, cancer, Addison's disease, Hodgkin's disease, exophthalmic goitre, leucocythæmia, and other affections.

Frequently diarrhœa arises from the combined action of several exciting causes, as when the disease is epidemic during summer and autumn Foul emanations from decomposing organic matter, over-crowding, food (and especially fruit) in a state of incipient decay, excessive heat, and chills, may then collectively determine the result. In children the exalted irritability of the nervous system during dentition predisposes to diarrhœa from slight determining causes.

Description and Varieties.—Diarrhœa may be broadly divided into the *acute* or occasional, and the *chronic* forms; and the numerous clinical and pathological peculiarities of different cases are conveniently grouped into typical varieties. The general effects, varying according to the intensity and duration of the flux, are mainly these:—Emaciation, and, in children, also arrest of growth—the weight either diminishing or ceasing to be progressive; anæmia, indicating defective hæmatosis; desiccation of the tissues from the rapid draining of serum from the blood—hence the thirst, and the very concentrated, acid, and even albuminous urine observed when there is a copious watery outflow from the bowels, as in choleraic and similar forms of diarrhœa.

It will be expedient to describe briefly the principal forms of diarrhœa.

1. **Irritative Diarrhœa.**—Synon.: *Diarrhœa Crapulosa* (Cullen).—Simple flux from direct irritation of the intestines is the most common variety of diarrhœa. The evacuations, usually preceded by severe griping pains, are at first fæculent and usually fetid and sour, then watery. In children (especially hand-fed) they are often like pale clay or putty, or they contain dense masses of undigested casein before being loose; after evacuation they frequently become greenish, like chopped spinach, from contact with very concentrated acid urine converting the brown colouring matter of the bile into green biliverdin; or they are dark green when passed, and may be so acrid as to excoriate the anus, the genitals, the inner parts of the thighs, and even the heels. Fever is usually absent.

Diarrhœa from irritation is frequently a preliminary stage of the inflammatory, dysenteric, and choleraic varieties.

2. **Inflammatory Diarrhœa.**—Synon.: *Diarrhœa Serosa.*—When the causes of simple irritation excite inflammation of the mucous membrane of the bowels, fever sets in, and the diarrhœa increases. Usually the evacuations become more serous, and contain shreds of fibrin or mucus or pus. Before the attack passes off the large bowels are apt to be the main seat of inflammation; then the motions are scanty, frequent, more mucous or glairy, contain streaks of blood and are passed with severe straining; while the skin is hot and dry.

3. **Choleriform Diarrhœa.**—Synon.: *Choleraic diarrhœa; Thermic diarrhœa* — prevails mostly in hot weather. The onset, indicated by vomiting and purging, is usually sudden. At first the vomited matters are mucous and bile-tinted, and the dejections are feculent—both quickly, however, becoming more and more abundant, watery, and colourless. The copious and incessant outflow of serum may in a short time, and especially in children, induce a striking resemblance to the symptoms of Asiatic cholera—a drawn, sunken, and cyanotic appearance, loss of temperature, scanty secretion of urine, insatiable thirst, and cramps; even in extreme cases the fluids from the stomach and bowels are, however, rarely free from bile, and are not so like rice-water as in true cholera. The collapsed algid condition as a rule rapidly gives place to recovery in previously healthy adults, while it is fatal in delicate children, children prematurely weaned, the debilitated, and the aged. Rarely, the cold stage being outlived, the patient becomes hot, and passes into a state of stupor, with either bilious vomiting or purging and tympanites—the typhoid stage. In children death is almost invariable if the cold stage exceeds twenty-four hours.

4. **Nervous Diarrhœa.**—The peristaltic movements, and the activity of the glands of the alimentary canal, are often increased by causes operating through the nervous system. Diarrhœa from mental, and especially emotional, perturbation, is the most common example. Even a chronic looseness may be maintained by debility of the nervous system, induced by worry and anxiety. Exalted innervation of the bowels may be natural, a proneness to diarrhœa from slight exciting causes having always existed; or acquired, when, for instance, a flux once established is apt to be maintained. The unstable nervous system of the periods of rapid development and of the climacteric change predisposes to it. It is often an important factor in chronic diarrhœa. The intestinal nerve-centres may become so sensitive (as in delicate children) that every meal, however small, may induce an immediate call to stool, the motions being liquid or pultaceous, and pale, but otherwise healthy. The peristaltic movements may be even so increased as to hurry the food through the stomach and bowels, so that it appears unchanged in the stools. Time is not allowed for digestion or absorption to be even begun. This form has

been termed *Diarrhœa lienterica*, and is most frequent in children before the period of the second dentition. The increased tonicity of the muscular fibres of the alimentary tract may have resulted from previous inflammation of the mucous surface, or is the propagation upwards of some irritation (ulcer, inflammation, &c.) of the mucous membrane of the rectum; or it arises from the products of imperfect primary digestion entering the duodenum. In adults indigestion is the usual cause. The appetite is as a rule voracious, and debility may become extreme. In painful or difficult dentition, diarrhœa arises from irritation of the nerves of the stomach and bowels; digestion is arrested, and the contents of the alimentary canal become acid from fermentation, and are ejected by vomiting and purging.

5. **Vicarious Diarrhœa.**—Embarrassment or suppression of the functions of the skin, kidneys, or lungs may be met by the bowels performing additional excretory work. The flux thus set up is salutary, because it is compensatory. Diarrhœa from chills (suppressed perspiration) is a common instance, while that from renal and pulmonary causes is less frequently observed, and may be misconstrued by the practitioner. Inasmuch as diarrhœa usually diminishes the quantity of urine, even sometimes to the verge of suppression, the reverse of this clinical fact may be easily overlooked or misinterpreted. Even when forewarned, the observer may at times—especially when the urine is free from albumen—find it difficult to determine whether the diarrhœa is a cause or an effect of imperfect renal elimination—a distinction having all-important bearings on the treatment. The uræmic and eliminatory character of it may be easily decided when the kidneys are known to be diseased; not so, however, when the only thing ascertainable is scanty—maybe albuminous—urine, or total suppression of urine in an elderly patient. In such a case there may or may not be organic disease of the kidneys, and still the diarrhœa may be uræmic, inasmuch as it may depend on 'renal inadequacy.' Diarrhœa from pulmonary embarrassment generally affords relief to breathing and cough. The chronic looseness of some gouty patients is also eliminatory: when checked, gout is apt to advance and the health to suffer.

6. **Diarrhœa from mechanical congestion.**—Draining of serum into the bowels is a common result of overloading of the portal vein from an impediment to the flow of blood, either in the vein itself, the vena cava, or the right side of the heart.

7. **Chronic Diarrhœa.** Synon.: *Cachectic diarrhœa.*—Chronic diarrhœa is frequently, if not generally, unconnected with intestinal lesions; it may be maintained by chronic catarrh of the intestines, or by an exhausted and impoverished state of the system, as in inanition, either from insufficiency of food or from enfeebled digestion, or in chronic wasting diseases, such as syphilis, malaria, or scurvy. The flux increasing, the debility on which it depends thereby perpetuates itself, and this vicious circle tends more and more to destroy life by anæmia and exhaustion, and even after apparent recovery there is a strong disposition to revert to it. These clinical features of chronic diarrhœa are well illustrated by the malady which, from the paleness of the stools, is commonly known in India as 'White Flux'—a result of deterioration of health by climate and malaria. When accompanied by fever and night-sweats, chronic diarrhœa is nearly always due to tuberculisation.

Diagnosis.—The different forms of diarrhœa may be readily distinguished from each other by a careful consideration of the causes and symptoms. The diseases most apt to be mistaken for diarrhœa are epidemic cholera, dysentery, and mucous irritation of the bowels from retention of fæces.

a. Cholera, in its less definite forms, may resemble bilious diarrhœa and choleraic diarrhœa. The probability in favour of it may be determined by the absence of the ordinary causes of diarrhœa, the paleness and watery character of the stools, tormina being slight or absent, the suppression of urine, and the early exhaustion. The presence of bile in the stools is always in favour of diarrhœa. Vomiting is more frequent in cholera; when it occurs in diarrhœa the vomited matter usually contains bile and undigested food, while in cholera it is a colourless fluid.

b. Dysentery is usually characterised by fever, tormina, and tenesmus, and frequent scanty muco-sanguinolent evacuations. Sometimes, however, in the early stage, the motions are copious, watery, and fæculent, as in ordinary diarrhœa; but the presence of tormina and tenesmus, and tenderness in the regions of the cæcum and sigmoid flexure, indicate the dysenteric nature of the disease. Chronic diarrhœa may be distinguished from chronic dysentery by the absence of a history of acute dysentery, or of mucus and tenesmus, and the less frequent discharge of blood in the evacuations.

c. Mucous irritation of the bowels.—Retention of fæces may induce a condition resembling diarrhœa—frequent thin muco-fæculent evacuations, which are, however, shown on enquiry to be somewhat scanty, and voided with straining.

Treatment.—(*a*) *Diet and hygiene.* In *acute* or *occasional* attacks of diarrhœa, everything should be taken in small quantity, and tepid or cold, never hot. Farinacea—arrowroot, sago, rice, tapioca, flour, and the like are useful, and may be taken in milk, or in chicken or mutton broth, or weak beef-tea. Animal broths—and especially beef-tea—when concentrated, or in large quantity, are apt to aggravate diarrhœa. Mucilaginous drinks—white of egg in water or milk, rice or barley or arrowroot water; and astringent liquids—infusion of dried whortleberries or roasted acorns, red light wines—may be given. Brandy is often of service, and may be mixed with spices or with the farinacea. Lime-water with milk is in many cases of much value.

Rest in bed secures a uniform warmth of skin, and favours the cessation of diarrhœa.

In children, errors of feeding should be corrected. Lumps of casein in the motions may be met by reducing the quantity of milk, and regulating the time between meals, providing a wet nurse, or substituting the milk of the goat or ass for that of the cow. Sometimes, however, milk in any form must be given up. The abdomen should be protected by a flannel bandage, and the feet and legs by warm clothing.

Inasmuch as in *chronic diarrhœa* the flux is perpetuated by the debility and anæmia which it induces, and by the activity of intestinal digestion, it has become a leading principle of treatment to prescribe food rich in materials for the construction of the blood and the tissues, and almost wholly disposed of by the stomach. Hence the happy results frequently observed from a diet exclusively animal, either raw or lightly-cooked, the digestion of which may be aided by hydrochloric acid alone or with pepsin. Individual peculiarity may be gratified, and variety obtained from the use of mutton, veal, chicken, pigeon, and game. Beef, the tough parts of veal, and pork are, as a rule, to be avoided. Milk and farinacea are gradually permitted during the progress towards recovery, but the period during which they should be interdicted may require to be very prolonged—even months. The treatment by *raw meat*, strongly advocated by Trousseau and Niemeyer, has been successfully applied to nearly every variety of chronic diarrhœa, but especially to that obstinate one occurring from the time of weaning to the close of the first dentition. The meat may be pounded into a pulp or finely minced, then mixed with salt, sugar, fruit jelly, or conserve of roses, or diffused through clear gravy soup or chocolate made with water or wine; or the juice may be extracted from it by pressure. Notwithstanding the prohibition of other food, it is best to begin with a small quantity, and to increase it gradually. The only drink allowable is water containing white of egg. Trousseau found opium in small doses, chalk, and bismuth, at and between meals, to assist this regimen. When a restricted animal diet cannot be digested, causes loathing, or aggravates the flux, other varieties of food may be added, and the feeding should be as generous and varied as possible, and adapted to the digestion of the individual. Articles of diet appearing undigested in the motions should be avoided. Low and damp situations should be exchanged for dry and open ones. Warm clothing, flannel next the skin, and flannel waist-belts should be worn.

(*b*) *Medicinal Treatment.*—The kind and degree of interference required should first be decided in each case of diarrhœa. A routine prescription of astringents is much to be deprecated. When the flux is moderate and salutary —for example, removing undigested or indigestible materials or irritating secretions, relieving an engorged portal vein, or supplementing a suppressed secretion—it may be left uncontrolled by medicine, or may be encouraged by laxatives, such as castor oil, rhubarb, or a saline aperient, combined with a mild sedative —for instance, henbane or opium: it cannot be checked without risk. As a rule, the treatment of diarrhœa should begin by removing irritating substances from the alimentary canal by aperients guarded by small doses of opium; and astringents, such as chalk-mixture with kino, catechu, hæmatoxylum, and opium, should be held in reserve. A purgative may increase the flux, which, however, soon subsides. Trousseau advocated the use of salines—sodæ sulphas, soda tartarata, magnesiæ sulphas—in progressively decreasing doses, dissolved in a small bulk of water, in the morning fasting, while others prefer castor oil, rhubarb, or other aperients. Castor oil is by far the most useful remedy for children, as well as for adults; for the former it should be emulsified in gum and syrup, and for the latter in yelk of egg, and as occasion requires combined with a small opiate, for example, compound tincture of camphor, vinum opii, or tincture of opium.

In *choleraic diarrhœa*, the best results are obtained from castor-oil guarded by a small dose of laudanum at the commencement, and repeated if the disease is severe; while astringents and opiates alone are withheld until the bowels are relieved of offensive materials, as in the later stages, the stools being copious and watery, griping and distension of the abdomen absent, and the tongue clean. Vomiting should be encouraged by copious draughts of warm water, and, if need be, by emetics of mustard or ipecacuanha. In children, when the motions are colourless, profuse, and incessant, it is best to give hydrargyrum cum cretâ in small doses every hour or two, and a very small enema of starch, containing plumbi acetas or cupri sulphas, with laudanum, which may be repeated if necessary; and the urgency of the case may likewise demand a firm astringent, such as logwood. In the cold stage there have been recommended mustard baths (for twelve or fifteen minutes, several times a day); emetics (ipecacuanha 2 to 3 grains twice or three times in twenty-four hours); diffusible stimulants (ether in syrup every hour or half-hour); and mercurials (hydrargyrum cum cretâ); in the stage of reaction, saline aperients or calomel in small doses throughout, white-of-egg in water as a drink; and, vomiting having ceased and diarrhœa being established, bismuth, chalk, and lime water.

In *nervous diarrhœa* the first indication is to allay reflex excitability by the bromides, or, these failing, by opium. When diarrhœa is excited by food, the dose should be given shortly before meals. In *lienteric diarrhœa* arsenic is invaluable. Mal-digestion should be met by hydrochloric acid, bismuth with alkalies, or other appropriate remedies, according to the indications. Occasional doses of castor-oil—alone, or with bismuth or small doses of opium or henbane—are useful in clearing away fermentescible matters, which are apt to maintain an irritable state of the bowels. Astringents should only be prescribed after the failure of these or similar measures.

In *vicarious diarrhœa* the skin should be made to act freely by warm baths, or hot air or vapour baths. In renal inadequacy counter-irritation across the loins, digitalis, and nitrate of potash may be likewise indicated. The diarrhœa should not be arrested or even checked unless it be profuse and exhausting, especially after restoring or augmenting the action of the skin and the kidneys; it is sometimes advisable to nurse and encourage it.

Diarrhœa from passive congestion of the portal vein is to be met by treating the cause, for example, disease of the heart, by digitalis, iron, and other remedies.

The flux of *chronic diarrhœa* cannot as a rule be stopped altogether by astringents only—the evacuations while thus retained may decompose, and induce flatulence and colic, or fever. The general health should be restored and anæmia removed; the secretions will then generally improve and the diarrhœa subside. Tonics—iron, arsenic, quinine, strychnia—may be aided by astringents—mineral acids, opium, bismuth, chalk, or hæmatoxylum. The best preparations of iron are iron alum—3 to 5 grains, and liquor ferri pernitratis—10 to 40 minims. Ipecacuanha and taraxacum are useful when the skin and liver are inactive: from 1 to 3 grains of pulvis ipecacuanhæ may be given night and morning. Podophyllum—2 or 3 minims of a solution of 1 grain in 1 drachm of rectified spirit three or four times a day—is indicated when the motions are watery, pale or high-coloured, and passed with severe cutting pains. Saline purgatives in the early morning are recommended—2 drachms of sulphate of soda, sulphate of magnesia, or soda tartarata on the first day, then 1 drachm for fourteen days, dissolved in a small bulk of water, with avoidance of fluids after the dose—and from 1 to 2 grains of rhubarb, also taken fasting. The profuse sweating and colliquative diarrhœa of hectic is best met by hæmatoxylum and dilute sulphuric acid, or opium with astringent mineral salts—nitrate of silver, sulphate of copper, or acetate of lead—by the mouth or rectum.

Suppressed secretions, particular cachexiæ, disturbed innervation, congestion of the portal vein, and organic diseases of the intestines, form special indications for treatment when diarrhœa is present.

GEORGE OLIVER.

DIATHESIS (διατίθημι, I dispose).—A morbid constitution, predisposing to the development of a particular disease. *See* CONSTITUTION, with which, in a somewhat more limited sense, this term is synonymous.

DIATHETIC DISEASES—Constitutional diseases. *See* CONSTITUTIONAL DISEASES.

DICROTISM (δίς, double, and κρότος, a stroke) is a term applied to the second great wave of the pulse. This dicrotic wave or dicrotism is due to a second expansion of the artery which occurs during the diastole of the ventricle. The *pulsus bis feriens* of old authors was a pulse in which a second beat became perceptible to the finger; an occurrence observed occasionally as an antecedent of hæmorrhage and also in the course of fevers. The second beat perceived by the finger is not always the true dicrotic wave, but may in some cases be an exaggerated tidal wave. This is the wave perceived in the high arterial tension sometimes antecedent to hæmorrhage. The mode of production of dicrotism is not quite agreed on; it is favoured by a low state of arterial tension, by elasticity of the arterial coats, and by quick and strong ventricular contractions. It is generally considered to be central in its origin, and to be a wave of recoil from the closed aortic valves reinforced by an oscillation set up in the aorta. The other view refers the origin of the dicrotic wave to the periphery. The wave of blood discharged at each ventricular systole is, in consequence of its acquired velocity, disturbed from its state of equilibrium, and, as a result of the resistance offered by the peripheral vessels, reflows towards the heart, whence it is again reflected. *See* PULSE.

BALTHAZAR FOSTER.

DIET.—DEFINITION.—Diet may be defined as expressing the regulation of food to the requirements of health and the treatment of disease.

GENERAL PRINCIPLES.—In order to sustain life, a diet must consist of a proper apportionment of the following alimentary principles:—

1. Nitrogenous principles.
2. Non-nitrogenous principles (fats, carbohydrates, &c.)
3. Inorganic materials (saline matters and water).

Whilst these principles hold different relative positions of value, the absence or deficiency of either group will render a diet unfit for the support of life. Milk, the product provided by Nature as the sole article of sustenance during the early period of the life of mammals, may be regarded as furnishing us with a typical dietetic representative of all these principles. The egg also holds a like position, and, as all the parts of the young animal are evolved from it, must needs comprise all the materials for the development and growth of the body.

The required principles are contained in food derived from both the animal and vegetable kingdoms, and the diet may be drawn from either; but, looking to man's general inclination and the conformation of his digestive apparatus, it may be assumed that a mixed diet is that which is designed in the plan of Nature for his subsistence, and it is that upon which he attains the highest state of physical development and intellectual vigour.

Animal food, being identical in composition with the body to be nourished by it, is in a state to be more easily appropriated than vegetable food. It also appeases hunger more thoroughly and satisfies longer: in other words it gives, as general experience will confirm, greater stay to the stomach. Animal food possesses stimulant properties which have sufficed in certain instances, as after starvation, and in those accustomed to a vegetable diet, to produce a state allied to intoxication. This stimulating effect is further illustrated by looking at the relative character of animal and vegetable feeders. Liebig says that it is essentially their food which makes carnivorous animals in general bolder and more combative than the herbivora which are their prey. He then relates that a bear kept at the Anatomical Museum of Giessen showed a quiet gentle nature as long as it was fed upon bread, but a few days' feeding on meat made it vicious and dangerous.

The standard diet framed by Moleschott has been accepted as furnishing a model of what may be considered the requisite proportion of alimentary principles for maintaining health in a person of average stature under exposure to a temperate climate and a moderate amount of muscular work. It runs as follows:—

Alimentary substances in a dry state required daily.

Dry Food	In ounces avoir.
Albuminous matter	4·587
Fatty matter	2·964
Carbo-hydrates	14·250
Salts	1·058
	22·859

This, it will be seen, furnishes a supply of about 23 ounces of dry solid matter, and of this one-fifth is nitrogenous. If we reckon that ordinary food contains about 50 per cent. of water, then 23 ounces will correspond to 46 ounces of solid food in the condition in which it is consumed. To complete the alimentary ingesta, a further quantity of from 50 ounces to 80 ounces of water may be assumed to be required to be taken daily under some form or other.

For a life of inactivity, it must be stated that a much smaller amount of food will suffice. The diet, for instance, which is ordinarily supplied to the patients of Guy's Hospital, and which suffices to satisfy and properly sustain them, only contains about 30 ounces of solid food, equivalent to about 17 ounces of water-free material.

It has been mentioned that there are reasons for regarding a mixed diet of animal and vegetable food as best adapted to our nature, and it may probably be considered that the most suitable admixture contains about one-fourth or rather more of animal food.

Looked at from the following point of view, it will be seen that an admixture of animal and vegetable food more economically supplies what is wanted, than either kind taken alone, unless the adjustment should be made with the proper apportionment of fat as a representative of a non-nitrogenous article. It is estimated that for a man of medium stature, and performing a moderate amount of work, about 300 grains of nitrogen and 4,800 grains of carbon are daily required to be introduced into the system with the food, to compensate for the outgoing of these elements that occurs. Now this is yielded, as nearly as possible, in the case of both elements, by 2 lbs. of bread and ¾ lb. of meat—that is, 44 ozs. of solid food; of which about one-fourth consists of animal matter. If the lean of meat only were consumed, rather over 6 lbs. would be needed to furnish the requisite amount of carbon, and there would be a very large surplus of unutilisable nitrogen; whilst if bread only were taken, the amount necessary to supply the requisite quantity of nitrogen would be rather more than 4 lbs., and this contains nearly double the amount of carbon wanted.

In order to preserve health it is necessary that a portion of the food consumed should be in the fresh state, and this applies to both animal and vegetable food. There may be no lack of quantity, and yet disease and death may be induced by inattention to this fact. Affections of the scorbutic class are produced, which can only be checked and removed by the supply of fresh food or the juice of some kind of succulent vegetable or fruit. The efficacy of lemon and lime juice, for instance, is well known in the prevention and cure of scurvy.

Climate influences the demand for food, and instinct leads to the adaptation of diet to the requirements that exist. Not only is there a correspondence between the amount of food required and the inclination for taking it, but the nature of the food selected in different countries varies and stands in harmony with that which is most in conformity with what is needed. The dwellers in the arctic regions, besides consuming a large quantity of food, partake of that kind which abounds in the most efficient form of heat-generating material, namely, oleaginous matter. In the tropics, on the other hand, it is upon vegetable products, largely charged with principles belonging to the carbo-hydrate group, that the native inhabitants mainly subsist.

Labour necessitates a supply of food in proportion to the amount of work done. The employer finds that the appetite of a workman may be taken as a measure of capacity for work—in other words, that a falling off of the appetite means a diminished capacity for the performance of labour.

Until recently, it was considered, in accordance with the teaching of Liebig, that muscular and nervous action resulted from an oxidation of muscular and nervous tissue, and that according to the amount of action occurring, so was a demand for the supply of nitrogenous alimentary principles created to replace the oxidised material. It is now held, however, that the non-nitrogenous elements of food contribute, as well as the nitrogenous, to the production of muscular and nervous force. Fick and Wislicenus undertook a known amount of work upon a non-nitrogenous diet, and proved that the oxidation of their muscular tissue, as measured by the amount of nitrogen voided with the urine, sufficed only for the production of a small proportion of the force expended in the accomplishment of the work performed. The muscles, in reality, appear to stand in the position of instruments for effecting the conversion of the chemical energy evolved by the oxidation of combustible matter into working power. Fats and carbo-hydrates can furnish the combustible matter required, and, under ordinary circumstances, probably do largely, if not chiefly, supply it. Nitrogenous matter can do so likewise, but it has to undergo a preparatory metamorphosis for effecting the separation of nitrogen in a suitable form for elimination. It must be said, however, that experience shows that hard work is best performed under a liberal supply of nitrogen-containing food. The explanation of this probably is that it leads to a better-nourished condition of the muscles and of the body generally. Under the use, for instance, of animal food, which is characterised by its richness in nitrogenous matter, the muscles are observed to be firmer and richer in solid constituents than under subsistence upon vegetable food.

Persons who lead a sedentary and in-door life naturally require less food than those engaged in active work, and less should be consumed by them to prevent the system becoming clogged with effete products, which act perniciously in various ways upon the body. The food should also be largely constituted of non-nitrogenous principles, as these tax the excretory organs less than the nitrogenous.

The diet of *infants* is a branch of dietetics the importance of which can scarcely be overrated. The proper food during the first period of infancy is that which has been provided by Nature for the young of mammals, namely, milk. Up to about the eighth month the infant is designed to be sustained solely by its parent's milk. The teeth, which ordinarily begin to show themselves about this time, indicate that some solid matter should now be consumed, and one of the farinaceous products will be the most suitable with which to commence. Bread, baked flour, plain biscuit, or one of the numerous kinds of nursery biscuits that are made, may be employed for a time as a supplement to the former food. At about the tenth month the mother, who ought previously to have commenced lessening her own supply, should now cease it altogether. As the child advances through its second year and the teeth become more developed, meat, preceded for awhile by gravy, may be given. If the mother cannot suckle her child, or a wet nurse, whose supply stands next best to that of the mother, be provided, the milk of one of the lower animals should be obtained, and that of the cow gives the nearest approach to what is wanted. Cow's milk, however, is richer in all its solid constituent principles than woman's, and the addition of a solution of sugar or—what is more in conformity with the natural supply—sugar of milk (lactine), in the proportion of an ounce to three quarters of a pint, is needed to bring the two in closer approximation. The milk of the goat is even richer in solid constituents than that of the cow, and therefore stands somewhat further removed from that of the human subject. If, however, it is not adapted for infants, it is highly useful for improving the condition of badly-nourished children, and is sometimes employed for this purpose.

THERAPEUTICAL APPLICATIONS.—The application of the principles of dietetics may be successfully brought to bear in the treatment of corpulency and thinness. A diet rich in nitrogenous matter conjoined with exercise promotes the growth of muscle, but the fat undergoes no increase. The conditions most conducive to an increased accumulation of fat are a diet rich in either fat or carbo-hydrates (provided the requisite amount of nitrogenous matter be present for affording what is wanted for the nutritive operations of life), exposure to a warm atmosphere, and inactive habits. A supply of fat in a direct manner, leads to an increased deposition of fat in the system, but the carbo-hydrates require in the first place to undergo assimilative change before they can be applied in the same direction.

The details of the dietary to be prescribed where the aim is to produce increased stoutness and an improved condition of the body, should comprise such articles as fat meats, butter, cream, milk, cocoa, chocolate, bread, potatoes, farinaceous and flour puddings, oatmeal porridge, sugar and sweets, sweet wines, porter, stout, and ales.

The converse mode of dieting is necessary for reducing stoutness. Mr. Banting, by his noted system of dieting, reduced his weight from 14 stone 6 lbs. to 11 stone 2 lbs. in about a year. Besides altering, however, the character of his food, he limited the quantity in a manner that must have contributed an important share towards producing the effect observed; not more than twenty-two to twenty-six ounces of solid food (corresponding with eleven to thirteen ounces of water-free material) being consumed, according to his statement, in the twenty-four hours.

As a guide to the corpulent it may be said that the fat of meat, butter, cream, sugar and sweets, pastry, puddings, farinaceous articles as rice, sago, tapioca, &c., potatoes, carrots, parsnips, beetroot, sweet ales, porter, stout, port wine, and all sweet wines should be avoided, or only very sparingly consumed. Wheaten bread should only be partaken of moderately, and brown bread is to some extent better than white. The gluten biscuits which are prepared for the diabetic may, on account of their comparative freedom from starch, be advantageously used as a substitute for bread in the treatment of obesity. The articles that may be taken to the extent of satisfying a natural appetite, are lean meat, poultry, game, eggs, green vegetables, succulent fruits, light wines, dry sherry, and spirits. Milk should only be taken sparingly.

Holding the position that food does in relation to the operations of life, the art of dietetics not only bears on the maintenance of health but is capable of being turned to advantageous account as a therapeutic agency; and it is not too much to say that success in the treatment of disease is oftentimes dependent upon a display of judicious management in regard to food.

In the therapeutic application of dietetics the maxim should be held in view that, whilst the particular requirements are secured, there should otherwise be no greater deviation from what is natural than the special circumstances of the case demand.

The quantity of food consumed may require to be regulated as well as its nature. The quantity administered at a time should stand in relation to the power of digesting it; and to properly compensate for a diminished capacity for taking quantity there should be a corresponding increase in the frequency of administration. 'Little and often' is the maxim to be followed upon many occasions, and much will sometimes depend upon the strictness with which it is acted up to; for, apart from harmonizing with what is wanted, upon the principle that has just been referred to, it meets the defective aptitude that exists in sickness for sustaining any lengthened duration of abstinence from food.

In febrile, acute inflammatory, and other conditions where there is a failure of digestive power, the food administered should be such as not to tax the stomach, and should therefore consist of liquid materials. Solid matter, by remaining undigested—and solids of an animal nature are particularly likely to do so—would act as a source of irritation in the stomach, and only serve to aggravate the condition of the patient. The articles under such circumstances to be selected from are beef-tea, mutton, veal, or chicken broth, whey, calf's-foot and other kinds of jelly, arrowroot, and such-like farinaceous articles, barley water, rice mucilage, gum-water, fruit jelly, and the juice of fruits, as of lemons, oranges, &c., made into drinks. Where a little latitude is allowable, the employment of milk and of eggs in a fluid form may be sanctioned. As circumstances permit, an advance may be made to solid substances which do not throw much work on the stomach, as rice, sago, tapioca, bread and custard puddings, and stale bread or toast sopped. Next may be allowed fish, beginning with whiting. As power becomes restored, calves' feet, chicken, game, and butcher's meat—mutton to begin with—may be permitted to follow.

In cases of ordinary dyspepsia the aim of the physician should be rather directed to raising, by appropriate treatment, the digestive capacity to the level of digesting light but ordinary food, than to reducing the food to an adjustment with a low standard of digestive power. Of butcher's meat, mutton is almost invariably found to be the most suitable; chicken and game are allowable, also white fish (boiled or broiled) particularly whiting, sole, flounder, and plaice. Stale bread, dry toast, plain biscuits, floury potatoes, rice, and the various farinaceous articles form the kind of food derived from the vegetable kingdom to be selected. Green and other succulent vegetables, it is found, are more apt to create flatulence than other kinds of food, and articles belonging to the cabbage tribe are particularly to be regarded as obnoxious to those who have a tendency to this form of derangement.

Much depends in cases of weak digestion upon the state in which the food reaches the stomach. Thorough mastication affords great assistance to the performance of digestion, and when the teeth are bad the food should be finely minced, or otherwise minutely divided before being eaten. Regularity in the periods of taking food, tends to promote the orderly working of the digestive organs. An interval of more than four or five hours' duration between the meals is to be avoided, as it acts perniciously in several ways. By inducing an exhausted state of the system it diminishes the energy of the digestive organs, and whilst having this effect it at the same time calls for the periodical exercise of increased energy, on account of the larger amount of food which must be taken at each meal to compensate for the length of time that is allowed to elapse between them.

In cases of ulcer of the stomach, acute gastric catarrh, and vomiting, the food must be selected from that which is nutritious and at the same time taxes least the digestive powers. Milk—and this is often better borne after being boiled—milk and water, or milk and soda water, will frequently be found to be tolerated when other articles excite irritation and are returned. Sometimes the milk may be advantageously mixed with isinglass, arrowroot, ground rice, or biscuit powder.

In dysentery and other forms of ulcerative disease of the intestine, scrupulous attention must be paid to diet. The food should consist of articles which are known to exert the least stimulant and irritant action on the mucous membrane and muscular coat of the alimentary canal, and those which best meet the demand in question are such as milk, isinglass, and the various farinaceous products, amongst which rice is preeminently valuable. Next to these come eggs, white fish, white-fleshed poultry, fresh game, and fresh meat. Salted and dried meats are highly objectionable, and fruits and succulent vegetables, with the exception of a floury potato, should be strictly shunned. *See* Peptonised Food.

The development of gout is known to be favoured by the consumption of a highly nitrogenised diet, especially if conjoined with sedentary habits. With those who have already experienced symptoms of the disease, and those also who have grounds for apprehending its invasion, it is important that an excess of nitrogenous food should be avoided. The diet should be simple, in order that the temptation may be avoided of eating too much, and should at the same time be adjusted to the mode of life. The principle to observe is that the higher the degree of inactivity the greater ought to be the preponderance of food derived from the vegetable kingdom.

Even of more importance than what is eaten is what is drunk, where the question of gout is concerned, and observation shows that it is not distilled spirits, but the stronger wines and malt liquors, which favour the production of the disorder. Nothing is more potent than port wine in leading to the production of gout, and a few years' liberal indulgence in it has often been known to be instrumental in bringing on the disease where no family predisposition had existed. Dry sherry and the light wines, as claret, hock, &c., may be drunk, certainly in moderation, with comparatively little or no fear of inducing the disease, although any kind of wine appears capable of sometimes acting as the exciting cause of a paroxysm where the gouty disposition is already established. Stout, porter, and the stronger ales, especially those that have become hard from age, rank next to port wine in their power of predisposing to gout. As regards the light bitter beers, which are so extensively used at the present time, the same must be said of them as of the light wines, viz. that with little, if any, disposition to induce the disease, they nevertheless appear capable of sometimes exciting its manifestation in a gouty subject. A pure spirit, as whisky, hollands, or brandy, diluted with water, often forms the only kind of alcoholic drink that is found to agree with those who are suffering from gout.

In Bright's disease with threatening uræmic poisoning it is a point of consideration to diminish as far as practicable the amount of excretory matter to be eliminated by the kidney. The fats and carbo-hydrates throw no work upon the kidneys. Their products of destruction escape through another channel. Nitrogenous matters, on the other hand, undergo metamorphosis in the system, and yield nitrogen-containing compounds—chiefly urea—to escape by the kidneys. In this way the kidneys become taxed by nitrogenous food, and, to lessen the work demanded of them, reason suggests that the diet should preponderate in food derived from the vegetable kingdom.

In diabetes mellitus there is a want of assimilative power over the saccharine and starchy principles of food. Whilst these principles become utilized and lost sight of when ingested by a healthy person, in the system of the diabetic they fail to become consumed, but pass off under the form of sugar in the urine, giving rise to severity of symptoms in proportion to the amount of sugar escaping. Much may be done towards subduing the symptoms of the disease by a properly arranged dietetic scheme, and the principle upon which it requires to be framed is the exclusion, as far as practicable, both from what is eaten and what is drunk, of articles containing saccharine or starchy matters.

Observation has shown that the reaction of the urine is susceptible of being influenced by the character of the food. The effect of animal food is to increase the acidity of the secretion, whilst that of vegetable food is to diminish it, and, even it may be, to produce alkalinity. Hence on persons affected with the lithic acid diathesis benefit is conferred by a plan of diet in which animal food is limited, and succulent vegetables and fruits, with the light wines, as claret, hock, &c., are freely supplied. On the other hand, with the phosphatic diathesis, the converse principle of action should be adopted.

F. W. Pavy.

DIGESTION, Disorders of.—The function of digestion is of a physico-chemical nature, being compounded of certain muscular acts, and of certain processes exercised by the digestive fluids on the ingesta.

Any interference with the due performance of the several components of the function will lead to indigestion, and though it may for convenience be desirable to consider these disturbances separately, it must be remembered that the occurrence of one condition is apt to be quickly associated with another, and hence the forms of dyspepsia as they usually present themselves are of a complex nature, however simple the primary fault may have been. Nor is it possible to consider irregularities of digestion only from the point of view of the organs immediately concerned. Complicated as our organism is, disturbances of other functions will speedily make themselves felt in the one under consideration, and failures in the absorption of the digested food, or in its subsequent metabolic changes and elimination, will tell back sooner or later on that process which is, strictly speaking, limited to its preparation. Dyspepsia then may be traced to (i.) the food; (ii.) disturbances of the so-called mechanical processes, viz. the muscular acts, solution, &c.; or (iii.) imperfections in the chemical changes exercised by the digestive secretions.

I. Imperfections of Food.—Imperfections in food, whether in quality or quantity, are among the most frequent causes of digestive disorders. A thorough knowledge of the principles of dietetics is essential, that the errors may be recognised and remedied. Since our digestive capability is limited, it is obvious that when those limits are overstepped, the domain of disease is entered upon; and although no very absolute lines may be laid down for universal application, the general rules for quantity and kind are capable of being stated. *See* Diet.

Even when the food is as it should be, dyspepsia may be determined by perversions of the appetite; or, on the contrary, such perversions may be due to the same causes which lead to the functional errors in the digestive organs. *See* Appetite.

(a) *Deficiency of Food.*—Except under rare conditions, such as famine, &c., this is not so common a cause of disease as is supposed. We habitually take a larger bulk of food than is demanded, and it is very certain that most active lives are led on an amount of food far below what is ordinarily regarded as being necessary. May it not be that many of the diseases looked upon as non-preventible, more particularly those connected with the excretory organs, are really due to their overwork in getting rid of the excess of the ingesta? Of the signs and symptoms of starvation it is not needed here to treat. But there are frequent occasions when, with no deficiency in the total bulk of food taken, there is yet a serious want in one or perhaps more of the needful alimentary principles, and this is especially liable to occur in the feeding of children. Setting aside those gross cases of cruelty, when infants and the youngest children are fed almost from their birth with bread, broth, or even meat, there are still too often to be met with children whose diet-scale is almost entirely wanting in nitrogenous matter. Fed upon milk and infants' foods, the latter consisting of little more than starchy material, their tissues are ill-formed for the want of proteids, which, during the period of growth, are required in a larger relative proportion. The relationship of rickets to prolonged suckling, with the accompanying deficiency in nitrogenous and amyloid food-stuffs, is now generally recognised.

The effect of a deficiency of food is a general state of malnutrition, in which any hereditary tendencies to disease that may exist have a more favourable field for development. There is a gradual diminution in the weight of the body, and an imperfect performance of its functions, as indicated by muscular weakness, mental lassitude, &c.

The deficiency in food taken may result not so much from a defective supply of nutriment, as from a disinclination to eat, a common symptom in most diseases, especially in febrile states, self-imposed fasting too frequent or prolonged, the anorexia of the hysterical temperament, and obstruction to the entrance of food into the stomach from stricture of the œsophagus, or the appetite may be impaired by over-indulgence in alcohol or tobacco.

(β) *Excess of Food.*—There is very little doubt but that more food is daily in the habit of being taken than is actually required to restore the tissue-waste, as there is equally little doubt that much of what is taken is not in the most digestible form. It is open to question whether the appetite would be satisfied by the ingestion of merely sufficient to balance the waste, particularly if the gross bulk of the food taken were diminished by the removal, as far as possible, of all indigestible matters, leaving little more than the needful alimentary principles. At the same time it must not be forgotten that the appetite is very easily controlled by custom, and determination can in time overcome a vicious habit.

An habitual excess of food, at least in this country, usually errs in the disproportionate amount of nitrogenous matter it contains. Remembering the relatively small quantity of this principle that is essential, and in what a number of the ordinary articles of diet it is contained, this statement will be the more readily accepted. Now, since all the proteid principles require, to fit them for absorption into the blood, a considerable amount of chemical alteration, and, physiologically speaking, there is good reason to believe that the subsequent metabolic changes of these matters, when absorbed, are more complex than those undergone by fats and amyloids, it would follow that those organs concerned in effecting these changes are very prone to suffer from overwork and its sequelæ. Again, it appears very probable that when the amount of nitrogenous food taken is much in excess of what is required, it undergoes certain oxidation-changes in the blood without becoming tissue previously, and an enormous ingestion of albuminoid matter is followed by its elimination very much as it is taken. Now, many of the compounds resulting from the oxidation of nitrogenous matter are liable to become positive poisons in the economy when existing in excess, and the proper elimination of such materials is specially provided for by such organs as the kidneys and skin. The frequency with which these organs become the seat of disease may at least indicate the probability of errors of diet being an important factor in determining the morbid changes, especially as considerable relief is often the result of a restriction of nitrogenous food. There can be little doubt but that the large group of diseases associated with failure in elimination of nitrogenous waste has for a prominent cause an habitual excess of nitrogenous food.

The results of an excessive ingestion of food are as numerous as they are diverse. In many cases there does not seem to be either impairment of health or shortening of life. In some obesity and in others leanness ensues. In a large majority of individuals whose food is much in excess of their wants, particularly if the exercise taken be but little, there are variable symptoms of indigestion, such as a general feeling of lassitude and want of energy, both muscular and mental, a liability to headaches chiefly frontal, constipation, or more rarely diarrhœa, high-coloured urine depositing abundance of urates, a general disposition to sleep, various skin-eruptions, particularly acne, and not infrequently a feeble heart's action from commencing fatty degeneration of its substance. Any or all of these symptoms may exist, and may be more or less completely relieved by a restricted diet. It is impossible to lay down any exact rules for the quantity of food that should be daily consumed; though it is desirable to remember that the tendency is to take too much, at the same time that age, season of year, and occupation are all circumstances determining variations both in quantity and kind.

(γ). *Improper Food.*—Setting aside those extreme cases of perverted appetite occasionally seen in the hysterical condition, there yet remains a very constant violation of the dietetic proprieties. These errors may be classed under the following heads:—1. Substances which are indigestible; either essentially so, or from imperfect preparation (cooking, &c.) 2. Substances which, though digestible, are innutritious or even poisonous. In the first group are included such bodies as the pips and seeds as well as the skins and rinds of fruits, the husks of corn and bran, the stalks and fibres of leaves, and gristle, elastic tissue, and hairs in animal food. For the reducing of these to a fluid and diffusible condition no chemical arrangement exists in the human organism, and they are thrown off very much in the same state as they are swallowed. Many articles of diet depend in great part for their digestibility on their proper preparation by division, cooking, &c. Thus most vegetables when taken in the raw state are but imperfectly digested, and such nutritious food as potatoes becomes when uncooked positively harmful. The apparent value of raw green vegetables, as lettuce, endive, cress, &c., would seem to depend on the peculiar condition of their mineral constituents, rather than on the vegetable tissues.

Such substances as the above-mentioned are apt to produce perversions of digestion in virtue of the mechanical irritation they give rise to, indicated by more or less pain of a griping character (colic), and frequently accompanied by diarrhœa. The constant ingestion of the more formidable may even set up a gastro-enteritis, acute or chronic. Occasionally articles of food, such as brown bread, oatmeal porridge, &c., are taken for the very aperient action they induce, owing to the irritating nature of the indigestible husks they contain. Symptoms of acute dyspepsia very frequently follow the taking of meat foods enveloped in greasy sauces, since the fat, being undigested in the stomach, prevents the action of the gastric juice on the proteid matter, which then passes on into the intestines, setting up irritation like any other indigestible substance. The most interesting among those articles of diet which, though easily digested may be poisonous, are those producing their effects only on certain individuals. Such, for example, are certain mushrooms, shell-fish, or indeed any fish. Remarkable cases are authentically recorded of serious and even fatal results following their ingestion. The symptoms may be those of an acute gastro-enteritis, or, as is very frequently the case, an urticaria is the result, with or without swelling of the eyes and throat. Severe nervous prostration has been met with occasionally. Be it understood that other people have partaken of the same diet with no ill results. The writer is acquainted with a gentleman who for many years was unable to remain in the room when fish of any kind was on the table; its presence inducing severe vomiting, abdominal pain, and general illness; and although the effects are now but slight from the mere smell of such food, very marked symptoms follow on partaking of any. The most digestible and nutritious articles of food may determine indigestion when taken too hot or too cold.

Finally must be included those substances which accidentally find their way into the alimentary canal with the food, as entozoa, ergot of rye; such foreign bodies as pins, needles, coins, buttons, &c.; or lead and other metallic poisons off the hands of workers in these poisons; all of which give rise to definite and for the most part characteristic symptoms.

II. IRREGULARITIES OF THE MECHANISM OF DIGESTION.—The motor factors of the digestive process depend for their due and normal performance on the integrity of the muscular tissue, the nerve-centres, and the connecting nerves. The several stages of the entire process are mastication, deglutition, the churning movements of the stomach, the peristaltic action of the intestines, and defæcation. Each of these is liable to impairment, in the direction of excess (spasm), or of deficiency (paralysis), due either to lesions of the nerve-centres whence the motor stimuli emanate, of the nerve-fibres by which these stimuli are conveyed, or of the muscular tissue by which the movements are performed. Not unfrequently more than one of these tissues may be at fault. Lastly, obstructions to the movements may be caused by tumours, cicatrices, &c. Irregularities of mastication, deglutition, and defæcation are fully considered elsewhere.

1. *Paralysis.*—Arrest of the peristaltic action of the gullet, stomach, or intestines, is undoubtedly often associated with diseased conditions of the central nervous organs, but the exact connection is far from being satisfactorily known. Those lesions which interfere with the action of the vagus nerve, and remove its accelerating influence over the peristaltic movements, have been regarded as most likely to bring about this condition. The nervous exhaustion induced by long fasting, continued vomiting, hysteria, and such diseases as typhus and puerperal fever, have been noticed as removing the influence of the pneumogastric. Over-brainwork, with the attendant altered conditions of cerebral vascularity, have been found to be accompanied with symptoms indicating loss of power of the muscular coat of the bowel; possibly in this case also the influence is conveyed by the vagus.

Paralysis of the stomach and intestines is a frequent result of affection of these organs themselves. Inflammation of the peritoneal or mucous coats, with the subsequent infiltration of the muscular coat with the inflammatory products, materially diminishes the power of the contractile tissue. Degeneration of the organs, particularly the lardaceous variety, which commencing in the mucous subsequently invades the muscular coat, obviously interferes with the movements. The movements of the alimentary canal may be considerably diminished by the administration of certain drugs, such as opium.

The results of these various paralytic affections are in most cases sufficiently apparent. The palsied lips and cheeks and tongue tell their own tale by the half-opened mouth, the dribbling saliva, and the cheeks distended with food which cannot be kept between the teeth. When the fauces and pharynx are affected, the painful efforts at swallowing, the rejection of food through the nose, and the passage of food into the larynx are signs not to be mistaken. Paralysis of the stomach and intestines is mainly recognised by the constipation from inability of the canal to propel its contents, and by the distension with gases, &c., which ensues; whilst the involuntary passing of the fæces indicates paralysis of the sphincter ani.

2. *Spasm.*—Spasmodic affections of the alimentary canal are characterised by an increased motor activity dependent on many causes for its production. However diverse such causes may be, they ultimately resolve themselves either into an increased irritability of the nervous and contractile tissues, or into some unusual or excessive stimulation, arising *ab extrâ*, and so producing its motor result in a reflex manner, or originating automatically in the cells of the motor ganglia. Spasms affecting the organs under consideration are determined both by central and peripheral causes, and occasionally by affections of the nerves independently of the nerve-centres. They are mainly of the tonic variety, and are usually accompanied by pain.

It is clear that with the muscular tissue of the alimentary canal arranged as it is, when a condition of spasm exists obstruction to the passage of the contents of the canal will take place, in proportion to the extent and duration of the cramp.

Spasm of the stomach and intestines is almost invariably accompanied by pain; and it is for that symptom, rather than for any obstruction, that the condition comes under notice. The pain at the back, so frequently complained of in anæmia, is believed to be mainly due to gastric spasm; and in certain other constitutional states, such as gout, it may be a prominent symptom. Occasionally it is due to uterine or ovarian disturbances, acting in a reflex manner. Spasm of the pylorus is of theoretic rather than practical interest. Intestinal cramp (colic, tormina, &c.) is of frequent occurrence as the result of irritating ingesta, lead-poisoning, hernia, intussusception, and ulceration in malignant disease. These spasmodic affections may also result from diseases of the spinal cord. How far over-action of the involuntary muscular tissue of the alimentary tract may exist without pain is uncertain; since we are ordinarily unconscious of the peristalsis, it is probable that any exaggeration of action is painful.

The normal tenacity of the sphincter ani may give place to painful spasm, a condition which is very apt to complicate fissure and ulcer of the anus.

Hyperkinesis, or exalted motor activity of the muscular tissue of the digestive organs, may be a part of the general state induced by such poisons as strychnine.

3. The due performance of the mechanism of digestion may be interfered with by alterations in the condition of the alimentary canal caused by various kinds of obstruction or dilatation. Thus deglutition may be rendered difficult or even impossible by a swollen tongue or tonsils, post-pharyngeal abscess, tumours of the œsophagus or larynx, or new growths situated at the cardiac aperture of the stomach. The various obstructive diseases of the pylorus and intestines will obviously interfere with the proper passage of the contents, and in those dilatations of the canal, which are liable to develop above a stricture, the food accumulates and is delayed in its passage. The adhesion of coils of the bowels to each other or to adjacent structures is a further source of imperfect movement.

Lastly, the subdivision of the solid food, so necessary for the effective action of the digestive juices, is only imperfectly performed when the teeth are deficient in number or are carious, and to this cause a large proportion of cases of dyspepsia may be fairly assigned.

So marked a perversion of the mechanism of digestion as vomiting is more fitly described by itself, though it is a very frequent symptom of indigestion.

III. IMPERFECTIONS IN THE CHEMICAL CHANGES.—Our knowledge of the normal chemistry of digestion, much as it has advanced of late, is still very far from complete, and, in face of our ignorance, but little can be said of the conditions existing in disease. Yet there are certainly no departures from the healthy working of the body so common as are those associated with the digestion of the food.

The various secretions, whose office it is to convert into a fluid and diffusible form those alimentary principles which without such preparation cannot be absorbed, are formed from the blood by the salivary, gastric, pancreatic, hepatic, and intestinal glands. It is clear that, for these juices to be secreted in proper quantity or of proper composition, the blood no less than the secreting cells must be in a healthy condition. If the circulating fluid be laden with imperfectly secreted products of tissue-change, or if it be charged with poison, of whatever origin, it is not to be expected that a normal secretion is to be obtained from it; whilst on the other hand a degenerated secreting epithelium is unable to perform a function intimately dependent on the integrity of its protoplasm. Of necessity these two factors—blood and cells—react on one another; any flaw in the one is reciprocated by the other, and thus becomes intensified by mutual interdependence. Experiment leads us to ascribe the efficacy of these juices in the changes they effect to the existence in them of certain so-called ferments, whilst the result they bring about is mainly one of hydration. How far the various mineral constituents of the secretions aid in the process is uncertain, but at least their presence cannot be dispensed with. In this way, the insoluble starches of our food are converted by the saliva, the pancreatic, and possibly the intestinal juices, into soluble and diffusible sugars; the various proteids are rendered capable of absorption into the blood, by the gastric and pancreatic juices, and perhaps also the succus entericus, being changed into bodies known as peptones. The fats are prepared for absorption by the bile and pancreatic juice, by being in part reduced to a sufficiently minute state of subdivision (emulsion) to permit of their passage through the tissue-interstices, and partly by being chemically altered into soaps. However closely we may imitate the separate actions of these fluids in our test-tubes and laboratories, the conditions are undoubtedly much more complicated in the alimentary canal, where so many sets of changes are going on, and so many sets of products are formed.

Despite our imperfect knowledge we can yet suggest in outline the causes of the abnormal chemical changes, however far we may be from ascribing with accuracy to their proper conditions the multiform symptoms which such changes undoubtedly give rise to.

Primarily the secretions may be deficient in quantity, improper in quality, or both, and the following are some of the causes leading to such results:—

1. *Perverted nervous influence.* The direct control of the nervous system over the quantity and quality of the secretions is well known, and there is every reason to suppose that the temporary arrest of the salivary fluid so frequently accompanying any severe mental disturbance, such as fright, represents, but in a transitory manner, a disturbance that may be more lasting and more serious in lesions of the central nervous organs. The imperfect digestion, as indicated by the tongue, breath, excreta, &c., so common in brain-diseases, even when all precautions are taken, is only to be explained in this way. There is nothing improbable in suggesting that a cause which may in one case bring about an arrest of secretion, may, if prolonged, induce a perversion of the same.

2. *Abnormal blood-supply.* A deficiency in blood being almost always associated with an alteration in its quality, it is easy to see why in a state of anæmia the digestive function suffers, whilst the more it fails the more will the anæmia increase. Hence the care needed both in diet and drugs for such patients. In some cases the blood may be wanting in those constituents which go to form the secretions. Occasionally persons are met with who, from habit or inclination, take a quantity of fluid far below the ordinarily supposed requirements. In such the secretions would seem to be insufficient in quantity to do their work, and an irritable form of dyspepsia, caused by the presence of imperfectly digested food, is the result. Or again, certain symptoms may point to a deficiency in such special elements of the secretions as hydrochloric acid, bicarbonate of potash, &c., and considerable relief or a cure may follow the administration of these substances, or it may be the ferments themselves are wanting, and pepsin or pancreatin are indicated. It is not asserted that our knowledge at present leads us to recognise with accuracy the exact nature of the deficiency in the secretions, but in view of the relief that is afforded by acting on the lines laid down by physiology, it is only reasonable to expect that in time the expressions of disease may be more exactly defined, and so a rational basis constituted for treatment. After prolonged fasting the gastric juice is secreted in but small amount, and under ordinary conditions that which is first poured into the stomach is far less active than that later formed. In other words the quality of the secretion improves as the food, which supplies its ingredients, is absorbed. Hence the occasional advantage of prefacing a meal with a small quantity of some piquant food.

From a blood laden with impurities, whether of ingesta or non-eliminated products of tissue-waste or specific poisons, healthy secretions are not to be expected, even did the secreting agents remain healthy. Thus the dyspeptic symptoms associated with alcoholism, gout, and the acute specific diseases are to be explained.

3. It has already been said that it is practically impossible to disassociate altered blood

states from perverted tissue-structure; and if the nutritive fluid of the body be diseased, the elements nourished by it may be expected to be imperfect. Some of these departures from the normal are not recognised, partly from the difficulty of observing them, and still more from ignorance of the exact standard of healthy structure in tissues which are perpetually changing, even within healthy limits. Other changes, however, we can see; and the degenerate cells of an amyloid liver, or the desquamating epithelia of the gastric follicles in scarlatina, can no more be expected to eliminate healthy secretions, than can a fatty heart to contract properly.

A further source of disturbance in the chemical changes in digestion is to be found in the fermentative and putrefactive processes set up in the contents of the alimentary canal. How far such processes are normal is uncertain; but occasionally the contents of the stomach are vomited in a state of active fermentation, and teeming with living organisms. All ill-smelling gases and excreta may be, indeed, indicative of the progress of putrefaction lower down in the canal. That gastric juice and bile will normally arrest putrefaction, whilst pancreatic juice favours it, is well known, and hence we are led to infer some alteration in the secretions when signs of decomposition appear.

Symptoms of Dyspepsia.—The almost numberless symptoms which indicate the perverted functions above described, may be considered as those associated with the special organ at fault; and those manifested by the system generally.

(*a*) Among the first group are *perverted sensations*. Ordinarily we are unconscious of the process of digestion, but in disease the function may be accompanied by alterations of sensation, varying from a mere sense of weight and discomfort in the abdomen to the severe spasmodic pain of colic. The ingestion of food may be followed by a feeling of abnormal repletion, or of emptiness with craving for food; or there may be heartburn, an ill-defined sense of burning felt in the epigastrium or over the chest, or extending to the throat, or positive pain or tenderness felt over some tolerably definite area. Sensations as of excessive movements of the bowels, of sinking, or of tightness across the abdomen, are of frequent occurrence.

(*b*) Affections of the *appetite* as results of indigestion have already been referred to.

(*c*) The various *movements* of the alimentary canal may be interfered with. They may be delayed or even arrested, as occurs in constipation; or excessive, with consequent diarrhœa. Vomiting, either directly or at a variable interval after taking food, is a common symptom, with or without pain; very frequently the vomiting relieves the unpleasant feelings that may be present. Eructations of gas, hiccough, and the frequent passing of much flatus occur in many cases.

(*d*) The *vomited matters* vary considerably. The food may be ejected very much as it has been swallowed, or it may be in a state of active fermentation and turning into ferments. A symptom very often complained of is the eructatation into the mouth of a fluid, which is frequently acrid and bitter, at other times tasteless (pyrosis): it is probably altered gastric secretion. Blood may be vomited (hæmatemesis); or passed per rectum (melæna). The breath may be foul.

(*e*) The state of the *tongue*, its colour, size, and general appearance as to fur, dryness, smoothness, and prominence of papillæ, are often indicative of the condition of the stomach and intestines.

(*f*) Such *sympathetic* symptoms as headache, pain in the back or in the right shoulder, dizziness, specks in the field of vision, palpitation, or irregular action of the heart, cough, disordered urine, &c., indicate the relation existing between the digestive organs and the body generally.

(*g*) The more *general* symptoms that are found associated with disordered digestion may be those of pyrexia, when an acute inflammatory condition of the digestive organs is the cause of the disturbance. Since, however, the affections are more usually of a chronic nature, a general wasting and emaciation from insufficient nourishment is likely to ensue. In such a state the patient is prone to develop any diathesis to which he may be liable, such as the neurotic, cancerous, &c. The peculiar sallow, muddy-looking skin, often slightly tinged with bile and markedly anæmic, is characteristic of many cases of chronic indigestion; a poorly nourished body can ill stand the slightest fatigue, though such patients are often apt to brighten up towards evening, and indeed as a rule dyspeptic patients are worse in the morning. All conditions of disordered temperament are met with, from a confirmed apathy and hypochondriasis to a persistent and increasing irritability. Whilst some patients are always drowsy, others complain of a distressing insomnia, or a troubled and dreamy sleep.

Treatment.—Oftener perhaps than may be supposed, the cause of the disturbance of digestion is a removable one; in any case it must be well searched for, and arrested if possible. A carefully regulated diet, both as regards ordinary food and drinks and special idiosyncrasies, is in all cases the most important, and the means from which much good is to be expected. Exercise, bathing, occupation both mental and bodily, change of scene and air, will require attentive consideration. Much, however, may be done with the aid of drugs. Sufficient indications often exist to justify prescribing, with perfect confidence, such tonics as vegetable bitters, quinine, strychnine, and iron; such constituents of the digestive juices as mineral acids, pepsin, and alkalies; or drugs whose value appears mainly to consist in their sedative action, as hydrocyanic acid, bismuth, opium, and belladonna. Arsenic, zinc, silver, creasote, charcoal, valerian, the hypo-sulphites, and the carminatives generally, are a few among the long list whose value is assured in different cases of dyspepsia. It is important to attend to the condition of the bowels; as well as to the hepatic functions. *See* Stomach, Diseases of.

Conclusion.—In the foregoing remarks no attempt has been made to enter into a detailed description of the various symptoms of disordered digestion, or to do more than indicate very generally the treatment to be followed. Such subjects are left to the diseases treated of in their respective articles. Nor has it been thought desirable in this article to treat the subject from the ill-defined point of view of 'varieties of dyspepsia.' Rather it has been sought to bring the matter of indigestion within the limits of an anatomico-physiological basis, since it is only on such lines that the protean symptoms of dyspepsia can be accurately defined. At the same time, whilst for clearness the various causes have been made to assume a somewhat tabular form, it is not intended that the interdependence of these states should be overlooked, or that one only of the causes mentioned is at work in any given case. The complexity and harmony of our functions alike forbid such a mistake being made. Yet for that mental analysis which the formation of a diagnosis presupposes, some such scheme as the foregoing is essential, no less than for the adoption of a rational treatment.

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DIGESTIVE ORGANS, Diseases of the.—The organs comprised in the digestive system have for their function the preparation of the solid and fluid ingesta of the body, so as to fit them for absorption into the blood. Some of the food requires little or even no such preparation; some needs considerable treatment, both physical and chemical. To effect this object it would appear to follow that there should be some receptacle or series of receptacles into which the food may readily be taken, and from which the worthless residue may escape, provided with muscular structures to ensure a movement of its contents. It would further follow that there should be certain organs communicating with the foregoing, whose function it should be to prepare those materials necessary to effect the required chemical changes in the food; and, lastly, that some arrangement should exist to permit of the ready absorption of the digestive materials. Such requirements we find supplied in the alimentary canal, with its terminal apertures, and its continuous muscular coat so arranged as to maintain a progressive advance of the contained food, though with varying degrees of speed—for some lengths, as through the gullet, without any arrest; in others, as in the stomach, with considerable delay. Into this canal open numerous glands (mucous, salivary, gastric, intestinal, hepatic, and pancreatic), the secretions of which play each their special part in the conversion of the food to a fluid and diffusible state. From an anatomical, and indeed a genetic point of view, these glands may be regarded as more or less complicated diverticula of the mucous surface. In order that the food when so treated may gain a ready entrance into the blood, the surface of the canal in contact with the digesting food—mucous membrane—offers various modifications—villi, &c.—to facilitate the process of absorption. Lastly, in beings so complex in structure as man, there is need for some controlling influence to bring the operation of this system of organs into harmony with the actions of other and interdependent systems. Such power of co-ordination is exercised *viâ* the nervous system, sympathetic and cerebro-spinal.

By the expression 'diseases of the digestive organs' is meant, departures from the normal structure of the tissues of which these organs are composed.

The constructive tissues of the alimentary organs are:—1. The Epithelial; 2. The Connective; 3. The Muscular; and, 4, a compound texture—the Vascular. Each of these is subject to its own perversions, either alone or in common with others.

Ætiology.—If we consider diseases to be altered functions dependent on altered structure, the latter being determined by some perversion in the normal stimuli to nutrition, either hereditary or acquired, we shall at once recognise that the opportunities for abnormal stimulation in the case of the digestive organs are most numerous. Communicating with the external world and continuously subject to the admission of foreign matter, we have in the character of the ingesta abundant sources of disease. Toxic agents, living and dead, find ready entrance, and excesses in quantity of food, no less than imperfection in its quality, alike serve to produce those departures from the normal structure on which perversions of function depend.

Furthermore, the tissues of the alimentary viscera are, equally with those of the body generally, subject to those more obscure hereditary influences which determine irregularities in structure and their sequence. And, finally, arrests in development of organs, not unfrequent in those under consideration, complete the list of possible diseases to which the alimentary system is liable.

Nor is this system independent of morbid conditions affecting other organs. So complicated as is the human body it is impossible that disease should for long be limited to one region. Sooner or later the functions which are now reacting the one upon the other, to constitute the harmonious working of healthy life, will feel the effects of the one that is out of gear, and will respond each in its own manner to the abnormal condition. A disease primarily located in the nervous system will produce an effect in the working of the nutritive functions, none the less real because the exact lesion cannot as yet be determined. Failures in elimination of the products of tissue-waste from structural diseases of the excretory glands, must tell back on the organs concerned in the preparation and elaboration of the ingesta, and such conditions constitute a frequent cause of disorders of digestion. The causes may be thus tabulated:—

A. Hereditary.

1. Arrests in development of tissues and organs.
2. Abnormal nutritive stimuli, determining new growths, &c.

B. Acquired.

1. Poisons,
2. Imperfections in quantity or quality of normal ingesta.
3. Failure of excretory functions with consequent circulation of an impure blood, and malnutrition of tissues.
4. Trophic disturbances acting *viâ* the nervous system.
5. Traumatic.

Classification of Diseases.—There is scarcely any form of diseased structure that is not to be met with in the tissues comprising the digestive organs. Since almost every variety of texture is found in them, and there is so extensive a liability to the causes of disease, this result is only to be expected.

I. **Affections of the Vascular State.**—Regarded collectively, the organs of digestion present several points in respect to their blood-supply worthy of remark. First, the arrangement of the vessels is such as to ensure a very extensive, and at the same time, very direct supply. The arteries to those alimentary organs situate in the abdomen are almost all primary branches of the aorta, and this, together with the numerous and free anastomosis between them, reduces to a minimum the chance of failure in circulation. Secondly, the blood from the same area is all collected into one large vein, the portal, and after circulating through the liver is carried by one—the hepatic—directly into the inferior vena cava close to the right auricle. Such an arrangement, whilst perhaps facilitating the direct return of blood, offers a double chance—viz., in the liver and in the heart—of producing a very general state of congestion of the alimentary tissue. Thirdly, the existence of such an organ as the spleen, which by its position and structure allows of great variation in the amount of blood it contains, will considerably affect the extent of vascularity of the digestive organs. Our knowledge of the conditions determining the variations in splenic blood-capacity is most imperfect, beyond the fact of the constant enlargement which the organ undergoes after a meal and its subsequent contraction after a few hours, the enlargement being due in great part to increase in the amount of blood contained in it. And, lastly, the alimentary organs probably undergo, within normal physiological limits, a wider variation in amount of blood than does any other system.

1. *Hyperæmia* is an excess of blood in the arterial side of the capillaries. How far a determination of blood to the alimentary canal may exist, unaccompanied by any change in the tissues, is a matter of doubt. In the normal process of digestion this condition obtains, but with it there is an alteration in the glandular epithelia, if in no other tissue-elements. It is conceivable, however, that a vaso-motor paralysis with consequent fluxion may occur, and such may be the case in certain mental states, as indicated by diarrhœa. The majority of circumstances that produce hyperæmia do not stop at that point, but bring about a state of catarrh and inflammation, in which the epithelial and connective tissues are also engaged. Exposure to cold and extensive superficial burns probably produce their well-known results of intestinal catarrh in this manner.

Among the digestive glands, the liver undoubtedly manifests states of simple hyperæmia without any appreciable changes in the parenchyma of the tissues. Excessive feeding, irritants such as spices and alcohol, hot climates and malaria, have all been recognised as producing temporary enlargements of the liver from vascular engorgement, although without doubt these causes if continued lead to structural affections.

2. *Congestion*, or an excess of blood primarily in the venous side of the capillaries, brought about by some impediment to the return of the blood in the veins, has little or no analogy with any normal physiological action. As a condition of disease it is more important and far more common than the preceding.

The two chief causes leading to its occurrence are—(A) Obstruction through the portal circulation in the liver, either by compression of the portal capillaries by cirrhosis, &c., or pressure in the portal trunk by enlarged glands, tumours, &c.; (B) as part of a general congestion due to obstruction at the right side of the heart from tricuspid dilatation. Due to the very direct communication of the veins of the chylopoietic viscera and the right auricle, these organs are among the first to experience the effects of the cardiac obstruction. Congestion of the alimentary canal and glands, when due to either of these causes, is in the main progressive in its nature, though occasionally liable to temporary relief from treatment.

Extreme conditions of vascularity, especially if associated with any hæmorrhage into the sub-epithelial tissue, present post-mortem appearances often mistaken for irritant poisons.

3. *Results of Increased Vascularity.*—(α) *Hæmorrhage.* Over-fulness of the capillaries, from whatever cause, is liable to lead to extravasation of blood, either by diapadesis of the corpuscles and transfusion of the fluid part of the blood, or from actual rupture of the vessels. It is much more common and far more extensive in venous congestion than in arterial hyperæmia. It must not be too readily assumed *post mortem* that either of these conditions alone is the cause of the hæmorrhage, since minute ulcers of the mucous membrane communicating with main vessels have been met with. Dependent on the course and situation, the effused blood may vary in colour from bright red to a coffee-ground appearance. Hæmorrhage due to altered states of the blood is of frequent occurrence in purpura, scurvy, &c. (β) *Œdema.* An over-distension of the vessels, especially of the veins, if it be at all persistent, is invariably accompanied by an effusion of serum into the substance of the viscera themselves and into the alimentary canal, in the latter case producing diarrhœa. (γ) Tissues the seat of a chronic congestion in time undergo certain structural changes as the result of their impaired nutrition, which are characterised by the presence of an excessive amount of connective tissue, containing fewer protoplasmic elements than normal, and exhibiting a marked tendency to contract. The fibroid substitution may occur throughout the entire digestive system, but is particularly noticeable in the stomach, intestines, liver, and pancreas.

4. *Anæmia.*—The alimentary viscera, in common with the rest of the body, may share in a general bloodlessness due to excessive loss or extreme malnutrition from wasting disease, &c. A deficiency of blood limited to these organs is not clinically met with.

5. *Infarctions.*—As compared with the brain, spleen, and kidneys, the organs of the alimentary system would appear to be less prone to suffer from emboli and thrombi, or at all events from the effects of their conditions. A partial exception to this general statement must be made in the case of the liver, which is a frequent seat

of abscess determined by the arrest in the portal capillaries of septic particles taken up by the portal radicals in dysentery, &c. Emboli, as a cause of gastric ulcer, are probably not so common as has been supposed by Virchow.

II. **Structural Affections.**—1. *Inflammation.* This term is applied to express those changes which take place in the nutrition of a tissue subsequent to the application of some abnormal stimulus which shall not have been sufficiently powerful to produce destruction. The changes in the structural elements of the textures result in the production of some material which is unlike the normal constituents of the part affected, and also in certain destructive phenomena. One or other of these aspects may predominate, as in suppuration and abscess or ulceration, &c. Certain variations present themselves in the nature of the new-formed material, and also in the general course of the process, constituting forms of inflammation, as simple, diphtheritic, phlegmonous, aphthous, &c. In vascular tissues there are in addition to the tissue-changes certain alterations in the circulation in the affected region, commencing with hyperæmia and leading to a variable amount of stasis.

Inflammation as it affects the alimentary tract offers no exception to this description. The transition, so far as anatomical appearances are concerned, from the normal state of activity of the organs, with their increased vascularity and cloudy appearance of the epithelial cells, to that of simple inflammation or catarrh, is but a step marked by no abrupt line. The entire canal, with the gland-ducts opening into it, may be the seat of various forms of inflammation, some regions being rather more prone than others, as the fauces, stomach, small intestine, and bile-ducts.

It is rare in inflammation of the canal for the muscular tissue to share in the process, which is practically limited to the epithelial and sub-epithelial connective tissue, and a similar condition exists in regard to the ducts of the various glands. It is a noticeable fact that the epithelia of the canal are but little prone to manifest that general suppurative form of inflammation accompanied by a large production of pus from the general surface, such as is so commonly seen in the bronchial, nasal, vaginal, and other mucous membranes. In inflammation of the various glands it would appear that next to the ducts the connective-tissue stroma is mainly the tissue affected, leading to a proliferation of the corpuscles and ultimate formation of a less protoplasmic form of fibrous tissue.

Among the chief results of inflammation are:—

(α) *Abscess.*—This may occur in any part of the submucous tissue, in the so-called phlegmonous and pyæmic inflammation, but is of most common occurrence in the tonsils and in the liver, often in the latter situation the result of inflammation determined by absorption into the mesenteric veins of septic particles from dysenteric ulceration.

(β) *Ulceration.*—The mucous membrane of the alimentary canal is particularly liable to this morbid process. Some preference is exhibited by the different forms of ulcer for certain regions of the canal, and a difference exists in the tendency to perforate the entire thickness of the tube, those of shorter duration frequently producing this result, whilst the chronic ulcers are usually accompanied by a slow formation of indurated connective tissue, which proceeds *pari passu* with the destructive process, and is especially likely to institute adhesions between the canal and adjacent organs. Ulcers are met with in the salivary, hepatic, and pancreatic ducts, very frequently as a sequence of inflammation determined by the passage of calculi.

The ulcers which are usually acute in their course are:—1. Simple. 2. Aphthous. These forms, though they may occur in any part of the mucous membrane, are far more commonly situated in the gums, cheeks, tongue and palate. 3. Acute specific ulcerations, as diphtheritic and scarlatinal, mainly affecting the fauces; or typhoid, limited to the jejunum and ileum, and originating in the solitary and agminated glands. 4. Dysenteric.

The ulcers that are commonly chronic in their course are:—1. Gastric. 2. Tubercular, which may occur in any part of the canal, but are usually limited to the same situation as the typhoid. 3. Syphilitic, most common in the mouth, fauces, and rectum. 4. Cancerous. 5. Dysenteric.

Ulcers, the result of injury or of corrosive poisons, may be either acute or chronic. The latter are rarely met with below the stomach.

(γ) *Sloughing and Gangrene.*—The inflammatory state may be so intense as to lead to molar death of the area affected, with the production of slough. This often follows scarlatinal inflammation of the fauces, and the surface of the large intestine in dysentery is frequently covered by large and numerous sloughs.

Gangrene is almost entirely limited to the mouth in children, when it produces the condition termed noma. The cheeks are usually affected first, the process rapidly involving the gums, jaws, &c. The cause is very obscure.

Post-mortem softening and destruction of the stomach and intestines is frequently met with, and is due to an actual digestion of the viscera by the gastric juice, which, thus escaping from the stomach, may cause destruction of adjacent organs. It is usually met with when death has occurred during the process of gastric digestion, and is more common in infants, possibly from the greater acidity of the products of digestion (lactic acid).

2. *Hypertrophy.*—A general overgrowth of the normal tissues of the digestive organs is practically unknown. Certain parts may manifest this condition, notably the muscular tissue of parts of the canal above an obstruction. The liver is described as being occasionally hypertrophied in certain cases of diabetes.

3. *Atrophy.*—The alimentary organs may share in the general atrophy and wasting of old age or inanition. This condition is apt to follow the disease of certain parts, as is seen in the thinning and shrinking of the stomach and intestines beyond an obstruction or an artificial anus. Pressure on the organs, as by tight-lacing, &c., may lead to the same result.

4. *Degenerations.*—Those morbid processes to which the term degeneration is applied, and

which essentially consist in the conversion of the tissues into materials of a less complex chemical composition than normal, associated with a diminished vital activity, may affect any or all of the structural elements of which the digestive organs are composed. Albuminoid infiltration or cloudy swelling is the invariable accompaniment of inflammation of the epithelial and muscular tissues. Fatty degeneration is a further result of inflammation, with caseation and occasional calcification. Although not the commonest organs to be so affected, yet not infrequently the intestine and stomach are the seat of the so-called amyloid or lardaceous degeneration, and not always limited to the vessels, but affecting the epithelial, fibrous, and muscular coats. The liver is especially liable to undergo degeneration, both fatty and albuminoid. Deposition of pigment may be found in the deeper epithelial strata of the mouth in Addison's disease, and in the liver in certain cases of intermittent fevers.

5. Changes in the secretions of the various glands may result in the production of *calculi*—salivary, pancreatic, or biliary.

6. *New Growths.*—There is scarcely any known form of neoplasm which may not be found in some region or another of the alimentary tract.

The new growths limited to the epithelial coat, or commencing in it, are condylomata, papillomata, encephaloid, and scirrhus.

In the fibrous tissue occur sarcoma, fibroma, myeloid, adenoid, gumma, enchondroma, and lipoma.

In addition there may be polypi, or tumours of the mucous membrane; myxoma; muscular tissue tumour; cysts; and vascular growths, such as nævi and hæmorrhoids.

7. *Traumatic.*—Certain parts of the alimentary tract are, from their position, more liable than others to external injury. Incised and punctured wounds of the mouth, œsophagus, stomach, intestines, and liver are of occasional occurrence, and rupture of the abdominal tissue is sometimes met with. The injection of corrosive substances may produce destruction of certain parts of the canal, and wounds may be determined by foreign bodies, as pins, fish-bones, &c., which have been swallowed.

III. Malformations and Malpositions.

1. *Hereditary.*—Of these the most important are hare-lip; cleft palate; fistulous communication between the pharynx and the exterior, or between the gullet and trachea; intestinal cæca; imperforate anus; herniæ.

2. *Acquired.*—Malformation and malposition of the viscera may follow from disease. Communications between the stomach and intestines, or between different coils of intestine, or between the gall-bladder and the gut, may result from chronic ulceration. Many herniæ are not developed until long after birth, from violent strains, &c.

Stricture of various parts of the canal is frequently associated with the healing of ulcers, and with new growths. Dilatation of the canal is apt to occur in the proximal, and contraction on the distal side of such strictures. The intestines may be considerably displaced from adhesions following peritonitis. Twists (volvulus), intussusception, internal strangulations, and prolapsus ani, are more or less common affections of the intestines.

IV. Abnormal Contents. — Concretions, chiefly of phosphate of lime, are found occasionally in the intestine. They usually are made up of consecutive layers of material deposited by the mucous membrane. They frequently have as a nucleus some foreign body. Similar bodies formed of chalk or magnesia which has been swallowed have been met with. Foreign bodies, such as pins, bones, fruit-stones, coins, &c., may also lodge in the alimentary canal.

Parasites.—The chief of these are Sarcina ventriculi, in the stomach; Tænia solium; T. mediocanellata; Bothriocephalus latus; all inhabiting the small intestines. Tænia Echinococcus (hydatid) in the liver. Ascaris lumbricoides, chiefly met with in the small intestines; and Oxyuris lumbricoides (threadworm) almost confined to the rectum. A few other species are rarely found.

The gases of the intestines may be so largely increased in quantity as to constitute an abnormal condition.

W. H. Allchin.

DILATATION (*dilato*, I enlarge).

Ætiology.—Dilatation of any of the cavities, tubes, or orifices of the body may either result from increased pressure from within, or from diminution in the resisting power of the walls of the tubes or cavities. These two causes are frequently combined, and, indeed, the latter is often the result of a long continuance of the former. Increased pressure from within may be due either to increased secretion of the normal contents of the cavity, or to some other effusion into it. This is the usual cause of dilatation of the closed cavities of the body; we have examples in the ventricles of the brain, the pericardium, the synovial cavities, the bursæ, the follicles of the thyroid body in cystic goitre, and the Graafian vesicles in some forms of ovarian dropsy. In the various tubes of the body, increased pressure from within may arise from obstruction, and the consequent accumulation behind the seat of obstruction of the substances which it is the function of the tubes to transmit.

Varieties and Characters.—1. *Cystic dilatation.*—In tubes which begin by blind extremities the result of dilatation is generally the formation of a cyst, and this is the usual mode of origin of the large class of *retention-cysts*, or *cystic dilatation.* We have examples in the sebaceous cysts, in the cysts of mucous membranes due to the ducts of the mucous glands becoming obstructed by the products of catarrhal inflammation, in cysts of the kidney formed by dilatations of the Malpighian capsules and uriniferous tubules, and in dilatations of the gall-bladder, and of the pelvis of the kidney.

2. *Uniform or cylindrical dilatation.*—In tubes not beginning by blind extremities, the effect of the obstruction is usually to produce a *uniform* or *cylindrical*, and not a cystic dilatation; though sometimes one part of the wall will yield, and so cause a diverticulum or sacculus. These uniform and cylindrical dilatations may occur in all the tubes of the body. They are met with in the

œsophagus and all parts of the digestive canal, in the heart, veins, bladder, ureters, bile-ducts, &c. This form of dilatation may be attended either with thickening and hypertrophy, or with thinning and atrophy of the walls. Usually, when the tubes are in the main muscular, hypertrophy occurs, from increased exercise of the muscular fibres in their efforts to overcome the obstruction; but when the walls are mainly fibrous or elastic, they generally become atrophied and thinned.

3. *Compensatory or collateral dilatation.*—Another form of dilatation from increased internal pressure may be termed *compensatory* or *collateral* dilatation; it is produced by the tubes having to transmit an increased quantity of fluid in consequence of the obstruction of other channels. Besides the blood-vessels, we may meet with examples of compensatory dilatation in one ureter when the other is blocked, and in the bronchial tubes and other parts. Resembling this form in its mode of origin is the dilatation caused by tubes having to transmit substances of too large a calibre, as, for example, in the passage of calculi down the gall-duct and ureters.

4. *Dilatation from changes in the walls.*—The last class of dilatations consists of those due to diminished power of resistance in the walls of the tubes or cavities. The most important examples of this class occur in the circulatory and respiratory systems; in the heart from fatty degeneration; in the arteries from atheromatous changes. In the respiratory organs it occurs both in the bronchial tubes and in the air-cells. Here, however, the loss of resisting power is itself usually caused by prolonged increased pressure from within; which in the air-cells, as their walls are elastic and not muscular, rapidly causes atrophy, and subsequent dilatation.

W. Cayley.

DILUENTS (*diluo*, I wash or dilute).

Definition.—Remedies which increase the proportion of fluid in the blood.

Enumeration.—Water is the only real diluent. It is given for this purpose in various forms—soups, ptisans, barley water, toast and water, milk, lemonade, aërated waters, &c.—to quench thirst, and increase secretion.

Uses.—Diluents are employed to lessen thirst, as in fever and diabetes. As the thirst may depend upon local dryness of the throat, as well as upon general want of fluid in the system, the power of water to quench thirst may be greatly increased by adding to it a little vegetable or mineral acid, or some aromatic, such as lemon or orange peel, which will stimulate the flow of saliva, and thus tend to keep the mouth moist after the liquid itself has been swallowed. The thirst-quenching power of water is also aided by the addition of mucilaginous substances, such as oatmeal, or linseed as linseed-tea, which, leaving a mucilaginous coat on the inside of the mouth and pharynx, retard evaporation, and thus lessen the dryness of the mucous membrane.

T. Lauder Brunton.

DIPHTHERIA (διφθέρα, a skin).—Synon.: Fr. *diphthérie, diphthérite*; Ger. *Diphtheritis.*

Definition.—A specific, contagious, asthenic, general disease, which sometimes prevails as an epidemic, and is endemic in certain places. It is characterised by the exudation in various situations—particularly on the mucous surface of the soft palate, uvula, tonsils, pharynx, larynx, and trachea—of a peculiar cacoplastic lymph, which, together with epithelial cells, generally forms a thick, tough, and stratified pellicle or false-membrane—a stroma made up of mucous and epithelial cells, arranged in layers of the cacoplastic exudation.

Name and Synonyms.—In 1826, Bretonneau of Tours, in his work, entitled *Recherches, &c. sur la Diphthérite*, created the name, and first pointed out the true pathology of the disease. In his latest memoir (1855) he substituted the term *diphthérie* for diphthérite, having discovered that the disease is not of an inflammatory character. *Diphtheria* was a word almost unknown in English medical literature till 1859, when the Sydenham Society published a volume of memoirs on the disease, translated by Dr. Semple from the French of Bretonneau and others. The name, slightly modified, has now been appropriated by all European languages; and at present there is no other word which can correctly be said to be synonymous with it, although it is equally true that the disease diphtheria has been described under many names, without, however, an exact appreciation of its distinctive character, by Hippocrates, Celsus, Sydenham, and others, from the dawn of medical history to the present day. 'Croup,' in cases named and described by Home, Cheyne, West, and others, is identical with Bretonneau's 'croup,' which he also calls tracheal and laryngeal diphtheria; but, nevertheless, croup and tracheal diphtheria being described by the majority of British authors as different diseases are not in a literary sense synonymous terms.

Geographical Distribution.—Epidemics of diphtheria have occurred in many countries far apart from one another, and differing essentially in physical features and climate. In recent years the geographical distribution of the disease seems to have become greatly extended, a circumstance which is probably attributable to the increasing intercommunication of peoples. Diphtheria has its favourite localities—localities in which it is always endemic, and frequently epidemic. Among such places may be particularly mentioned Florence and Paris.

Ætiology.—The disease is contagious. Apart from endemic and epidemic causes affecting its maintenance in foci, and its outbursts at particular times and in particular places, there are ætiological influences belonging to individuals in respect to:—

1. Accidental Predisposing Causes;
2. Age; and
3. Heredity.

1. *Accidental Predisposing Causes.*—Poverty and its concomitants—unventilated filthy lodgings, scanty clothing, and imperfect alimentation—impart to individuals a receptivity for the contagium of diphtheria. A similar receptivity exists in tuberculous persons and in all cachectic subjects. Scarlatina, measles, and whooping-cough peculiarly predispose to diphtheria. In twenty years, Barthez observed 605 cases of scarlatina: in 95 of them, that is, once in about

every six cases, diphtheria occurred as a secondary disease. Diphtheria of the air-passages may occur also as a secondary disease after a common inflammatory sore-throat, a circumstance which has led some to hold that diphtheria is an inflammatory disease. Recently-delivered women receive easily the diphtheritic poison. During epidemics the influence of the predisposing causes now enumerated is sometimes strikingly exemplified.

2. *Age.*—Diphtheria is most common between the ages of two and ten. Few persons are attacked after thirty; but there are occasional victims at all ages, from the earliest infancy to old age.

3. *Heredity.*—Diphtheria is not an hereditary disease; but a special aptitude to receive and develop the poison evidently pertains to certain individuals and families. This statement is borne out by the statistical enquiries of Morelli, Nesti, and others in relation to the recent epidemics of Florence; but the facts which establish it beyond a possibility of doubt are the numerous cases of particular families being desolated by diphtheria at intervals of years, and when the members attacked were widely separated. For example, a child died this year of diphtheria in Paris: a sister died of the same disease two years ago in Florence: about the same date, an elder brother similarly perished at the Cape of Good Hope: and the mother of these children was in childhood nearly carried off by the same disease. Family histories of this kind are so numerous, as to lead to the conclusion that there is often a certain stamp of similarity of constitution pervading a family, in virtue of which its members are specially disposed to receive and develop the diphtheritic contagium.

NATURAL COURSE.—Diphtheria has a tendency to run a definite course, as may be well seen in cases which are benignant or of moderate severity. In the cases termed *benignant* by authors—cases more numerous in some epidemics than in others, and commonly met with at the beginning and decline of most epidemics—the disease runs its entire course in from eight to ten days. In this class of cases complete and rapid recovery often takes place, not only without medical treatment, but also in spite of the most objectionable measures having been adopted. In many benignant cases the exudation is limited to the tonsils and pharynx, but sometimes it invades the larynx and trachea: nevertheless, under both circumstances, the false-membrane begins to loosen spontaneously, and to be got rid of between the fifth and seventh day. In cases of very malignant type—both in those which set in suddenly with intense symptoms, and in those which begin insidiously—the disease may run its course from health to death in less than one day, or, according to the greater or less severity of the poisoning, the fatal issue, or the dawn of recovery, may not occur for several days.

Incubation.—There is a great diversity of opinion as to the maximum period of incubation; but the general opinion is that it does not exceed a few days. There are facts and reasonings, however, which suggest the possibility of the diphtheritic poison remaining dormant in the system for weeks or months, till called into activity by favouring circumstances.

Invasion.—The invasion of the disease is generally occult and insidious. Slight fever, drowsiness, general discomfort, a little languor, loss of appetite, prostration, diarrhœa, rigors, pallor, tickling cough, husky voice, and hoarseness, often usher in diphtheria; but as these symptoms, separately or in conjunction, may occur in children from a multiplicity of causes, they assist in forming a diagnosis only when carefully studied in conjunction with one another, and with surrounding circumstances. It is, therefore, very difficult in most cases to fix the exact date of the commencement of the disease. Three or four days may be passed without the manifestation of characteristic signs, the patient during that time presenting no marked indications of seriously deranged health. The invasion-symptoms are sometimes so slight as entirely to escape notice. The disease may suddenly explode, without the smallest warning, by an attack of stridulous breathing; on looking into the throat we may then find false-membrane covering the tonsils and pharynx, and extending into the air-passages, so as dangerously to obstruct the passage of air into the lungs, and excite spasmodic exacerbations of dyspnœa. Sometimes, on the first, second, or third day of the disease, the patient is carried off before any exudation has taken place, the patient dying in a state of profound prostration from primary toxæmia. The diphtheritic poison sometimes kills without producing the diphtheritic pellicle.

SYMPTOMS.—The symptoms of diphtheria are *general* and *local*.

The *general* symptoms of pharyngeal, laryngeal, and tracheal diphtheria are those of the general specific disease of which they are local manifestations. Wherever the false membrane is situated—whether on the tonsils, pharynx, larynx, trachea, bronchial tubes, nares, eyelids, vulva, vagina, uterus, anus, or on a wound, ulcer, or cutaneous abrasion—its nature is the same. The general symptom never absent is *prostration of strength*: the local symptom absent only in a very few exceptional cases is the *formation of false-membrane.* The other symptoms of most importance, but which are more or less frequently absent, are albuminuria, change of temperature, cutaneous eruptions, enlarged glands, and paralytic affections.

1. *Prostration of Strength.*—This is a constant symptom, but its degree is very variable. Some patients succumb to the primary shock of the poison. In rapidly fatal cases, however, there are degrees of rapidity—there is a gradation of cases from those in which death takes place in less than a day without any characteristic sign except prostration, to others in which time is afforded for the formation of false membrane, and the development of some or all of the symptoms mentioned above.

2. *Formation of False-Membrane.*—There is always an exudation of false-membrane unless the patient be cut off before there has been time for its formation. The nature of the false-membrane has been already briefly described in the definition of diphtheria. Its existence is

sometimes not discovered during life; as, for example, in those rare cases in which the exudation commences on the lining of the bronchial tubes, and occasions death by asphyxia before it has extended upwards to visible parts. As a general rule—with, however, about two per cent. of exceptions—the exudation begins on the tonsils or pharynx, and next, but not always in continuity, on the larynx. From one to five, six, or even seven days may elapse between the first appearance of false-membrane and its exudation on the mucous membrane of the larynx.

3. *Albuminuria.*—Albuminuria is very commonly met with. The third and fourth days of the disease are the most usual for the first appearance of this symptom; but it may occur on any day from the second to the twelfth without the occurrence being considered unusual. It is sometimes permanent for days, and sometimes continues for weeks after convalescence has begun. Its duration is from one to sixty days. It is often intermittent, and still more frequently—without quite ceasing—its intensity varies at different periods of the twenty-four hours. It does not necessarily indicate a morbid state of the kidney, and—unlike the albuminuria of scarlatina—it is not associated with dropsy. It originates in different causes, which sometimes operate separately or in combination. Probably the chief causes are the rapid waste of tissue and the altered state of the blood, which are very early effects of the poison of diphtheria; there consequently arises a sudden necessity for an enormous discharge of effete matter by the kidneys. Another cause, one likewise almost always in existence, is the ingestion of aliment much in excess of assimilative power; the intermittent character of this cause is probably the explanation of the frequently intermittent character of the albuminuria. A pulmonary cause of albuminuria frequently comes into operation, as in pneumonia, and during the death-agony from all diseases. Obstruction of the air-passages by false-membrane induces albuminuria by producing great congestion of the lungs with more or less asphyxia. Finally, a renal cause may occasionally exist in pre-existing disease of the kidneys; or, secondarily, in their simple congestion from the strain of the extra-work, and their functional feebleness through general deficiency of innervation. The proportion of cases in which albuminuria occurs for one or more days is about one in three cases; but the proportion is different in different epidemics. Albuminuria is not a sign of danger; its prognostic significance belongs not to itself, but to its cause or causes.

4. *Changes of Temperature.*—High temperatures prognosticate danger; but moderate or even normal temperatures are often met with in rapidly fatal cases.

5. *Cutaneous Eruptions.*—Eruptions, varying much in appearance, are sometimes seen in the course of diphtheria. They seldom continue more than three days, and are sometimes visible for only a few hours. If the eruptions themselves were the only guides to diagnosis, the malady might be often mistaken for scarlatina. The eruptions of diphtheria which simulate those of scarlatina are sometimes vesicular, sometimes like urticaria, and sometimes they occur in bright red patches—rubeolar, roseolar, or erythematous. They are not followed by desquamation, as in scarlatina. The appearance or non-appearance of these eruptions does not influence the prognosis. Ecchymoses due to blood-poisoning may also occur, and are of course of very serious import.

6. *Enlarged Glands.*—Glandular engorgement is often one of the earliest indications of diphtheritic poisoning. It is not a secondary result of the throat-manifestation, but belongs to the general disease itself. In the recent epidemics of Florence, described by Morelli and Nesti, turgescence of the cervical glands is mentioned as a symptom commonly associated with general anasarca, and an eruption of red, pink, and dark red points on the face, neck, chest, and abdomen. This eruption was sometimes visible for only a few hours, and never for more than three days.

7. *Paralytic Affections.*—This important subject is only named in this its natural place, its consideration being more conveniently reserved for a separate article. *See* Paralysis, Diphtheritic.

Diagnosis.—When diphtheria has proved fatal too soon to afford sufficient time for the manifestation of its characteristic symptoms; and also, when the invasion-stage is insidious, the diagnostic difficulties are great. Sanné believes that the affection designated 'throat-herpes' (*herpes guttural*) by Gubler is a form of diphtheria, an opinion which, if erroneous, is not easily controverted. The difficulty of the differential diagnosis fully explains an opinion, repeated by several authors, to the effect that the diphtheritic nature of an affection cannot be declared with certainty till the membranous deposit has been seen to extend from the tonsils and pharynx to the respiratory passages. Some physicians, among whom is Trousseau, think that the herpetic nature of the affection is established when an eruption of herpes appears on the lips. Sanné says: 'Diphtheria commences with local phenomena which are very varied: the form and disposition of the false-membrane are insufficient to enable us to predict the nature of the malady, or to form a prognosis regarding it.' He adds, and with truth, if the statement be accepted only as a provisional clinical fact: 'This is one of the most important aphorisms in the doctrine of diphtheria.' Pathologically, however, there can be no diagnostic difficulty in these cases, if it be true, as an increasing number of physicians believe, that membranous sore-throat is always diphtheritic.

Prognosis.—The younger the subject, the less are the chances of recovery. This arises from two causes, viz., the smaller power in infancy to resist depressing influences; and the narrowness of the larynx in infancy and childhood. The elements of prognosis belong in part to the individual case; and are in part common to all the cases occurring at the same time and place.

First, in respect to the individual element The prognosis is unfavourable if false-membrane has been deposited, and continues to be formed on the mucous membrane of the air-passages during the first three or four days of the disease: on the other hand, the prognosis is favourable if these days be passed without formation of false-membrane on the air-passages; but only *provisionally* favourable, for a sudden membranous invasion of the air-passages may occur during that period. If at the seventh day the air-passages be not invaded, if there be adequate cardiac power, and if a fair amount of aliment be regularly assimilated, the prognosis is very favourable. We must, however, take into account peculiarities of constitution, the presence or absence of disease prior to the attack of diphtheria, and also the exact significance of each symptom in respect to its individual gravity, its grouping with other symptoms, and the period of the malady at which the prognosis is made.

Secondly, in respect to surrounding circumstances. In cold damp weather the mortality is greatest. The medical constitution of the season, and the character of an epidemic greatly influence prognosis. In some epidemics, in which the local manifestation of the disease is limited to the pharynx, recovery takes place in nearly every case. In an epidemic which prevailed in France in 1847, the mortality was 91 per cent. In the first quarter of 1876 the mortality from diphtheria in the hospitals of Paris was 79·75 per cent., whereas in the six preceding years it averaged only 76·54 per cent.

Anatomical Characters.—The lesions found after death from diphtheria are *primary* and *secondary*. The *primary* are those found in persons dying during the natural course of the disease; the *secondary* are not direct results of diphtheria, but are consequent upon the complications and retardations of abortive convalescence.

1. *Primary lesions.*—In persons who die during the first two or three days of the disease, in whom there are no complications, and in whom there has not been time for the formation of false-membrane, the only morbid appearance found on dissection is sanguineous congestion of the mucous membranes, lymphatic glands, and internal organs. In those who live a few days longer, say till the seventh or eighth day of the disease, a similar state of congestion is met with; and there are found on mucous surfaces, particularly on those of the pharynx, larynx, and trachea, layers of the characteristic pellicle. The only primary morbid appearances of diphtheria, visible to the unaided eye, are congestion of organs, and false-membrane on certain mucous surfaces. To these has of course to be added a dyscrasia of the blood, which probably exists from the very beginning of the attack.

2. *Secondary lesions*, which are numerous, vary according to the nature and duration of each case. It is particularly noteworthy that in the secondary, anæmia replaces the hyperæmia of the primary morbid conditions.

To the general statements now made in reference to the morbid anatomy of diphtheria, there are numerous exceptions; and as one of the more important of them may be specified pseudo-membranous deposits in the bronchial tubes, and hepatisation of the lungs occurring as early as the second or third day.

A brief sketch of some of the secondary lesions of diphtheria is subjoined:—*Lymphatic glands.*—The submaxillary and parotid are the most usually and the most acutely affected: next in order of frequency come the superficial cervical glands, the deep cervical glands, and the mesenteric glands. Glands sometimes suppurate: when this takes place the pus is generally found in small circumscribed depôts. They are sometimes infiltrated with a brownish sero-sanguinolent fluid: sections of glands so affected resemble sections of the healthy spleen. *The inner ear.*—This is sometimes invaded by false-membrane, extending from the skin of the outer ear, or advancing by the Eustachian tube from the pharynx. *Connective tissue.*—Sanguinolent and sanguineous effusions are sometimes found in the connective tissue, particularly in that subjacent to mucous membrane coated with the diphtheritic pellicle. In it abscesses are also met with, in the contiguity of engorged and suppurating glands. *Muscular tissue.*—In protracted cases of paralysis, the muscles of the arms, legs, chest, and eye-ball are often found to be more or less in a state of fatty or waxy degeneration. The muscular tissue of the heart is likewise sometimes similarly affected. *Lungs.*—Besides the primary specific lesions we may find on dissection anatomical evidence of simple bronchitis, pneumonia, and pulmonary apoplexy having occurred as secondary affections. *Trachea.*—Cases have been recorded in which the trachea has been found ruptured, the result of a desperate struggle for breath. In tracheotomy-cases, the pressure of a badly adjusted canula has frequently caused ulceration of the trachea. The cicatrisation of the ulcer sometimes produces stricture of the passage. *Mediastinum.*—Abscesses of the mediastinum occasionally follow tracheotomy. *Kidneys.*—A form of superficial parenchymatous nephritis, resembling the characteristic lesion of scarlatinal albuminuria, is said to be a common pathological condition in diphtheria. Perhaps under the term *parenchymatous nephritis* many cases of simple hyperæmia are included. The condition of the kidneys in diphtheria requires, however, further investigation. The granular and other degenerations of the kidney described as having been met with, have probably no peculiar or direct relation to the diphtheria. They may either represent disease which existed prior to the diphtheritic attack, or disease resulting from the general damage to the system induced by that attack, just as it might have been produced by an attack of some other debilitating, blood-disintegrating malady. Be that as it may, it is important to note that in patients who die in the first days of an attack of diphtheria after having had intense albuminuria, the only discoverable morbid condition of the kidney is moderate or considerable congestion. Sanné explains the rarity of the occurrence of œdema and cerebral symptoms in connection with diphtheritic albuminuria by the fact that one kidney only is affected and not both, as in scarlatinous nephritis. *Nervous system.*—Even when death has been preceded by protracted paralytic affections, the most minute microscopic examination has generally failed to detect any morbid change in the encephalon or spinal cord. On the other hand, in protracted cases of diphtheritic paralysis, various alterations in the nervous periphery are frequently found.

PATHOLOGY.—Diphtheria is a poison-disease acting primarily upon the whole system; the exudation of cacoplastic lymph is a manifestation of the general poisoning, and not, as Trousseau taught, an infection of the patient by the absorption of the poisonous material of the false-membrane. Gangrenous decomposition of the false-membrane sometimes, however, becomes a source of secondary toxæmia. The poisoning is then not diphtheritic; it is simply the result of the absorption of putrid matter.

TREATMENT.—Few diseases more severely tax the ingenuity and therapeutic resources of the physician than diphtheria. He has to devise and carry out innumerable little details—hygienic, dietetic, and medicinal—which do not admit of minute description, and yet upon the minutiæ of which success or failure frequently depends. The treatment must be carried out on a rational basis, no special trust being placed in nostrums, or in any of the so-called specifics announced in earlier and later times, and some of which are still recommended by honest enthusiasts of limited experience. It is requisite to pay the utmost attention to the hygienic surroundings of the patient. From the first it is necessary that decided and well-considered measures be carried out to support life, by the administration of alcoholic stimulants and of easily assimilated aliments. Medicines which have a depressing influence on the nervous system, or which tend to produce dyscrasia of the blood, are to be rigidly avoided. Prostration of strength and dissolution of the blood are conditions which exist to a greater or less degree in every case of diphtheria; and for that reason, the abstraction of blood, purging, and the use of alkalies, mercurials, and antimonials are inadmissible.

From first to last sustaining and recuperative treatment—alimentary and medicinal—is the great aim. If life be maintained for a certain number of days, nature, even in very severe cases, makes a decided curative effort: in other words, when the disease has run its natural course, there is a greater or less attempt at spontaneous recovery. The moment has then arrived when the physician can most usefully intervene with his culinary and pharmaceutical resources. It is his therapeutic opportunity. A somewhat varied and well-planned pepsinated aliment and ferruginous medication, which had up to that stage produced little benefit, will then wonderfully assist nature in accomplishing a cure.

The principal details of treatment may be considered under the following heads:—1. Hygiene. 2. Diet. 3. Stimulants. 4. Medicines administered internally. 5. Applications to the throat and air-passages. 6. Tracheotomy.

1. *Hygiene.*—The covering of the patient must be light; and yet such as to prevent loss of animal heat. The placing of one or more caoutchouc bags filled with hot water under the bedclothes, close to the patient, is a simple and an admirable method of keeping the body warm, and of enabling the windows to be opened from time to time, without risk, to relieve the distressing air-hunger, when there is obstruction of the air-passages, intensified by the close atmosphere of a badly-ventilated room. The temperature of the room ought to vary little, a temperature of about 60° F. being maintained. The patient ought to be carefully screened from currents of air, care being taken that free ventilation is not interfered with. A thermometer and a steaming kettle are indispensable in the room of the diphtheritic patient. After tracheotomy, the maintenance of good ventilation, combined with an equal temperature and a warm moist atmosphere, is a paramount necessity; and, in all cases, and in every stage of cases in which there exists diphtheritic sore-throat, it is important, as a means of moderating the paroxysms of glotto-pharyngeal spasm, that the air inhaled be soft and warm, and that the temperature be equable. Even in the rare cases in which throat-affection is absent, it is the duty of the physician to take the measures best calculated to secure such an atmosphere as has now been described, for the disease may at any moment manifest itself in the air-passages.

2. *Diet.*—Nutriment is urgently demanded; but it is useless—nay, it is mischievous—to push attempts at alimentation beyond very moderate limits, so long as the malady is in the ascendant. Assimilation is then very nearly at a standstill, as is shown by the rapid emaciation which goes on, even when large quantities of food are being put within the patient, and likewise also by the albumin which is passed with his urine. The albuminous urine of diphtheria arises from different causes; but, speaking in general terms, it is correct to say that it arises from no renal lesions, and is the expression of rapid waste of tissues and of the non-assimilation of food. Alimentation is the most important, and also the most difficult part of the treatment. Patients—even intelligent adults—often resolutely refuse food, and feel intense loathing, excited by the mere sight or mention of any alimentary substance, and the food taken is generally rejected at once by vomiting; or if retained it is very sparingly assimilated. To press food upon children in spite of their loathing of it is generally injudicious: to press it upon them in spite of their struggles is sometimes even dangerous, as the excitement and resistance takes more strength out of the already prostrate patient than can be compensated for by forcibly administered aliment. We ought to try quietly to get the child to take frequently small quantities of milk or beef-tea; and when we fail, we must give enemata of beef-tea and brandy.

The food given to diphtheritic patients ought to contain pepsine. The quantity administered must of course be proportionate to that of the food. In respect to the dose of pepsine, it is necessary to remember that genuine British *pepsina porci* is four or five times as potent a digestive as Boudault's pepsine, the mixture generally prescribed in France. Pepsinated pills of pounded raw beef, with a few teaspoonfuls of the expressed juice of raw or slightly roasted beef, are exceedingly useful in keeping patients alive while the disease is expending its immediately destructive powers. When the irritability of the stomach does not forbid the trial, strong egg-flips may be given. A strong egg-flip may be made by beating up together one teaspoonful of concentrated Swiss milk, one teaspoonful of brandy, and two or three teaspoonfuls of water. To these ingredients, two grains of *pepsina porci* may be added. Patients who have moderately severe attacks of the disease, and convalescents, can generally take such semi-liquid aliments as panada and chicken *purée* [*purée à la reine*]. Occasionally, but not generally, patients can take cod-liver oil. Milk ought to enter largely into the diet of diphtheritic convalescents. In them, as in all convalescents, it is an admirable mainstay; but there are some few cases in which it does not agree.

3. *Stimulants.*—Diphtheritic patients emaciate rapidly; and together with, as well as before the loss of flesh, extreme prostration occurs. Under such circumstances, the liberal exhibition of alcoholic stimulants is imperatively demanded as the principal, and when food is rejected, as the only means of supporting life during the most critical period of the disease. This great crisis is not generally prolonged for more than a few days, but stimulants may require to be more or less relied on for a long time. Sometimes for hours or days it may be impossible to give anything more than stimulants, of which the best are alcohol in some form, tea, coffee, and the juice of meat. When all kinds of food and stimulants excite nausea and vomiting, it is necessary to discontinue for a time nourishing the patient by the mouth. For some hours—for from six to twelve hours—he must be fed entirely by the rectum, so that the stomach may have an interval of complete rest. In such cases it is a good practice to precede renewed attempts at feeding by the mouth, by one or two doses of creasote and oxalate of cerium. Both can be given in very small bulk, which is a great advantage; and no other gastro-sedatives act less as depressants of the general system. The ordinary so-called creasote of commerce is bad carbolic acid, which, in place of allaying, frequently excites nausea and vomiting. If pure creasote cannot be obtained, pure carbolic acid may be substituted for it. The creasote may be given made into pill with breadcrumb; and the oxalate of cerium either in the form of pill, or wrapped in moistened wafer-paper as a pulpy bolus. The proper quantity of creasote to give at one time is from half a drop to two drops, and of oxalate of cerium from two to four grains. In the twenty-four hours we may administer as a maximum, according to the age of the patient and the circumstances of the case, from six to eight drops of the former, and from twelve to sixteen grains of the latter. Of the crystals, liquefied by heat, one drop is given in a tablespoonful of thin mucilage. This may be repeated several times in the twenty-four hours. When the remedies now mentioned have failed, the nitrate of bismuth in two or three successive doses of ten grains each may succeed. There are cases in which the nausea is so urgent a symptom that it is impossible, by any medicines, to overcome it. We must then trust entirely to the application of warm poultices, sinapisms, or turpentine-stupes to the pit of the stomach. The hypodermic injection of morphia, or the administration of an enema containing hydrochlorate of morphia, is another method of allaying nausea and vomiting, in the gastric irritability of fever and other diseases, but which is only applicable in a limited number of cases of diphtheria, in those cases in which the asphyxia is far advanced and is advancing. The quantity of hydrochlorate to be administered in clyster depends much on the age of the patient. Sixty drops of the Liquor hydrochloratis morphiæ of the British Pharmacopœia may be given by the rectum to an adult, while from five to ten drops is a sufficient dose in clyster for a child under ten years of age. Besides allaying nausea and vomiting, such a clyster soothes, diminishes the severity of spasmodic dyspnœal paroxysms, and gives the sufferer rest.

4. *Medicines administered internally* are usually employed either to accomplish some particular object; or to exercise a curative influence on the general disease.

There is another special object for which internal medicines are given, namely, the detachment and expulsion of false membranes from the air-passages. For this purpose the administration of emetics has been considered by many as one of the essential parts of the treatment of laryngeal, tracheal, and bronchial diphtheria. Their use is unquestionably indicated in certain cases, yet the range of their utility is very limited. There are two circumstances which obviously limit the advantages obtainable by emetics; first, if administered at an advanced stage of the disease, or at any stage when there exists great prostration, the vomitive efforts excited must act most prejudicially when they do not produce the desired result of expelling the false-membrane from the air-passages—they must draw dangerously upon the waning strength of the patient, and diminish his chances of pulling through with the aid of tracheotomy. Herein lies a great limitation of the use of emetics, because the cases are exceptional in which the blockade of the air-passages is effectually relieved by vomitive action; and when no such relief is obtained, the violent efforts excited by emetics only produce unmitigated evil—a large withdrawal of remaining vital power. Again, unless the exudative stage of the disease be ended, the ejection of false-membrane affords only a brief temporary respite, for new layers are speedily deposited to replace those which have been thrown off. These considerations show the narrow limits within which benefit can be obtained from vomitive action, and how much evil may accrue to the patient when that action is violent. Should it be judged expedient to induce vomiting, the emetic selected ought to be one which generally acts quickly and certainly, and which if it fail to act will not produce dangerous irritation of the intestines or great depression of the system. Tartar-emetic must not be employed. Sulphate of copper, an emetic much recommended by Trousseau and others under the circumstances now being considered, is also objectionable, because if it does not promptly cause vomiting, it will be nearly certain to excite enteritis and formidable diarrhœa. Ipecacuan and sulphate of zinc are perhaps the safest emetics to administer to a diphtheritic patient.

The repetition of dose after dose of any emetic is dangerous practice in diphtheria. For example, we may give, without apparent effect, successive doses to a semi-asphyxiated patient whose functional life is dormant; and seeing that we give him no relief in the way hoped for, we proceed as our last chance of saving him to admit air into the lungs by tracheotomy. Forthwith the vital powers awake, and the accumulated doses speedily act with violence—the patient has been saved by tracheotomy only that he may die of pharmaceutical poisoning.

Dr. Sanné (*Traité de la Diphthérie*, Paris, 1877) suggests that the recently discovered medicine apomorphia might be tried as an emetic in diphtheria. It possesses properties which seem to recommend it very specially in this disease. This drug is administered hypodermically. It acts very rapidly—in from three to five minutes: and supersedes or greatly reduces the duration of the period of nausea. It frequently succeeds when other emetics have failed to act. The advantages which it possesses are, therefore, facility of administration, rapidity of action, and less fatigue to the patient. The only objection to its general use is the difficulty of preserving it.'

Another suggestion of Dr. Sanné is noteworthy. He proposes that trial be made of jaborandi, given internally, as a means of producing detachment of the false membrane.

The medicines which have a curative influence on the general disease are few in number. Certain medicines—preparations of iron, for example, are, under certain circumstances, particularly useful in diphtheria.

Of the medicines which have had in their day repute as specifics, or as agents of high therapeutic value, but have now nearly ceased to be so esteemed, a few may be briefly mentioned. Bromine and its compounds, sulphuret of potash, copaiba and cubebs, chlorate of potash, sulphite of soda, chloride of sodium, carbolic acid, salicylic acid, chlorodyne, calomel, quinine, perchloride of iron, and many other medicines, have all been proclaimed as specifics, or at least as wonderfully potent in the cure of diphtheria. Perchloride of iron has a decidedly beneficial action under certain circumstances; but this action it possesses in common with other preparations of iron. It neither arrests nor modifies the character of the malady in its early and most perilous stages; but its utility is unquestionable as an adjuvant, when, in the natural course of the disease, a spontaneous curative tendency has begun to manifest itself.

5. *Applications to the Throat and Air-passages.*—With a view to detach, dissolve, or destroy false-membrane, a great diversity of topical applications have been employed. Trousseau, and those who wrote under his inspiration, strongly recommended destruction of the false-membrane by various caustics and solvents. In the (1868) edition of his *Clinical Lectures* which was in the press at the time of his decease, Trousseau insists that the topical treatment is pre-eminently the best treatment of diphtheria, adding that it is as much indicated in this disease as in malignant pustule. Fortunately this doctrine is no longer in vogue, and when topical treatment is still employed in France, it is now seldom by caustics or any irritating substances. Sanné, writing in 1877, expresses the general sentiment of French physicians when he says:—'Cauterization is now generally abandoned: it has serious drawbacks: it is dangerous: it is useless.'[1] The practice of attempting to destroy the false membrane by caustics and powerful solvents is unquestionably mischievous. It irritates the parts and increases the exudative tendency. The free application of the officinal glycerine of borax, by means of a camel's-hair brush, is at least harmless, and seems to loosen the membranous patches. Frequently, washing out the mouth with this preparation, diluted with from four to eight parts of water, is agreeable to most patients, and is useful from the local soothing which it produces. A very diluted solution of hydrochloric acid is equally innocuous, and as a mouth-wash is pleasant and cleansing. Lime-water and lactic acid, used separately or mixed, exercise a powerful solvent action on the false-membrane; and were it possible to apply them to it without their coming in contact with, and thereby irritating the contiguous mucous surface, they might be used with advantage, or at least with impunity. A small quantity of lactic acid added to an aqueous solution of pure glycerine or to the glycerole of borax — one part to fifty of glycerine — is a favourite topical application with some practitioners, and is one which may be used without fear of doing any harm. Catheterism of the larynx, and injection of solvents into the trachea, are now generally looked upon as objectionable measures. They still have, however, their advocates. Dr. Young of Florence states, as the result of large experience, that he has seen much benefit result from throwing into the throat every hour, by means of a ball spray-apparatus, a solution of three drachms of lactic acid in eight ounces of lime-water.

Notwithstanding much that has been written in a contrary sense, a careful review of the subject leads to the conclusion that very little advantage is derived from internal local applications, that they are often exceedingly mischievous, and ought never to be used without the greatest circumspection. They do not curtail or greatly modify the natural course of the general disease; and the local benefits which they can confer are limited to soothing the parts, and slightly diminishing the obstruction of the air-passages. Moist warmth applied externally to the throat gives much comfort and is in no way injurious. Only soothing, or at least non-irritating substances are admissible as internal applications. It must be remembered that topical applications can hardly ever be employed in young children without exciting resistant struggles, which agitate and exhaust the patient. The risk of incurring this danger often forbids their employment.

6. *Tracheotomy.*—Besides the perils of the general disease—prostrating toxæmia, difficult nutrition, and paralysis of the heart and respiratory muscles—the patient has the special risk of dying asphyxiated from obstruction of the air-passages by false-membrane. This terrible danger is one of very common occurrence. When nature and art have failed to remove or effectually lessen the mechanical impediment to the admission of air to the lungs, the physician has to decide whether there be any reason against his giving the patient

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[1] Sanné: *Traité de la Diphthérie*, Paris, 1877; p. 419.

a chance of life by making an entrance for the air below the membranous obstruction. If this one remaining chance remain in any degree, however small, he is bound to offer it to his patient. Sometimes no such chance remains. What conditions exclude the possibility of saving life by tracheotomy? That is the question. It is not whether the case be a favourable one for operation; for every diphtheritic patient is an exceedingly bad subject for any surgical operation. The simple question is:—Does tracheotomy give the smallest chance of life to a patient who without tracheotomy must inevitably die from asphyxia? The answer to this question may, as a rule, be given in the affirmative, if the obstruction be not below the situation in which tracheotomy is performed. If this rule be followed, the operation will often be performed in very desperate circumstances—circumstances in which the probabilities of success are very small compared with those of non-success. When the pseudo-membranous affection extends to the bronchial tubes—when pneumonia exists—when the diphtheria is an immediate sequel of measles, scarlatina, or typhoid fever—when the asthenia is extreme—or when the patient is phthisical—the probability of the operation saving him is small; and yet, in most unfavourable examples of the classes now mentioned, success has been obtained.

JOHN ROSE CORMACK.

DIPHTHERITIC.—Relating to diphtheria. The term is applied to the membrane formed in diphtheria; and it is also associated with certain symptoms occurring in the course of the disease, such as diphtheritic paralysis. *See* CROUPOUS.

DIPLOE, Diseases of. *See* SKULL, Diseases of.

DIPLOPIA (*διπλόος*, double, and *ὄπτομαι*, I see).—Double vision. *See* VISION, Disorders of.

DIPSOMANIA (*δίψα*, thirst; and *μανία*, madness). — SYNON.: *Oinomania*; Fr. *Manie ébrieuse*, or *crapuleuse*; Ger. *Trunksucht*.

DEFINITION.—An irritability of the nervous system, characterised by a craving, generally periodic, for alcoholic and other stimulants.

ÆTIOLOGY.—This peculiar condition may be brought on by a course of intemperate drinking; but it is seldom the result of that cause alone, and it is not infrequent in persons who have never been intemperate previous to the development of the morbid craving. The occurrence of this form of insanity, as of other degenerative nervous diseases, may generally be traced in the family history of the patients. But sunstroke, a blow on the head, or other direct injury to the brain may excite it; and it may be symptomatic of epilepsy, or of structural disease of the brain. It may be developed at any period of adult life; but most frequently declares itself during the pubescent and climacteric periods.

SYMPTOMS.—An instability of character and indications of peculiar nervous irritability may generally be recognised as having preceded the distinct development of the craving. It is also usual to find such persons as are predisposed to the disorder abnormally sensitive to the influence of stimulants. Sometimes very small quantities of alcohol produce appreciable intoxication. The duration of the periods of craving is variable; but most commonly they last one or two weeks. The remissions continue for periods varying from two to twelve months. During the period of craving the whole moral being is enthralled by the morbid desire; and the regard for truth, decency, or duty is generally altogether lost. Moderate indulgence in a stimulant may bring on the morbid craving; but the desire is frequently developed without any such introduction. Members of the household in which a patient lives can indeed often recognise the indications of a coming attack by a restlessness and depression which precedes any such indulgence. During the intervals the patient seems, except when the brain has been weakened by frequent attacks, to recover completely; and he generally displays great confidence in his ability to resist the tendency in future. Repeated attacks always produce a permanent degradation, both intellectual and moral; and if the patient live long enough he lapses into a state of dementia. It sometimes happens that some cerebral lesion, of which the dipsomania had been symptomatic, manifests itself in paralytic or convulsive symptoms; and the appearance of such phenomena is often accompanied by a modification of the craving.

DIAGNOSIS.—True dipsomania may easily be, and often is, confounded with mere habitual drunkenness. In dipsomania, however, there is, as a fundamental condition, a pathological condition of the brain which manifests itself irrespective of external circumstances of temptation. In habitual drunkenness the craving consists mainly in a desire to keep up a condition of stimulation to which the brain has become accustomed. The habit is the result merely of compliance with a vicious custom, and there is no such periodicity or independence of external influences in the symptoms as is found in the true disease.

TREATMENT. — Prolonged abstinence from stimulants, and adherence to the tonic regimen, are the only measures from which any amelioration can be hoped for. It is seldom possible to restrain the gratification of the craving without seclusion in an asylum or some similar institution; and even when such compulsory restraint has been successfully enforced for a considerable period, the morbid tendency is seldom eradicated. The present state of British law does not, however, permit us to confine either the dipsomaniac or habitual drunkard unless something more morbid than an abuse of stimulants can be alleged. And it is difficult to see how a law could be enacted which would be effectual without being open to serious abuse. Public attention has, however, been lately very earnestly directed to the subject, and it may be hoped that something will be done towards rendering efficient treatment possible.

JOHN SIBBALD.

DISCRETE (*discerno*, I separate).—This adjective is used in reference to certain cutaneous eruptions in which the spots or pustules are separate from each other; for example, discrete small-pox.

DISCUTIENTS (*discutio*, I drive away).

Definition.—Local applications, which are supposed to remove the congestion and effusion of inflamed parts, and the swelling of the skin over them.

Enumeration.—The chief discutient measures or agents are:—Friction; Pressure; Mercury and its preparations; Iodine and its preparations, including the Iodides of Potassium, Lead, and Cadmium.

Uses.—These remedies are generally applied over enlarged joints, enlarged glands, or cystic tumours. The most powerful amongst them are mercury and iodine and their preparations, either alone or in combination. Their action is aided by heat and pressure. The effect of the former is seen in the Indian treatment of goitre, which consists in rubbing iodide of mercury ointment over the tumour, and exposing the patient to the full rays of the sun, or to the warmth of a large fire. The beneficial effects of pressure are observed in the diminution which takes place in enlarged and swollen joints under the application of mercurial ointment or strapping, the friction with the hand in applying the ointment, and the pressure exerted by the strapping greatly increasing the efficacy of the mercurial preparation in removing swelling. *See* Friction.

T. Lauder Brunton.

DISEASE (*dès*, from, and *aise*, ease).—Fr. *Maladie*; Ger. *Krankheit*.

Definition.—Disease may be defined as a deviation from the standard of health in any of the functions or component materials of the body. *See* Pathology.

The expression 'a disease' is frequently used with reference to a supposed unit of causation. Thus, it may be applied to some simple phenomenon, for example, neuralgia, when that phenomenon is the sole effect of a cause; or it may include many concurrent or consecutive resultant phenomena, such as those of syphilis or typhoid fever.

General Considerations.—It is well known that changes of function and of structure are brought about and influenced by a great variety of agencies. These agencies, some of which act from within, others from without, are recognised as the *causes* of disease. Such changes, whether they be functional, affecting more especially the vital properties of the body, or structural, affecting its physical properties, constitute what is familiarly known as Disease, which is hence called respectively *functional* or *structural*. These changes are merely the evidence of an altered or perverted action, which is then in operation or has already occurred, the nature of which is considered under the head of *pathology*. When these deviations from health can be recognised during life they are described as the *symptoms* or *signs* of disease. For example, when a person, after exposure, it may be to wet or to cold, or both, is found to have an increased temperature, with a quick pulse and perverted secretions, and to complain of thirst, and pain at the joints with effusion in and around them, we say that such person is labouring under disease, and we call it 'rheumatism,' because that name has been assigned to a complexus of deviations from health, such as those then presented by this individual. When typhoid poison has been introduced into the body, it leads in like manner to a number of functional and structural changes, which, taken together, constitute what we call 'typhoid fever.' Or again, under certain circumstances there appears to be generated in the system, whether as the result of a tendency acquired before birth or by habits of life, an agency which, acting morbifically, produces a series of phenomena which we call 'gout.' These several forms of disease may be *classified* in groups, arranged in accordance with the causes which give rise to them, their nature, their seat, their duration, &c. Rules are laid down for the modes of distinguishing or *diagnosticating* one disease from another; for *prognosticating*, as far as may be, their result; and for their *prevention* and *treatment*.

Thus it comes that the discussion or description of any *particular disease* consists of an account of the causes that give rise to it, or its Ætiology; the changes of structure or of function which constitute it, that is, its Anatomical Characters and Pathology; the phenomena attending these changes, otherwise, the Symptoms and Signs of the disease; the facts that serve to distinguish this particular disease from other diseases, that is, its Diagnosis; the means of forecasting its progress and termination, which constitute its Prognosis; and finally the measures by which it may be prevented, relieved or removed, that is, its Treatment. Throughout this work the various diseases are, as far as may be practicable, discussed upon this uniform plan.

As thus understood—and it is well to remember it—Disease is an abstraction or relation, and not an entity having a special and independent existence. Physiology has in recent days diffused a clear and penetrating light over many of the processes of life in health, which were previously dark and obscure. Pathology, which is physiology applied to the study of unhealthy function and structure, anxiously follows the footsteps of the sister science. We are therefore not hoping and believing too much when we express our conviction, that the time is not remote when we shall be able to trace those early and minute changes which constitute disease, and the causes which give them origin, and that we shall thus be enabled to define in a more philosophic and practical form what disease really is. In the meantime we must be content to work upon the phenomena before us, to investigate so far as we can the causes of disease, how to recognise its presence and its nature, how to estimate its progress and its duration, and finally how to prevent its occurrence or to cure it when it has occurred. These varied and important points will be found discussed as above stated under suitable headings, in the articles immediately following, and in other parts of this work.

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DISEASE, Causes of. — Definition. — Whatever is capable of damaging the structure of any organ or tissue of the body, or interfering with its function, may be a cause of disease. This definition implies that such causes are numerous, and that of many science is yet ignorant. To give a succinct account of them is therefore difficult, nor is this difficulty diminished by the fact that, in most diseases, we can trace a succession or combination of causes.

General Classification. — The causes of disease have been divided into (1) *Predisposing* or *Remote*, (2) *Exciting* or *Proximate*, and (3) *Determining*. Illustrations will explain what is meant by these terms:—Two individuals are exposed to the contagion of typhus in equal degree; one, wearied by bodily and mental labour, 'catches' the disease—that is to say, his condition has *predisposed* him to the exciting cause of the malady; the other, in vigorous health, escapes the contagion—the *exciting* cause of disease. Predisposition in fact *prepares* persons by rendering them more susceptible to the influence of exciting causes of disease. Many persons are *predisposed* to emphysema because of hereditary taint; in them the air they breathe is day by day an *exciting* cause of this disease; they contract a bronchitis which, by its attendant cough, *determines* the malady. Such illustrations might be extended to a multitude of diseases, and justify the division of causes which the older physicians made. Predisposition may be inherited; or it may be acquired, and be due to various accidental causes. In most cases there is a combination of predisposing causes; in a man, for example, lowered by fatigue, want of food, and exposure, debauch will readily excite an attack of bronchitis or pneumonia. Practically, it is often difficult to say how much is due to predisposition, but, though many factors unite in the predisposition to disease, it is possible in most cases to estimate the part played by each. *See* Predisposition to Disease.

Moreover it is not always easy to distinguish predisposing from exciting causes. Predisposition carried to excess becomes an exciting cause of disease, and in many cases there is a combination of both. There are certain distinct exciting causes—for example, heat, cold, or injuries of various kinds, but most of these can claim a predisposing power. The contagia of the acute specific diseases and parasites are good examples of direct exciting causes.

In proceeding to discuss the subject of Ætiology, no attempt will be made to separate definitely predisposing from exciting causes of disease. The writer will endeavour rather to indicate as far as possible under the head of each factor of causation the direction in which it especially acts.

1. **Age.**—This has a most important influence as a predisposing cause of disease. In Wagner's *Manual of General Pathology* the periods of age are thus subdivided:—

(1) Nursing age (infancy)—from birth to 7th-10th month.
(2) Childhood—from 1st to 2nd dentition.
(3) Boyhood—from 2nd dentition to puberty.
(4) Adolescence—from puberty to 20th-25th year.
(5) Early manhood—from 25th to 45th year.
(6) Later manhood—from 45th to 60th year.
(7) Old age—from 60th onwards.

This division is excellent, but in no definition is there more need to look out for exceptions than in that of age. The term *age* is strictly comparative; some individuals are old at forty, others young at sixty. Persons fail with regard to particular organs while young in years; and, on the other hand, others acquire an increased power in the same as years advance, of which the brain affords an apt illustration. The minor organs of the body betray the like peculiarities, and in the early decay of the teeth, the changes in the hair and the skin, we meet with indications of old age, though the individuals are young in years. But, generally, the predispositions of the young and old are striking by their contrast. The young are exempt from fatty degenerations, which are so common amongst those of advanced life, and, in consequence, many diseases amongst them are, *cæteris paribus*, less deadly; and not only does age, by reason of the changes which naturally occur as life goes on, predispose to disease, but all outward conditions become changed. Children—speaking generally—are apt to suffer from acute catarrhal affections of the mucous tracts, glandular diseases, skin-diseases, tuberculosis of acute type, scrofulosis, and a variety of complaints traceable to improper feeding, bad ventilation, overcrowding, and to hereditary taint. From acute tuberculosis the aged are almost entirely exempt, and they do not suffer from hereditary taint nearly so frequently as the young. The very young and the very old are equally subject to bronchial catarrh, and the mortality from this disease at each extreme of life is exceedingly great. But in the young the predisposition to this affection is almost invariably associated with a predisposition to catarrh of the intestinal tract, and to diseases which indicate a general constitutional depression; while in the old bronchial catarrh is predisposed to by a degenerative change in the lungs themselves, or in the air-passages. In childhood there is an active stage of growth and development, and when one important organ is affected the others suffer with extreme rapidity; the excito-motory system is greatly developed, and hence arises a predisposition to spasmodic diseases—for example, to laryngismus stridulus, and to general or partial convulsions during the excitement of dentition. In the old the tendency to spasm decreases, and convulsions become much less marked. Some of the exanthemata, especially measles, scarlatina, and pertussis, are more common amongst children than adults, which is partly explained by the fact that the latter class have passed through the ordeal of those diseases, and are thus proof against them. Rickets also is essentially a disease of infancy and early childhood.

The onset of puberty is a constant source of predisposition to disease, for with it comes a complete transformation in the mental and physical characters, so that the individual, if not very carefully watched, deviates from even the most perfect health into a permanent tendency to disease. The system at this period—especially in the case of females—is frequently unable to bear anything which interrupts or interferes with its activity. The generative organs undergo great changes, and with them the whole moral and physical nature is altered. At this period of life there is a predisposition to both bodily and mental diseases. In fact, perversions of any organ or faculty may be started, and, once started, they are apt to continue, so that there is established, literally speaking, a permanent predisposition to disease, and this predisposition swells very largely the list of affections which are dealt with under the generic term Hysteria. Lung-affections—excepting pure bronchitis—are more common at and shortly after the time of puberty than in previous years; but, excepting in the instance of phthisis, hereditary taint is less manifested than during childhood. Even hereditary epilepsy is, if postponed beyond early years, likely to be postponed to the period of adult life.

As has been said, the degenerations of organs and tissues begin to show with much uncertainty, but after the fortieth year of life we almost invariably meet with one or other of them. Their degree and their consequences vary with the surroundings of the individual—with his habits, temperament, occupation, and like influences. Diseases of the large vessels are especially common at this epoch, such as aneurisms of the aorta and of the large arterial trunks in the extremities. Henceforward all the diseases peculiar to advancing age become common. The results of previous disease are now declared by a decided predisposition to exciting causes which have been hitherto withstood. Old age is a relative term. A man is old and predisposed to trifling excitants because his lungs have lost their elasticity, or his brain its regularity of circulation, or his heart its vigour—in each of these cases, as in a host of others, the predisposition is strictly one of degeneration. Again, inherited diseases do not declare themselves in some cases till the later years of life, and of this carcinoma is a striking example. The old are predisposed to lowering diseases—low pneumonia or bronchitis; and to a variety of nervous affections which the vigorous can resist. In them the failing heart-power tells a tale; they are the subjects of general vascular dilatation; and, in short, they succumb to insignificant exciting causes, because of the general or partial decay of the tissues and textures of the body.

2. **Heredity** is a prolific source of predisposition. There is amongst men not only an inheritance of such prominent diseases as phthisis, but of peculiarities in the manner they meet and pass through minor ailments. Thus, in families with a 'nervous history,' we meet with predisposition to headaches of nervous type, irregularities of digestion in the form of diarrhœa and vomiting, and a multitude of conditions which have of late been ascribed to vaso-motor disturbances. The members of some families live long in spite of exposure to almost every exciting source of mischief, and contrast most favourably with others who, as far as one can determine, have all things in their favour. There is no doubt that the effects of syphilis, malformations, gout, the hæmorrhagic diathesis, and tuberculosis are handed down from generation to generation. Of many minor complaints there is less certainty; but it is exceedingly probable that persons are predisposed to bronchitis and other catarrhs by inheritance. It is acknowledged that epilepsy descends from parent to child, and that, in fact, individuals, because of heredity, are often the subjects of nervous diseases excited by causes which those free from taint are enabled to throw off readily. The various forms of insanity are striking examples. It is supposed that the inheritance lies in the tissues themselves—that there is a something in the tissue-elements which predisposes to certain diseases in certain families. It has been asserted that there is even a predisposition by inheritance to the acute specific diseases—such as typhoid fever and diphtheria, and some remarkable occurrences in this country strongly bear out this view.

3. **Intermarriage.**—Intermarriage certainly predisposes to disease, but it is not easy to determine how far its predisposing powers extend. Breeders of first-class animals practise intermarriage, and thereby develop speed, quality, and endurance in the offspring. It is beyond question that this practice of breeders of race-horses is eminently successful for the time, but it by no means follows that the permanent results are good. We are bound to look not only to the immediate, but to the ultimate results of intermarriage—in short, to decide whether intermarriages predispose to disease, to the injury of the community. But no rule, free from exception, can be laid down on this subject, for beyond all doubt many intermarriages have led to both physical, moral, and mental advantages. There is no doubt that malformations are handed down, and that where these are marked in families it is injudicious for persons to intermarry. Where also, for example, serious diseases, such as phthisis, have been met with on both sides, it is most advisable that intermarriage should not take place.

4. **Sex.**—There are great differences in the organs and functions of the sexes, and in consequence a great contrast in their predisposition to disease. The female is more delicately constructed than the male, and those organs which the two sexes possess in common differ in weight and in 'fineness;' and a general consideration at once indicates that the female is less fitted than the male to resist many exciting causes of disease. This is particularly evident at climacteric periods of life; with the onset of puberty girls suffer far more than males, and especially from a variety of reflex spasmodic disorders, which require but little provocation for their development. All the phenomena classed under the head of hysteria often occur at this period. At the same time, and shortly afterwards, there is a tendency to ulcer of the stomach, to persistent constipation, to peculiar attacks of neuralgia—especially of the intercostal nerves, and to acute rheumatism, lapsing into the subacute or chronic kind. Anæmia and chlorosis are also common at the period of puberty, and if then neglected they are apt to persist, and predispose the individual still more to disease.

Even so early as the period of puberty the external circumstances of the sexes differ, and on this depends, in a certain measure, the difference in their predisposition. Education, domestic habits and customs, and, above all, occupation, play an important part. But, underlying these outside influences, there is inherent in the sexes a difference in predisposition; for when they are exposed, as often happens, to the same surroundings, they suffer from widely sepa-

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rated diseases. Males are more subject to epilepsy, tetanus, gout, diabetes, locomotor ataxy, vesical diseases, and acute lung-affections, than females. The list shows that occupations which involve hard mental and bodily work and constant exposure explain some of the varieties in predisposition. It is probable that females are more frequently ailing than males, but very often their illnesses are associated with the menstrual functions, and are trifling in degree, and, though more males are born than females, towards the later years of life the average of the sexes becomes more equally balanced, because the mortality of males is greater than that of females. It is sufficient to allude to the fact that pregnancy and lying-in predispose females to diseases from which males are entirely exempt; and that there is a considerable difference in the sexes as regards venereal affections, both as to predisposition and the effects of that predisposition.

5. **Temperament** is important as predisposing to disease. Persons of *sanguine* temperament are disposed to congestions of organs, and hæmorrhages, on comparatively small provocation. *Phlegmatic* individuals are the subjects of those diseases which are readily excited by want of mental and bodily energy and activity. A third set belong to the *nervous* temperament; they are easily excited and easily depressed, so that excitants cause either a form of hysteria or hypochondriasis, for example. The predisposition amongst this class is constantly met with in diseases of an acute character. Nervous persons suffer quickly from delirium and other brain-symptoms, which aggravate and render dangerous an otherwise hopeful malady. In the acute specific diseases this is particularly manifested; nervous people are undoubtedly predisposed to them, and when once attacked are predisposed to dangerous complications. Practically we meet with 'mixed' temperaments, though one perhaps especially prevails. *See* TEMPERAMENT.

6. **Climate and Locality.** — These differ widely in their predisposition to disease. Persons who have been accustomed to a particular climate frequently suffer when transferred to one differing from it; and on the other hand the sick often benefit by change. Particular diseases flourish in particular climates, and particular organs suffer. In the tropics various endemic fevers prevail which are unknown in this country, for they cease to exist when the temperature sinks below a certain level (about 60° Fahr.). Frost very often cuts short epidemics in our own country in like manner. Particular organs are predisposed to disease by climate—the liver in the East Indies, the lungs and the kidneys in regions where the temperature is capricious. Climates differ as regards air—whether moist or dry, hot or cold; but besides these things the topography must be considered, and the elevation of districts. Plains, mountains, and valleys have various predisposing influences, and while much of such influence depends on the configuration of the country, no little is due to the nature of the soil. No better proof of the latter fact can be given than that yielded by the observations of Dr. Buchanan, who has shown that where a proper system of drainage of soil-water is carried out, the tendency to pulmonary diseases is very greatly diminished. Clay soils are cold and damp, and favour diseases aroused by these combined agencies; sandy and gravelly soils readily drain themselves, are warm and dry, and thus far tend to protect those who live on them against disease. Climates are also modified by trees, rocks, rivers, lakes, &c. Detritus carried down by streams and deposited along their banks or at their estuaries, has, like ground vegetation and its decay, an undoubted predisposing influence. Particular districts also predispose to certain diseases. Cretinism is most common in close valleys; urinary calculus is endemic in many districts of Great Britain and elsewhere. In some circumscribed areas in Scotland, in Norfolk, and other districts, individuals are especially liable to stone. The influences of climate are well shown by the electric conditions of the atmosphere; some persons are so predisposed that they can foretell a thunderstorm by the change in themselves. Fogs in large cities depress most people; and it is not too much to say that many diseases may be traced to a predisposition which 'bad weather' has started. Alcoholism has been provoked in this way. It is clear, therefore, that under the head of climate there are many combining influences, which affect the moral, mental, and bodily nature of individuals, and through one or all may predispose to disease. In this country, and probably elsewhere, those who dwell on mountains are less liable to disease than the dwellers on plains; marshy plains especially predispose. It should be remembered, however, that it is not climate alone which varies the predisposition amongst persons residing in different regions, for their habits, diet, &c., differ far more than the climate in which they dwell, and predisposition to disease should never be ascribed solely to climatic conditions unless accidental influences have been investigated and eliminated.[1] *See* CLIMATE.

7. **Town and Country.**—The influences of town and country, as predisposing to disease, require a separate consideration. With them may be considered dwellings, and a variety of minor sources of predisposition. The mortality of country districts is less than that of towns, but towns differ in this respect amongst themselves. The health of the largest city in Great Britain, for example, compares favourably with any of the large manufacturing towns and with many rural communities. It is easy to understand that differences must depend on the occupation, food, and habits of the people, and on their external surroundings —air, light, drainage, and like conditions. In large towns occupations are more lowering than in country districts; while the physical and mental strain is greater, and has fewer interruptions. Late hours, intemperance, and prostitution prevail in towns; but it is by no means certain that, in proportion to the population, these ills are less frequent in the more remote districts. In towns overcrowding checks ventilation, makes

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[1] Imperfect drainage leads to what are popularly known as 'damp walls' in dwellings, and thus predisposes to pulmonary diseases by interfering with ventilation—in fact, by preventing the admission of pure air into such dwellings. This truth bears out the teachings we have derived from Dr. Buchanan's investigations at Ely and elsewhere.

drainage difficult, so that subsoils become saturated, clouds the atmosphere with smoke and dust, intermingles the sexes (amongst the lower classes) so that succeeding generations are stunted in their development, and in a variety of other ways predisposes to disease. But in some towns these evils have been obviated by sanitary measures, and as a consequence towns often predispose less than country districts to diseases due to defective drainage and overcrowding. Some startling illustrations of this fact have occurred since sanitary science has been acknowledged to be of national importance. In villages, for instance, reputedly 'model,' epidemics of disease associated with defective drainage and evil domestic arrangements have decimated the inhabitants, and the virulence of these epidemics has been greater than that of those met with in large towns. The latter are now-a-days for the most part better drained than country districts; thus milk-epidemics of typhoid fever have been imported into large cities from isolated farms where the drainage alone seemed to be at fault. Amongst children, rickets, scrofula, and tuberculosis are far more prevalent in town than country. The mortality amongst young children is far greater in towns than country districts. Adulterations are an evil in large communities, affecting people of all ages. From many of these country districts are free, and especially is this true as regards milk. So while dwellers in the country may have bad drainage and bad houses, they have pure air as a rule, every opportunity of breathing it out of doors, and unadulterated milk. Even the alcoholised drinks in many country districts are home-made and harmless when compared with the adulterated raw spirits taken by the lower classes of large towns.

8. **Hygienic Conditions.**—One of the most common causes of disease coming under this head is want of cleanliness. To this is due a variety of skin-diseases, such as eczema of the scalp in children, diseases caused by pediculi, &c. It interferes with the functions of the skin generally, and by it even a common cold is modified. Clothing is a part of this subject. Insufficient clothing is a most important source of predisposition, amongst the rich as well as amongst the poor; for, though the climate of this country is so variable, corresponding adaptations of dress are for the most part neglected. Flannels worn day and night also predispose to disease. Clothing is used to prevent the loss of heat, which occurs in three ways —by radiation, conduction, and evaporation, and a careful adaptation enables us to modify these sources of loss in such a way as to obviate a predisposition to disease. There is probably more care taken in tropical climates to regulate the heat of the surface than in the temperate zones. A very common cause of predisposition to disease is neglect of proper bedding. Deficient ventilation and overcrowding are prolific sources of mischief. Overcrowding without ventilation is one of the greatest evils of our chief cities and towns; and not only is it in their homes and workshops that populations are overcrowded, but in their places of recreation, such as theatres, and in their places of religious worship. Briefly it may be said that overcrowding predisposes to moral, mental, and physical deterioration; to epidemic diseases, and especially to typhus fever; to pulmonary affections; and to a variety of nervous diseases. By lowering the *morale* of populations it increases all other predispositions, and, in fact, passes into an active exciting cause of disease.

9. **Occupation.**—This is a common cause of disease, and is often associated with want of proper hygienic conditions. The overcrowded in work-rooms breathe an impure air, an air loaded with carbonic acid, irritant particles, and various exhalations, and thus are liable to disease. Miners breathe an air laden with carbon; knife-grinders inhale fine particles of metals; marble-polishers and masons are in the same plight; in all three cases occupation, combined with neglect of hygienic precautions, leads to pulmonary diseases. Occupation is in many cases a direct exciting cause of disease; for example, workers in arsenic, antimony, copper, lead, the mineral acids, &c., suffer from the poisonous effects of these substances. But oftentimes they escape the direct influences, yet are subject to a predisposition to various diseases, as a consequence of their occupation. Various other occupations, such as those of tailors, shoemakers, milliners, and brain-workers, predispose to disease in different ways.

Too much work and too little work (mental or bodily) predispose distinctly to disease. Continued overwork reduces the system generally, and special organs in particular, according to its nature. A coachman, who uses for many hours his pectoral muscles in driving, suffers chiefly in them when he has an attack of muscular rheumatism. So also those who use the brain too much in intellectual work are predisposed to functional, and even to organic derangements of the nervous centres. Physical overwork is often conjoined with exposure and improper or irregular food-supply, and the combination has a marked effect. It has so predisposed armies to disease that their ranks have been decimated by fevers, pneumonia, and bronchitis, far more than by the cannon or by the sword. Not a few medical men have been affected by the contagia of the acute specific diseases, because when exposed to them they were worn out by bodily and mental exertion, and by protracted fasting. Over-work reduces the nervous power, and thereby strikes at the very root of the healthy status. On the other hand a sluggish use of the mind and body are favourable to disease, and some persons are so constituted that they cease to be safe when their minds have lost the opportunity of active exercise; and the very fact that they substitute an abnormal intellectual employment is proof of this truth. And what is true of the mind is true of the body. A sudden change from active bodily exercise to bodily laziness predisposes largely to disease.

10. **Air.** — The question of air has already been alluded to, in considering climate, occupation, town and country, overcrowding, &c., and it is scarcely necessary to dwell much more on its ætiological effects. Air influences the predisposition to disease according to its degree of rarefaction, moisture or dryness, warmth or coldness, and the impurities, mechanical or chemical, which

may adulterate it. In the article CLIMATE many of these atmospheric conditions are fully dwelt upon, and their tendencies explained. Impurities in the air are exceedingly prevalent; and mechanical substances suspended in it can excite irritable conditions of the air-passages which may pass on to inflammation, and even destruction of the lungs. Throat and laryngeal affections are a common consequence of these impurities. All these chiefly occur amongst certain classes whose occupation loads the air with fine particles as already described. There is scarcely a mineral used in the arts which cannot, by inhalation, excite or predispose to disease. The air may also be rendered impure by chemical agencies, and the moment the normal proportion of its elements is disturbed it becomes a source of disease. Excess of carbonic acid is especially an element of mischief —causing headache, dyspepsia, and nervous depression. The presence of ammonia and of sulphuretted hydrogen is attended by like results. The human economy is, however, so framed that its organs can often very rapidly throw off the evil effects of these gases when breathed in overcrowded rooms, &c., so that no permanent mischief is established. Poisoned air plays a part in the production of scrofula, anæmia, and lowered conditions generally; but it is an incomplete comprehension of the causes of these conditions to set down all to this one. The air, also, may be poisoned by other gases, such as carburetted hydrogen.

The atmosphere is modified by currents—sometimes to the relief, sometimes to the danger of mankind. Winds can remove sources of contagion—they can 'clear the air.' But they can also bring contagion into localities according to many authorities. Cholera and other diseases have, it is said, followed aerial currents—that is, have been carried by them. East winds are a prolific cause of disease; they excite it directly, and carry off healthy individuals, even though the cold be not extreme. Sometimes westerly winds have a dangerous influence, and in the winter of 1877-1878 a wave of disease, having many of the characteristics of 'influenza' was carried across England by a west wind.

11. **Previous Disease.**—Previous disease often predisposes to the same or to some other affection, and no clinical history is of value unless it includes an account of former illnesses. In difficult and doubtful cases a true statement of these often gives the clue to diagnosis, and even patients themselves are alive to the value set upon an accurate account of their life-ailments. An attack of croupous pneumonia predisposes to recurrence, especially during the twelve months succeeding the attack; and it may leave behind a predisposition extending far beyond the original disease. Chorea, acute rheumatism, tonsillitis, and epilepsy tend to recur, as also do the ordinary convulsions of children; but in all these and many other cases it is difficult to estimate the exact part played by derived predisposition, because in all the primary predisposition may be the main agent in the subsequent attacks. In practical medicine it is distinctly recognised that certain diseases predispose to disease, and in their case recurrence is, very properly, jealously guarded against. Pertussis is supposed to predispose to measles, and *vice versâ*. There is distinctly a connection between chorea, rheumatism, and scarlet fever, and these diseases may follow one another in any order. Again, previous disease may leave behind pathological lesions which remain in abeyance until excited by causes which the healthy individual could readily withstand. Pertussis often ends to all appearances favourably, but afterwards the patients may suffer from severe lung-affections, upon trifling exposure to exciting influences. Calcareous deposits in the lungs may excite a new catarrhal phthisis; hepatic mischief followed by collection of gall-stones in the gall-bladder may cause peritonitis and other diseases. Slight complaints are even more marked in their predisposing powers than serious diseases. On the other hand, previous disease sometimes protects individuals and communities; for example, vaccination can save nations from the most terrible of scourges. In the case of scarlet fever, typhus, pertussis, measles, &c., an almost perfect immunity is acquired by those who have already suffered from them. Of course, as with small-pox, no one denies that second attacks of these diseases do occur, but such attacks are wholly exceptional.

12. **Mental and Moral Conditions.**—Bad news may cause sudden death, or, short of this, may interfere with the functions of particular organs. Sudden mental worry may excite dangerous interference with digestion, or start an abnormal cardiac rhythm. Fright has turned the hair white within a few days or hours in healthy persons. Mental and moral shock can check or increase the flow of urine, and, in fact, can affect all the excreting and secreting organs of the economy. Mental overwork can excite, *per se*, brain-conditions of a dangerous nature, such as hyperæmia or anæmia, and even, it is said, meningitis of simple or tubercular form, according to the inherited predisposition. Undue or sudden emotional disturbances can excite serious mischief, just as they can predispose to it. Again, the mind is affected by imitative influences; thus chorea is excited in some individuals by watching choreic movements, and a single hysterical patient may arouse in others symptoms almost identical with her own. The subject of the direct influence of the mental and moral state on disease is, however, too wide to be here dwelt upon.

13. **External Physical Conditions.**—These are very numerous as exciting causes of disease. Violent over-exertion can cause herniæ, hæmorrhages, as from the vessels of the lungs, cerebral congestions, and even ruptures of the valves of the heart, and in one or all of these cases lead directly to death. Over-exertion with the voice may be followed by pharyngitis or laryngitis. Syncope has occurred in the most healthy from violent exertion in hill-climbing, in boat-racing, walking and running matches, &c., acute dilatation of the ventricles probably occurring. Various forms of direct injury are frequent causes of disease.

14. **Poisons.**—Poisonous gases are powerful excitants of disease, and so are poisons generally, whether animal, vegetable, or inorganic. They

may kill quickly or excite a disease of long-continued or even permanent nature.

15. **Temperature.**—Heat and cold carried to excess may prove fatal at once. The influences of severe cold are described under the heading COLD, and it is only with the diseases excited by heat and cold in the everyday acceptation of these terms that we shall deal here. Long-continued heat lowers the vital powers, and may excite such diseases as slight eczema of a simple character, or such grave affections as inflammation of the membranes of the brain. Heat may kill suddenly, as in sun-stroke, or excite cerebral mischief just short of death; while in persons of tubercular diathesis it may induce tubercular meningitis; and even more general effects follow severe local applications of heat. Moderate heat applied to the back often depresses the heart even to syncope. Choleraic attacks in this country usually are associated with exposure to immoderate heat.

Cold is the most common cause of disease in temperate climates, especially in the changeable climate of this country. It can excite disease directly, and can affect probably all the organs of the body, causing either disturbed function or organic mischief. Cold, when severe, contracts the vessels; interferes with the circulation, and all vital activity; and in this way may cause death. But it is with moderate degrees of cold we have chiefly to deal. A momentary exposure to a cold draught is as frequent an excitant of disease as general exposure for a long time. A cold draught playing on the cheek may cause facial paralysis, sore throat, or bronchitis; that is to say, cold applied locally may excite disease in the neighbourhood of its application or in distant organs. It is probable, therefore, that cold may act in several ways: (1) it may interfere with circulation; (2) it may affect the extremities of nerves and excite disease by reflex action; or (3) it may check secretions of the skin, the mucous membranes. &c.

We cannot wonder, therefore, that diseases of the throat, larynx, and lungs are frequently excited by cold. Bronchitis and pneumonia are its most common results; and as the young and the old are less enduring of cold than adults, it carries them off with great frequency. Diarrhœa, renal diseases, congestion of the liver, acute and chronic rheumatism, simple dyspepsia, and a host of other affections, are traceable in many instances to cold. Predisposition has much to do with the effects of cold; some individuals suffer from one form of disease when exposed to it, others from entirely different affections. In some, 'a common cold' is most evidenced by severe muscular pains and fever, in others by a nasal discharge, in others by headache, and so on. Some persons never suffer from 'cold' without having an attack of herpes labialis; and numerous similar idiosyncrasies might be given. The effects of cold should always be considered with almost all predisposing causes of disease. 'Cold' is a vague term and not thoroughly understood; there is all the more reason why, when it comes under consideration in individual cases, its precise effects should be most carefully considered and recorded.

16. **Diet.**—Food and drink can by their abuse excite disease, and gluttony is as powerful an excitant as drunkenness, though in temperance outcries this fact is almost completely lost sight of. Excess of food does not refer simply to the quantity taken, but to its quality—its nature, richness, and the times when it is taken. Agricultural labourers eat more than the gentry, but live longer, and the gentry of old-fashioned type are longer-lived than whose who frequent the fashionable world. Excess of food overloads the stomach, makes calls upon it which it cannot meet, and dyspepsia is the result. Excess of food, if digested, charges the blood with materials not demanded by the economy, and disease of excretory organs or fatty degenerations may thus be excited. Want of food also excites disease, such as pneumonia, bronchitis, or other catarrh, especially in children, many deaths amongst whom are the direct consequence of improper feeding. When the proper admixture of the elements of food is neglected, disease results, as, *e.g.*, scurvy. Particular foods will immediately excite violent gastric catarrhs in some individuals, while others can bear them perfectly well. Putrid food is an active poison. Certain kinds of fish are poisonous in themselves, and some vegetable foods laden with salts of lime are supposed to cause urinary calculi. Water and milk are prolific sources of mischief, through the impurities they so often contain. The drinking waters of large towns are usually derived from rivers, and filtration is not a sufficient purification, so that disease may be excited by their use. Alcohol is a most extensive source of disease: it causes, when taken in excess, cerebral, gastric, intestinal, hepatic, and renal affections, and can lower the system so far as to predispose to other diseases. *See* ALCOHOLISM; and POISONOUS FOOD.

17. **Epidemic Diseases, Contagion, Malaria, Parasites,** and **Growths** are treated of under separate headings. It is now generally established that the diseases known as the acute specific diseases are mostly direct consequences of some contagium. So among the most common exciting causes of disease we must class the contagia of the several fevers, of syphilis, &c. *See* PERSONAL HEALTH; and PUBLIC HEALTH.

J. PEARSON IRVINE.

DISEASE, Classification of.—Various classifications of diseases, or systems of nosology, have been adopted by different writers, but it is beyond the province of this work to discuss these arrangements, neither of which fulfils all that is required, or can be regarded as satisfactory. All that can be done here is to point out the characters upon which the chief divisions of diseases are founded.

The first classification deserving of mention is that into (1) **General** and (2) **Local.** General diseases include those in which the whole system is involved from the commencement, and it comprehends as sub-divisions (*a*) The *acute specific fevers*, and certain other diseases due to the introduction of some morbific agent into the body from without, or in some instances developed within the system, for example, typhus and typhoid fevers, scarlatina, small-pox, malarial fevers, hydrophobia, syphilis, pyæmia and septicæmia. (*b*) The so-called *constitutional*, *cachectic*, *diathetic*, or *blood-diseases*, some of which seem to depend upon the production of deleterious elements within the system, which are capable of recognition, such as rheumatism and gout; while others are independent of any such obvious pathological causes, but are supposed to be severally associated with a peculiar dyscrasia or diathesis, for instance, cancer, tuberculosis, scurvy, rickets. **Local** diseases are those which primarily affect particular organs or tissues, each being liable to its own peculiar lesions. Thus we have diseases of the lungs, heart, stomach, liver, kidneys, brain, and the other organs; of the mucous membranes, serous or fibro-serous membranes, skin, periosteum, bone, and other structures. This division into general and local diseases is useful within proper limits, but it must be remembered that general maladies are often revealed or accompanied by local lesions, and that complaints which are originally local often more or less speedily set up general disturbance. Moreover, it is still a question whether some maladies are to be regarded as general or local in the first instance. *See* SYMMETRY IN DISEASE.

Another division of diseases, which applies more particularly to those which are of a local nature, is into (1) **Organic or Structural**, and (2) **Functional**. These terms are self-explanatory, the former implying that there is some organic change in the affected part, which we can discover and demonstrate; the latter indicating that there is mere functional disorder, which is independent of any recognisable lesion. That there are structural changes in many affections which are regarded as functional is, however, highly probable, though our means of observation are not sufficiently powerful to enable us to detect them. In connection with each organ, a special classification of its individual complaints under one or other of these primary headings is usually adopted, this sub-division depending upon the affections to which the particular organ is liable. As illustrations of functional disorders may be mentioned disturbed action of certain organs, as of the heart, causing palpitation; derangement of the secretory or excretory functions, as in the case of the stomach, liver, or kidneys; and many nervous disorders. Organic diseases are exemplified by inflammation and its consequences; alterations in growth and development; degenerations; malformations; and new growths. In this work it has not been deemed advisable to describe the diseases of the several organs according to any definite scientific arrangement, but in some cases an alphabetical order has been adopted, while in others individual writers have been allowed to classify the affections of a particular organ according to their own judgment.

Again, diseases may be classified according to their causation and mode of origin. Thus they are divided into (1) **Hereditary**, or those which are transmitted either directly from parents to children, or indirectly, as the result of a family taint; and (2) **Acquired**, or those which are developed anew in persons free from hereditary taint. When a morbid condition exists at birth, it is said to be **Congenital**. Other divisions, founded on an ætiological basis, are into (1) **Contagious** or **Infectious**, and (2) **Non-contagious**; and into (1) **Specific**, or those diseases which are due to a specific cause, and (2) **Non-specific**.

There are other classifications of diseases, which need only be mentioned here. Thus, according to their intensity and duration, they are said to be (1) **Acute**; (2) **Sub-acute**; or (3) **Chronic**. Another arrangement, founded on their mode of progress, is into (1) **Continuous**; (2) **Periodical**, or affections which come on at more or less definite intervals; (3) **Paroxysmal**, or those which are characterised by sudden or acute paroxysms; and (4) **Recurrent**, or diseases which tend to recur. Lastly, according to their mode of distribution amongst communities or in districts, complaints are said to be (1) **Sporadic**; (2) **Epidemic**; (3) **Endemic**; and (4) **Pandemic**. The meanings of these terms are defined under their several headings, but they are sufficiently familiar as indicating the mode of distribution of the diseases to which they respectively belong.

With regard to the classification of diseases which is likely to be permanently adopted in the future for general use, it is probable that this will be founded on a pathological basis, and that, as our knowledge of morbid conditions and processes becomes more extensive, accurate, and definite, it may become possible to establish a system of nosology which will be both scientific and practically useful.

FREDERICK T. ROBERTS.

DISEASE, Diagnosis of (διὰ, intens., and γινώσκω, I know).—SYNON.: Fr. *Diagnose*; Ger. *der Diagnose*.

DEFINITION.—Diagnosis is the art of recognising the presence of disease, and of distinguishing different diseases from each other. The term is also applied to the result obtained.

GENERAL CONSIDERATIONS.—The *general principles* only of diagnosis will be here discussed. *Special diagnoses* will be treated of in connection with the several diseases to which they have reference.

In many respects diagnosis is a subject of great interest and importance. First, in a scientific point of view, it is essential that all knowledge should be accurate. Secondly, accuracy of diagnosis, founded upon a sound pathology, enables us to frame a scientific classification of disease in its diverse forms. It is also by accurate determination of the nature of the disease which may be present in any given case that we are able to anticipate its course, and to employ the right kind of remedies in its treatment. It is imperfection of diagnosis which leads in many instances to an under-estimate of the value of therapeutical agents; for when the nature of a disease is mistaken we are led to employ improper and unsuitable remedies, the failure of which is then erroneously attributed to the inefficiency of the agents, and not to the unfitness of the treatment employed. If our diagnosis had been correct or complete, the remedy selected would more often have had the desired effect.

In order to arrive at a diagnosis we must study the phenomena or characters of each individual case, and trace its connexion with those groups of symptoms which have been previously recognised and described as belonging to special or distinct diseases. Assuming that the classification has been already made, we proceed to deal with the means which enable us to identify each individual case, and to connect it with a previously classified disease.

Means of Diagnosis.—To obtain accuracy in diagnosis we must be prepared with a knowledge of the several forms and varieties of disease; we must be familiar also with the functions and structure of the several organs of the body in health. It is by observing and comparing the changes caused by disease in the these functions and structures, that we are enabled to discover the presence of, and to determine the nature of disease. In forming, then, a diagnosis in any particular case, the physician must, as far as possible, keep in view the real or the ideal condition of the patient in a state of health. He must endeavour to place him in as natural a position as may be, and as little disturbed by the presence of his attendant, or by external circumstances, as possible. The physician must then obtain a history from the patient himself or from others of the incidence of the disease; and having done this he must proceed to investigate for himself the condition of the patient.

1. *Previous history of the patient.*—The history implies of course a statement of the age and sex of the patient, as well as of his home and his employment—each of which may have a special relation to disease. It should also include an inquiry into the antecedent generations of the patient, and how far he may have any proclivity to congenital disease or malformation. This inquiry should have reference to both positive and negative facts. It should extend not only to the previous existence of disease in the family, but also to the absence of particular diseases or types of constitution. The patient's history should include a statement as regards the diseases and injuries from which he may previously have suffered; the remedies used for them; and the climatic and other influences to which he has been exposed. Nor must the physician neglect to ascertain the history of any children that the patient may have had, as the nature of disease from which the offspring have suffered in many instances throws light upon the health of the parent.

2. *History of present illness.*—The history of the present illness should include the determination of the date of its commencement; its probable cause; and its progress as influenced by external circumstances, including treatment.

3. *The present condition of the patient.*—Here we have to deal with two classes of phenomena; namely (*a*) those feelings or facts of self-consciousness which the patient describes to us—*subjective phenomena*; and (*b*) those signs which we ourselves observe—*objective phenomena.*

a. Subjective phenomena.—The patient describes to us his feelings—as of strength or weakness, of numbness, tingling or pain, of wakefulness or wandering; he can tell of affections of vision, of hearing, of smell, or of taste; of breathlessness, cough, palpitation, or of feelings of sinking or faintness; of difficulty of swallowing, thirst, loss of appetite, nausea or sickness, or various sensations and actions connected with the abdomen; of feelings associated with the genito-urinary organs, such as pain or difficulty in passing water; of cramps, spasms, or other alterations of sensation or motility; or of disturbances of sensibility and activity, &c. Each of these signs of deviation from health will have its own value and significance. The physician must at the same time carefully note how far the condition of the patient is in accordance with his statements, and whether there may not be present some reason or cause for concealment or exaggeration.

b. Objective phenomena. In studying the objective phenomena connected with disease, the physician makes use of his special senses, assisted by the several instruments with which modern science has provided him.

First, in matters of *eye-sight*, he sees the general aspect and expression of the patient, which will include the colour of the skin (such as may result from the fulness or emptiness of the blood-vessels, from the yellowness caused by jaundice, from the blueness of cyanosis, or from pigmentation, &c.); the presence and character of cutaneous eruptions (especially in the exanthemata); the expression proper, such as that of ease or suffering, and of depression or excitement; the conditions of obesity and plethora, or of wasting and bloodlessness. He will also observe the position of the patient, how he lies, or sits, or stands, and how breathes; the appearance of the eyes, the tongue, etc. Further, the sense of sight will be employed in determining conditions of a local or less general nature. Observation must be made of the size, the shape, and movements of parts, and of their expansion or contraction. With the aid of special instruments, such as the ophthalmoscope, the laryngoscope, the various specula, sounds, &c., the physician will be able to examine parts of the body of the patient, beyond the reach of the unassisted eye. The chest-measurer or the stethometer will render more exact the information already obtained by the eye and hand as to the size and mobility of parts. The use of each of the several instruments above mentioned, as a means of diagnosis, will be found described under the heads of their respective names, or in the article on Physical Examination.

The sense of *hearing* tells of the character of the breathing, the voice, and speech of the patient, including cough, hoarseness or aphonia, 'aphasia,' &c. But the ear is especially applied to the study by auscultation of the sounds produced in connexion with the heart, the lungs, and other organs. The signs thus elicited will be found fully described elsewhere.

The sense of *touch* or feeling will communicate a knowledge of the temperature, of moisture or dryness, of size, shape, elevation or depression, of smoothness or roughness, of the pulse or pulsation, vibration, fremitus, of extent of movement, resistance, softness or hardness, and of fluctuation. The accuracy of the results of these observations by touch may be tested by the use of the thermometer, the calipers, and the tape-measure.

The sense of *smell* aids diagnosis in certain cases. The general odour of the patient may be observed in small-pox, in rheumatism, and some wasting diseases (such as phthisis), and in syphilis; and the odour of particular parts and secretions, as the urine in diabetes, and in cases of the use of certain drugs, or in poisoning. Information is also afforded by the odour of certain discharges, as in ozæna, leucorrhœa, cancer, &c.

The sense of *taste* is seldom employed in clinical investigation, but the physician may make use of the patient's taste, as in tasting the urine in diabetes.

Further aids in Diagnosis.—Having thus summarily described the employment of the special senses in diagnosis and given examples of their use, we may briefly mention some other agencies of more general application. The acuteness of the patient's sense of touch may be determined by the æsthesiometer; the capacity of the lungs may be measured by the spirometer, and the strength of muscles by the dynamometer; the contractility of muscles by galvanism; the force and character of the pulse are determined by the sphygmograph; constant use is found for the microscope, the test-tube, the spectroscope, and polariscope, which aid in determining the character of the various secretions or morbid matters that require to be submitted to investigation. The result of treatment may also be mentioned as an aid to diagnosis, as for example, when an indurated sore yields to the use of mercury. Again, the knowledge that a person has been in a malarious district enables us to decide on the intermittent nature of certain symptoms that may be present. In some cases it may be necessary to render a patient insensible by anæsthetics, with a view to making a complete examination, or in investigating feigned diseases. The administration of small doses of charcoal has been suggested as a means of determining the presence of a passage through the bowels when more or less obstruction exists.

Such then are the means used for taking note of those deviations from health which occur in the several functions and structures of the body, and which constitute what are known as the *Symptoms and Signs of Disease*; these are terms which will be found more specially treated of under the heads DISEASE, Symptoms and Signs of; and PHYSICAL EXAMINATION.

THE DIFFICULTIES OF DIAGNOSIS.—It needs scarcely be said here that the practice of diagnosis is not free from great difficulties. We know how hard it is to obtain in ordinary daily life a reliable account or description of any past or present event. There must be still greater difficulty in obtaining an accurate medical history of a patient's case. He has to tell of facts of which practically he may know much, but scientifically very little. He may be forgetful or ignorant on points about which we most need to be informed. He may be inclined to exaggerate or to suppress facts of material import. Nor are the difficulties less in regard to the *objective phenomena* with which we have to deal. The symptoms of a disease are rarely so clear and definite as to mark its nature, that is, to be *pathognomonic.* They are more often slight, undefined, obscure, and to be found with difficulty. The symptoms of one disease may very closely resemble those of another, whilst those of the same disease will vary at different stages, and in different individuals. Again, the symptoms of a disease may be complicated by the co-existence of those of another disease; whilst a symptom sufficiently striking in itself may be common to, and present in several different diseases. We need only mention, for example, feverishness, pain, cough, breathlessness, and blood-spitting.

These are some of the difficulties which he who has to study the operation of disease in life, has to contend with. He must come prepared for the duty with a knowledge, as we have already said, of the body, its structure and functions in health, and with a knowledge too of those combinations of morbid actions which constitute special forms of disease. For as regards this latter knowledge, all the observations made would remain as isolated phenomena if they could not in each case be grouped as constituting distinct diseases.

We have thus indicated the difficulties of obtaining accurate knowledge as regards both the subjective and objective phenomena. The difficulties are not less when the exercise of the intellectual and reasoning faculties is called upon to analyse, to compare, and to group these phenomena.

The physician may commence his inquiry by tracing up the history of the case and its several incidents, a method which is called the *synthetical*; or he may commence by ascertaining the present condition of the patient, and going as it were backwards in his inquiry—a method which is known as the *analytical.* As a general rule, both methods are combined in the practice of diagnosis.

Observers can sometimes arrive at a *direct diagnosis*, aided by the presence of some characteristic symptom or sign of disease. When diseases which are essentially different have symptoms more or less common to both, the physician will have to institute a *comparison* between them, until he finds sufficient evidence, in the presence or in the absence of some distinctive symptom or sign, to satisfy him as to the nature of the disease which is present. By being able thus to trace the absence or the presence of a given symptom, he may be able to *exclude* the possibility of the existence of one or other of the diseases under investigation. These modes of investigation will be found fully illustrated in the diagnosis of the several diseases described throughout the work.

In conclusion, it must be remembered that these investigations, which call for the exercise of the highest mental faculties, should be conducted without prejudice and without haste. We should never be ready to accept as clear that which is obscure, as established that which is open to question: above all we should remember that, though to err is human, it is our duty to endeavour to ascertain in each and every case, before commencing its treatment, what its real nature is, as far as it may be possible for us to do so. It cannot be too often repeated that the application of a right remedy depends on an accurate diagnosis, and that the prevention and the cure of disease are the aims and ultimate objects of our science. R. QUAIN, M.D.

DISEASE, Duration of.—The duration of a disease signifies the period which elapses between its onset and its termination, in whatever way this may take place. In some instances disease can hardly be said to have any duration, a sudden lesion occurring, which instantaneously, or in a very short time, destroys life; under such circumstances, however, some previous disease has usually existed, though perhaps without giving any clinical evidence of its presence, which determines the occurrence of the sudden result. This may be illustrated by some cases of apoplexy, and of rupture of the heart or of an aneurism. Most affections, as regards their duration, come under one of the three categories already referred to under the classification of diseases, namely, *acute*, *sub-acute*, or *chronic*, but it does not serve any useful purpose to fix any definite limit of time as specially expressed by each of these terms. *See* ACUTE, and CHRONIC.

Acute diseases are of limited duration, and in many of them this is remarkably uniform, as may be illustrated by the acute specific fevers and acute idiopathic pneumonia. Even in such affections, however, there are deviations from the ordinary course, instances occurring in which the duration is longer or shorter than that usually observed, and this fact depends on various circumstances, of which the most obvious are the intensity of the disease in any particular case, the previous condition and surrounding circumstances of the patient, the occurrence of complications, and the treatment adopted. Complaints which are *sub-acute* as regards their duration may be exemplified by many cases of whooping-cough and chorea, and by some cases of pleurisy, phthisis, pneumonia, gastric or enteric catarrh, and certain skin-affections. A large number of diseases are *chronic* in their duration, and many of these when once established become permanent, whilst others are ultimately capable of being cured. As illustrations may be mentioned organic diseases of the heart, most cases of phthisis, cirrhosis of the liver, chronic Bright's disease, dyspepsia, many skin-affections, and also morbid growths in various structures.

Some complaints, as regards their duration, can only belong to one or other of the groups just indicated, but a considerable proportion may in different cases be either acute, sub-acute, or chronic. Again it must be borne in mind that a disease may be acute or even sudden in its origin, but afterwards may subside into a chronic malady. Certain affections are chronic as regards their entire duration, but are characterised by the occurrence at regular or irregular intervals of acute or even sudden attacks, lasting a more or less definite time, which course of events is exemplified by cases of ague, epilepsy, and asthma. FREDERICK T. ROBERTS.

DISEASE, Germs of. — *See* GERMS OF DISEASE.

DISEASE, Prognosis of (πρὸ, before, and γινώσκω, I know).—SYNON.: Fr. *Pronostic*; Ger. *Prognose.*

DEFINITION.—Prognosis is the art of forecasting the progress and termination of any given case of disease. The term is also applied to the foreknowledge thus obtained.

GENERAL CONSIDERATIONS.—It is a matter of interest and often of great importance to be able to indicate with precision how a case of disease or injury will be likely to advance and terminate. This question must be always present to the physician's mind; and it can rarely be absent from that of the patient and of those who are interested in his well-being. It can easily be seen how much depends upon the answer of the physician to the questions constantly proposed to him, How long is this illness likely to last? How is it likely to terminate? If in recovery, will the recovery be complete or partial? If in death, when and how?

GROUNDS OF PROGNOSIS.—The knowledge which can give trustworthy answers to such questions as the preceding must be founded upon an accurate diagnosis of the nature of the disease from which the individual is suffering; upon the capability of remedies to control it; and, lastly, upon an estimate of the constitutional and vital powers of the patient.

First, as regards the *nature of the disease*. Some diseases which are mild in their nature run a definite course and end favourably; take, for example, a simple catarrh. Others commence with great intensity, and come to a favourable or unfavourable termination very rapidly, for instance, Asiatic cholera, of which many of the subjects die in less than twenty-four hours from the time of their first becoming manifestly ill. A third group, such as typhus, typhoid fever, and certain of the exanthemata, run a longer and more defined course, seldom terminating in death except after the lapse of many days, nor in recovery except after a period of some weeks. Another class of maladies, chronic in character, rarely acute, such as we see in tubercular diseases of the lungs, render the patient more or less an invalid so long as he lives, and generally end fatally. The like observation will apply to the so-called malignant diseases.

Secondly, the *intensity of the particular attack* affords further grounds for prognosticating the result. Thus in a fever, great prostration, high temperature, and rapid pulse, indicative of the severity of the disease, must lead to the formation of an unfavourable prognosis; just as great debility and wasting, with disturbance of the nutritive functions generally, would indicate a like result in chronic diseases.

Thirdly, in regard of local diseases or complications, whatever the nature of the disease may be, the *organ affected* must form an important element in prognosis. Thus disease of the brain, or of the heart, or of the lungs, or, in a lesser degree, of other viscera, must, even when not specially severe, be looked upon as affording grounds for anxiety, from a prognostic point of view.

Fourthly, as regards the *constitution, age, and sex of the patient*, it may be safely anticipated that in a patient with a good constitution the prognosis will be more favourable than in a person with a feeble or broken-down constitution. Persons whose vital powers are unimpaired will resist disease, and recover under circumstances which would be fatal to other individuals, in whom, on the one hand, plethoric habits may predispose to acute and rapid changes, or who, on the other hand, by degeneration of tissues may be rendered liable to succumb, and that rapidly, to morbid influences which healthier textures could resist and overcome.

Disease is badly borne by the very young and the very old. In very young children disease rapidly runs its course, favourably or unfavourably. The aged have little power of reaction or of resistance; and disease in them, though less pronounced, more frequently ends unfavourably. In middle life, disease may be expected to assume an acute or sthenic form.

As a rule, sex has little influence on the prognosis of disease, except that usually diseases of equal severity are more amenable to treatment in females than in males. Nervous symptoms are however more easily developed in women, exaggerating a condition that might not otherwise be unfavourable. Menstruation, pregnancy, parturition, and lactation have all a certain amount of influence, sometimes favourable and sometimes the reverse, on disease in the female.

Fifthly, with respect to *treatment*; a more or less favourable prognosis may be founded upon the fact that the patient can enjoy all the advantages afforded by rest, diet, change of climate, &c., which may not be available under other circumstances for like cases. It is well known that there are some remedies which have a specific effect upon certain diseases, as quinine upon intermittent fever; mercury in some forms of syphilis; iodide of potassium in certain stages of the same disease; and colchicum in gout. In such cases a much more favourable prognosis can, of course, be given than in those for which no such remedies are known to exist. Experience tells us that favourable results follow in many other cases in which suitable though not actually specific remedies can be applied.

Taking into consideration, then, the above conditions—the nature, the intensity, and the seat of the disease; the constitution, the resisting-power, the age, and the sex of the patient; and the possibility of applying suitable and efficient remedies—we are able, in a large number of cases, to arrive at an accurate conclusion as to what the course and result of a disease will be.

Difficulties of Prognosis.—Still, to arrive at an accurate prognosis is often very difficult. Disease is not always identical in its character, nor definite in its progress or results. The constitutions of individuals vary, and it is often very difficult to measure their powers of resistance. Remedies, too, vary in their action and their operation; and sometimes we are deceived in the best-founded conclusion as to the results that they will accomplish. There are few physicians who cannot recount the errors of prognosis made by themselves or by their colleagues. Many persons now live who had been doomed to die; and many persons have died whose death was not anticipated. It is the duty of the physician, when asked for his opinion, to state it honestly, but with great discretion, and in general with as much hope as is fairly admissible. He must be guarded as to the manner in which his view is communicated to the patient, for there are many individuals whose temperament is such that the progress of their disease would be greatly influenced for good or for evil by the expression of a favourable or of an unfavourable opinion. At the same time, the physician must avoid deceit; and if there be risk or danger in communicating an unfavourable prognosis to the patient, he must at least communicate it to some judicious individual amongst the patient's friends. Altogether, too much caution cannot be exercised in stating, in any obscure case, what its progress and result will be. There are many cases in which the medical attendant will be justified in replying that he is a physician, and not a prophet. He cannot always foretell results, his aim and object ever being to mitigate the patient's suffering, to prolong life, and to cure the disease if possible: full often to profess or to do more than this is beyond his art.

R. Quain, M.D.

DISEASE, Symptoms and Signs of.—When disease affects any of the functions or structures of the body, it produces certain altered actions or changes, which, when observed during life, become evidences of its presence and often of its nature, and which then are called the symptoms and signs of disease.

The terms *symptom* and *sign* are often used synonymously, though the derivations of the words are by no means the same. *Symptom*, according to its derivation (σύμπτωμα = a coincidence) means simply a *coincidence*, that is to say, it coincides with the presence of certain phenomena. The term *sign* (from *signum*) is more distinctive, and seems more directly to point to some special or peculiar condition. Recently, however, an attempt has been made to give a more special meaning to these terms. Symptom, more especially if it be characterised by the prefix *vital*, is intended to refer to modifications of functions, or to such *subjective* phenomena as we can learn from the patient's account of his feelings. On the other hand, the term *sign*, more markedly with the prefix *physical*, indicates those morbid changes which are *objective* or may be recognised by the senses of the physician, assisted by other appliances.

It would possibly be well if the meanings of the words—symptoms and signs of disease—as above stated, were to come into general use; but there are many difficulties in the way. For example, if the ear be applied to the chest in the case of incompetence of the aortic valves, we hear a murmur, and we say that there are 'physical signs' of aortic valve imperfection; but the locomotive pulse and its peculiar beat, would by many be called a 'symptom' of incompetence of the aortic valves. It is therefore extremely difficult to draw the distinction between the terms symptom and sign.

By whatever name these phenomena may be called, we must rely upon them as the means by which we are enabled to form our diagnosis. The more accurate and complete our knowledge of the functions of the body and of its component parts, and the more capable we are of interpreting, with all the completeness possible, the changes produced by disease, the more accurate will be our diagnosis as to its presence and its nature. How these phenomena may be best observed will be found discussed under the articles on Disease, Diagnosis of, and Physical Examination.

R. Quain, M.D.

DISEASE, Terminations of.—The terminations of a disease must be regarded both from a *pathological* and from a *clinical* point of view. Each pathological process or condition has modes of ending peculiar to itself, but it is beyond the province of this article to discuss these at any length, and one or two illustrations must suffice. Thus, inflammation may terminate by resolution; by the formation of different effusions or exudations; or by causing suppuration, softening, induration, ulceration, or gangrene. Fever, if it end favourably, may terminate by crisis, lysis, or a combination of these modes, or in an irregular fashion. An effusion of blood may remain more or less altered; may undergo organization; may soften and undergo a puriform change; may form a cyst; or may be altogether absorbed.

The *clinical* terminations of diseases are highly important, and demand more consideration. In the first place, a disease frequently terminates in the *death* of the patient. This event may take place suddenly or very rapidly, from the occurrence of some serious lesion, or of grave functional disorder of an organ essential for carrying on the phenomena which constitute life. In other cases death is the termination of a more or less acute illness, either affecting a person previously in the enjoyment of good health; or, what is not uncommon, being the consummation of a chronic malady, which has existed for a longer or shorter period. In still other instances, death is a slow and chronic process, the patient gradually sinking, several causes and morbid conditions often ultimately contributing to the fatal event. The modes in which death occurs are described elsewhere, and therefore need not be discussed in this article. *See* Death, Modes of.

In the next place, a large proportion of cases of disease end in *complete* and *entire recovery*, the patients being restored to their previous state of health, and no organic mischief established. This result may be expected in most of the ailments or functional disorders which are of such common occurrence, provided proper treatment is carried out. Again, the great majority of cases of acute disease terminate in complete recovery, taking them in the mass, though several affections of this class, when they do not prove fatal, are liable to leave behind them more or less serious deterioration of the general health, or even actual organic disease. In this class of cases, when recovery does ensue, it is usually only after a more or less prolonged period of convalescence. Chronic complaints, if they are of a structural nature, cannot in most instances end in complete recovery, although to all appearance the patient may often be quite restored. Even in these cases, however, an actual cure may sometimes be effected, and that after a disease has had a prolonged duration. This is illustrated by several chronic skin-affections, syphilis, and chronic inflammation of mucous surfaces. Or it may happen that the patient recovers perfectly, only with the destruction of some structure which is not essential to life, such as the lymphatic glands.

Thirdly, *partial* or *incomplete recovery* is a very common mode of termination. This is observed in many cases of acute disease, where either the patient remains permanently in a state of general ill-health, without any actual structural lesion being discoverable; or some positive organic affection has been established, of which phthisis remaining after acute pneumonia, or cardiac disease following acute rheumatism, afford apt illustrations. An attack of an acute malady may also serve to bring out some latent constitutional predisposition; or may leave the patient in such a condition that certain so-called constitutional maladies are readily originated from slight causes. Partial recovery, amounting often to very marked improvement, may take place in many serious diseases of a chronic nature. This is illustrated by numerous cases of pulmonary consumption, in which disease great improvement is often observed, not only as regards the symptoms, but also in the local lesions, so much so that patients not uncommonly regard themselves as cured. Again there are some complaints in which apparent recovery is brought about, but a tendency to recurrence remains, either without any obvious reason or from slight causes. Such affections are exemplified by ague, asthma, neuralgia, intestinal catarrh, bronchitis, and certain skin-diseases. As instances of incomplete recovery may be also mentioned the cure of some prominent symptom or symptoms, while the disease which originates these phenomena continues unaltered. Thus, it may be possible to get rid of ascites, which the patient regards as the disease from which he suffers, while cirrhosis of the liver, upon which the ascites depends, is a permanent condition; extensive dropsy and other symptoms associated with cardiac diseases may also be got rid of, while the organic mischief still remains. Sudden lesions may terminate in partial recovery. For instance, a case in which a sudden hæmorrhage into the brain has occurred, attended with marked apoplectic and paralytic symptoms, not uncommonly improves remarkably in course of time, the clot being more or less absorbed. Some complaints, which are usually sudden in their onset, may apparently be recovered from completely, but sometimes set up conditions which ultimately lead to permanent disease. Thus the passage of a gall-stone or of a renal calculus may excite such irritation as to cause an inflammatory process to be set up, which may induce permanent mischief, such as closure of the bile-duct or of the ureter in the several instances, and the effects may not be perceptible until a considerable interval has elapsed.

Lastly, it must be remarked that some affections can hardly be said to have any termination. They continue during the life of the individual, perhaps interfering but little or not at all with the health, or at all events not in any way contributing to the death of the patient, when that event does happen. This applies to many of the ailments from which people suffer; as well as to many chronic organic diseases not in themselves serious or giving rise to any important symptoms, and not implicating structures essential to life. Frederick T. Roberts.

DISEASE, Treatment of.—This term has reference to the means by which disease may be prevented—*prophylactic* or *preventive* treatment; or its effects counteracted when it occurs—*remedial* or *curative* treatment.

1. Preventive treatment will be found discussed under the heads—CONTAGION; CLIMATE; DISEASE, Causes of; DISINFECTION; MALARIA; PERSONAL HEALTH; PUBLIC HEALTH, &c.; as well as in the several articles treating of special diseases. It is therefore unnecessary to say more upon the subject in this place.

2. Curative treatment.—Bearing in mind that disease is a deviation from health in the functions or component materials of the body, it must be remembered that there is in organized bodies a tendency to maintain their healthy function and structure, and in case of disease or injury to recur to it. This is especially manifest in the lower types of animals, which when mutilated are capable of resuming more or less completely their original form, to the extent even of the restoration of parts that have been lost. In man and the higher animals this power of complete restoration is confined to the elementary cells and least complex structures of which the body consists; the more complex tissues are not reproduced, nor are lost parts restored. There is, however, in man, as in all organised beings, a tendency to rectify deviations from health, and to restore the organization to its normal condition. To remove or subdue the causes of disease, and to aid this restorative power in the establishment of healthy function and structure, is for the cure of disease the most philosophical indication that can be adopted. But our knowledge of disease and of remedial agents is not sufficient to enable us always to carry out these principles. As the treatment of disease has been directed sometimes to the one object and sometimes to the other, frequently to neither, it has given origin to a great variety of systems or methods of practice. Thus in the earliest history of the healing art, means the most diverse were used for the relief of suffering. Sometimes the suffering or the disease yielded whilst these means were being employed; and it was concluded, on very insufficient grounds, that these agents had 'cured' the disease. Persons who had felt, as they supposed, the beneficial effects of these particular remedies, communicated them to others as the result of their experience; and thus was established what has been known in Medicine as

Empiricism.—This mode of practice has its advantages and its disadvantages. When aided by accurate knowledge and discrimination it often leads to satisfactory results; and many remedies suggested by experience, and that alone, are now found to be in accord with our more advanced scientific knowledge; take, for example, the use of mercury in syphilis, which though long used empirically, is now known to act by its control over the nutrition of young cellular growths. So also with respect to quinine and other remedies of now established usefulness. On the other hand, mere empiricism, when vaguely applied, taints and damages to this day the treatment of disease. It is this practice which, for example, suggests opium to quiet a cough or a colic, without reference to the cause of the one or the other, and when an expectorant or a purgative would have been the suitable remedy; and it is this empiricism which does such harm in the hands of amateur practitioners, leading them to recommend for the relief of symptoms remedies which they supposed had relieved like symptoms in other cases, however different the real nature or causes of these symptoms may have been.

Rational Treatment.—On the other hand, modern science endeavours to take cognizance of the nature of disease, and also of the specific action of remedies; it seeks to counteract the operation of the one by the influence of the other. This constitutes the rational treatment of disease. To extend this system should be the object of the scientific practitioner. On the one side, it is his duty to study the nature of disease itself, its causes, and their effects; on the other, to study the action of various agents on the living body in health and in disease; and if possible to trace how far the one is capable of combating and subduing the other. This study of scientific therapeutics is of comparatively recent date, and is now pursued with great zeal. The results already arrived at are alike satisfactory and encouraging. As rational treatment becomes more firmly established, scientific medicine will take a more elevated and nobler position. The modes or methods by which the two great principles just alluded to, the foundations as they are of the healing art, have been applied are extremely various, and, although these different methods may be traced to the one or to the other, they have received distinctive names, according as they are marked by some special characteristic. A few of these modes of treatment may be briefly enumerated.

1. *Expectant treatment.*—This mode of treatment is founded on the principle that the restorative power should be allowed entire freedom of action, the practitioner neither assisting nor interfering with its operation.

2. What is called *Homœopathic treatment* would by some persons be included under the preceding head. It proposes to treat disease by giving in infinitesimal doses substances that are supposed to be capable of producing a diseased condition like that which they are intended to cure. It may be described in the words of Molière, who wrote long before Hahnemann, the inventor of homœopathy, as *l'art d'amuser le malade pendant que la nature guerit.* There is no doubt that in this and in similar methods of treatment, the imagination plays an active and useful part.

3. *Palliative treatment* consists simply in the adoption of means which are calculated to soothe, and to lessen suffering, and thereby to prolong life when the cure of disease is not possible.

4. *Stimulant treatment* is founded on a doctrine which regards most forms of disease as associated with or dependent on a lowered state of the vital powers, and which teaches that in such cases the free use of stimulants is the practice most to be relied on. *See* STIMULANTS.

5. *Antiphlogistic treatment* is the converse of the preceding. It recognises in many forms of disease increased nervous excitement and vascular fulness, which are to be remedied by depressing agencies, such as low diet, bleeding, purgation, &c. *See* BLOOD, Abstraction of, and DEPLETION.

6. *Purgative, diaphoretic,* or otherwise *eliminative* treatment aims at removing by the

intestinal mucous membrane, by the skin, or by the secreting glands respectively, certain morbid matters; and thus allowing the restorative power of the system to operate more efficiently. *See* PURGATIVES, &c.

7. The *Water cure*, including baths, acts partly on the principle of elimination, partly by exerting a tonic influence. *See* BATHS and HYDROPATHY.

8. *Revulsive treatment* acts by producing counter-irritation by means of blisters, setons, issues, and the like. *See* COUNTER-IRRITANTS, REVULSIVES, &c.

9. *Dietetic treatment* constitutes a greater or less portion of all modes of treatment. It implies a reference to the kind of food which is adapted to the circumstances in which the patient is placed, and which is suitable in the form of disease from which he is suffering. *See* DIET.

10. The treatment by *Climate* operates more or less by removing the patient beyond the region of noxious influences, and placing him in circumstances which promote healthy action of the several functions.

It is well known that under these several and varied modes of treatment disease may yield and patients may get well. Hence it has been said that as different means are made use of to obtain a single result, the treatment of disease can never be absolutely scientific. Phthisis is pointed out, for example, as a disease which one person seeks to relieve by cod-liver oil, another by climate, a third by tonics, a fourth by sedatives, a fifth by attention to the digestive organs, and a sixth by counter-irritation. We need scarcely say that the disease bearing the name of phthisis is an aggregate of phenomena or conditions, the relief of any one of which may lead to the amelioration of the others. Thus the general health might be improved by climate, and with it all the other symptoms. Cod-liver oil, with remedies calculated to improve the digestion, may lead to healthy nutrition, and thus to mitigation of all the symptoms. The like remark applies to the other agencies mentioned. The treatment of disease must not, then, be condemned as unscientific because it cannot remedy a variety of morbid states by a single agent, but would aim, on still strictly scientific principles, by different agencies to overcome disease the effects of which are manifested in different forms.

In conclusion, it may be repeated that the end and aim of the practitioner should be, if possible, firstly, to discover the cause or causes on which the disease depends, and to remove or counteract them if practicable; and, secondly, to endeavour, by every available means, to restore to health the functions of the body, and with that object to guide and assist Nature, but never to thwart her operations. R. QUAIN, M.D.

DISEASES, Types and Varieties of.—In the case of many diseases more or less distinct *varieties* are recognised, which in some instances constitute well-defined *types*. It is important to understand the precise significance of these terms in different cases.

In the first place the varieties of a particular affection may be founded upon diversities observed in its *clinical history*. Thus, according to the intensity of the symptoms and their duration, a large number of complaints are, as has already been pointed out, divided into acute, subacute, and chronic varieties. Again, many diseases, while presenting in the majority of cases a certain group of symptoms, upon which their general clinical description is founded, exhibit striking differences in the exact nature of the phenomena observed, as well as in their gravity, when the mass of cases is taken into account, and on these differences *varieties* or *types* are founded. This is well exemplified by some of the acute specific fevers, such as typhoid fever, scarlatina, measles, and small-pox. Of these affections several varieties are described, dependent upon the severity of the symptoms, the nature of those which are most prominent, or the characters of the eruption.

In the next place, the classification of a disease into varieties may be founded upon a *pathological* basis. For instance, pulmonary phthisis may arise from different morbid processes, and many attempts have been made to arrange the cases of this disease into corresponding groups. Illustrations of these pathological varieties are also found in the different forms of cancer; varieties of pneumonia, of laryngitis, and of fatty disease of the heart; and in the classification of serous inflammations according to their morbid products, such as fibrinous, serous, purulent, &c. Again, such a pathological condition as dropsy or fever may be divided into varieties. Thus dropsy is arranged according to its situation and distribution, as anasarca, ascites, &c.; or according to its pathological cause, whether cardiac, pulmonary, hepatic, &c. Fever is recognised as having several important types, founded upon its intensity, its course, and the exact nature of the phenomena accompanying the pyrexial state.

Another division of a disease into varieties is *ætiological*, the cases being grouped according to their causation, either the immediate pathological or the more remote exciting causes being employed as the basis of division. Thus we have the different forms of meningitis (simple, tubercular, rheumatic, &c.); the ætiological varieties of pleurisy or peritonitis (idiopathic, traumatic, perforative, tubercular, secondary, &c.); those of joint-inflammation, (simple, rheumatic, gouty, scrofulous, &c.); or those of intestinal obstruction. Ætiological varieties are often at the same time characterised by differences in the pathological results and products. Lastly, it must be mentioned that sometimes a certain *group of symptoms* is summed up for convenience under some single term, which symptoms really depend upon very different morbid conditions and causes; and therefore it often becomes necessary to classify affections thus named into varieties. Dyspepsia, neuralgia, apoplexy, epilepsy, and paralysis will afford illustrations of such an arrangement.

FREDERICK T. ROBERTS.

DISINFECTANTS. *See* DISINFECTION.

DISINFECTION.—SYNON.: Fr. *Désinfection*; Ger. *Desinficiren*.

DEFINITION.—Disinfection, in the proper sense of the term, means any process by which the contagium of a given disease may be destroyed or be rendered inert.

Disinfectants, however, are used in practice for several objects, and in consequence the term has often been vaguely applied to the use of heat or chemical means for preventing the generation or for the destruction of noxious agents, whether products of specific disease or not. In this vague and erroneous sense disinfectants have been confounded with *deodorants*, which merely cover or destroy offensive odours without affecting the contagia; and with *antiseptics*, which 'are fatal to the growth and multiplication of microzymes.' Following the line indicated by Dr. Baxter in his valuable report on an experimental study of certain disinfectants, it is necessary to distinguish—

1. The true meaning of the word—that of acting on the specific poisons of communicable diseases in such a way as prevents their spreading.

2. That of acting upon organic substances in such a way as renders them less liable to undergo molecular change and decomposition, whether spontaneously or under the influence of catalytic agents, as in the case of emulsin upon amygdalin, or under the influence of living organisms, such as are connected with fermentation and putrefaction. Examples of this kind of action are seen in salting meat, and in preserving small animals in weak solutions of carbolic acid.

3. That of preventing or arresting decomposition by killing the torulæ associated with fermentation in slightly acid media, or the bacteroid organisms associated with putrefaction in neutral or alkaline media. Properly speaking, this is the action of an antiseptic, but the relative power of disinfectants has been largely estimated by their efficacy in this respect, partly, no doubt, because antiseptic power is desirable in a disinfectant, but chiefly because it is so difficult to submit disinfectants to their proper test by experimenting upon contagium.

4. That of the destruction of the noxious products of the metabolism of dead organic matter, however brought about. These products consist chiefly of gases or vapours, many of which, such as sulphuretted hydrogen, ammonia, and sulphide of ammonium, are easily destroyed by appropriate agents, even when used in a very dilute state, and success in this respect is no proof of the value of a disinfectant in its true sense, though the power of destroying such emanations is possessed by almost all disinfectants of practical utility.

Mode of Action.—The manner in which disinfectants are supposed to act is very various. Some, such as permanganate of potassium, ozone, and oxygen, set free from water by chlorine, oxidise organic matter. Others, such as sulphurous acid, withdraw oxygen, and have a reducing influence; or, like chlorine, may combine with hydrogen and remove it, or form substitution-compounds. Those of a fourth class, such as chloride of zinc and some other metallic salts, are supposed to owe their activity to the power which they possess of coagulating albumen or combining with it. Another class, of which carbolic acid is the type, is supposed to arrest molecular changes, whether they be those necessary for vital manifestations or for decompositions. And finally, the mineral acids are supposed to be efficacious, in part, at least, because they alter the reaction of the media containing contagia. Most disinfectants act in several of these ways.

General Remarks.—It has been proved that the contagia of several diseases must consist of minute solid particles, for they are neither soluble, nor diffusible, nor volatile, and we may infer that all other contagia are particulate likewise. A characteristic of contagium, due to its particulate nature, is that dilution lessens the chance of infection, but has little effect upon the case if the disease be taken. There is either no effect at all, or a full specific effect. Contagium particles are apt to exist as clouds in air, water, or milk, instead of being equally distributed throughout; and this bears upon practical disinfection. The particulate and non-gaseous form of contagium floating in the atmosphere prevents it from being absorbed by any liquid or solid disinfectant which does not wash or come into intimate contact with every portion of the air, and as this is impracticable, infected air can only be purified by gaseous disinfectants, such as sulphurous acid or chlorine. Disinfectants of this kind, to be effective, must be present in such a quantity as is incompatible with the existence of human beings.[1] From this it follows that saucers of disinfecting fluids, or irritating vapours and gases in the sick-room, are merely a useless annoyance to the patient, except in so far as they may be desired as deodorants. The best method for dealing with infected air is to replace it by ventilation, especially by means of *ventilating* open fire-places. The proper use of volatile disinfectants is the purification of walls, ceilings, and inaccessible places; and for this purpose, if possible, enough should be used to saturate the atmosphere, remembering that the virulent particles are most likely protected by being buried in a bit of epithelium or surrounded by an albuminous envelope.

The nature of the medium in which contagious particles are suspended has the most important bearing upon the selection of a disinfectant. The presence of albumen is found to protect septic germs to a considerable extent against the action of permanganate of potassium and chlorine, but has little or no influence upon the action of sulphurous acid and carbolic acid. Dr. Baxter gives reasons for believing that the comparatively uniform quantitative action of carbolic acid upon contagia and septic microzymes, as compared with the striking differences between the disinfectant action of chlorine and permanganate upon contagia on the one hand and septic microzymes on the other, is chiefly or entirely due to differences in the media in which the respective particles are suspended, and not to differences in resisting power possessed by the particles themselves. This points to an important advantage enjoyed by substances like sulphurous acid or carbolic acid, which appear less influenced by the nature of the medium, and also shows the necessity of thoroughly mixing disinfectants with liquids or substances to be disinfected. The alkaline or neutral character of virulent substances led Dr. Dougall to select dilute hydrochloric acid, which has little action upon lead soil-pipes in the cold, as the best disinfectant for excreta.

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[1] Though disinfectant or antiseptic gases of such strength as can be tolerated in the sick-room are utterly inept as regards useful effect upon contagium, it is just possible that they may be of service in destroying or rendering incapable of change the organic matters evolved from the skin and lungs, which are always very noxious, and may be especially so in disease. These organic matters are necessarily more or less re-breathed unless the patient be placed in a current of air. If ventilation sufficient to prevent all odour cannot be provided, then some gas, such as chlorine or ozone, that will destroy the cause of the odour is certainly desirable.

A cardinal principle in disinfection is that it should be carried out at the source, or as near the source of the contagion as possible. Inunction with lard, with carbolised oil (1 to 40), or with glycerine, to clog epithelial scales, and regular washing and change of clothing, will do much to protect the purity of the air against contagium proceeding from the skin in such diseases as scarlet fever and small-pox. One of ethereal solution of peroxide of hydrogen to 8 of lard is an excellent application for the skin in typhus. Discharges from the mouth, nose, and bowels, as well as the urine, should be received in vessels containing disinfecting solutions to cover them and give protection to the air; and then larger quantities, or more concentrated solutions, as the case may be, should be thoroughly incorporated with the discharges before they are removed from the original vessels.

Of all agencies for preventing the spread of communicable disease, cleanliness is one of the most important. Facts have been adduced pointing to the conclusion that filth, when undergoing change of a fermentative or putrefactive nature, is in a condition the most conducive to the extension of infectious disease. Pending the removal of accumulations of dirt, and for the protection of workmen, fermentation may be delayed by the application of crude carbolic acid, chloride of zinc, or bichromate of potash, used in moderate quantity as antiseptics, and the whole accumulation might then be earthed over if it had to remain any time. For real disinfection the large quantity required and the mixing necessary would be prohibitory.

The ultimate fate of contagium is to be destroyed by putrefaction, and this appears invariably to destroy its specific infective power. In certain cases where real disinfection is impracticable, as in dealing with the accumulation of manure and litter from a number of animals suffering from cattle-plague, the natural processes may be hastened by stacking the material so that it shall 'heat,' or may even be destroyed by spontaneous combustion. Certainly putrefaction should not be delayed by small additions of disinfectants, which cannot accomplish the destruction of all noxious matter present.

Special Disinfectants. 1. **Heat.**—Heat, dry or moist, is perhaps the best disinfectant we possess. The experiments of Drs. Henry, Baxter, W. Roberts and others have shown the effects of this agent upon vaccine, malignant pustule, septic microzymes, scarlet fever, plague, &c. High temperature and length of exposure are, to a certain extent, mutually compensatory, but it appears that a temperature below 140° F. (60° C.) will not disinfect vaccine even with long exposure. Tyndall points out that some germs seem to be in a dormant condition, in which they resist the action of heat unless applied very long or intermittently, so as to start their vitality into growth, when they are easily killed. Experimental facts show that excessive temperatures are as unnecessary as dangerous in practical disinfection. It is extremely improbable that any contagium can withstand a temperature of 220° F. (104·5 C.), maintained during two hours. When contagium is shielded by thick material, into which heat penetrates slowly, the time necessary to reach the disinfecting temperature may be long, and hence the necessity for spreading clothing and opening out bedding in special hot-air chambers, where the heat ought not to be less than 220° F. (104·5 C.), nor more than 250° F. (121·1° C.). Hot-air chambers are usually built of brick, and are furnished with wooden supports for clothing, which should not come in contact with metal.

Dr. James B. Russell, Medical Officer of Health for Glasgow, has communicated to the writer the most important fact, that at the Infectious Diseases Hospital of that city no further disinfection of the linen and clothing of the patients is carried out than is afforded by the boiling, washing, &c., required in the judgment of the washerwomen to cleanse and dress the clothing; and yet a continuous careful scrutiny has failed to discover a single case of disease propagated by such clothing. It is probable that soda is used in the boiling, in some cases at least, and the extreme softness of Glasgow water doubtless helps by its osmotic and dissolving power.

2. **Carbolic Acid.**—A solution of this substance of the strength of 5 per cent., or 1 in 20, is the only one fit for use in disinfection. For steeping fine clothing a solution should be made from crystals. The solution generally useful is that obtained by making up one gallon of crude 80 per cent. acid to sixteen gallons with water. To disinfect a suspected liquid, an equal volume of one of these solutions is needed The results of the experiments of Baxter and others prove that 'no virulent liquid can be considered disinfected by carbolic acid unless it contain at least 2 per cent. by weight of the pure acid.' A preparation called *Macdougall's Powder* contains carbolic acid, but is inferior to the pure kinds, though safer and more applicable in many cases to prevent odour. Judging from the light of experiments, carbolic acid vapour is quite useless, though clinically Mr. Crookes and Mr. Hope thought it of use in cattle-plague, but the animals and surroundings were drenched with liquid acid or solution. Though carbolic vapour appears impotent as regards effect upon contagium it will preserve the freshness of a bit of meat suspended in it for months. Very small quantities of the liquid acid mixed with organic fluids enables them to remain fresh and resist decay for a long time. So little as one-fifth per cent. preserves milk. It is obvious then that small quantities of this disinfectant, instead of destroying contagium, may actually preserve its

activity, when otherwise it would have succumbed to the action of natural agencies. This danger may accompany the limited use of any disinfectant that has a 'pickling' or preservative action in small quantity. Owing partly to the volatility of carbolic acid, which removes it in time, and partly to the peculiarity of its action, another danger attends its use in anything short of full strength and full doses when applied to kill contagium. The acid may, for a time, deprive the contagium of its infective power without permanently abolishing it, and the virulent properties may be regained whenever the acid has evaporated. This has been proved experimentally by Dr. Dougall, of Glasgow, who found that vaccine mixed with carbolic acid (1 in 50) *regained* its infective power after 10 days' exposure to the air.

Carbolic acid coagulates albumen when in sufficiently strong solution; while it restrains putrefaction, and limits the growth of low forms of animal life. It decomposes potassium permanganate, and therefore cannot be used in conjunction with this agent or with chlorine. Though it does not destroy sulphuretted hydrogen, it is a good deodorant in some cases. When Demonstrator of Anatomy to the University of Edinburgh, the writer experimented on a large scale with different substances for removing odour from the hands of the students, after working in the dissecting-room, and found that a 1 per cent. solution of carbolic acid is superior in efficacy to permanganate, even when strong enough to stain the skin, and is also preferable to chloride of lime. In this connection it is worthy of remark that the 'septic ferment' connected with septicæmia, erysipelas, &c., appears to be destroyed by rather less carbolic acid than vaccine requires.

3. **Sulphur Dioxide.**—The aqueous solution of this substance contains sulphurous acid. Baxter's experiments show that it is the most potent volatile disinfectant known; and as it is very soluble, and is little affected by the presence of albumen, it is also powerful in the disinfection of liquids. It destroys sulphuretted hydrogen thus, $SO_2 + 2H_2S = 2H_2O + S_3$, and combines with ammonia. A strong solution of sulphurous acid is sold, but is difficult to use, on account of its suffocating odour. The solution can be made by deoxidizing hot concentrated sulphuric acid with copper-turnings or charcoal. For aërial disinfection the best plan is simply to burn sulphur in very large quantities. This disinfectant forms sulphites, and is a reducing or deoxidizing agent, in the first place, for it unites with the oxygen of many compounds to form sulphuric acid; but it may give up oxygen, and when mixed with much vegetable matter the sulphur may come off as sulphuretted hydrogen. Sulphur dioxide and chlorine, as well as this substance and permanganate of potash, mutually destroy each other, and therefore should not be used together. Sulphur dioxide destroys the activity of dry vaccine on points very rapidly, and even when much diluted stops the amœboid movements of living cells, kills vibrios, and acts deleteriously on vegetation. 'Whether chlorine or sulphur dioxide be chosen, it is desirable that the space to be disinfected should be kept saturated with the gas for not less than an hour.' 'A virulent liquid cannot be regarded as certainly and completely disinfected by sulphur dioxide, unless it has been rendered permanently and strongly acid. The greater solubility of this agent renders it preferable, *cæteris paribus*, to chlorine and carbolic acid, for the disinfection of liquid media' (Baxter). According to Baxter's experiments, a larger percentage of sulphur dioxide than of carbolic acid is required for the disinfection of the virus of infective inflammation, but a smaller percentage for other contagia. Sulphur dioxide preserves meat and other substances, when in closed vessels, for very long periods. It bleaches vegetable colours, attacks iron, and is absorbed by cloth and leather—facts to be remembered in practical disinfection. 1 lb. of sulphur, when burned, produces 11·7 cubic feet of sulphur dioxide gas.

4. **Chlorine** is most easily obtained from chloride of lime or bleaching powder, by adding hydrochloric or sulphuric acid. Exact proportions cannot be stated, as the value of the bleaching powder varies; but rather more acid than equal parts of bleaching powder and strong hydrochloric acid may be taken. The acid should be diluted before use. Another method is to pour strong hydrochloric acid upon heated binoxide of manganese; this method of disinfection is impracticable compared with burning sulphur. For deodorizing water-closets, some crystals of potassium chlorate may be thrown into a wide-mouthed bottle containing dilute hydrochloric acid. Euchlorine comes off gradually, and is both more effective and more agreeable than chlorine. The most marked character of chlorine is its strong affinity for hydrogen, which enables it to break up compounds containing that body, and to set free in a nascent or active state the oxygen combined with hydrogen in water. It is, therefore, one of the most universally applicable and powerful deodorizers in existence. Direct experiment shows that 'there is no security for the effectual fulfilment of disinfection short of the presence of free chlorine in the virulent liquid, after all chemical action has had time to subside.' Chlorine is soluble in water to the extent of 2½ volumes in one, and this solution may be used for disinfection. When merely used as a deodorizer, enough euchlorine may be expelled from moist chloride of lime by the carbonic acid of the air for most purposes.

5. **Permanganate of Potassium.**—This substance is non-poisonous, and is a good deodorant, especially for the emanations from organic bodies. It is, moreover, free from odour, and its aqueous solution shows, by loss of colour, when it is exhausted. It is a very suitable deodorant for the sick-room, as, when dissolved in water and a large surface of the solution exposed to the air, it will absorb gases to some extent. Contagium being non-gaseous, is not affected, unless in contact with the solution. Permanganate of potassium is a true disinfectant, oxidizing and destroying contagia as well as putrid matters; but the quantity required and the price render its use almost impossible, for enough permanganate has to be used to destroy the medium or vehicle bearing contagium as well as the contagium itself. Condy's fluid is

a solution of this substance in water. 'When permanganate of potash is used to disinfect a virulent liquid containing much organic matter, or any compounds capable of uniting with the permanganate, there is no security for the effectual fulfilment of disinfection, short of the presence of undecomposed permanganate in the liquid, after all chemical action has had time to subside' (Baxter). When the virulent liquid or matters are small in quantity, permaganate solution forms a capital receptacle, and may stand by the bedside as a deodorant till required as a disinfectant. The safe rule in employing permanganate as a disinfectant is to add it and mix till the colour is retained. Permanganate has no effect in restraining the appearance of bacteria, or preventing the onset of putrefaction.

6. **Acids.**—The mineral acids and glacial acetic acid have all disinfecting power when used in sufficient quantity; but, except sulphurous acid, there are serious difficulties in the way of their use, and we have better disinfectants. Hydrochloric is inferior to chlorine as a gaseous agent; but the solution is extremely cheap, and is useful for disengaging chlorine, as well as for employment as a disinfectant. Chromic acid, which has remarkable power in preventing putrefaction and killing microzymes, is too dear to be used outside the laboratory.

7. **Nitrous Acid.**—Nitrous acid can be easily disengaged as a gas by putting bits of copper into nitric acid, or pouring nitric acid upon sawdust or starch. It is the best deodorant for the deadhouse, and, without doubt, it is a vigorous disinfectant, but is too dangerous for ordinary use, as it may easily be breathed in quantity sufficient to cause fatal bronchitis.

8. **Chloride of Lime.**—Bleaching-powder gives off chlorine easily, and this probably explains its disinfecting power. It is very cheap and manageable, and hence of much importance.

In regard to the agents hitherto considered, we have more or less of the sure light of direct experiment upon contagium; but the claims of the following and a legion of other substances asserted to be 'powerful disinfectants, of which it is impossible to speak too highly,' rest entirely upon chemical theories, or the opinions of physicians, or upon their power of coagulating albumen, or of delaying or preventing putrefaction and fermentation, or of deodorising. It will be scarcely necessary to do more than enumerate the best, as follows:—

9. **Metallic Salts**, including—*a. Bichromate of Potash. b. Sulphate of Copper. c. Chloride of Zinc* (*Burnett's Fluid*) which can be made very cheaply by pouring hydrochloric acid upon calamine, the native carbonate, or upon zinc. It seems to be the most useful of the metallic salts. *d. Chloride of Aluminium. e. Ferric Chloride*, which, if strong, liberates offensive fumes from animal matters, but is a fair antiseptic and preservative. *f. Ferrous Sulphate. g. The Waste Chlorides*, from the manufacture of chlorine, contain $MnCl_2$, Fe_2Cl_6, and free HCl, which cost next to nothing, and might be used for larger masses of filth or drains.

10. **Ozone.**—This body, got by half immersing a stick of phosphorus in tepid water, or mixing gradually 3 parts strong sulphuric acid and 2 parts permanganate of potassium, oxidises organic matter, and so destroys odours. Terebene and cupralum, a preparation containing terebene, are good deodorants, and give rise to ozone.

11. **Charcoal.**—Charcoal condenses gases within its pores where combustible gases are destroyed by the condensed oxygen. Contagium, unless in water, does not enter the pores, for, being particulate, it is not absorbed from the air as gases are.

Practical Disinfection.—In conclusion a few remarks may be offered as to the modes of carrying out disinfection under circumstances in which it is commonly required.

1. **Clothing and bedding.**—In dealing with the ragged and worthless articles of the poor, local authorities will generally find it most satisfactory to both parties to burn them and replace with new. By such discreet generosity danger is averted, and good-will created, which helps in getting early information and carrying out measures, and so, by shortening epidemics, saves expense. If not burned, clothing may be baked (*see* Heat), or well boiled with soda. Before coming to the washhouse they may steep in 5 per cent. carbolic solution, or chloride of zinc (1 to 240), or chloride of lime (2 oz. to the gallon).

2. **Rooms.**—The foundation for disinfecting rooms is thorough cleansing with soft soap and hot water, which may contain 5 per cent. carbolic acid, but the carbolic solution is not so easily handled. The walls and ceiling should be brushed, and wall-paper removed. Furniture, if iron, is to be washed with carbolic solution, and removed from the room. Textile fabrics should be baked or boiled, or spread out in the room for fumigation, but this is not so effective, and colours are bleached. The chimney, doors, and windows are to be closed, and crevices covered with paper pasted on. Then one or more tubs of water are to be placed in the room, and an earthenware saucer containing sulphur placed over each, supported by a pair of tongs laid across to prevent danger from fire. The sulphur can be lighted by pouring a little alcohol upon it, or by means of a live coal. The usual rule is to use 1 lb. of sulphur for each 1,000 cubic feet of space, but this only gives 1·17 per cent. SO_2 to the air, and 3 lbs. is a more satisfactory quantity. The door is to be shut until next day, when the windows and doors are all to be opened, and kept open for twenty-four hours. In whitewashed rooms the walls should be scraped, and then washed with hot lime in addition to the fumigation.

3. **Drains, Water-closets, &c.**—Proper drains remove sewage so swiftly and completely, that little or no sewage-gas is formed if ventilation is given. For bad drains carbolic acid, chloride of zinc, or waste chlorides from the manufacture of chlorine are fair palliatives. The excreta from cases of infectious diseases require a very large quantity of disinfectant, which should be applied in a concentrated form before they are thrown into the water-closet or house pipes. When a reliable amount of disinfectant is in these cases sent down the pipes, it is apt to corrode them unless it has been allowed to

expend its energy on the excreta alone in the first place. If small quantities of disinfectants are poured down water-closets, it is better to mix them with the after-flush water which fills traps and basins, so that the little energy available may be devoted to the destruction of any slime adhering, or portions of organic matter retained. Permanganate of potash is the most pleasant agent for this purpose, though expensive. Chloride of zinc, from its cheapness and preservative power, is worthy of mention. When there are no water-closets, the excreta in cases of cholera and typhoid fever should be received in a vessel containing half a pint or more of a 1 in 20 solution of commercial hydrochloric or sulphuric acid, and then put along with some chloride of lime into a covered stoneware vessel in the back yard. After a few hours the contents of this vessel may be thrown into the cesspool or upon the midden.

4. **Dead bodies**, if putrid or bearing contagium, should be wrapped in sheets wet with 1 in 20 carbolic solution, or 1 in 40 chloride of lime; or, if coffined, sawdust saturated with one of these solutions should be packed around them.

It is necessary clearly to keep in view the object desired when selecting disinfectants, deodorants, or antiseptics; whether it be destruction of contagium, merely 'pickling' and preserving, arresting putrefaction and fermentation, or deodorisation. From all that has been said it is evident that the different 'disinfecting' nostrums, applied as their inventors direct, can have little effect upon contagium, but may have more or less power in the other directions indicated. JAMES A. RUSSELL.

DISLOCATION OF ORGANS (*dis-*, apart, and *locus*, a place). *See* ORGANS, Dislocation of.

DISPLACEMENT OF ORGANS. *See* ORGANS, Displacement of.

DISSECTION-WOUNDS. *See* POST-MORTEM WOUNDS.

DISTOMA (δὶς, double, and στόμα, a mouth).—SYNON.: Fluke; *Fasciola*; Fr. *distome*; Ger. *Leberwurm*.—A genus of trematode parasites, vulgarly called flukes. The term was founded by Retzius in 1786; but the title Fasciola, previously employed by Linnæus, is the more correct, especially when applied to the common liver-fluke, which is an occasional inhabitant of the human body. Nearly twenty instances of the occurrence of this parasite (*Distoma hepaticum* of some writers) in man have been placed on record. Besides infesting the liver-ducts and gall-bladder, it has been found under the skin behind the ear (Fox), beneath the scalp (Harris), and in the sole of the foot (Giesker).

Several other species of fluke are known to infest mankind, but with the exception of the Egyptian hæmatozoon (*Bilharzia hæmatobia*) none of them are of frequent occurrence. Thus the lancet-shaped fluke (*Distoma lanceolatum*) has thrice occurred, leading to a fatal result in a single instance, whilst the minute *Distoma hyterophyes* has only once been recorded. The large human fluke, sometimes known as Busk's fluke (*Distoma crassum*) had also, until lately, only once been noticed; but, through Dr. George Johnson, the writer has become acquainted with two more instances of infection from this parasite, and there is some ground for believing that the cases of fluke described by Dr. Leidy of Philadelphia refer to the same parasite. More recently also (*Lancet*, 1875) Dr. McConnell has recorded the occurrence of an undoubtedly new species from a Chinese, for which the writer has proposed the title of *Distoma sinense*. Large numbers infested the ducts of the liver. Professor Leuckart subsequently proposed the term *Distoma spathulatum*. Professor McConnell has also discovered another fluke in man (*D. conjunctum*, Cobbold) previously only known to infest the fox and dog. Taken as a whole the human flukes referable to the genus *Distoma* have very little clinical importance; but, since there were striking symptoms in connection with the above-mentioned cases of *Distoma crassum* (affecting an English missionary and his wife during their residence in China) it may be as well to mention that these large parasites, individually varying from one to three inches in length, appear to be capable of inducing severe diarrhœa and colic. Their organisation is totally distinct from that of the common fluke. They probably never gain access either to the liver or its ducts. (*Proceed. Linn. Soc.*, Feb. 1875.) The administration of santonine, male fern, and other anthelmintics has been unattended with positive results; those specimens that were expelled seeming to have been, as it were, starved out by the patients having been put upon a milk diet, recommended by Dr. Johnson. The missionary and his wife having returned to China were again attacked by *Distoma crassum*. In the spring of 1878, they again consulted the writer in London, not only on their own account, but also on behalf of one of their children, a little girl, who had also contracted the fluke-disorder in China. Flukes have twice or thrice been detected in the eye, but they appear to have been sexually immature worms, referable probably, as Leuckart has suggested, to the *Distoma lanceolatum*. The flukes described by Treutler and Delle Chiaje, if genuine, have no clinical importance. *See* BILHARZIA. T. S. COBBOLD.

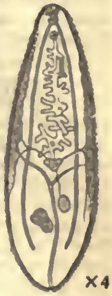

FIG. 16. *Distoma conjunctum* × 4 diameters. After McConnell.

DIURESIS (διὰ, through, and οὐρέω, I pass water).—A free excretion of urine, whether natural or artificially induced.

DIURETICS (διὰ, through, and οὐρέω, I pass water).

DEFINITION.—Remedies which increase the secretion of urine.

ENUMERATION.—The following comprise the most important diuretics:—Water; salts of Potash, Soda, and Lithia; Alcohol, Nitrous Ether, Turpentine, Juniper, Copaiba, Cantharides, Digitalis, Squill, Tobacco, and Scoparium. The action of diuretics is often aided by brisk purgation, depletion, counter-irritation over the loins, and sometimes by the use of mercury.

ACTION.—The secretion of urine appears to consist partly of mechanical filtration of fluid through the glomeruli of the kidney, and partly of secretion by the cells of the urinary tubules. The filtration in the glomeruli is increased by anything which raises the blood-pressure throughout the system generally, or in the renal arteries locally. The systemic blood-pressure may be raised by cold to the surface, digitalis, squill, and tobacco. Digitalis, and possibly other drugs have also a local action on the renal arteries, which are more readily affected by some drugs than other arteries in the body. The exact mode of action of the other diuretics is not determined, but common salt, nitrate of potash, urates, and urea increase the flow of urine, even although the pressure in the vessels of the kidney is very low. It is therefore probable that they stimulate secretion by acting on the nerves or cells in the kidney itself.

Uses.—Diuretics are employed to increase the flow of urine, and thus remove water or excrementitious products like urea from the body. They are used in cases of general dropsy, or of accumulation of fluid in the peritoneum or pleura. In febrile conditions they are given to aid in the elimination of waste matter. They are also employed in order to render the urine more watery, and thus prevent the deposition of solids from it, and the formation of calculi in the kidney or bladder, or to redissolve such concretions when they are already formed. Digitalis and squill are most useful in dropsy dependent on heart-disease; the other remedies are more effective in dropsy dependent on disease of the kidneys or liver. The action of digitalis and squill is greatly assisted by the addition of a little blue pill, and when the kidneys are much congested or pressed upon from without by accumulation of fluid in the abdominal cavity, diuretics sometimes fail to act until the congestion has been relieved by depletion from the loins or the use of a brisk purgative, and the pressure removed by paracentesis. T. Lauder Brunton.

DIZZINESS. *See* Vertigo.

DOCHMIUS (*δόχμος*, twisted).—A genus of nematoid worms established by Dujardin. *See* Sclerostoma.

DOTHINENTERITIS (*δοθιὴν*, a pustule, and *ἔντερον*, the intestine).—A synonym for a form of enteritis, accompanied by an enlargement of the follicles, which causes them to resemble pustules. *See* Intestine, Diseases of.

DOUCHE (Fr.).—Definition.—A jet of water propelled against some part of the body through a *doccia* or pipe. The size of the jet of water, the degree of its impetus, and its temperature, can all be regulated. A douche differs from simple affusion in its application, being more local, and the force with which it is applied being greater.

Application and Action.—Douches of cold and of hot water, of vapour, and occasionally of gas are employed; but those by far the most commonly used, except where there are hot natural waters, are of cold water.

The immediate effect produced by a cold douche on those who are unaccustomed to it is a feeling of shock, spasmodic shortness of breathing, palpitation of the heart, and sometimes pain in the back of the head. Locally the first effect of a douche is to deaden the sensibility of the part to which it is applied; but if the douche be powerful enough, reaction of the part comes on in about forty seconds. This continues for a time; but if the douche be kept up for three or four minutes, the pulse falls seven or eight beats, the deadening of sensibility returns, and the temperature of the part is greatly lowered; when the douche is withdrawn reaction again takes place. This alternate sedative and stimulating effect, producing emptiness and turgescence of the vessels, quickens the action of the capillaries of the part, and thus favours the transmutation of tissue. The mechanical effect of the force with which the douche is applied must not be overlooked. If great, it produces the highest amount of stimulation, which may almost amount to inflammation.

Different portions of the body have different degrees of tolerance of the douche. Thus the extremities and the head bear it better than the chest, and the chest somewhat better than the abdomen; and the posterior aspect of the body bears it much better than the anterior. Patients soon get accustomed to the cold. Warm douches produce less shock, and are more easily borne, but they are, comparatively speaking, little employed in private houses. An alternation of hot and cold douches, known somehow by the name of *Scotch*, is a valuable remedy; in it the hot water rapidly restores the irritability of the part deadened by the cold water, and there is a maximum of action and reaction of the part obtained. Under particular circumstances it may be expedient to use a jet of steam, but this, of course, must be used with caution; and a jet of carbonic acid is sometimes propelled against the eye or ears, or the neck of the uterus. What are called *ascending douches* are used for the rectum or the vagina. Douches for the eye and the ear have been used of late years. In a certain sense what the English call *pumping* is a variety of the douche, and the *shower-bath* is in reality merely a multiplication of fine douches. The action of douches is more or less general according to the portion of the body to which they are applied. Thus the application of a douche to the head has the most general action, and that to the spine the next so. In either case it is impossible to limit it very strictly, and there is a certain amount of affusion besides the direct douche. A douche, again, applied to one of the extremities may easily be localised; and a douche may be applied only to one part or to several parts of the body in succession.

Douches merely require a pipe with nozzles of various sizes in connection with a cistern at a certain elevation, or with a pumping machine, and can easily be improvised. Shower-baths can be procured with equal facility. A vapour douche can be got by attaching a pipe to a vessel of boiling water. In the case of the fine douches used for the eye, the water is propelled with sufficient force by the action of a caoutchouc bag worked by the hand. Carbonic acid is practically little used, and only where there is an abundant natural supply of the gas.

Perhaps 50° may be considered the average temperature of a cold douche, and from four minutes to a quarter of an hour its average duration. The course of douching will probably extend at least over a fortnight. As to the actual temperature of the water, the sensation it produces in the patient depends most on his condition. Thus water of 45° may feel ice-cold to one who has just quitted a hot bath. In like manner a douche of slightly-heated water may appear quite warm when applied to a part cooled by a cold douche. The temperature of a douche should vary according to the condition of the patient.

Uses.—As a general rule we may say that douches are only applicable in cases of chronic disease; that cold douches are most useful in constitutional diseases; and that warm douches, and the alternation of hot and cold, are most suitable in local affections.

The cold douche, when it is employed gradually and with judgment, is found serviceable in chlorotic and hysterical conditions, in hysterical paralysis, and in over-sensibility of the skin, with tendency to catch cold; and of late years it has formed a part of the special treatment of phthisis in elevated places. As cold affusion on the head is very serviceable in infantile convulsions, so the application of a douche of cold water to the head is a calmative and hypnotic in maniacal cases. It is, perhaps, not so much used in this way as formerly, as it has, like the shower-bath, come to be considered a sort of punishment to troublesome lunatics. Still it is a valuable agent. Hydropathic practitioners have found douches useful revulsives in congestion of the liver and of the uterus.

Locally douches have been used, but with moderate benefit only, in some cases of skin-affections and of chronic ulcers. Their principal local application, however, is in cases of old sprains, in chronic rheumatism or gouty thickenings of joints, in lumbago, in some neuralgias, and in paralysis when it is not too recent. The *Scotch* is far the most effective for these purposes, and there seems to be some evidence of its having been efficacious in threatened tabes dorsalis—certainly more efficacious than any other remedy. Douching might be used more extensively in private houses; still, as assistance is always required by the patient, public baths have advantages for their application.

John Macpherson.

DRACUNCULUS (*dracunculus*, a little dragon).—A synonym of the guinea-worm. Under this title the parasite was described by Lister (*Phil. Trans.*, 1690), and afterwards by Kaempfer (1694). Following the latter authority the writer has elsewhere recognised the term as of generic value, but the majority of helminthologists, after Gmelin, prefer to place the worm under the genus *Filaria* (*F. medinensis*). The Dracunculus was known before the time of Lister, having been described in a remarkable work by Velscius (1674) and by Agatharchidas as quoted by Plutarch. There is, indeed, every reason to believe that the so-called fiery serpents of Moses answer to the dracunculi of Plutarch. The matter is fully and learnedly discussed in Küchenmeister's treatise (*Parasiten*, S. 305; also in the English edition, p. 390 *et seq.*). *See* Guineaworm. T. S. Cobbold.

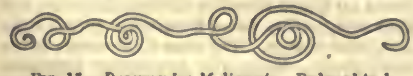

Fig. 17.—*Dracunculus Medinensis.* Reduced to ⅓.

DRAINAGE. *See* Public Health.

DRASTICS (*δράω*, I act).

Definition.—Violent purgatives.

Enumeration.—The drastics most frequently employed are:—Hellebore, Podophyllin, Gamboge, Elaterium, Scammony, Jalap, and Croton oil.

For action and uses of drastics, *see* Purgatives. T. Lauder Brunton.

DRIBURG, in Westphalia. Strong Chalybeate Waters. *See* Mineral Waters.

DROITWICH, in Worcestershire. Common Salt Waters. *See* Mineral Waters.

DROPSY (*ὕδρωψ*; from *ὕδωρ*, water, and *ὦψ*, aspect, appearance).—Synon.: Fr. *Hydropisie*; Ger. *Wassersucht*.

Definition.—Accumulation of serous fluid in the subcutaneous cellular tissue, or in a serous cavity.

Dropsy is known by various other names, according to the portion of the body affected. When confined to the subcutaneous cellular tissue it is termed *œdema* or *anasarca*; to the peritoneal cavity, *ascites*. The term is often limited to these two forms of the disease; and exudations similar to that of ascites in other cavities are termed *hydropericardium*, *hydrocephalus*, *hydrocele*, *hydrops oculi*, *hydrops articuli*, and *hydrothorax* or *pleural effusion*, according as they are contained in the pericardium, arachnoid, tunica vaginalis, eye, joint, and pleura respectively.

Pathology.—The accumulation of fluid in the tissues, or in a serous cavity, depends upon more fluid exuding from the blood-vessels than can be taken up by the absorbents. So long as no obstruction to absorption occurs, it rarely happens that more fluid can exude from the blood-vessels than the absorbents can again take up. Absorption is partly carried on by the veins, and partly by the lymphatics; principally, however, by the veins. When venous obstruction takes place, fluid is apt to accumulate in that part of the body from which the blood ought to return by the obstructed vessel. But it does not always so accumulate; for it may happen that the lymphatics are able to absorb all the fluid which exudes from the capillaries, and to return it into the general circulation. Thus it has been found by Ranvier that ligature of the vena cava in a dog does not usually produce œdema of the lower extremities, but if one sciatic nerve be divided in such an animal, the corresponding leg at once becomes œdematous. The reason of this is that so long as the nerve is intact, the lymphatics can absorb all the fluid which exudes from the capillaries, but when the nerve is divided the arteries dilate, more fluid is poured out than the lymphatics can absorb, it accumulates in the tissues and œdema ensues. This œdema is not due to paralysis of the limb, but to paralysis of the vessels. For if the sympathetic fibres through which the vaso-motor nerves pass to the sciatic nerve are divided before they join the motor fibres of that nerve in the sacral plexus the power of movement remains unimpaired, but œdema occurs just as if the whole nerve had been divided. If, on the other hand, the motor strands of the sacral plexus are cut before they are joined by the sympathetic fibres, the limb is as completely paralysed as if the sciatic nerve had been cut, but no œdema takes place. Any obstruction to the venous flow will operate in the same way as ligature of a vein, though to a less extent, the effect varying according to the amount of obstruction. Thus regurgitation of blood through the tricuspid valve tends to produce general anasarca, and obstruction to the portal vein by cirrhosis of the liver tends to cause accumulation of fluid in the abdominal cavity.

It has been mentioned how great an influence dilatation of the arteries from vaso-motor paralysis has upon the *production* of œdema in cases where the veins are obstructed. Arterial dilatation may also produce a local œdema, even when no such obstruction is present, as, for instance, in the tissues around an inflamed part. It has been shown, however, by Winniwarter, that the walls of vessels in an inflamed part are more permeable, and allow fluids to pass through them more easily than healthy vessels will do. It is probably in consequence of this that we find that a slight stimulus, such as scratching the skin, which ordinarily produces in a healthy person only slight dilatation of the capillaries, and consequently redness of the part scratched, will produce an effusion from the vessels, and local swelling of the part at the point scratched in persons suffering from urticaria. The same thing takes place when the skin is scratched in the neighbourhood of a part stung by a wasp.

But this alteration in the vessels is not the only cause of the œdema, which may occur without any obstruction to the circulation. An alteration in the composition of the blood appears to allow it to permeate more easily into the tissues, and to produce œdema, even when there is no obstruction of the veins. In cases of anæmia we find œdema occurring at the ankles, although there is no obstruction to the venous circulation other than that caused by the weight of the column of blood itself. In these cases, however, we have dilatation of the vessels, as is shown by the form of the sphygmographic tracing, and an altered composition of the blood is evidenced by the anæmic look of the patient. The dropsy of scurvy is probably also due to blood-vascular disorder. In albuminuria the altered composition of the blood appears to be the chief factor in the production of œdema, as the pulse in such cases may be hard, evidencing arterial contraction, and not relaxation.

Ætiology. — General dropsy affecting the subcutaneous tissue, the peritoneal cavity, and the internal serous cavities and organs generally, is usually the result of albuminuria, and most frequently of that form which depends on fatty degeneration of the kidney. In cirrhotic disease of the kidney the loss of albumen in the urine is much less, and the alteration in the composition of the blood consequently is not so great as in the first-mentioned form. The arterial tension also is greater than usual, instead of being less. In the amyloid form the œdema is generally moderate.

The next most common cause of dropsy is tricuspid regurgitation, obstructing the venous circulation throughout the body. This regurgitation generally depends on dilatation of the right ventricle consequent upon obstruction to the flow of blood through the lungs, either from chronic bronchitis and emphysema, or mitral obstruction and regurgitation. Dropsy from cardiac disease generally appears first in the feet if the patient has been for some time in an upright position, while dropsy from albuminuria is often first remarked by a puffiness of the eyelids. In the former it appears where the greatest obstruction to re-absorption takes place, and in the latter case in those parts where looseness of the cellular tissue most readily allows of exudation.

Local dropsies have, as a rule, local causes. Even the swelling of the feet in anæmic young women, although dependent on a general cause, viz., dilatation of the vessels, and altered composition of the blood, is determined locally by the greater obstruction to the venous circulation which the pressure of the long column of blood in the veins between the feet and the heart presents. In general dropsy also, those parts which are most dependent are apt to become most swollen. It is not, however, always so, as in certain cases the dependent parts have been noticed to be less dropsical than the others. This curious phenomenon seems to be due to some vaso-motor nervous influence on the vessels of the dependent part. The local œdema of a brawny character, often noticed around inflamed parts, is partially due to swelling of the tissues themselves, and partially to effusion of fluid between them. This effusion, as has already been mentioned, appears to be caused both by the dilatation of the vessels observed in inflamed parts, and by the greater readiness with which fluids pass through them.

Dropsy in Serous Cavities.—The serous cavities of the body, the arachnoid, pleura, pericardium, peritonæum, &c., are now known to be large lymph-sacs, in communication with the general lymphatic system of the body. The fluid which exudes into them from the blood-vessels is, in the peritonæum and pleura, removed, at least in part, by a pumping action in the movements of respiration. The central tendon of the diaphragm contains spaces, the walls of which are alternately drawn apart and pushed together during its ascent and descent. Their separation draws up lymph from the abdominal cavity, and their compression forces it onwards through the lymphatic vessels. The same thing occurs in the costal pleura, during the respiratory expansion and contraction of the chest. The accumulation of fluid in serous cavities may be due, like its accumulation in the cellular tissues, either to diminished absorption or increased exudation. The diminished absorption occurs here in consequence of pressure upon veins, and possibly also from interference with the pumping action just described. Accumulation of fluid in the ventricles of the brain, or in a sub-arachnoid cavity, is chiefly due to compression of the veins of Galen. In the peritonæum it may be due to obstruction of the portal vein by cirrhosis of the liver or by the pressure of tumours, and it may occur to a greater or less extent in all cavities of the body—from general obstruction of the venous circulation, by disease of the heart or lungs, in the same way as anasarca. It may also occur in these cavities from alteration in the blood, as in Bright's disease. Active dropsy may occur in a serous cavity from inflammation, and here the exudation of fluid is much more rapid than in passive dropsy, the vessels of the inflamed part being dilated and more pervious than usual.

Treatment.—The first thing to be considered in the treatment of dropsy is the removal of its cause, if this be at all possible. Where it is due to obstruction of a vein we must hinder, as much as possible, the accumulation of fluid in the vein, by preventing the part from remaining in a dependent position, while at the same time we try to aid the absorption of fluid by the lymphatics by gentle upward friction. Where it is due to obstruction of the circulation in the lungs, we must diminish, as far as possible, all obstructions to the pulmonary circulation by inhalations, emetics, and expectorants, pushed if necessary so far as to cause nausea or even vomiting. Where, the obstruction is due to dilatation or valvular disease of the heart, we must aid the organ to contract more powerfully by the use of cardiac stimulants, such as alcohol and digitalis. Digitalis probably has a threefold action in cardiac dropsy, by strengthening the heart, by contracting the vessels, and by stimulating the kidneys. It strengthens at the same time that it slows the cardiac pulsations, and by making the heart contract more powerfully it keeps up the onward current of the blood more efficiently, and at the same time lessens the dilatation which tends to render the valves incompetent. Besides its effect on the heart, digitalis has also an action on the vessels, causing the arterioles to contract, and probably reducing the dropsy in this way. For the contraction of the arterioles produced by digitalis is exactly the converse of the condition which occurs after division of the vaso-motor nerves, and which, as we have seen, produces dropsy whenever any obstruction of the circulation exists. It is not known at present whether digitalis also causes increased absorption, but it seems highly probable that it does so, because we know that it stimulates the vaso-motor centre, and stimulation of this part of the nervous system has been shown by Goltz to increase greatly the rapidity of absorption from the lymph-sac of the frog. In addition to this action on the heart and vessels generally, digitalis possesses a specific action upon the vessels of the kidney. It is a powerful diuretic, and by thus lessening the amount of water in the blood it will tend to increase the absorption of serous fluid either from the cellular tissue or serous cavities. When digitalis alone does not succeed, the addition of squill and of a small quantity of blue pill frequently increases its efficacy. Digitalis succeeds best in dropsy caused by valvular disease or dilatation of the heart. It is not so useful in dropsy arising from renal disease, and here other diuretics are preferable. One of the best is spirits of juniper, given either as a mixture or in the form of Hollands gin. Spirits of nitrous ether, nitre, bitartrate of potash, and broom are useful in all forms of dropsy. Copaiba occasionally succeeds where other diuretics fail. It seems to be most successful in dropsy due to cirrhosis of the liver. Hydragogue cathartics, such as compound jalap powder, elaterium, &c., which cause copious watery secretion from the intestines, supplement the action of diuretics, and by removing water from the body, as well as altering its nutrition, relieve or remove dropsy. In some cases of Bright's disease considerable relief has been obtained by the profuse sweating induced by vapour baths, hot-air baths, jaborandi, or pilocarpin. When the dropsy does not yield to other remedies, the fluid must be removed by paracentesis in the case of serous cavities, and by very small superficial incisions or punctures, or by the insertion of very fine trochars with drainage-tubes attached, in the case of the limbs.

T. Lauder Brunton.

DROWNING, Death by.—Drowning is employed, in an extended sense, to signify death from submersion in a liquid medium, and in a more restricted sense to signify death in consequence of obstruction of respiration so caused. Now, though death must necessarily ensue from asphyxia, when the air-passages are submerged, apart from any other complication, asphyxia is not always the mode of death in those who were alive at the moment of submersion. For death may result from mechanical injuries, concussion, shock, syncope, or apoplexy in the very act, or at the moment, of falling into the water. Devergie estimates that 12·5 per cent. of deaths occur from one or other of these causes. In the remaining 87·5 per cent., the phenomena of asphyxia pure and simple are present only in 25 per cent., while in 62·5 per cent. these are more or less modified by the causes above-mentioned, to which must be added the benumbing influence of cold.

When death is not sudden from shock, &c., the ultimate result is the same in the swimmer or non-swimmer, if there be no escape or rescue. All efforts to keep above water fail, vain clutchings are made at whatever comes within reach, water is drawn into the lungs and more or less swallowed, all struggles finally cease, and the body sinks.

The indications of such instinctive efforts form the most important evidence of submersion during life. Drowning is not necessarily to be inferred in the case of a dead body removed from the water; for the body may have been thrown in after death from other causes—asphyxia among the rest.

The Evidence of Death from Drowning is cumulative, for we can scarcely say that there is any one indication invariably present which can be looked upon as due to drowning and nothing else. But one or other, or more, of the following appearances are generally found.

External.—The face is either pale, or more or less livid, or frequently bloated if the body has lain some hours in the water. Foam at the mouth and nostrils is very common; and the tongue is swollen and congested, closely applied to the teeth, or even clenched between them. The skin is pale, or marked here and there by livid discolorations, and the muscles of the hair-bulbs are rigidly contracted, causing the appearance of goose-skin, or *cutis anserina.* The penis is remarkably retracted, so that it appears quite small in proportion to the size of the individual.

Indications of struggling are frequently seen in excoriations of the hands, mud and sand under the nails, or even weeds, straws, or other small objects, tightly clenched in the hands.

Internal.—The trachea, bronchi, and smaller air-tubes are congested and filled with a mucous froth, more or less tinged with blood. The lungs themselves are congested, œdematous, and pit on pressure. Pressure on them causes froth to exude into the smaller bronchial tubes, and on section a sanguinolent froth and water escape. Indications may be seen of sand, mud, or small weeds drawn deep into the air-passages along with the water in which submersion took place.

The stomach contains water. If this has any special character by which it can be identified with that in which submersion occurred, and not likely to have been drunk to quench thirst, it excludes the theory of its having been swallowed before submersion; and is a strong presumption, if it cannot be said to be a certainty, that it was swallowed during the death-agony, and did not find its way into the stomach after death. The same may be said of water in the lungs.

The right side of the heart and venous system in general frequently present the appearances characteristic of asphyxia; and the brain is often congested.

Without relying on any one sign as conclusive, we may say that a body which exhibits goose-skin, retraction of the penis, excoriations, &c., of the hands, froth at the mouth, water in the lungs and stomach, and congestion of the right heart and venous system, certainly died from drowning. In the presence of some and in the absence of other indications, a careful weighing of all the facts is necessary; but in most cases a satisfactory conclusion can be arrived at.

Complete submersion is usually sufficient to cause death within two minutes; but cases have been recorded of resuscitation after a much longer period. Many of these can be attributed to the exaggerated estimation of time by anxious on-lookers; but there are other well-authenticated instances, which may be explained by the supervention of syncope and temporary cessation of the respiratory process. That which renders resuscitation after submersion less likely than after a corresponding period of mere suffocation is the entry of water into the lungs by aspiration.

Treatment.—The treatment of the drowned consists in the persistent use of artificial respiration (*see* Artificial Respiration, and Resuscitation) so long as any signs of life remain, together with the application of means to counteract the great abstraction of body-heat which occurs even when the aërial temperature is comparatively high. Before commencing the movements of artificial respiration, the mouth and nostrils should be freed from water and froth, by holding the head somewhat low, face downwards, for a few seconds. Artificial respiration should then be immediately proceeded with; and at the same time the wet clothes should be removed and the body wrapped up in warm clothes obtained from bystanders, pending the arrival of warm blankets, hot bottles or bricks, &c., from the nearest house. Assiduous friction of the extremities should also be kept up. These directions—artificial respiration excepted—naturally presuppose assistance. If this be not at hand, the operator must rely mainly on artificial respiration. In the performance of artificial respiration by Sylvester's method, especial care must be taken against pressing on the stomach, for as it so frequently contains water, this may be pressed up the œsophagus, and drawn into the lungs by the next inspiratory movement.

When spontaneous respiratory movements commence, attention should be directed to maintain life, by the application of warmth externally, assiduous friction of the limbs upwards, and the administration of a teaspoonful of brandy and water, wine, or coffee. Lung-complications should be watched for and counteracted.

D. Ferrier.

DROWSINESS.—Inclination to sleep. *See* Sleep, Disorders of.

DRY.—A term applied to certain morbid conditions, to express the entire or comparative absence of fluid exudation or secretion, which is often present in such conditions; for example, Dry Gangrene, Dry Cavity, Dry Catarrh, and Dry Pleurisy. The word is also associated with certain ausculatory signs, which convey the impression of want of moisture; for example, Dry Rhonchus and Dry Crackle. *See* Physical Examination.

DUCHENNE'S PARALYSIS. *See* Pseudo-Hypertrophic Paralysis.

DUCTUS ARTERIOSUS, Patency of.—*See* Heart, Malformations of.

DUMBNESS.—Definition.—The condition of an individual incapable of articulating sounds.

Dumbness may arise from a variety of causes, and its prognosis and treatment vary accordingly.

1. Dumbness due to Deafness.—The most frequent cause of so-called dumbness is congenital or early acquired complete deafness, or defective power of hearing, so that the patient is unable to acquire in an ordinary way the knowledge of articulate sounds. It is important to bear in mind that complete deafness is not essential to this peculiarity. Dumbness is frequently met with in children and others where the only cause is *defective* power of hearing.

Treatment.—Whether the outcome of complete or partial deafness, the treatment must be based on the belief that the articulating power is latent, and may be developed by imitating the process of speaking in others, and by a methodical training in lip language. It is most important that sign language should not be cultivated at the same time, and that if a language of signs, whether by the hand or gesture, have been previously taught, it should be thoroughly and at once discarded. With patients who have full intellectual power, and who are trained as indicated above, it will be found that for them dumbness is a misnomer, articulate sounds, although with a defective modulation, being readily acquired. Individuals coming under this category are erroneously called deaf-mutes.

2. **Dumbness from Central Lesion of the hypoglossal nerve.**—This may arise from cerebral hæmorrhage, tumours, or embolism, and the prognosis is most unfavourable. It is usually associated with other paralytic conditions, but is of all the most persistent.

3. **Dumbness from peripheral lesion of the hypoglossal nerve.**—This is much less frequent as a cause of dumbness than central lesions; nevertheless cases are met with where hydatid or other tumours result in dumbness through pressure on the nerve itself.

4. **Dumbness from Lead Poisoning.**—Among the paralyses arising from the slow effects of imbibition of lead is paralysis of the tongue, with consequent loss of articulating power. This defect is usually associated with grave impairment of other parts.

TREATMENT.—The treatment of dumbness due to lead-poisoning will be best effected by elimination of the poison by the administration of iodide of potassium, and the judicious employment of galvanism to the spinal system.

5. **Dumbness from congenital defects of the tongue or of the palate.**—Various congenital local lesions are met with giving rise to dumbness.

TREATMENT.—Many of these cases are remediable by surgical or surgico-dental help, followed by methodical teaching.

6. **Dumbness from emotional lesions.**—Dumbness occasionally arises from great emotional disturbance, such as great anger or sudden fright. Moreover, it is often met with, without such marked cause, in individuals, especially of the female sex, having a highly developed emotional life.

TREATMENT.—Cases of this kind are usually successfully treated by faradisation about the muscles of the neck; the patient at the same time being encouraged to call his articulating power into action, and in proportion to his success the faradic current being discontinued. The moral treatment here indicated may be greatly assisted by promoting the general health, and placing the patient under the best possible circumstances as to hygiene and moral discipline.

7. **Dumbness from intellectual disorders.**—This is by far the most common cause of true dumbness. It may arise from idiocy or imbecility of a congenital nature; from that which has been acquired early in life; or from dementia as the outcome of acute or chronic brain-disease in middle or advanced life. Among the congenitally feeble-minded, dumbness is a very frequent phenomenon. This arises from the association therewith of deformed mouths and highly-arched palates; from defective power of co-ordination of the muscles of the tongue; and from an inability to transform ideas into word-signs. In the most profound cases there is such an absence of ideas that language of any kind is not required.

TREATMENT.—The treatment of this kind of dumbness is one which requires great tact, patience, and energy; and the success will be commensurate with these aids.

The physical health of the individual should be carefully attended to, so as to induce, by judicious food, frequent bathing, and warm temperature, the highest amount of nervous energy. The power of co-ordination should be sedulously cultivated by methodical exercises, especially of the hands, leading up to well-devised tongue-gymnastics. He should then be taught monosyllabic sounds, by being shown the object represented by the sound, while he imitates the sound when watching the teacher's lips. Having thus acquired the power of producing the word-sign by imitation purely, he is next taught to repeat it from memory when shown the object only. After nouns have thus been taught, the names of qualities and adverbial expressions should be added, and in this manner articulate speech built up.

Where the feeble-mindedness has been acquired after birth, the dumbness resulting therefrom should be treated in a somewhat similar manner to that having a congenital origin, but the prognosis is not so good.

Still more unfavourable is the forecast of dumbness when the result of dementia.

J. LANGDON DOWN.

DUODENUM, Diseases of.—These may be considered under the heads of—1. *Functional disorder*; and 2. *Organic diseases.*

1. *Functional disorder* of the duodenum is said to produce a form of dyspepsia, characterised by pain in the epigastrium and right hypochondrium two or three hours after meals, vomiting, and the distant effects of ordinary dyspepsia—vertigo, headache, drowsiness, burning sensation in the soles of the feet and palms of the hands, &c. Imperfect chymification which attends ordinary dyspepsia may induce these symptoms by generating products which irritate the duodenum. The *treatment* is mainly that of disordered digestion. The bowels and the diet are to be carefully regulated; and such remedies as alkalies, bismuth, oxide of manganese, prussic acid, or hydrochloric acid, exhibited, according to the special requirements of each case.

2. *Organic diseases.*—These are inflammation; ulceration; and new-growths.

a. **Inflammation.**—SYNON.:—Duodenitis; Fr. *Duodénite.*—*Acute* inflammation of the duodenum is usually of a mild catarrhal character. It either forms part of an enteritis, or is an extension downwards of a similar affection of the stomach. The ordinary exciting causes are exposure to cold, and irritating ingesta or acrid bile. Usually the symptoms of slight gastric catarrh—a loaded tongue, anorexia, nausea, vomiting of tenacious mucus—are followed by jaundice. When the duodenum is invaded there is said to be fulness and tenderness of the right hypochondrium. As a rule, however, new symptoms are not set up unless the bile-ducts become obstructed by mucus from extension of the catarrh into them, when jaundice supervenes without pain. The attack usually lasts a week or a fortnight, and, with suitable hygienic and dietetic treatment, passes safely off; it is, however, sometimes followed by jaundice unusually prolonged, and, even when the bile-ducts are free, by prostration and wasting out of proportion to the mildness of the disease in itself. While catarrhal duodenitis does not present characteristic symptoms, it is, however, usually suggested by painless jaundice following exposure to cold, catarrh of the stomach, and enteritis.

Treatment.—This consists in rest in bed, warmth, liquid diet, counter-irritation by mustard and hot poultices, and effervescing salines.

Chronic inflammation, resulting in thickening of the mucous and submucous tissue, and even adhesion of the duodenum to adjacent organs is usually associated with chronic ulceration, or with cancer of the duodenum, pancreas, liver, or other structures. Contraction of the duodenum produces symptoms of obstruction similar to those arising from stricture of the pylorus.

b. **Ulceration.**—*Perforating ulcer*, similar to that of the stomach, is said to be more frequent in men than in women, and hardly ever to occur during childhood; while it frequently follows severe and extensive burns and scalds. The ulcer, usually found in the upper horizontal portion, when recent has clean-cut edges free from swelling. The wall of the duodenum may be perforated, either without previous adhesion, being followed by the signs of general peritonitis; or with adhesion to adjacent parts, such as the liver, the gall-bladder, the pancreas, the colon, the hepatic artery, or the posterior wall of the abdomen—into which ulceration extends to a variable extent. Cicatrisation may induce stricture of the duodenum or obliteration of the bile-duct. As a rule the symptoms greatly resemble those of perforating ulcer of the stomach; more frequently, however, the disease is latent, and induces very obscure dyspeptic symptoms prior to fatal perforation. Jaundice is not more common than in the similar affection of the stomach. In burns and scalds perforation seldom occurs before the tenth day.

The duodenum may be ulcerated by the action of a gall-stone passing into it directly from the gall-bladder.

c. **New growths.**—The most important of these is scirrhous cancer, which may involve the walls of the duodenum, usually by extension. It tends to produce obstruction, or it may set up chronic duodenitis, or block up the bile-duct, and thus give rise to jaundice.

George Oliver.

DURA MATER, Diseases of. *See* Meninges, Diseases of.

DURATION OF DISEASE, *see* Disease, Duration of.

DYNAMOMETER (*δύναμις*, power; and *μέτρον*, a measure).

Description.—The dynamometer is an instrument originally invented by M. Duchenne, of Boulogne, for measuring and accurately recording the strength of the hand-grasp, and also for measuring the traction power capable of being exerted by other groups of muscles. The result is shown by an index, which traverses a semicircular dial bearing a scale graduated so as to enable the observer to record the number of kilogrammes which the applied pressure or traction represents. In practice this instrument has been principally employed for estimating the absolute or comparative force of the hand-grasp; and in view of this restriction, Duchenne's instrument is needlessly complex. It has, moreover, the absolute disadvantage of being a little too broad, and of requiring too much strength on the part of the patient to move the index over the lower figures of the dial. A patient with a small amount of motor power, especially if the hand is small, is often unable to set the index of this dynamometer in motion. A cheaper, simpler, and narrower instrument has, therefore, been devised by English makers, the index of which can be moved by the application of a much smaller amount of power. This consists of a simple elliptical ring of steel, to the inner and anterior face of which is attached a brass semi-circular dial graduated with two rows of figures representing pounds instead of kilogrammes. The compression of the steel ring, by lessening its shorter diameter, moves a metal bar projecting from and sliding in a groove behind the dial, and this by rack-work communicates its movement to the index.

Uses.—The dynamometer is a useful instrument, inasmuch as it enables us accurately to ascertain the relative compressing powers of the two hands in cases of incipient or actually developed hemiplegia, and also to learn in a positive and definite manner, from time to time, the amount of improvement or the reverse which may have taken place. Since the power of the muscles of the fore-arm and hand, like that of other groups of muscles, varies a good deal with the general state of health of the patient, the dynamometer is also capable of yielding valuable information concerning the strength of the patient, even where we have not to do with a case of paralysis. Any instrument which, in the place of fleeting and more or less vague impressions made upon the mind of the practitioner at the time, enables him to make a more accurate record in figures in his note-book, is a clear gain to practical medicine—more especially when its use involves no appreciable loss of time.

H. Charlton Bastian.

DYSÆSTHESIA (*δὺς*, with difficulty, and *αἰσθάνομαι*, I feel).—A term applied to impairment of any of the senses, but especially to that of touch. *See* Sensation, Disorders of.

DYSCRASIA (*δὺς*, difficult or bad, and *κράσ.ς*, a mixture). A morbid condition of blood.

This term signifies more than a disposition to disease; it implies the presence of some general disease exerting its pernicious effects upon the blood. Hectic fever, septicæmia, and metastatic inflammations are diseased conditions referable to dyscrasiæ. A person sickening for a fever is the subject of a specific dyscrasia. *See* Blood-Disease.

R. Douglas Powell.

DYSENTERY (*δὺς*, with difficulty, and *ἔντερον*, an intestine). Synon.: Fr. *Dysenterie*; Ger. *Dysenterie*.

Definition.—A specific febrile disease, characterized by considerable nervous prostration and inflammation of the solitary and tubular glands of the large intestine; sometimes ending in resolution, but frequently terminating in ulceration, occasionally in more or less sloughing or gangrene; always accompanied by tormina and tenesmus, the latter being most marked when the disease is located in the rectum or lower end of the sigmoid flexure; stools at first more or less feculent, later on yielding dysenteric products without much if any feculence, such as blood, mucus, slime, and gelatinoid exudation, or—as in the sloughing or gangrenous forms—like the washings of meat, and possessing a putrid or gangrenous odour, and so-called epithelial, ash-coloured, black, gangrenous, pus-infiltrated or tubular sloughs, chiefly consisting of tough, imperfectly organised exudation.

ÆTIOLOGY.—In almost all, if not in all, situations where malarious fevers abound, as in the vicinity of the swamps and sluggish rivers of tropical and sub-tropical countries, dysentery prevails in proportion to the intensity and frequency of these fevers. When, on the other hand, intermittents and remittents have been extinguished by improved drainage and the conversion of marsh into cultivated land, it becomes equally unknown. In or near the tropics, Great Britain, Canada, the United States, and in many other parts of the world, its diminution has proceeded *pari passu* with the decrement of malarious fevers. There would, therefore, seem to be some intimate connexion between the causation of dysentery and intermittent and remittent fevers.

Paroxysmal fevers interfere materially with the nutrition and functions of the digestive organs, and with the proper nourishment and constitution of the blood. Violent congestion of the abdominal viscera is one of the special conditions of the different forms of ague. Both the liver and spleen are liable to temporary and repeated engorgement, and so in fact are all the organs which minister to gastric and intestinal digestion. Even where malarious poisoning may never have resulted in any of the various forms of periodic fever, it may impair the power of the organic nerve-centres and the muscular tone of the blood-vessels, thus disturbing the balance of the portal circulation, and leading to more or less permanent repletion or congestion. As the congestion is most embarrassing during digestion, interfering with the appetite, and the capacity for digesting and assimilating food, its repeated and prolonged existence must deteriorate the quality and modify the quantity of such important secretions as the gastric juice, the bile, the pancreatic juice, and those furnished by the follicles of Lieberkühn, and by Brunner's and the solitary glands. Crude alimentary principles are thus assimilated from the intestinal tract. The liver is especially liable to functional derangement from the stagnation and slowing of the portal circulation, and thus it happens that in dysentery hepatic impairment is almost an invariable accompaniment. Such being some of the abnormal conditions produced by the operation of malaria in its active or latent form upon the chylopoietic viscera, it is not surprising that, under the prolonged strain, certain portions of the alimentary mucous membrane should break down. Why the solitary glands of the large intestine should be the special seat of dysentery, whilst the corresponding glands in the small intestine should, with few exceptions, escape, it is, in the present state of our knowledge, impossible to say. The most that can be hazarded is, that the elementary structures of these glands take on morbid action through the operation upon them of a *materies morbi* derived directly from their blood-supply. That this poison exists in the blood may be inferred from the fact that constitutional disturbance invariably precedes and accompanies the earlier stages of acute dysentery.

Unwholesome drinking-water is a fertile proximate and exciting cause of dysenteric disease. Bad and unwholesome food of whatever description, by providing aliment incapable of being perfectly digested, may act in producing the disease. In like manner impure air may, by preventing the proper aëration and depuration of the blood, and by promoting the retention in it of inassimilable material, light up dysenteric inflammation of the solitary glands. The transit of acrid and vitiated bile and other secretions poured into the digestive canal, often operates as an exciting cause, and frequently determines a morbid action which might be otherwise righted by resolution, to advance to ulceration, sloughing, or gangrene. It is thus that many a simple but neglected case, scarcely at first distinguishable from diarrhœa—unless indeed every evacuation is most carefully washed and scrutinised—ends in destruction of large masses of the mucous membrane, and death, from the conjoint effect of exhaustion and shock from the separation of the sloughs. Indigestible articles of diet, which cannot be reduced by the juices of the digestive tract to a condition admitting of ready absorption, may act as local irritants and exciting causes. Not only is this so in the earliest visible stage or that of active congestion, but it becomes much more susceptible of demonstration in the exudative and ulcerative phases of the disease, by the repeated investigation of the subjective and objective indications. Thus the aggravation of the tormina and tenesmus in adults and children is traceable to indiscretion in diet, or to the passage of undigested morsels of food, recognisable in the stools. Sudden vicissitudes of temperature from a high to a low range, or exposure to damp and cold combined, especially when the vital powers are physiologically depressed, by checking the excretory action of the skin and diminishing the cutaneous circulation, augment the portal congestion and excite dysenteric disease. This is probably the reason why, in a large proportion of cases, the onset of the disease is ushered in towards midnight or the early morning. The influence of epidemic states of of the atmosphere in the causation of dysentery, signifies only that it is most prevalent at those seasons when malarious fevers are most abundant. As there is an intimate connexion between the existence of malaria and the prevalence of dysentery, it is not difficult to understand why, both as regards type and seasonal frequency, dysentery should bear a striking relation to the severity and seasonal prevalence of malarious fevers.

Is dysentery a contagious or communicable

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disease?—Whilst many of the older physicians held that it might be spread by contagion from person to person, it may be affirmed that the experience of most modern practitioners is altogether opposed to this view. There is no clear and unimpeachable evidence to demonstrate that it is propagated in the same way as typhus or smallpox. It may possibly be communicable, like typhoid fever, through air, water, or food—liquid or solid—charged with material derived from the undisinfected and putrefying products of the disorder. Be this, however, as it may, the complete disinfection or destruction of the alvine evacuations should always be regarded as a sanitary measure of supreme importance.

Anatomical Characters and Pathology.—The dysenteric process generally consists of a specific inflammation of the solitary glands (Parkes, Baly, and others). The *first* visible change is congestion, the vessels surrounding and penetrating the capsules being turgid and engorged with blood. The *second* change is augmentation of their contents from the accumulation of albuminous exudation, and enlargement 'from the size of a millet seed to a small shot' (Baly). The *third* change is, provided the inflammation advances, rupture of some of the capillaries in the interior of these little vascular glands, extravasation of blood, with the area of the ordinary dark point on the free aspect increased. The *fourth* stage is now marked by atrophy and molecular disintegration of the free aspect of the capsular wall, and escape of its morbid gelatinoid blood-tinged contents into the canal of the intestine. This is the rule, but, in very exceptional cases, the capsule may burst through the attached portion, lighting up inflammation in the neighbouring connective tissue and muscular coat. In a large number of instances, the morbid process may stop short, under proper treatment, at any of the first three stages, and repair is then effected by resolution. In many cases the morbid action is cut short after the completion of the fourth stage, without further extension of the disease. The adjoining follicles of Lieberkühn do not, in these cases, necessarily participate, to any great extent, in the diseased process. Under these conditions, when the whole of the exudation has been expelled, the glands regain their tone and functions, and recovery—rapid and complete—ensues. It is not often possible to illustrate these conditions in the post-mortem room; because, when death supervenes from dysentery alone, the ravages committed upon every structure of the mucous membrane are so extensive as to destroy the earlier physical phases of the disease. In some cases, however, which have died from intercurrent affections, the writer has been able to demonstrate the earliest stages successfully to his students, at a period prior to the implication of Lieberkühn's follicles, of which the mucous membrane is in great part composed, and to exhibit to them the gelatinoid exudation, termed by others 'gelatinous mucus,' free from or tinged with blood taken from enlarged and diseased solitary glands (*Indian Annals of Medical Science*, p. 190, No. xxiii., 1868).

When, owing to neglect, to constitutional defect in spite of the most careful therapeutic and hygienic management, or to intensity or quantity of the specific poison, the disease is not cured by resolution, the disintegrating or ulcerative process is developed. The whole of the solitary glands engaged perish. The ulceration involves the neighbouring tubular glands, leading to ulcers varying from the size of a mustard-seed to that of a florin or more, in depth generally extending to the submucous connective tissue, and not infrequently laying bare the circular lamina of the muscular coat, sometimes involving the longitudinal layer and perforating it as well as the peritoneal coat, thus admitting of the extravasation of the contents of the bowel into the peritoneal cavity and lighting up peritonitis, which, if general, is invariably mortal, but which, if local and confined to the close vicinity of the perforating ulcer, is not necessarily so.

The ulcers vary in appearance, size, and shape. They may be mere abrasions without much loss of structure, *minute* though penetrating rather deeply into the submucous connective tissue; *irregular*, *serpentine*, or *rodent*, with here and there portions of the surrounding mucous membrane undermined and patulous; *transverse*, embracing partially, or completely, the entire circular outline of the mucous membrane; *circular*, or *oval*, with regular and even margins; or *tubercular*, involving the whole substance of the mucous membrane, looking as if they had been punched out of it. These ulcers, as generally observed in the post-mortem room, are free from sloughs, and present a pale ashy appearance. Sometimes they are of a vermilion or purple colour, from active or passive congestion. They are often covered with flakes of tenacious lymph or exudation, and this may sometimes be seen spread over the neighbouring mucous membrane. The floors of these ulcers are usually formed by inflamed and thickened submucous areolar tissue; but sometimes this has all been destroyed, and then they are constituted of the muscular coat, thickened and infiltrated by inflammatory products; and when the muscular structure has itself yielded to the ulcerative process, they are made up of congested and swollen peritoneum which, as already stated, occasionally becomes perforated.

When the ulceration proceeds solely by molecular disintegration massive sloughs are not observed. But when, as not uncommonly happens in asthenic, malaria-stricken, tubercular and worn-out constitutions, tissue-death occurs *en masse*, at an early period of the attack, sloughing of the mucous membrane, together with portions of the muscular coats, or gangrene, is to be seen. These sloughs, or gangrenous portions of tissue, may be limited in extent. Some or all of them may be successfully detached during life, and can be identified as they are examined from time to time in the stools. In the post-mortem room they may be found partly detached and lying loose, mixed with the fluid contents of the bowel, or attached more or less firmly, sometimes compact, nodular, ecchymosed, gray or olive-coloured, green or yellow and pus-infiltrated, black, flaky, shreddy, shaggy, flocculent like pieces of teased cotton-wool, or ragged and stringy. In the truly gangrenous dysentery, the mucous and muscular coats are enormously thickened, and large portions are found gangrenous, varying in colour from a pale olive to purple or black. These appearances and conditions may be restricted to the cæcum and ascending colon, or to the sigmoid flexure, but sometimes they are co-extensive with the internal structure of the large intestine from the ileo-colic valve to the anus. When the ileo-colic valve becomes destroyed, invagination of the lower end of the ileum into the cæcum sometimes happens, causing intestinal obstruction. Occasionally many inches of the gangrenous mucous membrane, with or without the muscular coat, is either found hanging loose in the lower part of the gut, or in process of being detruded from the anus.

In ordinary acute dysentery, advancing to ulceration or sloughing, repair is, doubtless, accomplished, as a general rule, by granulation and cicatrisation. This process can be readily observed in dysenteric lesions of the mucous membrane of the lower end of the rectum, and in healing of the surgical ulcer within the verge of the anus. The reason why repair is frequently accomplished so slowly is because, owing to the irritation caused by the exalted vermicular contraction of the gut and the passage of flatus, fæces, and other products, it is impossible to command the physiological rest necessary for speedy and substantial granulation and cicatrisation. Unless the destruction of tissue is very great, the contraction due to cicatrisation does not occasion much future inconvenience. But if it embraces a large portion of or the whole circumference of the mucous membrane, the subsequent contraction may produce dangerous narrowing of the calibre of the gut, or stricture of the sigmoid or rectum. The thickening and contraction, especially in the attenuated victims of chronic dysentery, can be identified by physical examination. These constrictions are frequently the mechanical cause of constipation and fæcal accumulations.

There is no valid reason for believing that, in true dysenteric ulceration, the lost tissue is ever actually reproduced. When the ulcers have been small, the contraction following repair is sufficient to bring the follicles of Lieberkühn on all sides into close juxtaposition. And this it is which has given rise to the impression among some pathologists, that the lost tissues have been renewed by a process of development and growth. But whenever the ulcers have been too large to admit of obliteration, microscopical examination shows that they have been bridged over by cicatricial tissue, devoid of solitary and tubular glands and sparingly supplied with blood-vessels and absorbents.

In addition to the above anatomical characters, the mesenteric glands are generally found to be enlarged, and as an accompaniment or sequel, organic disease of the liver or abscess is not infrequently discovered to complicate the disease.

Symptoms.—Every attack of acute dysentery is preceded by disordered digestion and constitutional disturbance, indicated by loss or capriciousness of appetite and furred tongue, constipation alone or alternated with looseness, dryness of skin, occasional chilliness and general malaise, with slight rise of the evening temperature. These signs may be viewed as cotemporaneous with the progress of the morbid action going on in the solitary glands. As the disease advances, there is more marked chilliness, succeeded by distinct feverishness. If the bowels have been confined, they now act spontaneously—expelling, at one or more acts of defæcation, almost the whole of the contents of the large intestine. If they have been loose, with or without aperient medicines, the feculence is not so great in quantity. But in either case, beyond a little mucus, there is not as yet any discoverable dysenteric product in the stools. Prior to this conservative evacuation of the bowels, the febrile excitement sometimes runs high; there is thirst, bad taste in the mouth, flatulency, a variable amount of nervous and muscular debility, griping, an accelerated and irritable pulse, restlessness, disturbed sleep, or actual insomnia. During, and immediately after, each evacuation there is tenesmus or painful straining—most intense in those cases where the disease is located in the descending colon, sigmoid flexure, and rectum. The stools are offensive, but there is nothing at this stage pathognomonic in their odour. If, as frequently happens in private practice, the patient comes under treatment at this period, a small dose of castor oil guarded by laudanum, or a full dose of ipecacuanha, with absolute rest in bed and bland liquid nourishment, is sufficient, in a certain proportion of cases, to put a stop to the morbid action, and to promote cure by resolution in from twenty-four to forty-eight hours.

When, however, the disease persists, the symptoms continue in an aggravated form. The tormina and tenesmus become intensified; the desire to go to stool is more frequent, and to remain on the stool or bed-pan more irresistible and enduring, especially if the disease be concentrated in the sigmoid flexure or rectum. In rectal dysentery, there is dysuria, frequent micturition, and sometimes retention, from spasm due to reflex action, necessitating catheterism. The consumption of solid food—even of the most digestible kind—provokes and aggravates the tormina. The griping and tenesmus are now so intensified in degree, and increased in frequency, that each recurrence of them produces much depression and exhaustion, and a pinched and anxious expression of the countenance, with augmented frequency and weakness of the pulse. There is abdominal tenderness. During the acme of the tormina, the patient experiences difficulty in localising this tenderness. He will then declare that he feels agonising pain over the greater part of the abdomen, with or without the application of pressure. But in the absence of the tormina, careful palpation will enable the practitioner to localise it in those portions of the intestine above the rectum affected by dysenteric inflammation. At this stage the tumefaction of the walls of the gut is seldom great enough to be distinguished through the abdominal parietes. The scanty stools are now characteristic, consisting of mucoid exudation tinged with blood, or bloody mucus or slime from the inflamed tubular glands, with isolated portions of gelatinoid exudation, more or less coloured with blood from inflamed and ruptured solitary glands, and with little or no feculence. These conditions are cotemporaneous with the rupture of the affected solitary glands, and a highly inflamed state of the adjacent follicles of Lieberkühn, as well as of the subjacent and intervening connective tissue. The muscular tissue, though not yet necessarily inflamed, is nevertheless hyperæsthetic. It is this hyperæsthesia which has more to do with the production of the agonising tormina than the diseased glandular organs implanted in and forming a constituent portion of the mucous membrane. These are the symptoms presented in a goodly number of cases met with in private practice, and in a smaller proportion admitted into hospital. The disease is said to have lasted from two to six or eight days. In uncomplicated cases occurring in tolerably good constitutions, they generally yield, without extension of the mischief, to rest, bland liquid food, and full doses of ipecacuanha.

In cases which have been neglected or aggravated by indiscretions in diet and drink, or by diathetic or other defect of constitution, the dysenteric process passes on to ulceration. If the patient has not been brought under proper therapeutic and hygienic management, the tormina, tenesmus, local tenderness, and hardening of the superimposed abdominal muscles are augmented. The calls to stool are more frequent and painful. The urine is scanty and high-coloured, and is surcharged with lithates and biliary pigment. The stools mainly consist of the foreign products already described, but in greater quantity, are now possessed of a peculiar sickly smell, and yield portions of exudation in masses of greater or smaller size, simulating sloughs, but which, on microscopical examination, are seldom found to afford positive evidence of dead tissue-elements.

Unless the disease bends to treatment, it may terminate in sloughing. This may be restricted or extensive. Death of portions of the mucous membrane is always accompanied by vital depression or well-defined muscular and nervous prostration, cardiac enervation, and an accelerated and feeble pulse. In some cases, tissue-death *en masse* happens at an earlier period, even before the rupture of the solitary glands, and the sloughs can be discovered in the stools in from the eighth to the thirteenth day. The acme of vital prostration is manifested during the detachment of the sloughs, when the exhaustion is often much increased by hæmorrhage. Improvement in the strength, volume, and slowing of the pulse, and in the expression of the countenance, the comparative relief from tormina and tenesmus, cleaning of the tongue, and the substitution of feculence for dysenteric products in the stools, signify, in these cases, the probable cessation or turning-point of the disease. The converse implies that the sloughing is extending, and a succession of sloughs of various kinds, with or without muscular structure, continues to be passed, which, in the process of separation, are accompanied by much bleeding, especially in patients poisoned by malaria or afflicted with the scorbutic or hæmorrhagic diathesis. The abdominal tenderness and hardening of the parietal muscles are marked during the separation of the sloughs. The affected portions of the colon can be felt to be swollen, doughy, and 'puddingy' (Chevers). The skin, in unfavourable cases, becomes clammy, features and eyes shrunken, body emaciated, appetite in abeyance, thirst great and distressing, tongue dry and brown, pulse feeble and running, and stools extremely offensive, bloody, slimy or watery, with varieties of sloughs and exudation. The sensibility becomes so blunted that the stools are passed without much pain—often involuntarily; and the patient eventually dies from sheer exhaustion from the extension of the sloughing, or the end may be accelerated by perforation of the bowel in one or more places, leading to extravasation of some of the contents of the intestine into the peritoneum, and general peritonitis.

Sometimes, from the commencement of an attack, or during the course of acute dysentery, rapid sloughing, passing into gangrene, of large patches of mucous membrane, attended by increasing prostration and soon merging into collapse, forms the chief pathological condition. As this extends until, in many instances, it involves almost the whole of the mucous membrane, submucous tissue, and muscular structure, it is characterised by intensified collapse. The tormina and tenesmus, at first excruciating, suddenly disappear, to the delusive relief of the sufferer. Until the gangrene has spread to a great extent, the stools contain a large quantity of slime, blood, pellicular-looking exudation, and much gelatinoid exudation; but as the living mucous membrane becomes diminished, these products also decrease, and, in their room, we notice a watery product of a dark purple or black colour, resembling the washings of meat, giving off an incomparably offensive and gangrenous odour. To the naked eye, and on washing, these stools seem to be absolutely devoid of feculence. They yield a granular sediment of a black colour—gangrenous *débris* blackened by the combination of sulphur with the iron of disorganised cruorin. The abdomen, at first doughy, becomes tympanitic and free from pain on pressure, and the surface cold and clammy; the countenance resembles the haggard and sunken appearance presented during the algid stage of cholera; the tongue is dry, brown, and fissured; the pulse is thready and rapid; food and medicines are rejected, the dejecta are passed involuntarily, perception is blunted, delirium supervenes; and the patient at last succumbs, worn out and exhausted, in from the sixth to the thirteenth day, according to the range and severity of the disease and the constitutional power of the patient.

Chronic Dysentery.—This is sometimes the result of acute dysentery, in spite of the most appropriate management, in persons poisoned by malaria and weakened by fatty or waxy degeneration of the spleen or liver, or both, and in strumous or scorbutic constitutions. The dyscrasia may be so pronounced that the material exuded is incapable of healing up the ulcers by granulation and cicatrisation. The ulcers are repeatedly disturbed by peristalsis, the passage of flatus, fæces, undigested morsels of solid food, and the acrid unutilised secretions of the liver, stomach, and pancreas. Thus they are liable to become irritable from renewed congestion and inflammation. The muscular coat participates in the excitement and becomes infiltrated with exudation, which eventually becomes organised and leads to thickening. The floors and sides of the ulcers are constituted of unhealthy structure. The difficulty thus experienced in effecting repair is augmented. In other cases the intestine becomes atrophied, attenuated, and transparent. The stools are made up of serous exudation, slime, blood, and sometimes of puriform material, with feculence generally unformed. Almost every stool will be found on washing to contain dysenteric products. The appetite is uncertain; the tongue often clean, shining, and devoid of epithelium; the pulse weak and irritable; and the abdominal tenderness easily localised. Thickening can often be detected. Tormina are always present, and unless the disease be confined to the cæcum or ascending and transverse colon, there is tenesmus. Multiple abscesses of the liver frequently supervene and carry off the patient, or after months or years of suffering he may perish from inanition and exhaustion, or from intercurrent disease.

Complications.—Acute dysentery is frequently complicated by the various forms of malarious fever, typhoid fever, the tubercular or the hæmorrhagic diathesis, purpura, scurvy, hepatic and splenic enlargement, malarious cachexia, or abscess of the liver; and in children by dentition. In every case of dysentery the strictest attention should be paid to existing complications. In patients inhabiting marshy districts, and those following a seafaring life, the gums should be carefully scrutinised and the cutaneous surface examined with a view to ascertain the freedom or otherwise from purpuric or scorbutic taint. The history of the patient should be gone into, in order to make out the probable diathetic proclivities—acquired or hereditary.

Sequelæ.—That abscess of the liver, single or multiple, frequently follows acute and chronic dysentery, is indisputable; but whether as a result of the general condition existing, or of local pyæmic poisoning or embolism originating in the veins within the area of the ulcers, is still an open question. Dysentery sometimes terminates in permanent thickening of the parietes of the gut with eventual contraction or stricture, causing constipation, fæcal accumulation or obstruction. When the seat of stricture can be reached, as in the lower part of the rectum, much relief can be afforded by simple incision and subsequent dilatation by means of bougies. Fissure of the anus, or ulcer within the verge of the anus, is a common sequel. Once diagnosed by examination of the stools and by means of the speculum, it admits of speedy relief by incision and after-surgical management.

Diagnosis.—From diarrhœa, dysentery can be diagnosed by the abdominal tenderness, tormina, tenesmus, and the existence of dysenteric products in the stools. Dr. Edward Goodeve, late Professor of Medicine in the Calcutta Medical College, was the first to carry out the practice of washing the stools in dysentery and diarrhœa. The stools are first examined as they lay in the stool-pan. Water is then added in considerable quantity. After a short interval, to allow the dysenteric products to sink to the bottom, the supernatant fluid is gradually poured off. The washing is repeated until the foreign products remain clean and destitute of much smell. When these products are putrescent, or perhaps in all cases, it is convenient to wash the stools with a solution of carbolic acid or other colourless disinfectant. Dysentery is diagnosed from *fissure or ulcer of the rectum* by the fluid or loose character of the stools, with dysenteric products, and by the absence of ulcer, as determined by examination by means of the anal speculum.

Prognosis.—*Favourable.* The following are to be regarded as favourable features in the prognosis of any given case:—The ordinary uncomplicated form of acute dysentery; early subsidence of the constitutional disturbance; a steady, firm and strong pulse, with diminishing frequency and increasing power; moderate abdominal tenderness; absence of tympanites; a placid and normal expression of countenance; absence of sloughs or putrescent matters in the stools; early subsidence of tormina and tenesmus with the appearance of feculence and the cotemporaneous decrease of dysenteric products; return of appetite and power of digesting and assimilating food; and the absence of inflammatory or suppurative mischief in the liver.

Unfavourable.—Unfavourable features, on the contrary, are:—The persistence of an elevated temperature; quick pulse with increasing feebleness; sudden freedom from tormina, tenesmus, and abdominal tenderness, with great vital depression or collapse; doughy thickening of the colon with dulness on percussion where there should be resonance; sudden increase of abdominal tenderness, with hiccup, nausea, vomiting, and great nervous prostration, tympanites, and peritonitic pain with constant hardness and tension of the abdominal muscles; increase of putrescent and gangrenous products in the stools like the washings of decomposing flesh; excessive hæmorrhage from the bowel; bleeding from chapped and fissured lips, gums, and mouth; harsh, dry, black or glazed tongue; delirium; picking at the bed-clothes; scantiness or suppression of urine.

Treatment.—Should an aperient be required in the congestive, exudative, or ulcerative stages of acute dysentery, or in sudden relapses supervening upon chronic forms of the disease, the readiest, simplest, and most painless is a tepid water enema of from two to four pints. After the operation of the enema, or immediately the patient presents himself suffering from any of these dysenteric conditions, in those cases where no preliminary aperient is indicated, a turpentine epithem or mustard plaster should be applied to the epigastrium for twenty minutes. At the same time, from twenty grains to a drachm of ipecacuanha suspended in two drachms of syrup of orange-peel and four drachms of water, or in half an ounce of infusion of camomile, with ten grains of carbonate of soda or bismuth, or simply made up into conveniently sized pills, should be administered. The recumbent posture, with the head lower than usual, should be enforced. Liquids should be resisted as much as possible for an hour or two. Thirst may be quenched by sucking pieces of ice, or, when this cannot be procured, by cold water in teaspoonsful at a time. Nausea will probably occur; perhaps, in some cases, retching and vomiting. But as the vomiting is exceptional, and when it does occur seldom happens before the lapse of an hour after the exhibition of the drug, the ejected matter usually consists of small quantities of gastric secretion. Should the ipecacuanha be rejected, the dose should be repeated as soon as the stomach has been tranquillised. It will be found beneficial to time the large doses, so as to allow of one being given night and morning so long as their use is considered necessary. The signal for the relinquishment of these doses is freedom from tormina and tenesmus, with the occurrence of refreshing sleep, feculent, bilious, or ipecacuanha stools, and restoration of the primary processes of assimilation. If no great amount of disorganisation of the mucous membrane has taken place, these favourable changes are frequently noticed after the administration of the first or second dose, and even if undoubted ulceration has set in, they are generally discerned on the second or third day, or earlier, In either case the drug should be abandoned, as the disappearance of the tormina and tenesmus and the absence of mucus, blood, and slime from the stools indicate the cessation of dysenteric inflammation, and that the affected portions of the bowel have been placed in the most favourable condition to undergo cure by 'resolution,' if the case has not proceeded to ulceration, or by 'granulation and cicatrisation,' if ulceration or even sloughing has already taken place. Chalk-mixture with hyoscyamus and astringents is now quite sufficient to wind up the cure. In some cases ferruginous and bitter tonics are demanded, to give tone to the digestive organs, and to improve the condition of the blood. Counter-irritation by means of turpentine epithems and mustard plasters to the abdomen, or fomentation, are valuable adjuncts in the management of the disease.

The diet should consist of chicken broth, beef-tea, essences of chicken, mutton, or beef; sago, arrowroot, or tapioca; and small quantities of port wine or brandy. During the active period of the disease all food should be given in a liquid form. The disturbing effect of the ipecacuanha given as above directed is only temporary. Abundance of time is, therefore, available between the large doses for the digestion and assimilation of liquid food. As the stools become more feculent and consistent, solid food in the shape of tender chicken, lamb, and mutton, with biscuit and bread, light sago, rice, or tapioca pudding should be allowed. Potatoes and other vegetables should be avoided until the tone of the digestive system has been fully re-established. When the dysentery is complicated with a purpuric or scorbutic condition of the blood, the administration of the juice of the grape, orange, pomegranate, lime, and bael sherbet are essentially necessary as dietetic rather than therapeutic agents.

Opium by the mouth is seldom required. When swallowed it 'locks up' the secretions of the liver, pancreas, and alimentary mucous membrane, rather favouring than reducing the inflammation of the solitary and tubular glands. These bad effects counterbalance the benefits derived from the sleep, diminution of peristaltic action, and temporary decrease of tormina and tenesmus consequent on narcotism. This explains why the real character of the disease is often completely masked by opium, and why apparent amendment is taking place, whilst destructive ulceration and sloughing of the mucous membrane is rapidly extending. As ipecacuanha speedily brings about all the good without any of the evil effects of opium, this narcotic, in any form, excepting as an enema or suppository to relieve tenesmus, particularly in sigmoidal or rectal dysentery, is not only superfluous but injurious. There is less objection to uniting the ipecacuanha with such remedies as are acknowledged to possess the power of lessening the irritability of the stomach, and of increasing its tolerance of the drug, without interfering with the functional activity of those organs whose secretions we are endeavouring to promote with a view to rectify the disturbed balance of the portal circulation. On the contrary medicines of this order may be beneficially associated with ipecacuanha—such as carbonate of soda, bismuth, chloroform, camphor, and hyoscyamus.

When dysentery occurs in pregnant women, large doses of ipecacuanha are not contra-indicated; because, if the disease be allowed to proceed (which is more likely to happen under the old than the ipecacuanha treatment) abortion or premature labour is almost certain to follow; and when such a complication supervenes, in the later months of gestation, the mortality almost surpasses that of any other disease. When the dysenteric inflammation is summarily put a stop to by the ipecacuanha, abortion or premature labour is prevented. Under the opiate method of management, premature labour is not averted, but, in the majority of cases, occurs at the acmé of the disease, when the sloughs are being thrown off; and the patient succumbs to the conjoint shock to the system. In dysentery complicated with pregnancy opiate enemata to relieve irritation in the rectum are more essential and permissible than under other circumstances.

In the acute dysentery of children ipecacuanha is invaluable. For a child of six months a grain, and for a child of one year two grains, should be given with an equal quantity of carbonate of soda, night and morning, until the tormina, tenesmus, and slimy and bloody stools are replaced by relief from pain and by feculent evacuations. It will not often be necessary to continue the drug beyond two or three days at a time. But it should be recollected that the disease adheres with greater tenacity to children than to adults; and although we observe that ipecacuanha has an immediately beneficial effect in diminishing the blood, mucus, slime and frequent stools, still we find that dysenteric or slimy motions with undigested food continue to pass. In that case the ipecacuanha, combined with chalk, bismuth, carbonate of soda, or aromatic powder, should be repeated, once or twice a day, for a certain period, till healthy evacuations are restored. The gums must be lanced when necessary; turpentine liniment or stupes may be applied to the abdomen; weak chicken-broth or arrowroot should be temporarily substituted for milk; and, above all, food must be given in small quantities at a time, and at regularly stated periods. From the age of one year the dose is regulated by adding one grain for each additional year of age up to eighteen, when the doses indicated for adults should be employed.

In cases where evident malarious taint pervades the system and complicates acute dysentery, disulphate of quinine is indispensably necessary. A scruple of the antiperiodic will be most speedily absorbed if dissolved in water acidulated with sulphuric acid, and the exhibition of this may precede by an hour the first dose of ipecacuanha. Ten-grain doses should be given midway between the large doses of ipecacuanha, or during abatement of febrile excitement, until the feverish symptoms have been subdued. Quinine here is quite as important as ipecacuanha, for, until it has successfully checked the disturbing influence which malarious poisoning exercises upon the capillaries of the portal and general circulatory systems, the good effects which ipecacuanha produces are only temporary and incomplete. The mildest febrile exacerbations of a miasmatic origin re-excite dysenteric action, and thus undo the good effected by the action of the ipecacuanha. Hence, the urgent necessity for removing without delay every vestige of masked or active malarious fever complicating dysentery. No drug enables us to accomplish this object so safely and so quickly as the disulphate of quinine in large doses.

When ipecacuanha fails to preserve the life of the patient, its failure may be generally attributed to—(1) coexistence of abscess of the liver; (2) unchecked malarious poisoning; (3) permanent enlargement of spleen or liver, or both; (4) irretrievable constitutional cachexia; (5) Addison's disease of the supra-renal capsules; (6) morbus Brightii; (7) phthisis or tuberculosis; (8) strumous disease of the mesenteric glands; (9) peritonitis with or without perforation of the gut; or (10) the existence of extensive sloughing or gangrene.

The advantages of the 'Ipecacuanha Treatment' (for the revival of which the profession are indebted to Mr. Scott Docker, of the 2nd battalion of the 7th Royal Fusiliers, stationed at the Mauritius,—*Lancet* of July 31 and August 14, 1858) in the congestive, exudative, and ulcerative stage of almost every form and type of acute dysentery, as well as in the acute attacks supervening upon chronic dysentery, may be briefly stated to consist in (1) its simplicity, (2) its safety, (3) its certainty compared with any other method, (4) the promptitude with which the inflammation is stopped, (5) the rapidity with which repair takes place—(*a*) by resolution or (*b*) by granulation and cicatrization, (6) conservation of the constitutional powers, (7) abbreviation of the period required for convalescence, (8) decrease in the frequency of chronic dysentery, (9) decrease in the frequency of abscess of the liver, (10) diminution of mortality to cases treated—all of which are accomplished, (*a*) without local or general blood-letting, (*b*) without salivation, (*c*) without calomel and irritating purgatives, and (*d*) without opium by the mouth.

Ipecacuanha in large doses may be said to fulfil many important indications. It produces (1) all the benefits that have been ascribed to blood-letting without robbing the system of one drop of blood, (2) all the advantages of mercurial and other purgatives without their irritating action, (3) all the good results of antimonials and sudorifics without any of their uncertainty, (4) all the euthanasia ascribed to opium without masking, if not aggravating, the disease whilst the mischief is silently accumulating within. Thus, we possess in ipecacuanha *a non-spoliative antiphlogistic, a certain chologogue and unirritating purgative, a powerful sudorific, and a harmless sedative* to the heart and the muscular fibres of the intestines.

The objections which have been urged against large doses of ipecacuanha in dysentery are, *first*, its 'depressing influence' kept up by nausea and vomiting; and, *secondly*, that it is liable to set up 'uncontrollable vomiting.'

First, the depressing power, nausea, and vomiting have all been over-estimated. Nausea is only a temporary and evanescent effect. Vomiting is an exceptional occurrence; and even when it does supervene, it seldom lasts long. As much nourishment, therefore, as may be required to support the strength can be allowed in the intervals between the large doses of ipecacuanha. But what contributes more to the conservation of the patient's stamina and to the prevention of depression or asthenia, is the speedy cessation of the dysenteric process accomplished by the drug, followed by refreshing sleep and the power of digesting and assimilating nourishing food. Such remarkable results as these soon reconcile any patient suffering from dysentery to an otherwise disagreeable remedy.

Secondly, when uncontrollable sickness and vomiting succeed the employment of this drug in the manner already recommended, the existence of one or other of the serious conditions previously enumerated may be more than suspected. In the absence of these complications, unmanageable vomiting is seldom if ever witnessed. Hence, in a preponderating majority of the cases of dysentery met with this objection is quite untenable. The truth is that every physician who has used ipecacuanha in heroic doses soon learns that depression of the vital powers from it is not to be feared, and is surprised at the small amount of vomiting that follows its administration, and at the unexpected ease with which the stomach tolerates its presence.

When dysentery becomes *chronic* no time should be lost in counselling removal from a malarious to a non-malarious and mild climate. A sea voyage—provided easily digestible food can be secured—is often attended by the happiest results. To men so afflicted 'the salt ration,' as remarked by Dr. Maclean, 'is simply destruction.' The clothing should be warm, and flannels always worn around the abdomen; Dr. Maclean also recommends 'the use of a water belt over the abdomen for some hours daily. This acts as a fomentation, and the steady uniform pressure it maintains seems to favour the absorption of the fibrine effused between the intestinal coats. If there be much uneasiness about the fundament, a water compress over the anus affords more relief than opiate enemata.' The food should be chiefly concentrated soups, milk and lime-water, and sago, cornflour, arrowroot, &c., egg-flip with port, sherry, or brandy; or, if solid food can be digested, the tenderest chicken, lamb, or mutton, with bread and biscuit, may be allowed. Beyond airing in a carriage or chair, no exercise should be attempted. The position should generally be recumbent or semi-recumbent. The erect position excites peristaltic action, and thus disturbs the physiological rest required to facilitate the repair of the ulcers. Antiscorbutic juices should be given where there is the least taint of scurvy or purpura. Frequent blistering does much good. All forms of counter-irritation are beneficial.

Gallic acid, acetate of lead, sulphate of copper, nitrate of silver, are reputed to act beneficially. Dr. Maclean's favourite remedy, 'particularly in men returning from tropical regions, anæmic from loss of blood and the depraving influence of malaria, is the solution of the pernitrate of iron. Under this remedy the whole system often rallies wonderfully, the condition of the blood improves, colour returns to the blanched cheek, the stools become more natural and less frequent, the appetite improves, and digestion is more perfectly performed. The citrate of iron and quinine may after a time be substituted.' As nearly all chronic cases are underlain by a malarious taint, quinine should form an important element in the therapeutic management, and the greatest care should be taken to secure for the residence of the patient a climate at once mild and temperate and free from suspicion of malaria. Bathing during convalescence is an efficient and welcome auxiliary. Tepid or warm baths medicated with Tidman's sea-salt or with nitro-muriatic acid act in stimulating the secreting function of the skin. But it will often happen that, in spite of the most careful dietetic, hygienic, and therapeutic management, no substantial progress towards the repair of the ulcers is made, and the patient eventually dies, worn out from suffering and the asthenia consequent literally on inanition.

JOSEPH EWART.

DYSIDROSIS (δὺς, with difficulty, and ἱδρῶς, sweat).—This is a disorder of the sweat-follicles hitherto confounded with eczema, and first differentiated therefrom and accurately described by the writer. It occurs in winter as well as in summer, and often in those who perspire freely; and it attacks the hands chiefly, and especially the interdigital and the palmar surfaces. The disease is characterised by the development of vesicles, which are not formed in the usual way in the rete, but are distensions of the sweat-apparatus by sweat secreted in excess, and which fails to find its way outward free upon the surface. These sweat-vesicles are at first situated beneath the level of the skin, and indeed appear as little boiled sago-grains imbedded deeply in the substance of the skin, and when once seen are readily recognised again. If pricked, a little sweat oozes out. In the earliest stage the reaction of the fluid may be acid, but it soon becomes alkaline from admixture of serosity. These vesicles are distinct the one from the other at first, and are scattered about the interdigital surfaces or the palms, or they may be grouped. In some cases their fluid contents dry away, and a little dryness and perhaps slight degeneration follow. They may enlarge and become prominent upon the surface, or run together into bullæ, and if the sweat-secretion is free, large bullæ may form. Usually the cuticle becomes white and opaque from maceration in the fluid which collects beneath it; and subsequently it peels off in a membranous manner, leaving behind, however, a dry reddened surface, but not a discharging one as in eczema. One or both hands may be affected; and the feet may also be attacked. The disease occurs in connection with nervous debility. It may be attended with much itching or burning pain; and may be accompanied by miliaria.

ANATOMICAL CHARACTERS.—If a portion of skin be excised and examined in the early stage of the disease, it will be observed that there is no true dermic inflammation, but that the morbid changes are limited to the sweat-apparatus, as the writer has shown (*Pathological Society's Transactions*, 1879). The sweat-gland-coils are congested, and the results of such congestion are also seen in the duct-walls as they run upward to the Malpighian layer, where the vesicles are formed. In the early condition the sweat-ducts are dilated, and choked by epithelial débris, and gradually this portion and the rete layer immediately outside the ducts, dilate into vesiculations under the pressure of the fluid poured out into the tube. In later stages the effusion is so free, and the distension of the tissues so decided, that the nature of the original formation of the vesicles is not recognised, and the vesicles may simulate those of eczema, save that the amount of inflammatory products is less, and there is no distinct connection between vesicles and engorged papillary vessels beneath. In the earlier stages of the vesicles, however, ducts can be distinctly traced entering the vesicles from above and leaving them from below, which conclusively proves that the vesicles are formed in connection with the sweat-apparatus.

TREATMENT.—This consists, internally in exhibiting diuretics, to be followed by nervine tonics according to circumstances, and locally in the use of soothing and astringent applications.

TILBURY FOX.

DYSMENORRHŒA (δὺς, with difficulty; μὴν, a month; and ῥέω, I flow.—Difficult and painful menstruation. *See* MENSTRUATION, Disorders of.

DYSOREXIA (δὺς, with difficulty, and ὄρεξις, the appetite).—An obsolete term for impaired or depraved appetite. *See* APPETITE, Disorders of.

DYSPEPSIA (δὺς, with difficulty, and πέπτω, I concoct).—A synonym for indigestion. *See* DIGESTION, Disorders of.

DYSPHAGIA (δὺς, with difficulty, and φάγω, I eat).—Difficulty in swallowing. *See* DEGLUTITION, Disorders of.

DYSPHONIA (δὺς, with difficulty, and φωνὴ, the voice).—Difficulty in producing vocal sounds, so that the voice is more or less enfeebled. *See* VOICE, Affections of.

DYSPNŒA (δὺς, with difficulty, and πνέω, I breathe).—Difficulty of breathing. *See* RESPIRATION, Disorders of.

DYSURIA (δὺς, with difficulty, and οὐρέω, I pass water).—Difficult or painful micturition. *See* MICTURITION, Disorders of.

E

EAR, Diseases of.—The natural division of the ear into external, middle, and internal, suggests a rational, as well as a convenient classification of the disorders to which the auditory apparatus is liable.

I. External Ear.—In examination of the external meatus and tympanic membrane, bright diffused daylight, or, when this is not obtainable, light from a bull's-eye lamp lit with gas, is the best for illumination, and the light should be reflected from a concave perforated mirror of eight-inch focus down a tubular speculum. In any operative proceedings the mirror should be worn on the forehead, as in examining the throat, but otherwise should be held in the hand. As great variations in the calibre of the auditory meatus are met with, it is necessary to be provided with specula of several sizes, the most convenient form being that known as Gruber's.

Of the affections of the external ear the most important are the following:—

1. **Eczema.** — Although the acute form of eczema occasionally affects the auricle and external auditory meatus, it is far more common to meet with the chronic variety. Elderly females are especially subject to eczema of the ear, and it is to its long continuance that the remarkable narrowing of the external meatus throughout its whole extent, met with occasionally in the subjects of this complaint, is generally attributable. Such narrowing will often amount to almost complete closure, and it is in these instances that eczema becomes the cause of greatly impaired hearing; for when this condition is arrived at, the passage down to the tympanic membrane is at times so small as only to admit of a very small probe. It is for this reason that, although no special methods of treatment are called for, beyond what is necessary when parts other than the ear are affected with eczema, it is of the greatest importance to keep the meatus sedulously free from secretion, and this occasionally is not a very easy matter.

2. **Changes in cartilage.**—Another condition, in which the external passage becomes subject to partial closure, is shrinking of the cartilaginous part of the meatus. This again, is a complaint of old age, and is attributable to no known cause. It is readily relieved by the patient wearing a piece of silver tube, to keep the passage patent.

3. **Bony growths** in the osseous part of the canal present two entirely distinct phases: one in which, beyond the enlargement of bone, there is no discoverable disease, and no impairment in hearing power; the other where the growth would seem to owe its origin to some irritation.

In the first case, the enlargements are very frequently symmetrical in either ear, and synchronous in their growth. So exactly is this so, that often where they exhibit three curves in one part of the bony canal on one side, the curves will be found to be precisely similar in size and position in the other ear. As the enlargements are not attended with pain, the patient will obviously be quite ignorant of his condition, until his attention is directed to one ear by a slight accumulation of cerumen, which will suffice to obstruct the passage of sound to the tympanum.

In the other example alluded to, disease of the tympanum precedes the so-termed exostosis, and a perforation of the tympanic membrane, attended with a purulent discharge, will be present perhaps for some years before the growth of bone is discovered. It is in such a case that sometimes the exostosis, by preventing the escape of pus, becomes the indirect cause of death due to cerebral abscess. This is especially so where, in addition to the exostosis in the meatus, there is a polypus growing from the tympanic cavity.

Treatment.—With this complication, or where the meatus becomes completely closed, and in these two cases alone, it occasionally becomes imperative to remove the bony growth. The position of the tumours, and their extreme hardness, make this no simple task; and (except in the instance mentioned by the late Mr. Syme, when they were exceptionably friable) their removal has been attended with great difficulty.

Up to the present time two modes of proceeding have been the most successful. The first of these is as follows:—Two needles being inserted into the base of the growth, holes having been drilled for this purpose, the continuous current derived from ten to twenty pairs of plates (Stöhrer's battery) has been passed through them for a few minutes, and in the course of about six weeks the bone thus destroyed has become loose, and is readily removed with forceps. The second method consists in grinding the bone away by means of a drill, now in common use with dentists. Either proceeding is attended with so much pain that an anæsthetic is necessary.

4. **Inflammation.** — The external auditory meatus is subject to inflammation, diffused or circumscribed, the latter occurring in the form of small abscesses or boils. Both affections are attended by acute pain, and in each the general health of the patient has been out of order for some time previous to the local trouble.

Treatment.—Treatment in the direction of improving the general health; and local bleeding by means of leeches applied in front of the tragus, will often rapidly relieve the diffused form of inflammation; but when it has continued for a long period (as it not infrequently does), in addition to the soft tissues the periosteum becomes affected. The passage then throughout its whole extent becomes so swelled as to nearly close the external opening, and pain is constant. The only treatment which gives complete and permanent relief under these circumstances is to make two or three free incisions down to the bone, along the whole extent of the osseous part of the canal. A convenient instrument for this purpose is a small sharp-pointed curved bistoury. As to the propriety of opening abscesses in this situation there can be no question, for, owing to the extreme denseness of the tissues and their approximation to bone in the external auditory canal, abscess in this part is slow in its progress and attended with very great suffering. These abscesses being especially liable to recur, a proper regimen and medicines appropriate to the failure in general health are required.

5. **Fungi.**—The external auditory meatus has been occasionally found to be the seat of two varieties of vegetable fungus, namely, *Aspergillus flavus* and *nigricans.* The symptoms which they have given rise to have been great irritation, and a slight discharge. They have been readily destroyed by syringing, and the local application of spirits of wine.

6. **Polypus** of the ear is usually preceded by inflammation in the tympanic cavity and perforation of the membrane; and is considered along with diseases of the *middle ear.*

7. **Hæmatoma Auris.** *See* HÆMATOMA AURIS.

II. MIDDLE EAR.—All affections of the middle ear originate in some part of that tract of mucous membrane which, commencing where the Eustachian tube opens into the pharynx, forms the lining of this tube, and of the cavity of the tympanum, finally becoming the innermost layer of the tympanic membrane. To the character of this tissue is due the term catarrh, which, in its two forms of purulent and nonpurulent, is used in describing any deviation from health which, directly or indirectly, is the cause of pathological change in the Eustachian tube or tympanum.

1. **Obstruction of the Eustachian Tube.**—One of the most frequent conditions under which the Eustachian tubes become the seat of obstruction is that met with in children or young persons. The subjects of this affection present a very characteristic aspect. They breathe almost entirely through the mouth, which, sleeping or waking, is kept partially open; their tonsils are often enlarged, and they snore loudly during sleep. The mucous membrane of the nares and pharynx is swollen, and secretes in excess; owing to this tumid state of the fauces the passages to the Eustachian tubes in this situation do not admit of the constant necessary supply of air to the tympana. The air in these cavities undergoes partial absorption, and thus becomes more rare than that external to the tympanic membrane; the density of the outer air remaining the same, the equilibrium from pressure is destroyed; the membrane, consequently, is retracted, the chain of ossicles are pressed inwards, and thus the conduction of sound becomes interfered with—in short, the patient is more or less deaf. In these cases inspection of the tympanic membrane at once reveals the state of affairs. As the cavity of the tympanum is not involved in the catarrhal change, its translucency and lustre are not impaired; the handle of the malleus is tilted inwards, the head of this bone is unusually prominent, and there is a distinct fold crossing the upper part of the posterior section of the membrane. Where the obstruction has lasted for a long period, the membrane will appear to be almost fallen in upon the walls of the tympanum, and the promontory and incus may be distinguished. If under these conditions the tympanum be inflated on Politzer's plan,[1] an instant return to good hearing follows, but in the course of a few days the improved hearing partially dies away, leaving the patient, however, in some degree better than before the operation.

TREATMENT.—This should be twofold. In the first place the tympanum should be regularly inflated, and this may be practised at first every three or four days, and gradually at longer intervals. Secondly, astringent applications should be applied to the pharynx. Of these applications one of the best is a solution of perchloride of iron, 2 drachms to 1 ounce of water, and it should be used daily by means of a curved camel's-hair throat-brush. When the nares are much obstructed, great benefit will follow the use of saline solutions through the nasal douche, or they may be insufflated, that is, drawn up through the patient's nose into the pharynx and then spat out.

If the tonsils are so much enlarged as to interfere with the respiration, it will be necessary to remove them; but the reason for this proceeding is not that they press upon the opening of the Eustachian tube, but because their presence keeps up the unhealthy condition of the pharynx.

Under this routine of treatment the patients completely recover their hearing; the space of time during which it is necessary to continue treatment varying according to the obstinacy which each case manifests.

Obstruction of the Eustachian tubes in *adults* presents certain well-marked differences from the affection as it prevails in *children.* An ordinary cold is the beginning of the trouble. It is more usual to find one instead of both tubes obstructed, and more often than not the tympanic cavity is involved in the catarrh. Where this is not the case—and it will be evident from the retained lustre and transparency of the membrane—the same principles of treatment as are pursued in the case of children will hold good, except in so far that the affection in grown-up persons is less persistent after the tube has been once artificially opened; and that, to effect this, Politzer's method is sometimes not sufficient, or, even if so, not as efficacious as the Eustachian catheter. It must also be borne in mind that in the treatment of cases in which one ear is healthy, by means of the catheter the affected ear exclusively may be subjected to the air-douche, whilst with Politzer's method it is impossible to avoid forcing a stream of air into the healthy tympanum, and this is not always an advisable proceeding.

The Eustachian Catheter.—The following is the mode of using the Eustachian catheter:—'Place the patient in a chair, and let him lean back; steady his head with the left hand firmly fixed on the top of it; hold the catheter lightly in the right hand, with the curve downwards and pass it quickly in this position through the inferior meatus of the nose to the posterior wall of the pharynx. When this is felt, withdraw the catheter about half an inch, and tilt the point of the curved end rather upwards, and to the left or right, according to the side which is being operated upon. Now hold the catheter and end of the patient's nose steadily between the thumb and the first two fingers of the left hand. All this time the ear of the patient and that of the surgeon are connected with the otoscope. The point of the catheter is now supposed to be in the pharyngeal orifice of the Eustachian tube, but the only certain sign of this being the case is that when air is forced into the catheter it will be heard through the otoscope to impinge upon the tympanic membrane when a stream of air is passed down the catheter.'

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[1] This method of inflating the middle ear (now in such general use) consists in passing a stream of air from an india-rubber bag through one nostril whilst the patient swallows some water. The operator at the same time closes one nostril with the forefinger of the left hand, and completes the closure of the other with the thumb. The mouth must be kept firmly shut.

The catheter may be made of silver or of vulcanite, but, of whatever material, it must be inflexible whilst being used. Beyond this, suffice it to say here that in practised hands its employment is invaluable, and indispensable in the treatment of most affections of the middle ear, not only in overcoming obstruction of the Eustachian tube, but also as a means by which injection of fluids may be applied to the cavity of the tympanum. In making use of the air-douche an indiarubber bag fitted to the catheter should be employed, and in using injections to the tympanum a similar arrangement is necessary.

2. **Catarrhal Inflammation of the Tympanum.**—When the tympanic cavity has become involved in the catarrhal state, or when the affection, instead of proceeding up the Eustachian tubes, begins in the tympanum, as it frequently does, those changes have commenced which, of all others, form the most frequent impediments to the conduction of sound—in other words, which make the subjects in which they are found more or less deaf; and it may be broadly stated that the extent to which this affection is remediable depends directly upon the time at which the patients suffering from it apply for treatment. In the early stages, the obstruction to the passage of sound through the tympanum is solely due to the effusion of mucus in this situation, and this is easily demonstrated by the moist gurgling sound which inflation of the tympanum produces, as may be heard upon connecting the ears of the patient and surgeon by means of a piece of indiarubber tubing.[1] Afterwards comes what may be termed the dry stage, *i.e.* when the fluid portion of the mucus has suffered absorption, and when any of the products of inflammation may have become more or less organised, or at least in a condition which, if not interfered with, suffers no further change. The morbid conditions which result from non-purulent catarrh of the tympanum are twofold. First, those which affect the tympanic membrane, and are, therefore, demonstrable during life; secondly, those which are met with after death in the tympanic cavity. The first of these include changes in curvature, in colour, and in consistence.

The slighter changes in curvature have been noticed in speaking of obstruction of the Eustachian tube, which condition is necessarily more or less present in all cases where the tympanum has been the seat of catarrh, and these changes are met with indefinitely increased until the state of complete collapse is reached.

In this condition the membrane has the appearance of being in close apposition to the walls of the tympanum, and lapped round the ossicles, so that the forms of the malleus, incus, and sometimes the stapes are distinctly traceable.

In so extreme an example, the membrane is generally bound down to the tympanic wall by adhesions. The first change which the membrane exhibits is a loss of its lustre and transparency; it becomes opaque. Further alterations in colour, in cases of long standing, consist in the formation of patches of brown, yellow (colour of parchment), and white. Variations in consistency will include thickening throughout the membrane, or in parts of it, especially in the cases of dense chalk deposits (phosphate of lime); and thinning in places, so observable sometimes that inflation will induce bladder-like protrusions, which, as inflation is suspended, fall back again: changes in all these respects completely metamorphosing the appearance of the membrane. After death, within the tympanum may be found collections of dried mucus around the ossicles; thickening of the lining membrane; bands of adhesion in all directions; and anchylosis of the ossicles to each other, as well as between the stapes and fenestra ovalis.

As additional evidence during life of obstruction in the tympanum, it may be mentioned that sounds from a vibrating tuning-fork placed on the vertex are intensified when such obstruction exists, and the nerve remains unimpaired: this test is especially valuable where one ear is healthy, inasmuch as the sound will be heard exclusively on the deaf side, this being due to the fact that vibrations of sound thus conveyed to the auditory nerve, on their passage outwards through the tympanum, meet with the obstruction in this position, and are reflected on to the labyrinth. The appearances above described, together with the history of the case, serve sufficiently to distinguish affections of the conducting from those of the nervous apparatus, and the sounds which are produced upon inflation of the tympanum, whether of a moist or dry character, give evidence as to whether the mucus in the cavity of the tympanum is in a more or less fluid state, or has reached the dry stage where the fluid part of the secretion has become absorbed, the more solid portion remaining.

In the first of these conditions, the inflation at once increases the hearing power; in the second, it produces no change in the hearing. An indication in this direction is a most useful guide in respect of treatment, for whatever differences in opinion may exist as to details in relation to this subject, experience has amply shown that the injection of fluids into the tympanum is for the majority of cases the treatment of all others the most successful, and, speaking generally, it may be said that when the sounds which accompany inflation of the tympanum are of a moist character (showing that undue secretion from the mucus membrane is going on), astringents, such as sulphate of zinc, 1 to 2 grains to the ounce of lukewarm water, will be found most efficacious; and that when the dry stage has been arrived at, alkaline solutions—bicarbonate of soda or potash, 5 grains to the ounce, or still better an injection containing hydrochlorate of ammonia, 5 grains to the ounce—should be substituted.

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[1] This tubing should always be used, whether air or fluids are being injected through the Eustachian tube, for upon the sounds thus heard, as well as on the patient's own perception, the answer to the question whether the inflation is complete depends.

Injecting the Tympanum.—There are three modes of injecting the tympanum, and their order of efficiency stands as follows:—Firstly, when the Eustachian catheter has been placed in position, a few drops of the injection are introduced into it from a small glass syringe, and forced into the tympanum by means of an indiarubber bag, the nozzle of which is made to fit the open end of the catheter. Secondly, a few drops are placed in the inferior naris, on the same side as the ear under treatment, and injected in front of a stream of air blown to the tympanum on Politzer's plan, the patient's head being inclined to the side to be acted upon. Thirdly, the fluid being arranged in precisely the same way, the patient forces it up the Eustachian tube by attempting to blow through the nostrils, whilst the mouth and nose are closed.

The injection may with benefit generally be repeated every other day for from two to four weeks, but for this no rule can be laid down which would apply in every case.

Such is the briefest outline of the treatment under which these cases recover in greater or less degree. The degree of improvement varies within wide limits, but the greater benefits may always unhesitatingly be predicted during the moist stage of the catarrh. Indeed, the necessity for early treatment is abundantly shown, in the instance of catarrhal affection of the middle ear, by the extremely satisfactory termination of cases treated early in the disease, and the slight relief which but too often follows when the affection has been allowed to proceed for years unchecked. In such cases as the latter, the fact that considerable quantities of inspissated mucus have been found in the tympanic cavities first suggested the operation of making an incision into the tympanic membrane, and attempting the removal of mucus through the incision by passing a stream of air through the tympanum. This proceeding, with certain modifications afterwards introduced, is no doubt very useful in cases favourable for its employment, but it should be reserved for those which have defied the less severe means, and where there is unmistakable evidence of an obstruction to the passage of sound through the tympanum. Experiments with the tuning-fork, already referred to, give valuable evidence in this direction; but for a detailed account of this method of treatment, introduced some years ago by Mr. Hinton, the reader is referred to *Questions of Aural Surgery*. Suffice it to say here that an incision about one-eighth of an inch in length is made in the posterior section of the membrane with a cataract-needle, and this is followed by passing a stream of fluid (a weak solution of soda) through the tympanum and Eustachian tube by means of a syringe made to fit the external meatus. In appropriate cases it is often undoubtedly of very great service, and is neither a dangerous nor a harmful proceeding so long as there is no nervous complication; where, however, this is present, surgical interference has at times proved most disastrous.

Another operation, performed by Dr. Weber Leil of Berlin, consists in the division of the tensor tympani muscle, but up to the present time the results at the hands of others do not warrant it as a recognised operation for the relief of conditions inducing deafness.

3. **Purulent Catarrh of the Tympanum.—Perforation.**—The form of tympanitis in which the effused products become purulent, is an acute and generally an extremely painful affection. Usually the pus rapidly makes its escape from the tympanum into the external meatus, by a process of ulceration through the tympanic membrane, leaving as its result a perforation of this structure. In quite the early stage the affection may often be cut short by the free application of leeches in front of the tragus, followed by fomentations, but more often than not the membrane has given way before the patient comes under observation. Even then, if the tympanic cavity be emptied of the pus by the free use of Politzer's inflation and repeated syringing, the opening will often close, and leave very little, indeed sometimes hardly any appreciable deafness. If, however, a purulent discharge through the opening be allowed to go on unheeded for any length of time, it is the exception for the perforation to heal. This condition is constantly seen after scarlet fever, measles, or any of the exanthemata. A perforation of the tympanic membrane presents an infinite variety of aspects, from a small pin-hole to nearly complete loss of the membrane, but there will always be a slight remaining external rim of membrane. This latter is perhaps the most frequent of all forms of perforation, and especially when the ulceration dates from an attack of scarlet fever. Although the handle of the malleus occasionally remains, it more usually comes away in these and other cases where the loss of tissue is very extensive. The head of this bone, however, may always be distinguished, unless there has been complete disorganisation of the tympanic cavity. Among other forms of perforation commonly met with may be mentioned those in which the anterior or posterior half of the membrane is left, and is bounded internally by the handle of the malleus; the so-called *reniform* perforation, where the lower part of the membrane is lost and the umbo of the malleus indicates the position of the hilus of the kidney; and the small, smooth-edged circular perforation which is common alike to all parts of the membrane. Occasionally, though not very often, the tympanic membrane is the seat of a double perforation. Similar variations in hearing accompany this condition, between slight deafness and total loss of hearing power. The size of the perforation affords no guide in this respect, extreme loss of hearing being met with when the perforation is very small, and very slight deafness where the loss of tissue has been most extensive, so that it may be unhesitatingly stated that the loss of the membrane is but in a very small degree the cause of the deafness in these cases, the disorganisation in the tympanic cavity mainly accounting for this. Such disorganisation is at times so com-

plete (especially after scarlet fever) as to include the loss of all the ossicles, total deafness, and paralysis of the muscles supplied by the portio dura. A very small perforation in the anterior and superior part of the membrane may from its position escape notice, but the diagnosis can be always verified by the facility with which air may be made to pass through the opening, or the reverse, provided that the communication between the Eustachian tube and the tympanum is not closed by cicatricial tissue—a very rare condition when so little of the membrane has suffered ulceration.

Treatment.—The treatment of purulent tympanitis and perforation will include assiduous cleanliness; keeping the Eustachian tube free from obstruction; and the use of astringent injections. When the exposed surface of the tympanum is covered, as it sometimes is, with exuberant granulations, much benefit will be derived from the application of solid nitrate of silver to the granular surface, care being taken not to touch any other part. As the condition of the ear improves under these measures, so will the hearing power vastly increase when it has not been completely lost; but there still remains the ofttimes invaluable application of what is spoken of as the *artificial* membrane. Of all kinds, the best undoubtedly is the flattened pad of moistened cotton-wool, applied by the patient, every morning, with a pair of forceps constructed for the purpose. Until this be tried in each case it is impossible to say whether it will do good; but when it is useful—as it is in a large number of cases—by its help the patient will recover very good hearing, and this even when the perforation has existed for a period of many years. That its effects depend upon the support which it gives to the ossicles, thus re-establishing the normal pressure of the stapes upon the fenestra ovalis, has been unquestionably demonstrated.

4. **Polypus.**—One of the most frequent complications in cases of perforation of the tympanic membrane is polypus, a term employed to designate a fleshy tumour in the ear. Although polypi are occasionally present in the meatus independently of perforation, the most usual situation from which they arise is the lining membrane of the tympanum. Sometimes the exact point of origin is the edge of a perforation, and still more rarely the sides of the meatus. In size these growths vary from a small protrusion through a perforation, to a tumour which entirely fills the meatus and projects externally from the ear. In this latter instance the growth presents a very distinctive appearance, not unlike a raspberry. Sections of aural polypi hardened in chromic acid with few exceptions show the structure to be fibro-cellular, the fibrous element preponderating over the cellular in proportion to the age of the tumour.

Treatment.—In all cases polypi should be removed, and the best instruments for this purpose are the rectangular ring polypus forceps, or, in the case of a large growth, a Wilde's snare. Owing to their remarkable tendency to recur, removal is only the preliminary step in treatment. The principal part of this consists in their complete eradication by caustics. Of these the most efficacious and convenient is chlor-acetic acid, and later in the treatment nitrate of silver. The acid may be applied on a very small camel's-hair brush, or on the point of a probe defended by a small twist of cotton wool, and a convenient form of nitrate of silver is a bulb of the melted salt fused on to a probe or platinum wire. The caustic should be applied daily for some time after the polypus has been removed, and then less frequently. The treatment should also include the same scrupulous cleanliness and application of astringents, so desirable in the case of perforations. It is simply to the want of attention to details that failure in the treatment of aural polypus may be ascribed.

Complications of Tympanic Disease. — *a. Facial Paralysis.*—This is due to inflammation around the portio dura in its passage through the aqueduct of Fallopius. When suppuration in the tympanic cavity, with caries of the bony canal, precedes or accompanies the loss of function in the nerve, recovery is hopeless; but when the paralysis follows a subacute catarrh of the tympanum, not ending in a perforation, as is sometimes the case, the paralysis in time disappears no less certainly than when it is dependent upon an affection of the nerve at a point after its exit from the temporal bone.

b. Pyæmia: Cerebral Abscess; and *Meningitis.* When the mastoid cells become the seat of inflammation, the pain, tenderness, and pitting on pressure over the mastoid process, will at once suggest an early incision down to the bone, and it may be truly said that this is often delayed too long, and perhaps is never done too soon. Again, when the symptoms point definitely to pus within the mastoid cells, the bone should be pierced so as to make the external opening communicate freely with the cells. Relief given in this way will occasionally be the means of saving life, by preventing the absorption of poisoned material into the lateral sinus. Besides pyæmia thus induced, other fatal issues which suppuration in the middle ear frequently entail have their starting point in the tympanic cavity, and in such instances cerebral abscess or meningitis may be the immediate cause of death. In the latter case a post-mortem examination reveals pus in the arachnoid cavity, or between the roof of the tympanum and the dura mater; in the former, the seat of the abscess may be either in the cerebrum or cerebellum; this portion of the brain (the cerebellum) being more generally, though not always, the part affected when the mastoid cells are involved as well as the tympanum.

The pathology of cerebral abscess, as a result of ear-disease, cannot with truth be said in all cases to be completely explainable, and this for the following reason:—Whilst in most cases a distinct communication can be traced between the diseased roof of the tympanum and the sac of the abscess, in a few the most careful examination fails to show any connection between the two, the abscess being separated from the bone by healthy brain-tissue. Occasionally, no disease can be detected in the bone itself, and this even after the bone has been macerated and sections of it made.

Fatal terminations of this nature most frequently occur when cleanliness and local treatment of the ear have been neglected. Hence the necessity for such care.

But the fact that even under the most favourable conditions such events are possible when there is a fistulous opening in the tympanic cavity should induce caution with Insurance offices in taking the lives of persons with this lesion, at the ordinary premiums. Fatal cases of this kind might seem in practice to be almost divisible into two classes, namely, those in which cerebral symptoms come on soon after the establishment of the perforation; and others where there has been a purulent discharge from the ear (that is, from the tympanum) for many years before the advent of such symptoms. In this latter class must be included those cases in which the temporal bone has become the seat of caries; and it may be stated, subject to no exceptions, that whenever exposed bone can be detected by means of examination with a probe within the cavity of the tympanum, the subjects of this condition are always more or less in a perilous state, and that at any time fatal symptoms may commence with a severe rigor, the earliest of all succeeding symptoms. For this reason, even when exposed bone cannot be absolutely demonstrated in the way mentioned, the existence of bone-granulations where there is a perforation of the tympanic membrane should be regarded as a most serious complication. The same danger, though in a very much less degree, may be said to be present when dead bone can be detected in the mastoid process—in a less degree, because the outer table of the bone is often affected whilst the inner remains healthy. The dead bone then in the former position becomes exfoliated, and the external wound heals. Such are briefly the points of importance in connection with caries of the temporal bone. How caries of the mastoid process may be obviated by a timely perforation of the mastoid cells, and how the chief part of the temporal bone may when carious be removed and the patient survive, may be seen on reference to a paper entitled 'Disease of the Mastoid Bone' by the writer of this article in the *Transactions of the Medical and Chirurgical Society* for 1879.

c. Malignant Disease.—In the paper just mentioned is also reported a case of malignant disease of the ear, in which the cavity of the tympanum, having been the seat of suppuration for some time, became affected with epithelial growth, which caused the death of the patient. From all recorded cases of malignant disease of the ear it would seem that the seat of origin of the new-growth will be found to be the lining membrane of the tympanic cavity, and that a purulent discharge from this surface always precedes the appearance of the cancer, and must therefore be regarded as the exciting cause of the growth. In its early stages cancer in this situation bears a strong resemblance to the ordinary forms of polypus. The same cause, then, which in some cases calls into being a polypus may occasionally give rise to malignant disease, and this without any predisposing cause (so far as can be ascertained) in the patient towards cancerous growth.

III. INTERNAL EAR. — Apart from deafness due to local changes in the external or middle ear, the function of hearing is subject to impairment from causes which have their seat in the nervous structures of the ear; in other words, although the conduction of sound may be good, the perception of sound may be faulty. The inability to hear the vibrations of sound conveyed through the cranial bones, such as from a vibrating tuning-fork placed upon the vertex, is indicative of this condition. For the rest, the absence of tympanic disease, and the history of the case, must supply the evidence required for a diagnosis. Familiar examples of this nature are the deafness which often accompanies old age, or which is left after fevers when the middle ear has not suffered; the two forms of syphilitic nervous affection mentioned below; the sudden and sometimes total loss of hearing which occasionally follows severe mental shock; the deafness after loud explosions near the ear, so common in artillery-men and naval men; and that which is caused by blows on the head and boxes on the ear. An attack of mumps will sometimes leave behind an irremediable loss of hearing in one or both ears, unattended with any discoverable change in the tympanum. In a similar way weakly women occasionally become more or less deaf during their confinement, and this symptom becomes aggravated when each successive child is born. In connection with this subject, prolonged suckling may be mentioned as one of the numerous debilitating causes which undoubtedly aggravate the trouble of an already impaired ear.

Among the nervous affections of the auditory apparatus possessing certain characteristics which serve to distinguish it from others is the so-termed Menière's disease, an attack of which at times gives rise to symptoms which would be alarming if their true origin passed unrecognised. A patient who suffers in this way is seized with an attack of vertigo so severe that he not infrequently falls, and for some hours afterwards requires assistance in walking; occasionally vomiting succeeds the giddiness; and he recovers to find himself very deaf in one ear, with which previously he had heard well. Milder attacks of the same nature generally follow the first, and each one leaves the patient more deaf. Although the presumptive evidence is in favour of the theory that the seat of morbid changes in Menière's disease is in the semi-circular canals, up to the present this point has not been quite satisfactorily determined. No treatment appears to exercise any influence upon the disease.

SYPHILIS.—The affections of the ear due to syphilitic disease demand separate consideration, and they occur under the following varieties:—Firstly, in the form of sores and warts in the external meatus, which yield to local treatment. Secondly, affections of the middle ear during the secondary ulceration of the throat, the treatment for which, beyond specific medicines, in no way differs from what is useful in the ordinary catarrh of the same parts. Thirdly, failure in hearing power during the secondary stages, unattended with any change in the middle ear. This disappears under constitutional remedies. Fourthly, the loss of function in the auditory nerve, so commonly met with in the subjects of inherited syphilis. In these patients the hearing power begins to fail between five and fifteen years of age (very seldom later in life); and proceeds to very great and often total deafness, the period between good hearing and the extreme point of deafness arrived at varying from a few weeks to several years. From this cause children sometimes become in the course of a month or six weeks totally deaf, but such rapidity is exceptional. Experience has shown how powerless treatment is to arrest the progress of this affection, so that attention should be confined to preventing its subjects from becoming dumb, if they are attacked after they have acquired speech and before they are likely to forget it, viz. from about four to seven years of age. This is best attained by teaching them lip-reading, and if they can read, by making them do so (*aloud*) several times each day. In this way a child will retain its recollection of language when otherwise speech would pass away.

W. B. Dalby.

EAUX-BONNES, in France.—Sulphur waters. *See* Mineral Waters.

EAUX-CHAUDES, in France.—Sulphur waters. *See* Mineral Waters.

EBURNATION (*ebur*, ivory).—A state of bone-tissue in which it assumes the whiteness, smoothness, and hardness of ivory, in consequence of an increased deposit of calcareous matter. It occurs chiefly in rheumatoid arthritis. *See* Rheumatoid Arthritis.

ECBOLICS (*ἐκβολὴ*, abortion).—This name is given to the measures that produce abortion. In moderate doses ecbolic drugs act as emmenagogues. *See* Emmenagogues.

ECCHYMOSIS (*ἐκ*, out of, and *χυμὸς*, juice).—An extravasation of blood into the cellular tissue, due either to injury or to disease. It presents at first a more or less blue or bluish-black appearance, which changes with age, passing through green to yellow. *See* Extravasation.

ECHINOCOCCUS (*ἐχῖνος*, a sea-urchin, and *κόκκος*, a grain).—This term, in its original generic signification, was employed by Rudolphi for the purpose of including several varieties of bladder-worm infesting man and animals (*Echinococcus hominis; E. veterinorum; E. granulosus, &c.*) These different bladder-worms are now collectively spoken of as *hydatids*, and all of them are known to be mere varieties of the common hydatid, which (as proved by the experimental researches first successfully instituted by Von Siebold, and subsequently verified by Haubner, Küchenmeister, Leuckart, Nettleship, and others) forms one of the larval or sexually immature stages of growth of a small tapeworm, normally resident in the intestinal canal of the dog and wolf (*Tænia echinococcus*). From a physiological point of view, a thorough knowledge of the mode of origination and development of the so-called echinococcus becomes most instructive; but a full exposition of the histological and other changes that accompany the metamorphoses cannot be given in this place. Practically, the term echinococcus has at length come to be employed in such a restricted sense as to refer only to the scolices, or *heads* of the future Tæniæ, which are normally developed from the granular layer or internal membrane of the hydatid. Different opinions exist respecting the precise structural changes involved in their formation, but what is already known and accepted by helminthologists is the result chiefly of the labours of Leuckart, Naunyn, Rasmussen, Wilson, and Huxley. The clinical and hygienic bearings of this subject in relation to the so-called echinococcus-disease will be discussed elsewhere. *See* Hydatids.

T. S. Cobbold.

ECHINORHYNCHUS (*ἐχῖνος*, a sea-urchin, and *ῥύγχος*, a beak).—A genus of thorn-headed worms, belonging to the order Acanthocephala. Until the year 1857 there does not appear to have been a well-authenticated instance of the occurrence of this form of entozoon in the human body. In that year a young example (*E. hominis*, Lambl), was found, *post mortem*, in the small intestine of a boy, nine years of age, who died of leukæmia (*Prager Vierteljahrschrift*, 1859.) This specimen measured less than a quarter of an inch in length. It has been supposed that the parasite was an immature example of *Ech. gigas*, but this view has been disproved by Leuckart. Whether it be a new and altogether distinct species remains uncertain. The more recent instance alleged by Welch cannot be accepted as genuine, but must be referred to *Pentastoma*.

T. S. Cobbold.

ECLAMPSIA (*ἐκλάμπω*, I flash, I explode).—This term is now used as a synonym for convulsions, whatever may be their cause. *See* Convulsions.

ECPHYMA (*ἐκ*, out of, and *φῦμα*, a swelling). A growth from the integument. The term was employed by Mason Good as a designation for warts and corns, but is at present almost obsolete.

ECSTASY (*ἐξίστημι*, I amaze).—Definition. The term ecstasy has been applied to certain morbid states of the nervous system, in which the attention is occupied exclusively by one idea, and the cerebral control is in part withdrawn from the lower cerebral and certain reflex functions. These latter centres may be in a condition of inertia, or of insubordinate activity, presenting various disordered phenomena, for the most part motor.

Description.—The subjects of ecstatic phenomena are commonly of the female sex, or are men who lead celibate and ascetic lives. To these individuals they are in the present day almost confined. In the middle ages, on several occasions, under special circumstances, an intense dominant emotion, with some attendant ecstatic manifestations, spread widely by a sort of moral contagion.

Women who are the subjects of this morbid state are usually single, frequently present menstrual irregularities, and often distinct evidences of hysteria, of which the ecstatic condition may be but a part. The immediate cause of the attack is usually some repeated vivid emotion, commonly religious, sometimes one of fear. The direction taken by the motor or other phenomena of the ecstatic state is often very obviously determined by imitation. With this are associated, in some cases, assertions of supposed facts, which transcend the ordinary course of natural phenomena, and which have been proved, in many instances, to depend on intentional fraud.

As forms of ecstasy we have the condition of religious enthusiasts, who lose, in their one dominant emotion, all control over the other mental processes, and the latter may act in entire subordination to their religious feeling. Dreams and visions are determined by the ecstatic emotion, and add to its intensity. All consciousness of the body may be lost, so that all sensation may seem to be gone for a time: while the corporeal functions, ingestion and egestion, are reduced to a minimum, and a little exaggeration may represent them as in complete abeyance. Hence the 'fasting girls' of various countries, by whom 'stigmata' marks, in the position of the nails employed in crucifixion, are sometimes presented, probably by artificial production, possibly by the influence of the mental state on the processes of nutrition. In some hystero-epileptics a state of ecstasy—of rapt, intense emotion—forms part of the paroxysmal seizures, and then wild muscular spasms replace the tranquil repose of the more volitional ecstatics. Occasionally—when an intense emotion is shared by many persons—insubordinate muscular movements occur, of a rhythmical character, seen in the Jumpers and Shakers of the present day, and more strikingly in some of the dancing religious ceremonies of half-civilised races, and in the dancing epidemics of the middle ages. Such were the original dance of St. Vitus, in which the exciting emotion was religious; and the tarantella, in which the excitant was terror at the supposed consequences of the bite of the tarantula, which the dance was intended to avert.

Treatment.—It is rarely now that ecstatic manifestations have to be treated except as part of pronounced hysteria, and the treatment is that of the hysterical state which underlies the ecstasy. The measure of paramount importance is the substitution of a 'healthy moral atmosphere' for that under which the symptoms have arisen; and the exposure of actual fraud. Occasionally, even now, examples of solitary ecstasy come under observation. In these considerable care and tact are needed. Ecstatics are not amenable to the motives which influence most persons, and if there is actual fraud, will sometimes die rather than be found out. In the case of fasting girls, due observation of the body-weight during a short time will answer as well as, and is much safer than, a long exclusion of food. But the removal of the ecstatic to other surroundings is the most important step for both detection and cure. W. R. Gowers.

ECTHYMA (ἐκθύω, I burn out.)—A pustule or pimple; pathologically occupying a mid-place between a pustule and a furuncle. The so-called tar-acne, the small inflammatory pustules developed around a mother-boil, and the commoner eruptions produced by iodine and bromine, are examples of ecthyma. *See* Skin, Diseases of.

ECTOPIA (ἐκ, out of, and τόπος, a place).—An abnormal protrusion or displacement of a part; for example, *ectopia vesicæ*, protrusion of the bladder. *See* Organs, Displacement of.

ECTOZOA (ἐκτὸς, without, and ζῶον, an animal).—A term employed by some naturalists to embrace all the external parasites. *See* Epizoa.

ECTROPION } **ECTROPIUM** } ἐκ, out of, and τρέπω, I turn).—A condition in which the eyelid becomes everted, so that the conjunctival surface is exposed. *See* Eye and its Appendages, Diseases of.

ECTROTIC (ἐκτιτρώσκω, I miscarry).—A term applied to arresting the course of a morbid process, for example, the development of small-pox. The agent by which the pustule is made to abort, namely, the ectrotic, may in this instance be a point of nitrate of silver. A coating of plaster, and especially substances which will exclude the light, such as mercurial ointment, or an ointment of lampblack, are likewise employed as ectrotics of small-pox.

Erasmus Wilson.

ECZEMA (ἐκζέω, I bubble up).—Synon.: Fr. *Eczéma*; Ger. *Eczem*.

Definition and General Remarks.—Eczema is an inflammation of the skin, remarkable for a multiple series of pathological symptoms, and for extremes in degree of development and duration. It may be taken as the type of inflammation of the integument, and as an illustration of the varied pathological manifestations of the skin. As in other organs, the inflammation may be acute or chronic, may vary in severity and extent, and may occur at every period of life; but the special position and functions of the skin render the progress of eczema always uncertain and slow.

Ætiology.—The proximate cause of eczema is hyperæmia. Every exciting cause giving rise to hyperæmia is capable of producing eczema, and if the tissue of the skin be weak will necessarily be the occasion of that affection. It is in this way that local irritants act on a susceptible skin, so as to produce eczema; such, for example, as heat and moisture, friction, mechanical and chemical stimulants, and obstructed venous circulation. It is in this way that a poultice, a water-dressing, a stimulating lotion, or the action of the sun or of a pungent atmosphere, may be the local cause of eczema. Constitutionally, disturbed nervous function, however induced, by producing disturbance of the circulation and nutrition of the skin, is among the commonest of the causes of eczema. The starting point may be malassimilation occurring at any period of life; malassimilation will act as a disturber of nutrition and circulation of the skin, and those pathological processes known as eczema will be the result. In this manner we may trace back the cause to disordered digestion, painful dentition, painful menstruation, pregnancy and parturition, or nervous shock; and we are led to the conclusion that feeble digestion, assimilation, and nutrition constitute a predisposing cause of general and cutaneous debility, which only requires the interposition of an exciting cause to become an eczema. That eczema is powerfully under the influence of the nervous system is shown by the sudden and sometimes periodical exacerbations of its symptoms, and their subsidence under the influence of agents which soothe and tranquillise the nerves. In the simplest form of expression eczema may be said to be a general as well as a local debility, and to be induced and kept up by every cause which tends to lower the life-force of the organism.

Eczema is specific neither in its nature nor in its cause. Every cause of irritation acting on a frame and on a tissue enfeebled by disordered function is capable of becoming a cause of this affection. It is hereditary only in the sense of the transmission of natural tendencies from parent to offspring, and not by virtue of any special virus or *causa morbi*; and for a similar reason it is non-contagious. Nurses are occasionally affected with eczema from contact with the acrid secretions poured out by the inflamed skin, but the same result would follow in an equal degree from contact under similar circumstances with any other kind of irritant fluid, the two essential factors of eczema being a susceptible skin, natural or artificial, and the presence of an irritant. The warmth, the moisture, and the stimulation of the wash-tub are as active a cause of eczema to a sensitive skin as the most profuse contact with eczematous discharge. And there is no more energetic generator of eczema than the sun's rays when operating on the enfeebled integument of the victims of a city life.

Symptoms and Varieties.—The objective signs of eczema are—redness, slight swelling, papulation, vesiculation, exudation, incrustation, desquamation, thickening, hardening, fission or chapping; and the subjective sensations, burning heat, itching, and pain. The whole of these symptoms are not necessarily present at the same time, but they may all be in existence at once on different parts of the same person, and their separate preponderance is marked by distinguishing names, constituting the so-called varieties of Eczema. Thus, for example, when the prevailing symptom is redness, the case is one of *E. erythematosum*, and may subside with simple desquamation. When the hyperæmia causes congestion of the follicles and their up rising in the form of pimples, the case is termed *E. papulosum*. With the moderate swelling or œdema which always characterises eczema resulting from serous effusion, there is commonly exudation beneath the horny cuticle, giving rise to small vesicles, or *E. vesiculosum*, the typical eczema of Willan; and in a pyogenic constitution these vesicles may be converted into pustules, constituting *E. pustulosum* or *impetiginosum*. When the exudation from the surface is so excessive as to sweep away the cuticle completely, and pour forth from the inflamed skin like a veritable catarrh, the form is termed *E. ichorosum seu madidans*, and, from the depth of colour of the vascular base which supplies the exudation, *E. rubrum*. When the exuded secretion is dry on the inflamed surface in the form of crusts, the case is one of *E. crustaceum*, and is well illustrated by the *crusta lactea* of children. When, in consequence of thickening of the affected integument consequent on interstitial exudation, the cuticle is produced in excessive quantity, and continues to desquamate, the eczema is termed *squamosum*, and is the psoriasis of Willan and Bateman. In a more advanced degree of thickening, accompanied with induration, and in chronic stages of the disease, the skin is apt to crack and break, constituting *E. fissum*, the cracks and chaps being termed *rhagades*. Such a form is not uncommon in the palm of the hand, and constitutes one of the varieties of *psoriasis palmaris*. When, from any cause, a state of permanent hyperæmia is maintained in a part, such as the lower extremities, where it is likewise associated with obstructed venous circulation, the whole of the fibrous and epidermic tissues are apt to become hypertrophied, giving rise to *E. hypertrophicum*.

Besides these, the varieties of eczema due to the predominance of a particular symptom, we recognise dry eczema or *E. siccum*, and moist eczema or *E. humidum*, together with other varieties consequent on locality, such as the scalp, the face, the flexures of the joints, the perineum, and the palms of the hands. We also distinguish, as dependent on severity and duration, acute and chronic eczema, and on period of life, *E. infantile*.

Eczema must be considered as one of the most pruriginous of the affections of the skin; hence its Greek names *psora* and *psoriasis*, the former being applied to its more acute, and the latter to its chronic form. Itching is most severe in the dry forms of the disease, such as the erythematous, the papulous, and the desquamating kinds, and is relieved by the exudative process, whether occurring normally or produced artificially by the action of the nails or envelopment. In the moist forms the suffering assumes the character of pain, tingling, shooting, and aching, the pain being sometimes so severe as to be suggestive of the term *E. neurosum*.

Eczema being an inflammation of the surface-membrane of the exterior of the body, is not unfrequently associated with a similar inflammation of the mucous membrane of the air-passages of the lungs, giving rise to bronchitis; hence the complication of eczema infantile with bronchitis is far from uncommon, and in that respect is frequently derivative, a sudden increase of the cutaneous inflammation relieving the mucous membrane, and *vice versâ*; and this association of bronchitis and eczema is sometimes maintained during the whole lifetime of the individual. Sometimes the eczematous bronchitis subsides into a chronic asthma, and sometimes eczema alternates with hay-asthma. Not unfrequently eczema alternates with gout, rheumatism, or neuralgia, acting as a substitute for those affections and suggesting the commonly received opinion that eczema is a consequence of the gouty diathesis. Another and a common complication of eczema are boils; and, in weakly constitutions lymphadenomatous tumours are met with in the axillæ, and sometimes in the eczematous portions of the skin. The complication of eczema with hæmorrhoids and varicose veins of the lower limbs is a well-recognised fact; in the latter instance the dilated and obstructed veins being not only the exciting cause of the eczema, but leading to hypertrophous enlargement of the integument and cellular structures of the limb—to a state that may fairly be compared with elephantiasis Arabum.

Course, Terminations, and Prognosis.—The prognosis of eczema will be mainly influenced by the cause of the disease and the constitution of the patient; and, although constantly teazing and generally tedious, it has a natural tendency to cure, and very rarely imperils life. It is chiefly obnoxious through its itching, which is sometimes so great as to produce violent excitement of the nervous system; and prolonged nervous irritation increases the exhaustion of the sufferer. Where the health of the patient is in other respects fairly good the prognosis will be favourable; but where exhaustion of power prevails, where assimilation is seriously disturbed, and where much irritability of the nervous system exists, the prognosis must be correspondingly unfavourable. Thus eczema infantile, even when extensive, is easy of cure if the constitution of the child be moderately good; the same may be said of the eczema which depends on vaccination, dentition, and growth. The eczema of puerperal patients yields without difficulty to a tonic and nutritive regimen. The eczema which is substitutive of dyspepsia, gout, rheumatism, or neuralgia, is especially influenced by the vitality of the constitution, and so also is that which is due to exhausted nerve-power. The neglected eczema of infancy and childhood may be prolonged for a lifetime and eczema is not unfrequently one of the indications of broken health, which may alternate with other manifestations of disorder of internal organs, or may be associated with or follow disease of the kidneys, and so prove fatal. Eczema must, therefore, be regarded as a subjective rather than an objective disease, and, although troublesome and tedious, is generally curable. It may annoy the patient for many months or years, recurring with fresh force from time to time, changing with the seasons, and as a complication of other diseases, contributing secondarily to the destruction of life.

Treatment.—The treatment of eczema must be *constitutional* as well as *local*; in a very few instances of chronic eczema, when all participation with the original cause has ceased, local treatment alone may be sufficient, but such cases are exceptional. Constitutionally it will be needful to promote and regulate the functions of digestion and assimilation, and restore the powers of the system; but as eczema always implies a want of vital power, a conservative treatment must be maintained throughout. Our best regulators of the digestive functions are saline purgatives with bitter infusions, quinine and iron; sometimes nitro-muriatic acid with a bitter infusion, and a mild aperient pill. When these have effected their purpose, we may have recourse to more decided tonics, such as the citrate of quinine and iron, strychnine, cinchona with sulphuric acid; or when assimilative debility prevails, to the citrates of potash and ammonia. Where there is much nervous irritability the bromides of potassium and ammonium are serviceable; and in the gouty diathesis moderate doses of blue pill, colchicum, and diuretics.

It is not until these remedies have performed their share of duty that we should call into use the valuable aid of arsenic, and then arsenic, as a nerve-tonic and an assimilative tonic, may be said to be specific. To effect these purposes it should be given in small doses, *e.g.* two to four minims of liquor arsenicalis or the hydrochloric solution, in combination with wine of iron or tincture of cinchona. In some instances the perchloride of mercury with bark has also proved advantageous. Alkalies, as a rule, are objectionable, and if found necessary for a while, should be discontinued as soon as they produce a debilitating influence on the vital powers. In some few instances, where nervous irritability is the prevailing diathesis, arsenic may be adopted from the beginning of the treatment, and infants in general require no preparation for its use.

The *local* treatment of eczema should be alleviative in the acute forms and stages of the affection, and stimulant in its chronic forms. First amongst the soothing remedies is the benzoated oxide of zinc ointment; whilst the stimulants are represented by the mercurial ointments, alkaline ointments, and tar. The oxide of zinc ointment is especially intended to form a thin coating of protection to the inflamed skin, and therefore, where it cannot be secured by a bandage will require to be repeated several times a day; for a like reason, and to prevent the removal of the artificial covering so produced, washing of the diseased skin should be carefully prohibited.

In the earliest stages of the eruption great comfort may be afforded by dusting the eruption with starch powder, or starch powder with the oxide of zinc, or simply with fuller's earth; and zinc powder suspended in lime water forms a very useful lotion for protecting the eruption from the atmosphere at all stages of its progress. This latter application is also serviceable in relieving the distressing pruritus which always accompanies eczema. However, the most important of the remedies for the relief of itching are the preparations of tar, and especially a tar lotion composed of soft soap, tar, and alcohol, more or less diluted, and sometimes combined with hydrocyanic acid.

Where eczema is accompanied with much infiltration and œdema of the integument, especially occurring in the extremities, a process of sweating the limb by means of water-dressing and a waterproof envelope has been adopted with considerable success. And a modification of this treatment by the use of the envelope at night, and the zinc ointment during the day, may be very conveniently adopted in cases where the patient is unable to keep his bed, and is called upon to pursue his daily avocations in life during the continuance of the treatment.

In very chronic cases, again, where there is considerable hardness and condensation of the skin, it may be necessary to apply a blister over the part, and afterwards dress the blistered surface with zinc ointment; or, a milder course consists in the application of a strong alkaline solution or soap. Erasmus Wilson.

ECZEMA Marginatum. *See* Tinea.

EFFUSION (*e*, out, and *fundo*, I pour).—The escape of a fluid from its natural channel or cavity into the substance of organs or the cellular tissue, or from free surfaces. As examples, may be mentioned dropsy in its various forms, and effusions resulting from inflammation.

EGYPT, UPPER.—A very dry, tonic,

Trinity Medical College.

winter-climate. Mean winter temperature, 62°. Season, October to March. *See* CLIMATE, Treatment of Disease by.

ELECTRICITY.—The purposes for which electricity is employed in medicine are various. It is used as a stimulant to excite muscular and nervous tissue which is the seat of paralysis or pain, and as a stimulant to the tissues generally; its chemical action may be employed for dissolving tissues and coagulating blood within aneurismal sacs; and its thermal effects are employed in surgery for heating cauteries. Electricity is used in its three forms of (1) *Franklinic, Static,* or *Frictional* electricity; (2) *Faradism* (*i.e.* electricity generated by induction, whether voltaic or magnetic); and (3) *Galvanism* or Voltaism, which owes its existence to chemical action.

APPARATUS.—*Franklinic electricity,* which is generated by the friction of glass discs or cylinders, and which was formerly much in vogue, has now become nearly obsolete in therapeutics, and need not detain us in an article like the present.

Faradic batteries should consist of (1) a coil of insulated copper wire, the ends of which are in connection with the plates of a galvanic cell. This is called the *primary coil,* and contains a bundle of soft iron wire in its interior. 2. A second coil of insulated copper wire made of finer wire and containing a greater number of spirals than the primary, which is made to slide over the primary; this is called the *secondary coil.* 3. An *interrupter,* capable of interrupting the current automatically and with great rapidity by means of the constantly recurring magnetic action of the bundle of iron wires in the interior of the primary coil. These batteries should have means of graduating the intensity of the current of either coil, and of including the patient in the circuit of either coil without altering the connections of the conducting wires. Sometimes the galvanic element is replaced by a large magnet, as in the well-known rotating magneto-induction apparatus.

Galvanic batteries when used for therapeutic or electrolytic purposes should be composed of (1) a large number of small cells of low electromotive force, and as constant in their action as possible. The cells known as the 'Leclanche' are the best. (2) Means of including in the circuit any number of cells at will, so that thereby the intensity of the current may be regulated. (3) Means of opening or closing the circuit at will and of reversing the direction of the current without altering the position of the current-carriers (rheophores) on the patient's body. This is effected by means of a simple contrivance known as a *key and commutator.*

Batteries which are required for heating wires and cauteries must be composed of cells of high electromotive force and as large as is practically possible. The number of cells or elements is of less importance than their size. It is not unusual to have, for this purpose, Groves' or Bunsen's cells capable of containing a pint of liquid each.

The essential and distinctive differences of the two forms of current (galvanic and faradic) are the following:—

The Galvanic Current is (1) *continuously evolved* (hence it is spoken of frequently as the 'continuous current'). (2) It *flows always in the same direction, i.e. from* the positive pole (which is in connection with the copper or receiving plate) *to* the negative pole (which is in connection with the zinc or generating plate). This fact must be constantly borne in mind, because the action of the two poles is markedly different, and it has been asserted (on very doubtful evidence, however) that the direction of the current in the body, whether towards the nerve-centres or towards the periphery, has an important effect upon the physiological and therapeutical results. (3) It has well-marked *chemical* and *thermal effects.* This action is most marked at the negative pole, with which if a moderately intense current be used, heat, redness, inflammation, and even sloughing of the skin may be readily produced. It is, therefore, always necessary to frequently change the position of the negative pole on the body. (4) It has *electrolytic* effects. When a galvanic current is passed through a conducting compound liquid, decomposition of the liquid results, oxygen (if water only be used) and acids (if saline solutions be used) being evolved at the positive pole, while hydrogen or alkalies, as the case may be, are evolved at the negative pole. Since the human body consists of a mass of cells which contain and are bathed in saline fluids, many of the phenomena observed on passing galvanic currents through the human body, or any part of it, are probably due to this electrolytic action. Faraday called the positive pole the *anode,* and the negative pole the *cathode,* and these terms are frequently employed.

Induced Current.—With regard to the induced current, the following points must be remembered. (1) It is *momentary* in *duration.* (2) Its *direction is constantly changing,* so that in using it it is less necessary to distinguish between the poles. (3) Its *chemical, thermal, and electrolytic effects* are *nil.* (4) It has much greater '*tension*' than the galvanic current, that is, it overcomes the resistance of the body with far greater ease. (5) It *causes the contraction of healthy muscle* far more readily than the galvanic current. Muscular contractions only occur at the moment of making or breaking a current, and it is mainly to the rapid interruptions of the induced current that its high stimulating power is due. The current of the secondary coil has greater tension, more penetrating power, and greater stimulating power than the current of the primary coil or 'extra-current.' This is due to its being composed of finer wire and having a greater number of turns.

The stimulating effects of the galvanic current which cause muscular contraction, occur only at the moment of making or breaking the current and not during its continuance, and the stimulating effect of the two poles is different, as may be demonstrated by the 'Polar method of investigation,' instituted by Brenner, of St. Petersburg. If one rheophore be placed on an indifferent part of the body, as the back, and the other be placed over a nerve-trunk or muscle, we are able by means of the commutator and key to study the action of either pole on nerves and muscles during the making and breaking of the current. With weak currents it is found that contraction ensues only when the stimulating rheophore is negative (cathode), and only on closing the circuit. This is called Cathodal Closure Contraction (C.C.C.). If the strength of the current be slightly increased we get contraction also when the stimulating rheophore is positive (anode), and the circuit is opened (A.O.C.). Next follows Anodal Closure Contraction (A.C.C.), but Cathodal Opening Contractions (C.O.C.) never occur in healthy muscles with any currents short of those of unbearable intensity.

The galvanic current, unlike the induced current, affects the nerves of special sense. If applied in the neighbourhood of the eyes, flashes of light are seen, and blindness has resulted in one case from the incautious application of strong currents to the face. The gustatory nerve is affected in a similar way, and the 'galvanic taste' is perceived when the rheophores are placed on the cheek. The taste is acid with the positive, but metallic and coppery with the negative pole. If the rheophores are held to the ear rumbling noises are produced, and it is said that stimulation of the olfactory nerve will give rise to a peculiar smell.

Onimus has pointed out a further distinction between the induced and the galvanic current. 'An induced current,' he says, 'only acts during the infinitely short time of its passage, after which everything returns to order. . . . It can never be anything else but a series of slight excitements. With constant currents real excitement is determined only at the times of making and breaking. . . . It is during the silent period, however, that the principal action of the continuous current makes itself felt.'

It is certain that the rapid interruptions of the induced current and the strong muscular contractions caused thereby, are capable, if the current be moderately strong, of rapidly and completely exhausting the irritability of a muscle, and, if this fact be not constantly borne in mind, harm instead of good will result from the application of faradism. The galvanic current, on the contrary, possesses remarkable refreshing effects, a fact which has been demonstrated by Heidenhain on frogs, and by the writer on the human subject. It is found that a man can sustain a weight at arm's length far longer than he otherwise could, if a galvanic current be passed through the nerves of the limb. The feeling of fatigue can be removed by the application of the current, and the force of muscular contraction is increased thereby. These facts have important therapeutic bearings.

Modes of Application.—To apply electricity we need to have conducting wires and rheophores or current-carriers attached to the battery. The best conductors are made of ordinary telegraph wire, which should be as thick as is compatible with pliability. Telegraph wire is not damaged by moisture and can be readily connected to all forms of batteries and rheophores, and is therefore economical as well as convenient. Rheophores vary much in design. They should all have insulating handles, and the junction between the conductor and rheophore should be about the middle of its length, so that both conductors may be held in one hand without risk of the metallic junctions coming in contact. The most generally useful rheophore is the sponge-holder. An excellent sponge-holder, which retains the sponge with absolute firmness, has been made for the writer by Messrs. Weiss, from a design by Kidder of New York. Rheophores should be of different sizes, from a sponge as big as half-a-crown to the pointed extremity of an olive-shaped conductor. They should be made of metal and not carbon, because the latter is too brittle. They may be obtained in the form of discs, balls, points; and of endless design for reaching particular organs and regions, as the eye, ear, larynx, bladder, rectum, and uterus. They are usually covered with wash-leather, and used moist. A wire brush is useful for influencing the skin. The dry hand of the operator, who allows the current to pass through his own body to that of the patient, may be used for the same purpose. It is often convenient to fix one rheophore to the patient's body, which may be accomplished by placing an ordinary sponge on the surface of the body, laying thereupon the naked end of the conducting wire, and securing the whole with one turn of a bandage. If we wish to influence the surface only, we may use one rheophore dry; but if we wish to affect deeper-lying structures we must overcome the resistance of the epidermis by thoroughly moistening it with hot salt-and-water. We may use one rheophore dry, and one moist; or we may use as a rheophore a porcelain or gutta-percha vessel containing water, into which the limb is placed.

There are two methods of applying electricity, known as *general electrisation* and *localised electrisation*. By the former method we pass the current through the entire body or great part of it; it has been employed for many diseases, but its utility is doubtful. By the latter method, which we owe to Duchenne, we seek to influence special nerves, muscles, or organs, and to limit the action of the current strictly to these parts. If we wish to influence a muscle we may do so either by applying the rheophores directly over the fibres of a muscle (both the rheophores being held in one hand and 'promenaded' over the whole surface of the muscle). This is the direct method, and is the method advocated by Duchenne. Or, instead of trying to influence the muscle itself, we may stimulate the nerve supplying it, and so cause the muscle to contract. This is the indirect method, advocated by Ziemssen. It is effected by using two rheophores of different sizes. A large rheophore is affixed to an indifferent part of the body, while with a small pointed rheophore an endeavour is made to touch the exact point where the nerve we seek to influence is most superficial. Neither of these methods is to be exclusively adhered to. Certain deep-lying muscles, such as the diaphragm and the supinator brevis, are only capable of indirect stimulation. It will be found also that, in certain diseased conditions, muscles will not respond to stimulation through the nerves, but only to the direct application of the current. When we wish to use the refreshing effects of the current, as in cases of paralysis which are on the road to recovery, or in cases of fatigued muscles, &c., it is advisable to combine the application of the galvanic current with a rhythmical exercise of the affected muscles. Benedict lays it down as a rule that the *locus morbi*, be it brain, spinal cord, nerve, or muscle, should always be included between the rheophores.

Diagnostic and Therapeutical Uses. — 1. **Diagnostic Uses of Electricity.**—For purposes of diagnosis, electricity is of undoubted service, since by its means we are often enabled to distinguish between paralysis due to central lesion and paralysis due to peripheral lesion. We are accustomed to speak of a paralysis as 'central' so long as that portion of a nerve-centre is sound from which the nerves supplying the paralysed muscles take origin. Thus in cases of damage to one corpus striatum, the spinal cord and the greater part of the brain being healthy, we speak of the case as one of central paralysis. In cases, too, of paraplegia from local injury, the cord below the injury being healthy (notwithstanding that all mental control is cut off) we speak of the paralysis as central. In such cases of central paralysis we find (*a*) that reflex stimulation of the muscles is possible, (*b*) that the muscles undergo but little wasting, and (*c*) that the irritability of the muscles to faradism is scarcely diminished. We speak of paralysis as due to a peripheral lesion whenever the paralysed muscles are cut off from communication with their nerve-centres, or directly communicate with centres whose physiological activity has been destroyed by disease. In such cases we find (*a*) that reflex stimulation of the paralysed muscles is no longer possible, (*b*) that the paralysed muscles waste with remarkable rapidity, and (*c*) that the irritability of the muscles to faradism is rapidly diminished, and is generally ultimately destroyed. To establish the fact of diminished irritability to faradism is generally not difficult, and in cases of paralysis affecting one side of the body only it is done by comparing the paralysed muscles with their healthy fellows. We must take care that the current does not vary in intensity, and that it passes through exactly similar lengths of the body for the stimulation of both sets of muscles. It will be found convenient to fasten one rheophore to the middle line of the body (a big sponge tied to the back of the neck answers well), and then when the patient's limbs are arranged exactly symmetrically, test the healthy muscles first with a small or pointed rheophore and determine the current of least intensity which will cause contraction. Then the rheophore is to be applied to exactly the same spot on the opposite limb, and, if contraction follows as readily as on the healthy side, we know that there is no diminution of irritability. If, however, contraction do not follow, we increase the strength of current, and so determine to what extent the irritability is diminished, and whether or no it is completely extinguished. We should add that in cases of peripheral paralysis the diminution and extinction of irritability does not supervene immediately on the occurrence of the paralysing lesion, but only after the lapse of a week or ten days. In cases of paraplegia or other cases in which paralysis affects both sides of the body it is, of course, impossible to compare a paralysed muscle with its healthy fellow, and in such cases we can only judge of the amount of irritability by experience and mental comparison with previous cases. It is found, in cases of peripheral paralysis, that after complete extinction of faradic irritability the muscles will respond to a slowly interrupted galvanic current, and that not unfrequently the irritability of the muscles to galvanism is greater on the paralysed than on the sound side of the body. It is said by some German writers that not merely quantitative but qualitative changes take place in the irritability of these muscles and that the Anodal Closure Contraction (A.C.C.) soon becomes very marked, and equals or even surpasses in force the Cathodal Closure Contraction (C.C.C.); and further that the Cathodal Opening Contraction soon becomes more marked than the Anodal Opening Contraction. These reactions, which are supposed to depend upon degenerative changes in the muscle, have been spoken of as the *degenerative reactions*. These quantitative and qualitative changes in irritability are found (1) in some forms of paraplegia due to degenerative changes in the cord; (2) in so-called spinal paralysis both of infants and adults; (3) in traumatic paralysis due to injury of the nerve-trunks; (4) in rheumatic paralysis, that is, paralysis due to 'rheumatic' thickenings of the neurilemma; and (5) in lead-paralysis.

In ordinary hemiplegia the irritability of the muscles remains, as a rule, unchanged. In some cases, however, the irritability is increased in the early stages; and occasionally after the paralysis has lasted some time we find slight diminution of irritability. In the disease known as Progressive Muscular Atrophy, the irritability of the wasted muscles to faradism remains undiminished to the end.

2. **Therapeutical Uses of Electricity.**—*a. In Paralysis.*—The treatment of paralysis by means of electricity must be conducted rationally and with discrimination. By means of electricity we may attempt to remove the cause of the paralysis by influencing the nutrition of the parts where such cause is situated, by acting on the sympathetic nerve-branches supplying the blood-vessels of the part. Thus it is asserted that the absorption of a clot in the brain may be hastened, and that the nutrition of a damaged brain may be improved, by acting upon the cervical sympathetic nerve. To influence the cervical sympathetic we place one rheophore over the superior cervical ganglion (which may be reached by pressing inwards behind the angle of the jaw), and the other on the back, over the first and second cervical vertebræ. The use of such a proceeding is more than doubtful, and in case of any improvement occurring it would be impossible to know to what such improvement ought to be attributed, since the passage of a current across the upper part of the neck must influence many important nerves besides the sympathetic. On the whole, we think that galvanisation of the sympathetic is not to be advised in the early stages of paralysis. Galvanisation of the sympathetic has been employed in chronic degenerative changes in the brain or cord, but with very doubtful success.

The localised application of the electric current to the paralysed muscles is of undoubted service, and in employing it we should bear in mind the following rules. 1. As to the object of our treatment we should remember the words of Sir T. Watson. 'That our aim is to preserve the muscular part of the locomotive apparatus in a state of health and readiness, until peradventure that portion of the brain from which volition proceeds having recovered its function, or the road by which its messages travel having been repaired, the influence of the will shall again reach and reanimate the palsied limbs.' 2. Always to employ that form of current to which the muscles most readily respond. Thus if the muscles act readily to faradism, then faradism is to be used. In some cases of peripheral palsy we find that contraction follows only on the application of a very strong galvanic current, very slowly interrupted, and accordingly a slowly interrupted galvanic current must be used. As the case improves we shall find that a weaker current produces similar results, and that the muscle contracts with moderately rapid interruptions. And so will improvement gradually take place in favourable cases till faradic irritability and lastly voluntary power are restored. 3. Always to employ the weakest currents which will cause muscular contraction, and never to run the risk of exhausting a muscle by causing a too prolonged contraction. Each muscle should be taken in turn, and be made to contract two or three times in succession, and having gone over the whole of the paralysed muscles seriatim the process may be repeated. An application of this kind every other day is usually sufficient. 4. If the paralysis to the will remain absolute, and if the contractility of the muscles be perfect, we do no good by persevering with electrical treatment. This condition is often met with in hemiplegia. The patient is absolutely helpless on one side, although the paralysed muscles are in no degree wasted, and their irritability remains normal. 5. If the paralysis to the will remain absolute, and if the irritability of the muscles be diminished, then electricity is useful, in so far as it helps to improve the nutrition of the muscles and restore their normal degree of irritability. The normal degree of irritability and nutrition being restored (the paralysis to the will remaining absolute) electrical treatment may be discontinued. 6. If the irritability to both forms of current has completely disappeared, we are not justified in persevering too long, nor in holding out delusive hopes to the patient. Nevertheless, treatment should not be abandoned without a patient trial. [For the treatment of special forms of paralysis by electricity, the reader is referred to the appropriate sections of this work.]

β. *In Painful Affections.*—The power of electricity to relieve pain is very great. The relief is usually temporary, but in many cases is permanent. Electricity may act by serving to divert the mind from troubles real or fancied, or its counter-irritating effects may serve the same purpose as other counter-irritants whose power to relieve pain is well recognised. Occasionally electricity will give relief when every known remedy has failed, and in such cases we must suppose that it acts by bringing about some change in the nerves themselves by its specific action on nervous tissue. All three forms of electricity are employed for the relief of pain, but the galvanic current will be found the most generally applicable. Some writers insist that the anode (positive pole) shall be applied to the painful spot. Strong faradisation serves in some cases to give relief. The effects of galvanism should be tried in every case of neuralgia, but it is not capable of relieving all cases, and disappointment is not unfrequent. Where muscular movements increase the neuralgic pains, a rhythmical exercise of the affected muscles should be conjoined with the galvanism. Headache of all kinds not unfrequently yields to electricity; lumbago, sciatica, and those painful muscular conditions which we call 'rheumatic,' are quickly relieved by it. Tinnitus aurium will sometimes yield to the galvanic current when all other remedies have failed.

γ. *In Spasmodic Diseases.*—In the treatment of spasmodic diseases, electricity is of limited utility. Some forms of tremor are relieved by it. Some aggravated cases of writer's cramp have yielded to it when all other remedies have failed, and a few cases of clonic torticollis have received undoubted benefit by its judicious application. Tonic spasm of internal organs, such as the bowel and bladder, has been relieved by the galvanic current.

δ. *In other diseases.*—In addition to the treatment of diseases of a purely nervous character, electricity has been employed as a remedial agent in diseases whose origin is not so obviously connected with the nervous system. It has relieved the paroxysms of angina pectoris, and the burning pains which accompany herpes zoster. It has been employed in the treatment of many obstinate skin-diseases by American physicians, and Dr. Cheadle has recorded a case in which the dilated vessels in a case of acne rosacea were made to contract by faradisation. Rheumatic gout is said to have been benefited by a 'central' application of galvanism (one pole to the nucha, and the other to the epigastrium). The flow of urine in diabetes has been stated to be diminished by a similar process; and the symptoms of exophthalmic goitre have (it is said) been diminished by galvanisation of the cervical sympathetic. There is in fact scarcely a disease, from epilepsy to chilblains, in which it has not been alleged that electricity has been of use. In obstetric medicine, for the arrest of post-partum hæmorrhage, faradisation is now one of the recognised means to be employed; and it has been of more doubtful service for the rectification of displacements of the uterus. Ovarian pain and tenderness have been relieved by the galvanic current, and amenorrhœa has often yielded to electricity.

ε. *Galvano-cautery and Galvano-puncture.*—The chemical and thermal effects of galvanism are largely employed both in surgery and medicine. Its thermal effect has been used for the heating of cauteries; and cauteries so heated have very obvious advantages over all other forms. The chemical effect of the negative pole has been used as a caustic for the destruction of tissues, and tumours of considerable size have, it is said, been 'dispersed' by this means.

Galvano-puncture has been used in the treatment of hydatid cysts of the liver, but it is at least doubtful whether simple puncture is not quite as serviceable. Galvano-puncture seems likely to take a recognised position among the means at our disposal for the treatment of aortic aneurisms. Several cases have been recorded in which improvement has followed this method of treatment, and it seems possible that the operation may be accomplished without danger and almost without discomfort to the patient. The current employed should be generated by a number of small cells of low electromotive power (Smee's cells as modified by Foveaux seem the best). Each pole should terminate in a fine steel needle, carefully insulated except at the point. Both these needles should be passed completely into the aneurismal sac, care being taken that the points of the needles are free in the sac, and that they do not touch, but are separated by an interval of an inch or inch and a half. When the current passes, the whole of its effect will be exerted on the blood within the sac; and, owing to the insulation of the needles, the coverings of the sac will receive no damage. The effect of the current is to cause a firm coagulum to form round the positive pole, while the liberation of gas at the negative pole causes there a frothy soft coagulum. As a rule the gas generated is swept onwards by the blood-current and causes no trouble, but occasionally distension of the sac has resulted. The clot formed at the positive pole seems to act as a foreign body, and further coagulation may take place around it, until complete consolidation of the aneurism has resulted. It will be found that a current from ten or twelve cells can be borne for an hour or more, and that no chloroform will be needed for the operation. When the needles are withdrawn the orifices must be closed by collodion. A repetition of the operation is generally necessary, and may be performed at suitable intervals.

G. V. Poore.

ELEPHANTIASIS ARABUM (ἐλέφας, an elephant).—Synon.: Fr. *Éléphantiasis*; Ger. *Elephantiasis*.

Definition.—A non-contagious disease, characterised by recurrence of febrile paroxysms, attended by inflammation and progressive hypertrophy of the integument and areolar tissue, chiefly of the extremities and genital organs; and occasionally by swelling of the lymphatic glands, enlargement and dilatation of the lymphatics, and in some cases by the co-existence of chyluria, and the presence in the blood of certain nematode hæmatozoa; together with various symptoms indicative of a morbid or depraved state of nutrition.

Ætiology.—Elephantiasis is endemic in India, the Malayan peninsula, China, Egypt, Arabia, the West Indies, and parts of America, chiefly in localities within the influence of the sea air; and it occurs sporadically all over the globe, excepting, perhaps, in the extreme north and south. Certain conditions of soil and climate, such as humidity, heat, malarious influences, and proximity to the sea-coast, seem to be concerned in producing the disease and influencing its development. Removal from the territorial endemic area checks the disease, whilst return there reproduces it. Elephantiasis affects both sexes, and persons of all ages and conditions of life. No race is exempt, but it is much more frequent in dark than in fair races; and more men suffer from it than women. It occurs at all ages, but is most common in adult and middle life, comparatively rarely beginning in young children or in the aged. Elephantiasis is doubtfully hereditary; but Richards found that of 236 persons, 73 per cent. had one or both parents affected. Various causes are assigned for the disease. Air, water, food, and, as it is common near the sea-coast, eating fish have been frequently credited with producing it. The presence or vicinity of certain forms of vegetation, and the geological formation of the soil, have also been regarded as predisposing and determining causes. Climate and locality, combined with bad living, are doubtless the real predisposing causes; and it is probable that, as Dr. T. Lewis has suggested, it may be found to be intimately associated with the presence in the blood of certain parasites. No race is exempt from the disease, but, whatever may be the explanation, the white suffer less than the dark races. It does occur occasionally, though very rarely, in the pure European in India, but more frequently in those of mixed descent; it will generally be found that where it occurs in persons of apparently European parentage, there is a mixture, however slight, of dark blood.

Anatomical Characters.—The hypertrophy of elephantiasis in most cases appears to be simply an increase in the natural elements of the part, the blood-vessels and lymphatics sharing in the growth. In other cases the lymphatics and lymph-spaces are most concerned, giving rise to a condition that has been described as *nævoid elephantiasis*, in which the appearance is presented of a soft and fluctuating swelling, which when punctured gives issue to a white or pinkish fluid, very closely resembling chyle. The lymphatic glands also share in the enlargement. In other respects the progress of this is like that of the ordinary form of the disease.

The *Filaria sanguinis-hominis* is sometimes found in great numbers in the blood of persons suffering from elephantiasis. *See* Filaria Sanguinis-Hominis.

Symptoms.—The ordinary form in which elephantiasis presents itself is hypertrophy of the integument and areolar tissue of some part of the trunk or limbs, and notably of the legs and genital organs. The skin becomes enormously thickened by hypertrophy of all the fibrous elements of its structure, attended by the deposit of a quantity of albuminous fluid in the cells of the areolar tissue. The papillæ are prominent and much increased in size. The integument is formed into hard masses or folds, with a rugose condition of the surface, not unlike the appearance of an elephant's leg. The feet and toes are sometimes almost hidden, and the scrotum or labia form enormous outgrowths. The scrotum often attains great weight, and may be accompanied by large hydroceles. Scrotal tumours have been removed weighing upwards of 100 lbs.

The onset of elephantiasis is frequently violent and attended with great suffering. There is high fever; intense pain in the lumbar region, groin, spermatic cords, and testes, which become swollen; while acute hydroceles form. These symptoms are often attended with sympathetic vomiting, nausea, and rapid erythematous swelling of the external parts; and, if the extremities be attacked, the swelling may be tense and painful, accompanied by much effusion into the areolar tissue. The surface of the integuments is much inflamed, and sometimes discharges a serous ichor or chylelike fluid, according to the extent to which the lymphatics are engaged in the particular case. The great tension and swelling of the spermatic cords are apt to dilate the abdominal rings so widely, that after recovery the patient may suffer from hernia.

In some cases of elephantiasis the integuments are also the seat of a dilated and turgid condition of the lymphatic vessels, which during the periods of vascular excitement, when the febrile attacks occur, give way and discharge a chyle-like fluid; in other cases the surface temporarily assumes a herpetic condition, which weeps an acrid and offensive serous exudation.

Elephantiasis not unfrequently occurs without much or any obvious injury to, or disturbance of the general health during the intervals between the febrile attacks, which in some cases are few and slight. The appetite, spirits, and strength are good, the functions are all normally performed, and the only inconvenience is that due to the size and weight of the outgrowth. On the other hand, it is frequently quite the reverse; the rapidly recurring febrile attacks, pain, exhaustion, suffering, and visceral complications, induce a state of cachexia and debility sometimes so serious as to render even surgical interference impracticable. Withal, hepatic and splenic enlargements do not as a rule result from the persistence of the elephantoid fever alone; though not unfrequently, as a more direct result of malarious poisoning, they seriously complicate the evils of the sufferer's condition. Albuminuria, as well as chyluria, is occasionally present.

In some cases, after the outgrowth has attained a certain bulk, it ceases to grow altogether, or increases slowly and insidiously without febrile disturbance, and in such cases the general health remains good. But there is generally a tendency to recurrence of the fever once or twice a month, when the parts affected become tense, hot, painful, and swollen, and often discharge a serous or lymph-like fluid, which may be acrid and offensive. Some tumours, on the other hand, are very slightly, if at all so affected, and remain perfectly dry. In all cases, however, some growth goes on, and even when, as occasionally happens, fever has ceased to recur, there may be a gradual, but slow and painless, increase of the hypertrophy. The greatest variety and uncertainty obtains in the duration and progress of the growth; sometimes it is very rapid, at other times it is slow, with intermissions of activity and indolence of development.

The disease elsewhere than in the genitals, unless it be accompanied by exhaustion and debility, causes no failure in the generative powers in either sex. Women may have a tendency to miscarry when suffering from elephantiasis.

Course, Duration, and Terminations.—According to Richards, the average duration of the disease, as deduced from the observation of 636 cases, was 11½ years; and he notes that the earliest age was nine years, whilst the latest at which he observed it was eighty years. It appears from this that the disease has little influence in shortening life.

Pathology.—The outgrowths in elephantiasis are the local expressions of a constitutional disease, and are not to be regarded merely from their local point of interest. They are the result of certain climatic influences whose exact nature is not at present determined; though, considering the geographical range of the area where the disease is endemic, it seems probable that, whatever other cause may be at work, the so-called malarious influences play an important part in its production.

The recent researches of Dr. T. Lewis into the pathology of chyluria in India, and his discovery of certain hæmatozoa in the blood of those affected with that disease, coupled with the fact that the subjects of chyluria and hæmatozoa are also frequently, if not always, affected by elephantiasis with its febrile paroxysms, hypertrophied integument, and lymphatic disturbance, are very suggestive of a community of origin of these morbid conditions.

Treatment.—Little has yet been done by constitutional treatment in cases of elephantiasis. Remedies useful during the febrile paroxysms have little power in preventing recurrence or in checking the disease. Iodine, combined with quinine, arsenic, and iron, has been found useful to a certain extent. During the febrile state salines, diaphoretics, and such remedies as are needed during the pyrexial state of malarious fevers, are indicated. Opium may be necessary to relieve the intense pain which often accompanies the onset of the stage of excitement. When the febrile stage has passed, quinine is useful, which, if anæmia exist, should be combined with iron. The local application of iodine in such forms as the iodide of lead or the biniodide of mercury has been thought useful; but as this is generally combined with pressure in the recumbent posture, the benefit is probably due to the latter. Such measures, along with improved hygienic conditions, may no doubt control the progress of the disease and relieve suffering. No remedy, however, is so potent as change of climate, by removal from the endemic site of the disease. This, if effected in the earliest stages, may completely arrest the disease, and perhaps even disperse any incipient structural change. This has been observed in the rare cases in which elephantiasis occurs in Europeans, who on returning to Europe, have after a time lost the disease, and almost, or entirely, any hypertrophic changes that may have occurred. Natives of India improve if they leave the endemic area during the early stages, and go and reside in other and drier localities. However, when the hypertrophy is advanced, the paroxysms of fever are still liable to recur, even when the climate is changed, though with less violence.

Surgical treatment, where the hypertrophy is advanced, is often most successful in relieving the sufferer, not only of the local trouble, but also of the fever. Tumours of the genital organs, sometimes of enormous size, are now removed with complete success and comparatively small mortality. Before commencing the operation, especially in the case of a large scrotal tumour, it is well to drain it of blood by placing the patient on his back, and elevating the tumour on the abdomen for an hour or so, during which time pressure by a bandage (a modification of Esmarch's) may be tried, and cold (ice) may be applied. During the operation the application of a whipcord ligature drawn tightly round the neck of the tumour also prevents loss of blood.

The removal of a scrotal tumour is effected by incisions along the course of the cords and the dorsum penis. The cords, testicles, and penis are turned out by a few touches of the knife, and then reflected and held up on the abdomen, while the mass of the tumour is rapidly swept away by a few bold incisions in the perinæum. The numerous venous and arterial bleeding points should then be arrested and the wound dressed with oiled lint covered with antiseptic dressing. No attempt should be made to preserve flaps of integument either for the penis or testes. It is unnecessary, and almost certain to be followed by recurrence of the disease. The process of cicatrisation goes on rapidly, and in from two to four months all is closed in by cicatrical tissue, which gradually perfects itself, and has no liability to become the seat of a return of the disease. If the shock be severe the patient should be left on the table until reaction has thoroughly set in. Of 193 cases of scrotal elephantiasis operated on in the Medical College Hospital in Calcutta, 18·2 per cent. proved fatal.

Joseph Fayrer.

ELSTER, in Saxony.—Alkaline sulphated waters. *See* Mineral Waters.

EMACIATION (*emacio*, I make lean).—Wasting or loss of flesh. The term is applied both to the process of wasting, and to the condition that results therefrom. *See* Atrophy.

EMBOLISM (ἔμβολον, a plug).—Synon.: Fr. *embolie*; Ger. *Embolie*.

Definition.—The arrest in the arteries or capillaries of some solid body, which has been carried along in the course of the circulation.

Pathology.—Emboli usually consist of portions of fibrine derived from thrombi of the veins or heart, or of vegetations detached from the cardiac valves. They may, however, be formed by fragments of tumours which have grown into the blood-vessels, or of other foreign bodies which have obtained entrance into the circulation.

The effects of embolism may be divided into two classes:—First, those which are caused by the arrest of the circulation; and secondly, those which are due to any specially irritating properties of the embolus.

The embolus may, first, be supposed to consist of some indifferent substance not possessing any irritating qualities. The effects which may then be caused by arterial embolism are mainly these:—First, a transient anæmia of the territory supplied by the blocked artery. This may pass away without leaving any permanent consequences. Secondly, necrosis of this territory. This may be either sudden, in the form of gangrene; or more gradual, in the form of softening or withering. Thirdly, the formation of a *hæmorrhagic infarction*, that is, congestion of the territory, followed by extravasation of blood into the tissues, and so the formation of a firm, solid patch of a dark red colour, usually of a wedge shape, with the apex towards the embolus, and the base towards the periphery. In very soft organs, as the brain, the extravasation may break down the tissue and cause the ordinary phenomena of an apoplectic clot. These hæmorrhagic infarctions undergo various subsequent changes. Usually a process of degeneration sets in; the blood-pigment passes through its usual transformations, the patch changes from dark red to tawny and yellow, undergoes molecular disintegration, shrinks away, and ultimately leaves a depressed fibrous patch in which the remains of the altered blood, crystals of hæmatoidin, &c., may often be recognised. Sometimes the patch softens down into a puriform fluid, which may become surrounded by a fibrous capsule, and ultimately dry up, or even calcify. When recent these patches are usually surrounded by a halo of congested vessels.

The cause which determines these different results of arterial embolism is, in the main, the anatomical arrangement of the blood-vessels. Supposing the embolus to be lodged in an artery which gives off anastomotic branches between the seat of the embolus and the final capillary distribution, the effect in most cases will be transient anæmia, the collateral channels will enlarge, and the circulation will be again restored. A thrombus will form on the embolus and will extend back to the next arterial branch, and the changes described in the article on thrombosis will take place in it (*see* Thrombosis). If the blocked artery be of large size, and supply important organs, the symptoms of temporary arrest of function of the part supplied by the artery will follow, as transient paralysis, dyspnœa, coldness of the extremities, &c., according to the artery affected. Should, however, the artery be small, and not supply important organs, no symptoms whatever will be caused, and this is the case in the majority of embolisms. Supposing, however, the artery is what Cohnheim calls a *terminal* artery, *i.e.* one which gives off no anastomotic branches between the embolus and the final capillary distribution, and that the capillary anastomosis with other arterial territories is insufficient to supply a collateral circulation, and that the presence of valves prevents the reflux of blood into the territory from the veins, it is manifest that the embolism must completely cut off the blood-supply, and consequently cause necrosis in some form or other of the territory.

The network of anastomosing channels is, however, so close in most parts of the body, that in order to produce this effect it is necessary either that the main artery of the part be obstructed, or else that there be multiple embolisms blocking up at the same time several arterial branches, and so stopping the channels of collateral circulation.

The mode in which the hæmorrhagic infarction is produced is still a subject of dispute. According to Cohnheim, whose views until recently were generally accepted, the hæmorrhage is due to a reflux from the veins into the territory supplied by the blocked artery. This first causes congestion, and then extravasation, in consequence of impairment of nutrition of the walls of the blood-vessels, for the integrity of which the circulation of the blood is essential. According, then, to Cohnheim, in order to produce the phenomena of the hæmorrhagic infarction it is necessary that the artery be a terminal one, *i.e.* one which gives off no anastomotic branches for some distance before its final capillary distribution, and that the veins be not furnished with valves. These conditions are met with in the spleen, the kidney, the brain, certain branches of the pulmonary artery supplying surface lobules, and the central artery of the retina; and on these grounds he accounts for the frequent occurrence of hæmorrhagic infarctions in these organs, though there is no reason to suppose that, with the exception of the lungs, embolisms are more frequent in them than in other parts.

The more recent researches of Dr. M. Litten, *Zeitschrift für klinische Medicin*, Vol. I., render, however, these views no longer tenable. He shows by experiments on the kidney, spleen, lung, &c., that if the blocked artery be a strictly terminal one, *i.e.* one whose area of distribution has no other arterial supply, the phenomena of the hæmorrhagic infarction do not occur, even though the vein have no halves; and under other circumstances that the infarction takes place although the vein has been ligatured, hence the cause of the infarction cannot be venous reflux. Thus if both the renal artery and vein be ligatured, infarction of the kidney takes place, the kidney receiving a sufficient collateral supply of blood from other sources; but if the capsule were first stripped off, and the kidney be left attached only by the renal artery and vein, no infarction took place, though the vein was left pervious. Similar results were obtained in other organs; hence it would seem evident that the congestion and infarction following embolism are produced by an afflux of arterial blood into the territory from collateral channels. Should these be numerous, and should small arteries open directly into the anæmic territory, the circulation will soon be restored, and no infarction will take place; should, however, the communication be imperfect, and only by means of capillaries, a congestion of the territory leading to diapedesis and infarction will result, the *vis a tergo* being insufficient to propel the blood onwards into the veins.

He has also shown that the vessels in which the circulation has been arrested retain their integrity much longer than was supposed by Cohnheim, and that in the kidney long before the vessels suffer necrosis of the epithelium takes place, the nuclei of the cells disappear, their protoplasm coagulates, and they become converted into swollen hyaline masses (*coagulation necrosis*), which have a remarkable tendency to calcification. Hence the wedge-shaped white embolisms often seen in the kidney are not produced by decolorisation of hæmorrhagic infarctions, but are simply the result of the necrosis of the epithelium; and the halo of injection which is often seen to surround them is due to inflammatory congestion caused by the presence of the necrosed patch.

This explanation of the mode of production of the hæmorrhagic infarction is more closely in accord with the view originally propounded by Virchow, who regarded the hæmorrhage as due to collateral fluxion.

We have now to consider the effects of emboli which possess irritating or poisonous qualities, such as those derived from the puriform softening of venous thrombi in cases of septic inflammation, &c. The mechanical effects will be the same as those of the previous class; but, in addition, these emboli set up a suppurative inflammation in their vicinity, quite independent of any obstruction of the circulation. Hence it is that we meet with pyæmic abscesses, as the result of infecting emboli, in all parts of the body, while the effects of obstructed circulation are, for the most part, confined to certain organs. Thus the liver is very frequently the seat of embolic abscesses, while hæmorrhagic infarctions do not occur there. In the lung, where in parts terminal arteries are found but for the most part there is free anastomosis, the two processes are often seen side by side. The different effects of these two classes of embolism are very manifest in the capillaries. Simple emboli, of such small size as to become first arrested in the capillaries, either cause no permanent change at all, or, at most, produce a punctiform hæmorrhage. Infecting emboli, on the other hand, give rise to the miliary abscesses so characteristic of pyæmia.

W. Cayley.

EMESIS (ἐμέω, I vomit).—A synonym for vomiting. *See* Vomiting.

EMETICS (ἐμέω, I vomit).—Synon.: Fr. *Emétiques*; Ger. *Brechmittel.*

Definition.—Agents that produce vomiting.

Enumeration.—Copious draughts of lukewarm water, Mustard, Sulphate of Zinc, Sulphate of Copper, Carbonate of Ammonia, Common Salt, Alum, Chamomile, Tartar Emetic, Ipecacuanha, and Apomorphia.

Action.—The act of vomiting consists in the simultaneous spasmodic contraction of the diaphragm and abdominal muscles, and relaxation of the cardiac orifice of the stomach, so that its contents are expelled. When the diaphragm and abdominal muscles contract, but the cardiac orifice remains closed, so that the contents of the stomach cannot escape, the expulsive efforts are termed *retching*. The nervous centre which regulates these movements is situated in the medulla oblongata; and it may be excited either directly by the action upon it of drugs carried to it by the blood, or reflexly by irritation of various nerves. The drugs that act directly upon it have the same action, whether they are introduced immediately into the circulation or absorbed by the stomach. They may thus produce vomiting and evacuation of the stomach without being taken into the stomach at all, and on this account they are termed *indirect* emetics, although they act directly upon the vomiting centre. Such are ipecacuanha, apomorphia, and tartar emetic. Similarly the drugs that excite it reflexly are still termed *direct* emetics, because they are applied directly to the stomach. Such are the sulphates of zinc, copper, and alumina; carbonate of ammonia; salt; mustard; and chamomile, which irritate the nerves of the stomach. Tickling the fauces with a feather, or with the finger, also excites reflex vomiting, and may be adopted either alone, or in order to aid the action of other emetics. The terms *direct* and *indirect*, therefore, as applied to emetics, relate to the stomach and not to the centre for vomiting.

Direct emetics, as they stimulate the nerves of the stomach only, have little action except that of simply exciting vomiting. The indirect emetics, which excite vomiting by their action on the medulla oblongata, act also on other parts of the nervous system, and cause secretion of saliva, secretion of mucus from the œsophagus, stomach, and bronchial tubes, and perspiration. They also cause much nausea, depression of the circulation, and loss of nervous and muscular power. Further, the vomiting they induce is more continuous and violent, and often expels the contents of the gall-bladder, causing part of the bile to flow into the stomach, and be thus evacuated.

Uses.—Emetics are employed to remove the contents of the stomach under various circumstances. Firstly, when the food is causing irritation, and not undergoing proper digestion, as, for example, in dyspepsia or sick-headache; and in such cases large draughts of lukewarm water, of mustard and water, or of an infusion of chamomile are usually found beneficial. Secondly, in cases of poisoning; and here mustard, sulphate of zinc, or sulphate of copper are best, as they empty the stomach most quickly and effectually. Thirdly, to cause the expulsion of bile from the gall-bladder, or remove bile from the body in biliousness, fevers, and ague. When the bile-duct is stopped by a small gall-stone, the pressure exerted on the gall-bladder during vomiting has been known to cause the expulsion of the calculus. In biliousness, excess of bile is more readily removed by vomiting than by purging, as there is no opportunity for the bile to be absorbed on its way from the gall-bladder to the mouth, whereas it may undergo absorption on its passage through the intestines. It is supposed by some that various poisons circulate occasionally in the bile, such as the malarious poison which occasions ague, and possibly other septic poisons which give rise to fevers. The advantage of emetics in ague is undoubted, as it can certainly sometimes be cured by them without quinine, and the action of quinine is always aided by their use. They have also been recommended in the early stages of continued fevers. In such cases tartar emetic or ipecacuanha are most serviceable. Fourthly, to cause expulsion from the air-passages of false membrane in croup or diphtheria, or of secretions in bronchitis and phthisis. For these purposes ipecacuanha is the emetic most frequently chosen, but if it does not act rapidly in croup, sulphate of zinc or sulphate of copper may be employed, and in cases of either croup or bronchitis where there is great depression of the circulation carbonate of ammonia may be used with advantage, as it not only causes vomiting, but at the same time stimulates circulation.

T. Lauder Brunton.

EMMENAGOGUES (ἔμμηνα, the menses, and ἄγω, I move or expel).

Definition.—Emmenagogues are remedial agents which stimulate or restore the normal menstrual function of the uterus, or cause expulsion of its contents.

Enumeration.—Emmenagogues may be either *indirect*, as Iron, Strychnia, and other tonics, Warm Hip-baths, Leeches, Mustard Stupes, Aloetic purgatives, &c.; or *direct*, as Rue, Borax, Savin, Myrrh, Cantharides, Guaiacum, Apiol, Quinine, Digitalis, and Ergot—most of which, when given in larger doses, produce abortion, and are called *Ecbolics*. The most efficient means, however, of obtaining this last-named action are those of a mechanical nature, so well known to obstetricians, and directed either to the actual rupture of the membranes, or to their separation from the cervix.

Action.—The *indirect* emmenagogues act by improving the quality of the blood, giving tone to the nervous system, or irritating adjacent parts or organs, from which a stimulating influence is conveyed by reflex action to the womb.

The *direct* drugs in moderate doses gently stimulate the uterus, promoting the menstrual flow, or even checking it when in excess; but when further pushed they cause powerful contraction of the unstriped muscular fibre, of which its walls are mainly composed. Ergot, which is the principal, and in fact almost the only really useful member of the group, is believed to act either directly on the muscular tissues themselves, or through the intermediate intervention of some central or peripheral nervous influence.

Uses.—Checked or retarded menstruation frequently results from anæmia or general debility, and the indirect emmenagogues will under these circumstances usually effect a cure. If, however, the case prove more obstinate, a little ergot added to the iron will often restore the suspended function. If even this do no good, some mechanical impediment probably exists, or some altered physical condition of the womb which mere drugs cannot rectify. Ergot is frequently employed in cases of lingering labour from simple inertia of the uterus, but its use must be strictly confined to those cases in which there is no marked disproportion between the maternal passages and the head of the child. Advantage is also taken of its contractile powers in the treatment of uterine hæmorrhages, or for the destruction of the smaller varieties of polypi, which are so frequently contained within the womb, by cutting off their blood-supply. Finally, it may be necessary, under certain conditions, to induce abortion or premature labour, as when constant sickness, or albuminuria, or compression of adjoining neighbouring viscera seems to endanger the mother's life, or when pelvic distortion renders it impossible for a living child to be born at full term. When the medical attendant has made up his mind that interference is necessary, he generally has recourse to one or other of the mechanical methods which are fully described in works more particularly devoted to obstetrics.

Robert Farquharson.

EMOLLIENTS (*emollio*, I soften).—Definition.—Substances that soften and relax the parts to which they are applied.

Enumeration.—The principal emollient applications are:—Warm water, Steam, Poultices made of substances which retain heat and moisture, for example, linseed-meal, bread, bran, flour, oatmeal, and figs; Fatty Substances, as linseed, olive, almond, and neat's-foot oil, lard, and suet; Spermaceti, Wax; Soap Liniment and other liniments; Glycerine; and Paraffines, such as vaseline, unguentum petrolei, &c. To these may be added such substances as do not properly relax the tissues, but protect the surface from irritation, such as White of Egg, Gelatine, Isinglass, Collodion, and Cotton-wool.

Action.—Emollients relieve the tension and pain of inflamed parts by their action both upon the blood-vessels and upon the tissues themselves. They cause all the contractile tissues to relax and dilate, and thus, lessening pressure upon the nerves of the part, they relieve pain. They soften superficial parts by supplying them with either fat or moisture, and by increasing the supply of blood. In this way they prevent the skin from cracking after exposure to cold. When the cuticle is lost they form a covering, under which the skin may heal; and they prevent the injurious consequences of friction from without.

Uses.—Fatty emollients are used to prevent the skin or mucous membranes from cracking; to prevent irritation or ulceration between parts constantly in contact, as on the limbs of children near the joints; to prevent bed-sores; to aid the healing of blisters; or in skin-diseases, such as eczema. They are also used, especially in the form of linimentum calcis, as applications in burns and scalds, for which purpose such substances as cotton-wool are likewise frequently employed. Mucilaginous substances are useful when swallowed to relieve pain and irritation in the throat, and to lessen irritable cough; and such substances as figs are employed to protect the intestines from injury by hard and pointed substances which have been swallowed. Warmth and moisture are applied in the form of poultices to the surface in pustules, boils, carbuncles, and deep-seated inflammation of the limbs, and in inflammation of the internal organs (*see* Poultices). In the form of vapour they are useful in inflammation of the air-passages (*see* Inhalations).

T. Lauder Brunton.

EMPHYSEMA of Lungs. *See* Lungs, Emphysema of.

EMPHYSEMA, SUBCUTANEOUS (ἐν, in, and φῦσα, wind).—Synon.: Fr. *emphysème*; Ger. *Windgeschwulst*.—Subcutaneous emphysema is the distension of the spaces of the areolar tissue with air or any other gas. There is thus produced a swelling, in slight cases affecting a very limited area, in extreme cases extending to the subcutaneous tissue of the whole body. Unless the tension is great the swelling is slightly lobulated; it is elastic, and although the finger sinks readily into it, no lasting impression is left. When the area affected is small, the gas can be driven in any direction by the pressure of the hand. On palpation a peculiar fine crepitation is felt, which is absolutely diagnostic. On percussion there is superficial resonance, the note resembling that obtainable from a bladder loosely filled with air. Unless the gas causing the emphysema is the product of decomposition of gangrenous tissues, as in spreading gangrene, there is no redness of the skin. The swelling usually forms rapidly and may extend in a few minutes over the greater part of the body. In such cases it is most marked where the subcutaneous tissue is lax. In the face the features are obliterated, and the eyes closed by the swelling of the lids. The scrotum and penis become enormously distended.

Ætiology and Pathology.—Wound of the lung from a broken rib or from a stab is the most common cause of subcutaneous emphysema. If from a stab, it can only occur when the opening in the pleura and that in the skin no longer correspond with each other, in consequence of an alteration in the position of the patient, or when the wound has been artificially closed. When from wound of the lung, it may occur with or without pneumothorax. Nothing is more common than to find a limited emphysematous swelling round a fractured rib, without any signs of air in the pleural cavity. This arises either from adhesions existing between the parietal and visceral layers, or from the escape of air being very limited. In severe cases with pneumothorax the mechanism of the production of emphysema is as follows:—A wound in the lung always allows air to pass from it readily, but from the way in which the soft pulmonary tissue falls together, no amount of force can drive air through the wound in the opposite direction. It thus acts somewhat like the valve of an air-pump. The first effect of the escape of air into the pleural cavity is to cause collapse of the lung. As the chest expands with each inspiration air rushes from the wound in the lung into the pleural cavity: as it contracts in expiration, the air, being unable to pass back by the wound, is driven through the opening in the parietal pleura into the subcutaneous cellular tissue. In such cases there is gradually increasing dyspnœa, with great distension of the subcutaneous cellular tissue, and unless relief is given the patient dies asphyxiated.

Emphysema occasionally occurs from rupture of some of the air-vesicles during a violent expiratory effort. Walshe states that this accident has happened from 'the efforts in parturition, defæcation, raising weights, coitus, violent coughing, paroxysms of rage, excessive laughter, and hysterical convulsions.' The air usually escapes first into the cellular tissue between the lobules of the lung, giving rise to the condition known as *interlobular emphysema*. It then finds its way into the mediastinum and from thence to the root of the neck. Interlobular emphysema gives rise to intense dyspnœa, and has been known to cause sudden death. Emphysema has also been seen as a consequence of ulceration of the trachea, and in a few very rare cases as the result of ulceration proceeding from a cavity in the lung through the adherent pleura and intercostal muscles to the subcutaneous cellular tissue.

Localised emphysema of the face is a symptom of fractures implicating the antrum.

Emphysema of the flanks is an occasional symptom of rupture of the third part of the duodenum, behind the peritoneum, and of perforation of the cæcum at its posterior part.

Emphysema of the perineum and scrotum may arise from a wound of the bowel in the administration of an enema.

In non-penetrating wounds of the thorax and abdomen, a small quantity of air may find its way into the areolar tissue in the immediate neighbourhood, in consequence of the movements of respiration. In compound fractures emphysema is often found extending some distance above and below the wound, if the patient has been carried some distance and the injured limb much shaken.

Emphysema from the gases produced by decomposition is only seen in cases of rapidly spreading moist gangrene.

Progress and Terminations.—The effects of emphysema differ with the source of the gas. When the air comes from a superficial wound of the lung, it has no tendency to cause decomposition of the effused blood with which it may come into contact. Thus, in surgical cases, no evil consequences result from emphysema around a simple fracture of a rib. This is explained by the fact that the gas in the air-vesicles is absolutely free from solid particles of any kind; as shown by Tyndall's experiment, in which the residual air, in forced expiration, makes a gap in the beam of an electric light when breathed across it. On the other hand, air admitted from without, as in a compound fracture, tends to favour the decomposition of the effused blood, and renders treatment by occlusion or by antiseptic dressing difficult and uncertain. In ordinary cases the effused air is rapidly absorbed without causing inconvenience of any kind. If the amount of air in the tissues be very great, and the case be complicated by pneumothorax, fatal dyspnœa may occur, unless relieved by treatment.

Treatment.—The swelling itself requires usually no treatment, the gas being absorbed without difficulty. If it is complicated by pneumothorax, or if the dyspnœa be such as to threaten death, the wound, if one exists, must be opened up, or, if there is none, a free opening must be made into the pleural cavity. If the swelling be such as seriously to inconvenience the patient, a few punctures may be made with a triangular needle. Emphysema from intestinal flatus is always limited, and requires no treatment beyond that applicable to the cause of the escape of gas.

Marcus Beck.

EMPIRICAL (ἐν, by, and πεῖρα, experience). This term is applied to treatment founded on experience, as opposed to *rational*, founded on scientific reasoning. *See* Disease, Treatment of.

EMPROSTHOTONOS (ἔμπροσθεν, forwards, and τείνω, I stretch.)—A bending or drawing forwards of the body, due to tonic contraction of the muscles, observed in some cases of tetanic convulsions. *See* Tetanus.

EMPYEMA (ἐν, in, and πύον, pus).—Strictly speaking this term signifies a collection of pus within the cavity of the pleura, but it is often conventionally used to denote any inflammatory effusion in that situation which has assumed a chronic character. *See* Pleura, Diseases of.

EMS, in Germany.—Thermal muriated alkaline waters. *See* Mineral Waters.

ENCEPHALITIS (ἐγκέφαλος, the brain). Inflammation of the brain and its membranes; or, more properly, inflammation of the brain-substance itself. *See* Brain, Inflammation of.

ENCEPHALOCELE (ἐγκέφαλος, the brain, and κήλη, a tumour).—A hernial protrusion of a portion of the brain-substance through an opening in the skull, which may be either congenital or the result of accident. *See* Brain, Malformations of.

ENCEPHALOID (ἐγκέφαλος, the brain).—A form of cancer, so named on account of its obvious resemblance to brain-tissue. *See* Cancer.

ENCHONDROMA (ἐν, in, and χόνδρος, cartilage).—A new-growth consisting of cartilaginous tissue. *See* Tumours.

ENCYSTED (ἐν, in, and κύστις, a bladder). —Contained within a cyst. A term applied to new-growths or collections of fluid thus enclosed.

ENDARTERITIS (ἔνδον, within, and ἀρτηρία, an artery).—Inflammation of the internal coat of an artery. The disease is generally chronic or subacute, rarely acute. Two special forms of endarteritis have been described, namely, *endarteritis deformans*, or atheromatous disease (*see* Arteries, Diseases of, and Atheroma); and *syphilitic endarteritis*, which most frequently affects the vessels of the brain, but the specific nature of which has lately been questioned (*see* Syphilis, and Brain, Vessels of, Diseases of).

ENDEMIC (ἐν, in, and δῆμος, a people).—This term is applied to diseases that prevail in particular localities or districts, and which are due to special ætiological conditions existing there. *See* Disease, Causes of.

ENDERMIC (ἐν, in, and δέρμα, the skin). A term generally applied to the method of introducing remedies through the skin. The horny layers of the cuticle interpose so effective a barrier between most remedial agents and the absorptive surface of the true skin, that the endermic plan of treatment when introduced was looked upon as a therapeutic gain. The ease with which drugs could thus be administered, and the excellent results obtained in neuralgia and other nervous affections, were held to far more than counterbalance the pain of the application, the resulting disfigurement, and the occasional troublesome ulceration which ensued. And, although the hypodermic syringe, with its greater rapidity and efficiency, has rendered the endermic method almost obsolete, there are still circumstances which might induce us to use it. For instance, a blistered surface might be ready to hand; or it might be considered advisable to combine counter-irritation with the subsequent local use of morphia or other sedative drugs; or it might not be possible to procure an instrument for subcutaneous injection, or an invincible objection might be made to the needle-prick, which is sometimes a source of apprehension to sensitive natures, and we might then be glad to avail ourselves of a moderately efficient substitute.

Mode of Application.—We detach the epidermis either by any ordinary blistering application, or by the button-cautery, and after its careful removal, we apply our selected drug to the raw surface, in the form either of powder or of an ointment, which latter plan has seemed to the writer rather more efficient, as ensuring more prolonged contact, the application being also less easily washed away by the effusion of serum from the skin. The principal remedies used in this way have been morphia, which, in doses of from a quarter of a grain to two grains, is undoubtedly beneficial in cases of neuralgia, sciatica, and localized rheumatism; strychnia, which was formerly much employed in amaurosis, lead palsy, infantile paralysis, and other nervous affections, in doses of from $\frac{1}{12}$-grain to one grain; and quinine, which in 6-grain doses has apparently cured obstinate cases of ague.

Robert Farquharson.

ENDOCARDITIS (ἔνδον, within, and καρδία, the heart).—Inflammation of the lining membrane of the heart. *See* Heart, Inflammation of.

ENDOGASTRITIS (ἔνδον, within, and γαστήρ, the stomach).—Inflammation of the mucous membrane of the stomach. *See* Stomach, Diseases of.

ENDOMETRITIS (ἔνδον, within, and μήτηρ, the womb).—Inflammation of the lining membrane of the uterus. *See* Womb, Diseases of.

ENDOPERICARDITIS. — Inflammation of the endocardium and pericardium together. *See* Heart, Inflammation of; and Pericardium, Diseases of.

ENEMA (ἐνίημι, I inject).—Synon.: Lavement; Clyster; Fr. *Clystère; Lavement*; Ger. *Klystier.*

Definition.—An enema is a liquid injected by means of a suitable instrument into the rectum or the colon.

Instruments.—Various instruments are used for the administration of enemata:—1. A simple elastic bottle with ivory or gum-elastic pipe, which has superseded the old bag and pipe. 2. An india-rubber bottle with flexible tube at either end and double action. 3. An ordinary piston syringe, worked by the hand, which is either simple, or provided with a double action, so as to supply a continuous stream. The *simplex enema* made by Messrs. Arnold is very convenient; the piston works on a spring, and requires no packing. 4. A French instrument, known as the *irrigateur*, worked by a spring. 5. The hydraulic enema, which consists of a piece of india-rubber tubing about six feet long, furnished with an ordinary ivory rectum-pipe at the one end, and a metal cone, or a screw nozzle, at the other. The tube, being filled with the injection, has one end placed in the containing reservoir, or is connected by the screw; while the pipe at the other end is introduced into the bowel. The vessel supplying the injection being placed on an elevation, the liquid gravitates into the bowel, filling the large intestine. When it is desirable to inject a large quantity the patient should lie first on the left side, then on the back, and lastly on the right side, to promote the filling of the whole intestine. In all cases care should be taken to prevent the injection of air into the bowel, and also to ascertain that the nozzle of the injecting pipe is free in the rectum, not thrust against the sacrum, or into a hard fæcal mass.

Varieties and Uses.—The chief varieties and uses of enemata are as follows:—

1. **Anthelmintic Enemata.**—To cure threadworms injections of salt and water, or lime-water, or from two to four drachms of spirits of turpentine diffused by yolk of egg in four ounces of water are serviceable. The enema of aloes or of assafœtida may also be employed in the small quantity just named.

2. **Antispasmodic Enemata.** — Puerperal convulsions have been relieved by the injection of half a drachm or more of chloral hydrate. Injections of assafœtida or of rue are also given. Injections of warm water with ʒij or ʒiij of sulphuric ether have sometimes relieved spasmodic invagination of the bowels. When the intestine is tympanitic and distended, the enema terebinthinæ acts well as a stimulant and carminative.

3. **Astringent Enemata.**—These are used either to check diarrhœa, to arrest hæmorrhage, or to cure ulceration and mucous discharges. For the first of these purposes the enema opii is valuable. In cases of hæmorrhage from the bowels, as well as from the womb, injections of ice-cold water are frequently used. Ulceration with mucous discharge is often successfully treated by enemata of nitrate of silver (five grains to one pint of distilled water), of sulphate of zinc or alum (one or two grains to the ounce of water), or of sulphate of copper (one grain to the ounce of water).

4. **Emollient Enemata.**—Demulcents, such as decoctions of starch, linseed, or barley, or pure linseed oil, are at times used with the object of imparting nourishment to the system, and of soothing an irritable mucous membrane.

In dysentery, from four to six pints of warm water, or of milk and water, have been injected as an internal fomentation.

5. **Nutrient Enemata.** — In cases of exhaustion enemata of beef-tea and eggs beaten up are used; about four or six ounces should be given at once. Should the rectum become irritable, the irritability may be often lessened by adding a few drops of laudanum to each enema. Defibrinated blood, in its recent or dried form, has lately been recommended as a material for nutrient enemata (see paper by Dr. Sansom on Supplementary Alimentation, *Lancet*, 1881, vol. i. p. 288). The digestion and assimilation of nutrient enemata may be facilitated by the addition of preparations of pancreas and pepsine. *See* Peptonised Food, page 1116.

Injections of brandy and water, or beef tea and brandy, have been given with benefit in prostration from uterine hæmorrhage.

6. **Sedative Enemata.**—These are often employed in painful affections of the rectum and bladder. The enema opii, containing half a drachm to a drachm of tincture of opium, is well suited. In spasm of the bowels and in hernia the enema tabaci may be resorted to, but it may produce faintness and collapse. An infusion of twelve grains of dried belladonna leaf in six ounces of hot water is also used with advantage.

7. **Purgative Enemata.**—These are used to overcome constipation. For this purpose—in the case of an adult—from one to two pints of fluid must be slowly pumped into the bowel. If the process be conducted gradually, stopping occasionally and making pressure on the anus if the injection threaten to come away, as much as four or five pints can be got into the bowel. The injection should be retained as long as possible, as thus a complete evacuation is insured. As a general rule about a pint of liquid is enough for an adult; for an infant an ounce; for a child of four years, four to six ounces.

Composition.—Soap and water, gruel with olive oil, castor oil, and sometimes oil alone, may be used. The enema magnesiæ sulphatis contains one ounce of epsom salts, and is an efficient purgative. Enema aloes is also recognised. In cases of intestinal obstruction the introduction of a large volume of soap and water—with oil, perhaps, added—by means of the gravitation-tube, may be had recourse to with advantage. Obstruction due to impacted fæces generally yields to this method of treatment.

The frequent use of very large injections is undesirable, lest undue distension result. The frequent use of injections washes away the mucus designed to lubricate the bowel.

John C. Thorowgood.

ENGADINE, UPPER, in Switzerland.—A bracing mountain climate. Elevation of valley 5,000 to 6,000 feet. Season, June to September. *See* Climate, Treatment of Disease by.

ENGHIEN, in France.—Sulphur waters. *See* Mineral Waters.

ENGLISH CHOLERA.—A synonym for simple cholera or choleraic diarrhœa. *See* Choleraic Diarrhœa.

ENGORGEMENT.—Overloading of the vessels, or of the heart, with blood. A synonym for congestion. *See* Circulation, Disorders of.

ENTERALGIA (ἔντερον, the intestine, and ἄλγος, pain).—Synon.: Enterodynia; *Neuralgia mesenterica vel meseraica*; Colic.

The terms enteralgia and colic—generally regarded as synonymous—include all forms and degrees of paroxysmal intestinal pain in cases where there is no febrile disturbance. Enteralgia, implying more especially the neuralgic nature of the sensori-motor disturbance, is sometimes preferred, as by those who hold that colic proper—of which lead-colic is a typical example as distinguished from symptomatic colicky pains—is a visceral neuralgia. It is likewise frequently applied to colic occurring in neurotic, asthenic, anæmic, or gouty subjects, even when there is a local exciting cause, such as flatus, retained fæces, &c.; and to conditions in which pain predominates over spasm. The clinical features of enteralgia are, however, indistinguishable from those of colic; a similar local disturbance, according to its intensity, is reflected by the nerves to the heart and the peripheral arteries—the action of the former becoming slow and feeble, and the latter contracting, hence arising the small, infrequent, tense pulse, the cool pale skin, and the other signs of collapse which mark the distant effects of colic; and, as in this disorder, the termination of the attack may be sudden, perhaps following the expulsion of flatus or fæces—a free perspiration, a copious flow of pale urine, the menstrual or lochial or other discharge, or a fit of the gout.

Treatment.—The main indications in the treatment of enteralgia are to endeavour to remove any cause of the pain; and to administer opium or other anodynes for the relief of the suffering. *See* Colic, Intestinal.

George Oliver.

ENTERIC FEVER.—A synonym for typhoid fever. *See* Typhoid Fever.

ENTERITIS (ἔντερον, a bowel).—Inflammation of the intestines. *See* Intestines, Diseases of.

ENTEROCELE (ἔντερον, a bowel, and κήλη, a tumour).—A hernia containing a portion of bowel. *See* Hernia.

ENTOPHYTE (ἐντὸς, within, and φυτὸν, a plant).—A plant parasitic in any part of the body. *Entophytic Diseases* are diseases that are supposed to depend upon the growth of such plants, as, for example, fungus-foot. *See* Fungus Foot of India.

ENTOZOA (ἐντὸς, within, and ζῶον, an animal).—This term not only embraces all the animal parasites coming under the category of 'worms,' or 'intestinal worms,' but also a great variety of creatures which take up their residence in the soft and hard tissues as well as in the cavity of the digestive organs of their human and animal bearers. Under the article Parasites is given a definition which will probably be found more comprehensive than any hitherto offered. In this place, with the double view of facilitating reference and supplying an epitome of the whole subject, a complete alphabetical list of the separate headings under which the entozoa are discussed in the body of this work is appended. The articles stand as follows:—Acephalocysts; Ascarides; Bilharzia; Bladder-worms; Bothriocephalus; Chigoe (Sandworm); Cysticercus; Demodex: Distoma; Dracunculus; Echinococcus; Echinorhynchus; Fasciola; Filaria; Filaria Sanguinis-Hominis; Fluke; Guinea-worm; Hæmatozoa (Blood-worms); Helminths; Hydatids; Intestinal worms; Lumbricus; Measle; Œstrus (Bots, Maggots, Insect Parasites, Gadfly); Oxyuris; Parasites; Pentastoma; Round-worms; Sclerostoma (Anchylostomum, Dochmius); Seat-worm; Tænia; Tapeworm; Thread-worm; Trichina; Trichinosis; Trichocephalus; Vermes; Whip-worm.

The Ectozoa are noticed under the article Epizoa. T. S. Cobbold.

ENTOZOON FOLLICULORUM.—A synonym of the animalcule of the follicles of the skin, otherwise named acarus (Simon), demodex (Owen), and steatozoon folliculorum (Erasmus Wilson). *See* Acarus and Demodex.

ENTROPION (ἐν, in, and τρέπω, I turn).—A morbid condition in which the eyelid is inverted, so that its free margin is directed towards the eye. *See* Eye and its Appendages, Diseases of.

ENURESIS (ἐν, in, and οὐρέω, I pass the urine).—Involuntary discharge or incontinence of urine. *See* Micturition, Disorders of.

EPHELIS (ἐπί, due to, and ἥλιος, the sun).—Synon.: Sunburn; Fr. *Ephelide*; Ger. *Sonnenflecken*.—This word is applied to pigmentary discoloration of the skin, of a brown, grey, or black colour, resulting from the stimulus of light and heat, as of the sun's rays, or scorching by fire. Two principal varieties of the affection have been noted, namely, Ephelis solaris, and Ephelis ignealis. *See* Pigmentary Skin-Diseases.

Erasmus Wilson.

EPHEMERAL FEVER (ἐφ', upon, and ἡμέρα, a day).—A mild form of milk-fever, so called on account of the rapidity with which it subsides, lasting not more than a day. *See* Milk-Fever.

EPHIDROSIS (ἐπί, upon, and ἱδρόω, I sweat).—A term signifying a state of sweating, and synonymous with Idrosis. *See* Perspiration, Disorders of.

EPIDEMIC (*epidemicus*, affecting the people; from ἐπί, upon, and δῆμος, a people).—The word epidemic is used in two senses by medical writers and by medical men, namely, (1) in a general sense, and (2) in a technical sense.

As a *general term* the word signifies 'common to, or affecting, a whole people, or a great number in a community; prevalent; general.' (*Webster's Dictionary*.) It is in this sense that the word is used when it is applied to mental, moral, and social phenomena, as, for example, when we speak or write of 'epidemic suicide,' 'epidemic folly.' This employment of the word is consistent with received literary practice. Thus we read, 'There was a time when *wit was epidemic*.' (*Athenæum*.) Again, M. Littré, writing to the *Temps*:—'It argues great confidence in oneself and one's own enlightenment to treat with haughty disdain, and without reserving any compromise, the opinion of so many citizens, and to regard it as a case of *epidemic aberration*.'

As a *technical term* having reference to disease, the word epidemic has several different meanings attached to it. All these meanings include the notion of general prevalence among a community or a people, but some of them would go on, beyond what etymology justifies, to attach a peculiar hypothetical or theoretical conception to the term. Thus (*a*) Mayne restricts the term to diseases which are contagious, making contagion the essence of *epidemicity*, as he would phrase it; (*b*) Dunglison implies by the term a particular constitution of the air ('*constitutio aeris*, or condition of the atmosphere'); (*c*) other authoritative writers use the term as signifying a widespread cause, telluric, atmospheric, cosmic, as the case may be, acting at the same moment of time on many individuals, or as something occult, regarding which speculation is vain, and which they designate *epidemic constitution* or *epidemic influence*.

The foregoing technical significations attached to the word epidemic are not less misleading than insufficient. Mayne's definition imposes an arbitrary limitation upon the meaning of the word, while it involves but a partial notion of the phenomena of epidemic prevalence of contagious diseases. Dunglison's definition does not rest upon a scientific foundation, and its phraseology, derived from a period when medicine was still hampered with semi-mystical speculations, cannot well be dispossessed of the vague traditional meanings which adhere to the word 'constitution.' Other technical definitions (if that can be called a definition which makes obscure what should be rendered clear) rest on mere assumptions or relegate the term to the incomprehensible and insoluble. Of these last-named definitions Léon Colin has recently said:—'They signify implicitly a common cause, apparently indecomposable, to which individuals are not exposed successively but simultaneously . . . . a something isolated, impersonal, inaccessible to reason, detached from the disease itself, the epidemic genius [constitution, influence] . . . . a creative force of the different epidemic affections, compelling, directing, extinguishing them.'

The promiscuous use of the word *epidemic* in medical literature and medical talk, and the different irreconcileable significations attached to it as a technical term, have been, and still continue to be, sources of almost hopeless confusion in treating of diseases in respect to which the phenomenon of (etymologically) epidemic prevalence is observed. It is not difficult to apprehend how this has come about. The diseases in question (the *morbi populares* of some writers) include among their number plague, the eruptive and continued fevers, influenza, malignant cholera, &c. 'They have the peculiar character of attacking at intervals great numbers of people within a short period of time; they distinguish one country from another, one year from another; they have proved epochs in chronology; and, as Niebuhr has shown, have influenced not only the fate of cities, such as Athens and Florence, but of empires; they decimate armies, disable fleets; they take the lives of criminals that justice has not condemned; they redouble the dangers of crowded hospitals; they infest the habitations of the poor, and strike the artizan in his strength down from comfort into helpless poverty; they carry away the infant from the mother's breast, and the old man at the end of life; but their direst eruptions are excessively fatal to men in the prime and vigour of age.' (Wm. Farr.) Exercising at all times in their greater and more fatal prevalence the profoundest influence over the mind, as well of the people generally as of the medical profession, these diseases, partly from the terror they inspire, partly from the extreme complexity of the phenomena they display, have formed a never-ceasing subject of the wildest speculation. No part of medicine has retained so much of the semi-mystical teachings of the older physicians as that which relates to epidemics, and general history has contributed with medical history to propagate in regard to epidemics that habit of thought which refers the unknown to the occult—using the latter term in the sense in which it is applied with regard to the imaginary sciences of the Middle Ages. Much of the speculation as to epidemics which passes current for science at the present day is in reality an unsuspected continuation of the mystical teachings of earlier medicine: magnetism, or electricity, for example, taking the place of Saturn or Mercury in the scheme of causation. The terminology is modernised, but the underlying conception remains the same. Again, the so-called '*precursors*' of epidemics which still find a place in treatises on medicine are the relics of the doctrine of portents of the Middle Ages. They rest on the assumption of an epidemic being determined by some common extra-mundane or intra-mundane cause, of which it is but one of several effects. The celestial 'portents,' such as comets and meteors, and the more manifest telluric 'portents,' such as earthquakes and volcanic eruptions, have been discarded; but the 'portents' derived from exceptional developments of insect life, from murrain, from unusual prevalence of certain diseases, and from remarkable perturbations of the weather, are retained under the denomination of 'precursors.' For example, the earlier epidemics of malignant cholera which visited Europe were believed to have been heralded by an unusual prevalence of 'fevers' and of diarrhœal affections. The epidemic of 1865–66 gave an excellent opportunity of studying the facts bearing on this question. Europe was taken by surprise when cholera appeared in 1865, on the south coast of the Mediterranean, at Alexandria, and began thence to extend rapidly to the southern and eastern shores of that sea. It was not, indeed, until the disease had effected a lodgment in several parts of the Continent that the attention of governments and the public with regard to it was fully aroused. No change of the public health in the several places visited by the epidemic had occurred of such a nature as to give rise to any, even the least suspicion, of impending pestilence. Moreover, notwithstanding the prevalence of steppe murrain and of cerebro-spinal fever in Northern Europe at the beginning of 1865, there was nothing to suggest (indeed it was not suggested) that these phenomena were 'precursors' of the coming epidemic of cholera, or of the extension of yellow fever to the shores of England the same year. In fact, the different occurrences were parts of contemporaneous rather than successive phenomena. The condition of the public health preceding the appearance of cholera in England, and especially in respect to diarrhœal antecedents, was made the subject of careful study by the late Professor Parkes and others. These observers failed to obtain any inkling of a change in the public health which could be regarded as presaging pestilence—of the existence, in short, of any so-called 'epidemic constitution.' It is true that John Sutherland had described an increase of 'fevers' and diarrhœal disease in Malta, as preceding the appearance of cholera there, in June 1865, observing that:—'These facts are sufficient to show that long before cholera began to come towards the north-west, there were indications of a changed condition of the public health in Malta;' and after giving an account of two groups of choleraic cases which occurred in May, he adds, 'It appears to me scarcely possible to escape from the conclusion that long before cholera appeared in Malta, possibly before the first outbreak in Arabia, the earliest wave of the coming epidemic had passed over those islands.' But while, according to Dr. Sutherland, the coming epidemic was thus clearly foreshadowed in Malta, no change in the public health presaged its appearance in Gibraltar in July. The absence of all foreshadowing of the epidemic at Gibraltar can hardly be reconciled with the suggested presence of such foreshadowing at Malta. The facts which have been interpreted as presaging the appearance of cholera in the latter island are, indeed, to be regarded as coincidental rather than related. It is true, also, that MM. Didiot and Gués have endeavoured to show that prior to the appearance of cholera at Alexandria in 1865, choleraic disease existed in Marseilles, and that the outbreak of the epidemic in the latter town was preceded by 'une constitution médicale cholérique.' The evidence they advance in support of their conclusions simply shows that deaths from infantile cholera, which, as they properly remark, is 'à la vérité, fréquente à Marseille,' and from so-called 'sporadic' cholera, are apt to occur in Marseilles during the months of May and June, as perhaps in every city and town of southern and central Europe.

Another illustration to the same effect as the above, in regard to the 'precursors' of epidemics, is furnished by the history of the small-pox epidemic of 1869–73, the greatest epidemic of this disease in recent times—a true pandemic (πάνδημος, from πᾶν, all, and δῆμος, the people) extension of the malady. The acutest observers were taken by surprise with the malignity and diffusibility of the disease during the epidemic—phenomena wholly unforeseen. Here, again, the study of the diseases preceding or accompanying the epidemic yields no facts of variation in their prevalence, from which the approach of a great epidemic might have been inferred, nor give any hint that they were dependent with it on some common cause.

There were *concurrent* phenomena of disease during both epidemics, but they were concurrences of certain diseases existing at the same time among the population affected by the great epidemic, and some of them probably having certain secondary elements of causation in common. This is a different question to that of an assumed 'epidemic influence' or 'epidemic constitution.' The subject of the *concurrence of epidemics* is a new field of investigation, which has lately been opened by an arithmetical study of George Buchanan's, relating to epidemics in numerous extra-metropolitan registration sub-districts in England. This study was directed to ascertain—as necessarily introductory to a statistical investigation regarding community of causation or mutual antagonism of various epidemics—the arithmetical probability of their concurring as a mere matter of chance. The data used were taken from a particular quarterly return of the Registrar-General, and they extended to 946 occurrences of epidemics (small-pox, measles, scarlet-fever, diphtheria, whooping-cough, fevers, and diarrhœa and simple cholera) in 1,490 districts. The result showed a good deal of general correspondence between the calculated number of concurrences and the actually observed number, but with departures, of more or less magnitude, of the actual from the calculated degree of concurrence, which deserve to be followed up by further investigation. The departures were shown in an excessive frequency of the concurrence of measles with the other epidemics, of diarrhœa with all other epidemics except small-pox, and of scarlet-fever with the 'fever' of the Registrar-General. On the other hand, it is of interest to observe that there was an absence of any notable excess of frequency of concurrence between scarlet-fever and diphtheria, or between scarlet-fever and whooping-cough.

In view of the extreme looseness with which the word *epidemic* is used in medicine, sometimes simply as a descriptive term, sometimes as a technical or quasi-technical term involving various hypothetical and theoretical conceptions inconsistent with each other, and sometimes as implying an occult influence, it would be well if it could be discarded from medical literature and language. *Epidemic*, in its present medical uses, is an instance of words which, as Bacon says, when writing of the effects exercised by a bad and inapt formation of words on the human mind, 'force the understanding, throw everything into confusion, and lead mankind into vain and innumerable controversies' (*Nov. Org.* App. 43). But the retention of the word, from its long and familiar usage, is practically a necessity in medicine; moreover, it would be difficult if not impossible to find a substitute which, if the word be used in its ordinary signification, would supply its place.

It is suggested here that the technical meaning of the word epidemic should be assimilated to the common meaning; or, more accurately, that the technical meanings now attached to the word should be abandoned, and the word used in medicine in the same sense as in general literature and in ordinary converse; that is to say, as a merely quantitative term applicable to particular phenomena, whether pathological, mental, or social, in so far as they are 'common to a whole people, or to a great number in a community;' or in a word are 'prevalent' or 'general.' In this way not only would the confusion arising from the present medical uses of the word be got rid of, but the scientific study of epidemic phenomena would be facilitated in the only direction which gives promise of successful issue. As Léon Colin has aptly written:—'It is the disease which constitutes the epidemic, not the epidemic the disease. The evil always remains the same, the number of affected alone being increased.' The medical study of epidemics is essentially a study of the individual diseases which are apt to become epidemic, and not, as has been too commonly the case hitherto, of some figment of the imagination (*epidemic constitution*, or *influence*, or *genius*), apart from the diseases. It is only in proportion as researches have been directed to particular diseases liable to become epidemic, and to the conditions under which they prevailed epidemically, that recent advances in our knowledge of epidemics have been made. In this country the two most important events which have occurred in this connection of late years were the discrimination of *typhus* from *typhoid*, by A. P. Stewart and Wm. Jenner, and the researches on the *typhus of horned cattle* (steppe-murrain, *cattle-plague*), promoted by the Royal Commission of 1865–66, on Cattle-Plague. The discrimination of typhus from typhoid proved that the voluminous speculations which to that time were current on the epidemiology of the continued fevers of this country, then regarded as but *one* disease presenting several varieties, were for the most part meaningless verbiage, by showing that the two most common forms of fever were distinct diseases clinically, pathologically, and ætiologically. This discovery proved to be the inauguration of a true method of investigation concerning epidemics, by making evident that epidemic phenomena did not admit of accurate study, except in so far as it was based upon a just discrimination of the diseases manifesting them, and upon their clinical and pathological histories. The same lesson was taught, not less clearly, although in another fashion, by the researches promoted by the Royal Commission on Cattle Plague, with which the names of Lionel Beale and Burdon Sanderson are especially connected. These researches demonstrated the essentially infectious nature of the malady, and that its prevalence was dependent upon the dissemination of the infection, directly or indirectly, from animals sick of the disease to the healthy. It was shown, indeed, in the pathological laboratory, that preconceived doctrines of some occult epidemic influence which had been submitted to the Commission as determining the prevalence of the cattle-plague had no existence in fact when the disease was subjected to experimental study, and that its conditions of prevalence were fully within human control. These researches proved the starting-point of those important investigations on the intimate pathology of contagion carried out by Burdon Sanderson and Klein, for the Privy Council, under the direction of John Simon, and to which Wm. Roberts and others have independently contributed so largely—investigations which promise speedily to revolutionise our knowledge of the intimate pathology of infectious diseases. It is interesting to note that the Royal Commission on Cattle-Plague included the following medical members:—Richard Quain (M.D.), H. Bence Jones, E. A. Parkes, T. Wormald, and R. Ceely. *See* also PERIODICITY IN DISEASE. J. NETTEN RADCLIFFE.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.—A synonym for cerebro-spinal fever. *See* CEREBRO-SPINAL FEVER.

EPIDEMICS, Occurrence of. *See* Periodicity in Disease.

EPIDERMIS, Diseases of. *See* Skin, Diseases of.

EPIDERMOPHYTON (ἐπὶ, upon; δέρμα, the skin; and φυτὸν, a plant).—The name of the epiphyte, or parasitic fungus, of phytosis versicolor, also called Microsporon. *See* Epiphyta.

EPIDIDYMITIS (ἐπὶ, upon, and δίδυμος, a testicle).—Inflammation of the epididymis. *See* Testes, Diseases of.

EPIGASTRIC REGION.—This region is situated at the upper and central part of the abdomen, just below the ensiform cartilage, and between the sloping margins of the thorax down to the level of the ninth cartilage, corresponding to what is popularly known as the 'pit of the stomach.' The structures within the abdominal cavity which normally occupy the epigastrium are the greater part of the stomach, a small portion of the liver, and more deeply a part of the pancreas, the aorta giving off the cœliac axis and superior mesenteric branch, the vena cava inferior, the veins forming the commencement of the portal vein, the receptaculum chyli, and the solar plexus.

Clinical Investigation.—Clinically, it will be found that patients frequently complain of abnormal sensations specially referred to the epigastrium. These are generally associated with the stomach, and may merely amount to a sense of discomfort, fulness, or tightness; or to actual pain of varying character, more or less severe according to the condition upon which it depends, and often much influenced by the ingestion of food. Sensations of trembling, throbbing, or sinking in the pit of the stomach are also of common occurrence, especially in females. These are often merely of a nervous character. In some cases there is evident tenderness, either over the entire epigastrium or in some limited spot, and it is important to recognise whether this is superficial or felt more or less deeply, for it may be connected with the superficial structures, the peritoneum, the liver, the stomach, or the pancreas. The sensation experienced in connection with hunger is referred mainly to the epigastrium, and it may be of a painful character. Here may also be noticed the epigastric pain termed *gastralgia* or *gastrodynia*, which is usually felt chiefly when the stomach is empty, being relieved by taking food. A most unpleasant sensation at the pit of the stomach accompanies nausea, which may be of a horrible but indescribable character; while violent vomiting or retching causes considerable pain or aching in this region, partly associated with the stomach, partly with the abdominal walls. Heartburn is another sensation which seems to start from the epigastrium. Sometimes the pain is situated deeply, or shoots towards the back. This may depend upon disease affecting the posterior wall of the stomach, pancreatic disease, aneurism, or other causes. A sensation of tension or actual pain is sometimes experienced just below the ensiform cartilage in cases where the diaphragm is much pressed downwards, as from extreme emphysema, abundant accumulation of fluid or air in the pleura, or extensive pericardial effusion. A deep pain is not uncommonly referred to the epigastrium in cases of Addison's disease, and also in those of pernicious anæmia. Probably this is connected with the sympathetic plexuses.

Physical examination of the epigastric region is often of the greatest value, and important objective signs of various morbid conditions may thus be readily recognised. Of course organs which are normally confined to other regions may enlarge so as to extend into the epigastrium, or may become very movable and consequently be felt in this region. It may, moreover, be occupied, along with other parts of the abdomen, by growths or accumulations of fluid. The objective signs and conditions which are more especially connected with the epigastrium may be indicated as follows:—

1. It is customary to apply the hand over the epigastrium for the purpose of counting the respirations, if these cannot be reckoned by merely watching the patient breathing.

2. Morbid conditions of the abdominal walls may be confined to the epigastric region, such as an abscess; and here it may be remarked that the recti muscles frequently become very hard and rigid when palpation is practised over this part, and so might be in danger of being mistaken for some serious lesion, unless care were exercised in the examination.

3. Growths connected with the peritoneum, especially the great omentum, may be felt chiefly or entirely in the epigastrium in some instances.

4. Abnormal states of the stomach are necessarily revealed mainly by corresponding signs in the epigastrium. Thus there may be evidence of dilatation of this organ; carcinomatous infiltration of its anterior wall; a localised tumour; or of some accumulation in its interior, whether solid or liquid. It must be remarked, however, that the stomach, when diseased, frequently extends into other regions beyond the epigastrium.

5. When the liver is the seat of organic disease, this is often revealed in the epigastric region, usually along with other regions, but sometimes the abnormal physical signs are noticed specially in this part. Thus a cancerous mass may present here, or a hydatid tumour or hepatic abscess may tend in this direction. The gall-bladder has also occasionally been found, when the seat of some accumulation or of malignant disease, to have been displaced towards the epigastrium and become fixed there.

6. Pulsation is not uncommonly felt in the epigastrium. When situated at its upper part, just below the ensiform cartilage, it depends upon the heart, usually its right side, being due either to shortness of the sternum, displacement of the heart, or enlargement of its right cavities. Very often a pulsation is felt, and sometimes even seen, due to a pulsating aorta; and an impulse from this vessel may be transmitted through an enlarged pancreas, or through an abscess of the liver, of which the writer has seen a marked example. Occasionally an impulse in the epigastrium is connected with an aneurism, either of the aorta or of one of its branches. A pulsation in this region has also been attributed to regur-

gitation of blood from the right auricle into the inferior vena cava and hepatic vein, in cases of tricuspid incompetency. A murmur may sometimes be heard in the epigastrium. Usually this is a conducted cardiac murmur, but occasionally it depends on an aneurism.

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EPIGLOTTIS, Diseases of. *See* LARYNX, Diseases of.

EPILEPSY (ἐπιλαμβάνω, I seize upon).—SYNON.: *Morbus comitialis, sacer, major, &c.;* Fr. *Épilepsie, haut mal, &c.*; Ger. *Fallsucht.*

DEFINITION.—An apyretic nervous affection, characterised by seizures of loss of consciousness, with tonic or clonic convulsions.

Of these two features—muscular spasms and loss of consciousness, neither is alone sufficient to establish the existence of epilepsy. Still, each of these two kinds of symptoms, when occurring in the form of an attack, is an *epileptiform* manifestation, as we find that patients who generally have convulsions only, are sometimes simultaneously seized with unconsciousness, and *vice versâ* that in those very rare cases in which patients are attacked only with loss of consciousness, without any marked spasmodic action of any muscle, there are sometimes complete fits of epilepsy. The relationship between the two essential characteristics of epilepsy was well exemplified in the cases of two patients who were placed under the writer's care in London, in 1860, by his lamented friend, Dr. W. Baly. These patients, who were brother and sister, were both incompletely epileptic: one had only attacks of convulsions, the other only attacks of loss of consciousness. Their father had been completely epileptic, and one of these two young patients had inherited one aspect of the disease, the other the other aspect.

Efforts in two absolutely opposite directions have been made to modify the significance of the word *Epilepsy.* Some writers give that name only to the special affection which others call *Idiopathic Epilepsy.* Other physicians have considered as belonging to epilepsy, most if not all of the nonfebrile affections consisting in attacks of aphasia, of amaurosis, of paralysis, &c., or of disordered involuntary movements (choreic, tremulous, rotatory, &c.). There is no doubt that all apyretic nervous affections, appearing in seizures, have in that feature a common link with epilepsy, and it would be important to have a name for that group of paroxysmal neuroses. But the word epilepsy must remain for the special morbid manifestations that we have mentioned. As regards the application of the word epilepsy to those cases only in which no organic disease either of the nervous centres or other organs can be looked upon as a cause of that convulsive affection, neither the symptoms, nor the prognosis, nor the principal rules of treatment, show that we must entirely separate the idiopathic from the other kinds of epilepsy. It is, however, important, as will be shown hereafter, to try to find out, in every case of epilepsy, whether this convulsive affection is of the kind we call idiopathic, or proceeds from a peripheric or central organic lesion or irritation, or from some alteration of the blood.

PATHOLOGY.—Under this head it is only necessary to give an idea of the state of the nervous system that seems to exist in epilepsy. As early as 1857, the writer, in his work on this affection, showed that it essentially consists in an increased excitability of certain parts of the nervous system. This augmentation of excitability may exist only in the cerebro-spinal centres, or partly there and partly also in some peripheric parts of the nervous system. The analysis of phenomena when epilepsy is gradually produced in animals leads forcibly to that view. We find in these animals, that, after a few days have passed from the time of the lesion which causes epilepsy (either a section of the sciatic nerve or of a lateral half of the spinal cord, in the dorsal region), the first change manifested consists in an increase of the reflex power of certain parts of the skin of the face and neck, while a greater excitability takes place in the medulla oblongata, in the upper part of the cervical region of the spinal cord, and in some parts of the trigeminal and of the two or three first cervical nerves. Gradually the reflex excitability of the nerve-cells in direct communication with the fibres of the nerves we have named increases, so that the irritation of the skin of the face and neck, instead of producing only, as at first, a reflex contraction of the neighbouring muscles, causes a tonic spasm of all the muscles of the trunk, neck, and head, on the side of the lesion and of the irritation. Later on the reflex spasmodic action extends to the other side, and at last a complete attack of epilepsy (a month or later after the traumatic injury which acts as a cause) supervenes, characterised, as in man, by loss of consciousness, with tonic or clonic convulsions. In cases of injury to certain parts of the base of the brain in some animals, the same changes may take place, but with two differences: 1st, the rapidity of increase in the reflex excitability of the parts above-named is very much greater than after an injury to the spinal cord or to the sciatic nerve; 2ndly, the zone of skin that acquires the power, when irritated, to give rise to an attack, is on the opposite side to that of the brain-injury, while it is on the corresponding side to that of the lesion of a nerve or of the spinal cord.

Want of space prevents the writer from giving the many reasons which show that what takes place in animals rendered epileptic by the lesions mentioned, applies in a great measure to the production of epilepsy in man. It will suffice to state that there are abundant facts which tend to establish the conclusion that in all nervous affections in which there are seizures, attacks, or fits of any kind, the essential feature is a morbid increase of the reflex excitability, while the differences between the various symptomatic manifestations depend on what nerve-cells are altered in their vital properties. In other words, we would say that, although there is the same morbid change, there are epileptiform, choreic, amaurotic, paralytic, aphasic phenomena, according to the particular nerve-cells in which that change takes place.

Nothing has resulted from the efforts that have been made to establish the theory that epilepsy depends on disease in any part having a special name in the nervous centres. The so-called *seat of epilepsy* has been successively placed in the cerebellum, the cornu ammonis, the pons Varolii, the medulla oblongata, the convolutions of the brain, &c. There is just as much reason to place that seat in those parts, as there would be to place it in the mucous membrane of the bowels or in the sole of the foot, or in any peripheric part of the nervous system, where an irritation is found causing epilepsy. In cases such as these last, as well as in the preceding, the very same things occur; an irritation starts from the place where we find an organic lesion, and proceeds to nerve-cells in the base of the brain and in the upper part of the cord (or in one of those parts alone). Through this irritation those nerve-cells have their nutrition altered, and after a time they acquire that morbid excitability which is the essence of epilepsy. We do not think it will ever be possible to recognise what cells are altered, as it is quite likely that the change in them is more dynamical than physical, and that no more microscopical differences could be detected between two of them, one normal and the other possessing great morbid reflex power, than there are visible differences between two pieces of magnet—one poor, the other rich in magnetic power.

The true seat of epilepsy therefore is in nerve-cells, having the power of producing morbid reflex muscular contractions; but the location of these cells must be variable, as is shown by the fact that the first symptom of an attack may be in the most different parts of the body. That these cells are located chiefly in the base of the brain is a conclusion borne out by many facts. But as we have ascertained, experiments on animals show that the very same kind of epileptiform convulsions can take place after an irritation of the skin, whether the nervous system is left entire or diminished notably by the ablation of the brain and cerebellum, and also of the pons Varolii and part at least of the medulla oblongata. The spinal cord has therefore a share in the production of epileptiform convulsions, and as we know that it can, in man as well as in animals, arrest the activity of the brain under some stimulation, we may easily admit that it may help in producing in man an arrest of cerebral activity during a fit of epilepsy.

Ætiology.—*Heredity* deserves to be noticed first in this respect, not because it is the most frequent, but because it is a most undeniable cause. If we canvass what has been said by many writers on the subject of the heredity of epilepsy, we find that most statistics published do not give sufficient details to enable us to ascertain what are the morbid states of the brain in a parent which can cause epilepsy in the offspring. Pritchard has justly shown that all neuroses have the greatest relationship one to another. It is but natural, therefore, that epileptics are very often found to have had a father or a mother attacked with some nervous disorder. Moreau has shown that epileptics often have insane persons as their parents. If we put together those three groups of affections—organic disease of the brain, neuroses, and insanity—we find that epilepsy will often exist in the offspring of people who have been attacked with an affection belonging to one of those three groups.

As regards the influence of *sex*, we believe that there is a marked difference among women and men of somewhat advanced age, the proportion of women being larger than that of men; but this is not the case, and it is even in some degree the reverse, for people under twenty-five years of age.

Age has certainly, independently of sex, a decided influence on the appearance of epilepsy. The following table given by Hasse is important, as it is the most extensive. It agrees fully with the results of the writer's own observation:

Age at commencement	No. attacked
Congenital	87
Under 1 year of age	25
From 2 to 10	281
" 10 " 20	364
" 20 " 30	111
" 30 " 40	59
" 40 " 50	51
" 50 " 60	13
" 60 " 70	4
	995

It is difficult to say at what age hereditary epilepsy is most prone to make its appearance. The writer's experience seems to show that it is between ten and twelve in boys as well as in girls. It is certainly by far more frequent to find that inheritance manifests itself before than during the period of change that puberty causes. Romberg, Dr. Russell Reynolds, and several other writers have already pointed out that such is the general rule.

Is puberty itself a cause of epilepsy? This is clearly proved by the large number of epileptics who, as shown in the preceding table, have been attacked between the ages of ten and twenty (364 out of 995).

Of other causes the most powerful are not those usually stated. In patients under fifteen years of age the most frequent cause after heredity is some more or less obscure alteration of nutrition of the brain, or congestion of that organ or of its membranes, remaining a more or less considerable time after typhoid fever or scarlatina. It is frequent, indeed, that in examining such patients (even when there are reasons to believe in heredity), there are a number of symptoms showing some deficiency in the action of the brain, as regards its motor, sensitive, or sensorial functions. It is most important to detect those symptoms (and they are so slight generally that they would not be noticed if not most carefully looked for), as the form of epilepsy, due to or allied with the cerebral alteration which then exists, is often curable, or at least can be considerably benefited by treatment.

Of the different ætiological factors we have mentioned—heredity, age, puberty, sex, fevers—none but heredity can be looked upon as a real and direct cause of the form of epilepsy which is called idiopathic. The other factors only give origin to predisposing conditions; excepting fevers, which can do more, as they may cause diathetic, sympathetic, or symptomatic epilepsy.

Purely *psychical* and *emotional* causes seem to be by far less frequent than has been supposed. They act chiefly, if not only, as means of bring-

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ing on attacks in persons more or less ready to have them.

If idiopathic epilepsy be set aside, we find that the ætiology of the other forms of that affection is much more easily found out, and that almost always the cause is some recognisable irritation of a part of the nervous system. Diseases or injury of any part of the trunk and limbs or of the viscera; diseases or injury of any part of the cerebro-spinal centres or of their meninges, often produce epilepsy. The mucous membrane of the bowels and the cerebral meninges are the parts most capable of giving rise, not only to simple convulsions, but also to sympathetic epilepsy. Among the various organs constituting the encephalon, those having the greatest power of giving rise to symptomatic epilepsy are the optic thalami and the convolutions, especially those of the parietal lobes. But it would be quite wrong to conclude from the facts recently discovered by Fritsch and Hitzig, in their experiments on dogs and other animals, that certain parts of the cortex cerebri, near the fissure of Rolando, are much more connected with epilepsy than any other. The truth is that that neurosis can be caused by a disease of, or an injury to, any part of the cerebro-spinal centres: the anterior, the posterior, as well as the middle lobes, the base of the brain as well as the cerebellum or the spinal cord.

Sympathetic epilepsy is very frequently due to an irritation of the sexual organs, especially brought on by masturbation. In Anglo-Saxon countries, where children of the two sexes are less watched and less warned against the dangers of that fatal habit than in other civilised countries, epilepsy due to that cause is particularly frequent.

Alterations of *blood*, in quantity or quality, are certainly favourable circumstances, if nothing more, in the production of epilepsy. As regards the experiments of Kussmaul and Tenner, we will say that although a rapid and considerable loss of blood can cause an epileptiform attack, it has not been shown that such a cause has produced epilepsy. It is nevertheless true that anæmia is a very frequent factor in the causation of epilepsy or any other neurosis. A weak and slow action of the heart also is found in a number of cases to be among the causes of epilepsy. But the reverse is sometimes observed; and we have not rarely seen cases of epilepsy in which the pulse was strong and beating more than 100 times a minute, without any disease of the heart or of any other organ, that could account for this great activity of circulation. In these cases the only morbid condition that could be looked upon as a cause of epilepsy was the abnormal circulation. In a case of this kind, placed under the writer's care by Sir Thomas Watson, the patient was rapidly benefited by treatment, and has had no more attacks since 1863, so that that kind of epilepsy is sometimes curable, as is the form due to anæmia.

Whether epilepsy due to syphilis or to Bright's disease, or to affections of the liver, is ever produced in a direct way, and exclusively by some alteration of the blood, is not yet established; but it is certain that, especially where there exists one of the two last causes just mentioned, the state of that fluid has a notable share in the production of the neurosis. But other ætiological factors then exist: an irritation of the nerves of the kidneys, or of the liver, or of the meninges, and some alteration of structure of blood-vessels or of other parts of the brain, or sometimes a morbid deposit in the encephalon, or its membranes.

SYMPTOMS.—We shall consider this part of the subject under three heads:—the *premonitory*, the *paroxysmal*, and the *inter-paroxysmal* symptoms.

1. *Premonitory.*—The frequency of premonitory symptoms, according to the writer's experience, is much greater than is generally known. It is extremely important to find out the existence of these warnings, as in many cases attacks may easily be prevented if we know when they are on the point of taking place. When we say that premonitory indications are extremely frequent, we do not mean that the classic or *Galenic aura* is often found. That vague, queer, and unexplained sensation, whether accompanied or not by a muscular contraction, is certainly more frequent than is admitted, but is by far less often observed than the other kinds of warnings. Among the premonitory symptoms, there are four oftener observed than others:—one is a change of temper (irascibility appearing or increasing); another is a vascular contraction in the feet or hands, producing a diminution of temperature; and the two others a spasmodic state of some muscle, or an optical illusion or hallucination. It is impossible to sum up the various manifestations which indicate that an epileptic attack is forthcoming. Alterations of the various functions of the brain, sensations of all kinds, headache or backache, vertigo, sensorial disturbances, sleeplessness or sleepiness, palpitation, dilatation or contraction of blood-vessels anywhere, altered breathing, diminution or increase of the various secretions (of the skin, mucous membranes, or of the visceral glands), hæmorrhages from the nostrils or other parts, fever, more or less marked weakness (general or local), hunger or thirst, disgust for food or drinks, sexual appetite or the diminution or loss of sexual desire or power, erection of the penis, spasm of the bladder, sometimes with involuntary evacuations of urine, involuntary expulsion of fæces, cramps, trembling, choreic movements, tendency to run forwards, backwards, or round, rigidity or convulsions of a limb or other parts, paralysis of a limb or other parts, etc.,—such is an abbreviated list of the forerunners which have been noticed by a number of observers, and all of which we have seen, or have been found in our patients.

Sometimes one or several of these symptoms will appear a day or two before the attack, but generally the warning shows itself a few hours, or a very much shorter time (even only a few seconds or a minute or two) before the seizure. In cases of epilepsy due to organic cerebral disease, or to cerebral congestion (much more rarely in other cases), there occurs rather frequently, either during the attack or before it, drawing of the head towards one shoulder. If this occur before the loss of consciousness it is a most valuable warning, as it is then almost always possible to produce an abortion of the attack. Premonitory symptoms unfortunately are sometimes deceptive, as they may appear more or less frequently without being followed by the attack; and in cases in which warnings usually precede the seizures, there are sometimes attacks without any forerunner.

2. *Paroxysmal.*—As regards the paroxysmal symptoms, they vary considerably according to the kind of attak. If the attack is one of *petit-mal* (*epilepsia mitior*), there may be no other symptom than a loss of consciousness, with either a fixed state of the muscles of the eye, or a slight contraction of one or more muscles of the face or neck, or a movement of the lips, tongue, and throat, as in the act of swallowing. If we spoke according to our personal observation, we should affirm that an attack of *petit-mal* never consists in a loss of consciousness only, without the least trace of any other trouble whatsoever. Dr. Russell Reynolds, however, states that he has seen such attacks, and therefore we must admit that sometimes a pure and simple loss of perception and volition is all that exists in a seizure of epilepsia mitior. In such an attack the patient may, if walking, continue to walk, but if talking, he stops—generally for so short a time, however, that the trouble may pass absolutely unnoticed by listeners. Usually an attack of that kind lasts only from one to four or more seconds.

An attack of complete epilepsy (*epilepsia gravior*) is a very complex series of phenomena. Years ago (in 1857) the writer gave the following table, which shows at the same time in what order and by what mechanism the symptoms appear. Only on a few points has he to alter the views held twenty years ago. It will be seen that in this table the effects successively produced become causes in their turn.

CAUSES.	EFFECTS.
1. Excitation of certain parts of the excito-motor organs of the nervous centre.	1. Contraction of blood-vessels of the brain and face; tonic spasm of muscles of the eye and face.
2. Contraction of the facial blood-vessels.	2. Facial paleness.
3. Contraction of the blood-vessels of the cerebral lobes.	3. Loss of consciousness; congestion in the base of the brain and the spinal cord.
4. Extension of the excitation in the excito-motory organs of the nervous centre.	4. Tonic contraction of the laryngeal, the cervical, and some respiratory muscles (laryngismus and trachelismus).
5. Tonic contraction of some respiratory and vocal muscles.	5. Epileptic cry.
6. Further extension of the excitation in the excito-motory organs.	6. Tonic contraction reaching most muscles of trunk and limbs.
7. Loss of consciousness alone, or with tonic spasm in trunk and limbs.	7. Fall or precipitation, forward or backward, to the ground.
8. Laryngismus, trachelismus, and rigid spasm of some respiratory muscles.	8. Insufficient breathing; obstacle to entrance of blood into the chest, and to its issue from the cranio-spinal cavity.
9. Insufficient breathing; rapid consumption of oxygen, and detention of venous blood in the encephalon.	9. Increasing asphyxia.
10. Asphyxia and perhaps pressure by accumulated venous blood in the base of the brain.	10. Clonic convulsions everywhere; contractions of the bowels, the bladder, the womb; increase of secretions; efforts to inspire.
11. Exhaustion of the nervous power generally, and of the reflex excitability especially; return of regular respiratory movements.	11. Cessation of the fit; coma or fatigue; headache; and sleep.

Space does not permit of our insisting on the explanations given in this table. We will only say that the loss of consciousness is too rapid, too complete, to be due only or chiefly to a contraction of the blood-vessels of the cerebral lobes. In that case, as well as in cases of loss of perception and volition from a hæmorrhage, a softening, or some other disease of the brain, it is owing to an *inhibition* of the activity of cerebral nerve-cells that this symptom appears.

We will add to the above-given list of symptoms that besides the sudden loss of consciousness, with tonic spasm of the muscles of the eye, face, neck, chest, and limbs, and the uttering of a loud cry, which we observe in the beginning of a complete attack of epilepsy, there is sometimes biting of the tongue or lips. After the first stage, which is usually extremely short (not lasting generally more than from 10 to 20 seconds), general clonic convulsions appear, the face becomes more or less violet or purple, the temperature of the body rises, the skin becomes covered with perspiration, and saliva, reddened by blood or not, flows out of the mouth.

After the cessation of the convulsions, the patient is often so exhausted that the limbs fall, if lifted up, as if they were quite paralysed; the respiration is stertorous; and the heart beats with great force and rapidity. If care be not taken to have the tongue brought forward, and if the head be not placed on one side, the heavy breathing and the comatose state which often exist, continue for a long time. Even if care be taken about the position of the tongue, these disturbed states of the brain and breathing may last an hour or longer, in very bad cases. In some epileptics who have a series of fits in rapid succession, there is a more or less prolonged period of coma after each attack. Sometimes in such cases death terminates the scene after a more or less considerable number of attacks.

On waking up either from the coma or the sleep following an attack, most patients are very tired; their limbs and trunk aching as well as their head. Usually there is some mental alteration, often consisting of confusion or stupor, and sometimes delirium. The mind, however, may be quite clear, even after a violent attack, and the head free from pain, the only effect of the fit being general lassitude. On the contrary, after an apparently slight seizure, there is sometimes considerable mental disorder. The degree and duration of stupor after an attack have no relation to the duration of the convulsive period. Stupor is an effect of asphyxia and is, therefore, in direct relation with laryngismus, trachelismus, and the spasms of the thoracic muscles, of the diaphragm, and perhaps of the bronchial tubes also. It has been stated and denied that the urine passed after an attack of epilepsy sometimes contains albumen, in patients free from kidney-disease. In at least two cases the writer has ascertained that there was a notable amount of albumen in the first issue of urine after attacks in which there had been violent spasmodic contractions of the abdominal and thoracic muscles. These two patients afforded no evidence of disease of the kidneys or of the heart.

Attacks of epilepsy are sometimes very slight, consisting only, besides the loss of consciousness, of an extremely short tonic spasm of muscles of the trunk, the neck, the head, and the limbs. But even in the shortest and slightest attack of that kind the epileptic cry may be uttered and the tongue may be bitten.

The symptoms of a seizure of epilepsia mitior (*petit-mal*) are very different from those of a violently convulsive attack of epilepsy (*haut-mal*). The loss of consciousness occurs only for one or a few seconds, and the spasmodic contractions take place in a few muscles only, in the face, tongue, throat, eyes, and neck. If seized while standing up the patient very rarely falls, and on the contrary, if walking, he may continue his movement as regularly as before the fit. If attacked while speaking, he stops while the consciousness is lost, and on recovering it he may complete the unfinished sentence, so that the bystanders may know nothing of what has occurred. Sometimes, however, the patient's mind is deeply altered, even when the attack of petit-mal has been as short and slight as possible.

Nocturnal attacks of epilepsy may occur without any knowledge of their having taken place. Indeed, the writer has sometimes been consulted by persons who only asked for advice on account of headaches, and who had no pain in the head except after nocturnal attacks of epilepsy occurring without their knowledge. In such cases the patient, after a seizure during sleep, wakes up tired, as if he had walked considerably; he has pains in the limbs, the back, and the head. He finds his mind confused, and his memory affected; he feels disinclined to get out of bed or to exert himself in any way; and he often is excitable or depressed. Sometimes his tongue or his lips are sore, and if the pillow is examined it shows bloody spots. More rarely it is found that an involuntary evacuation of urine has soiled the bed. Anyone sleeping within hearing distance of the patient may be wakened by the piercing epileptic cry, and then hear the noise of the shaking of the bed, caused by the convulsive movements. Such attacks, although very frequent and also very violent, may remain altogether unknown and unsuspected by the patient and his friends.

3. *Inter-paroxysmal.*—The general health of epileptics is usually very poor. Besides the alterations of their mental powers, and especially of their memory, they show a great deal of excitability and often depression of spirits. Their circulation and their digestion are often affected. There is nothing special to them, however, either in the morbid state of their mind and of their feelings, or in the disturbances of their physical health. We do not consider the mental aberrations observed in the inter-paroxysmal state as elements in the symptomatology of epilepsy. These aberrations can exist without epilepsy, and in a great majority of cases epilepsy is unaccompanied by them.

The frequency of attacks varies immensely in epilepsy. In one case the writer learned that for more than seventeen years the patient had passed no night without a fit, and for more than ten years the average nightly number of fits had been about twelve, which gives a total of more than forty thousand attacks in ten years. On the other hand, he was once consulted by a patient, sixty-two years old, who has had but seven attacks since the first occurred, forty-three years ago, the interval between that and the second fit having been thirteen years, and the interval between the two last seizures having been seven years. Between extremely different cases like the two just mentioned, we find the greatest variety as regards the frequency of attacks. Usually, however, there are a number of fits every month. If there are attacks with extremely violent convulsions, the frequency is generally much less than when the convulsions are slight. Seizures of *petit-mal* are usually very frequent. A perfect periodicity is extremely rare, but an approximation to periodicity is not rare, especially in women. Singular and inexplicable periods will sometimes exist; the writer knows of a number of cases with a weekly periodicity, and of a case in which for years attacks recurred every forty-nine days.

Diagnosis.—In most cases it is easy to distinguish epilepsy from the few affections which resemble it. Sometimes, however, difficulties exist. There is no essential difference between the attacks of eclampsia in women and children and attacks of epilepsy, except the existence in eclampsia of a peripheric cause of irritation, which is likely to disappear. But those purely reflex epileptiform attacks of women and children are sometimes succeeded by genuine attacks of epilepsy, changes in the nervous centres occurring during the eclamptic attacks, which lay the foundation of persistent epilepsy, showing itself after the peripheric irritation, which was the first cause, has ceased to exist. It is sometimes, therefore, almost impossible, in children especially, to say if we have to deal with eclampsia or epilepsy. The same may be said of all kinds of attacks of loss of consciousness and convulsions due to a peripheric cause, whether we call the affection eclampsia or reflex epilepsy. (*See* Convulsions.) The first cause in those cases may cease to exist without our discovering positively that it has disappeared, and still attacks may continue. As the treatment is to be very much the same, except that in purely reflex epilepsy we have to fight against the peripheric cause besides making use of means against epilepsy itself, a mistake is not dangerous.

Hysteria sometimes borders on epilepsy, so much so that we must accept for certain groups of nervous symptoms, the name of hystero-epilepsy. Usually, however, there is no complete loss of consciousness in hysteria: there is rather a disordered consciousness. The convulsions generally do not follow the ordinary cycle of those of epilepsy: they are not merely tonic first and then clonic; they often are alternately, and many times successively, clonic and tonic. They sometimes resemble voluntary movements rapidly executed. The attack is not followed by the stupor that follows so often a fit of epilepsy. Before and after the attack, the patient exhibits (or has done so) purely hysterical symptoms. Usually, pressure on the ovary during the attack stops or increases it, while nothing of the kind is found in a fit of epilepsy, except, of course, one of hystero-epilepsy, in which case the two affections are blended in one.

Epilepsia mitior (*petit-mal*) sometimes cannot be easily distinguished from syncopal attacks. Usually, however, the pulse does not lose so much in frequency and force in *petit-mal* as it does in fainting. The loss of consciousness lasts for a shorter period in *petit-mal* than in syncope.

Between idiopathic epilepsy and cerebral epilepsy, there are generally very marked differences. In epilepsy due to disease of the brain, attacks are almost always preceded by an aura, consisting either in referred sensations or in cramps; in such attacks, convulsions often occur without loss of consciousness; very frequently the convulsions are unilateral, either on the paralysed side or on the other side; and almost invariably, if they are not clearly unilateral, differences in intensity, in kind, and in duration exist as regards the spasmodic contractions between the two sides of the body.

Prognosis.—Inherited epilepsy is very rarely cured. The writer can positively state, however, that it may be cured. Among other good cases of persistent cure, he has seen two extremely remarkable. The patients were first cousins, and had inherited the disease from a grandmother: one of them died from a fall while intoxicated, five years after his last attack of epilepsy; the other died in China, from typhoid fever, seven years after his last attack. They had both been treated for about two years, in 1852 and 1853.

There is a very great difference as regards prognosis between pure idiopathic epilepsy and other forms of that neurosis. The chances of cure, although never great, are by far greater when some curable or amendable organic alteration exists, as a cause of epilepsy, than when no such thing exists. One form of this nervous affection—that which is due to some congestion or even a more serious alteration of the brain, —consecutive to typhoid fever, scarlatina, or measles, is very often much benefited by treatment, if not cured. Epilepsy caused by disease of the brain—syphilitic or not—is much more curable than any other form of that neurosis. Epilepsy beginning in childhood, from teething or a bowel-complaint, and having lasted many years, is almost incurable.

Complications and Sequelæ.—Epilepsy has no necessary or usual complication. The diseases which accompany it often are frequently its causes and not complications. Bright's disease and other organic affections of the kidney, diseases of the liver, the womb, and other viscera, when allied with epilepsy, if they have not been the first and only cause of it, are powerful additional causes. There are no sequelæ of epilepsy worth mentioning except some amnesia, which we invariably find in patients cured of that affection, after having suffered from it for many years.

Treatment.—A most important fact ought at first to be pointed out under this head: it is that as every attack causes in the nervous centres changes which prepare other attacks, it is essential to produce, if possible, the abortion of attacks whenever warnings occur. The treatment to obtain such an abortion varies with the kind of warning. In cases in which a real aura exists many means can be employed with the greatest benefit. The writer long since showed that the old-fashioned mode of prevention of attacks, consisting in the application of a ligature round a limb, acts not as the Galenic doctrine supposed that it did, that is, by barring the way to something going up to the brain; but, on the contrary, in doing just the reverse, that is, by sending an irritation towards or rather to the nervous centres. The writer has also shown that the ligature need not be left applied, and that a greater success is obtained by tying suddenly and very quickly a handkerchief or a band, and repeating this tying several times in succession, than by applying the ligature even very tightly and leaving it so. He has also demonstrated:—1st. That the ligature can do good even when applied on another limb than that where the aura is felt, although it is usually more efficacious on the latter; and 2nd. That pinching or striking the skin, or irritating its nerves by heat, by cold, by galvanism, or by repeated pricks with a needle, will generally do as much good as the ligature.

In those cases in which an involuntary muscular contraction takes place before an attack—that is before the loss of consciousness—one of the most efficient means to produce an abortion of the fit is to draw forcibly on the contracted muscles, so as to elongate them. For instance, in those cases in which the unconsciousness is preceded by a contraction of the muscles of the neck, drawing the chin towards one shoulder, turning forcibly and rapidly the head towards the opposite shoulder, gives in most cases a very good chance of checking completely the tendency to the fit. In case of contraction of the flexor muscles of the forearm, forcible extension of the hand over the fore-arm may succeed in preventing the attack. A blow, pressure, or friction on parts where some muscles become rigid, may have the same favourable effect.

If there are disturbances of breathing among the premonitory symptoms, the inhalation of ether or chloroform may prove successful. In cases of laryngismus similar means, or the cauterisation of the fauces by a strong solution of nitrate of silver has been found most useful by the writer. The use of anæsthetics as a means of warding off an attack is too much neglected. By the help of ether in inhalations we have succeeded, with Mr. R. Dunn, in preventing an attack in a patient who had had a fracture of the arm in a previous seizure, and who used to have a fit regularly every week. A whole week was gained in that way. In some cases the recurrence of attacks has been warded off by giving chloroform or ether (by inhalation) to patients who had had the first of what would have been otherwise a series of many fits. There is, in cases in which a fit is expected, a considerable chance of preventing it by etherisation or chloroformisation.

According to the kind of warning and to its seat one means or another out of a very large number (only some of which we shall mention), ought to be used. An emetic, a purgative, a stimulant, the immersion of the two hands in hot water, the application of a lump of ice to the back of the neck or between the shoulder-blades, the subcutaneous injection of a solution of $\frac{1}{40}$ of a grain of atropine with $\frac{1}{4}$ of a grain of morphine, powdered *asarum* taken as snuff, a dose of 25 grains of hydrate of chloral, the inhalation of a small dose of nitrite of amyl, extremely rapid and ample voluntary respiratory movements for five or six minutes, jumping, running for at least ten minutes, reading very loud and fast—such are some of the means which we have found to be the most successful.

The second point of importance about treatment is to try to discover a part of the body which can by irritation give rise to a premonitory symptom of an attack, or even to an attack itself. If such a part is discovered, counter-irritation of some kind is to be applied there. Our remarks must be confined to saying, that hard pressure on certain parts of the head, the spine, the breast, the abdomen, or the limbs, has in a number of cases produced an attack or some symptoms of it. We have seen the passage of a galvanic current produce the same effect. In such cases a blister or other local application has done good in diminishing the violence or frequency of attacks, and even, in a few instances, helped notably to a cure.

The modes of treatment of epilepsia gravior or mitior which chiefly deserve to be noticed are the following:—

Against idiopathic epilepsy the most powerful means consists in the simultaneous use of some tonic remedy (such as strychnine or arsenic) in a solution to be taken after meals; and of a mixture composed more or less like the following:—

℞ Potassii iodidi, ʒij.
Potassii bromidi, ℥j.
Ammonii bromidi, ʒiij.
Potassæ bicarbonatis, ʒj.
Tinct. calumbæ f. ℥j.
Aquæ destillatæ f. ℥vj.

Of this solution may be given to adults four doses a day, three of one teaspoonful each before meals, and the fourth of three teaspoonfuls at bed-time with as much water as desired. According to many circumstances the dose of one or another of the ingredients is to be changed. For example, if the *petit-mal* exists alone, or coexists with the complete epilepsy, the dose of the bromide of ammonium must be larger, and that of the other bromide diminished. If there is a weak pulse the sesquicarbonate of ammonia is to be substituted for the bicarbonate of potash. In the writer's work on functional nervous affections all the rules relating to that mixture are given, and we will only say now that its use is by far more beneficial than that of any of its ingredients alone or of two of them. Two essential rules are to be followed when either such a mixture or any of the many bromides is employed against epilepsy; the first is, that there ought to be no interruption whatever in the use of such remedies, as the whole benefit that may have been obtained may be lost at once after an interruption of even only a few days; the second is that the treatment must be persevered with for at least two years after the appearance of the last attack. There is no marked harm in the great majority of cases from a prolonged use of a mixture like the above; many patients have taken it for several years, and some for six, eight, or ten years without any marked bad effect.

Idiopathic epilepsy (either the complete or the incomplete, that is the *petit-mal*) has been successfully treated (very rarely cured, but often benefited) by the use of a number of remedies. Judging by his own experience, the writer names, as the most powerful, atropine and the ammoniated sulphate of copper. Although not able generally to produce as much and especially as prompt a good effect as the above mixture, these two remedies have the superiority over this mixture that they need not be constantly used, and that there is no necessity of continuing to employ them longer than eight or ten months after the last attack. Next in importance after the three means spoken of, will come the cotyledon umbilicus, the nitrate of silver, and zinc preparations, especially the bromide of zinc.

The other forms of epilepsy require pretty much the same modes of internal treatment; but, of course, according to the cause of each form some special means should be employed. In the above prescription the dose of the iodide of potassium must become as large as that of the bromide of potassium, when syphilis is considered to be the cause of epilepsy, and, if needed, mercury should be administered also. If epilepsy depends on some visceral affection it is clear that the treatment should be directed against that affection. But if the liver is diseased from some influence of malaria the sulphate of quinine should not be given, as it is almost always a bad remedy against epilepsy, often more hurtful than it can be useful. Arsenic then should be the remedy used against the sequelæ of fever and ague. If quinine must be employed in cases of clearly periodical epilepsy, the valerianate should be given rather than the sulphate.

It may seem strange that we do not name iron among the remedies against epilepsy. The writer's experience shows that in most cases iron is rather harmful than useful. It is only in cases of epilepsy allied with or caused by chlorosis or considerable anæmia that its good effect is often very marked. Even then, we have sometimes found manganese more serviceable. There is, however, one salt of iron—the citrate—which, although less powerful against a deficiency of blood-globules, is however less apt to give rise to attacks than are most ferruginous preparations in a number of cases.

Of other internal remedies, cod-liver oil if well borne is certainly useful, especially against the *petit-mal*. The importance of giving simultaneously with the bromides either arsenic or strychnine has been already mentioned. Arsenic alone can do much against any form of epilepsy, perhaps chiefly against *petit-mal*, but the writer does not personally know of a single case of cure by its use. Strychnine can also alone do good, but less than arsenic. Digitalis or digitaline have been credited as having effected cures; so have turpentine and a number of other medicines. The writer has obtained only a very limited good from the use of digitalis or turpentine. As regards the curative influence of the nitrite of amyl, it is yet *sub judice*.

From counter-irritation there is a great deal to be expected. Ice (not in a bag) the actual cautery, blisters, &c., applied to the back part of the neck and between the shoulder-blades, are most useful in any form of epilepsy, especially when there is a great deal of headache and considerable heat in the head. When attacks are very violent and frequent, there is some good, and at times a decided amelioration to be obtained from croton oil applications on a great part of the shaved head. Setons and issues very rarely do any good, and often weaken and irritate.

A circular blister round a limb, a finger or a toe, is most useful in cases of an aura starting from those parts. It is known that in such cases a nerve has been divided, sometimes with great success. Of more serious operations, there is one which ought to be completely rejected, unless there is good reason to suspect the existence of an intracranial aneurism on the carotid artery or one of its branches, namely, the ligature of that artery in the cervical region. Although beneficial in a few cases it is a dangerous operation, and much inferior to many other means of treatment. Trepanning the cranium, except on clear, rational ground, is certainly to be avoided, although it has in a few such cases cured or ameliorated the condition of the patient. But when the attacks are extremely violent and frequent, especially if they seem to endanger the life of the patient, and when there is a clear evidence of pressure exerted on the brain, that operation, which in such cases has often been useful, ought to be resorted to, after the failure of other means. Laryngotomy or tracheotomy are to be rejected, except in those instances in which the operation would have to be performed even if there were no epilepsy. In cases of laryngeal epilepsy the writer has found the cauterisation of the fauces and of the larynx itself with a strong solution of nitrate of silver a very useful means, and even in one case a means of complete and persistent cure.

During an attack of epilepsy, excepting what simple common sense suggests, there is very little to be done. Pressure on one or on both carotid arteries, which we now know to act on account of the accompanying pressure on the par vagum and on the cervical sympathetic nerves, will sometimes considerably shorten an attack, especially if there is violent action of the heart. At the time convulsions cease, the tongue ought to be drawn forward and the head of the patient, if not his body, turned sideways, so as to avoid the covering of the larynx by the half-paralysed tongue. No other interference at all with the patient should be the rule after the attack.

C. E. Brown-Séquard.

EPILEPTIFORM
EPILEPTOID } .—Partaking of the characters of epilepsy; terms generally applied to convulsions. *See* Convulsions.

EPILEPTIC INSANITY.—The different classifications of mental diseases agree generally in making a separate division of the intellectual derangement related to epilepsy. This latter ranks prominently among the predisposing causes of insanity, but has not been found to proceed from it, unless the epileptiform convulsions observed with the majority of mental affections be improperly regarded as epilepsy. Evidently, the fits of *petit mal* are associated with insanity more frequently than even the most violent of *grand mal*; however, from this association it does not necessarily follow, as currently believed, that insanity should be a mere consecutive accident of the fit. Falret, endeavouring to reconcile the views on the subject put forward by French alienists, asserts that insanity chiefly occurs as a consequence of epileptic attacks recurring at short intervals after a prolonged suspension of the disease—which is very true. Yet, insanity may besides break out after nocturnal attacks, or seizures of *petit mal*, without any relation whatever to the length of their suspension, or number; and mania—usually of the most furious character—may also appear as a forerunner instead of the sequel of the fit; or it may originate with the very first epileptic seizure and recur continually thereafter. Lastly, the existence of epilepsy and paralysis brings about, from the beginning, a gradual though obvious impairment of the intellectual faculties, which becomes exacerbated by the fits, and terminates in dementia. No less open to objection is the kindred nature of the physical and psychical manifestations of epilepsy, admitted by Falret, to establish thereupon the *intellectual petit mal* and the *intellectual grand mal*. The first correspond with the incoherent and violent state described as furious mania. The second may continue from several hours to several days, constituting an intermediate condition between the irregularities of character which attend the fit, and the highest disturbance of the furious maniacal seizures. In the midst of this confusion of mind epileptics recall to their memory the painful past impressions, which spontaneously spring up in their imagination, always the same at every new access, and give themselves up to instantaneous, sudden acts of violence. After such fit of violence, the epileptic either quickly returns to himself, regaining his consciousness and rendering an imperfect account of his misdeeds, or, on the contrary, he escapes, running away in a bewildered and greatly agitated condition. In either case the confusion, if not the complete oblivion of what has happened, is almost always a striking essential feature of this mental state, so much resembling the awakening from a dreadful dream. The foregoing phenomena are, indeed, exhibited by the insane epileptic; but the distinction between the *intellectual grand mal* and the *intellectual petit mal*, and their respective reference to the physical paroxysms of epilepsy, supposed by Falret, implies an essential connection which is far from being constant. The most fearful fits of rage, or frenzy, may follow the *petit mal*, or may burst out without any visible attack at all, while nocturnal fits, or *petit mal* and *grand mal*, recurring separately or together, may often herald a harmless insanity with the highest degree of melancholia with stupor, without the least violent reaction—which, as set forth by Falret, should exclusively occur upon the physical *grand mal*. In other common instances, the epileptic, without any dejection or stupor, but excessively disposed to react violently on the slightest moral or physical incitation, talks and acts coherently, in an apparently rational manner, but actually without any appreciation whatever of his outward relations—a strange state that may occur along with diurnal or nocturnal fits, or irrespective of any manifest physical paroxysm, as the only exponent of the epileptic malady. For all these reasons, instead of attempting to establish an immediate relation of cause to effect—which cannot be proved—between the psychical and physical paroxysms, it is safer to regard epileptic insanity, or, using a more adequate term, *cerebral epilepsy*—as one of the manifestations *per se* of the spasmodic neurosis, recognising its essential source, not in this or that kind of fits, nor in their frequency, but in the very pathogenetic elements of the disease. Unconsciousness, with an excessive reflex susceptibility, displays itself as the chief characteristic of cerebral epilepsy, capable of occurring either alone, or coupled with any other form of the epileptic malady, preceded sometimes by an *aura*, identical to that which may foretell other attacks.

DESCRIPTION.—Assuming the practical view above maintained, it is readily observed that epileptic insanity—like every other variety of insanity—manifests itself under an *intermittent*, a *remittent*, and a *continuous* form.

The *intermittent* form is characterised by periodical attacks, breaking out at irregular intervals, either before or after the fits, which, moreover, often explode as though they were an intercurrent accident of the maniacal seizure. When this latter directly follows the *grand mal*, the patient instantly passes from the clonic stage of the fit into the maniacal, without any intermediate period of sleep or coma. The intermittent attacks of cerebral epilepsy rarely last less than two or three hours; they may be developed one or more days after instead of closely accompanying the fits, and ordinarily have then a longer duration; or, again, the intellectual disorder may reach its most dreadful stage without any spasmodic fit being seen or suspected. Morel proclaims that in these cases the occurrence of convulsions never fails to disclose the true nature of the insanity, as such patients ultimately arrive at the convulsive fit and die. This, however, is too absolute a statement, for undoubted cases of cerebral epilepsy are frequently met with, without the supervention of any spasms in the final state of cerebral congestion, the patient sinking into a profound coma, but sometimes executing automatically in this insensible state the same movement of the head, or some other habitual gesture. It is in intermittent cerebral epilepsy that unconsciousness appears most strikingly, although no reference has been hitherto made to its clinical or far-reaching medico-legal significance, nor to the explanation it furnishes to the strange oblivion or amnesia, so peculiar to epileptics after the commission of their criminal acts. Religious monomania and erotomania are common in the earliest stages of intermittent cerebral epilepsy. However, the peculiar disposition to wander about in an aimless manner, the volubility and instantaneous changes characteristic of the deportment of individuals labouring under this stage, may be transformed into an opposite manner of acting, the epileptic then remaining for hours or days entirely motionless and silent, with a sullen expression of countenance, in a physical and mental condition which almost verges on catalepsy, and involuntarily passing his urine and excrements, like those suffering from stupidity or *melancholia attonita*.

No complete recovery of intellectual soundness takes place between the paroxysms or maniacal exacerbations of *remittent* epileptic insanity. In the *continuous* form the mental trouble persists throughout, not essentially modified by the recurrence of the fits. In either instance dementia, imbecility, or a range of symptoms very similar to those of general paresis, is more noticeable than the unconsciousness with high irritability and sudden violent acts observed in the intermittent cases. The remittent and continuous forms offer no embarrassment as to their diagnosis, and afford, upon close examination, the most typical examples of *folie circulaire*.

The intermittent cerebral epilepsy, which occurs in no proximate connection with any fit of *grand mal* or *petit mal*, corresponds to the *larvated epilepsy* of Morel, *intellectual epilepsy* of Maudsley, *psychical epilepsy* of Krafft-Ebing; and most of the cases of the so-called *instinctive mania* (*manie sans délire*), and of *mania transitoria* also belong to this category. The main points to observe in this perplexing aspect of the spasmodic neurosis are the following:—Cerebral epilepsy implies an advanced stage of the epileptic malady, but may and does nevertheless appear at any time throughout its progress, even when it has been developed in a sort of hidden or larvated manner. The discrimination between larvated epilepsy and other forms of intermittent mania is rendered easy by a reliable account of the antecedents of the patient. The demonstration of parents stained with any constitutional nervous disease, or addicted to intemperance, an extreme susceptibility to anger, with strange peculiarities of character, moral depravity, and a more or less dwarfed development of the intellectual faculties, in addition to the onset of fits during infancy, or adolescence, and subsequent vertigo or fainting fits or instantaneous absence and giddiness, are elements of diagnosis which evince the true epileptic nature of any transitory, instinctive, or mental disorder that has recurred without variation, or with such a complete resemblance to the preceding paroxysms as we notice but exceptionally in any other kind of mania. The attacks of cerebral epilepsy recur with the periodicity and similar premonitory symptoms peculiar to other epileptic paroxysms. When displayed from the beginning, as after traumatic injury to the head, syphilis, &c., they ordinarily recur at shorter intervals than otherwise. The manifestations of cerebral epilepsy are never solitary, they involve a repetition of fits of mental or physical character. Consequently, such insanity, as already advanced, discloses an active but not ultimate progress of the epileptic malady, and hence the possibility of its cure or relief. Epileptic insanity is rarely manifest before puberty, for idiotcy accompanies congenital epilepsy in *idiotic epileptics*, and imbecility the epilepsy which develops itself during childhood in *epileptic imbeciles*. There is a clear relation between the intensity and length of the epileptic insanity and the impediment to the cerebral circulation, which in its extreme degrees may terminate in meningitis. Giddiness with perspiration of the head, sometimes very profuse, and epistaxis, are symptoms existing during or immediately after the paroxysms. The cerebral congestion is further betrayed by the bloated and livid appearance of the face; the injection of the conjunctivæ, with a thick white discharge collected in the angles of the eyelids; and the heavy look of the patient. The pupils during the exacerbations of the paroxysm—when the patient becomes boisterous and violent, exhibit a dilatation and contraction, like that which may last for several seconds or even a minute after the fits of *petit mal* or *grand mal*. Slowness of the respiratory activity, with marked loss of its normal relation to the pulse, is regularly detected in every case where the *epileptic habit* has become well established, as also an increased temperature of the skin before the explosion of the attack, ordinarily attended with incontinence of urine when it takes place during sleep in nocturnal epilepsy. There is always at the close of the fit of epileptic insanity a period of sleep, which effects the transition to a sound condition of mind. This sleep may be prolonged several hours, accompanied by a heavy breathing or snoring, which makes it easily mistaken for the sleep of drunkenness, a mistake strongly countenanced by the quick recovery of the patient. Another conspicuous sign of epileptic insanity is the *epileptic echo*, or repetition by the patient of the same word or phrase addressed to him, or present in his mind. Romberg has described the *echo sign* as indicative of softening in cerebral diseases, but in epilepsy it chiefly evinces a perverted will. The phenomenon renders itself very evident in the writings of the epileptic insane, even during the very occurrence of the fit, thus affording confirmation of the automatic repetition of motory and intellectual acts so peculiar to epilepsy.

Morbid sensorial phenomena of various kinds existed in 86 per cent. of 267 cases of epileptic insanity. Hallucinations of hearing were recorded in 62 per cent. of the said number; of sight in 53 per cent.; of hearing and sight in 42 per cent.; of smell in 6 per cent.; and finally about 30 per cent. of the cases showed some disturbance of general sensibility, such as anæsthesia, hyperæsthesia, &c. If we take into account the almost constant occurrence of some of these morbid sensations, and the hyperæsthetic condition attending epileptic insanity, it will not be difficult to realise the manner in which its victims are fascinated by the feelings they experience, which ordinarily assume the most frightful and deceitful character. Whenever we have data for comparison, we shall see that the hallucinations of hearing are the most frequent, as shown by the foregoing statistics. Morel has, with great propriety, insisted on the unmistakable character of these hallucinations of hearing, and the piercing sudden noises, usually heard by epileptics, differing entirely from the noises complained of by those labouring under the delirium of persecutions, which always lead an attentive observer to a definite diagnosis of cerebral epilepsy.

The intellectual aura, which like precursory clouds of a threatening storm may anticipate the outbreak of a fit of cerebral epilepsy, is an accessory symptom common to all the attacks, already noticed in the general description. In regard to the moral and intellectual changes which characterise epilepsy, and may be superinduced from its very outset, effacing—as Maudsley says—the moral sense as it effaces the memory, there is one brief remark to be made. Such moral depravity is more apt to occur from the very inception of the attacks, when epilepsy is induced by a traumatic injury to the head; its appreciation is beset with difficulties, and although these morbid dispositions do not constitute a state of insanity, they must place the epileptic—as justly declared by Baillarger—beyond the common rule, and extenuate at least his legal responsibility.

Legal Relations.—Bearing in mind the reflex nature of the physical and mental phenomena inherent in epilepsy, and our inability to avoid the effects of reflex actions, it follows as a matter of course that epileptics should be regarded irresponsible for any criminal act they might commit under the influence of a paroxysm. Those familiar with epileptics know that the majority have no knowledge, or at least a very imperfect idea, of their misdeeds, such state of unconsciousness being the chief characteristic of epileptic insanity generally. This unconscious cerebration exhibits itself in a high degree in epilepsy, but is not peculiar to it, for we observe it more or less in all forms of insanity, and notably in somnambulism. Finally, a clear demonstration of the above-described phenomena is indispensable before we can fully appreciate or decide upon the nature of any act perpetrated during an alleged condition of epilepsy.

The reasons here briefly presented for the irresponsibility of confirmed epileptics prove no less forcibly that society, in its turn, must be protected from their misdeeds, since they are unquestionably the most dangerous class of individuals. Therefore criminal epileptics should never be allowed to go at large until sufficient time has elapsed to demonstrate the arrest of their malady, upon continued observation by a competent physician.

Treatment.—The treatment of epileptic insanity does not differ from that of epilepsy generally (*see* Epilepsy). Let it be simply noticed that ergotine in doses of three to six grains, and succus conii in doses of three drachms to one ounce, in often repeated doses, with counter-irritation to the lower part of the neck (seton or cautery), and cold shower-baths or packing, are among the most reliable means to be resorted to, to abate or prevent the great excitement of the insane epileptic. M. G. Echeverria.

EPIPHORA (ἐπὶ, upon, and φέρω, I carry). A flow of tears, so persistent that they run down the cheek, due either to obstruction of the lachrymal duct or to excessive secretion. *See* Lachrymal Apparatus, Diseases of.

EPIPHYTA (ἐπὶ, upon, and φυτὸν, a plant). These are the plant-like organisms found on the skin, and its appendages or on mucous surfaces, the so-called *vegetable-parasites*, originating certain diseases, such as the various forms of tinea and thrush. The more important of them are the Achorion, Trichophyton, and Microsporon. The achorion Schoenleinii is the vegetable fungus which constitutes the mass of the crusts of favus, and belongs to the group of Oidiæ. The trichophyton is the dermatophyte of tinea and sycosis, and is found in the substance of the hair as well as in the epidermis. The microsporon, termed Epidermophyton by Bazin, is the parasitic fungus of phytosis versicolor. Both the latter are members of the group of Torulaceæ. *See* Epiphytic Skin-Diseases, and Aphthæ. Erasmus Wilson.

EPIPHYTIC SKIN-DISEASES.—Synon.: Vegetable parasitic skin-diseases; *Tineæ*; Dermatophytic diseases.

Definition.—Epiphytic diseases are diseases due to the attack upon the integuments of parasitic fungi.

Description.—Speaking generally it may be said that an epiphytic disease consists of three component elements—(*a*) a soil favourable to the growth of the attacking epiphyte; (*b*) the growing epiphyte itself; and (*c*) the effects produced upon the skin-tissues by the development and increase amongst them of the epiphyte.

Epiphytic Soil.—As regards the soil it is difficult to exactly describe it, but it is indisputable that the young, those whose assimilation is at fault, the lymphatic, and fair children, furnish a soil peculiarly favourable to the growth of vegetable parasites.

The Epiphyte.—The epiphyte itself consists of reproductive cellular bodies called *conidia* or sometimes spores, formed of an outer envelope composed of cellulose, and an inner membrane or utricle, enclosing granules floating in a liquid, and mycelial filaments. The spores are round (as in tinea tonsurans) or oval (as in favus), having an average diameter of ·006 mm., and furnished in most cases with a nucleus. These conidia are double-contoured, solitary, or arranged in rows, or massed in groups (tinea versicolor). The mycelial threads vary somewhat in appearance; they may be fine transparent filaments, or large distinct double-walled tubes. They are jointed by real dissepiments, and more or less constricted, and contain granules and cells, whilst the terminal filaments bear various forms of fructification. In many cases there is a stroma, made up of a number of very small granules, resulting from the subdivision of the granules and cells in the interior of the filaments, and even of the conidia. Some question the vegetable nature of these fungus-elements, and aver that they represent a granular degeneration of normal skin-structure; but no transitional stages have been discovered betwixt the two structures. Further, these fungi can be made to develop the characteristic fructification of the common moulds of undoubted vegetable nature, and similar fungi occur in situations—as the hard structure of corals, &c.—in which they could not have been derived from any kind of epithelial or other animal tissue. Conidia may readily be mistaken for fatty granules and *vice versâ*. But the former refract light strongly, are nucleated, and unaffected by ether in the least degree.

Effects.—Concerning the effects induced by their growth in the skin, it may be said that fungi act like ordinary irritants, inducing inflammation of the skin; and as the fungi grow equally in all directions from a given centre, the eruption is usually circular. Its signs are most marked at the circumference, where the fungus is in its most active state; but, in addition, the fungus invades the epithelial tissues; grows downwards into the follicles, causing irritation and effusion therein; then gradually attacks the hairs or hair-shafts, absorbing their moisture, separating the component fibres, and causing the hairs to become thickened, more or less opaque, twisted, uneven in size along the shaft, and brittle, so that they easily break. Nothing but the growth of fungi in them can produce the disease of the hair observed in the epiphytic diseases.

Varieties.—There are seven clinical varieties of undoubted epiphytic diseases, and an additional one, about which great difference of opinion has been expressed. The seven are as follows:—

1. *Tinea favosa* or *favus*, or honeycomb ringworm, caused by the *achorion Schönleinii*.

2. *Tinea tonsurans* (ordinary ringworm of the scalp), the fungus occurring in connection with it being termed *trichophyton tonsurans*.

3. *Tinea kerion*, a modification of the last-named, having the same parasite, and being characterised by inflammatory prominence of the follicles, and exudation therefrom of viscid fluid.

4. *Tinea circinata* (ordinary ringworm of the body), including the ringworms of Oriental places,—Burmese, Chinese, Indian ringworm, &c., having the same parasite as tinea tonsurans, and only differing from it essentially in the fact of its occurrence on the non-hairy parts.

5. *Tinea sycosis*, or ringworm of the beard; the parasite being *microsporon mentagraphytes*.

6. *Tinea versicolor* or *phytosis versicolor*, the *chloasma* of English writers; the parasite of which is *microsporon furfur*.

7. *Onychia parasitica* or *onychomycosis*, parasitic disease of the nails, caused by the growth

in the nail of the fungus of tinea tonsurans or tinea favosa; in other words, the trichophyton or the achorion.

At one time it was thought that the disease known as *tinea decalvans* was parasitic and caused by the growth of the *microsporon Audouinii*, but this is at present a disputed point. *See* ALOPECIA.

These several varieties of tinea will be described in detail under that heading.

TREATMENT.—The principles of treatment in parasitic disease consist in improving the tone of the nutrition, and in bringing parasiticides into contact with the fungus-elements, so as to ensure their destruction; the latter, however, is a matter of much difficulty when the fungi are imbedded deep in the hair-follicle, or in the lower parts of the shafts of the hairs of the scalp. *See* TINEA. TILBURY FOX.

EPIPLOITIS (ἐπίπλοον, the omentum).—Inflammation of the epiploon or great omentum. *See* PERITONÆUM, Diseases of.

EPISPADIAS (ἐπὶ, upon, and σπάω, I draw).—A malformation of the penis, in which the urethra opens on its upper surface. *See* PENIS, Diseases of.

EPISPASTICS (ἐπὶ, upon, and σπάω, I draw). Substances which, when applied to the skin, are capable of producing a blister. *See* COUNTER-IRRITANTS.

EPISTAXIS (ἐπὶ, upon, and στάζω, I drop). SYNON.: Fr. *Épistaxis*; Ger. *Nasenbluten*.

DEFINITION.—Epistaxis signifies a bleeding from the nose.

ÆTIOLOGY.— Epistaxis is either *traumatic* or *idiopathic*.

The *traumatic* form may be occasioned by violent sneezing, by snuffing up irritating substances, or by direct violence; but in these cases there frequently appear to be general or local *predisposing* causes, to account for the readiness with which it occurs, such as a hæmorrhagic diathesis, an inflammatory or congestive hyperæmia, or some ulceration of the mucous membrane.

The *idiopathic* form of epistaxis frequently occurs in children, particularly boys, just before or about the age of puberty, and in girls as a form of vicarious menstruation. Epistaxis may be one of the forms of bleeding in persons of hæmorrhagic diathesis, in which case it is a source of anxiety and difficulty. Occurring in advanced life, it may be indicative of over-distension or obstruction of the cerebral venous system from chronic Bright's or cardiac disease; and the blood which flows is then often venous in appearance. Occasionally it occurs as a spontaneous relief to determination of blood to the head, in which form the blood generally proceeds from one nostril only. In other instances epistaxis is connected with serious disorder of the blood, as in the specific fevers. Thus it is often associated from the outset with remittent, enteric, typhus, or scarlet fever, and is indeed regarded in some degree as pathognomonic of enteric fever. It may also attend scurvy, purpura hæmorrhagica, splenic disease, pyæmia, and erysipelas, being a sequence of the septic condition.

In its passive form, epistaxis is often associated with organic disease of the heart, pleurisy, emphysema; or with ascites or ovarian dropsy, on account of pressure on the diaphragm inducing a stasis of the venous circulation. It may occur spontaneously from exposure either to great cold or great heat, or a sudden change from cold to heat, or from the diminution of atmospheric pressure, as in going up high mountains.

SYMPTOMS.—Hæmorrhage from the nose is too familiar to demand description in this place. The flow of blood may be either continuous or drop by drop. As a rule, the escape of blood is from one nostril, bleeding from both being rare. It may last a very short time, or for some hours, and in severe instances for days, causing syncope, or even being attended with fatal results. It is at times met with as occurring periodically.

DIAGNOSIS.—Epistaxis must not be confounded with hæmoptysis, as may happen if the epistaxis takes place posteriorly, and the blood passes into the mouth.

TREATMENT.—When epistaxis is obviously a salutary process, as it undoubtedly is in a good many instances, it subsides spontaneously; where it occurs frequently and severely, recourse must be had to mechanical, cutaneous, and internal remedies. The local application of cold in the form of cold water or iced compresses to the nose, neck, or forehead is most useful, acting as these agents do either directly or by inducing a reflex effect on the vaso-motor nerves. Simple pressure upon the nostril, or upon the septum nasi, by compressing the bleeding nostril with the finger of the opposite hand, while the arm of the affected side is raised above the head, is the most readily practicable and effectual of all measures. The application of mustard over the stomach or upon the ankles is sometimes successful. When simple means fail, astringents, either in the form of solution or powders, may be injected into the cavities, or applied on plugs of lint or cotton-wool, such as alum, acetate of lead, the salts of iron, or gallic or tannic acid.

Internally, the frequent administration in small doses of tinctura ferri perchloridi, turpentine, bromide of potassium, or belladonna and quinine may be necessary in cases of periodic attacks.

In very severe cases the operation of plugging the nares, and thereby favouring the formation of a clot, must be resorted to, and the most ready and easiest method is by the employment of Bellocq's sound, or more properly canula. If, however, this instrument be not at hand, a catheter or an eyed probe should be threaded with a stout silk or hemp ligature, and pushed along the floor of the nose, until it protrudes beyond the velum palati; one end of the thread should now be pulled out of the mouth by the fingers or forceps, and a roll of lint or a piece of sponge tied to it, and then pushed up behind the velum. The catheter and the attached thread being now withdrawn through the nostril, the plug is pulled forcibly against the posterior nares, and by the pressure exerted the hæmorrhage can generally be arrested. EDWARD BELLAMY.

EPISTHOTONOS (ἔπισθεν, forwards, and τείνω, I extend).—A synonym for emprosthotonos. *See* EMPROSTHOTONOS.

EPITHELIOMA (ἐπὶ, upon, θάλλω, I grow—epithelium; and ὁμὸς, like).—A variety of cancer, consisting essentially of epithelial elements. *See* Cancer.

EPITHELIUM, Diseases of.—The different kinds of epithelium must be separately considered, as they differ in their pathological relations, namely, *squamous* and *cylindrical* epithelium of mucous surfaces; *serous* epithelium, or *endothelium*; and finally *spheroidal* or *glandular* epithelium. The last kind will be better treated of under the heads of the several glands.

A. Diseases of Squamous and Cylindrical Epithelium.—1. **Catarrhal Inflammation.**—Both varieties of epithelium occurring on mucous surfaces are subject to inflammation, which usually takes what is called the catarrhal form.

Catarrhal inflammation is characterised by hyperæmia, swelling of the tissue, rapid production and casting-off of cells, and increased production of the normal mucous secretion of the parts, without the production of any coagulable exudation, or any layer of new material. The cells thrown off are partly epithelial, partly leucocytes or pus-cells. The secretion contains mucin. The proportion of the various factors of catarrhal inflammation varies greatly, sometimes hyperæmia with swelling, sometimes cell-production, sometimes fluid secretion predominating; and these differences sometimes mark different degrees or stages of the inflammatory process. When the number of leucocytes thrown off is very large, the catarrh becomes purulent, which differs only from the other in degree. Catarrhal inflammation is the ordinary result of irritation applied to a mucous surface; but it persists after the irritation has ceased, and has a marked tendency to become chronic. While the chief share in producing and maintaining the phenomena of catarrh must be referred to the condition of the blood-vessels of the mucous membrane, the part played by the epithelial cells in these processes is a point of great interest and importance, though as yet imperfectly determined. These cells, whether squamous or cylindrical, enlarge and alter in shape, while there must be (since so many are shed) a rapid new formation of them; but the seat of this new formation, whether in the normal or the pathological condition, is still obscure. Further, it is not unusual to find swollen epithelial cells which show division of the nuclei or partial division of the cell itself, and others which show within their substance several smaller, roundish bodies, with the general character of young cells. These appearances have been regarded as indicating (1) multiplication of cells by fission, (2) endogenous cell-formation within the mother-cells, and (3) the origin of the numerous pus-corpuscles seen on the inflamed surface. There is, however, no reason for thinking that new epithelial cells are thus formed. By others again the presence of pus-corpuscles or young cells within the epithelial cells is regarded as an unimportant and accidental complication, the young cells which possess the power of migration being absorbed into the protoplasm of the epithelial cells, so as to appear as if originally formed there. The production of vacuoles or spaces in the altered epithelial elements is also explained in two ways, either as a part of the process of cell-proliferation, or as indicating partial absorption of the substance of the cell. It must therefore be regarded as still uncertain, whether epithelial cells do, by a process of proliferation, give rise to any new elements.

2. **Croupous Inflammation.**—Croupous inflammation is distinguished by showing, in addition to hyperæmia and swelling, the production of a layer of new material, or false membrane, easily detached from the surface. This form is usually, if not exclusively, seen on surfaces covered with cylindrical epithelium, as in the air-passages. The false membrane, composed of fibrin cementing together layers of detached epithelium and leucocytes, does not owe its origin to any alteration of the epithelium itself.

Croupous inflammation of epithelial surfaces has been regarded as always indicating some specific form of inflammation. It now appears, however, that it may be produced by simple irritation, such as that which produces the catarrhal form, provided the irritation be sufficiently intense.

3. **Diptheritic Inflammation.**—This is a name used with much variation of meaning, but generally to signify a process in which there is production of a false membrane closely adherent to the epithelial surface, and which is accompanied by some degree of necrosis or gangrene. In the production of the diphtheritic false membrane an important part has been assigned to the epithelium, it being held that the new material which appears like exuded fibrin is really produced by a metamorphosis (the so-called *fibrinous transformation*) of the pavement epithelium. It is pretty clear that when this condition occurs on surfaces covered with this variety of epithelium some such change in the epithelium does take place, but not that the membrane is made up wholly or even in any large degree of such altered cells. Moreover, even this cannot be clearly traced on surfaces covered with cylindrical epithelium. The membranes consist in large measure of cast-off epithelium, and also (as the writer holds) partly of fibrin, though the presence of the latter constituent is denied by some authors. It should be noted that the terms croupous and diphtheritic inflammation, as here used, are not synonymous with the diseases named croup and diphtheria.

4. **Fatty Degeneration.**—It is very common to find the protoplasm of both squamous and cylindrical epithelial cells dotted with oil-globules, so much so that this must be considered normal, to a certain extent, in some glandular epithelium (as kidney), and does not appear to interfere with the function of the cells. When the fatty change, however, is extensive, and more especially when the whole body of the cell is opaque, the condition must be regarded as one of fatty degeneration (*see* Fatty Degeneration). This is seen in the stomach in cases of alcoholism, in poisoning with metals or phosphorus, and in cases which are probably nothing more than chronic catarrh. It is also seen in the alveolar epithelium in pulmonary emphysema. Fatty degeneration appears in epithelium to be a process leading to atrophy.

5. Mucous or Colloid Degeneration.—Epithelial cells, especially in parts which are naturally adapted to the production of mucus, particularly cylindrical epithelium, are liable to undergo a form of degeneration in which a portion of their protoplasm becomes converted into mucous substance, and thus liquefied. Cells having this character are often seen in catarrhal conditions of the mucous membrane of the air-passages, but the change does not appear to occur as a substantive disease. It has not been traced in squamous epithelium.

6. Albuminoid (Waxy or Amyloid) Degeneration.—This form comparatively rarely affects epithelial cells, but still in cases of albuminoid disease we may sometimes find that the mucous surface of the intestines is stained with iodine in the characteristic manner. In one or two cases the writer has observed a similar change in the surface of the pelvis of the kidney, and even the bladder, where there has been albuminoid disease of the kidney.

B. Diseases of Endothelium.—The single layer of flat epithelium found on serous surfaces, which differs so much from the other forms as to be now generally known by another name, *endothelium*, differs also in its pathological relations.

1. Catarrhal Inflammation is unknown on serous membranes, their characteristic form of inflammation being exudative and fibrinous, corresponding thus to the

2. Croupous Inflammation of mucous surfaces. In this inflammation the endothelium does not necessarily take any part, though when the inflammation is once established the endothelium is, in part, simply shed, in part shows changes of a proliferative kind; cell-division, multiplication, and endogenous cell-formation being observed here with less ambiguity (as it appears to the writer) than in the epithelium of mucous surfaces. Similar changes appear to occur in chronic inflammation of serous surfaces, and to play an important part in the production of fibrous adhesions between opposing surfaces.

3. Fatty Degeneration.—Endothelial cells are also subject to fatty degeneration, which may be very clearly seen in surfaces macerated by a collection of fluid, as in serous effusions of the peritoneum or pleura.

The other pathological changes of endothelium have not been studied.

The epithelium (or endothelium) lining the inner surfaces of the walls of arteries and veins, closely resembles the endothelium of serous surfaces. It is very subject to fatty degeneration, as may be seen on examining atheromatous arteries. Proliferative changes have also been traced by some observers in the process of occlusion of ligatured arteries or veins obstructed by thrombosis; but they do not appear to play any important part in idiopathic disease.

C. Diseases of Glandular Epithelium.—The diseases of glandular epithelium are best spoken of under the head of diseases of the several glands. *See* Breast, Diseases of; &c.

J. F. Payne.

EPITHEM (ἐπὶ, upon, and τίθημι, I place). A general term for a class of external applications which are soft and moist, such as poultices and fomentations. *See* Fomentations, and Poultices.

EPIZOA (ἐπὶ, upon, and ζῶον, an animal).—A term formerly much used by zoologists to characterise a peculiar and distinct group of parasitic creatures which attach themselves to fishes, but now more generally employed to embrace all kinds of parasites having the habit of residing in or upon the surface of the body of man and animals. In the writer's judgment the more comprehensive term *Ectozoa* is preferable, and the distinctions which have been created as to the relative value of these two terms ought to be abolished. In any case it should be understood that the equivalent terms epizoa and ectozoa have no zoological significance, being simply employed for convenience' sake when we are speaking of external parasites, of whatever character; in contradistinction to the term entozoa. The epizoa comprise such parasites as lice and mites (*Dermatozoa*), and the term might also be made to include fleas, bugs, and other creatures whose residence on the surface is only occasional, and of very short duration. *See* Parasites, and Entozoa; also Acarus, Demodex, Chigoe, Pediculus, and Œstrus.

T. S. Cobbold.

EPULIS (ἐπὶ, upon, and οὖλον, the gum). *See* Mouth, Diseases of.

EQUINIA (*equus*, a horse).—A synonym for glanders. *See* Glanders.

EQUINIA MITIS. *See* Glanders.

ERETHISM (ἐρεθίζω, I irritate).—A condition of excitement or irritation, affecting either the whole system or a particular organ or tissue. The word has been especially applied to the condition of the body in the early stage of acute diseases, and also to that induced by the too free use of mercury (*mercurial erethism*). *See* Mercury, Poisoning by.

ERGOTISM.—Synon.: *Morbus cerealis*; Fr. *Ergotisme*; Ger. *Ergotismus*, *Kriebelkrankheit*.

Definition.—A disease due to the action of ergot upon the organism.

Ætiology.—This disease derives its name from the fact that it is the result of the ingestion of ergot—the stroma of a fungus called *Claviceps purpurea*, which grows parasitically in the ear of the Rye. In some seasons this form of blight affects the grain so extensively that ten per cent. of the meal may consist of ergot. The phenomena to be described as symptoms of ergotism have been regularly and exclusively traced to the use of articles of food made from rye-meal thus contaminated. The appearance and severity of the disease vary with the amount of ergot consumed. Children at the breast are never attacked. Ergotism has frequently broken out in well-marked epidemics, after unfavourable harvests. In ruder times it constituted a severe form of scourge; but now it usually occurs sporadically, or is limited to families or small communities.

Anatomical Characters.—Nothing definite is known respecting the morbid anatomy of ergotism.

Symptoms.—Within a few days of the first ingestion of meal poisoned with ergot, the ordinary phenomena of irritant poisoning are developed, namely, vomiting, diarrhœa, severe abdominal pains and cramps, and general depression—giddiness and headache being specially marked.

Along with the preceding, certain special symptoms gradually make their appearance. The first and most characteristic of these is formication, attended with severe itching of the skin of the extremities. The other special senses, such as vision and hearing, may also become disordered. Occasional spasms occur in the muscles. Ravenous hunger is said to be a striking symptom in some instances. The pulse is infrequent and small. Respiration is not markedly disturbed.

The remaining phenomena peculiar to ergotism are usually described as belonging to two forms, the *gangrenous* and the *spasmodic*, according as the circulation or the nervous system is chiefly affected.

a. Gangrenous Ergotism.—Gangrene, due to ergot, is peculiar only in respect of its cause. The toes, fingers, feet, ears, and nose are the parts most commonly attacked. The incipient discolouration, pain, and swelling are observed within a period of two days to three weeks from the commencement of the other toxic symptoms. The necrotic process passes through the ordinary stages of development; may be either 'wet' or 'dry;' and advances to complete separation of the part, if this have not been previously removed by operation.

b. Spasmodic Ergotism.—The leading symptom of this form of the disease is the occurrence of severe intermittent cramps or painful spasms, specially affecting the lower extremities. These develop into tonic contraction of the muscles, with fixation of the limbs; and end perhaps in general convulsions, prostration, unconsciousness, and death. Abortion does not appear to be of frequent occurrence.

Course, Duration, and Terminations.—Many cases of ergotism are acute rather than chronic; but when gangrene appears, the course may be very protracted and variable. Spasmodic ergotism may last from two weeks to as many months. The mortality is said to have fallen from sixty to ten per cent. In a few cases, resolution occurs in affected extremities.

Pathology.—Beyond its effect as an irritant poison, the specific influence of ergot is exerted upon the organs of circulation, upon the central nervous system, and upon the uterus.

The Circulation.—Ergot produces a remarkable slowing of the cardiac rhythm; the arteries become contracted, with diminution or even disappearance of their channel, or formation of thrombi; the blood-pressure falls; and the veins become dilated and distended. The most recent and consistent theory respecting these phenomena is, not that the muscular coats of the arteries actively contract, but that the venous walls are primarily relaxed. The veins are thus overfilled, and the arteries drained of blood; the blood-pressure is lowered; and the heart being insufficiently fed, contracts feebly and slowly.

The Nervous System.—Certain of the spinal centres, both motor and sensory, are first stimulated and afterwards paralysed by ergot—directly, according to some authorities, indirectly according to others.

The Uterus.—The unquestionable action of ergot upon the uterus is explained by some authorities as due to stimulation of the centre for the uterus in the cord. Others consider that ergot acts upon the muscular fibres of the organ, either directly or indirectly through the blood-supply.

Whatever may be the value of the several 'explanations' of the action of ergot, the facts connected with it suffice to account for the specific phenomena of ergotism. The small, feeble, and infrequent pulse are due to interference with the circulation; while the painful spasms, as well as the formication and other sensory disturbances, are the direct result of the action of the poison upon the cord. The gangrene may also be partly due to the latter cause.

Diagnosis.—The occurrence of gangrene in a number of young and previously healthy persons should remove all difficulty from the diagnosis of ergotism. The spasmodic form of the disease may be distinguished from epidemic cerebro-spinal fever by the absence of pyrexia.

Prognosis.—The prognosis depends chiefly upon the early recognition and removal of the cause. The probability of the escape of affected extremities may be estimated by the degree to which the gangrenous process had advanced.

Treatment.—The treatment of ergotism consists in removing the cause of the disease; in hastening the elimination of the poison by the cautious administration of emetics and purgatives; in allaying the symptoms of gastro-enteritis; and in supporting the strength of the patient by internal and external stimulants, such as alcohol, warmth, and friction. Gangrene must be averted by careful local stimulation, by means, for example, of warm fomentations; or treated, if it should arise. *See* Gangrene.

J. Mitchell Bruce.

EROSION (*erodo*, I gnaw).—A superficial destruction of tissue, caused especially by friction, pressure, corrosion, or certain forms of ulceration.

EROTOMANIA (*ἔρως*, love, and *μανία*, madness).—Synon.: Love-melancholy, Satyriasis (in men); Nymphomania (in women); Fr. *Monomanie érotique*; Ger. *Liebeswuth.*—Insanity characterised by excessive sexual excitement; sometimes symptomatic of cerebral lesion, sometimes of disorder in the reproductive organs. *See* Insanity.

ERRATIC (*erro*, I wander).—Wandering, shifting, or irregular. Applied to pains, eruptions on the skin, and other morbid phenomena when they shift or move from place to place.

ERUCTATION (*eructo*, I belch).—Definition.—The sudden escape or expulsion of gas from the stomach upwards, with or without an admixture of portions of liquid or solid food, or of gastric juice, or other liquids.

Description.—The act of eructation may be voluntary or involuntary. In the former case a small portion of air is first swallowed, and by the over-distension thus produced the escape of a portion of the gaseous contents of the stomach is favoured. When involuntary, we must suppose that the cardiac orifice, which is closed in the normal state of digestion, is relaxed, and thus permits the rejection of portions of undigested matter. From the violence with which eructations often take place, we may also assume that the muscular coat of the stomach contracts spasmodically at the same moment that the relaxation of the cardiac opening occurs. The nature of the material rejected varies greatly. Sometimes it is tasteless, in others acid, and in rarer instances alkaline.

Ætiology.—Eructations occur in all gastric diseases attended with an undue formation of gas. They are constantly complained of in atonic dyspepsia, more especially in that form which occurs in elderly people, and are probably the result of an imperfect contraction of the stomach, preventing the due expulsion of the digested food into the intestine. They form a prominent and distressing symptom in dilatation of the stomach. In such cases the patient often complains of a sense of fermentation in his abdomen, and immense quantities of gas are expelled, generally mixed with an acid or acrid fluid.

Treatment.—The indications in the treatment of eructations are to prevent the decomposition of food, and the formation of gases and other products; to restore tone to the stomach, and remove any morbid condition of this organ; and to give remedies with the view of absorbing gases, or assisting the act of eructation. *See* Stomach, Diseases of. Samuel Fenwick.

ERUPTION (*eruptio*, a bursting forth).—This term is commonly applied to a pathological manifestation in the skin; more or less general; sometimes marked by colour, sometimes by prominence, but more frequently by both. When sudden and hyperæmic, a term derived from the efflorescence of a plant, namely, *exanthema*, is employed, as in the instance of the exanthematous eruptions—scarlatina, rubeola, roseola, and variola. The term is equally applicable to less acute forms of dermatosis, such as urticaria, eczema, impetigo, ecthyma, acne, and furunculus; and is also used for still more chronic forms of disease, for example, lepra vulgaris; and for outgrowths of the skin, due to aberration of nutrition, as in the instance of warts and molluscous tumours.

Erasmus Wilson.

ERYSIPELAS (ἐρύω, I draw, and πέλας, near).—Synon.: Lat. *Erysipelas*; Fr. *Érysipèle*; Ger. *Erysipelas*. Popular names:—St. Anthony's Fire (English); the Rose (Scotch); *der Rothlauf*, and *die Rose* (Ger.)

Definition.—Inflammation of the integument tending to spread indefinitely (*Royal College of Physicians' Nomenclature of Diseases*). The vagueness of this definition indicates the looseness with which the term is employed. The features common to all inflammations usually spoken of as erysipelatous are fever, usually preceding the local phenomena; and an inflammation tending to spread indefinitely by means of the lymph-spaces and lymphatic vessels of the affected part.

Summary of Varieties.—Erysipelas is usually divided into (*a*) Simple Cutaneous, (*b*) Phlegmonous or Cellulo-cutaneous, and (*c*) Cellular, or Diffuse Cellulitis (Nunneley). In addition to these three chief varieties, erysipelatous inflammation of the lymphatic vessels and veins, and of serous and mucous membranes, is also described.

Pathology.—All the inflammatory affections thus loosely classed together, as erysipelas in its various forms, have one feature in common. They all belong to the class of infective inflammations—that is to say, the inflammatory products possess the property of setting up an inflammation similar in character to that at the original focus in any part with which they may come in contact. In erysipelas these infective products diffuse themselves by the lymphatic vessels and lymph-spaces, and thus set up a spreading lymphatic inflammation. As the poison diffuses itself, it seems in most cases to lose its intensity, and thus the spreading is finally arrested. Of the exact nature of the poison we know nothing definite. As in other infective inflammation the exudation-matter contains minute organisms (micrococci); but the part these play in producing the disease, and their mode of origin, are matters of dispute. The poison, whatever it may be, is communicable from one individual to another. It is probable, however, that simple cutaneous erysipelas differs entirely in nature from cellulo-cutaneous and cellular erysipelas. The two latter are in most cases purely local in origin, and the poison which causes them probably varies, both physically and chemically, in different cases. In some cases it may be merely decomposing animal-matter, in others it may be something as truly specific as the infective products of malignant pustule or the poison of a venomous reptile. The effect produced by the inoculation of such poisons depends to a great extent upon the susceptibility of the individual. This is increased by all bad hygienic conditions, and above all by the abuse of alcohol and consequent visceral disease. When these affections commence apparently spontaneously, careful inquiry will almost invariably show that the starting point has been some local injury occurring in a person previously in ill-health. Simple cutaneous erysipelas, on the other hand, partakes much more of the nature of an acute specific fever. It is communicable not only by direct inoculation, but by infection; there is a distinct period of incubation, the duration of which is uncertain (variously stated from a few days to two weeks); the constitutional symptoms precede the local inflammation, often by a day or more; and the disease occurs in epidemics. It differs from other acute specifics in its extremely irregular course, and by its not conferring on the patient any immunity from a second attack; in fact, one attack predisposes to another. Two views are therefore held by different authors with regard to it. On the one hand some consider it primarily a *general* disorder, the local manifestation of which is a diffuse inflammation starting from any wound that may exist on the person of the patient, or, failing that, choosing by preference the points of junction of mucous membrane and skin. On the other hand it is described as originally a purely *local* inflammation, infective in character, and secondarily giving rise to constitutional disturbance. Others again suppose both forms to exist, and describe them as *traumatic* or *surgical*, and *idiopathic* or *medical* erysipelas. At the present time the question cannot be considered as definitely settled.

ÆTIOLOGY.—I. *Infection.* Erysipelas is undoubtedly infectious and inoculable, as the experience of hospitals sufficiently teaches us. Its power of infection is, however, not very great, certainly much less than that of measles or scarlet fever, and probably about equal to that of diphtheria. The development of the disease will depend, therefore, to a great extent upon the patient and his surroundings.

II. *Predisposing causes.* A. *In the patient:* 1. Constitutional predisposition. This is said to be increased by a previous attack, and sometimes to be hereditary. 2. Disease of some important viscus, especially liver and kidneys. 3. The presence of a wound. 4. Age. This has little effect; the disease affects all ages alike. 5. Sex. Erysipelas is said to be most common in women, especially at the menstrual period. 6. Intemperance and want of proper food are great predisposing causes.

B. *In the patient's surroundings.* 1. Meteorological conditions. East winds, low temperature, excessive moisture, cold and heat, have all been considered causes. It is said to be most common in spring and autumn. On all these points there is no really reliable evidence.

2. General hygienic conditions. Overcrowding in hospitals, want of ventilation, dirt of all kinds, bad food and impure water are all predisposing causes.

3. Epidemic influences. Erysipelas undoubtedly occurs in epidemics, and the type of the disease often varies in different outbreaks.

We shall now proceed to discuss in detail the several varieties of erysipelas summarised above.

I. Simple Cutaneous Erysipelas.—This is the most typical form of the disease.

ANATOMICAL CHARACTERS.—The post-mortem appearances of erysipelas are by no means characteristic. The redness of the inflamed area of course fades after death, leaving a faint yellowish tint. The skin feels hard and inelastic, and the subcutaneous tissue contains an excess of serous fluid. In very acute cases there may be the usual signs of blood-change seen in all malignant fevers—early post-mortem staining, imperfect coagulation of the blood, subserous petechiæ, swollen and soft spleen, and cloudy swelling of the liver and kidneys. Hiller states that microscopic examination of the blood before death shows many of the white corpuscles to have undergone degenerative changes and become converted into masses of highly refracting granules. Busk has described plugs of such altered corpuscles in the small vessels of the lung, and Bastian has observed a similar condition in the vessels of the brain. Microscopic examination of the affected part of the skin shows large numbers of migrating leucocytes, lying in the spaces of the fibrous tissue, amongst the fat-cells, and in the lumen of the lymphatic vessels. They are especially abundant round the small vessels. Lukomsky (Virchow's *Archiv*, Band lxv.) has described the presence of micrococci filling the lymph-spaces and lymphatic vessels at the advancing margin of the erysipelatous inflammation. These are not observed where the rash is receding, nor in those parts which have been affected for any length of time. This observation has been confirmed by subsequent observers.

SYMPTOMS.—In simple erysipelas the constitutional symptoms usually precede the local. The invasion is marked by chilliness, seldom by an actual rigor; loss of appetite; general malaise; nausea, but seldom actual vomiting; headache; pain in the limbs; and the usual signs of pyrexia. The invasion is tolerably sudden. The temperature rapidly rises to about 103° F. or higher. The rarer symptoms at this stage are epistaxis in adults, and convulsions in children. Usually within twenty-four hours of the invasion the characteristic cutaneous inflammation appears. It may, however, commence simultaneously with the febrile disturbance, or be delayed even for two or three days. Frequently the lymphatic glands nearest to the part are swollen before the cutaneous eruption appears; afterwards they are invariably enlarged and tender. The local inflammation usually, if not always, starts from some wound, scratch, or abrasion. It commences indifferently in a fresh wound or a granulating sore. When no wound can be recognised as its starting-point it usually starts from the junction of mucous membrane and skin, most commonly from the corner of the eye, causing a swelling across the bridge of the nose. It may also start from the angle of the mouth, the external auditory meatus, or the anus. It may commence in the nasal fossæ or pharynx, and extend outwards to the skin of the face. Possibly in all cases it starts from some slight abrasion which is scarcely to be detected (Trousseau). The inflamed skin is bright red in colour, with sometimes a yellowish tinge; the redness advances in all directions, but usually most rapidly in that of the lymph-stream. The advancing margin is irregular, sharply defined, and very slightly raised. The cutis is œdematous, and pressure with the finger-nail leaves a deep and abiding mark. Where the subcutaneous areolar tissue is lax, as in the eyelids or scrotum, it also becomes greatly swollen. In the limbs the subcutaneous swelling is great only in severe cases. In many cases small vesicles rise, which may coalesce, forming blebs of considerable size. These ordinarily contain clear yellow serum, which, in bad cases, may be stained with blood-pigment. As these bullæ burst they dry up, forming scabs on the surface, but no ulceration takes place beneath these scabs. The inflammation has but little tendency to end in suppuration; when this does occur it is in those parts in which the œdema has been greatest, as the eyelids. There is heat, tension, and pain in the affected part, and a peculiar sensation of stiffness, which may even precede the appearance of the redness. The febrile symptoms which usher in the attack remain unrelieved so long as the redness continues to spread. The pulse is at first quick and full, but it soon loses force, and in bad cases becomes extremely rapid and feeble. It is by the pulse, more than anything else, that the gravity of the case is marked. The temperature seldom rises above 106° F., though 107·5° F. has been recorded. The daily variations are not great, there being merely the usual slight morning fall and evening rise. Delirium is not uncommon at night, even in mild cases. In erysipelas of the head it may be a prominent symptom. It is usually due to the blood-condition, and not, as was formerly supposed, to extension of the inflammation to the membranes of the brain. This, however, does occur in rare cases, especially in erysipelas of the orbit or in that following a compound fracture of the skull. The tongue is always foul and usually dry, in bad cases becoming cracked and brown, with sordes on the lips and teeth. In erysipelas of the head the fauces are always red and congested, even when the inflammation has not actually extended to that part. The bowels are sometimes confined, but diarrhœa with offensive motions is liable to occur. There is nothing characteristic about the urine. As in other acute febrile diseases it frequently contains a small quantity of albumen. In erysipelas of the head, when the disease reaches its height, the appearance is often hideous in the extreme, the features being completely obliterated by the swelling of the lax subcutaneous tissue, and the face further disfigured by the scabs formed by the dried blebs. The duration of simple erysipelas is very uncertain. The cessation of the disease is marked by the inflammation ceasing to extend, and by a simultaneous fall of temperature, often very sudden. This may occur as early as the fifth day, or be delayed till the end of the second or middle of the third week. As the rash fades its margin loses its distinct outline, and the redness shades off insensibly. It is not uncommon to see the inflammation spreading at one part, fading at another. After the subsidence of the inflammation there is desquamation of the cuticle, and in erysipelas of the head often complete loss of hair, which is, however, never permanent. Suppuration occasionally takes place in the nearest lymphatic glands. Even after a mild attack the patient's strength is much reduced, and he often remains weak and anæmic for a considerable time. Relapses are by no means uncommon. When death occurs from simple cutaneous erysipelas, it arises most frequently from exhaustion. It may also be due to the gravity of the blood-change. Occasionally the fatal termination is preceded by violent delirium ending in coma. Sometimes it is due to some complication, as pleurisy or pneumonia, or in very rare cases meningitis. When sloughing of the skin or suppuration occurs, death may take place from septicæmia or pyæmia.

VARIETIES.—Some writers have divided simple erysipelas into *medical* and *surgical*—or *idiopathic* and *traumatic*—and have described these varieties as distinct diseases. They are, however, probably identical, for the following reasons:—they closely resemble each other in mode of invasion, course, and pathological changes; infection from so-called idiopathic erysipelas will give rise to the traumatic form in patients suffering from an open wound; and during an outbreak of erysipelas in a surgical ward patients without open wounds are occasionally attacked by the idiopathic form. Erysipelas has also been subdivided according to the part it attacks, as erysipelas faciei, capitis, scroti, &c.

Erysipelas occasionally affects the mucous membrane of the pharynx and upper part of the larynx. This form presents some peculiarities, and is spoken of as *erysipelatous pharyngitis* and *laryngitis*. The invasion and constitutional symptoms are similar to those of simple cutaneous erysipelas. There is a bright redness of the back of the pharynx and the fauces, always accompanied by considerable œdema of the soft palate and some swelling of the tonsil. The glands at the angle of the jaw are swollen and tender. The danger of this affection arises from extension to the glottis, causing œdema glottidis, with intense dyspnœa, expiration being more easy than inspiration, and both liable to obstruction by spasm. In such cases tracheotomy or laryngotomy may be required at any moment, to prevent death from asphyxia. In other cases the inflammation may extend forwards and appear on the face, either at the nostril or mouth, and afterwards extend as ordinary facial erysipelas.

Erysipelas occasionally attacks new-born infants, starting from the navel or genitals. This form has been spoken of as E. neonatorum. Serous membranes, especially the peritoneum, are said sometimes to be affected by erysipelas following wounds. In lying-in women the poison of erysipelas seems, in common with that of many other unhealthy inflammations, to be capable of causing puerperal fever.

Dermatologists have, according to their wont, invented a name for every possible variation. Thus when the inflammation spreads at one part while fading at another it has been called E. ambulans or erraticum; when spreading in a winding course, E. serpens; when causing small vesicles, E. vesiculare or miliare; when blebs form, E. bullosum; when there is much swelling, E. œdematosum, &c. Such names are useless, and may be multiplied *ad infinitum*.

DIAGNOSIS.—When the eruption is fully developed it is scarcely possible to mistake the disease. During the stage of invasion, before the appearance of the rash, diagnosis is impossible. Simple diffuse inflammation round a wound or abscess is distinguished from erysipelas by the absence of the characteristic invasion, and of the sharply defined border. Simple erythema differs from erysipelas in the absence of fever, and in the eruption being composed of numerous isolated patches. Occasionally, in malignant small-pox, there may be much redness and swelling of the face before the appearance of the vesicles, but the symptoms of invasion are much more severe than those of erysipelas.

PROGNOSIS.—The prognosis depends chiefly upon the gravity of the general symptoms. The following are bad signs:—high fever, violent delirium, excessive diarrhœa, early prostration, and very dry tongue with sordes. The extent of the inflammation is of less importance. Old age, disease of the kidneys or liver, and especially chronic alcoholism, add greatly to the gravity of the case. When erysipelas affects the pharynx there is always danger from œdema glottidis. In uncomplicated cases the death-rate is not high.

Of 25 cases treated in the medical wards of University College Hospital from 1872 to 1876, only one died, and he was suffering from chronic Bright's disease.

TREATMENT.—1. *Constitutional.* Erysipelas being a most exhausting and depressing disease, no antiphlogistic treatment is ever justifiable. Clear the bowels at the commencement of the attack, but avoid violent purgation. Only two drugs have any reputation in the treatment of erysipelas. The tincture of perchloride of iron, in large and repeated doses, has been strongly recommended by Dr. Reynolds and others, and is stated by some to act as a specific. To be of any use it must be given in doses of forty minims every four hours. Aconite if administered as soon as the temperature begins to rise is said to cut the attack short. It may be given in half-minim or minim doses of the tincture, at first every quarter of an hour for one or two hours, and afterwards hourly till the skin becomes moist and the temperature falls, but its effects must be very carefully watched, to avoid dangerous depression. The *diet* must be as nourishing as possible; beef-tea, eggs and milk, &c. Solid food can never be taken during the advance of the disease. Stimulants are usually required, and the amount must be regulated by the pulse. Large quantities are often necessary.

2. *Local.*—Local treatment is very various. Warmth and avoidance of variations of temperature are essential. Cold is utterly inadmissible; it aggravates the inflammation, and tends to cause suppuration or even sloughing. Hot fomentations or hot baths may be employed when the part affected renders them admissible. In other cases dry warmth must be used; it is best obtained by covering the affected part with a thick layer of cotton wool. Poultices should be avoided, as they needlessly irritate the skin, and are dirty and apt to get cold. With the application of warmth innumerable varieties of local applications have been recommended. These may be divided thus:—(*a*) *Indifferent applications.* These are intended only to exclude the air, but they have the disadvantage of shutting in the secretion of the skin. The most common of these are collodion, oil, and a thick layer of flour or starch under cotton wool. (*b*) *Sedative applications.* The most important remedy of this class is belladonna. It is best applied as a paint composed of equal parts of the extract and glycerine. It is especially useful when there is much inflammation of the lymphatic vessels and glands. (*c*) *Powerful Astringents.* Valette of Lyons recommends a 30 per cent. solution of perchloride of iron; Higginbottom a solution of the 'brittle stick of nitrate of silver' 20 grains to one drachm of water. Before applying either of these the skin must be carefully washed with soap and water to free it from grease. The perchloride of iron must be rubbed in with a glove. (*d*) *Antiseptic applications.* Marshall recommends creasote made into a paste with kaoline; Dewar, equal parts of sulphurous acid (B.P.) and glycerine; tincture of iodine is a common application. Lately Hueter has practised the subcutaneous injection of a 30 per cent. solution of carbolic acid. He states that this causes an immediate arrest of the inflammation for a small distance round the puncture; if, therefore, the treatment is adopted at so early a stage that the area of inflammation can be surrounded by four or five punctures the disease may be checked. Beyond this there would be danger of carbolic acid poisoning. (*e*) *Drawing a limiting line* in front of the advancing rash. This has been done with solid nitrate of silver and with blistering fluid. It is utterly useless.

Erysipelas of the fauces is best treated by the local application of a strong solution of perchloride of iron. If there is œdema glottidis the swollen parts must be scarified, and if that fails to give relief, tracheotomy may be necessary.

II. **Phlegmonous or Cellulo-cutaneous Erysipelas** was described by Dupuytren under the name of 'diffuse phlegmon.'

ANATOMICAL CHARACTERS.—Incisions made into the inflamed part in the early stages show the spaces of the areolar tissue distended with serous fluid; a little later on the fluid is found to be turbid, resembling thin pus; later still the subcutaneous cellular tissue is represented by masses of shreddy sloughs soaked in a puriform fluid. Unless exposed to the air by incisions or by sloughing of the skin these sloughs are free from any odour of decomposition and contain no gas. There is nothing characteristic in the post-mortem appearances of the internal organs.

SYMPTOMS.—The invasion is usually marked by chilliness or a rigor, elevation of temperature, nausea, headache, and general malaise. The local inflammation may commence in some wound or abrasion, but it may also arise spontaneously. From the beginning there is marked œdema of the subcutaneous tissue. The skin is reddened, but the margin of the redness is not sharply defined, and swelling and tenderness of the lymphatic glands is often absent. As the area of inflammation extends, the affected part becomes tense and brawny, and vesicles or large blebs form. The tension may become so great that firm pressure with the finger scarcely makes any impression. In a few days from the commencement of the disease, the greater part of a limb may be involved. If unrelieved by treatment the tint of the redness becomes more dusky, and dark purple patches appear. At the same time the tension becomes less, and gives place to a soft, boggy feeling, indicating sloughing of the subcutaneous cellular tissue. Then livid patches appear, which break down into sloughs. As these sloughs separate, large shreddy masses of gangrenous cellular tissue can be drawn out, leaving the undermined skin connected with the deeper parts only by bands containing the larger vessels. Finally, the remaining skin being insufficiently nourished may thin and melt away, leaving large tracts of the fascia and muscles beneath exposed to view. In this way if proper treatment be not adopted in time, the greater part of a limb may be denuded of its cutaneous and subcutaneous covering. The extreme stage may be reached in a week or ten days, but a longer time usually elapses before all the sloughs are separated. In the earlier stages there is much burning and tensive pain, but this subsides as gangrene sets in. The constitutional symptoms are grave from the beginning. There is high fever, the thermometer often reaching 105° F. The tongue is dry and brown, and sordes accumulate on the lips and teeth; there is total loss of appetite; and diarrhœa is a frequent symptom. The pulse, at first full and bounding, soon loses force, becoming rapid and weak. Delirium, usually of the muttering type, is always present in severe cases. Death occurs from exhaustion or from some complication, such as pneumonia, pleurisy, &c. During the separation of the sloughs septicæmia and pyæmia are of frequent occurrence. The disease most commonly attacks one of the limbs, but it is occasionally seen in the scrotum, and a peculiarly virulent form has been described as affecting the face. Phlegmonous erysipelas most commonly occurs in adult patients of broken constitution, suffering usually from the effects of the abuse of alcohol, or from some disease of the liver or kidney.

Diagnosis.—From simple erysipelas the phlegmonous form is distinguished by the great swelling and brawny hardness, by the want of a sharply defined edge, and by the early tendency to sloughing; from spreading gangrene by its slower progress, and the absence of the rapid decomposition and development of gas in the tissues. Acute necrosis somewhat resembles it, but this disease is limited to young subjects, the swelling is less brawny, and when pus forms there is distinct fluctuation and not the boggy feeling of phlegmonous erysipelas.

Prognosis.—The prognosis is always grave, especially if there is any delay in adopting the proper treatment. Early failure of the heart's force, excessively dry tongue, diarrhœa and vomiting are bad signs. The gravity of the case increases directly with the area affected.

Treatment.—The patient must be supported by good beef-tea, milk and eggs, and stimulants are usually required to be freely given. No depletory measures are ever justifiable. Ammonia-and-bark is sometimes of service. *Locally* the treatment in very mild and doubtful cases must consist in the application of hot fomentations, and extract of belladonna made into a paint with an equal amount of glycerine. As soon as there are any signs of tension, free incisions must be made to relieve it. The patient's danger will be greatly lessened if these are made with all the precautions of Lister's antiseptic method.

III. Diffuse Cellulitis, or Cellular Erysipelas.—In this disease the inflammation is confined to the subcutaneous cellular tissue, or to the planes of areolar tissue amongst muscles or beneath fasciæ. The course of the inflammation is similar in many respects to that of phlegmonous erysipelas, the only important difference being that the skin remains unaffected, or is only implicated in the later stages as a consequence of the sloughing of the subcutaneous tissues.

Anatomical Characters.—The post-mortem appearances are similar to those of phlegmonous erysipelas.

Symptoms.—The local signs of diffuse cellulitis when occurring in the subcutaneous tissue or beneath the superficial fascia, are marked œdematous swelling, gradually becoming brawny, slight redness of the skin, and usually mottling from over-distension of the superficial veins. There is no sharp limit to the swelling. There is intense tensive or burning pain, increased by movement, and acute tenderness on pressure. The neighbouring lymphatic glands are in most cases swollen and tender. As the disease advances, the swelling becomes doughy, and possibly an indistinct sensation of fluctuation may be felt. The skin now becomes redder, and the gangrenous inflammation may even extend to it, unless prevented by treatment. An incision in the œdematous or brawny stage merely shows the areolar spaces distended with serum, sometimes clear, more often turbid. If the incision be delayed till the later stages the affected cellular tissue is reduced to a mass of shreddy sloughs soaked in pus. Gas does not form amongst these sloughs till after air has been admitted from without. In mild cases the inflammation may localise itself, and lead to the formation of a large abscess. The constitutional symptoms are always grave. The temperature is high, 104° to 106° F. There are the usual symptoms of fever; the tongue is foul and speedily becomes dry; vomiting and diarrhœa are not uncommon; the pulse, at first quick and full, soon becomes feeble and rapid. There is almost always delirium. The disease usually runs a rapid course, two or three days sometimes being sufficient for it to reach its extreme stage.

Diffused cellulitis, as above described, is most frequently the result of a poisoned wound; it may then start from the wound or make its appearance at a distant part. It forms the most fatal variety of post-mortem wound; and, as is well known, in such cases the puncture may appear healthy, whilst the areolar tissue in the pectoral region may be the seat of most acute diffuse inflammation. The bite of the less poisonous reptiles causes a similar diffuse inflammation. Diffuse cellulitis of the pelvis is a common cause of death after lithotomy, and is not uncommon in women after labour. Diffuse cellulitis beneath the pericranial aponeurosis is of frequent occurrence after scalp wounds. Occasionally the disease arises spontaneously, and it is then most common in the upper limb, but it has been seen in the areolar tissue of the neck and in many other regions. In pyæmia and septicæmia patches of diffuse cellulitis may appear in intermuscular spaces, or in the subcutaneous tissue.

Diagnosis.—The diagnosis of cellulitis is often difficult when the mischief is deep-seated. The œdema, pain, and tenderness, with the severe constitutional symptoms, are the chief guides; but even when these are well marked, the extent of the inflammation, and the necessity for active treatment are often difficult to determine.

Prognosis.—This depends much upon the cause and upon the previous health of the patient. It is a very bad sign when the gravity of the general symptoms is out of proportion to the local mischief. In the pelvis cellulitis may be fatal from peritonitis; in the neck it is very fatal; it is much less dangerous in the limbs. When it occurs as a part of pyæmia or septicæmia the prognosis is of course very grave.

Treatment.—Early incisions into the inflamed cellular tissue, with antiseptic applications, and abundant support, form the only reliable treatment in severe cases. In slight cases the application of extract of belladonna and glycerine (equal parts), with hot fomentations, may lead to resolution or limitation of the inflammation.

IV. **Erysipelatous Lymphangitis.**—Inflammation of the superficial lymphatic vessels is a common accompaniment of all varieties of erysipelas; but in some cases it forms by far the most prominent local morbid condition.

Symptoms.—This affection is characterised by red lines running in the course of the lymphatic vessels from some local sore or wound. The lines are at first tolerably sharply defined, and about a quarter of an inch in width, but after a short time they spread out and several may coalesce, forming a patch exactly resembling simple cutaneous erysipelas. There is slight œdema, some pain and stiffness, and acute tenderness on pressure. The lymphatic glands to which the vessels lead are swollen and tender. The constitutional symptoms are the same as in simple erysipelas.

Diagnosis.—This affection can only be mistaken for phlebitis, but the diagnosis is easily made by observing the course of the lines, and by the absence of the knotted cord formed by the coagulation of the blood in an inflamed vein.

Treatment.—The treatment is the same as in simple erysipelas. The extract of belladonna and glycerine is especially useful in this form of erysipelatous inflammation.

V. **Erysipelatous Phlebitis.**—Inflammation of the superficial veins, rapidly spreading in the course of the circulation, accompanied by thrombosis, redness of the skin, and acute tenderness, has been supposed by some authors to be erysipelatous in character. The only evidence in favour of this view is that the invasion and the constitutional symptoms resemble those of erysipelas, and that the affection is not uncommon during epidemics of erysipelas. *See* Veins, Diseases of.

Various other diseases have been classed as erysipelatous: the chief of these are whitlow, some forms of puerperal fever, and diffuse peritonitis after operations affecting the peritoneum; all these will be described elsewhere. Diffuse inflammation not unfrequently occurs after punctures made to allow of the escape of the fluid in the dropsy of Bright's disease. That punctures made into feebly nourished tissues bathed in decomposable serous fluid should set up diffuse inflammation is not surprising, but evidence is wanting to prove that such inflammation is necessarily connected with erysipelas.

Marcus Beck.

ERYTHEMA (ἐρυθρὸς, red). Synon.: *Rose-rash*; Fr. *Érythème*; Ger. *Hautröthe.*

Definition.—A non-infective superficial inflammation of the skin, the essential characteristic of which is redness, which disappears on pressure by the finger, reappearing when the pressure is removed. The hue may vary from a bright rose to a dark blue red; it may or may not be accompanied by swelling; the part may be hotter than natural; and the appearance may present itself as spots, circumscribed or diffuse, or as wheals. It is sometimes attended by a sensation of slight burning or itching, but generally gives rise to no subjective symptoms. After it has disappeared the skin is either normal, or remains slightly pigmented, or desquamates. Generally there is an increase of temperature, with slight feverish symptoms. Erythema may be either *symptomatic* or *idiopathic.*

a. **Symptomatic Erythema.**—Ætiology and Varieties.—Erythema occurs in rare instances after the administration of drugs. Cases are recorded after the ingestion of arsenic, belladonna, chloral, copaiba, cubebs, digitalis, iodides, opium, quinine, salicylic acid, stramonium, strychnia, and turpentine. The rash usually appears immediately after the absorption of the medicine into the circulation; after arsenic it appears at a later period.

Exposure to heat or cold, and contact with various acrid or poisonous substances are also common causes of erythema. Friction and, in the absence of cleanliness, the secretions of the skin itself, may give rise to it, as when *erythema intertrigo* is produced between the scrotum and thighs by the irritation of profuse sweat and sebaceous secretions. The blush of shame and anger is an erythema produced by the immediate action of the vaso-motor nervous system.

Variola, cholera, enteric fever, rheumatic fever, and various other less distinctly defined febrile conditions, are frequently accompanied during various stages of their course by a more or less generally diffused and mostly ephemeral form of erythema.

The *roseola infantilis* of authors is an erythema that accompanies intestinal disturbance, teething, and various other disordered conditions of the system in children. Its appearance may exactly simulate that of measles or scarlatina, but it differs from these in disappearing in less than twenty-four hours, and in leaving no desquamation behind it.

The erythema that accompanies small-pox —*roseola variolosa*—appears generally on the second day of the disease, either as a diffuse redness of the whole integument, or as bright red spots, which are seen first on the face and then on other parts of the body. It lasts from twelve to thirty-six hours, and disappears when the small-pox eruption begins to show itself. A special limited form of erythema has been observed on the second and third days of small-pox, extending from the hypogastrium down the front of the upper two-thirds of the thighs; the affected surface, when the legs are closed, having the form of a triangle the base of which is across the lower part of the abdomen. This surface remains almost or entirely free from the variolous pustules, and many of the cases in which it is present end fatally.

From the third to the eighteenth day after vaccination, small or large erythematous patches —*roseola vaccina*—are sometimes seen, generally on the arms, but also on other parts of the body. They usually disappear within twenty-four hours, and leave neither desquamation nor pigmentation.

The forms of erythema mentioned above can not be considered as being in themselves specific varieties of disease, and pathologically consist in a temporary injection of the capillary blood-vessels of the skin. They are to be distinguished from the erythemata that run a distinct course, terminating in pigmentation and desqua mation, and in which the capillary injection is accompanied by exudation.

b. **Idiopathic Erythema.**—I. *Erythema multiforme.*—This form of idiopathic erythema is most commonly seen in spring and autumn, and is distinguished by its localisation. It begins on the backs of the hands and feet, and frequently is found in these situations only. In some cases it extends upwards to the shoulders and hips, and in very rare cases is also found on the trunk.

The appearance consists in flattened papules from the size of a pea to that of a bean, of a dark blue or brown-red colour. They are surrounded on their first appearance by a red zone which soon disappears, and the border of the papule then stands out in fuller relief. The mildest form of this disease consists in papules which disappear after a few days—*erythema papulatum* seu *tuberculatum.* Instead of thus disappearing it may spread outwards from the edge, and flatten and become pale in the centre, thus forming a red ring, the condition being known as *erythema annulare.* While the first circle persists a second ring may form round it, and the circles may be constituted by small papules, forming the condition recognised as *erythema iris* seu *mamellatum.* Another stage may be reached by the enlarging circles meeting, and so forming segments of a circle, constituting the form known as *erythema gyratum* seu *marginatum.*

At any of these stages the eruption may disappear. The sequlæ are slight pigmentation and desquamation.

The disease, whose different stages have received the different names above indicated, has been designated, on account of the different forms under which it may be seen, *erythema exsudativum multiforme.* It is accompanied by a slight feeling of burning, or by very slight itching. Constitutional symptoms are only present exceptionally, and when the eruption is universal. Hebra relates that in a woman who died whilst an eruption of *erythema gyratum* was on the skin, similar red rings were found in the small intestine. It is most common in adolescence, and is more frequent in males than in females.

II. *Erythema nodosum.*—This name is given to a disease characterised by the appearance on the skin, and chiefly on that of the lower extremities, of pale red hemispherical or oval swellings. These vary in size from that of a pea to that of a hen's egg, and are painful on pressure. Fever is sometimes present.

The swellings are at first pale red with a yellowish tinge, later dark red, and finally livid; after they disappear they leave behind them a yellow pigmentation similar to that which follows a contusion. The number of swellings may vary from a very few on the lower extremities to successive crops on different parts of the limbs and trunk. In the latter case the feverish symptoms are well-marked. The course of the disease is completed in two to four weeks. The swellings never suppurate, never itch, are always painful, and the redness never spreads to the adjoining skin. This variety can occur in combination with the previously described forms of *erythema multiforme.* It is a disease of childhood and adolescence, and is chiefly seen in females.

Prognosis.—The prognosis of the special forms of erythema—*multiforme* and *nodosum*—is always favourable. Those varieties seen in the course of other diseases do not modify the prognosis of the particular disease which each accompanies.

Treatment.—The treatment of erythema consists in palliating the attendant symptoms. Dusting with flour, or the application of spirit-lotion, should be employed when productive of a sense of comfort to the patient. In *erythema nodosum* warm applications of infusion of poppies or chamomile are soothing; while aperients, and, when fever is present, gentle diaphoretics may be given internally. In many such cases tonics, especially quinine, are required.

George Thin.

ESCHAROTICS (*ἐσχάρα*, a slough).

Definition.—Escharotics are substances that completely destroy the tissues to which they are applied, and produce a slough. They are distinguished from other caustics simply by the greater intensity of their action.

Enumeration.—The chief escharotics are:—The hot iron, Sulphuric Acid, Nitric Acid, Potash, Chloride of Antimony, Chloride of Zinc, Acid Nitrate of Mercury, Bromine, Chromic Acid, and Lime. Weaker caustics are—Nitrate of Silver, Sulphate of Copper, Sulphate of Zinc, Iodine, Carbolic Acid, Arsenious Acid, Sulphide of Arsenic, and Dried Alum.

Action.—Escharotics combine with the tissues and destroy them. Around the part thus killed inflammation is set up, and the part is separated as a slough. Besides their local action these agents act reflexly on other parts of the body through the nerves of the region to which they are applied.

Uses.—Escharotics are employed, first, to destroy the virus in, and the tissues around, a poisoned wound, and thus prevent the absorption of the poison, for example, in bites by snakes or rabid animals, or in cases of inoculation with syphilis, or with animal-poisons in dissection or post-mortem examinations. Secondly, they are used to destroy unhealthy tissue, such as exuberant granulations, and to remove excrescences and morbid growths, as warts, condylomata, nævi, polypi, hæmorrhoids, and cancer. Thirdly, they are used to open abscesses, especially those of the liver. For this purpose caustic potash is usually employed. Lastly, by means of escharotics it is usual to establish issues, and thus react beneficially on distant organs.

T. Lauder Brunton.

ESSENTIAL PARALYSIS.—A synonym for infantile paralysis. *See* Infantile Paralysis.

ETHER, Uses of. *See* Anæsthetics.

ETIOLOGY. *See* Disease, Causes of.

EUSTACHIAN TUBE, Diseases of. *See* Ear, Diseases of.

EUSTRONGYLUS GIGAS. *See* Sclerostoma.

EVACUANTS (*evacuo*, I empty).—Definition.—Medicines used to produce some evacuation from the body.

Enumeration.—The chief evacuants are:—Sternutatorics, Expectorants, Sialagogues, Emetics, Cholagogues, Purgatives, Diaphoretics, and Diuretics. *See* the several articles upon these subjects.

EXACERBATION (*exacerbo*, I make violent).—Increase in the severity of the symptoms of a disease.

EXANTHEMA, EXANTHEMATA.—(ἐξ, out, and ἀνθέω, I blossom).—Synon.: Fr. *Exanthème*; Ger. *Ausschlag*.

Definition.—A rash or eruption on the skin.

The use of this term, once denoting any cutaneous eruption, is now restricted to the eruptive fevers called the *exanthemata*. Dermatologists discriminate the febrile rashes or exanthems of local or individual origin—urticaria, erythema, and roseola—from the true exanthemata, which are acute specific infectious diseases, namely, Typhus, Variola, Varicella, Morbilli, Rötheln, Dengué, Scarlet Fever, Typhoid or Enteric Fever, and perhaps Erysipelas. In this article some leading features of these diseases will be shortly stated; and, as each of them will be found fully discussed under their several heads, it is only necessary further to notice certain less defined and regular eruptions associated with fever.

All the exanthemata are attended with fever and enlargement of the lymphatic glands.

Typhus.—The mulberry rash appears suddenly on the fourth and fifth days of illness as a dull red mottling of irregular, persistent, non-elevated spots; the fever, high at the commencement, continues so after the rash is fully developed.

Typhoid.—In typhoid fever the small, raised, rose-spots do not appear till the second week of fever; sparsely scattered on the trunk, they fade on pressure, disappearing in three or four days, while new spots arise.

Small-pox.—Marked fever of sudden ingress occurs two days before the raised eruption; sometimes a rose rash first appears, but the severe symptoms begin a full day before this and not more than two days before the characteristic spots appear. The cervical glands are enlarged.

Varicella.—The eruption begins on the first day of illness; the fever is often high and comes on suddenly, but enlarged cervical glands and spots somewhere are always to be found at the same time.

Measles.—Three days of fever and catarrh, with palpable enlargement of the cervical glands, precede the rash; there is then sudden increase of fever, subsiding while the rash is at its height.

Rötheln; Rubeola sine catarrho.—The rash appears within a few hours of the first feeling of illness, which is slight and soon over. The rash is at first spotted rather than finely diffused. By the time it is fully out the fever has subsided, but the enlarged cervical glands which marked the ingress always remain to indicate a specific disease; fine desquamation rarely follows, and there is no albuminuria. Rötheln is invariably transmitted by contagion, the incubation being from two to three weeks; this long period of incubation causes the source of infection to be often overlooked, and even the possibility of it to be denied; when carried to a family or school either an unnecessary alarm of measles is raised, or the next sufferers are said to have all drunk cold water together after being heated.

Dengué.—Widely-spread in Africa, the warmer parts of America, and both the Indies, dengué may possibly be limited to hot climates; its presence with us is as yet undetermined. The rash is at first discrete, like that of measles, but follows soon after infection, and the disease in its general course is allied to scarlet fever.

Scarlet Fever.—The finely diffused redness is found on the skin and in the mouth and throat often within a few hours of the sudden ingress of fever; the fever increases with the development of the rash, both persisting for several days. Often the throat is first complained of; the glands at the angle of the jaw are full and tender. Scarlatina is often declared three or four days after surgical operations. The skin is not swelled as in erysipelas, nor the redness so circumscribed; the throat also is redder; the cervical glands are enlarged in both.

Epidemic Roseola.—An epidemic roseola, having such relation to scarlet fever as rötheln to measles, has but slender claim to autonomy. Mild cases of scarlet fever often begin with a finely-diffused redness shortly after some feeling of faintness or giddiness; an incubation of from three days to a week is observed; sometimes albuminuria occurs as an early symptom. The finely-diffused rash, enlarged cervical glands, and slight sore-throat, even with very little elevation of temperature, raise the suspicion of scarlet fever; should albuminuria follow, or any shreddy desquamation of the hands and feet, no uncertainty remains. Scarlet fever so modified often spreads and gives rise to the severer forms of the disease when it has been called only rose rash or roseola; the use of these terms without a distinctive qualification always leaves a doubt as to the completeness and safety of the diagnosis.

Erythema comes nearest to these cases in appearance, so near as often to be spoken of as recurrent scarlet fever or erysipelas, but there is no enlargement of the cervical glands in erythema, and so little fever that the temperature of the reddened skin is barely elevated above the normal. Since Fuller's *Exanthematologia* this kind of flush passes under different names of roseola, according to the variations in shape of the red patches, or the seasons of the year at which they occur.

Erythema nodosum is often preceded by slight fever for a day or two; this may reach 102°, but subsides as the red swellings appear; locally there is little or no elevation of temperature even when the tender part feels hot.

Exanthematous Roseola occurring in the course of other specific diseases is distinguished from the roseola which depends on nerve-irritation, caused, for example, by acrid ingesta, by the presence either of high fever, or of glandular enlargement, or of both, as when it precedes the true variolous eruption. During enteric fever this form of roseola may occur quite independently of the special lenticular rose-spots.

An eruption of this kind is not infrequent in the early stages of diphtheria, sometimes as a diffused rash limited to certain parts of the chest and body, or as discrete spots on the limbs and back of the hands and feet. Influenza, and some forms of catarrh, winter 'colds,' or summer diarrhœa as noticed by Bateman, may begin with punctiform roseola on the back, shoulders, and chest; the cervical glands are perceptibly enlarged, though there may be little fever. In these cases it is not the roseola, but the specific disease on which it depends, that might, without precautions, be communicated to others.

Syphilitic Roseola.—A special roseola marks the secondary stage of syphilis; in appearance it resembles the rash of measles; so does the *roseola ab ingestis* when produced by cubebs, but this has neither fever nor glandular enlargement.

The absence of fever from the roseola after vaccination refers this form of eruption, like that occurring from dentition, to the class of rashes from nerve-irritation. *Vaccinia* is itself an exanthem in the wider definition of the term, reproduced after a definite period of incubation by inoculating a special contagium. Wanting this character the different forms of herpes are excluded, though resulting from a general febrile disturbance; though inoculable, ecthyma and impetigo are local affections not belonging to the exanthemata. William Squire.

EXCITANTS (*excito*, I excite).—It seems hardly necessary to give any special consideration to this therapeutical class, as all that may be said on the subject ranges itself with greater propriety under the heading Stimulants. Stimulation is, in fact, a degree of excitement, and it is only when its effects are more vigorously pushed that we obtain that inebriation or exhilaration which is so commonly observed to follow the use of alcohol, ether, and the anæsthetic vapours. *See* Stimulants. Robert Farquharson.

EXCITING CAUSE. *See* Disease, Causes of.

EXCITO-MOTOR Disorders. *See* Reflex Disorders.

EXCORIATION (*ex*, from, and *corium*, the skin).—The superficial destruction of a portion of the skin or mucous membrane.

EXERCISE.—Definition.—In its widest and most correct signification, exercise is the setting in motion any active body; and when the term is used in a physiological connection, it may refer to the functional activity of any of the organs, whether muscular, nervous, nutritive, secretory, or reproductive. In this very comprehensive sense, the subject of Exercise includes a large portion both of hygiène and of therapeutics. The popular signification of Exercise is, however, much more limited than the preceding, having reference only to the muscles directly, and to the parts called into play through the same—especially the circulatory and respiratory systems.

Whether in its wider or in its narrower sense, exercise has several important relations to Medicine. 1. It is essential to the preservation of health (*see* Personal Health). 2. It has to be regarded as frequently associated with the causation of disease (*see* Disease, Causes of). 3. Exercise is a most rational and successful means of treatment in certain disorders and diseases (*see* Movement, Therapeutics of). 4. Exercise is often abused; and excessive indulgence in some forms of it gives rise to serious consequences. The present article will be devoted to the consideration of Exercise in the last-named aspect only; and the subject will be discussed according to the more limited and popular definition of the term.

Abuse of Exercise.—From the moment an infant is born until the end of life, exercise, duly apportioned to rest, is the normal state of existence; and whilst continued overstrain of any portion of the human machine is the forerunner of disease, so, on the other hand, is equally, if not more so, that want of exercise which induces wasting and degeneration.

Principles.—Dr. Parkes, in his *Practical Hygiene*, has given a very complete statement of the results of the investigations of himself and others on the changes effected by the stimulus of muscular exercise on the various organs and tissues of the body, from which he has drawn the following conclusions:—

'The main effect of exercise is to increase the oxidation of carbon, perhaps also of hydrogen. It also eliminates water from the body, and this action continues—as seen from Pettenkofer and Voit's experiments—for some time; after exercise the body is therefore poorer in water, especially of the blood; it increases the rapidity of circulation everywhere, as well as the pressure on the vessels, and therefore it causes in all organs a more rapid outflow of plasma and a more active absorption—in other words, a quicker renewal.

'In this way, also, it removes the product of their action which accumulates in organs; and restores the power of action to the various parts of the body. It increases the outflow of warmth from the body by increasing perspiration. It therefore strengthens all parts. It must be combined with increased supply both of nitrogen and carbon (the latter possibly in the form of fat), otherwise the absorption of oxygen, the molecular changes in the nitrogenous tissues, and the elimination of carbon, will be checked. There must also be an increased supply of salts, certainly of chloride of sodium, probably of potassium phosphate and chloride. There must be proper intervals of rest, or the store of oxygen, and of the material in the muscles, which is to be metamorphosed during contraction, cannot take place. The integrity and perfect freedom of action both of the heart and lungs is essential, otherwise neither absorption of oxygen, nor elimination of carbon, can go on, nor can the necessary increased supply of blood be supplied to the acting muscles without injury.'

The proper amount of exercise requisite for health is difficult to determine, in consequence of the varied constitutions of individuals. It may, however, be accepted that whilst in youth the great spirit of emulation tends to an overstrain of mind or body, so, as life advances, one or other or both are liable to be allowed to pass into a state of unhealthy inactivity.

Since the recent more general practice of gymnastics in this country, and the stimulus that has been given to aquatic exercises by our University competitions, great attention has been drawn to the effect of bodily exercise on health, and more especially with regard to the heart and lungs, these being the organs upon which its influence is most immediately exerted.

a. Prolonged and Excessive Exercise.—Of all exercises, rowing is the one which is generally accepted as the best variety to select if we are to endeavour by a consideration of its influence upon those who practise it to form an estimate of the effect of a continuous strain on the circulation and respiration; yet the difficulty of procuring trustworthy evidence on such a subject is extreme. Dr. Morgan, in his *University Oars*, by collecting the various experiences of nearly all the men who rowed in the University races from 1829 to 1869, has obtained about the most accurate testimony available in regard to one aspect of the subject. These men are unanimous in their belief that they experienced no injury from the great strain they underwent in their youth. But it must be borne in mind that they were the picked athletes of their colleges, men with large frames and full chests, typical specimens of health, capable of undergoing very prolonged exertion with but passing fatigue, and to whom no permanent injury could be anticipated, after careful training, from an exceptional display of strength. Such evidence affords no clue to the effect of the strain imposed on the heart by the two hundred or more of each University, who annually use the utmost exertion to belong to the chosen few, and many of whom, unguided in their violent efforts to achieve success, have in after-life to pay the penalty of allowing mere feeling or spirit of emulation to overrule their reason.

b. Exercise under Unnatural Conditions.—But it is not only the case that exercise which is excessive or too prolonged proves highly deleterious; even a moderate amount of exercise under unnatural conditions may prove equally harmful. Thus the young soldier of light frame, with irritable palpitating heart, who has broken down in his preliminary training, is a marked and good example of the early injurious effect of overstrain of the heart, under the impediment caused by tight clothing and accoutrements to the free expansion of his chest. When at rest he feels perfectly well, and has little or no sensation of throbbing in his chest. So soon, however, as he puts on his tunic and accoutrements, and begins his drill, throbbing occurs with more or less violence, accompanied with a feeling of oppression, and with difficulty of breathing, and this being followed by a sensation of faintness, sickness, or dizziness, he has to fall out of the ranks. At first the condition of the heart is one purely of functional disturbance, which, though rendering him unfit for the duties of a soldier, does not interfere with his gaining his livelihood as a civilian.

This functional derangement of the heart, which is readily shown by the dicrotism in the sphygmographic tracing of the radial pulse when auscultation can detect little or no change in the heart-sounds, is frequently found in those youths of delicate frame in our schools and colleges, who, 'breaking down' in attempting feats of strength or in the preliminary training, experience no ill-effects in the ordinary avocations of after-life from that overstrain of heart which, if neglected, would be apt to lead to graver forms of heart-disease.

Whether it be by sudden or prolonged violent exertion, by rowing, or by running, or by the many other severe exercises of the body entailed by labour or pleasure, there can be no doubt that the heart and lungs have at times an inordinate amount of strain forced upon them, which, in a state of health, or under favourable circumstances, they may reasonably be expected to bear with no more injury than temporary distress, and that this capability to bear strain is greatly enhanced by careful training.

It is customary for the healthy boy, however, owing to the character of his amusements, always to be in training, so far as his body is concerned, and with very little supervision he ought to suffer no harm from sudden and exceptional strains. But it is very different with men who have settled down into the real business of life, but who, during their nominal periods of rest from their daily labours, undertake violent exercises without any preliminary training, and thus throw such an unexpected strain on the heart and great blood-vessels, that instead of mere functional disturbance, as in early life, they sow the seeds of organic disease. Such being the case, how much more injurious must sudden overstrain be to a heart already weakened by disease? There is often found amongst men a great aversion to having their hearts examined, and when disease is discovered it is sometimes considered of questionable advantage to inform the sufferer of his condition; but this is a mistake, for from want of knowledge of his state he may, by unnecessary strain, rapidly aggravate it, and thus shorten a life which might otherwise have been much prolonged.

The purport of these observations is thus to point out that:—Firstly, whereas exercise is necessary to preserve our bodies in a proper state of healthy activity, its tendency, when carried to extremes, is to set up organic lesions. Secondly, that as in some athletic competitions a very great strain is thrown upon the thoracic organs, it is essential that no boys of delicate frame should be allowed to take part in them, or in the preliminary training, excepting under careful medical supervision. And, thirdly, that in manhood no violent competition should be undertaken, which would throw a great strain upon the thoracic organs, without their being previously examined and pronounced sound, nor until their full powers have been brought into play by careful preliminary training.

A. B. R. Myers.

EXFOLIATION (*ex*, from, and *folium*, a leaf).—The separation of a portion of dead bone or cartilage from the living tissue, in the form of layers (*see* Bone, Diseases of). The term is also applied to the separation of a false membrane which has been mistaken for the whole mucous lining of the bladder or uterus. *See* Bladder, Diseases of.

EXHAUSTION (*ex*, from, and *haurio*, I draw out).

Definition. — Exhaustion is a phenomenon which all irritable tissues can be made to manifest, and consists in a failure to respond to stimulation. Exhaustion of muscle and nerve is brought about by excessive, quickly repeated, or continuous stimulation. It is favoured by cutting off, or by an alteration in the quality of, the blood-supply; by previous insufficient exercise of function; by exposure to extremes of temperature; by an insufficient supply of oxygen; by an excessive supply of carbonic acid; and by exposure to certain toxic agents. These facts, which have been established by physiological experiments, are fully borne out by clinical experience.

Exhaustion may be *general* or *local*.

1. **General Exhaustion.**—General exhaustion is brought about by over-work, whether physical or mental, and especially by unremitting and monotonous duties which keep the same paths of action in a state of constant activity. It is not often, if ever, that any permanent harm is produced in a healthy man by mere physical labour, however great; but excessive mental labour, especially if it be monotonous, is certainly capable of permanently damaging the nervous tissues. When in addition to hard mental work, which is performed voluntarily, some constant stimulus, which cannot be arrested, unceasingly works upon the brain, exhaustion quickly results; as when, for example, a man who is harassed by trying to earn sufficient for his family meets with some shock to his nervous system (such as a railway accident, the sudden death of a dear relative, or a severe money loss) which haunts him like a spectre day and night, robs him of his rest, and deprives him of his appetite. General exhaustion is favoured by all conditions which give rise to anæmia or faulty nutrition, such as hæmorrhage, prolonged pyrexia, inadequate diet, persistent morbid discharges, or venereal excess; by the retention in the tissues of the products of their activity, which is favoured by working in a foul atmosphere, or by derangement of the excreting functions; by exposure to extremes of temperature; and by a previous condition of excessive slothfulness. General exhaustion may occasionally be suddenly induced by physical causes, such as a severe injury (collapse from shock), or psychical causes, such as fright.

Symptoms.—The symptoms of general exhaustion are:—1. Loss of sleeping power, persistent dreaming, talking in the sleep and somnambulism. The patient may wake in the morning feeling totally unrefreshed. 2. Incapacity for work, and inability to seriously apply the mind to one subject for any length of time. 3. Headache, and a feeling of oppression in the head. 4. Languor and general lassitude. 5. A rapid feeble pulse. 6. An anxious expression of face; and (as stated by Dr. George Johnson) a contracted and sluggish pupil. In addition to these we may get tremor, delirium, hypochondriasis, hysteria, epilepsy, chorea, mania, and general paralysis. Two instances have come within the writer's knowledge of transient hemiplegic symptoms having been induced by excessive application to literary work. The digestion is often deranged, and functional disturbance of the heart is common. Occasionally the urine is altered in quality, and may contain alkaline phosphates or sugar. More rarely it manifests excessive acidity.

2. **Local Exhaustion.**—Local exhaustion is the result of excessive local stimulation, and it is particularly liable to occur as a prominent symptom in patients who are suffering from general exhaustion. The loss of power in the rectum which results from the excessive use of purgatives; the failure of the uterus in cases of protracted labour; and the failure of the voluntary muscles which occurs in those professional ailments of which 'writer's cramp' is the type, may be taken as examples of local exhaustion.

Treatment.—In the treatment of exhaustion the main indications are to lighten the labour, and obtain rest. In cases of general exhaustion it is often advisable to administer narcotics, such as opium, hydrate of chloral, or bromide of potassium, and it will be generally found that, when once refreshing sleep has been established, the more aggravated symptoms will subside. Fresh air and a good diet are most necessary. Stimulants must be used with great caution, for it is clearly not desirable to goad the exhausted organs into further action, although it may be necessary to employ stimulants to give temporary power while the faculty of sleeping is being re-established. All causes of anæmia must be removed. When recovery is established, the patient must be encouraged to relieve the monotony of his life by some pursuit which should be, as it were, the complement of his ordinary occupation. Thus the head-worker should endeavour to amuse himself in his leisure hours by gentle out-door exercise, by music or painting, or by practising some handicraft. *See* Debility, and Fatigue.

G. V. Poore.

EXOMPHALOS (ἔξω, beyond, and ὀμφαλὸς, the navel).—A term applied to umbilical hernia. *See* Hernia.

EXOPHTHALMIC GOÎTRE (ἔξω, out, and ὀφθαλμὸς, the eye; and *goître*).—Synon.: Graves' Disease: Basedow's Disease; Fr. *Maladie de Graves, Goître exophthalmique*; Ger. *Glotzaugenkropf, Basedows'che Krankheit.*

Definition.—Enlargement with vascular turgescence of the thyroid gland, accompanied by protrusion of the eyeballs, breathlessness, palpitation, and anæmia.

Ætiology.—This disease is comparatively rare among men. It occurs most frequently in women between the ages of twenty and thirty, but is met with amongst older persons. Patients suffering from it often belong to the so-called nervous diathesis. Its occurrence is often preceded by menstrual disturbance and anæmia. Sometimes no exciting cause can be discovered, but in many cases it comes on after violent nervous excitement.

Symptoms.—Before exophthalmic goître makes its appearance, alterations in temper are frequently observed, the patient becoming irritable and depressed. Functional disturbances of the circulation and heart occur at frequent intervals, the heart palpitating, the face flushing, and a sensation of fulness being felt in the head, eyes, and throat. The palpitation increases, the eyes become prominent, and a visible swelling appears over the thyroid gland. The eyes are lustrous and projecting, and there is frequently a slight loss of co-ordination between their movements and those of the eyelids, so that when the eyes are quickly cast down the eyelids follow them so slowly that a white ring of sclerotic may be noticed between the iris and the lower margin of the upper eyelid. Usually there is no disturbance of vision. The exophthalmia is most marked during emotional excitement and at the menstrual period, and at these times the patient suffers from an increased feeling of fulness in the eyeballs. Sometimes the projection of the eyeballs is so great that the lids do not perfectly cover them, and inflammation and ulceration may consequently occur. The thyroid is generally unequally enlarged. Its size varies from time to time, increasing, like the protrusion of the eyeballs, with emotion. It is soft and elastic, and pulsates, so that it has sometimes been mistaken for aneurism. The palpitation of the heart is generally noticed before either the exophthalmos or enlargement of the thyroid, and is the first symptom to attract the patient's attention. It is increased by emotion or exertion; and the violent cardiac action frequently produces a prominence of the præcordial region. The cardiac pulsations are rapid and sometimes irregular. The cardiac sounds are loud; and a soft, systolic bellows-murmur is frequently audible at the base, and in the large arteries. The carotids are sometimes, but not always, dilated. The circulation appears to be rapid, the veins filling quickly when emptied, and pulsation being felt even in small arteries. The temperature is frequently high. There is a feeling of general debility. The digestion is sometimes normal, at other times the appetite is diminished or capricious, and diarrhœa may occur. The swelling of the neck may give rise to a feeling of difficulty of breathing; and the voice sometimes becomes altered and hoarse, or may be lost entirely. The course of the disease varies considerably; it may sometimes go on increasing for several months, then it becomes stationary for one or two years, and afterwards begins to decline. The temper improves, the appetite increases, and menstruation frequently is re-established. The palpitation, enlargement of the thyroid, and prominence of the eyes gradually diminish, although they rarely disappear completely. Death may occur from intercurrent disease, from organic cardiac lesions, or from gradual wasting. Danger is also said to arise from pressure on the trachea by the enlarged thyroid.

Pathology.—The protrusion of the eyeballs is due either to dilatation of the vessels in the orbit, or to contraction of the involuntary muscular fibres in the orbital membrane which covers the spheno-maxillary fissure, or possibly to both causes combined. The enlargement of the thyroid is due to dilatation of the vessels of the gland. After the disease has lasted some time, increased formation of tissue in the thyroid gland may occur. Palpitation of the heart is probably due to stimulation of the accelerating cardiac nerves; and this, as well as the alteration in the nerves of the orbit and thyroid, has been ascribed to disease of the lower cervical sympathetic ganglia, in which increased connective tissue and diminution of ganglionic cells have been observed.

Diagnosis.—When the three leading symptoms are present, it is impossible to confound exophthalmic goître with any other disease. The enlargement of the thyroid is distinguished in this disease from that of cystic goître by its greater elasticity, by its paroxysmal enlargement, and by its pulsation. The exophthalmos is distinguished from that due to disease of the orbit or cranium by being equal in both eyes, and by the absence of squint. It is distinguished from prominence due to cardiac disease by the lustrous appearance of the eye; from hydrophthalmia by the natural condition of the pupil; and from the prominence which may occur in myopia by the vision being natural, and by the paroxysmal increase of the prominence in exophthalmic goître.

Prognosis.—This must be guarded, the disease not being very amenable to treatment, and very rarely disappearing altogether, although after continuing for some years it may gradually improve.

Treatment.—The treatment of exophthalmic goître chiefly consists in securing fresh air, gentle exercise, the avoidance of the least fatigue or emotional disturbance, and careful diet. Iron is sometimes useful, the milder forms, such as the tartarated iron or citrate of iron and ammonia, being preferable to the more powerful preparations. Quinine, alone or in combination with digitalis—and perhaps with belladonna—often produces good results. Aloes and myrrh may be employed to keep the bowels open. Galvanism to the neck has sometimes been productive of benefit, one pole being placed in the nape of the neck and the other over the sides of the thyroid tumour. When the eyeballs are so prominent as to become liable to inflammation and ulceration, care must be taken, by means of a shade, to protect them from irritation; and if this should prove unavailing, the inflammation must be treated by appropriate remedies. T. Lauder Brunton.

EXOSTOSIS (ἔξω, out of, and ὀστέον, a bone).—A bony outgrowth from any part of the skeleton. *See* Bone, Diseases of.

EXPECTANT ATTENTION.—An important mental state. *See* Mesmerism.

EXPECTORANTS (*ex*, out of, and *pectus*, the chest).—Synon.: Fr. *Expectorants*; Ger. *Auswurfsbefördernde Mittel.*

Definition.—Medicines which facilitate the removal of secretions from the air-passages.

Enumeration. — The leading expectorants are:—(A) Ipecacuanha, Antimony, and Iodide of Potassium; Chlorides of Potassium, Sodium, and Ammonium; and Inhalation of Steam. (B) Squill, Senega, Benzoin, Benzoic Acid, Benzoate of Ammonia; Myrrh, Storax, Balsam of Tolu, Balsam of Peru, Ammoniacum, Galbanum, Assafœtida, Anise, Fennel, Larch Bark, Tar, Copaiba, Vapour of Chlorine, Iodine, Ammonia, Creasote, and Carbolic Acid. (C) Ammonia, Carbonate of Ammonia, Strychnia, Nux Vomica, and Belladonna.

Action.—The mode of action of expectorants is not well understood, and any explanation of it in the present state of our knowledge can only be regarded as provisional. Expectorants may be divided into two classes:—1. Those which modify the nature of the secretions from the respiratory passages; and, 2. those which modify the respiratory movements by which the secretions are expelled. In considering the mode of action of the first class it must be remembered that the secretions from the respiratory passages depend, like many other secretions, on two factors, the *direct* influence of the *nerves* upon the secreting structures, and the *amount of blood* supplied to them. Each of these two factors may be influenced to a different extent by various drugs. As has already been said, the exact action of each cannot be determined at present, but the first class of expectorants may be subdivided into two divisions which are distinguished in the foregoing enumeration as A and B. The division A rather diminish than increase the activity of the circulation, and are therefore called *sedative* expectorants. The division B somewhat increase the circulation, and are called *stimulating* expectorants. Those comprised under C stimulate the respiratory centre in the medulla oblongata, and increase the respiratory movements.

Uses.—Sedative expectorants (class A) are useful when there is congestion of the respiratory passages, with very scanty, tough expectoration, as in commencing bronchitis. In such circumstances, when dry râles are heard abundantly, with few or no moist râles, the patient often coughs until quite exhausted, bringing up scarcely anything. The administration of sedative expectorants renders the secretion from the respiratory passages more fluid, abundant, and easy to expectorate. When these expectorants do not succeed in ordinary doses, their action may be much assisted by the administration of a purgative, or, still better, by giving either ipecacuanha or tartar emetic in such a large dose as to produce sickness and vomiting. When the distress of the patient is great, the abstraction of a small quantity of blood by cupping or by venesection may give great relief. The inhalation of steam alone is also beneficial, and the air of the patient's chamber should be kept warm and moist. Stimulating expectorants (class B) do more harm than good when administered in the conditions just described, but are beneficial when the acute symptoms have passed off. When this is the case, but the expectoration is tough and somewhat scanty, squill is a useful expectorant; but when the expectoration is abundant, benzoin, balsams, or ammoniacum are preferable. In chronic bronchitis, inhalations of ammonia, chlorine, iodine, creasote, carbolic acid, or pine oil are useful. When the expectoration is fœtid, chlorine, iodine, and carbolic acid inhalations are best. The expectorants which act on the respiratory movements (class C) are useful in cases of debility, as they stimulate the respiratory nervous centre in the medulla oblongata, as well as assist the failing circulation. They may be advantageously combined with stimulating expectorants, such as squill or benzoin, according to the nature of the secretion.

T. Lauder Brunton.

EXPECTORATION (*ex*, out of, and *pectus*, the chest).

Definition.—This word, which strictly means the act of expelling anything from the chest, is usually applied to the matter so expelled, which is also called *sputum* or *phlegm*.

The Act of Expectoration.—The smaller bronchial tubes are kept free from obstruction by the action of ciliated epithelium. The area of the smaller tubes being greater than that of their trunks, the air passes more forcibly through the latter, and so tends, even in natural breathing, to carry speedily away any accumulated secretion. The forcible acts of coughing (*see* Cough) and 'hawking' increase the natural force and fulness of the expiratory effort, and clear the air-passages; the repeated closure of the glottis in coughing increases still further the expulsive effect, by causing the air to escape in sudden jerks. If, in consequence of laryngeal disease, the glottis cannot close, the act of expectoration becomes painful and difficult. Efforts at expectoration are also laboured and futile if, in consequence of emphysema or muscular weakness, the power to take a deep inspiration is lost.

Inability to expectorate is often the immediate cause of death, the 'suffocative catarrh' of the dying being another name for accumulation of phlegm, which the patient is powerless to remove. By teaching the patient 'how to expectorate,' by the administration of a timely stimulant or a quickly acting emetic, or by change of posture, life may in such a case be prolonged. Should the sufferer be allowed to get flurried, the breathing becomes more and more shallow, and deep inspiration and free expectoration are impossible. If, however, the patient can be induced to breathe calmly and deeply, to assume a more easy posture, and to swallow a solution of ammonia with ether, the breathing gradually becomes less shallow and rapid, air enters the deeper parts of the lung, and power is gained to evacuate the accumulated secretion. The act of expectoration is, as a rule, most easy in that posture in which respiration is most free. Sometimes, when the secretion comes mainly from one lung, the aid of gravitation may be called in to empty the obstructed tubes.

Characters and Varieties.—Before auscultation was practised, diagnosis was often based on the character of the expectoration, unwarrantable importance having been attached to the distinction between pus and mucus, on the assumption that pus was diagnostic of phthisis. At the present time we are apt to lose much by falling into the opposite error.

In health, the secretion from the mucous membrane of the air-tubes is a transparent, colourless, slightly glutinous liquid, like thin mucilage; it contains *mucin*, a varying quantity of saline matter, and water.

The saline matter is abundant in the transparent viscid expectoration, deficient in the opaque and less tenacious kind, least in that which is actually purulent.

The ordinary mucous secretion is increased in quantity and viscidity as a result of simple catarrhal inflammation of the bronchial membrane. When bronchitis has existed for some days, a change occurs in the character of the secretion;

Instead of being transparent and viscid, it becomes semi-transparent and then opaque, the colour changing to a yellow or greenish hue.

The sputum becomes frothy from the admixture of air; and rusty or prune-juice-coloured if the inflammatory action extends to the ultimate bronchial ramifications, and is of so intense a kind as to allow of oozing from the capillary vessels.

Fibrinous moulds of the bronchial tubes, or chalky masses consisting of inspissated and calcified cheesy matter, are not unfrequently expectorated.

The dark grey or blackish stain often seen in expectoration may be derived from carbon in the atmosphere; or, if it fade on the addition of nitric acid, it may be due to pulmonary pigment formed under slight irritation.

The expectoration may afford important aid in diagnosis, as may be illustrated by the following examples:—If a person with severe chest-complaint coughs frequently and spits only frothy salivary fluid, we may suspect pleurisy. If the fluid is glairy like white of egg, we may suspect bronchitis. If it has a rusty tinge and resembles thick gum-water coloured with blood, we are not likely to err in recording pneumonia. If there is a sudden gush of fœtid pus we may diagnose abscess in the lung or an empyema.

Purulent expectoration may occur in bronchitis as well as in phthisis, but if long-continued, and unaccompanied by distinct rhonchus, it almost always comes from a vomica.

In phthisis the sputum is at first salivary or frothy, the result of irritation; then viscous, indicative of more confirmed affection of the mucous membrane; and subsequently dotted and streaked with blood. Whitish opaque spots, giving a pearly aspect to the expectoration, next appear; these enlarge, become flocculent and ultimately nummular, being inspissated and moulded in a cavity. As the disease advances and involves both lungs, the expectoration is entirely purulent, and shortly before death is often surrounded with a pinkish halo. On placing under the microscope one of the small pearly points described, masses consisting of several air-cells choked with granules, or mere fragments of elastic tissue may occasionally be seen. By the addition of acetic acid the sputa may be rendered transparent, and the elastic tissue is then, if present, more certainly detected; but practically the experienced eye is the best guide in the selection of those small pin-head flocculi of expectoration, in which the microscopic particles of lung-tissue are to be detected.

The microscope may be also helpful by indicating, from the character of the cells, the part of the respiratory tract involved, and the degree of disease existing.

Treatment.—In treatment, much may be gained by study of the expectoration. The cough may often be relieved, and the dyspnœa and other symptoms removed, by effecting an alteration in the nature of the secretion.

If by the frothy character of the sputa congestive disorder is indicated, this may be met by the application of warm poultices, turpentine stupes, or hot flannels externally; and by such means as are calculated to reduce fever and irritability, namely, the administration of salines with antimony or aconite. If the expectoration is too viscid and glutinous for easy removal, lemon-juice, liquor potassæ, soda, or various inhalations give relief, by lessening the tenacity of the secretion; or the change from tenacious and transparent to opaque less adhesive secretion may be hastened by giving iodide of potassium with a few drops of antimonial wine.

When muco-purulent secretion is established and shows no sign of diminution, the use of senega and of the gum-resins is indicated; while benzoin, tolu, and copaiba are also of value. Acetic or tannic acid, given in small and frequently repeated doses, reduces the quantity of secretion.

When the combined glairy and muco-purulent condition of the expectoration and other symptoms give evidence of bronchitis of an established kind, associated with gout or abdominal torpor, a combination of calomel with antimony and guaiacum (as in Plummer's pill) is of the greatest service; but this treatment needs perseverance, discrimination, and watchfulness. The morbid surface may at the same time be medicated by the inhalation of tar, creasote, or oil of juniper, until, with the improvement of the general health, under cod liver oil and iron, the evil is entirely removed.

E. Symes Thompson.

EXPOSURE, Effects of.—Were the term 'exposure' to be taken in its widest significance, it might fairly assume to include a range of subjects only bounded by the limits of practical medicine. Infection naturally implies exposure to some contagious influence, poisonous gases, or malarious or other unhealthy emanations, bearing in their train a formidable sequence of ill results. Many of the disorders which impair our comfort and shorten our lives may, in short, be traced, in some degree, to exposure of some kind, to an excess of heat or of cold, to a variety of complicated reactions, arising, in whole or in part, from unnatural impressions made on the physiological processes of life by various external agencies. Any study of our subject, however, from this extended point of view, would clearly be out of place here, and effects of extreme elevation and depression of temperature will be fully considered elsewhere, so that exposure, in the sense in which it will be treated here, may be narrowed down to the results which ensue when persons of average constitution-power are submitted, for a longer or shorter time, to the influence of ordinary cold, or wet, or damp. Now, it is an old saying, that if five or six people, of either sex, suffer shipwreck, or are wet through, or excessively chilled by moist cold, each will probably suffer in some different way. One may altogether escape, and not experience inconvenience of any kind; a second may 'catch'—as the popular expression puts it—a sore throat, or a 'bad cold;' whilst a third may be seized with pneumonia, and a fourth with rheumatic fever.

Individual constitution or peculiarity of system partly explains these differences, and the familiar term of a 'weak point somewhere,' if not conveying much impression of scientific accuracy, is right so far in showing that the internal congestion caused by sudden contraction of cutaneous arterioles is most naturally directed to that organ whose vessels have been weakened by previous inflammation. If the patient, therefore, have previously suffered from tonsillitis, or bronchial congestion, or rheumatism, he will be predisposed to a recurrence of the same affection on a renewal of the exciting cause. If, again, from sedentary occupation and over-indulgence in nitrogenous food, his blood be overcharged with the products of retrograde metamorphosis or of imperfect assimilation, it only needs the closure of the eliminatory agency of the skin, to provoke the irritation of internal organs, and to induce an attack of gout or rheumatism, or an acute inflammation of kidneys or liver. The effects of exposure, even in this limited sense, are thus tolerably various both in extent and in degree, and may be studied on a large scale during our greater campaigns, and in lesser degree during the ordinary autumn manœuvres, when the weather happens to be unfavourable. Here, however, everything injurious is minimised by the healthy condition of the men, their good clothing and food, and the enforced regularity of habits, which prevent, in great measure, one of the most fertile causes of damage from exposure. It is now well known that nothing tends so seriously to impair the power of bearing either extreme of temperature as the excessive indulgence in strong drink; so that in treating anyone who has been exposed to the influence of cold and wet, we must not forget to take also into account the probable combination of the depressing effects of alcohol on the nervous system. Illustrations of this must be familiar to all, and we must all have met with numerous cases in which tramps or other persons with weakened bodily vigour have been brought into our hospitals, suffering from the effects of exposure in various degree.

Treatment.—In seeking to remedy the effects just described, it will be found that some of the cases will recover under the influence of warmth and good food, and the generally invigorating effects of careful nursing, whilst others, on the other hand, may succumb to the rapidly destructive tendencies of acute disease, or to the slower pathological processes of chronic lung or kidney degeneration. In the treatment, therefore, of such cases, we must not only add to the genial influences of home or hospital care such special drugs as the varied development of symptoms may require, but we must carefully take into account the occurrence of various serious or profoundly disorganising complicating causes. Thus if our patient has been found in an insensible state, we may reasonably suspect apoplexy or alcoholic or narcotic poisoning, and act accordingly. And only when all such suspicion is finally removed can we rest on our oars, and confine our attention to the immediate effects which follow exposure of the kind indicated above. Warmth, rest, and the regulated use of stimulants and food will now be indicated, and must be employed, with all the precautions suggested by the ordinary principles of therapeutics, and common sense.

Robert Farquharson.

EXSANGUINE (*ex*, without, and *sanguis*, blood).—Deprived more or less of blood—bloodless. Sometimes used synonymously with anæmic. *See* Anæmia.

EXTRA-UTERINE PREGNANCY.—*See* Pregnancy, Disorders of.

EXTRAVASATION (*extra*, without, and *vasa*, vessels).—Synon.: Fr. *Extravasation*; Ger. *Extravasat.*

Definition.—Extravasation is the escape of any of the fluids of the body, normal or abnormal, from the vessel, cavity, or canal that naturally contains it, and its diffusion into the surrounding tissues. The result of the effusion is also called an extravasation. Extravasation is the effect of rupture or perforation of the walls of a hollow organ, and may therefore be due to injury, to weakness of the parietal structures, to morbid conditions of the blood, or to increase of internal pressure. *See* Perforations and Ruptures.

The fluids most frequently found extravasated are blood, urine, bile, the contents of the alimentary canal, and certain constituents of morbid growths and fluid collections. The present observations will apply chiefly to extravasation of blood.

Extravasation of Blood.—The blood is peculiarly liable to extravasation, the vessels being universally distributed, much exposed to injury, and subject also to a constant pressure from within, which may be suddenly and greatly increased. Any portion of the circulatory system may give way: either the heart, as in fatty degeneration; the arteries, as in aneurism; the capillaries, as in pulmonary hæmorrhage; and the veins, as in the subcutaneous rupture of a varix.

When the effusion takes place into one of the serous sacs, it forms a collection of blood, variously named *hæmothorax*, *hæmatocele*, &c. If the subcutaneous, submucous, or other connective tissue, or the substance of an organ be invaded, the effused blood finds its way between the elementary textures, separating and compressing them; and there are formed what are described simply as *extravasations* of blood, or more definitely, according to their extent, as *parenchymatous* or *interstitial hæmorrhages* or *apoplexies*, *suffusions*, *ecchymoses*, *petechiæ*, or *vibices*. The seat of effusion appears of the colour of blood or its derivatives: but if much below the surface, the extravasation may not be visible for some days, after which time it appears of a bluish, greenish, or yellowish hue. The extravasated blood generally coagulates; the fibrin and albuminous substances are absorbed; and the products of decomposition of hæmoglobin, which are much more slowly removed, give rise to the discolourations. Much less frequently the effused blood becomes encapsuled, forming a *hæmatoma* or *blood-cyst*. In other cases it decomposes, and sets up gangrene around, or inflammation of the nature of severe cellulitis, which may end in ulceration of the surface. When the blood is forced between the coats of the perforated vessel, there is formed what is called a *dissecting aneurism*. If the extravasated blood escape from the surface of the skin or mucous membranes, one form of *hæmorrhage* or a *bloody flux* is the result.

The *symptoms* of extravasation of blood are so various that they cannot be stated in general terms. If extensive and affecting vital parts, the effusion may be attended by shock, syncope, or death; and it may lead to constitutional disturbance in many forms. Local pain is not common unless the extravasation be severe. The pressure of the effused blood upon the vessels, nerves, and muscles of the part, for example in a limb, may produce paralysis, disturbances of sensibility, œdema, loss of temperature, and even gangrene. As a rule, however, extravasations of blood are very limited in size, give rise of themselves to no serious symptoms, and readily disappear by absorption.

J. Mitchell Bruce.

EXTROVERSION (*extra*, outwards, and *verto*, I turn).—The eversion or turning inside-out of a part, as the eyelids or bladder. In the bladder, extroversion is associated with that condition, usually congenital, in which the anterior wall of this organ and of the abdomen are deficient, and its posterior wall projects through the opening thus formed.

EXUDATION (*exudo*, I sweat).—The process by which certain of the elements of the blood pass through the walls of the blood-vessels into the surrounding tissues, as in inflammation. It also indicates the products of the process when they are of a fibrinous or coagulable character. *See* Inflammation.

EXUDATION-CORPUSCLES.—The cells found in inflammatory products, whatever may be their origin. *See* Inflammation.

EYE, and its Appendages, Diseases of.—It will be most convenient to arrange the consideration of the diseases of the eye according to the anatomical order of the structures affected, namely:—I. Diseases of the Conjunctiva; II. Diseases of the Cornea; III. Diseases of the Sclerotic; IV. Diseases of the Iris; V. Diseases of the Crystalline Lens; VI. Glaucoma; VII. Diseases of the Optic Nerve and Retina; VIII. Diseases of the Choroid; IX. Diseases of the Vitreous Body; and, X. Diseases of the Eyelids.[1]

I. Diseases of the Conjunctiva.

1. *Inflammation.* Synon.: Conjunctivitis.—The conjunctiva is exceedingly liable to inflammation, and its inflammations are commonly arranged in groups, which are sufficiently distinct in their typical examples, but are not separated by any definite boundary lines.

In their earlier stages inflammations of the conjunctiva possess many characters in common. They are all attended by the four signs of inflammation—heat, redness, swelling, and pain; although both the heat and the swelling are usually kept within limits by the discharge, which is often free, sometimes profuse, at first mucous, afterwards muco-purulent or truly purulent in character. If, however, the exudation be of a firmer consistence than usual, it not only produces a superficial discharge, but distends the meshes of the sub-mucous tissue, elevates the conjunctiva from the sclerotic, and causes it to overlap the corneal margin as a swollen ridge, a condition which is known as *chemosis.* The redness depends, of course, on the degree of the congestion, which may or may not be sufficient to obliterate the intervascular meshes, and to produce an uniform colour; and the pain is not severe, except in cases of very dense sub-conjunctival swelling. From other forms of inflammation, that of the conjunctiva is distinguished by certain negative characters. Unless as a result of secondary changes, or as a mechanical effect of the presence of a film of turbid secretion, the transparency of the cornea is not affected, and the acuteness of vision is not impaired. The congestion is limited to the conjunctiva, and the distended vessels can be emptied for a moment by pressure through the lower lid, so as to reveal a glimpse of the white sclerotic underneath.

In mild cases conjunctivitis is an unimportant affection, but in its more severe forms it is attended by two distinct sources of danger. During its acute stage it may produce partial or complete necrosis of the cornea, leading to great impairment of sight and not seldom to blindness; and when chronic it often occasions great hypertrophy of the papillæ of the portion of the membrane which lines the lids. These papillæ may even become converted into shaggy or warty excrescences, which mechanically irritate the corneal surface, and cause the development of vessels beneath its epithelium. In time the papillæ dwindle, and the effusion round about them contracts, thus rendering the tarsal cartilage (especially that of the upper lids) incurved, and bringing the cilia to rest upon the surface of the eyeball. Great distress and permanent impairment of vision may be thus occasioned; and the progress of the contraction may be so slow as to deprive it of any manifest connection with the inflammation in which it had its origin.

The chief varieties of conjunctivitis are:—(*a*) *infantile*; (*b*) *simple* or *catarrhal*; (*c*) *contagious*; and (*d*) *diphtheritic.*

(*a*) *Infantile Conjunctivitis.* Synon.: *Ophthalmia neonatorum.*

Ætiology and Symptoms.—Infantile conjunctivitis is probably due, in most cases, to direct inoculation with vaginal secretion. It usually commences on or about the third day after birth, and passes rapidly into the purulent form. It is attended by considerable puffy swelling of the lids, and by profuse thick discharge, which soon dries upon the tarsal margins, and often causes them to cohere. If neglected or improperly treated, the disease often leads to sloughing of the cornea; but it may always be cured if it is seen while the cornea is still bright.

Treatment.—The treatment required is to wash away the discharge carefully and frequently; to apply an astringent lotion (the best is a solution of 2 grains of nitrate of silver to an ounce of distilled water) to the conjunctival surface every four hours, or less frequently when improvement is established; and to anoint the edges of the lids with simple ointment to prevent their agglutination. In cases of inherited syphilis mercurial inunction should be prescribed; the infant's food must be carefully regulated if it is brought up by hand, and if it is very feeble it may take a little cod-liver oil, combined in an emulsion with two-minim doses of liquor cinchonæ. Where the mother's milk fails, it is often desirable to obtain a wet-nurse; but the local treatment is that which is chiefly important, and upon which, in most cases, entire reliance may be placed.

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[1] *See* also Vision, Disorders of; Ophthalmoscope; and Ophthalmoscope in Medicine.

(*b*) *Simple* or *Catarrhal Conjunctivitis.*

Ætiology and Symptoms.—This form of conjunctivitis is usually due to exposure to cold or to some chemical or mechanical irritant. Its most distinctive character is that the discharge is chiefly mucous, and has not much tendency to become purulent.

Treatment.—In every case the surface of the eyeball, and the lining membrane of the lids, should be carefully examined for any foreign body which may be the cause of the trouble; and if such should be found and removed, there will seldom be need for further treatment. If there is no foreign body, the 2-grain solution of nitrate of silver may be placed within the conjunctival sac, by means of a quill or dropping bottle, every two or three hours, and speedy recovery will usually be the result. During the treatment the eyes should have functional rest, and should be sheltered from external cold, from dust, or from glare.

(*c*) *Contagious Conjunctivitis.* Synon:—Purulent Ophthalmia.

In this form the discharge rapidly assumes a purulent character. This may happen when the simple form is aggravated by the state of the patient or by accidental circumstances; or when the disease is produced by inoculation with the discharge from a similar case, or with contagious pus from the urethral or vaginal mucous membrane. The state of the patient which is most likely to promote the development of the contagious form is that in which the conjunctiva is beset with the granular semi-transparent bodies, formed by aggregations of lymph-corpuscles, which are known as 'sago-grains' or follicular granulations. These bodies are commonly present in the eyelids of persons (especially of young persons) who are crowded together under insanitary conditions of living, as in barracks, camps, or badly regulated schools; and their presence renders the conjunctivitis of simple irritation prone to assume a purulent character. It is impossible to say how soon the discharge of conjunctivitis becomes contagious, or capable of reproducing the disease in others; but its activity in this respect seems to bear some proportion to the intensity of the inflammation which produces it; and the activity of gonorrhœal pus is probably greater than that of any conjunctival product. In the more intense forms of purulent ophthalmia there is great swelling of the lids and of the ocular conjunctiva, early chemosis, and a tendency to speedy sloughing of the cornea; while the milder forms pass into the catarrhal by imperceptible gradations.

Treatment.—In the space available for the purpose in these pages, the treatment of contagious conjunctivitis cannot be described in detail. It mainly rests upon the action of local astringents, graduated in strength according to the severity and the stage of the disease. In the worst cases the eyelids must be everted, and the whole of the palpebral conjunctiva carefully touched with a stick composed of one part of nitrate of silver fused with four parts of nitrate of potash. The caustic should be neutralised by a drop or two of a solution of common salt, applied by means of a camel's-hair pencil, before the lid is suffered to return into contact with the cornea; and the cauterization must be done carefully and with a light hand, so that the resulting eschar may include only the epithelium; for if the basement membrane is destroyed, there will be danger of subsequent adhesions between the eyelids and eyeball. The cauterization should be repeated about every eight hours, or as soon as the eschar falls, and in the intervals, if the patient is awake, the conjunctiva should be gently syringed every hour with a weak alum lotion at a comfortable temperature. The tension of chemosis may be diminished by radial incisions, outwards from the corneal margin, carried nearly down to the sclerotic; the strength must be supported by good diet and tonics; and the nervous system calmed by anodynes. In milder cases the principle of treatment must be the same, but the local applications less severe; and in chronic cases the local applications must be continued, after apparent recovery, so long as any residual thickening, capable of undergoing eventual contraction, can be found lurking in the palpebral folds.

(*d*) *Diphtheritic Conjunctivitis.* This malady has chiefly been made known to us by the observations of German writers, and very few authentic instances, if any, have been recorded in this country. But it has from time to time prevailed extensively in Berlin, and might at any time make its appearance amongst ourselves.

Symptoms.—Diphtheritic conjunctivitis is attended with great heat and pain, and with very hard, brawny swelling of the eyelids; but its most characteristic symptom is the infiltration of the sub-conjunctival tissue by the so-called diphtheritic effusion, which does not form a pellicle upon the surface, but distends and fills the cavities of the areolar tissue. The result is to produce a pale, firm swelling of the conjunctiva, and a great tendency to rapid sloughing of the cornea. The subjects of the malady are mostly feeble and badly-fed children, and the cases are described as being almost hopeless unless early admitted into hospital.

Treatment.—The indications for treatment are chiefly to support the strength by suitable regimen; to apply ice or bags of freezing mixture to the lids during the hot stage; and to change the cold applications for hot ones as soon as the period of resolution, absorption, or repair can be said to have commenced. In the meantime iron and quinine should generally be administered internally.

2. *Episcleritis.*—An affection which is apparently but not really conjunctival, being situated in the tissue between the conjunctiva and the sclerotic, is that which has received the name of *episcleritis*, and which was formerly described as 'sclerotitis with inflammation of the insertion of a rectus muscle.'

Symptoms.—It appears as an elevated patch of congestion, gradually passing into the natural level and appearance of the parts, and seated on the ocular surface near the corneal margin, most frequently on the temporal side. On close examination, the congestion, with the exception of a few dilated vessels, is seen to be sub-conjunctival, and to be attendant upon a circumscribed but not sharply defined swelling or thickening, which is adherent to the sclerotic, and which presents, in the interstices between the blood-vessels, an appearance as if it consisted of some new deposit, generally of a yellowish tint, external to that membrane. The swelling is indolent, chronic, and in itself generally painless, although it is sometimes accompanied by severe neuralgia. The subjects are most frequently women, especially such as are anæmic or otherwise out of condition. Episcleritis may last for months with little change, and it seems to be harmless as regards the other structures of the eye.

Treatment.—The writer has found episcleritis resist all medication except the internal administration of mercury, to which it will often yield in the course of a short time. The best preparation is the perchloride, in doses not exceeding $\frac{1}{16}$ of a grain, which may usually be combined with five or ten minims of the tincture of perchloride of iron. At the same time it is often desirable to sprinkle a little dry calomel over the swelling once in twenty-four hours; but this application is less important than the internal treatment, and should not be continued unless it is soon and distinctly beneficial.

3. *Hæmorrhage.*—Effusion of blood beneath the conjunctiva may occur spontaneously, but is generally traceable either to a direct injury or to violent exertion. Thus it may follow slight blows upon the eyeball, as from a twig or switch; or may be produced by a paroxysm of coughing, especially in pertussis; or may occur from the rupture of a vessel during parturition, or upon lifting a heavy weight. It is always unsightly. When traceable to any of the foregoing causes, the hæmorrhage is usually a matter of no moment; but when it happens during the night in young people, it should lead to a suspicion of nocturnal epilepsy, which has often been first discovered by its means. Moreover, in advanced life, more especially when occurring without adequate cause, it may point to arterial brittleness, of a kind which may indicate danger of a like hæmorrhage within the cranium. On these grounds it is a symptom which always calls for full inquiry into its causes, and which may sometimes afford useful warning of impending danger.

Treatment.—Absorption may be promoted by covering the closed lids by a compress moistened with a lotion of spirit and water, or of tincture of arnica and water if an appearance of more decided medication is desired.

II. Diseases of the Cornea.—Diseases of the cornea, as already indicated, are often secondary to those of the conjunctiva, and may arise in their course as complications.

1. *Ulceration.*

Ætiology and Symptoms.—To the present group belong all the corneal ulcerations of purulent ophthalmia, whether infantile or of a later period of life; and also the forms of corneal ulcer which are produced by the friction of eyelids rendered rough by inflammation, or by the friction of eyelashes which have been turned inwards by distortion of the tarsal cartilage. When ulceration of the cornea occurs in the course of conjunctivitis, it at once invests the latter malady with a highly formidable character. The corneal tissue, once destroyed by ulceration, is not reproduced in its original transparency, but only as a more or less dense and opaque white cicatrix, which is at the same time disfiguring to the appearance and an impediment to vision. If the ulcer should perforate, the iris almost necessarily becomes adherent to the cicatrix; and if the loss of substance is of large superficial extent, the resulting cicatrix is often thin and feeble, so that it is rendered prominent by the pressure within the eye, producing the condition which has been called 'staphyloma,' and gradually elevating and distorting the surrounding portions of clear cornea. The first effect of the healing of a corneal ulcer is generally to flatten the natural curvature of the membrane; but the secondary effect, if the cicatrix becomes prominent, may be to modify this curvature in various ways. Hence it follows, even when a cicatrix of the cornea is surrounded by a still transparent annulus, behind which an artificial pupil may easily be made by the excision of a portion of the iris, that the surgeon cannot predict with any certainty the quality of the vision which will be obtained, unless he is able, before operating, to determine the state of the corneal curvature. This is only possible when the margin of the pupil is so far free that it can be dilated with atropine sufficiently to render the fundus of the eye visible with the ophthalmoscope. When this can be done, any portion of cornea through which a clear view of the retinal vessels can be obtained by the surgeon will also afford clear vision of external objects to the patient; but, if no such place can be discovered, a very cautious opinion should be given with regard to the degree of benefit which may be hoped for from an operation.

Treatment.—The extreme importance of the cornea to the visual function renders it necessary that its integrity should be guarded with the greatest possible care. In any case of conjunctivitis, of even moderate severity, the cornea should be watched from day to day, and any appearance of turbidity about its central portion, or of elevation or irregularity of the epithelium at its margin, should lead to a reconsideration of the treatment which is being pursued. The former of these conditions is the ordinary precursor of sloughing ulcer or necrosis; the latter, of the extension to the cornea of an inflammatory process.

The general principles which govern the treatment of sloughing ulcer are, that the eye should be kept under the influence of eserine, which has a marked effect in checking the extension of ulceration by arresting the migration of white corpuscles; that any astringents which may be applied to the conjunctiva should be prevented from coming into contact with the cornea; that strength should be supported, pain relieved, and local nutrition stimulated by hot applications. When the ulcer continues to spread, its progress may often be arrested by diminishing the tension of the globe by the evacuation of the aqueous humour; and this may be accomplished either by repeated paracentesis at the corneal margin, or by Saemisch's method of cutting through the base of the ulcer, and reopening the incision daily until a process of repair is well established, or by the performance of iridectomy. Of these three courses, the last-named is the most generally applicable. It not only produces the immediate effect which is desired, but it has also the incidental advantage of establishing an artificial pupil at the side of the cicatrix.

The application of eserine is best effected by using a solution of the neutral sulphate, of the strength of four grains to the ounce of distilled water; and a drop of this solution may be placed within the conjunctival sac twice or thrice daily.

The sloughing ulcers of the cornea which arise from causes other than conjunctivitis, as injury, or failure of nutrition, must be treated upon the same principles which have already been laid down. There are, however, inflammatory ulcers which require the use of local applications of a stimulating kind, among which dry calomel and other mercurials hold a prominent place. Such ulcers have usually a leash of vessels running from the corneal margin, and are often obstinately recurrent; whence they are known as 'recurrent vascular ulcers.' They are usually connected with some manifest systemic derangement, and are often attended by photophobia. They leave scars upon the cornea, of a size and opacity proportionate to their extent and depth; and on this account it is desirable, whatever constitutional treatment may be required, to heal the ulcers themselves as speedily as possible, by the aid of local applications. In the early stages of the ulceration, eserine should be used; but afterwards either dry calomel or an ointment containing from ten to thirty grains to the ounce of the precipitated yellow oxide of mercury, which may be thrown down by any alkali from a solution of the perchloride. This ointment was introduced into practice by Dr. Pagenstecher, of Wiesbaden, and is often called by his name. In very obstinate cases Mr. Critchett recommends setons in the temporal regions; but the operation of iridectomy will often afford a still more efficacious remedy. Where there is much photophobia, the use of eserine is especially indicated, because, in addition to its action above mentioned, it produces contraction of the pupil, and thus gives comfort by lessening the quantity of light which is admitted into the eye. If the photophobia is very severe or intractable, it is often beneficial to divide the orbicularis muscle freely at the outer canthus, so as to diminish the pressure which is caused by its spasmodic contraction, and which sometimes seems to be a chief cause of the irritability. After such an incision, a cold compress should be applied, and the patient kept in the dark for a few hours, after which there will often be a marked alleviation of this distressing symptom, and a greatly increased general amenability to treatment.

2. *Inflammation.* Synon.: Keratitis.—Inflammation of the cornea presents three distinct types, the *suppurative*, the *vascular* and the *interstitial.*

(*a*) *Suppurative keratitis.* Suppurative inflammation or abscess of the cornea seems to be essentially a phlegmon or boil of the corneal tissue, a portion of which dies, and is cast off in the form of a slough.

Symptoms.—The abscess commences as a very tender grey spot in the cornea, surrounded by a zone of turbidity, and accompanied by a good deal of ciliary neuralgia, as well as by a variable degree of lachrymation, conjunctival congestion, and intolerance of light. Under the influence of atropine, hot fomentations, and such constitutional treatment as the state of the patient may demand, the threatened suppuration is sometimes averted, and the turbidity clears away. More commonly pus is formed, and makes its way either externally, leaving an ordinary ulcer; or internally, producing the condition called *hypopyon*, in which there is pus in the anterior chamber. Sometimes it separates the corneal laminæ to a considerable extent before perforating them, and is then called *onyx*, from a fanciful resemblance to the lunula at the base of a finger-nail.

Treatment.—When suppuration is no longer doubtful, the best practice is to evacuate the abscess by a puncture from within, by thrusting a cutting needle into the anterior chamber near the corneal margin, and then causing its point to penetrate the cavity of the abscess. The mingled pus and aqueous humour will escape as the needle is withdrawn, and its wound of entrance may be reopened once or twice daily by a probe, so as to insure the complete removal of all inflammatory products, until the healing process has made some way. If the abscess has burst internally before the case is seen, atropine should be applied without delay. If the pupil dilates fully, and the quantity of pus in the anterior chamber is but small, the case may be left to the *vis medicatrix naturæ*, care being taken to enforce rest and to exclude noxious influences. If the quantity of pus is large, it should be let out by paracentesis; and if the atropine reveals adhesions of the iris, iredectomy should at once be performed. An abscess which has burst externally leaves simply an ulcer, generally with a disposition to heal readily, and requiring only such treatment as has already been described.

(*b*) *Vascular Keratitis.* Vascular inflammation of the cornea is often a very severe and protracted malady, which usually leaves behind permanent opacity and impairment of sight.

Symptoms.—It commences, in typical cases, by the formation of two crescent-shaped patches of vascularity, one at the upper and the other at the lower portion of the cornea. The patches are formed by the development on the corneal surface of innumerable fine blood-vessels, so closely packed together that the interstices which separate them are scarcely discernible by the naked eye, and the affected parts present an uniform aspect of vivid redness. The crescents are somewhat elevated above the general corneal surface, and each crescent is bordered, along its concave or advancing edge, by a line of precursory epithelial turbidity. At the same time that the crescents increase in size, the borders of precursory turbidity are pushed before them; until at first these, and afterwards the crescents them selves, may meet and coalesce on the horizontal diameter of the cornea, so that its whole surface may become uniformly red. When this stage is reached, vision is almost abolished, but there may still be much intolerance of light. The corneal tissue is softened, and its margin is surrounded by a zone of sclerotic vascularity, which is visible through the congestion of the conjunctiva. As the inflammation subsides the vascular crescents slowly recede from the centre of the cornea towards its circumference, and finally disappear, leaving behind them a dense opacity of an extremely obstinate character. A severe case of vascular keratitis generally affects both eyes, and threatens a long period of actual blindness, followed by a long period of very imperfect vision. The worst examples of the malady are those which have been treated at the outset by astringent or irritating applications; and, even in the slighter forms, the malady is nearly always obstinate and protracted. As long, however, as the march of the vascular crescents, or their precursory turbidity, has not encroached upon the portion of cornea in front of the pupil, so long vision is not seriously jeopardised.

Treatment.—The great object of treatment is to arrest the new vascular development at a comparatively early stage; and for this purpose it is necessary to have recourse to eserine and sedatives locally, and to such constitutional treatment as the general condition may require. A solution of two grains of the neutral sulphate of eserine to an ounce of distilled water should be dropped into the eye twice daily, and the closed lids should be frequently fomented with hot poppy decoction, or with cold solution of extract of opium in water, according as one or the other temperature is the more agreeable to the feelings of the patient. Apart from any special indication, the medicines most generally useful are those which appear to influence local nutrition through the central nervous system, such as the iodide and bromide of potassium, and the sulphate of quinine. These, if they are likely to exert a beneficial effect, generally do so speedily; and if the malady should be rapidly extending, it is always prudent to reconsider the prescription without much loss of time. In severe cases, especially when the lids are somewhat tumid and there is much photophobia, a leech may often be applied with advantage, usually over the temporal muscle, close to the outer margin of the orbit, or a little blood may be taken more rapidly, by means of Heurteloup's artificial leech; and when, notwithstanding treatment, the malady pursues its course unchecked, a large iridectomy should be made without undue delay. The operation not only tends to arrest the vascular formation, but it also leaves a lateral pupil through which good sight may often be obtained long before the transparency of the central parts of the cornea is restored.

Development of vessels upon the cornea.—It is necessary carefully to distinguish vascular keratitis, properly so called, from that development of vessels upon the cornea which may occur in connection with the cicatrisation of ulcers, or in consequence of the friction of lids left granular by conjunctivitis. In both these forms the new vessels are arborescent and irregular in their distribution, instead of being closely packed together: and they are not attended by the pink zone of circum-corneal congestion, which is never absent in true corneal inflammation.

The vessels which attend the formation of cicatrices generally dwindle in course of time; while those produced by granular lids, and which, when they are very abundant and closely set, constitute the condition called *pannus*, will often disappear without direct treatment if the state of the lids themselves can be favourably modified by the application of astringents. In many cases the vascular network of pannus will be comparatively absent from the lower third of the cornea, so that sight may be much improved by an artificial pupil made in a downward direction. When pannus covers the whole cornea with a close vascular network, so that sight is almost destroyed, and when it resists milder treatment, it may sometimes be cured by inoculation with the discharge of infantile purulent ophthalmia. The pus is inserted between the lids, and the artificial malady suffered to run its course unchecked, except by cleanliness and frequent bathing. When the discharge has ceased, the cornea will often clear in a surprising manner, and its abnormally vascular state protects it, to a very great degree, against the risk of sloughing. Still, this risk is by no means absent, and the treatment by inoculation should be regarded only as a last resource.

(c) *Interstitial Keratitis.* This is a chronic malady which is seen chiefly, or perhaps exclusively, in the subjects of inherited syphilis, who possess the peculiar teeth and *facies* which Mr. Hutchinson has shown to be characteristic of their inheritance. The disease was long described as a variety of 'strumous ophthalmia;' and, although the late Sir William Wilde pointed out how frequently it was associated with deafness, and also laid stress upon the value of perchloride of mercury in its treatment, its syphilitic character seems to have been first suspected by Mr. Hutchinson, who, having once obtained the clue, followed it with characteristic diligence until he arrived at a conclusive demonstration of the accuracy of his suspicion.

Symptoms.—Interstitial keratitis commences as a slight cloudiness of the central portion of the cornea, with some roughening or irregularity of the epithelium. It extends from the centre towards the margin, and is liable to be attended, in different cases and at different stages of its course, by variable degrees of ciliary and corneal congestion, and intolerance of light. If neglected, or if treated by irritants, it is liable to assume the characters of vascular keratitis, and also to extend to the iris, in such instances often doing irreparable mischief. It is most common during childhood, but its appearance may be delayed until adolescence, or even until adult age. It attacks both eyes, one commonly somewhat later than the other, and its course is often protracted over several months. When severe, it leaves some residual cloudiness of the cornea, and, even when mild, it is doubtful whether the cornea ever entirely regains the transparency of health. Still, when a case is seen and judiciously treated early, the prognosis may generally be a favourable one.

TREATMENT.—The treatment consists primarily in the avoidance of all irritants; the use of eserine and local sedatives; and the administration of perchloride of mercury, or of iodide of potassium, with or without iron or cod-liver oil. When they are not contra-indicated by any special circumstances, the perchloride of mercury and the oil are the remedies on which the greatest reliance may be placed. The earliest indications of photophobia, showing, as they do, that light is acting as an irritant, should be met by continement to an almost darkened room, and by frequent bathing of the closed lids with cold water; but in fine weather daily exercise should be taken in the open air, the eyes being covered for the time with a black silk bandage and compresses of carded wool, so as to exclude light entirely. As soon as photophobia subsides, these precautions may be left aside—the eserine and mercury being still continued, at least until the acute stage of the malady has entirely passed away. After this the absorption of residual opacity may be promoted by the application, once daily, of a morsel of an ointment containing a small quantity (about ten grains to an ounce) of the precipitated yellow oxide of mercury.

In cases which have been neglected, or aggravated by irritants in their early stages, and in which the phenomena of ordinary vascular keratitis become grafted upon the interstitial, it is generally desirable to perform iridectomy with as little delay as possible.

3. *Arcus Senilis.*—The condition thus named (although the adjective is not always appropriate) is fully described elsewhere. (*See* ARCUS SENILIS.) It may be distinguished from the peripheral zones of opacity, which are sometimes left after the subsidence of certain forms of keratitis, by the circumstance that arcus never extends quite to the margin of the cornea, but is always surrounded by an annulus of transparent tissue.

Besides the foregoing, there are a few other forms of corneal disease, of comparatively rare occurrence, which it would be beyond the limits of these pages to describe, but which must be treated on the same general principles; and there is also the malformation known as 'conical cornea,' which falls wholly within the domain of surgery.

III. Diseases of the Sclerotic.—Diseases of the sclerotic, which were once regarded as a numerous and important group, have been reduced by recent investigations to comparatively insignificant proportions.

Inflammation. —SYNON.: — Sclerotitis. — Excepting in a narrow annulus immediately around the cornea, the sclerotic is almost extra-vascular; and any real inflammation of its structure is almost confined to this particular region, where it seldom occurs excepting as a complication, or as a part of some of the more severe forms of iritis or keratitis, especially when either of these affections extends to the ciliary body. In such cases we often see the sclerotic undergo inflammatory softening, as a result of which the ciliary region may be much altered in shape, yielding to the distension of the eyeball and to the traction of the recti muscles, and becoming distinctly elongated. Occasionally the sclerotic may be so much softened and thinned as to bulge into irregular prominences around the cornea, generally under the upper lid; and this condition is described as *sclerotic staphyloma.*

TREATMENT.—The inflammations thus arising call for no other treatment than that which is demanded by the more important inflammations of the cornea, the iris, or the ciliary body, with which they are associated; except that any evidence of yielding of the sclerotic would be a reason in itself for the performance of iridectomy, in order to preserve the shape of the eyeball by diminishing its tension. It was once believed that the sclerotic, in its character of a fibrous membrane, was especially prone to gouty or rheumatic inflammation; and it is perhaps true, though certainly not proven, that the tendency of iritis or of keratitis to spread to the anterior sclerotic zone is more marked in persons of gouty or rheumatic diathesis than in others. The possibility is at any rate sufficient to require, in all these cases, an investigation of the tendency to lithic acid formation, and the use of appropriate remedies when this tendency is discovered. But a large proportion of the examples of supposed gouty or rheumatic ophthalmia are nothing more than cases of the sub-acute or remittent form of glaucoma; and the pain associated with them is not really rheumatic but simply tensive. Vision has been irretrievably lost, in hundreds of instances, because a belief in the rheumatic character of these affections has interfered with the timely performance of iridectomy; and the proposal to adopt the epithet 'rheumatic,' in any form of eye-disease, is one which should be scrutinised very closely before it is accepted as a guide to practice.

IV. Diseases of the Iris.—In so far as they come into the province of the physician, diseases of the iris are not numerous, and are almost limited to the varieties of inflammation of that membrane.

1. *Inflammation.* SYNON.: Iritis.—Iritis may be classified according to its actual or supposed causes, as rheumatic or syphilitic; or according to the nature of the morbid process, as *plastic*, *serous*, or *suppurative.* The former classification must often rest upon very slender grounds, and the latter has the great advantage of expressing facts rather than inferences.

(*a*) *Plastic Iritis.* SYMPTOMS.—In plastic iritis the first symptom is usually some loss of the natural lustre of the surface of the iris, and of the clear definition of its fibres, together with some damping or alteration of its colour. These changes are probably always due to turbidity of the aqueous humour, and they may be imitated more or less closely by turbidity of the cornea, and especially by disturbance of its epithelium. In iritis, however, they are associated with a diminished range and quickness of pupillary variation under variations of light; and, in a short time, with the effusion of plastic lymph, by which the margin of the pupil becomes tied down, here and there, to the surface of the anterior capsule of the crystalline lens. At the same time there is usually some congestion of the conjunctiva, and of the zone of fine vessels immediately around the cornea in the sclerotic. There is frequently more or less pain, especially towards night, but this is a very uncertain symptom. In severe cases, and especially in such as are clearly syphilitic in their character, the quantity of effused lymph may be very considerable, so as quite to cover the pupil, while in mild cases it is only sufficient to fasten down the margin here and there. Iritis is sometimes a very insidious and seemingly slight affection, the real gravity and importance of which may be wholly overlooked by the patient.

Treatment.—The first principle of treatment is to prevent the formation of adhesions, or to break them if they have been formed; and for this purpose our main reliance must be placed upon the instillation of atropine. The anatomical structure of the eye is such that a moderately contracted pupil is in contact with the lens-surface, while a fully dilated pupil is separated from it by a film of aqueous humour. Hence, as long as the pupil is contracted, any lymph which is effused tends to the immediate formation of adhesions; while, as soon as the pupil is dilated, the lymph diffuses itself harmlessly in the surrounding fluid, and no adhesions are produced. In ordinary circumstances, and in cases of only ordinary severity, the iritis then runs its course without inflicting any permanent injury, and vision is completely restored as soon as resolution has taken place. When, on the contrary, the pupil cannot be dilated, the lymph deposited in the area of the pupil forms an impediment to vision; and the adhesions themselves tend to render the iritis a recurrent affection, which is apt to return again and again until the eye is disorganised and destroyed.

The first principle of treatment is, therefore, to produce and maintain dilatation of the pupil; and for this purpose it is necessary to use a watery solution of a salt of atropine. The neutral sulphate is the one best adapted for the purpose, and it should generally be of the strength of four grains to the ounce of distilled water. The pharmacopœial solution of atropia, which contains spirit, should be avoided on account of its irritating action. Of the pure watery solution, a drop should be carefully placed within the lids by a dropping-tube or quill, repeated in five minutes, and again in another five minutes, and this threefold application should be repeated three times a day. A mydriatic agent still more powerful and more rapid in its action than atropine has lately been introduced into practice in *duboisin*, the active principle of an Australian shrub, Duboisia myoporoides. Duboisin should be used in a watery solution, of the strength of four grains to the ounce; and it is said to have less tendency than atropine to produce local irritation. If the pupil can be fully dilated in twenty-four hours, no other treatment will be necessary than to maintain the dilatation by using atropine less frequently, and to protect the eye from being injured by exertion, or by exposure to great variations of temperature or of light. If, on the contrary, after the use of atropine for twenty-four hours, the pupil either remains contracted or dilates irregularly, showing that it is bound down here and there, it is necessary to have recourse to mercury without further delay, and to use one of the preparations, such as blue pill or calomel, with which the effect of the medicine upon the system can be rapidly secured. There is never any occasion to carry the effect of the mercury farther than to the formation of a slight line upon the gums; and, in most cases, as soon as this line is perceptible, a notable amelioration of the eye-symptoms will be observed. It is desirable, however, that this degree of mercurial influence should be reached quickly, in order to cut short the disease as soon as possible; and when it has been reached, it will usually require to be maintained, for some days at least, by the administration of smaller and less frequent doses. In favourable cases, under the combined influence of atropine and mercury, the effused lymph will be absorbed, the adhesions broken through, and the eye restored to its original condition. In those of a less favourable character the inflammation will, indeed, subside; but the adhesions will remain, and the pupil will be left permanently more or less crippled and distorted. Whether or not sight will be impaired will chiefly depend upon whether the effused lymph has formed a film or membrane across the pupillary opening. In the worst cases, notwithstanding treatment, the inflammation may extend to the ciliary body and choroid, and may produce functional destruction of the eye. This scarcely happens except when the iritis has been of great original severity, and when it has been neglected, or aggravated by irritants, in its early stages. Even the suspicion of iritis should absolutely preclude the use of the astringent applications on which we have mainly to rely in the treatment of the inflammations of the conjunctiva.

If an iritis is not seen until it has been three or four days in existence, so that the adhesions have had time to acquire a certain degree of firmness, it is not desirable to wait twenty-four hours before having recourse to mercury. The mineral should be given without further delay, so that it may be abandoned if atropine should dilate the pupil, and may be pushed if dilatation cannot be produced.

While the atropine, or atropine and mercury, are being employed, the remainder of the treatment must be governed by general considerations. Rest of the other eye must be strictly enforced; local depletion may be practised whenever the congestion is considerable in degree; and such a regimen and mode of life must be prescribed as the patient can bear. Unless there is photophobia, it is seldom or never necessary to exclude light altogether from the eye; and, when photophobia is present, it is better to apply a protective bandage than to keep the patient in a dark room. The latter practically excludes him from cheerful companionship, and leaves him to dwell upon his troubles in darkness and solitude. Pain, if present, should always be subdued, either by combining a sufficient dose of opium with the mercury, or by the subcutaneous injection of a solution of morphia. However the anodyne is administered, provision should be made for repeating it sufficiently often to produce and maintain the desired effect.

When recovery takes place leaving adhesions, these will, in the majority of cases, lead to a second attack of iritis, and this is almost always the predecessor of regular recurrence. In a few cases, however, the second attack does not follow; but, whenever it occurs, the tendency to future mischief should be stopped by surgical means, either by the detachment of the adhesions or by the performance of iridectomy.

(*b*) *Serous Iritis.*—The serous form of iritis differs from the plastic in the greater quantity and the more liquid condition of the effusion, which does not form adhesions, but distends the eyeball and compresses its contained structures. In a well-marked case the pupil is contracted and insensible to atropine (which in all probability is not absorbed); the aqueous humour is turbid; the iris is pushed back and its anterior surface appears concave; vision is greatly impaired; and the eyeball is perceptibly hardened to the touch.

TREATMENT.—Until the distension is relieved, no remedies will be effectual; and, when it is relieved, they generally cease to be needed. The treatment should be either by frequently repeated paracentesis of the anterior chamber or by a large iridectomy, and the latter is generally to be preferred. Serous iritis occurs chiefly in persons of unhealthy or broken-down constitution; which may perhaps account for the unorganizable character of its products. As soon as the distension of the eyeball is relieved, the pupil is readily dilated, and the iritis soon subsides.

(*c*) *Suppurative Iritis.*—In a small number of cases iritis assumes from the first a suppurative character, and leads to the formation of pus in the anterior chamber.

TREATMENT.—Such a condition calls for atropine; for stimulating and tonic medicines rather than for mercury; and for the evacuation of the pus by paracentesis if it is considerable in quantity, or if its presence appears to be a source of increased irritation.

2. *Inflammation of the ciliary body and choroid.* SYNON.: Cyclitis; Irido-choroiditis.—In some instances, which fortunately are not numerous, iritis is not confined to the membrane in which it originates, but spreads backwards to the ciliary body and the choroid. The most marked examples are those in which the original inflammation has been excited by morbid changes, resulting sometimes from disease, but more frequently from injury, in the opposite eye; and these cases are called *sympathetic ophthalmia.* They have been abundantly shown to depend upon the propagation of peripheral irritation through a nervous centre, and they point very clearly to the presence of some central nerve-irritation, or functional failure, as the essential point of difference between the iritis which dies out as a localised affection, and that which spreads by continuity to the deeper parts of the eye. However occasioned, the issue of declared irido-cyclitis or irido-choroiditis is generally disastrous; for the inflammation is always of a plastic character, and the effused lymph is scarcely ever absorbed in time, or with sufficient completeness, to prevent its contraction from inflicting profound injury upon the visual apparatus. The perceptive layer of the retina is not only in contact with the choroid, but the rods and cones derive the materials of their nutrition from the chorio-capillaris; and hence, as regards these delicate structures, an inflammation of the choroid, upon which they are directly dependent, is of far greater importance than an inflammation of the retina itself, which may be limited to the connective tissue of the fibre-layer, and may leave the percipient elements almost unaffected.

SYMPTOMS.—The first sign of the extension backwards of iritis is usually furnished by tenderness of the ciliary zone, so that this region feels acutely the slightest touch of a probe, or of the end of a rolled paper spill, which is a more delicate instrument for testing the sensibility of the ocular surface. At the same time there is always a greater degree of impairment of vision than the iritis alone will explain, together with increased general congestion of the eye, and, in many cases, with an appearance of visible vessels on the iris.

TREATMENT.—The treatment to be pursued does not differ materially from that which is required by the more severe forms of simple iritis; and consists of depletion from the temple, generally by means of Heurteloup's leech; the application of atropine; the administration of mercury, both internally and by inunction upon the brow; the control of pain; and the maintenance of strength. In sympathetic cases, the eye in which the mischief originated should be removed, even although the usefulness of this proceeding is somewhat doubtful when once the secondary affection is established. It is often necessary carefully to continue the use of mercury for a long period, generally in the form of small doses of the perchloride combined with iron; and it is chiefly when this has been done that some small vestige of vision is saved out of the wreck. The lens, in such cases, often becomes coated by lymph, and ultimately requires removal; and it may be necessary to perform iridectomy for closure of the pupil more than once, in consequence of the tendency of the artificial opening to be drawn together again by contraction. On account of the severity of sympathetic ophthalmia, and of its generally unfavourable termination, it is a rule of practice to anticipate its occurrence, and to remove a diseased or injured eye which is likely to produce it before the mischief has been done.

V. **Diseases of the Crystalline Lens** are separately treated of under the article CATARACT.

VI. **Glaucoma.**—In its modern signification, this word is applied to denote all the conditions which are produced by a morbid increase of tension within the eye, that is to say, by an excess of its contained fluids; and the different forms of the affection are mainly due to differences in the rate at which the tension increases.

SYMPTOMS.—If the increase be rapid, the loss of sight will be rapidly produced, and will be associated with other changes occasioned by sudden interference with the circulation and innervation, and by sudden stretching of the ocular tunics. When, on the other hand, the increase of tension is very gradual, so that the eye has time to become accustomed to the new conditions as they are produced, the symptoms often present a deceptive resemblance to simple atrophy; and these cases were at one time described as 'atrophy with excavation of the optic nerve.' In some of the more acute forms of increased tension, the pupil presents a clouded aspect of a greenish colour; and it was to cases of this class that the word glaucoma (from γλαυκὸς, sea-green) was originally applied, at a time when the pathology of the condition was not understood. When this pathology was rendered clear, and when it became known that the glaucoma of the ancients was in all essential respects identical with cases in which the most manifest symptoms were of a different kind, the word was retained as a convenient general term, to express states of disease to which it had no longer any apparent reference; and hence we still speak of glaucoma, although, in the great majority of the cases in which we do so, the green aspect of the pupil is conspicuous by its absence.

The estimation of increased tension by the fingers is a matter which requires the *tactus eruditus*, and is best accomplished by directing the patient to close the eyes gently, and to cast them downwards. The tips of the two forefingers should then be placed upon the upper lid immediately below the margin of the orbit, and, when one finger has fixed the eye by holding it gently back against the orbital contents as far as it will recede, the other estimates the degree in which it may be dimpled by slight pressure. This degree varies to some extent in different persons within physiological limits, but a morbid increase of tension can scarcely be missed if it is looked for. Moreover, the diagnosis of glaucoma does not rest upon increased tension alone, but upon the combination of increased tension with decreasing sight. The rate of slow increase which may simulate atrophy, or of rapid increase which may simulate inflammation, are matters of detail which should not, in either case, be suffered to obscure the true nature of the morbid process.

Treatment.—The treatment of glaucoma is entirely surgical, the affection being capable of arrest by iridectomy or sclerotomy in the great majority of cases. In the more acute forms, an operation, if performed sufficiently early, usually restores vision to its integrity; but the time during which this can be done is limited, and in the more chronic forms no operation will do more than preserve what amount of sight is still retained. Hence it is important that treatment should not be delayed by any error of diagnosis; and the points to which attention should chiefly be directed, in any case of impairment of vision in which the question may arise, are increasing hardness of the eyeball as determined by palpation, and gradual contraction of the field of vision. Whenever the eye is becoming harder, and the circumferential extent of vision is narrowing in, the case is one in which an operation should be accomplished with as little delay as possible. At the same time, until the operation can be performed, a four-grain solution of eserine should be applied every four hours; this drug having a marked effect in controlling and diminishing tension. The more acute cases of glaucoma are attended by much pain from the distension of the ocular tunics, and often by congestion and inflammation, the results of this distension; and such cases were at one time described as 'acute internal arthritic ophthalmia,' or by some similar name. Vision has been irretrievably lost, in hundreds of cases, by endeavours to control this form of glaucoma by medical treatment, to the neglect of operation; and the erroneous practice has been kept alive by the circumstance that some of the cases will undergo partial and temporary amendment. In such circumstances, however, the vision never rises to the degree of acuteness which existed prior to the attack, and the amendment is never more than temporary. Another increase of tension soon occurs; and, without surgical aid, blindness sooner or later closes the scene.

VII. Diseases of the Optic Nerve and Retina.—As shown by the ophthalmoscope, these diseases cover a very wide field of pathology. In order to understand them accurately, it is necessary to bear in mind the anatomy and relative arrangement of the affected tissues. The optic nerve in the orbit is invested by a double sheath, and the interval between its layers, which is continuous with the sub-arachnoid space, terminates in a cul-de-sac towards the eyeball, the two layers becoming intimately united where they blend with the sclerotic. At this point, the opening in the sclerotic for the admission of the optic nerve is crossed by a film of perforated connective tissue, the *lamina cribrosa*, with which the sheaths of the nerve-fibres blend, or in which they are lost, so that the nerve anterior to the lamina consists of a bundle of unsheathed fibres, enveloping the central artery of the retina, which enters the eye with them, and the central vein of the retina, which passes out in the same position. On entering the eye the nerve-fibres bend round to form the anterior layer of the retina, which contains also the retinal blood-vessels almost to their ultimate divisions, together with some delicate connective tissue. The capillary circulation of the nerve itself is derived from the anterior cerebral artery, and is distinct, save for a very slight amount of anastomosis, from the capillary circulation of the sheath, which is fed by the arteries of the pia mater. It follows that hyperæmia of the sheath, or of the circle surrounding the nerve, may exist without hyperæmia of the proper nerve-tissue, and it has been supposed that fluid pressure in the intervaginal space may interpose an obstacle to the circulation in the vessels which pass through the sclerotic foramen, and may thus occasion dropsy of the termination of the nerve within the eye. Of the two foregoing conditions, either may undergo resolution harmlessly, or may produce such changes in or around the nerve as to occasion atrophy and loss of sight. Neither of them interferes with sight directly, because the circulation may be seriously disturbed by a degree of pressure which is insufficient to stop the conduction of impressions through the nerve-fibres. There is yet a third condition, properly called optic neuritis, or *neuritis descendens*, in which the capillary network of the nerve itself participates in changes propagated downwards from the cerebrum, and in which impairment of vision holds a very early place among the symptoms.

1. *Perineuritis.*—The true perineuritis, in which the unchanged nerve-disc is surrounded by a zone of high vascularity, is only seen as a

result of meningitis, which may be either tubercular or due to other causes. It was at one time hoped by Bouchut, by whom this especial phenomenon was first described, that perineuritis might serve as a diagnostic sign in cases of doubtful meningeal inflammation; but this expectation has not been realised. The perineuritis itself has only been observed in cases the character of which was scarcely doubtful, and which, in most instances, have terminated fatally. Very probably, however, it would be found, if looked for, in those cases of exanthematous and other fevers which are attended by cerebral symptoms, followed after recovery by impairment of vision. In these we eventually find, as a rule, a partial nerve-atrophy, which does not lead on to complete blindness, but which does not appear to be susceptible of improvement; and this partial atrophy may no doubt be due to the pressure of perineural exudation during its contracting stage.

Treatment.—The treatment of perineuritis must generally be that of the affection in which it has its origin; but, in any fever in which this symptom had been detected, it would be a question whether mercury should not be cautiously administered for a considerable time after convalescence, in order to promote the absorption of any effused lymph by which the optic nerve entrance might be constricted.

2. *Choked Disc.* Synon.: *Dropsy of the Optic Nerve Entrance.* This is a condition chiefly seen in connection with intracranial tumours, whether syphilitic, tubercular, or of some other kind; and it almost invariably affects both eyes. It was formerly supposed to be due to the pressure of fluid driven down the intervaginal space around the nerve, and so constricting the latter at the terminal *cul-de-sac* as to impede the outflow of venous blood. This hypothesis is now generally abandoned, but the condition visible with the ophthalmoscope is one of distension and tortuosity of the retinal veins; arrest of the capillary circulation; impediment to the arterial inflow; dropsical effusion into the disc-tissues; and, sometimes, secondary inflammatory changes, such as effusion and cell-proliferation, comparable to the erythema which occurs in the integument of a dropsical limb. All these changes may exist without impairment of vision, because they neither affect the perceptive layer of the retina, nor arrest the conduction through the nerve-fibres. At a later period, however, when any plastic elements in the exudation begin to undergo contraction, the interference with the circulation becomes more complete, the nerve-fibres themselves become compressed, and then failure of sight commonly occurs. At the same period, the nerve passes into a state of atrophy from the interference with its circulation; and these cases of nerve-atrophy were once sources of great perplexity to surgeons, and were referred to alcohol, tobacco, and to other causes which probably had very little to do with them. In consequence of the sight not being affected during the preliminary stage, the occurrence of this stage was for a long time absolutely overlooked, and was only discovered when physicians began to use the ophthalmoscope, as an ordinary instrument of diagnosis, in all cases of cerebral affection. It was then soon established, notably by the labours of Drs. Hughlings Jackson, Buzzard, and Clifford-Allbutt, that the atrophy had been preceded by swelling of the disc and by obstruction of its circulation; and it was shown before long that the cases of atrophy which had this history were recognisable, after the swelling had passed away, by the tortuosity of the retinal veins which was left behind, and by the way in which these veins were lifted into bold curves at the margin of the disc; this alteration of their original course having been due to the swelling, and remaining after the swelling had subsided. The contraction of the effusion, and the consequent atrophy of the nerve-fibres and closure of the capillary vessels, would be likely to occur earlier in some parts of the disc than in others; and hence, at the time when commencing failure of sight first induced the patient to seek advice on account of it, the disc was commonly seen to be invaded by sectors of whiteness, but to retain its vascularity, or perhaps more than its normal vascularity, in other parts; while, at the same time, the sight was first lost in those regions of the retina the fibres from which were first compressed. Hence it follows that a partial invasion of the disc by atrophic changes, and a partial invasion of the field of vision by blind portions, are among the earliest symptoms in cases of the class under consideration; and these symptoms were at one time referred rather to the nervous centres than to the retina or the disc itself, to changes in which they are now attributed. A not uncommon clinical history in such cases is that there has been constitutional syphilis, imperfectly treated, and ultimately producing headache or other cerebral symptoms, which have probably called for the administration of iodide of potassium and have been relieved by it. Some weeks afterwards there is for the first time a complaint of failing sight; and then the ophthalmoscope reveals that the discs are passing into atrophy, that the retinal veins are lifted into prominent curves at the disc-margins, and that their further course over the retina is generally serpentine. In many cases, the recovery of the patient, as far as general health is concerned, leaves the precise character of the intra-cranial mischief doubtful; but, in fatal cases, a tumour is the morbid condition most frequently discovered. *See* Ophthalmoscope in Medicine.

When the merely passive dropsical effusion into the disc becomes complicated with inflammatory changes, as results of the disturbance of the tissues, the sight begins to fail before atrophic changes become manifest; and such cases are very difficult to distinguish from those in which there is (3) *primary* or *descending neuritis.* The blood-supply of the optic nerve being derived from the anterior cerebral artery, we may reasonably expect to find capillary engorgement of the nerve-substance of the disc in connection with arterial hyperæmia of the brain; and this capillary engorgement may pass into inflammation, either of local origin or by transmission downwards from above. In any case, if the first changes in the disc are of the character of neuritis rather than of obstruction, we see capillary or arterial hyperæmia of the nerve-substance rather than venous congestion; and effusion of plastic material upon the disc itself, with comparatively little prominence or disc-swelling, and with comparatively little extension over the disc-margins upon the surrounding retina. At the same time, even in the early stage of the affection, we find great impairment of sight, the conducting power of the nerve-fibres being seriously injured. Such cases are frequently syphilitic, and, unless the absorption of the effusion should be quickly brought about by treatment, its contraction, like that of the effusion of obstruction, soon occasions atrophic changes. In these cases, however, the swelling having been absent or inconsiderable, the vessels do not show that elevation into bold curves at the disc-margin which has already been described; and the contraction being interstitial in the nerve-substance, and from the first affecting veins and arteries in an equal degree, the arterial inflow is diminished *pari passu* with the diminution of the vein-channels, and the latter vessels are seldom distended in such a manner as to render them distinctly varicose or tortuous. The ultimate result is a white disc, on which the arteries and veins are dwindled to threads, or at least greatly reduced from their normal calibre.

We may therefore have three conditions which in their typical forms are tolerably distinct, but which are prone to run into one another by almost imperceptible gradations, and which may all lead on to atrophy and complete blindness: namely, perineuritis, neuritis, and choked disc. The liability to the last-mentioned condition should be carefully remembered by physicians, and should lead to careful ophthalmoscopic examination in all cases of obstinate headache or other cerebral symptoms of obscure origin, more especially in a patient with a syphilitic history.

TREATMENT.—It is manifest that the best hope of preventing ultimate blindness, in persons in whom choked disc has occurred, will be secured by the administration of medicines calculated to assist the absorption of the effusion, and by continuing these medicines, with comparatively small reference to the general symptoms, until the discs have cleared. The writer has seen such clearing occur, without loss of sight, in circumstances which rendered it almost certain that neglect of the disc-effusions would have been followed by blindness at no distant date. The same general rule will apply, of course, to the more directly inflammatory effusions of neuritis or perineuritis; and, when we find any one of the three conditions passing into atrophy, or when we find commencing atrophy in discs which show traces of past effusion, the principle of treatment is to endeavour to promote the absorption of any contracting material which may be the physical cause of the atrophy; and then, when this has been done, to seek to stimulate the nutrition of the nerve-fibres, and to assist them to recover from the shock which they have sustained. The mode of fulfilment of the first indication must depend mainly upon whether there is a history of syphilis, and, if so, upon the manner in which it has been treated. In the numerous cases in which a short course of mercury has been administered, enough to alleviate secondary symptoms, but wholly insufficient to eradicate the disease, it will generally be desirable to give iodide of potassium in full doses for a time, and to follow this by the prolonged administration of the perchloride of mercury, in the hope of really curing the patient. There are, in the writer's opinion, few things better worth remembering in therapeutics than that the iodide, immeasurably the most valuable drug which we possess as a remedy for a late syphilitic symptom, is none the less almost useless as a remedy for constitutional syphilis. It will remove the present symptom, speedily and often completely; but it can scarcely be said to have any tendency to prevent the recurrence of syphilitic symptoms at a future time, in the same or in some different form. For this purpose, the only trustworthy agent is mercury; and therefore, while the administration of the iodide for a sufficient time, and in sufficient quantities to test its power of doing good, will be enough in the cases in which syphilis is neither known nor suspected, the iodide must be followed by mercury whenever a syphilitic history of the affection is either clear or highly probable. The second indication, to stimulate the nutrition of the nerve-fibres, is usually best accomplished by strychnia, given at such intervals and in such doses as to produce evidence of its constitutional effect before its administration is abandoned. It may perhaps be most effectually given by hypodermic injection; but this is a point which must be settled in accordance with the circumstances of the case in each individual instance.

3. *Sclerosis of the Optic Nerve.*—Besides the consecutive forms of atrophy above enumerated, there is yet another of common occurrence, which is either a primary sclerosis of the optic nerve, or a sclerosis secondary to a similar affection of other parts of the nervous centres. This form of atrophy is not preceded by effusion, nor is it attended by any marked decrease in the calibre of the central vessels of the retina, even when the capillary circulation of the disc has almost wholly disappeared. It is often seen in connection with disease of the spinal cord, as in locomotor ataxy; and also occurs in apparently healthy people, seemingly as a purely local affection.

Sclerosis is easily distinguished from the atrophies consecutive to effusion, whether active or passive, by the circumstance that the effusion, as it undergoes contraction, tends to render the nerve-tissues opaque as well as to bleach them, and thus leaves a disc-surface of an almost ivory whiteness and of uniform colour. In sclerosis, on the other hand, the nerve-tissue disappears to a great extent, and reveals the mottled surface, often of a bluish-white tint, of the lamina cribrosa. When this is plainly seen, and when, at the same time, the vessels are neither much diminished in calibre nor altered in their normal curvatures, sclerosis may be assumed to exist; and this form of atrophy may also be distinguished from that which is produced by the most chronic forms of glaucoma, by the circumstance that in the latter the vessels bend into the excavated disc at its margin, while in the former they pass over the margin in straight lines or nearly so. Chronic glaucoma would also be distinguished by the character of the failure of sight, which would be marked by regular or almost concentric contraction of the field of vision, even when central vision was only a little impaired; and also by the gradual hardening of the eyeball, which would be present in glaucoma and absent in nerve-sclerosis. Still it cannot be denied that this particular diagnosis is not without its difficulties, and that in certain cases it has given rise to differences of opinion between men of large experience on all sides of the question at issue.

The diagnosis is important as well as difficult; since the mischief of glaucoma may admit of arrest by iridectomy or sclerotomy; so that to mistake chronic glaucoma for atrophy, and to neglect operation, may be to condemn the patient to unnecessary blindness. The opposite error can at least do no harm; and therefore, whenever a doubt really exists upon the point, the most proper course is to give the benefit of that doubt to the patient, and to advise the performance of an operation which cannot injure, and which may relieve him. The atrophy of sclerosis scarcely admits of treatment, but it may perhaps sometimes be delayed, or even prevented from becoming complete, by the administration of full doses of strychnia and iron.

4. *Atrophy from other causes.*—Besides the foregoing forms of atrophy, there is a variety which appears to be associated with chronic lead-poisoning, and in which the discs may acquire a peculiar gray or bluish tint; and the optic nerves may also undergo secondary wasting in consequence of other conditions presently to be mentioned, such as obstruction of the central artery by an embolus, or the long continuance of pigmentary retinitis.

5. *Retinal Hæmorrhage.*—The chief disorders of the retinal circulation displayed by the ophthalmoscope are hæmorrhages, which may be attended by very different circumstances, and may present widely different characters.

a. Single.—When blood proceeds from one of the larger veins of the retina, which yield a considerable quantity, and which are situated immediately underneath the limiting membrane, the hæmorrhage usually spreads out over the fundus as a red patch of uniform colour and aspect, and vision is suddenly, and sometimes almost totally, obscured. The writer has seen such bleeding occur from the yielding of a vessel during parturition; but this accident is extremely rare, and the large hæmorrhages in question are certainly more common in women at the period of cessation of the menstrual function than under any other circumstances. At this time, and when the health is not seriously affected, a favourable prognosis may be given with some confidence; for the blood will before long be absorbed, and restoration of vision, at least in a considerable degree, may be expected. The writer has once seen complete restoration to the normal standard, but this is an exceptional occurrence.

TREATMENT.—The only treatment necessary is to pay attention to the requirements of the general health; and to prescribe such diet, medicines, regimen, and habits as may tend to calm and equalise the circulation, and to prevent local congestions. The occurrence of sudden loss of sight in one eye will justify the suspicion of hæmorrhage; but the suspicion can only be converted into certainty by the ophthalmoscope.

b. Multiple.—A form of venous hæmorrhage which at first seems less formidable, because it is attended by a smaller degree of immediate interference with sight, but which calls for a less favourable prognosis, is that in which the hæmorrhages are multiple, often singly of small size, and scattered over the whole fundus of the eye. The appearances which they present differ, apparently in accordance with their precise position in the retina. If they proceed from vessels which are superficial, the blood is spread out, as in the last variety, in round or oval patches beneath the limiting membrane, but, if the vessels lie a little deeper, and are fairly engaged in the fibre-layer, the blood will separate the fibres and find its way between them, forming flame-shaped or brush-like patches, which are often very numerous. Such multiple hæmorrhages are very slowly absorbed, and have a tendency to recur; so that they must always be regarded as placing the sight in serious jeopardy. They are often monocular, and they do not point to any definite disturbance of the general health. The only endeavour so to connect them with which the writer is acquainted was made by Mr. Hutchinson, who described some cases of flame-shaped hæmorrhage in persons all of whom he said were 'gouty;' but it will certainly be the experience of most practitioners that flame-shaped hæmorrhages occur in many patients who are not 'gouty' in the ordinary sense, and that they do not occur in vast numbers of those about the reality of whose gout there can be no question. The presence of multiple hæmorrhages is sometimes attended by a considerable degree of irritation, or even inflammation, in the tissues among which the blood has been effused; and this condition, in which the retina between the blood-spots may become opalescent or turbid, has been described as a form of retinitis—*Retinitis apoplectica.* The element of inflammation, in such instances, is probably merely a reaction consequent upon the injury inflicted upon the tissues, and it cannot be inferred that the bleeding is itself the result of any inflammatory process.

TREATMENT.—In this, as in the former variety, there is no special indication for treatment, which must be confined to the correction of any manifest disorder of the general health, followed, in most instances, by the administration of iodides or bromides, as medicines calculated to assist in the absorption and removal of the effused products. Any indication of a general hæmorrhagic tendency, or of a state allied to purpura or scurvy, would require, of course, full consideration and appropriate treatment. The extent of the ultimate injury to sight will usually depend upon the extent to which the perceptive elements of the retina have been compressed or disorganised, either by the bleeding itself, or by other changes consecutive to it.

c. Arterial.—Hæmorrhages which are distinctly arterial are not uncommon in the fundus of the eye, and can generally be distinguished without difficulty from the venous variety, not only by the colour of the effused blood, but also by the situation of the bloodpatch, and by its manifest relations to a small arterial branch, which may often be seen to have dwindled or closed beyond the point at which it has given way. Arterial hæmorrhages are mostly multiple, but of small individual extent; and, when not in the immediate neighbourhood of the optic disc, are most commonly seen near the outer limits of the ophthalmoscopic field of view. They are generally attended by sufficient impairment of vision to occasion complaint, and thus to lead to their detection; but they seldom occasion blindness. They call for an examination of the urine for albumen, and, failing any evidence of renal mischief, they are chiefly important as indications of a weakened and brittle state of the arterioles, likely to lead to intracranial hæmorrhage.

Treatment.—Arterial hæmorrhages into the retina point to the necessity of diminishing, as much as may be possible, the strain upon the arterial coats, by such means as the avoidance of muscular exertion or mental emotion, and by seeking to diminish the quantity of the circulating blood by a diminution in the quantity of fluid ingested. Even when all precautions have been taken, arterial retinal hæmorrhages are common forerunners of apoplexy.

6. *Embolism of the Central Artery of the Retina.* Embolism of the central artery of the retina, or of one of its branches, is a condition of not infrequent occurrence.

Symptoms.—When sudden blindness of one eye occurs in a person who is the subject of valvular disease of the heart, the diagnosis can scarcely be doubtful; but the ophthalmoscopic appearances will suffice to remove doubt if it should exist. The immediate effect of the sudden arrest of the arterial circulation of the retina is to render that membrane opaque and of a milky whiteness, except over the macula lutea, where the absence of connective tissue prevents any such change from being produced. Here, and here only, the original transparency is retained, and the colour of the choroid is seen through; with the result that the macula appears as a cherry-red spot in the midst of a white surface. When not concealed by the opacity, the larger veins of the retina are diminished in calibre and contents, and their blood is sometimes broken up into detached portions separated by interspaces. The arteries are empty, and are either invisible or traceable as white lines of fibrous tissue in the general milkiness of the fundus. The disc is usually bleached, but it will sometimes happen that its condition may be temporarily obscured by arterial hæmorrhage, occurring from some twig given off just below the seat of the embolus, and entering the eye independently.

The driving home of the embolus will throw upon such a twig the whole force of the circulatory *vis a tergo*, and may thus rupture it—an occurrence of which the writer has seen several examples. The blood so effused is usually absorbed in a very few days, revealing the white disc and the collapsed arteries, and removing any uncertainty which might have existed with regard to the diagnosis. The opalescence of the retina also disappears before long, and then only the secondary nerve-atrophy and the disappearance of the arteries remain to disclose the nature of the original affection. Embolism seems to be a perfectly hopeless condition, because there is no anastomosis between the retinal and other vessels of a sufficient extent to maintain a collateral circulation. The writer has met with one instance in which only a sector of the field was affected, and with one in which embolism of a very small branch produced loss of sight over all the peripheral parts of the field, leaving central vision almost intact; but such cases are among the curiosities of ophthalmology, and complete and permanent loss of sight of the affected eye is the result which must always be anticipated.

7. *Retinitis.* Retinitis is commonly described as occurring in three chief forms, the *albuminuric*, the *syphilitic*, and the *pigmentary*; but the writer is inclined to believe that only the last of these three is a genuine retinitis, and that in the others the inflammation, if it should exist, is merely a secondary consequence of the irritation produced by the presence of adventitious deposits.

a. Albuminuric Retinitis. In the so-called albuminuric retinitis, the sequence of events appears to lend some support to the contention of Sir William Gull and Dr. Sutton, to the effect that the renal disease is not an original affection, but only a result of morbid or degenerative changes which are common to the whole of the small arteries of the body.

Symptoms.—In many cases of albuminuria, the sight is not affected from first to last, and the retinæ remain healthy. In some, the retinal changes precede the appearance of albumen in the urine; and, in the majority, the renal and retinal changes are coincident. The retinal changes are of two kinds; namely, arterial hæmorrhages, occurring in the fibre-layer, so that the blood-patches assume a fibrillated aspect with brush-like terminations; and the formation of white patches, either of cholesterine deposit or of fatty degeneration, or of both combined, scattered irregularly over the fundus, but often grouped into a stellate figure around the macula lutea, and into an irregular ring around the disc. To these appearances are added, in some cases, those of swelling of the disc-margins with effusion into the retinal fibre-layer; and, when the last-named appearances are presented, there is always a far greater deterioration of sight than when they are absent. It is a matter of daily occurrence that the existence of renal disease is not suspected until impairment of sight leads to an ophthalmoscopic examination, and this to the discovery of the retinal changes; and, in every hospital, cases which apply for relief to the ophthalmic department are constantly, on this ground, transferred to the physician.

Treatment. — The treatment of the renal maladies which produce albuminuria is in no way modified on account of the presence of a retinal complication; and the unfavourable prognosis which must generally be given as regards life throws into comparative insignificance the gradual failure of vision, which seldom proceeds to complete blindness.

b. Syphilitic retinitis. This is usually an incident of the most advanced stages of the disease, and is most frequently seen in persons who have been inadequately treated during the primary stage, but who have for some months or even for a year or two been free from symptoms.

Symptoms.—Dimness of sight is then complained of, and the retina is found to present scattered patches of very irregular outline, and of a filmy whitish aspect. Such patches may be more or less obscured by slight general turbidity of the retina itself, or of the vitreous body in its immediate vicinity, the latter condition being of itself almost conclusive of the nature of the malady.

Treatment.—The treatment must be greatly governed by the past history of the case, but may in most instances turn upon the use of iodide of potassium for the relief of the retinal troubles, followed by a sufficient course of mercury for the eradication of the syphilitic taint.

c. *Pigmentary Retinitis.* This appears to be a true inflammation of the retina, differing from the foregoing affections in that it attacks the percipient elements, instead of the fibre-layer or the connective tissue of the membrane.

Ætiology.—The subjects of pigmentary retinitis are of all ages, from nine or ten years to seventy; and, in some instances, the duration of the disease has been as much as twenty years, from the first appearance of the symptoms to their ultimate termination in blindness. As a rule, however, the patients are young adults, or persons not past middle age.

It is a remarkable feature of pigmentary retinitis that it almost invariably attacks more than one member of a family; and it has been said to be especially frequent in the offspring of marriages of consanguinity, but this statement is not borne out by English experience. During the last twenty years the writer has only met with one family in whom the malady had this history.

Anatomical Characters.—From the extreme chronicity of its course, from its obstinacy, and from its peculiar anatomical distribution, pigmentary retinitis should probably be regarded, together with some forms of choroiditis, as having its analogies among some of the chronic skin-diseases rather than with any other retinal affection. It commences in a narrow annulus near the equator of the eyeball, and gradually spreads inwards towards the optic disc; the tissues affected are the perceptive and pigmentary layers of the retina and the subjacent chorio-capillaris, which slowly become disorganised and matted together in one common and undistinguishable ruin. Coincidently with the progress of the disease, pigment is deposited in the parts affected, and in the retina superficial to them, in the form of irregular lines and striations, and especially along the course of the main arterial branches. As the annulus of disease gradually closes in upon the macula, the optic disc undergoes atrophy of a kind which gives it a peculiar tint of whiteness, very readily recognisable when it has once been noticed, and the central vessels, both veins and arteries, dwindle in size.

Symptoms.—The subjective symptoms are as characteristic as the ophthalmoscopic appearances. Over the region actually invaded, the perceptive elements of the retina are destroyed, and the power to receive visual impressions is lost. The fibre-layer not being implicated, the conduction of impressions from parts of the retina more peripheral than the disease may remain unaffected; and hence we may have a blind zone surrounding the centre of the field of vision, and surrounded itself by a zone still more external, in which dim vision is preserved. But the salient symptoms are two: the gradual contraction of the field of vision due to the progressive encroachments of the disease; and night-blindness, due to the nerve-atrophy, which interferes with the conduction or perception of any but strong impressions. When these symptoms co-exist, when the field of vision is small and becoming gradually smaller, and when the patient, who can still see fairly in the daytime, can scarcely find his way about as dusk begins to fall, we may predict the ophthalmoscopic appearances with a very near approach to certainty. The optic disc will be unnaturally pale, and the fundus overstrewn, towards the periphery, with irregular black lines and stripes, of which it is quite possible that none may be visible within that portion of the field of the ophthalmoscope which includes the disc.

Diagnosis.—Pigmentary retinitis may possibly be mistaken for the most chronic form of glaucoma, on account of the contraction of the field of vision; but it may be distinguished by the absence of high tension, by the night-blindness, and by the pigmentation of the retina. It may also be mistaken for the atrophy of sclerosis, but only if the ophthalmoscopic examination is limited to the nerve-disc, to the exclusion of the surrounding parts of the fundus.

Treatment.—In the treatment of a disease so essentially chronic, it is difficult to arrive at any trustworthy evidence concerning the efficacy of a remedy, but the prolonged administration of iron, rather as a food than as a medicine, is at least of a certain degree of utility in arresting the progress of the malady. The preparation employed is probably not material, and some may be found to suit particular persons better that others; but the writer is accustomed to begin with the tincture of the perchloride, in doses of five minims, well diluted and given three times a day as part of a meal.

8. *Detachment of the Retina.* Synon.:—Subretinal dropsy. This is a condition the causes of which have never been satisfactorily explained.

The first symptom which attracts the attention of the patient is the loss of part, usually either the upper or the lower part, of the field of vision; and it is manifest that loss of the upper part of the field means detachment of the lower part of the retina, and *vice versâ*. Detachment is sometimes produced by a blow or injury, but more frequently it occurs without any assignable cause, either local or constitutional. One or both eyes may be affected.

The diagnosis of the disease is rendered easy by the ophthalmoscope, which exhibits the detached portion as a sort of floating prominence, projecting into the interior of the eyeball, generally bluish-white in colour, and crossed by the retinal blood-vessels.

The prognosis is very unfavourable in the majority of instances, and treatment is seldom effectual.

Treatment.—Cases have been recorded in which disappearance of the sub-retinal fluid, and restoration of vision, have followed prolonged confinement in the supine posture; and the occurrence of improvement after spontaneous rupture of the detached portion suggested to Von Graefe the advisability of producing such a rupture by artificial means. Various operations have been undertaken for this purpose, and also for the evacuation of the sub-retinal fluid through a puncture in the outer tunics of the eye, and are said by those who have performed them to have been in a few instances partially successful; but the evidence in their favour is at present very feeble, and hardly establishes more than that attempts of such a nature may be made, if it is certain that the sight will be irretrievably lost in the absence of interference. The tendency of detachment, especially in the upper portion of the retina, is to increase until the whole membrane is elevated from the choroid, and vision is entirely destroyed. It must be borne in mind that detachment may be simulated, or may even be caused, by the growth of intra-ocular tumours, sarcomatous or gliomatous, which may demand the early removal of the eyeball. Such cases would be distinguished from simple detachment by the increased hardness of the eyeball, which the morbid growth would necessarily occasion, and which would be the more significant inasmuch as detachment alone is usually accompanied by diminished tension.

9. *Glioma.* This name has been given by Virchow to a malignant growth which has its origin in the neuroglia, or connective tissue of the nervous system, and which was formerly described as encephaloid cancer. When originating in the retina, it early produces loss of sight, and presently shows through the pupil as a substance of a primrose-yellow colour, by which the still transparent lens is pressed forward towards the cornea. It is chiefly a disease of childhood, and has been seen by the writer as early as the fifth week of infant life. It is liable, by superficial observers, to be mistaken for congenital or infantile cataract, an error which must be carefully guarded against, because the early and entire removal of the eye, together with as much of the optic nerve as can be reached, furnishes the only hope of preserving the life of the patient. When the operation is performed sufficiently early, it has in a few instances been completely successful, cases having been recorded in which no recurrence of cancer has happened after the lapse of years. In the great majority, however, recurrence and death have terminated the history.

10. *Sarcoma.* This differs from glioma in having its origin in the choroid, and in being of a darker colour, and sometimes pigmented or melanotic. It is at least equally malignant, produces similar symptoms, and requires the same treatment.

VIII. **Diseases of the Choroid.**—Diseases of the choroid, recognisable by the ophthalmoscope, are almost limited to certain chronic forms of inflammation and of atrophy; for, in any acute choroiditis, there is always too much turbidity of the vitreous body to allow the state of the membrane to be seen.

1. *Chronic Choroiditis.*—The chronic forms of choroiditis are remarkable for leading to an undue formation, or to a great displacement, of the choroidal pigment; and to the ultimate complete wasting and disappearance of the portions of the choroid which are affected, so that over these portions there will ultimately be no choroid visible, and the ordinary red colour of the fundus will be replaced by the ivory whiteness of the inner surface of the sclerotic.

Chronic choroiditis may be divided into two chief varieties, the *disseminated* and the *diffused.* The *disseminated* occurs chiefly in children, and chiefly, perhaps exclusively, in those who are the subjects of inherited syphilis. It is seldom seen until its period of activity is past. A child is brought on account of defective vision, which has probably existed from birth or from a time but little subsequent to it; and the ophthalmoscope displays a number of small white spots, with black borders, scattered irregularly over the fundus of the eye. The white spots are patches of choroidal atrophy, and the black borders are rings of increased pigment-formation, by which the spots of inflammation, which must have been comparable to little pimples, have been surrounded.

TREATMENT.—Such cases admit of no treatment, except in the rare instances in which some active mischief may be detected, in the shape of small patches or spots in which effusion has not yet passed into atrophy, and in which such an antisyphilitic treatment should be employed as the state of the patient may otherwise permit or indicate.

Diffused choroiditis is more frequently an affection of adult age; and, although very frequently syphilitic, is not invariably so. It differs from the foregoing chiefly in the absence of any defined shape or precise limitation of the parts affected. In the early stages the choroid is seen to be troubled by congestion or effusion, and these conditions pass gradually into abnormal pigmentation and atrophy. The course of the disease may be very chronic and irregular, and different stages of it may be seen at the same time in different parts of the same eye.

The prognosis may in general be moderately favourable; for, although the choroiditis destroys the portion of retina immediately in front of it, its extension is very capricious, and it may often be arrested in time to leave large portions of the eye, and especially the central portions, unhurt. When it occurs in the vicinity of the macula lutea, so as to imperil central vision, it is much more formidable than when confined to the more peripheral parts of the choroidal membrane.

TREATMENT.—Whenever there is a history of syphilis, this must be taken as the clue to treatment; and, if no syphilis can be discovered, the chief reliance must be placed upon rest of the eyes, occasional depletion from the temples by Heurteloup's leech, counter-irritation by blisters or setons, and such internal medication as the general state of the patient may suggest.

IX. **Diseases of the Vitreous Body.**—Diseases of the vitreous body are as yet very imperfectly understood, and we know little more concerning them than that this substance is liable to become turbid in certain forms of acute general inflammation of the eye; and that it is sometimes rendered turbid, without inflammation, by the presence of floating films which may be readily seen by the ophthalmoscope, and which may be so numerous as to form a serious impediment to vision.

1. *Turbidity.* Turbidity of the vitreous is very

common in syphilitic cases; but the films referred to are seen when no syphilis can be suspected. Their number, and their free movements, show that the vitreous must in great measure have lost its natural semi-solid consistence, and have become fluid; but little or nothing is known of their actual pathology.

TREATMENT.—The most effectual treatment for flocculi in the vitreous is usually diaphoresis by the subcutaneous injection of from two to four minims of a 10 per cent. solution of hydrochlorate of pilocarpine, which may be repeated on alternate days. Local counter-irritation with iodine may also be practised; and iodide of potassium may be given internally in such doses as circumstances will allow.

2. *Muscæ Volitantes.* A phenomenon referred to the vitreous body is the appearance of the moving particles, or strings of beaded filaments, which are commonly called *muscæ volitantes.* True muscæ are known by the negative character that the particles which produce them cannot be seen by the ophthalmoscope; and by the positive character that they never so intervene between the eye and an object, however small, as to exclude the latter from view. They are seen most readily against a white field, as a white wall, or a white cloud, or in the illuminated field of a microscope when there is no object in view; and they float about with uncertain movements, but always a little out of the direct line of sight. They are occasioned by the filamentous framework of the vitreous body, and by the cell-nuclei or other irregularities upon the filaments. These bodies, without being opaque, yet differ in the precise degree of their transparency from the fluid which surrounds them; and hence they cast upon the retina shadows, which are then mentally projected outwards into space as floating objects. The projected shadows appear, of course, enormously larger than the microscopic specks which produce them, and the latter are wholly unimportant and of no morbid signification. Muscæ may be discovered by any person by the simple expedient of looking through a very fine perforation in a metal disc at a bright surface; and they are more conspicuous to some persons than to others, on account of the varying differences which may exist in different eyes or in the same eyes at different times or under different conditions, between the index of refraction of the filaments and nuclei and that of the surrounding fluid. Moreover, by the operation of an obvious physical law, the more distant the particle from the retina, the larger will be its shadow upon that membrane, and the larger and more conspicuous will it appear. For this reason, and on account of the elongation of the myopic eyeball, muscæ are usually more complained of by the short-sighted than by others. They are often sources of great uneasiness to patients; but, when once their true character is known, they may be entirely disregarded as harmless appearances, the natural results of physiological structure. It is often important that the physician should be able to make their nature understood, in order that he may dissipate, once for all, the unfounded apprehensions which may be occasioned by their presence.

X. Diseases of the Eyelids.—The external surfaces of the eyelids, as parts of the common integument, are liable to all its diseases, and may thus participate in erysipelatous inflammation, in eruptions, and in the results of injury, besides becoming the seats of nævi, moles, warts, and other growths. Among the diseases special to the formation of the eyelids, the most important are the variations of shape to which they are subject, generally from the contraction of inflammatory exudations, but sometimes from perverted muscular action; the cystic tumours which are produced by obstruction of the orifices of meibomian glands; the inflammation of the follicles of the eyelashes, or blepharitis; spasmodic closure, from abnormal muscular contraction; and either patency or passive closure, from paralysis. Many of these affections are distinctly surgical, and others are only parts or symptoms of more general disorders.

1. *Blepharitis.* Blepharitis, or inflammation of the follicles of the eyelashes, has received a great variety of names from different writers, and is frequently known as *tinea tarsi*, or, in its more advanced stage, as *lippitudo.* The disease consists essentially of an inflammation of the lining membrane of a hair-follicle from which an eyelash springs.

SYMPTOMS.—The first manifest symptoms are a small swelling close to the edge of the eyelid, generally of the upper lid; and the formation of a crust around the bases of the cilia which proceed from the swollen part. The swelling does not extend farther up the lid than to the breadth of about a line, but it soon spreads along the border until the whole length is involved, and it usually spreads also to the lower lid, manifestly in consequence of the contagious character of the discharge. If the crust is removed, and if the part from which it springs is magnified and carefully examined, it will be seen that the mouths of the follicles are somewhat open, no longer fitting closely to the issuing hairs; and, in a few moments, a clear fluid will be seen to exude, and speedily to dry into a crust or film, which covers the opening as if with a varnish. Many of the hairs in the affected follicles are loosened, and fall readily, or may be removed painlessly by slight traction. If the case is neglected, the follicles are before long destroyed as hair-bearing organs, so that the lost cilia are no longer reproduced; and, at the same time, the exudation which constitutes the subcutaneous swelling of the lid-margin begins to undergo contraction, and in this way gradually everts the cartilage of the lid. The edges of the lids become red, swollen, and unsightly; the lachrymal puncta are displaced outwards in such a manner that they can no longer take up the tears; the eyes have lost the protection of the lashes, and are exposed to numerous sources of irritation from atmospheric particles and other causes, so as to be especially prone to conjunctival and corneal inflammations; and these results are almost incurable. It is therefore very important that blepharitis should be effectually treated in its early stages, when, if only due care be taken in the selection and use of remedies, it is an exceedingly trivial affection.

TREATMENT.—The most essential part of the treatment is to remember that the secretion which forms the crust is of such a nature that it is not very easy of removal, and that while it remains *in situ*, no remedies, however judiciously chosen, can obtain access to the parts really affected by the disease. The crust is composed partly of the already mentioned secretion from the inflamed surfaces, partly of the greasy secretion of the meibomian glands, and it is the admixture of the latter which renders the crusts difficult of removal by water alone. A solution of bicarbonate of soda, of the strength of five grains to the ounce of warm water, will remove them readily; and this solution should be applied in such a manner as to soak into the crusts and loosen them thoroughly before any attempt is made to detach them. As soon as they are detached, the surface beneath should be gently dried with a morsel of absorbent rag, and then an astringent should be applied immediately, so that it may find its way down into the depths of the hair-follicles, and may thus reach the seat of the malady. The best astringent is generally the ointment of the precipitated yellow oxide of mercury, or Pagenstecher's ointment, already recommended for the cure of ulcers of the cornea; and this may be applied to the affected part by the tip of a finger. If amendment does not speedily follow, it may be suspected that the crusts have been imperfectly removed, or the applications imperfectly made, and it will be well for the practitioner personally to superintend the process. When this has been done, if the affection continues obstinate, some other astringent should be tried, and the nitrate of silver is among the best for this purpose. Amendment of the lid-margin may generally be quickly produced; but the disease will for a long time lurk in the depths of the follicles, and the treatment must be continued until all subcutaneous swelling has disappeared from the lid-margins. Unless this be done, speedy relapse is inevitable, the inflammation soon creeping out of the follicles again and recovering the ground of which it had been deprived. Such a result is constantly seen in hospital practice, in spite of all efforts to guard against it, and, in undertaking the care of blepharitis, it is always desirable to warn parents of the perseverance which will be required, and of the great importance of obtaining a radical cure. There can be no doubt that blepharitis is exceedingly contagious through the medium of its secretion, conveyed upon sponges, towels, or fingers, and this should be fully recognised whenever it attacks children who are attending a school. The name 'tinea tarsi' may perhaps be taken as the expression of a belief that the disease is allied to tinea tonsurans, and that it is produced by the growth of a parasitic fungus. The writer does not at present see any sufficient ground for the adoption of this opinion.

2. *Entropium and ectropium.* Incurvation and excurvation of the eyelids may be looked upon as purely surgical maladies. The former exposes the eyes to injury from the irritation of inturned eyelashes (*trichiasis*); the latter from foreign bodies of various kinds.

Treatment.—The remedy for both, when any is practicable, must usually be sought in a surgical operation. An exception depends upon the fact that ectropium is sometimes produced by paralysis of the facial nerve, which renders the orbicularis muscle flaccid and powerless, and permits the lower lid to fall downwards under the influence of gravity. The cure of the general nerve-affection may restore the power of the muscle, and may in time lead to complete recovery of the natural position of the lid. In such cases, even if electricity does not form part of the general treatment of the paralysis, it may generally be applied with benefit to the orbicularis.

3. *Blepharospasmus.* This term is generally employed to denote an intermittent closure of the eyelids by an involuntary action of the orbicularis, in response to some concealed source of irritation; and is thus broadly distinguished from the spasm which accompanies photophobia.

Symptoms.—The spasm is most liable to occur in circumstances of mental excitement. Thus, in one of the writer's patients, who was a skilful cook, the eyes were apt to close, and to remain closed for some minutes, at the critical period of an important dish. Another patient was a schoolmistress, and the spasm would interrupt the progress of a lesson to a class, being doubtless to some extent excited by the dread of its occurrence. In a third case, the patient being a gentleman habituated to riding and driving, the spasm would be excited by physical irritants, such as wind or dust, and, almost certainly, by circumstances which required the eyes to be wide open as a condition of safe guidance. The motor nerves appear, as a rule, to be merely the passive conductors of a reflected impulse, and the trouble seems usually to be dependent upon a morbid condition of the fifth, or upon a source of irritation in some peripheral part from which a twig of the fifth passes to the centre.

Treatment.—In the treatment of such cases, it is sometimes possible to find the twig which conveys the impression; that is to say, to discover a point where pressure, sufficiently firm to arrest conduction, will at once relax the spasm. Such points should be looked for at the supra-orbital notch, over the malar bone, and in any other situation suggested by special circumstances; and, if a point at which pressure will arrest the spasm is discovered, we learn at once by what branch of the fifth, and therefore approximately from what region, the irritation is conveyed, and where its source is to be sought for. If nothing can be discovered by careful examination, decayed teeth, accumulations of cerumen in the ears, and conjunctival granulations are possible conditions which should be looked for, and which should receive attention if they are found. When all other treatment has failed, the spasm has sometimes been stopped by subcutaneous section of a sensory nerve; and this may always be practised hopefully if the spasm can be arrested by pressure on some definite spot, which must then serve for the guidance of the knife. If no such spot can be found, section of the supra-orbital nerve, and next of the subcutaneous malar, may be attempted; since neither of these are sufficiently important for their temporary disablement to be set against even the possibility of relief from a very distressing affection. In some cases, however, it would appear that the mischief must be central, and that no section of an afferent nerve can be useful. The division of the motor nerves of the orbicular muscles, if it could be successfully accomplished, would produce a paralysis even more injurious than the spasm; and the cases in which the latter is due to central irritation or other trouble, unless they can be relieved by medicine, and by the rectification of whatever may be manifestly wrong in the condition of the patient, offer very small hope of improvement. *See* FACIAL SPASM.

4. *Ptosis.*—Ptosis is a condition of permanent passive closure of an upper eyelid as a consequence of paralysis of its levator muscle, or it may happen in consequence of this muscle having been torn from its attachment to the tarsal cartilage, so that it can no longer modify the position of the lid.

SYMPTOMS.—Paralytic ptosis may be either partial or complete, according to the degree of the nerve-affection; and as the levator palpebræ is supplied by the third nerve, which supplies also the superior, the internal, and the inferior rectus, as well as the inferior oblique, the sphincter pupillæ, and the ciliary muscle, ptosis is usually accompanied by paralysis of one or more of these muscles. When they are all affected, the eyeball is turned outwards by the action of the external rectus, and is immovable in other directions excepting feebly by the superior oblique. The pupil is dilated, and the power of adjusting the eye for near vision is impaired or lost, although when the lid is raised, near objects can still be distinctly seen by the aid of a convex lens. When all the muscles supplied by the third nerve are affected, the inference is that the cause of paralysis is acting upon the common trunk of the nerve; and such a cause is not unfrequently the presence of periosteal swelling at the sphenoidal fissure. If only some of the muscles are affected, the inference is that the cause of the paralysis is either limited to the central nuclei of origin of certain filaments, or else that it is situated anteriorly to the division of the main trunk into the branches which proceed to different parts; and it is conceivable that the limitations of the paralysis may point, with tolerable certainty, to the precise locality of the disorder.

The causes of ptosis, as of other paralytic affections of single cranial nerves, apart from injuries and the pressure of morbid growths, may almost be reduced to syphilis and to impaired nutrition of the centres, the latter usually connected with hard mental work and worry. In every case, evidence of syphilis should be carefully sought for; and, if found, should determine the nature of the treatment, as it will also of the prognosis, which, in such instances, may be generally favourable. In cases of the second class, where there is no evidence of syphilis, and where the symptoms point to general impairment of nervous energy, the administration of iodide of potassium, in combination with tonics, will sometimes be useful, but the main reliance must be placed upon rest, good living, and external surroundings favourable to the restoration of health.

5. *Diplopia.*—Double vision, although it has no proper relation to the subjects treated of in the present section, is yet so far allied to ptosis that, when occurring suddenly, it is almost always an effect of paralysis or of paresis either of the sixth nerve of one eye, supplying its external rectus, or of the branch of the third which supplies its internal rectus. In the former case the affected eye will deviate inwards, and will have limited range of movement towards the outer canthus; while in the latter case these conditions will be reversed.

As regards the causes and treatment of these limited forms of paralysis, there is nothing to add to what has already been stated about ptosis. It is sometimes desirable, while the diplopia continues, to exclude the deviating eye from vision by a shade, an opaque spectacle glass, or other suitable contrivance, on account of the vertigo and uncertainty of gait which may be occasioned by the double images.

See also EXOPHTHALMIC GOITRE; LACHRYMAL APPARATUS, Diseases of; LAGOPHTHALMOS; ORBIT, Diseases of; STRABISMUS; STYE; and VISION, Disorders of. R. BRUDENELL CARTER.

F

FACIAL PARALYSIS.—SYNON.: Paralysis of the Portio dura; Bell's Paralysis.

DEFINITION.—Paralysis of the muscles of the face, due to disease or injury of the nucleus or fibres of the portio dura of the seventh pair of nerves.

Above the nucleus, in the middle of the pons, the motor tract decussates and mingles with that from the arm and leg; damage, therefore, in the upper part of the pons, crus, corpus striatum, or hemispheres produces facial paralysis as a part of hemiplegia. This paralysis, on the same side as in the limbs, is partial only, affecting chiefly the muscles of unilateral use (as the zygomatici and muscles about the angle of the mouth); and very little those of bilateral use, in the upper part of the face (orbiculares palpebrarum, and frontales). In this article paralysis from damage to the fibres or nucleus of the nerve will alone be considered.

ÆTIOLOGY.—(1) The most common cause of facial paralysis is damage to the nerve as it passes through the narrow canal in the temporal bone. There the slightest effusion will cause pressure on the nerve. Such effusion may be due to exposure to cold—'rheumatic;' contiguous bone-disease—caries; syphilis; or hæmorrhage; but often occurs without discoverable cause. Cold has been supposed to act most commonly by paralysing the peripheral nerve-twigs, but this is rarely, if ever, the case; since in all cases lasting more than a few days, evidence of changed nutrition may be detected in the nerve-trunk as it emerges from the stylomastoid foramen. (2) Injury to the nerve outside the skull by blows, or incised wounds, or parotid and other tumours, is an occasional cause. (3) Within the skull the nerve may be damaged by meningitis, acute or chronic, and especially by syphilitic inflammation, or by pressure of neighbouring growths. The radicular fibres within the pons, or the nucleus beneath the fourth ventricle, may be damaged by hæmorrhage, softening, or growth affecting that part.

Double facial paralysis is very rare, and is due to damage to the nerves at the base of the brain from meningitis, or symmetrical syphilitic disease; or to an affection of the nuclei by disease of the pons, or by loss of function of the nerve-cells composing the nuclei. Syphilis and diphtheria are the most common antecedents.

Symptoms.—The onset of facial paralysis is usually gradual, occupying from a few hours to three or four days in its development. It is found, for instance, one morning that in drinking the fluids run out of the side of the mouth; the face is noticed to be a little unsymmetrical; at night the eye cannot be completely closed; and next morning the paralysis is found to be complete.

In complete unilateral facial paralysis all the muscles on one side of the face are paralysed. At rest, the smooth forehead and lowered angle of the mouth are the chief indications, but on movement the difference between the two sides becomes very marked; the one half of the forehead moves alone in frowning or elevation of the eyebrow. The eyelids cannot be brought together, and in the attempt to close the eye the eyeball is rolled upwards so that only the sclerotic appears between the gaping lids; the patient commonly imagining that the eye is shut. During sleep the eye remains open. In smiling, the lips may be displaced altogether to the healthy side, from the unopposed action of the zygomatic muscles, the nostril of the affected side cannot be dilated, the upper lip cannot be raised, the cheek flaps loosely from the relaxation of the buccinator, and from the same cause food accumulates between the jaws and the cheek. Whistling is impossible, from the paralysis of half of the orbicularis, and the lips cannot be approximated sufficiently even to permit of a candle being blown out. When the lesion is between the origin of the large petrosal and the chorda tympani nerves, taste is partly or entirely lost in the front of the tongue. The loss of power of recognising acid and saline substances is most marked, but bitters and sweets are also not tasted in this part. In rare instances loss of taste has followed division of the nerve outside the skull. When the disease is above the origin of the great superficial petrosal, the uvula is said to be oblique, from paralysis of its muscle, and the palate to be motionless on that side. Of this there is much doubt. Obliquity of the uvula is common under normal conditions. The writer has never seen paralysis of the palate or uvula in these cases.

In some cases giddiness marks the onset of facial paralysis. In less severe cases there may not be complete loss of power, but the loss is at first pretty equally distributed over all parts of the face.

In cases which recover, some return of power takes place in from a week to two months, and improvement is usually earliest in the upper part of the face; the power of frowning, winking, and closing the eye being soonest regained, that of moving the lip and mouth returning last. Even after several months of immobility, recovery may take place, but in these cases it is rarely complete, and a troublesome condition is apt to supervene; some of the muscles, especially the zygomatici, become shortened in late rigidity, and hence at rest the naso-labial wrinkle is deeper on the paralysed than on the healthy side, although the possible movement may be much slighter. This condition sometimes comes on rather suddenly. If, in addition, a troublesome associated over-action of muscle manifests itself, whereby the orbicularis palpebrarum and the zygomatic and other muscles about the mouth act together, in smiling the eye shuts, and on closing the eye the mouth is drawn upwards.

The electrical condition of the muscles is very important. It is that always seen in paralysis from nerve-lesion. The muscles, after a day or two of slightly increased irritability to both faradisation and the slowly interrupted battery current, lose gradually their irritability to the former, retaining that to the latter, and even exhibiting to it increased irritability, so that they act to a smaller number of cells than on the healthy side. In the nerve, on the other hand, the irritability is lost to both forms of electricity, this loss proceeding *pari passu* with the degeneration which follows separation of the nerve from its nutrient centre. In slighter and more transient forms of facial paralysis the change in irritability of muscle and nerve may be slight, but even in most, which last but a few days, a slight change in irritability may be discovered.

Diagnosis.—The diagnosis of facial paralysis is easy. It is important to observe all the muscles of the face, and to ascertain the electrical reaction, in order to determine whether it is the variety now described, or is cerebral and part of an unnoticed hemiplegia. The recognition of the place of the lesion is less easy. When within the pons, it is often associated with paralysis of the sixth nerve, or with hemiplegia of the opposite side from damage to the fibres from the limbs. At the base of the brain the auditory nerve is usually affected at the same time. Where there are no other paralyses, the disease is probably within the bony canal. Deviation of the uvula is a guide of most doubtful value. Special inquiry should be made for ear-disease, for syphilis, or for a blow.

Prognosis.—The majority of cases of facial paralysis are due to rheumatic affection of the nerve, and recover, but the duration of some of these is considerable. In recent syphilitic cases the prognosis is good. In caries of the temporal bone and in intracranial disease, unless syphilitic and recent, the prognosis is less favourable. Whatever be the cause, the electrical reaction of the nerve and muscles affords valuable informa-

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tion, since in proportion to the slightness of the change in relation to the length of time the symptoms have lasted, will the degree and duration of the affection be less.

In double facial paralysis the probability of central mischief will render the prognosis less favourable, but recovery may be hoped for if there are no symptoms of disease damaging structures contiguous in position, and not merely related in function, and if the disease be of short duration.

Treatment.—The treatment of facial paralysis will depend on the probable cause. When due to the effects of cold, hot fomentations to the side of the head and face may be employed in the early stage of the affection, and afterwards counter-irritation by blisters behind the ear. At first, diuretics and small doses of iodide of potassium, and subsequently tonics, are useful. Electricity to the muscle and the nerve is of great service; faradisation should be used if the muscles will respond to it; if not, the voltaic current, slowly interrupted by a commutator, or by the negative pole being moved over the individual muscles, and only such strength being employed as shall produce distinct muscular contraction. If the faradic irritability be lost at first it will return as the muscles recover, and faradisation should then be employed. If electricity does no more, it keeps up the nutrition of the muscular fibres and aids the recovery of function in the nerve. Ultimate recovery is thus more speedy and more complete than without local treatment. Rubbing may be employed, the individual muscles being subjected to a process of gentle shampooing. The treatment of the late contraction which occurs in severe cases is often difficult. Faradisation of the opposite side of the face has been suggested, but can scarcely be of service. The zygomatic muscles may be elongated a little by frequent gentle traction, and the other contracted muscles should be gently rubbed, so as to lengthen them. Inunctions of oleate of morphia may be tried. The muscles that are contracted should not be faradised. The condition usually lessens after a time, but often remains for many months, or even years.

Where facial paralysis is due to syphilis, it usually readily yields to antisyphilitic treatment, if recent; but even here electricity is useful, since degeneration of nerve and muscle rapidly occurs. In intracranial disease the treatment of the facial paralysis is usually subordinate to that of its cause. When there is indication of sudden and increasing mischief at the nucleus of the nerve, galvanism must be employed with caution.

The treatment of double facial paralysis presents no special points for consideration.

W. R. Gowers.

FACIAL SPASM.—Synon.: Mimic cramp. Fr. *Tic convulsif.* When affecting the eyelids, Blepharospasm; Nictitation.

Definition.—Spasm, sometimes tonic but more often clonic, involving some of or all the muscles supplied by the facial nerve.

Ætiology and Symptoms.—Spasm in the face may be part of a wider convulsive movement, as in epilepsy, hysteria, chorea, or torticollis, diseases dependent on central change. Secondly, it may be due to irritation of the trunk of the facial nerve by growths, pressure, or caries of the temporal bone. Spasm of this form may follow facial paralysis. Thirdly, it is very commonly reflex, produced by the application of cold, by intestinal worms, or especially by some disease or injury of the fifth nerve. Affections of the eye frequently lead to spasmodic closure of the lids—*blepharospasm.* Lastly, in other cases no cause can be assigned for it, especially in the local clonic spasm affecting the eyelids—one or both—and known as involuntary winking or *nictitation.* The latter form is seen especially in neurotic persons; in nervous children it is not uncommon, and in hysterical girls. It is markedly increased by emotion and attention. All forms cease during sleep.

Prognosis.—The prognosis of facial spasm is good, if the cause can be discovered. Where there is no discoverable source of reflex irritation the affection is often most obstinate.

Treatment.—General tonics and local sedatives are the most important elements in the treatment of most forms of facial spasm. When irritation affects the fifth or the facial nerve, counter-irritation by blisters is useful. A careful search must be made for reflex or other causes, and if possible they must be removed, decayed teeth extracted, and neuralgia relieved. When there are tender places in the course of the fifth nerve, pressure on which stops the spasm, much improvement can usually be obtained. Morphia, belladonna, and aconite are the best local sedatives; the former may be used as a hypodermic injection or by inunction. Arsenic may be injected in some cases with advantage. Iron and quinine are useful, especially the latter. Bromides and phosphorus are of little value. Where the affection runs into an habitual movement, facial gymnastics may be of service. A weak voltaic current, applied from the ear to the muscles, unbroken, may do some good; but it rarely, if ever, affects a cure. The same is true of the application of voltaism to the sympathetic. *See* Eye, and its Appendages, Diseases of.

W. R. Gowers.

FACIES HIPPOCRATICA (Latin).—A peculiar expression of the face, so named from having been graphically described by Hippocrates. It is most strikingly observed in persons exhausted by copious discharges, as in cholera, by prolonged wasting diseases, or by starvation; and especially before impending death. It is thus described by Hippocrates:—'A sharp nose, hollow eyes, collapsed temples; the ears cold, contracted, and their lobes turned out; the skin about the forehead being rough, distended, and parched; the colour of the whole face being green, black, livid, or lead-coloured.'

FÆCES, Examination of.—An examination of the fæces frequently affords valuable evidence of the condition of the organs engaged in the process of digestion, and furnishes important data on which to found a diagnosis, and suggest a rational treatment. Not only may structural changes in the alimentary tract be discovered, but also the completeness of action of the various digestive juices be recognised. As with the examination of the renal secretions, a previous knowledge of the healthy characteristics is an essential; that being granted, the investigation may be pursued on the same lines in both cases, as regards the general, microscopic, and chemical characters. Since, however, these characters are more directly dependent on the ingesta, and less upon the excretions, their examination cannot be so valuable an index of tissue-change as is the investigation of the urine.

I. **Physical examination.**—1. Quantity. This is extremely variable. Taking the normal average for an adult to be about 5 ounces daily, it may vary from 2½ to 10½ ounces. The quantity would seem to bear no relation to the size or weight of the individual, but is rather influenced by the quantity and kind of food, and the activity of the secretions of the alimentary canal. As a rule, the amount is increased by a vegetable diet. In children it would seem the total daily amount is relatively slightly greater, whilst in old age there is an absolute diminution. When in disease the quantity is increased it is chiefly of the fluid portion, whilst a diminution affects both the solid and fluid parts. Tea is said to diminish the quantity of the fæces (Chambers). *See* Constipation, and Diarrhœa.

2. Consistence and Appearance.—Departures from the normal cylindrical shape are frequent, and depend very much on the existence of constipation or diarrhœa. In infants the evacuations should be unformed and of a pappy consistency. The contents of the bowels pass from a semifluid condition in the ileum to the firmer state in the colon, mainly from an absorption of fluid constituents; should there be any delay in the passage the motions are liable to become hard and nodular (scybala), and this may occasionally be extreme, the fæces having all the appearance of sheep's dung, and being passed with considerable pain. On the other hand, an increased frequency of action of the bowels (diarrhœa), is associated with motions of all degrees of fluidity. This is very marked in the various forms of irritation to which the intestinal mucous membrane is liable, from the simple effects of a saline purge to the extreme conditions of ulceration, as in typhoid fever or dysentery.

The existence of hæmorrhoids, rectal growths, or an enlarged prostate, may be recognised by groovings and marks on the excrement. Among drugs, iron and vegetable astringents will render the fæces hard and firm. Occasionally the motions are passed in a fermenting condition, due to the presence of sarcinæ, and present a frothy brown, or yeast-like, appearance, similar to certain vomits.

3. Colour.—This is dependent on the bile-pigments, and is subject to considerable variation even within the limits of health. The usual brown colour becomes much darker if long retained, or with an exclusively meat diet, and pale yellow with milk food, as seen in infants, and tends towards a greenish tint when vegetables form the bulk of the food.

The most important abnormal causes affecting the colour are the following:—

(α) *Bile.*—Obstruction to the passage of bile into the duodenum, causing the motions to be clay-coloured, or putty-like. Such evacuations are often combined with distinctly bile-coloured fluid, which is secreted by the mucous membrane of the bowels from the bile-laden blood, &c., as is the coincident high-coloured urine. In extreme anæmia and the rickety cachexia the stools are usually pale from deficiency of bile-pigment.

(β) *Blood.*—This may either appear as streaks or patches of pure blood on the surface of the motion, as is the case when hæmorrhoids or ulceration of the rectum exists. Or the fæces may be of a uniform brick-red or almost black colour when there has been a hæmorrhage from the intestinal surface, the blood becoming intimately mixed with the fæces, and more or less affected by the sulpheretted hydrogen of the bowels, forming a black sulphide of iron. If the blood has escaped into the stomach the action of the gastric juice on the blood-pigments is such as to convert the fæces into a tarry-looking material of a very characteristic appearance. *See* Melæna.

(γ) *Articles of Diet, Drugs, &c.*—Among the former may be mentioned spinach, coffee, claret, and porter, which confer on the excrement their characteristic tints. Among the latter, logwood and charcoal may be detected by their colour in the fæces. Salts of iron and bismuth, by being converted into the sulphides, render the motions black or olive-green.

The exact cause of the green stools so frequently seen in children during dentition is uncertain; whether it be due to a direct conversion of blood that has been slowly effused into the alimentary canal, by the digestive juices and gases, or whether it be bile-pigment altered by these same agents. Inasmuch as the biliary colouring matters are more or less directly obtained from the hæmatin of the blood, the original source of this green colour (biliverdin) is the same in both cases. But its occurrence cannot be certainly taken as an indication of increased secretion of bile, for it possibly may depend on a diminished absorption.

4. Odour.—The characteristic odour of the fæces is in part due to certain substances developed during pancreatic digestion and partly to special secretions from the glands of the colon, as well as to certain articles of diet such as garlic, or of medicine such as sulphur. Disturbance of either of the above conditions will affect the odour. Absence of bile from the alimentary canal, by interfering with the pancreatic digestion, and also by the want of its own special antiputrescent power, is accompanied with very ill-smelling motions. In this case the fæces may be almost putrid, which is not a normal condition. This state is still more marked in certain diseases of the colon, as dysentery, when the evacuations are of a most foul and acrid character. In children the alvine discharges are very apt to be offensive from errors in diet, or to emit a peculiar sour odour.

5. Foreign bodies.—By inspection of the evacuations we may discover:

(*a*) Substances *accidentally* swallowed, such as coins, pins, &c.

(*b*) *Indigestible food*, such as fish-bones, cherry-stones, &c.

(*c*) *Undigested food.*—Portions of food that have escaped digestion. In certain severe disturbances of the digestive functions some of the food may be passed scarcely, if at all, altered soon after ingestion, and may be easily recognised. This condition, known as lientery, is especially prone to occur in the intestinal catarrh of young children during dentition.

(*d*) *Fatty or soapy masses.*—These may follow the administration of oils—castor, cod-liver, &c. They are more likely to occur when the biliary and pancreatic secretions are deficient, and appear as nodular masses, as large as filberts, or as cylindrical pieces, which have been compared to macaroni. Curdy lumps derived from milk are often met with in infantile diarrhœa.

(*e*) *Entozoa*, such as segments of tænia, the various round-worms, or the contents of hydatid cysts that may have burst into the canal.

(*f*) *Gall-stones, intestinal concretions, mucous or membranous casts of the intestines, portions of bowel sloughed off from intussusception, &c.*

II. Microscopical examination.

Method.—The evacuations, when of ordinary consistency, require to be shaken up with two or three times their bulk of distilled water and allowed to stand. This may be repeated several times, and the washings successively submitted to microscopic examination, as well as the final sediment. When the discharges are very fluid this process is not needed.

Constituents.—The usual microscopic constituents of the fæces are—

(α) *Undigested and indigestible residues of the food.* Such are starch-cells, woody fibres, particles of husks of corn and other seeds; muscular fibres with their characteristic structure and generally bile-stained; shreds of elastic tissue and fibres from the blood-vessels; portions of cartilage; hairs.

(β) *Epithelium.*—This is derived from the mucous membrane of the canal. The cells may be more or less distinct and separate, or form by cohesion amorphous yellowish masses which constitute a considerable portion of the solid matter.

(γ) *Oil.*—Occasional oil-globules are seen.

(δ) *Crystals of triple phosphates.*

(ε) *Amorphous granular matter.*

Since the nature of the food varies so widely it is impossible to state anything in regard to the relative proportions in which these objects occur. In certain states they are found absent or in excess. When from any cause the fats are imperfectly digested they may be recognised in the discharges. Crystals of ammonio-magnesian phosphates are very abundant in typhoid evacuations. The spores of fungi, and the ova of intestinal parasites, and the hooklets of hydatids may be met with, and bacteria would seem to be very frequent, possibly in connection with pancreatic digestion.

III. Chemical examination.—The imperfect knowledge we possess of the actual chemistry of the tissues and secretions, with the exceeding variety in the composition of the ingesta, prevents our obtaining, from any analysis of the fæces, much information of a practical character. It is seldom if ever that such examination furnishes evidence of primary importance, as does the urine; it is only occasionally that the results correspond to what other signs and symptoms indicate to be the case.

On an average the fæces contain about 23 per cent. of solid matter to 77 per cent. water, but this proportion is liable to the widest variations both in health and disease. Thus in cholera-stools the solid residue may be but a few grains per pint.

1. Special Constituents.—Two bodies—excretin and stercorin—have been described as characteristic of the fæces. Both are non-nitrogenous, crystallizable, non-saponifiable bodies, the former containing sulphur. They differ in their crystalline form and solubility in alcohol and ether. They appear to be closely related to cholesterin, with which in many points they agree. It is found that when the bile which normally contains cholesterin is prevented reaching the intestines, that neither of these bodies occur in the fæces; and that they are also absent, being replaced by cholesterin in the meconium, and in starving and hybernating animals, when there is no obstruction in the bile-flow. Flint considers about ten grains per diem to be the average amount of stercorin and the excretin of Marcet to be about a fifth of that. Cholesterin itself, except in very small quantities, cannot be regarded as a normal constituent of the fæces, but the precise significance of its occurrence is uncertain.

2. Fatty Acids, Fats and Soaps.—Excretolic acid, one of the fatty series, is described by Marcet as a constant ingredient. Free stearic and margaric acids only occur in minute proportions, in ordinary circumstances, but are readily increased to considerable amounts when the alkaline secretions of the liver and pancreas are prevented entering the intestines. A vegetable diet is also said to increase them. Butyric acid does not seem to be of normal occurrence in human fæces. The presence of neutral fats in the excrement may be taken to indicate that there has been excessive ingestion or a diminished digestion, since under ordinary circumstances they would be absorbed. The soda and potash soaps ordinarily formed by the ingested fats with the bile and pancreatic juices should be in great part taken up by the lacteals; but a portion meeting with any lime or magnesian salts that may be in the alimentary canal, form with them insoluble hard soaps which are passed in the fæces. Marcet describes a case in which a large quantity of bi-stearate of soda was voided, the bile and pancreatic juices having been absent from the intestine.

3. Salts.—They form but a small amount, and are chiefly the earthy and triple phosphates, with small quantities of iron and silica; there is a marked absence of chlorides. When the stools are very alkaline the triple phosphates may be very abundant, and in cholera-discharges the whole amount of salts is largely increased, there being nearly an ounce in every hundred fluid ounces of evacuation, a large proportion of which consists of chlorides.

4. Pigment.—The ordinary colour of the fæces is due to a modification of the bile-pigments, but the exact nature of the change is unknown. The absence of colour from the discharges when there is an arrest of bile-flow has been referred

to; but though clay-coloured stools as a rule do indicate such arrest it is not invariably so, for the writer has met with a case in which normally coloured fæces in the small intestines were absolutely deprived of their pigment in passing over a diseased portion of the lower end of the ileum.

5. Mucus, Albumen, &c.—There is usually a small amount of mucus passed with the fæces, and this may be considerable in amount, resembling jelly, when any irritation of the rectum or colon exists, or occasionally more condensed, forming cylindrical casts of portions of the canal.

Albumen as such can scarcely be looked upon as a normal ingredient of the evacuations, but the fluid part of cholera-stools, which resembles blood-serum in composition, contains a very appreciable quantity.

Ferments similar in action to ptyalin and pepsin are described as existing in the fæces, but how they may be modified in disease is quite unknown.

Next to the undigested and indigestible residues of food, the fæces may be regarded as an excretory channel of certain materials from the blood by means of the bile. The other digestive juices are probably re-absorbed. As an index, however, of bile-excretion, the fæces are very unreliable, inasmuch as no ingredient of the bile is normally found in them as such. Whether pigment, bile-acids, or cholestearin, they all undergo a change. The occurrence, therefore, of any of these materials in the alvine discharges may be taken as evidence that the changes in the biliary constituents which should take place in the intestines are interfered with.

6. Reaction.—As a rule, the reaction of the fæces is acid, showing that there is no putrid decomposition. Occasionally, however, it may be slightly alkaline. When the strongly alkaline secretions of the liver and pancreas are prevented through obstruction or disease from entering the canal, the motions may be strongly acid from the existence of free fatty acids.

For the **Diagnostic Characters** of the **Fæces** in disease, *see* Stools, Characters of.

W. H. Allchin.

FÆCES, Involuntary Discharge of.—Under normal circumstances the fæces are retained within the rectum by the closure of the sphincter ani. When defæcation takes place the sphincter is relaxed, there is increased peristalsis of the lower bowel, and there is pressure on the intestines, from the contraction of the expiratory muscles with the glottis closed. The nerve-governance of these three phases of the act is different in each case. The contraction of the abdominal muscles is mainly due to an effort of the will. The activity of the colon and rectum is reflex, from irritation of the intestinal ganglia by the accumulated fæces. Lastly, the relaxation of the sphincter depends on the inhibition of the tonic centre in the lumbar enlargement of the spinal cord; such inhibition being brought about either in a reflex manner from the rectum or directly from the cerebral centres. It is obvious that the relaxation of the sphincter is the most important stage in the act, for until that takes place no discharge can occur. Up to a certain point the increased peristalsis and pressure on the bowels may be resisted by a voluntarily increased contraction of the sphincter, but at a certain stage the inhibiting influence is exerted, and relaxation results. Since this influence is beyond the control of the will, it would follow that the chief causes of the involuntary discharge of the fæces are to be found in those conditions which interfere with the normal tonicity of the sphincter. At the same time, any circumstances which may increase the pressure of the abdominal muscles or the activity of the bowels much beyond what ordinarily occurs, may lead to an involuntary discharge.

Ætiology.—The causes of involuntary discharge of fæces may be thus tabulated:—

1. *Violent contraction of the expiratory muscles*, such as may be induced by strychnia-poisoning. It is of rare occurrence in tetanus.

2. *Increased peristaltic action* of the intestines. This is chiefly dependent on causes of irritation situate in the bowels themselves, such as inflammation or ulceration of the walls; irritating contents; worms, &c. Extreme fluidity of the fæces is frequently sufficient to induce their partially involuntary discharge, and is noticeable in the diarrhœa of infants and children.

3. *Abnormal relaxation of the sphincter ani.* As already said, the previous mentioned causes are powerless to produce the discharge of the fæces until the sphincter yields; and how far the sphincter may relax as a result of their efforts, or independent of them, is not easy to determine. The nervous influence emanating from the lumbar centre which normally determines the tonic state of the sphincter may be inhibited—

a. Reflexly, as from worms, fissure of the anus, or calculus vesicæ. It is quite true that the immediate result of irritating the sphincter is to determine in a reflex manner an increase of its contraction, as may be experienced in introducing instruments, &c., into the rectum; but it would also seem that at a certain point the irritation may lead to an arrest of the tonic influence, and so allow the sphincter to yield, and this is particularly the case with affections of the bladder.

β. From cerebral disease. That certain emotional conditions may lead to involuntary defæcation is well known, and that a similar result follows some diseases of the cerebral centres is not uncommon. The paralysis of the sphincter that occurs under these circumstances is brought about by inhibiting the normal tonic stimulus emanating from the lumbar centres. Involuntary evacuations frequently occur in epileptic fits; in profound comatose states induced by apoplexy, opium and other forms of poisoning; and in death by hanging or suffocation. Its occurrence can scarcely be regarded as indicating lesion of any one part of the cerebral centres, but rather as a result of what at present are termed general brain-states. It constitutes a troublesome complication in such chronic forms of brain-disease as general softening, paralysis of the insane, &c.

γ. From spinal disease. The relaxation of the sphincter may of course be produced by disease or injury of the lumbar enlargement of the spinal cord. Inasmuch as it is from the cells of this region that the normal tonic influence is understood to emanate, a destruction of the nervous tissue can readily be understood to prevent the origination of such stimulus to contraction. It is noticeable that changes in the substance of the cord itself, myelitis, &c., are more frequently accompanied by paralysis of the sphincter than is spinal meningitis.

3. *From local disease.* The control over the sphincter may be lost from injury to the muscle itself, as occurs in laceration of the perinæum, involving the lower end of the bowel.

Treatment.—Beyond removal, when possible, of the cause, no direct treatment of incontinence of fæces is of avail. As a distressing complication of certain diseases of the nerve-centres, which are too frequently incurable, little remains to be done for it beyond adopting such measures as will permit of the escape of the discharge with every regard to cleanliness. W. H. Allchin.

FÆCES, Retention of.—Ætiology.—In the absence of mechanical obstruction, such as adhesions, bands of false membrane, uterine pressure, stricture, tumours, morbid growths, or hæmorrhoids, the main causes of fæcal accumulation are:—(*a*) a sub-paralysis of the intestinal muscular fibres from defective innervation, or from over-distension of the walls of some portion of the large bowel; (*b*) loss of reflex irritability of the rectum; and (*c*) dryness of the mucous surface of the colon. Hence it is frequently met with in the debilitated, the bedridden, the paralysed, the aged, and the sedentary, and women are more prone to it than men. Loss of reflex sensibility in the rectum is frequently the sole cause. The fæces delivered into the rectum by the contractions of the sigmoid flexure and the descending colon no longer excite the act of defæcation, and collecting there as a large dessicated mass, determine a gradual and painless retention in the colon, and particularly in the most distensible parts—the sigmoid flexure and the cæcum. The accumulation once set up tends also to perpetuate itself by arresting more and more the peristaltic movements, and leading to atrophy of the walls of the bowels.

Symptoms.—Fæces often accumulate slowly and without the knowledge of the patient; hence in cases in which sensibility has been blunted by age, disease, or great debility, the discovery of large collections in the rectum or colon may surprise even the practitioner, who is generally led to a local examination by disturbances set up by the retention. There is usually constipation or an insufficient discharge of solids; a regular and even excessive relief of the bowels does not, however, exclude accumulation, for even fluid fæces may pass through the centre of or over old collections. The evacuations are lumpy, or consist of detached hard, dry, dark scybala, or of a single mass; when the accumulated matters are dislodged by aperients, they often emit an offensive and sour odour. Fæcal collections in the rectum and sigmoid flexure are apt to excite tenesmus and frequent voiding of mucus and blood, but without the putrid flesh-like odour of dysenteric evacuations; and the finger encounters a mass of hardened fæces in the rectum.

An accumulation in the cæcum, or any part of the colon, may be detected through the abdominal wall as a tumour more or less movable and uneven, and doughy to the touch; and in rare cases the large bowel throughout may be so greatly distended as to apparently fill the abdomen with a solid mass which, like other fæcal collections, yields to the firm pressure of the finger. A tympanitic state of the abdomen may, however, so obscure the examination as to prevent the recognition of even moderately large accumulations.

Flatulence, colicky pains, inflammation, (typhlitis, colitis), ulceration and perforation—the cæcum is by far the principal seat of this accident—and intestinal obstruction, are not uncommon results of retention of fæces, concerning which the reader is referred to the articles on Constipation; Cæcum, Diseases of; Colon, Diseases of; Flatulence; and Colic.

Treatment.—A hard ball of fæces or of agglutinated scybala in the rectum resisting dislodgment by aperients, or enemata, should be broken up and removed, by introducing within the sphincter two or three fingers, a scoop, or the handle of a spoon. This may be facilitated by introducing the fingers within the vagina in the female. Fæcal concretions in this situation, even though not impacted, may require similar mechanical aid; and in consequence of the hardness and size of these bodies the extraction is frequently difficult. When purgatives and injections fail—the former perhaps aggravating the vomiting induced by the obstruction—a long elastic tube should be passed through the indurated mass which resists its progress, and warm olive oil, followed by milk or gruel, should be gradually injected by the stomach-pump or Davidson's syringe; sometimes, however, large injections as ordinarily administered, repeated twice or three times a day, render this proceeding unnecessary. The removal of collections of hard fæces in the rectum may be facilitated by macerating them with suppositories of cacao-butter, or of glue or isinglass softened in cold water, While a brisk aperient, such as a full dose of calomel, or castor oil with croton oil, may afford timely aid, the general medicinal treatment of the accumulation should consist of a prolonged course of gentle, yet efficient evacuants combined with tonics. The gradual collection of fæces, the toneless state of the walls of the large bowel, the scanty secretion of intestinal mucus, and the loss of reflex sensibility in the rectum, require the persevering use of these remedies. A pill containing aloes, belladonna, and nux vomica—to which extract of colchicum is often a useful addition —generally affords the most satisfactory results. When aperients fail to dislodge the fæcal collections, and the abdomen becomes painfully distended, a combination of opium, belladonna, and aloes, given at regular intervals—the dose of aloes, at first small, being increased as the pain diminishes—may enable the bowel to overcome the difficulty; but when there is severe pain, and above all obstinate, and especially stercoraceous vomiting, opium and belladonna should be given alone or with nux vomica until the subsidence of these symptoms, when aloes may be prescribed along with these agents with the best effect. Obstruction from paralysis of a portion of the bowels in which fæces have accumulated may be met by strychnia, 'restoring capacity of action,' followed by a mild aperient which promotes peristalsis, or by the interrupted galvanic current. Distressing tympanites, which, thwarting the peristaltic movements, intensifies the obstruction, has been overcome by puncture of the cæcum with a fine trochar or aspirator after failure of other means; but this proceeding is not unattended with danger of fatal peritonitis from fæcal extravasation, or from perforative ulceration set up by the punctures, and cannot be safely recommended. GEORGE OLIVER.

FAINTING.—A popular synonym for syncope. *See* SYNCOPE.

FAINTNESS.—Faintness signifies a feeling of great weakness or exhaustion, as if the subject of it were about to become exhausted, or to sink or faint.

FALLING SICKNESS. — A popular synonym for epilepsy. *See* EPILEPSY.

FALLOPIAN TUBES, Diseases of.—The oviducts are liable to the following morbid conditions:—1. Malformations; 2. Displacements; 3. Contractions; 4. Dilatations; 5. Inflammation; 6. New Growths; and, 7. Tubal Pregnancy.

1. **Malformations.**—The Fallopian tubes may be congenitally wanting, either on one or on both sides; or they may be impervious; and, instead of a single opening into the abdominal cavity there may be two or more.

2. **Displacements.** — The tubes may be stretched or widely displaced from their normal position by growths or effusions in their neighbourhood, such as ovarian, parovarian, &c.

3. **Contractions.**—These canals may be impervious, from inflammation of the lining membrane, or from peritonitis, pressure, or torsion.

4. **Dilatations.**—The Fallopian tubes may be distended, even to a great degree, by (*a*) mucous or serous fluid (*hydro-salpinx*); (*b*) pus (*pyo-salpinx*); or (*c*) blood (*hæmo-salpinx*). In hydro-salpinx the tubes, if much distended, become sacculated, giving rise to a string of cystic tumours. The fluid collects chiefly at the abdominal end of the tube, but occasionally it may escape, and in large quantity, through the uterus. Should the tube burst and discharge its contents into the peritoneal cavity serious results may ensue, especially if the fluid be pus. When hæmo-salpinx is the result of menstrual retention from atresia uteri, bursting of the tubes internally is apt to follow operations for the relief of the obstruction.

5. **Inflammation.**—Inflammation of the Fallopian tubes (*salpingitis*) is apt to be caused by gonorrhœal infection, or it may occur during the puerperal state. Stenosis or *pyo-salpinx* may be the result.

6. **New Growths.**—The Fallopian tubes may be the seat of the following new growths—fibroid tumours, mucous polypi, cysts, cancer and tubercle. Lipomata, involving the integrity of the tubes, may also arise in the adjacent tissues. Fibroids resemble those of the uterus, and may attain a considerable size. Small polypi growing into the canal may partially obstruct the duct. The cysts are usually the so-called *hydatids of Morgagni*, an embryological relic; but other small simple cysts may be met with at the orifice of the tube, around the morsus diaboli. Primary cancer of the tubes rarely, if ever, occurs. Tubercle, however, may be primary, and may occur before puberty. It usually begins at the abdominal end, and may lead to blocking of the tube.

7. **Tubal Pregnancy.**—An important affection of the Fallopian tubes is that arising from the variety of extra-uterine pregnancy called tubal, where the product of conception grows within the tube in some part of its course. This abnormity is apt to be attended with very serious results, bursting of the tube frequently occurring about the third month of gestation; and serious, sometimes fatal, internal hæmorrhage may hence ensue. Tubal gestation usually occurs on one side only, while other affections of the tubes are often symmetrical, a point of diagnostic importance. *See* PREGNANCY, Disorders of.

Regurgitation of blood, of septic matters, and of fluids injected into the uterus, sometimes takes place along the Fallopian tubes, and this accident is always attended by grave consequences.

Mechanical Obstruction of the Fallopian tubes is not an infrequent cause of sterility.

TREATMENT.—The diagnosis of affections of the Fallopian tubes being difficult, their treatment is likewise obscure; and must be in a measure guided by general principles in each case. In pyo-salpinx severe peritonitis and death may result from rupture of the sac, as may speedy dissolution from internal hæmorrhage in tubal gestation. In the former case, and in hydro-salpinx, puncture with the aspirator might be permissible were a clear and unequivocal diagnosis made. In the latter case proximal ligature of the implicated tube might save life, but the diagnosis is surrounded by so many difficulties that such an operation can only rarely be justified.

ALFRED WILTSHIRE.

FALSE MEMBRANE.—An inflammatory exudation of a fibrinous character, which is deposited in layers, chiefly on mucous surfaces, and occasionally on abrasions of the skin. It is well exemplified by the deposit in diphtheria and plastic bronchitis.

FAMILY DISEASES.—Diseases which are found to run in families, or diseases to which members of the same family seem peculiarly liable. *See* DISEASE, Causes of.

FARADISATION, Uses of. *See* ELECTRICITY.

FARCY.—A synonym for glanders. *See* GLANDERS.

FASCIÆ (*fascia*, a band).—The fasciæ are subjects of medical and surgical interest, with respect both to their anatomical relations, to the diseases to which they are liable, and to points of diagnosis in connection with them.

I. **Anatomical Relations of Fasciæ.**—The situation and connections of the fasciæ, according as they are fasciæ of *investment* or fasciæ of *attachment*, are of the greatest practical impor-

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tance in the following classes of diseases:—1. Suppuration; 2. Extravasations, and Cellular Emphysema; 3. Herniæ; 4. Dislocations; 5. Diseases of Encapsuled Organs; and, 6. New Growths.

1. SUPPURATION. — The physical influences exerted by fasciæ upon pus are chiefly two. First, fasciæ may limit the size of an abscess, determine its tension and the many results of the same, and thus affect both the local phenomena and the general symptoms. Secondly, when the pus is not confined, the fasciæ serve to determine the course that it will take and the situation in which it will discharge. Every abscess may be said to be influenced in this way by the relations of fasciæ, but certain fasciæ have to be specially noted as causing pus to burrow, and hence they should be enumerated here:—

a. Fasciæ of the Head and Neck.—The fasciæ of the scalp; the temporal fascia; the cervical fascia; and the post-pharyngeal fascia, which conducts pus from the cervical vertebræ to the parotid region and tonsil, and to the region of the carotid vessels.

b. Fasciæ of the Upper Extremity.—The axillary fascia; and the deep fascia of the upper extremity generally, including the palmar fascia and the sheaths of the tendons.

c. Fasciæ of the Thorax.—The fasciæ of the intercostal spaces and of the mammary region; the fasciæ reaching from the neck to the upper part of the pericardium and the aorta, and to the posterior mediastinum, respectively; the fasciæ of the anterior mediastinum; and the fasciæ connected with the diaphragm—all of which determine the course of intrathoracic abscesses.

d. Fasciæ of the Abdomen and Pelvis.—The transversalis fascia; the fasciæ connected with the transversalis muscle, especially posteriorly, which influence the course of lumbar abscess; the sheaths of the psoas and the iliacus; the pelvic, recto-vesical, obturator and anal fasciæ; the fascial investment of the prostate; the superficial and deep layers of the superficial fascia of the perinæum; the superficial and deep layers of the triangular ligament; and the fascial investments of the rectum, bladder, uterus, and vagina, which determine the course of purulent collections in the pelvis.

e. Fasciæ of the Lower Extremity.—The fascia lata and its processes; the tensor fasciæ femoris; the popliteal fascia; the deep fascia of the leg; and the plantar fascia and its compartments.

2. EXTRAVASATIONS AND CELLULAR EMPHYSEMA. —When blood or urine escapes from its natural reservoirs, or when air or gas has found its way amongst the tissues, the direction that the extravasated substance takes is markedly influenced by the fasciæ with which it comes in contact. The principal fasciæ of importance in this respect are as follows:—

a. Fasciæ of the Head and Neck.—The fasciæ of the scalp, and the cervical fascia.

b. Fasciæ of the Thorax.—The fasciæ of the intercostal spaces; and the mediastinal fasciæ, through connections with the cervical.

c. Fasciæ of the Upper Extremity.—The deep fascia in general.

d. Fasciæ of the Abdomen and Pelvis.—Scarpa's fascia, or deep layer of the superficial fascia; both layers of the superficial and of the deep perineal fascia; and the fasciæ of the prostate and bladder—all being of the greatest importance in cases of extravasation of urine or fæces.

e. Fasciæ of the Lower Extremity.—The fascia lata in general; the popliteal fascia; the deep fascia of the leg; and the plantar fascia.

3. HERNIÆ.—The occurrence of herniæ, and the direction that they take, are in a great measure determined by the condition of the fasciæ in contact with the viscera. Most important in this relation may be mentioned—the fascia transversalis, the iliac fascia, the sheath of the femoral vessels, the obturator fascia, the cribriform fascia, and the fascia lata.

4. DISLOCATIONS. — Certain fasciæ serve as supports for the heads of bones, and for the viscera; and these will have an important influence either in promoting or in preventing dislocation, displacement, or other injury of these parts, as the case may be. The shoulder is supported by the costo-coracoid fascia, and this relation considerably affects the signs of dislocation at that joint. In fractures of the patella, the fasciæ of the knee-joint promote separation of the fragments. The fascia of the neck helps to support the pericardium, and must limit the displacements of the heart. The bicipital fascia of the forearm protects the brachial artery beneath it in venesection, at the bend of the elbow. On the other hand, the attachment of the cervical fascia to the jugular veins facilitates the entrance of air into the circulation through a wound at this point. And, lastly, the pelvic viscera are supported by the transversalis, pelvic, iliac, and recto-vesical fasciæ; whilst the cord and testis have their special fasciæ to keep them in position.

5. DISEASES OF ENCAPSULED ORGANS.—A considerable number of organs, many important vessels, and a great variety of muscles are contained in distinct fascial capsules, sheaths, or envelopes, which will affect the course of the diseases of these structures in many ways—defining their limits, or determining the direction in which they spread, and thus influencing both their local and general phenomena. This has been already alluded to under the first head; but it is necessary to enumerate here the principal fasciæ that act in this way, namely:—*a. Arterial sheaths*:—of the carotid, subclavian, thoracic-aortic, and femoral. *b. Muscular sheaths*:—of the masseter, buccinator, psoas, iliacus, quadratus lumborum, erector spinæ, pectineus, rectus abdominis, levator ani, tensor vaginæ femoris, and the palmar and plantar muscles. *c. Visceral capsules*:—of the thyroid gland, parotid and submaxillary glands, tongue, prostate, penis, vagina, bladder, rectum, and mamma.

6. NEW GROWTHS.—The direction, rapidity, and extent of spread of new growths are considerably modified in certain situations by the relations of the fasciæ above described.

II. Pathological Relations of Fasciæ.—The principal diseases of fasciæ are:—1. Inflammation and its results; 2. Ossification; 3. Calcification; 4. Rheumatism; 5. Gout; 6. Syphilis; 7. Contraction; and 8. Extension.—None of these conditions can be said to be common, or of serious importance.

1. Inflammation.—Inflammation involving a fascia is usually secondary, having spread to it from the neighbouring structures, and especially from the muscle or organ of which the fascia may form the sheath. Even under these circumstances, a fascia rather resists than participates in the inflammatory process, as has been described above; and when it is involved it tends to ulcerate on account of its feeble vitality, and to be discharged in the form of sloughs. The healing process is extremely slow in fasciæ, and after serious lesion their function is never completely restored.

2. Ossification.—Occasionally in aged persons portions of fasciæ are found transformed into bony tissue.

3. Calcification.—Calcification is very rare in fasciæ.

4. Rheumatism.—The condition known as muscular rheumatism, or according to its situation as lumbago, torticollis, &c., is believed by some authorities to involve the fibrous coverings or fasciæ of the affected parts. In the same way, many of the aches of some forms of 'chronic rheumatism' may possibly have their seat in fasciæ; and certain cases of neuralgia are probably to be referred to rheumatic inflammation of the nerve-sheath.

5. Gout.—Amongst the pains of the gouty subject are some which are no doubt due to affections of fasciæ, such as pains in the heel and instep, and neuralgia of the sciatic, the anterior crural, and the brachial nerves.

6. Syphilis.—Syphilis may attack the fasciæ in the form of nodes, which in places of low vascularity are apt to ulcerate, as, for example, at the inner aspect of the knee.

7. Contraction.—Contraction is the most obvious of the morbid conditions of fasciæ, giving rise as it does to well-marked deformities. The fasciæ of the hand and foot are most liable to this change, with the result of unnatural flexion of the fingers and toes. Such contraction of the palmar and plantar fasciæ may be due to wounds, burns, or inflammation from any cause, or to gout or rheumatism; it is sometimes congenital; and it sometimes occurs without evident cause.

8. Extension.—A fascia or sheath, though extremely inelastic, is liable to be stretched by swelling of the parts which it envelopes; and, if the cause do not speedily disappear, may remain more or less permanently extended. The best instance of this condition is pendulous abdomen after pregnancy or other form of abdominal enlargement. J. Mitchell Bruce.

FASCIOLA (*fasciola*, a thin band).—A genus of trematode parasites of which the common liver-fluke forms a good type. This entozoon (*F. hepatica*) is characterised by the possession of a branched intestinal canal, thus differing from the flukes belonging to the genus *Distoma*, in which the canal is simple and bifurcated. The liver-fluke is of rare occurrence in man, though extremely abundant in, and destructive to, ruminating animals. *See* Distoma. T. S. Cobbold.

FASTING.—The manifestation of vital activity implies consumption of material; and unless the supply of material in the form of food is equivalent to the loss occurring, a progressive wasting of the body and failure of power must ensue. Hence these phenomena constitute the necessary accompaniments of fasting; and with its prolongation the question resolves itself into one of time—when the exhaustion of material shall have proceeded to such an extent as to render the continuance of life impossible.

Pathology.—To Chossat we are indebted for showing that the immediate cause of death from fasting is a reduction of the bodily temperature. At first there is a gradual, but not very extensive fall. Afterwards a more rapid decline occurs, until the reduction amounts to about 29° or 30° (Fahr.) below the normal point, when death ensues. Chossat noticed that if, whilst in the state of torpor preceding death, the temperature of the animal experimented on was raised by exposure to artificial warmth, a restoration of consciousness and muscular power was induced; and some of his subjects of experiment which were thus rescued from impending death afterwards thoroughly revived on being supplied with food.

Symptoms.—The most prominent symptoms arising from fasting are those due to the special sensations produced by the absence of food and fluid, and those attributable to a decline of the physical and mental power. In the first place there is great uneasiness in the epigastrium. This is followed by a sense of sinking in the same region, accompanied by insatiable thirst; and if fluid be persistently withheld as well as food, the thirst becomes the chief source of distress. The countenance assumes a pale and cadaverous appearance, and a look of wildness is presented about the eyes. Emaciation becomes more and more marked, and with it there is a decline of the bodily strength. There is also failure of the mental power. Stupidity may advance to imbecility; and a state of maniacal delirium frequently supervenes. Life terminates either calmly by gradually increasing torpidity, or, it may be, suddenly in a convulsive paroxysm.

Duration of Life.—The usual duration of life under complete absence of food and drink may be said to be from eight to ten days. The special circumstances, however, existing may exert a modifying influence, and from the nature of these the period may be either diminished or increased. A stout person, as may be readily understood, has a chance of living longer than a thin one, on account of the store of combustible material which may be drawn upon being larger. Exposure to cold in conjunction with starvation very much hastens death. The presence of moisture in the atmosphere favours the prolongation of life, by diminishing the exhalation of fluid from the body. It may be assumed to be owing to the existence of warmth and moisture that persons buried in mines, or otherwise similarly placed, have been known to live considerably beyond the ordinary period.

The Welsh fasting girl, about whom so much excitement was created in 1869, lived exactly eight days from the time she was placed under systematic inspection to solve the problem of whether she could exist, as had been alleged by her parents, for an indefinite period without food!

It appears that during the first part of the time she was cheerful and exhibited nothing extraordinary. Later on it was found that she could not be kept warm, and ultimately she sank into a state of torpor, from which she could not be roused and which speedily terminated in death.

In the Troedyrhiw colliery near Pontypridd an inundation occurred in 1877, which led to the imprisonment of four men and a boy in one of the headings of the mine. The accident happened on Wednesday evening, the 11th of April. Efforts were at once made, by means of a cutting, to reach the chamber in which the imprisoned persons were confined, and to release them. This was not accomplished till the afternoon of Thursday, the 19th, when all were rescued alive and did well. They had been imprisoned in an atmosphere of compressed air nearly eight days, without food but within reach of water. The more recent case of Dr. Tanner throws no new light upon the subject.

Treatment.—Caution is required in the administration of food after prolonged fasting. Sudden transitions of all kinds are trying to the body; and, instead of allowing the rescued sufferer to gratify his desire to eat and drink according to his inclination after several days' abstinence, the supply of both food and drink should at first be limited, and afterwards gradually increased. There is reason to believe that the non-observance of this rule has upon some occasions been followed by disastrous consequences which a different plan might have averted. F. W. Pavy.

FAT.—Fat becomes a disease under the following circumstances:—

1. **As Obesity.**—Fat may be found generally diffused in excessive quantity beneath the skin, beneath serous membranes, and in and upon the various tissues and organs of the body. This condition constitutes what is known as Obesity. The subject will be found fully discussed under that head.

As a **Partial Growth** of fat, which sometimes occurs in paralysed muscles, and constitutes a characteristic feature of what is called pseudo-muscular hypertrophy. *See* Pseudo-Hypertrophic Paralysis.

2. **As Fatty Interstitial Growths.**—Fat as fat-tissue becomes more especially a disease when it is deposited upon and in the textures of organs, interfering with their structure and functions. It does this by pressing upon the elements of the organ invaded; and its effects are more particularly seen when it invades the muscular tissue of such an organ as the heart, the fibres of which, becoming more or less atrophied and distorted in their course and direction, are rendered inadequate for the performance of their functions. *See* Heart, Fatty Diseases of.

3. **As Fatty Tumours.**—Fat may also occur in isolated or circumscribed masses, constituting what are known as *Fatty Tumours* or *Lipomata*. *See* Tumours.

4. **As Fatty Infiltration.**—Fat in the form of oily particles is found to be present in excess in the cells of various secreting organs, constituting fatty infiltration. Thus it appears in the epithelium of the intestinal mucous membrane during digestion; in the cells of the liver and biliary passages; and in the kidneys of certain animals—for instance, the cat. When this condition becomes permanent it must be considered as a disease. Glandular organs thus affected, as in the case of the liver, assume a buff or yellow colour, and become softer and more friable than normal; while microscopically their cells are found to contain one or more large well-defined oil-globules, which tend to coalesce and occupy the cell. The quantity of oily matter in the cells may, however, vary from time to time, and the infiltration may be either of a transient or of a permanent character. In the one case, the function of the organ may not be materially interfered with; in the other case, the activity of the cells may be so far affected as greatly to impair the secreting functions of the organ.

The causes of fatty infiltration are of two kinds—general and local. First, the *general* causes are (1) a superabundance of fatty matters in the blood, as occurs in persons who indulge in rich food and in beverages containing alcohol; (2) imperfect oxidation, as in chronic tuberculosis of the lungs; and (3), according to some observers, the metastasis of fatty deposits from one part of the body to another.

Secondly, with respect to the *local* causes of fatty infiltration, one is a peculiar affinity or selective power of the cells of certain tissues, by virtue of which they incorporate with their substance oily or fatty matter. This facility has been explained in the case of the cells of the liver and of the passages traversed by bile, by the presence of that fluid, which, as Virchow and others describe, is a powerfully determining cause of the infiltration of fat into protoplasm. Another local cause of the accumulation of oil in cells is their inactivity or imperfect power of eliminating it, as is found to occur in the cartilages of the aged, and in inactive muscles.

It must be said here, with respect to the appearance of fat in the last-named situations, that though, in some cases, it is derived unquestionably from the fat contained in the blood or chyle, it may in other instances be derived from the disintegration of the protein elements of the tissues. This subject, however, will be found discussed in the article upon Fatty Degeneration. R. Quain, M.D.

FATIGUE (*fatigo*, I weary).

General Remarks.—Fatigue is a regular and constantly returning symptom experienced by all persons. Periods of functional activity invariably alternate with periods of repose during which the waste caused by the exercise of function is repaired. We are indebted to Sir James Paget for having pointed out that 'rhythmic nutrition is a law of nature,' and although the truth of this dogma is recognised on all hands, and may be said to be axiomatic, it has hardly received that careful consideration at the hands of practical physicians which it deserves. Our whole life is composed of a series of vibrations—periods of tension alternating with periods of relaxation; and although the rapidity of these vibrations varies immensely, they are recognisable in all our acts, whether voluntary or otherwise. The vibrations of the heart are about seventy in a minute, those of the respiratory organs about sixteen. The whole body requires a certain period of absolute and continuous repose in each twenty-four hours (amounting to nearly one-third of the period), so that we may say its rate of vibration is once in the twenty-four hours. In like manner the period of relaxation of the heart is about one-third of the total period of a revolution, and this proportional correspondence between a local and a general condition is not a little interesting and suggestive. Again it is universally ordained amongst civilised nations that once in every seven days there shall be a remission of labour and a change of occupation; and we recognise the fact that it is highly advisable for those who are occupied in one pursuit to break away from it at least once a year and indulge in that variety of work which we call amusement.

Fatigue occurs directly we attempt to alter the rhythm of our vital vibrations by prolonging the periods of tension at the expense of the period of relaxation, or by demanding for any length of time a quickening of the normal rate of vibration. We recognise the fact that athletes who over-train run risks of cardiac troubles and loss of wind; that the man who from any cause is unable to sleep runs a serious risk of permanent impairment of health; and when we find patients pursuing their avocations too zealously we know that, if such offence against the laws of nature be persisted in, general paralysis, or other forms of 'break-down,' are likely to be the result.

Fatigue may be *general* or *local*, and both forms may be either acute or chronic. That fatigue in all its forms is due to impaired nutrition there can be little doubt, and we shall find that the symptoms of chronic fatigue are often the prelude of definite and recognisable degenerative changes.

DESCRIPTION.—**General Fatigue.**—General fatigue is recognised with ease both in its acute and chronic forms. There is a disability to perform either mental or physical work, and this disability is noticed first in work requiring attention or sustained effort, and last in those acts which have become automatic or secondarily automatic. The symptoms of general fatigue are usually referable to the nervous centres.

Local Fatigue.—Local fatigue is either acute or chronic, and the symptoms of it are referable usually to the muscles; but we must always bear in mind that muscle and motor-nerve are practically one and indivisible, and that recent experiments have given great probability to the idea that every muscle is connected with a certain definite spot in the brain. When, therefore, we speak of a sense of fatigue, we must necessarily be in doubt, notwithstanding the fact that the symptoms are apparently located in the muscles, whether the brain, nerve, or muscle, one or all of them, be really at fault.

Acute local fatigue.—The symptoms of acute local fatigue are, first, loss of power to a greater or less extent. By too frequent or too prolonged stimulation the irritability of the muscular tissue becomes exhausted, and it either refuses to respond, or responds but feebly to the stimulus of the will; whilst our power of adjusting the force of contraction to the act to be accomplished is lessened, and accuracy of movement and delicacy of co-ordination are destroyed. The second symptom of acute fatigue is tremor, as everyone must have experienced who has been called upon for any unusual exertion. The third symptom is cramp-like contraction; and the fourth is pain, the pain being the pain of fatigue, and absolutely distinct from other varieties of pain. Fatigue is caused far sooner by prolonged muscular effort than by repetitions of short muscular efforts having due intervals of relaxation between them. Anyone who has attempted to hold out a weight at arm's length knows the impossibility of continuing the effort for any length of time; and it is proverbially true that standing in one position is, to most people, far more tiring than walking, the reason being that in standing the muscles which support the body are subjected to a prolonged strain while in walking we use the muscles on either side of the body alternately. The great increase of power which we obtain by using the muscles on either side of the body alternatively would seem to be one of the chief reasons for the bilateral symmetry of the body. Not only is sustained effort a far more potent cause of fatigue than repeated effort, but we find that when fatigue supervenes, actions requiring sustained effort are the first to fail, and in this local fatigue resembles general fatigue. The last acts to be affected by fatigue are such as are automatic, and are accomplished without mental effort, and by the expenditure of the least possible amount of force. It is quite possible to exhaust a muscle by artificial stimulation, and if one of the small interossei muscles be continuously faradised, it will be found that in a very short time its power of contraction to any form of stimulus may be absolutely abolished. It is tolerably certain that the brain can have no share in artificial fatigue thus produced, and there seems good reason to suppose that, in some people of energetic temperament, the irritability of a muscle may be exhausted, while the power of mental stimulation remains almost unimpaired.

Chronic local fatigue.—This form of fatigue has causes and symptoms similar to those of acute local fatigue, and there can be little doubt that this condition is a common cause of many of those chronic maladies which seem to result from overwork, and are characterised by irregular muscular action. That some cases of writer's cramp (*see* WRITER'S CRAMP) are due to chronic fatigue of certain muscles employed in writing, and particularly of those subjected to prolonged effort, there can be little doubt. Some cases of torticollis seem due to the same cause. Duchenne and Brudenell-Carter have pointed out how, in cases of 'short sight,' the strain on the internal recti has caused troubles of vision, and even brain-symptoms, and quite lately Mr. C. B. Taylor, of Nottingham, has shown reason for including in the category of fatigue-diseases a peculiar form of nystagmus, occurring amongst miners, who try their eyes by working in the dark.

TREATMENT.—The treatment of fatigue in all its forms is *rest*, and the restoration of the proper rhythm of nutrition, if this be found perverted, by substituting rhythmical exercises for unrhythmical efforts. G. V. POORE.

FATTY DEGENERATION.—Synon.: Fr. *Dégénérescence graisseuse*; Ger. *Fettige Metamorphose.*

Definition.—The process by which protein elements are converted into a granular fatty matter.

Seats of Occurrence.—This change may occur in any of the component elements of the body, whether normal or abnormal.

Physiologically. The production of milk from the protoplasm of the mammary cells, and of sebum from the cells of the sebaceous glands, are instances of fatty degeneration. The cells of the corpus luteum are partly in a condition of fatty degeneration; and it is by a similar change in the peripheral cells of the mature fœtal portion of the placenta that normal involution of that organ is accomplished. Non-vascular structures, such as the cartilages, the cornea, and the intima of blood-vessels, frequently undergo fatty transformation of part of their substance. In a less marked form, fatty degeneration occurs in the walls of the uterus and other muscular organs when returning to their ordinary size after temporary hypertrophy.

Pathologically. As a purely morbid process, fatty change is most frequently met with in the muscular tissue of the heart, in the walls of capillaries, and in the urinary tubules; but it also occurs in the central nervous system, constituting the condition known as 'white softening'; in the liver; and in tubercular deposits, cancerous growths, infarcts, and inflammatory products in any situation whatever.

Anatomical Characters.—*Physical Characters.*—An organ that has undergone fatty degeneration presents the following physical characters. The bulk and weight are generally increased; the consistence is reduced, sometimes to a pulp, as in white softening of the brain; the colour is changed, either as a whole or in the affected portions of the organ, into a buffy or yellowish bloodless hue; and the resistance or firmness is diminished, so that the affected tissue is markedly flabby, and readily yields to pressure. The solid cut surface may appear compact and shining; and the section leaves a greasy stain upon the knife and fingers. When fatty degeneration is greatly advanced, as it may be seen, for example, in the liver, a portion of the organ thrown into water will float.

Microscopical Characters.—In fatty degeneration the muscular tissue of the heart and the walls of capillaries are most suitable for microscopical investigation. The earliest changes in the *cardiac muscle* in fatty degeneration are loss of sharpness of the individual striæ and the appearance of minute particles of oil between the elements. These changes, beginning near the nuclei, spread throughout the fibres in a longitudinal direction, while the particles increase in size and assume the well-known characters of oil-globules. When the process is advanced, the whole of the sarcous substance is replaced by fatty particles contained within a delicate albuminous envelope. Finally the degenerated fibres either become atrophied by absorption of certain parts of the fat, and so disappear; or suffer rupture with discharge of their contents. The fatty nature of the change is proved by the solubility in ether of the particles that have escaped from the fibres.

Fatty degeneration of the *walls of vessels* is best seen in the capillaries and smallest arteries. The tunics first lose their normal translucency; minute granules appear in their substance; and these increase to form unmistakable oil-globules. Finally the vessel gives way, and the oily particles and blood are discharged into the perivascular space.

In the other organs referred to, the microscopical characters agree with those just described, with certain differences dependent upon the special structure of each. Thus fatty degeneration of a leucocyte leads to the formation of the body known as a *compound granular corpuscle*, in which the oil-drops finally replace the whole of the protoplasm. In 'white softening' of nervous tissue, the nerve-cells and probably all the nuclei of the part are converted in a great measure into granular corpuscles; and these breaking down into a fatty detritus, the whole constitutes a soft creamy-looking substance, which, as Virchow expresses it, 'is milk in the brain, instead of in the mammary gland.' 'Yellow tubercle' consists in part of cells and nuclei that have undergone fatty degeneration, and of fatty detritus. In the case of the uterus during involution the fat is probably rapidly absorbed, so that the appearances presented to the eye are those rather of atrophy than of replacement of the muscular substance by fat.

Pathology.—We have now to trace whence comes the fat that is found in this form of degeneration, and how. It is evident that in a number of instances—such as the production of milk and sebum—fatty degeneration is a truly physiological change, which is subservient to health when active, while its derangement or cessation constitutes disease. In other cases the process is essentially pathological, as, for example, in fatty degeneration of the heart and white softening of the brain; the functional activity of the part being impaired, or so abolished that the name of *necrobiosis*, or death-in-life, has been given to the condition. The fatty change in the two instances is, however, manifestly one and the same. The condition known as fatty degeneration had long been described, and it has always been a favourite subject with pathologists to discover its nature and its cause. It was generally assumed that the fatty matter present was introduced from without, being deposited from the blood as morbid material in place of the pre-existing tissues which were absorbed. Modern research has demonstrated that this is not so, and that fat is derived from a molecular change in the tissue or textures in which it is found. The subject is one of immense importance, involving the whole field of pathology; and it is but right to state that our acquaintance with the true nature of the process, is almost entirely due to the investigations of Dr. Quain, which were published in the *Medico-Chirurgical Transactions* for 1850, and with reference to which Sir James Paget has remarked:—'Dr. Quain has candidly referred to many previous observers by whom similar changes were recognised; but the honour of the full proof, and of the right use of it, belongs to himself alone.'—*Lectures on Surgical Pathology*, 1st ed. vol. i. p. 107, *note*. Dr. Quain's conclusion was that the molecular fatty matter in the degenerated fibre was the result of a chemical or physical change in the composition of the tissue, occurring independently of those processes which we call vital. The arguments which he adduced in support of this view were the following:—(1) That in the formation of the substance known as adipocere from albuminous material after death, the places of the muscular fibres, blood-vessels, and nerves are occupied by fatty matter which could not have existed in them as such during life. (2) That a true fatty degeneration may be artificially produced *post mortem.* (3) That masses of albuminous material deprived of nutrition in any part of the body, or the centre of non-vascular structures such as tubercle, undergo fatty degeneration to a marked degree. (4) That the circumstances under which fatty degeneration occurs in the living body exhibit impairment of general and local nutrition, such as blood-disorder, or disease of the nutrient vessels. More than twenty years later (1871), Dr. Quain's conclusions respecting the nature of fatty degeneration were experimentally confirmed in the living animal by the investigations of Bauer and Voit, of Munich. On administering phosphorus to a starving dog, in which the amount of nitrogen (urea) daily excreted had become constant, these experimenters found that the amount of the excretion was thereby increased threefold; that this nitrogen was derived from the albumen of the tissues and not of the blood; and at the same time that three times the normal amount of oil had accumulated in the viscera. This oil could have its origin only in the transformed or decomposed albumen of the organism; the other product being the urea which had been excreted. The same results have been observed in poisoning by phosphorus in the human body.

Many other instances of the formation of a fatty from a nitrogenous body might be adduced if necessary, such as the ripening of cheese; the increased flow of milk on a meat diet; the formation of wax by bees from sugar and albumen; the production of fatty acids and their allies from proteid compounds in the process of pancreatic digestion; the increase of oil in olives by keeping; and the development of a rancid oil in the flake of salmon under similar circumstances. The numerous instances just adduced combine to strengthen the position—which was, however, sufficiently established by Dr. Quain—that in true fatty degeneration, the nitrogenous material of the tissues themselves, and not the blood, must be considered the source of the oily matter. It has been said that the circumstances under which fatty degeneration occurs are further confirmatory evidence in the same direction. These must now be considered.

Conditions of Occurrence.—The circumstances under which fatty degeneration occurs are either such as affect the nutrition of the whole system generally, or of a given organ, or portion of it, specially.

General.—When the amount of blood in the body is quickly reduced, for example, by severe but not actually sudden hæmorrhage, death may occur from fatty degeneration of the heart, the voluntary muscles and the other viscera being likewise, but less seriously, affected. Again, general fatty degeneration is frequently due to depraved quality of blood, and especially to the presence in it of certain poisons, such as phosphorus, arsenic, antimony, and the more complex animal-poisons of the acute specific fevers.

Local.—Disease of the nutrient artery of a part is the morbid condition most frequently associated with localised fatty degeneration. A good instance of this is furnished by fatty degeneration of patches of the muscular tissue of the heart corresponding with degeneration, obstruction, or compression of a branch of a coronary artery. Another excellent example of the same is white softening of the brain from vascular degeneration. This is analogous to what occurs in dry gangrene, with the exception that decomposition takes place in the latter, probably from the admission of air.

Summary.—When we review the circumstances under which fatty degeneration is found to occur, we discover that the condition that is common to them all is interference with nutrition, and especially with the process of oxidation. The red corpuscles are believed to be primarily affected in phosphorus-poisoning; they are numerically reduced in continued hæmorrhage; and they do not reach the tissues in sufficient numbers when the vessels are obstructed, or otherwise diseased. In the cases of the hypertrophied uterus and heart, of the placenta, and probably of the corpus luteum, the degeneration is probably due to the decline or cessation of functional activity, and the consequent decrease in the blood-supply to the large mass of protoplasmic structures.

With respect to the *intimate* or *essential nature* of fatty degeneration, it may be stated as highly probable, as far as our present knowledge extends, that the metabolism or decomposition that is constantly going on in living protoplasm is not simple or immediate; but that a primary decomposition occurs of albuminous substances into urea (or its allies) and fat, and a further or secondary decomposition of the fat into carbonic acid and water. If the amount of oxygen furnished by the blood is deficient, whether absolutely or relatively, the primary decomposition of the protoplasm alone may be effected; and the secondary decomposition, or the oxidation of fat into carbonic acid and water, may not occur. The result therefore of an absolute or relative deficiency of oxygen in protoplasmic tissues will be the accumulation of fat within them.

Effects.—The physical effects of fatty degeneration of a tissue have been already described under the head of physical characters, being chiefly—change of colour, diminished consistence and resisting power, softening, rupture, dilatation and excavation, and alteration of size. The chief physiological effect is diminished functional power or activity, which is especially marked in muscular parts such as the heart, and in the kidneys.

Treatment.—The subject of the treatment of fatty degeneration will be found discussed under the head of the diseases of the several organs which it may affect. J. Mitchell Bruce.

FATUITY (*fatuus*, silly).—Mental imbecility. *See* Imbecility.

FAUCES, Diseases of. *See* THROAT, Diseases of.

FAVUS (*favus*, a honeycomb).—SYNON.: *Tinea favosa*; Fr. *Favus*; Ger. *Wachsgrind.*

ÆTIOLOGY.—Favus is very uncommon in England; it is more frequently seen in Scotland and abroad. It usually attacks the scalp, rarely the body, of young children amongst the poorer members of the community. It may be contracted from certain animals, especially mice.

ANATOMICAL CHARACTERS.—If the favi be examined microscopically—that is, if small portions be placed in potash and put under the microscope—they are seen to be made up entirely of fungus. The fungus by its growth irritates the scalp, and making its way down the hair-follicles, it finds access to the hair-shafts, which are swollen, altered in texture, and loaded with fungus-elements, whilst the hair-forming apparatus becomes more or less destroyed and the hair falls. The fungus (*achorion Schönleinii*) consists of oval, nucleated conidia, $\frac{1}{3500}$ inch in diameter, free, jointed or constricted; large branching or tortuous mycelial filaments, $\frac{1}{8000}$ inch or so in diameter, filled with granules and spores; and stroma made up of minute cellular elements.

DESCRIPTION.—The characteristic feature of the disease is the development of light sulphur-coloured, circular, cupped crusts, called *favi*, penetrated by the hairs in their centres. At first a minute opaque spot is visible beneath the epidermis, and this gradually enlarges into a *favus*. These favi are about the size of a split-pea, or larger, varying, in fact, from $\frac{1}{12}$ to $\frac{3}{8}$ of an inch in diameter, and $\frac{1}{25}$ to $\frac{1}{8}$ of an inch in depth. They lie or are imbedded in a depression of the derma, and are convex therefore on their under aspect, but concave above, and the surface has a stratified appearance. These favi may be discrete or crowd together into an irregular mass, in which the distinctness of the several favi is more or less lost. In severe cases redness, soreness, tumefaction of the scalp, and baldness result.

DIAGNOSIS.—Favus may be mistaken for impetigo at first sight, but only by a careless observer, because characteristic favi are always present.

TREATMENT.—The treatment is both disappointing and tedious. The patient must be placed under the best hygienic régime; his nutrition must be improved by good living, and the exhibition of cod-liver oil, steel, and quinine; the favi must be removed by poulticing; and parasiticides must be continuously applied, in conjunction with the practice of epilation. At first sulphurous acid lotion (one part to three or four of water) may be continuously soaked-in for some time; and this may be followed by the infriction of iodide of sulphur ointment, double strength, if it can be borne, to which is added oil of cade in the proportion of two drachms of the latter to an ounce of the former.

TILBURY FOX.

FEBRICULA (*febricula*, slight fever).—SYNON.: Fr. *Fébricule*; Ger. *Febricula.*

DEFINITION.—Simple fever, of one (*Ephemera*) or not more than a few days' duration; not preceded by any one known invariable antecedent; and not attended by any one definite organic lesion.

It may well be doubted, however, whether such a thing as simple fever, in the strict sense of the term, exists; anyhow it must be one of the rarer forms of disease. The conditions which, from our necessarily imperfect knowledge, it is convenient to call Febricula are numerous and of great practical importance. They may be somewhat roughly grouped as follows:—

1. Abortive or incomplete forms of some one or other of the specific continued fevers, namely, typhus, typhoid, or relapsing. The writer's own experience leaves no doubt in his mind that such irregular forms are met with during epidemics of those diseases.

2. Instances of some of the exanthemata, especially scarlatina and modified variola, in which the usual rash is either absent or so slight or brief as to pass unnoticed.

3. Intermittent fevers in which for some reason or other the paroxysms do not recur, or only at uncertain and distant intervals.

4. Cases in which the local symptoms usually attending certain forms of fever are very slight or very obscure, and therefore difficult, perhaps impossible, to detect. Instances of this occur in connection with tonsillitis, erysipelas, rheumatic fever, and tubercular disease.

5. Cases in which considerable febrile movement is present during the development of the primary as well as of the secondary symptoms of syphilis, and of which it is not easy to ascertain the real cause.

6. Fever as the consequence of exposure to a high external temperature, for instance, the *febris ardens* of tropical climates (Murchison); and of violent and prolonged muscular exertion.

7. Fever as the consequence of irritation of any organ or tissue, such as the stomach by indigestible matter, of the colon by scybala; or of catarrh of a mucous surface, for example, urethral fever.

8. Certain ill-understood but not uncommon disorders of nervous centres, cerebral, spinal, or sympathetic, are often followed by febrile movement.

ANATOMICAL CHARACTERS.—Fever, however caused, which runs high produces congestions and tissue-changes in the viscera, especially in the lungs; but, in view of the short duration of febricula, it would in most cases be impossible to decide whether any pathological change found after death were the consequence or the cause of the febrile movement. It is possible, but not yet proved, that there may exist some contagion capable of producing febricula, and febricula only.

SYMPTOMS.—Febricula is characterised by a rise of temperature, rarely exceeding 102·5° F., but sometimes, especially in cases due to exposure, reaching 105° F. or even higher, although only for a short time. The access of fever may be gradual, or marked by slight rigors; and some or all of the common clinical symptoms of fever may be present in varying proportion and in greater or less degree, such as general malaise; dry skin; frequent pulse, amounting to 100 or 120 per minute; tongue furred and with a more or less distinct central dry reddish-brown streak; thirst, loss of appetite, and nausea; constipation; scanty high-coloured urine;

and headache, intolerance of light, slight deafness, restlessness, sleeplessness, and slight delirium at night.

Diagnosis.—The diagnosis of febricula rests upon the exclusion of all the other recognised kinds of idiopathic or of symptomatic fever. As a matter of practical diagnosis at the bedside, almost every disease attended by rise of temperature is now and then, at its outset, mistaken for febricula.

Prognosis.—The prognosis depends upon the degree and duration of the pyrexia, but in this country is almost always favourable.

Treatment.—In the absence of any special indication, rest in bed for a day or two, liquid food until the desire for solids returns, and, if constipation be a marked feature of the case, a moderate dose of some mild purgative, will be sufficient. It is, however, always prudent to remember that what seems to be febricula may be the beginning of some serious and perhaps highly infectious disease. Cooling drinks such as Citrate of Potash in effervescence, Liquor Ammoniæ Acetatis with a little Spirit of Æther; or Nitro-hydrochloric or Dilute Nitric Acid (one drachm to a pint of water) with some fresh lemon-juice added, may be given according as the one or the other is grateful to the patient. Anything like active treatment, except the use of the cold or tepid bath in cases of heat-fever, is unnecessary, rarely does good, and is almost always positively injurious. J. Andrew.

FEBRIFUGES (*febris*, a fever, and *fugo*, I drive away). Synon.: Antipyretics.

Definition.—External applications or internal remedies which tend to lower the bodily temperature when it has been abnormally raised by the processes of fever.

Enumeration.—The principal febrifuges, given in the order of their activity, are: Cold Baths; Cold Affusion or Wet Pack; Alcohol, and Diaphoretics; Salicylic Acid, Quinine, Digitalis, and Aconite; Trimethylamine; Iron; and Water and Diluents generally.

Action.—Following Professor Binz, we may divide febrifuges into two classes:—1. those which directly withdraw heat from the fevered organism; and, 2. those which lessen its production.

1. In the first division we must give the foremost place to cold baths, which powerfully abstract caloric from the surface of the body and rapidly cool down the blood. Diaphoretics and alcohol act more feebly in the same direction, by dilating the cutaneous arterioles, and thus allowing the mass of the circulating fluid to be effectually exposed to the chilling influence of the air. *See* Cold, Therapeutics of; and Diaphoretics.

2. Secondly, we have to consider those drugs which actually check the febrile condition itself, and our explanation of their effects must naturally depend on the views held regarding the intimate nature of fever. If we believe in an overborne or paralysed condition of the nervous system as any essential factor, or if we look upon the vascular structures as primarily at fault, then we must shape our theories accordingly; but if we believe, with our best authorities, that the true explanation must be looked for in the introduction of extraneous ferments or septic material into the blood, the matter is much simplified. Quinine and salicylic acid then merely act in virtue of their antiseptic power over protoplasm; and if malaria really depends on the fermenting influence of vegetable germs from decaying vegetation, then the so-called specific action of quinine is readily explained. Again, temperature may be lowered by checking the oxidation of the tissues, and interfering with the oxygenating function of the hæmoglobin, and alcohol is said more particularly to act by lessening the activity of secreting cells. The free use of water tends to promote excretion, and thus to remove the products of oxidation.

Uses.—Antipyretic treatment is not adopted in this country as a matter of routine, holding as we do that temperatures raised within certain limits are not *per se* elements of danger, and that even although we may effectually cool down our patient, the progress of the disease may go on quite unchecked. But when the thermometer registers 105°, and still tends upwards, we know that dangerous limits are reached, and that as a rule life is not long sustained after 107°. It then becomes our duty to interfere, and this is best done by plunging our patient into a bath at 95°, and gradually cooling it down to 65°. When the temperature goes down to within 4° or 5° of the normal we remove him to bed, remembering the dilatation of vessels which must follow the contracting effect of cold, and the consequent cooling process which must continue to go on. Here, as in all febrile conditions, the thermometer is our surest guide, and we must be directed by it as to when to resume the treatment, for frequent repetition may be needed, and on the Continent as many as 200 baths have been given in the course of a single illness. Along with this the Germans combine the use of large doses of quinine; but notwithstanding the marked tolerance of the drug under pyrexial conditions, the danger of perilous depression from such free medication is no imaginary one; and, putting ague apart, we find this valuable drug most beneficial in such fevers as seem to owe their origin to septic poisoning. Digitalis is not a powerful antipyretic, and in large doses is too depressing to the heart, and too apt to produce gastric derangement, to inspire much confidence; while veratria seems simply to act by throwing the patient into a form of collapse. The influence of salicylic acid over acute rheumatism is remarkable, as it seldom fails to reduce temperature and relieve pain in forty-eight hours, but in other feverish conditions its beneficial action is by no means so well marked. Iron is of value in erysipelas, and exerts some controlling power over acute rheumatism. Aconite and diaphoretics are of undoubted service in aiding the defervescence of some of the minor febrile disorders. R. Farquharson.

FEBRIS (Latin). *See* Fever.

FEIGNED DISEASES.—No insignificant part of the real difficulty in the practice of our profession depends on what we may call feigned diseases. The art of diagnosis consists in the power of recognising morbid conditions with skill and promptitude; and in proportion to the natural sharpness and well-digested experience of the medical man, is his success in the discrimination of one symptom from another which resembles it more or less superficially. Many disorders possess a strong family likeness in their very early stages, whilst others may prove deceptive throughout their whole career, and if to this we add the efforts at deception occasionally resorted to by impostors, we see the caution which must of necessity be adopted by those who exercise their calling within wide limits. In considering, therefore, the subject of Feigned Diseases a greater amount of order may attend our studies if we adopt the following simple classification:—

1. Those diseases which naturally resemble one another, and in the deception attending the diagnosis of which the patient has no share.

2. Those diseases which are also difficult of diagnosis, but in which the patient involuntarily deceives under some morbid nervous impulse.

3. Cases in which the patient sets himself deliberately and elaborately to deceive those around him.

1. Under this heading we may perhaps include the exanthemata and other acute feverish affections, which are confessedly difficult of diagnosis before the eruption or other marked points of difference are fully established. Important though it may be, in the case of public schools or large bodies of men, to act promptly in the face of such an emergency, the medical man will often feel himself compelled to postpone his decision, but he should at the same time act on the defensive by the timely exercise of quarantine and hygienic precautions. Some diseases, again, are difficult to distinguish from one another, even after their prodromata have passed away, and among these we may include small-pox and pustular syphilis, which occasionally in our own experience have caused more than a shade of suspicion to pass over the mind; whilst mild variola and severe varicella must always have too many points in common, to render them otherwise than stumbling-blocks even to the initiated. Various forms of roseola may closely simulate measles; scabies is often hardly to be picked out from amongst the eruptions which its irritation causes; whilst throat-affections may apparently overlap each other and engender the idea of diphtheria where nothing more than superficial or aphthous ulceration really exists. But it is when the ailment under which our patient labours resembles something else during its whole career, that mistakes are naturally most likely to arise. We are frequently shocked with some scandal in which the innocent victim of brain- or other organic disease has been consigned to a police-cell, and where the plea of drunkenness has been attempted to be sustained by the guardians of the public peace. So difficult is it to make a really trustworthy diagnosis between the coma of alcohol, of uræmia, of opium, and of certain apoplectic conditions, that the really cautious and well-informed practitioner would prefer not to attempt to do so offhand. It is impossible to lay down any general rules, but we may remember that alcohol in poisonous doses lowers the temperature and dilates the pupil; that in uræmia an examination of the urine will put us in the right track; whereas opium will produce a contracted pupil; and in cerebral hæmorrhage some elevation of the body-heat may not improbably be observed.

But all these points may fail us from time to time, and we had best act at all times as though the case were really a serious one, and worthy of being treated by all the best resources of the medical art.

A very little consideration will enable every experienced practitioner to recall other instances of this sort of natural mimicry; of the difficulty he must often experience in deciding between syphilitic and other brain-affections; of the close affinity between pulmonary consumption and dilatation of the bronchial tubes; of the resemblance between specific and malignant ulcerations; between various diseases of the testicle, the bladder, and the stomach, respectively. All these form part of the regular teaching of medicine and surgery, and will be treated of at greater or less length elsewhere.

2. We must now consider the cases in which diseases are feigned not by the direct action of the patient himself, but because he is unable to resist the vagaries of his weak and excitable nervous system.

Problems of the greatest complexity and difficulty are here presented to the medical man and require for their due solution much tact and experience. Functional affections so closely simulate organic disease under these circumstances that suspicion is often completely disarmed, and treatment adopted the very opposite of that which would most probably prove curative. Hysteria, in its protean forms, supplies the greater number of these cases, and may very closely simulate a large variety, more especially of neurotic conditions. Paraplegia, incontinence of urine, joint-affections—in short, almost any disease which does not admit of palpable objective demonstration—may thus be feigned, and very severe treatment may even be adopted under the belief that real organic changes have to be met by the usually appropriate remedies. It is only necessary for us to refer thus briefly to these perplexing cases here; but it must always remain an interesting problem as to how the mechanism of causation here works, so to speak, and whether the patient actually suffers the acute pain of which she complains so forcibly. Sympathy, as we well know, however, is quite thrown away when dealing with these persons; and apparent roughness, with nervine tonics, and mental discipline, will often effect a cure, when the most elaborate combinations of other drugs ignominiously fail. A sudden shock, the pressure of poverty, or the absolute necessity for immediate exertion, will often effectually and permanently arouse the bedridden hypochondriac of many years, and restore him to his friends as a useful member of society, and we need never despair of success even under apparently hopeless circumstances. And although in minor measure the hypochondriac may fancy that every organ in succession is the seat of disease, and may even succeed in thus imposing on the unwary, the experienced practitioner will speedily detect the fiction and be able to relieve the unhappy sufferer from the weight of his woes.

But let it not be forgotten that 'expectant attention,' or the constant direction of the mind to the supposed morbid condition of any particular organ, may actually catch the unconscious deceiver in his own net by converting mere functional disturbance into organic disease.

3. To the third division of our subject the term Feigned Diseases can perhaps alone strictly be applied. Here we are met face to face with deliberate and premeditated imposture, and there is nothing for it but to match our own wits against those of the deceiver, and to thwart his native cunning by the superior sharpness of science. Now, there is nothing in the history of medicine more remarkable than the elaborate expedients adopted, and the amount of actual discomfort and suffering endured, by persons who have been desirous of escaping military or other duty. The exhaustive works of Gavin and Marshall, and Boisseau and others, give us details no less ingenious than interesting of these devices; but it is curious to note in how limited a range the more traditional modes of imposture seem to run, and how the same old stories are made to do duty over and over again. Thus we read of blindness, and deafness, and epilepsy, and paralysis being carefully imitated, and can hardly withhold our admiration from the astonishing tenacity with which the apparent symptoms were duly maintained. Incontinence of urine, dysentery, hæmoptysis, jaundice, and insanity were among the most favourite rôles in the repertoire, and ingenious as were the preparations for duly sustaining the part, no less ingenious were the means for detection, which usually proved successful. However carefully the impostor had studied his character, some little point was usually omitted. The yellow conjunctiva of jaundice can hardly be feigned; the incontinence of urine was generally found to be attended by an expulsive effort; the blood apparently proceeding from the lungs was by no means intimately mixed with the pulmonary mucus; the blindness, or the deafness, or the paralysis were not proof against some sudden shock or mental impression. Most of the cases so carefully described by writers on military medicine are now mere matter of history, and are hardly likely to occur again. And the reasons for this are twofold. First: the inducement for deception is practically gone. In former days, when the soldier's pay was small and his hygienic condition bad, discharge from the service as an invalid was eagerly prized as a means of escaping irksome duty, but things have greatly changed for the better of late years. Not only is the emolument and the comfort of our army vastly increased, but short service and the Reserve enables men to retire early into civil life, whilst the abolition of bounty has removed the principal pecuniary inducement for frequent desertion and re-enlistment. It is now found much easier for a man simply to desert than to go through any elaborate process for the personification of disease. Again, the savage process of forcible impressment for naval service was naturally productive of many attempts to escape from the hard work and ferocious discipline of our men of war. Secondly: the process of science and improved means of diagnosis have rendered the task of the impostor difficult, if not well-nigh hopeless. Feigned blindness can hardly resist the test of the ophthalmoscope; electricity will clear up many apparently anomalous nervous symptoms; the stethoscope and the sphygmograph will tell us the real condition of the heart; and careful observation will detect the rougher attempts to deceive. Again, malingering may often be exposed by examination under chloroform or ether. We are not likely now to be taken in by a piece of liver tied to the breast to simulate cancer, or by an artificial nasal polypus; and although skin-diseases and ulcerations may be made or kept up by local applications, we only require a suspicion to cross our minds to put us on the right track for discovery.

We are not, however, to suppose that all attempts at deception have finally passed away, that feigned diseases are now things of the past. Anyone whose practice lies among prisoners or soldiers or schoolboys will very soon be convinced to the contrary. Experience, however, will soon show him what the schemers are, and enable him to circumvent their endeavours; and the range of symptoms simulated will soon be found to be singularly narrow. Subjective sensations are of course very difficult to detect, and if a headache, or pain in the back or leg or arm, be complained of by the sufferer, real or assumed, we may often find it best for our own reputation to give him the benefit of the doubt. A case which happened to the writer whilst medical officer to Rugby School, forcibly illustrates this position. A little boy complained on several successive mornings of most severe pain in the right calf, rendering him almost or quite unable to walk. Inspection could discover nothing wrong, there was no redness nor tenderness, and he had no recollection of any injury. Some suspicion of malingering was aroused, but it was thought most prudent to allow him to remain at rest. Four days later a red spot appeared about the middle of the calf, followed by a superficial abscess, which broke in due course, giving exit to half an ordinary sewing needle, which had evidently been working its way gradually upwards among the muscles of the leg. How it obtained admittance could not be ascertained. Whilst proceeding, therefore, with due caution, the practitioner must endeavour to hold the balance between an excess of suspicion and a too credulous attitude, remembering that the good of society and of the public service must be fairly considered, whilst all care must be taken not to confound the innocent with the guilty in dealing with disorders which ingenuity has occasionally been enabled to feign.

Robert Farquharson.

FEIGNED INSANITY. *See* Insanity, Feigned.

FESTER.—A superficial suppuration resulting from irritation of the skin; the pus being developed in vesicles of irregular figure and extent. The suppurating inflammation caused by a thorn or splinter of wood forced into the flesh is a common example of a fester.

FEVER (*ferveo*, I am hot).—Synon.: *Pyrexia*: Fr. *Fièvre*; Ger. *Fieber*.

Definition.—One of the most remarkable facts in connection with disease, is the rise of temperature which is attendant upon almost every disturbance to which the body is subjected. This rise of the temperature of the body, when it attains a certain height, and lasts a certain time, is called Fever, and is accompanied by derangement of function, attributable to the febrile condition itself, and in a measure independent of the initial cause.

General Considerations.—Fever plays so important a part in acute disease generally, is accepted so universally as a mark of the severity of the disease, and so often presents itself as apparently the chief antagonist with which the physician or surgeon has to contend, that the attempt to penetrate the secret of its essential nature has always been a favourite task, and every school in every age has had its theory of the febrile process. It is only, however, within comparatively few years that exact measurement of the body-heat by the clinical thermometer, combined with chemical examination of the various excretions at different temperatures, and aided by the experimental method of investigation, has furnished the data for such a theory. A minute description of fever in the abstract, distinguishing, as would be required, between phenomena proper to fever, and phenomena due to the condition or lesion on which the fever depended would be lengthy, and so crowded with qualifications and exceptions as to be vague and unsatisfactory. The attempt, indeed, would have a more radical defect. Either some variety of fever must be taken as a type to which other forms are referred, which is vicious in principle; or all the phenomena of all febrile conditions must be enumerated and classified, which would confound the accidental with the essential, and would result in a heterogeneous collection of facts without due relation among themselves.

A mere outline therefore will be given of the principal deviations from normal functional action observed in fever, and the space set apart for the subject will be reserved for an exposition of what is known of the nature of the febrile process.

Description.—In every attack of fever there are traceable the three stages of invasion, domination, and decline, with or without an antecedent period of incubation. They may all be run through in the course of a few hours, as in a paroxysm of ague, or they may extend over weeks.

The period of invasion is characterised by a rising internal temperature, while the surface may remain cold and pale, the patient feeling chilly and suffering from rigors or shivering; the pulse is frequent, but generally small and long, from contraction of the arteries. During the dominance of fever the temperature remains high, the skin is hot, and the shiverings are replaced by a subjective sense of heat; the pulse is now full and bounding from relaxation of the arterial wall. The decline is indicated by a falling temperature, a softer and less frequent pulse, and by a return towards normal conditions generally; it may be initiated or accompanied by a critical sweat or other evacuation. Death may take place at any period of the disease.

Taking the temperature as the index of the duration and character of each stage, we may find it in the first stage rising abruptly or gradually, continuously or with remissions. If the invasion extends over several days as in enteric fever, nocturnal exacerbations and morning remissions are, as a rule, observed. A rapid rise of temperature is usually continuous, or nearly so. When the opportunity occurs of making the observation, as in intermittent or relapsing fever, or when fever is experimentally induced in animals, or in man by surgical operation or accidental septic inoculation, the increased heat is found to be the initial phenomenon, preceding the rigors and all other symptoms.

The end of the period of invasion, and the setting in of the stage of dominance, is more distinctly marked by the change in the character of the pulse, and by the determination of blood to the surface, together with the substitution of the subjective sensation of heat for that of cold, than by the thermometer.

During the dominant stage the temperature remains at, or oscillates about, a given point, and the fever is considered to be moderate if the morning temperature is 102° or under, and the evening not above 103°; to be high when it ranges between 103° in the morning and 104° in the evening; and to be severe when these limits are exceeded; while, with rare exceptions, a temperature of 106° indicates great danger. As the stage advances, the heat may gradually rise or fall; the oscillations being slight or considerable, and at times irregular and extreme. Except when the fever is due to local inflammation, or to continual entry into the blood of morbid particles or fluids, the duration of the dominance is usually in proportion to the time occupied by the invasion.

The decline again is generally abrupt, and has the character of a *crisis* when the invasion has been rapid, and is protracted when it has been gradual.

A fatal termination may be ushered in by hyperpyrexia; more commonly the temperature falls below the normal point and there is collapse.

The pulse is always increased in frequency by fever, but while during the height of the disease there is usually some relation between the body-heat and the pulse-rate, the pulse is often extremely frequent before the temperature has reached its height during the invasion, and it does not in all cases fall with it *pari passu* in the decline. The different stages are marked rather by differences in the character of the pulse than in its rapidity; during the period of invasion the arteries are more or less in spasm, and the pulse is small and long; during the dominance, with certain exceptions, the arterial walls relax, the vessels are large, and the pulse full and bounding; as the fever declines the arteries are still further relaxed, but the action of the heart is less powerful, so that the pulse becomes softer.

Respiration is frequent, following as a rule the pulse: the amount of carbonic acid expired is greatly increased.

The tongue is generally more or less furred, its appearance varying with the degree and kind of fever and with its cause. It becomes brown and dry, or unnaturally red in protracted and adynamic fever, when the teeth and lips may also be coated with sordes. There are almost always thirst and loss of appetite. The bowels are usually confined.

The secretions are all more or less modified. The perspiration may be greatly increased as in acute rheumatism, or apparently checked, causing the skin to be dry and burning. The amount of urine will vary to a certain extent inversely with the amount of perspiration; but the tendency is to increase, and the solid organic matters—urea and other nitrogenised substances—are always considerably augmented in quantity. The chloride of sodium, on the contrary, is diminished.

The characteristic nervous phenomena of the stage of invasion are rigors, which may be slight, and represented only by shivering or chilly sensations, or, on the other hand, may be intensified to convulsion. Severe headache is more common at this period than in the later stage, and there is usually considerable depression. When the fever has reached its height the rigors will have ceased, and there may be little or much delirium according to the severity of the attack, or the idiosyncrasy of the patient, or, again, according to the kind of disease giving rise to the fever.

Pathology.—The description of the febrile state has been cut short in order to leave place for a discussion of the nature and cause of the febrile process.

This will be facilitated by a brief reference to the production and regulation of the heat of the body in health, and would be comparatively easy had physiologists arrived at a complete and satisfactory solution of this problem. In the normal state the main source of animal heat is blood- and tissue-combustion. Another very slight and unimportant cause will be obstructed motion of the blood in the capillaries: of direct conversion of nerve-force into heat we know nothing definite. The interesting and difficult part of the question is that which relates to the regulation of the temperature. It has been found that the changes which evolve heat are most active in muscle, in the nervous structures, and in the abdominal viscera; while in the lungs, any combustion which may take place is not more than will counteract the loss of heat by evaporation and by the expired air. The skin, on the other hand, is the great cooling agent; there is little combustion of its structures and it is continually losing heat by conduction when the surrounding temperature is low, but still more abundantly by evaporation under all conditions of external temperature. Heat is thus abstracted from the blood circulating in, and immediately beneath, the skin. At first sight then it would seem that the mechanism by which the temperature was regulated was extremely simple, and that it was to be found in the vaso-motor system of nerves. There being an internal heat-producing mass of tissue, and an external refrigerating surface, to raise the temperature, the arterioles of the skin are contracted, shutting off the blood, while those of the deeper structures are relaxed, allowing it to reach them in greater abundance; in this way a double influence is exerted, less heat is lost by the skin, and more is produced in the muscles and other internal parts. Conversely, the temperature would be lowered by flushing the skin with blood—which would thus be exposed to cooling influences—and diverting it from the heat-forming, deep-seated structures. This explanation, however, is inadequate; it is true that the distribution of the blood, superficially or deeply, by means of the vaso-motor nervous system, contributes largely to the regulation of the temperature, but heat-production in muscle or gland is not directly proportionate, simply to the amount of blood circulating through it; tissue-combustion, and consequent evolution of heat, are excited or repressed by cerebro-spinal nerves not governing the arteries. The nervous system thus intervenes directly in heat-production as well as indirectly through its influence on the circulation, and it has been shown that the stimulus to tissue-change and heat-production is a reflex from peripheral impressions. This is not the place to discuss the question whether there are special thermal nerves and centres, but it may be said that this has not been proved.

Taking the increased heat as the characteristic of fever, the first question which arises is whether this is due to increased production of heat, or to diminished loss. While the diminished circulation in the skin, in the early stage, will obviously tend to retain heat within the body, there is now no room for doubt that there is increased heat-production; the temperature rises in spite of profuse perspiration, when of course heat is very rapidly lost, as in acute rheumatism, or when perspiration has been induced by jaborandi before a paroxysm of ague (Ringer); and it has been shown by direct experiment that in fever a man raises the temperature of a given quantity of water in which he is immersed more quickly, and to a higher point, than in health (Liebermeister). It is unnecessary to give other proofs or further refutation of the hypotheses which explain the heat of fever solely by diminished escape of heat from the body.

It may further be taken as certain that the immediate cause of the increased generation of heat is increased blood- and tissue-oxidation. This is shown by the increased products of combustion given off in the different excretions. The febrile elevation of temperature is attended at once by increase in the amount of carbonic acid expired. This is more marked during the rise than when the heat has attained its maximum, because the increasing temperature expels the gases of the blood, and the greater rapidity of the circulation sends the blood more freely and quickly through the lungs, and exposes it more to the air. At first there will thus be eliminated not only the carbonic acid formed under the influence of the febrile process, but that which was held in solution by the cooler blood, and is driven off as its temperature rises; when the expulsion of dissolved carbonic acid is completed, the amount excreted will be diminished by so much, but it still remains larger than at the normal temperature.

A similar indication of increased tissue-combustion is furnished by the urine. The amount of urea is usually absolutely increased, notwithstanding a diminished consumption of nitrogenised food; or if the urea itself is not excreted in larger quantity, there is more nitrogenised waste in other forms. The total of nitrogenised matter contained in the urine is always augmented by fever.

The real difficulty of the problem arises when we inquire what is the cause of the increased tissue-combustion. It has been already stated that the distribution of the blood to the deep structures and organs and to the skin respectively is not a sufficient explanation of the physiological balance of heat; but it might be supposed that the greater rapidity of the circulation in fever renewing the supply of oxygenated blood within the structures more frequently and more freely, would account for the greater oxidation. The rise of temperature, however, is not in proportion to the flow of blood through the vessels, and hyperpyrexia is often coincident with a failing circulation, the heat, indeed, apparently in some cases actually increasing after death.

One step towards the solution which may be considered certain is that the nervous system is concerned in the maintenance of the heat of fever. Each disease has its own characteristic range and variations of temperature, and this fact alone, that febrile heat is not vague and irregular, but that there is the substitution of a morbid for a normal balance, is evidence of nervous control. Numerous observed facts and experiments point to the same conclusion. We need only mention the hyperpyrexia often resulting from injuries to the brain, and following section of the cord in the cervical region.

Another item of positive knowledge obtained by experiment is that pyrexia may be excited by the introduction into the blood of septic or other matters, which, it is important to note, need not be particulate, but may be diffusible fluid. The increased heat may therefore be independent of capillary embolisms and of bacteroid or other organisms.

Now in disease or after injuries we have almost always both causes in possible operation —an impression on the nervous system, and the entry of altered organic matters into the blood. In endeavouring to assign prominence to one or other, we have, on the one hand, such facts as the hyperpyrexia of cerebral lesions, which cannot be due to blood-contamination, and, on the other, the teachings of antiseptic surgery, which demonstrate that absorption of putrescent discharges is the great cause of surgical fever. It still remains to be determined whether the presence in the blood of foreign matters gives rise directly to increased activity of oxidation, or whether the poison, as we may call it, produces this result through its action on the nervous system, either by affecting the nerve-centres themselves, or by producing irritation in the capillaries, which is carried to the nerve-centres, and reflected along efferent nerves. In the present state of our knowledge this question cannot be definitely settled.

If a theory of the febrile process is to be formed it must be based upon a theory of the relation between the nervous system and the processes of nutrition and oxidation, and especially the latter. Numerous facts of disease and of experiment point to the conclusion that the circulation of duly oxygenated blood through the tissues at the usual rate would, without some check to oxidation, result in more rapid tissue-change and the production of a higher temperature than the established norm. The restraining power is supplied by the nervous system, the loss of this influence being illustrated in hyperpyrexia. The mode in which the nervous system acts may be represented as being through the tension maintained in the nerve-centres. All nervous actions have the character of phenomena of tension, and the tension generated in the cells is sustained in the nerve-fibres to their peripheral terminations, where they are merged in the structures, and so blended with them that all nutritive and oxidative changes are common to the nerve-endings and the tissues in which they end. If we suppose that the nerve-tension can modify chemical action, as can electrical tension or thermal conditions, and that, *vice versâ*, the nutritive and oxidation changes in the tissues can influence the tension of the nervous structures, we can represent to ourselves the interaction between the nervous system and the blood and tissues in the febrile process. When from disease or injury of the great nerve-centres their power of maintaining tension is abolished, and their influence destroyed, the affinities of the blood and tissues have unrestricted play, and the result is hyperoxidation and pyrexia. When, on the other hand, septic matters or other substances are introduced into the blood, acting as ferments or in some other way, they increase oxidation, and directly raise the temperature, overpowering the restraining influence of the nerves until this is reinforced, which may possibly occur through increased evolution of energy, resulting from the increased activity of metamorphosis. We cannot, however, here develop or fully elaborate this hypothesis.

Treatment.—The treatment of fever is of course primarily directed to the removal of the cause on which it depends, but together with the measures adapted to this end are usually employed means for the moderation of the febrile process as such, and these may at times take the first place. We can do little more than mention the more important of them, taking first what may be called the general methods, and premising that rest in bed, simple food, &c., are taken as understood. Venesection is now scarcely ever practised as a means of combating fever. Purgatives are often useful, as are also diaphoretic and diuretic salines, with abundance of water to drink, either alone or in the form of some agreeable *tisane*. Free action of the secretions, which is the object of these remedies, is of service in removing the increased products of oxidation, the water taken co-operating by acting as a solvent and vehicle, and it is possible that medicines which promote this activity may directly bring down the temperature. When, for example, perspiration has been induced, a coincident fall of temperature may be due more to some change antecedent to the perspiration than to the loss of heat by transpiration and evaporation.

Of special measures for the reduction of febrile heat when this is becoming dangerous, either from its intensity or duration, the first to be mentioned is the cool or cold bath. This should be resorted to in all cases of hyperpyrexia, from whatever cause; its efficacy, first established in the high temperature of acute rheumatism and enteric fever, has been proved also in cases of septic hyperpyrexia after ovariotomy, and even in injuries to the brain. Here the water may be positively cold. When the bath is employed to control temperature, not dangerous from its height, but from its duration, as in enteric fever, it need not be lower than 70° or 65° Fahr. An ice-cap devised by Mr. Knowsley Thornton, for applying cold of 32° to the entire head, has been found useful in hyperpyrexia following ovariotomy.

Many alkaloids have the property of reducing febrile temperatures when taken in large doses. The most powerful, and the one most generally employed to combat fever, is quinine. When given for this purpose, it is administered in doses of from ten to twenty or even thirty grains once in twenty-four or forty-eight hours, or three to six grains of the neutral sulphate may be injected under the skin. Salicylic acid has a remarkable influence on the temperature in acute rheumatism, and some effect, though far less marked, in fever from other causes. It may be added that when pericarditis has come on in rheumatic fever, this drug usually altogether fails to influence the temperature. The only other drug which need be specially mentioned is aconite, the mode of action of which is totally different from that of quinine, and of which it may almost be said that it antagonises the fever process rather than reduces temperature; its most marked influence being on the force of the heart and the contraction of the arteries. The opportunity for the manifestation of its powers occurs in the early stage of catarrhal fever, the result of chill. Given in frequent small doses (a drop or two of the tincture every five minutes till twenty minims or half a drachm has been taken) when the temperature is rising, the pulse frequent and hard, with headache and burning skin, the effects are often striking. When a local inflammation is established, it is no longer of much use; and when the fever is protracted, as in enteric fever, or when there is pneumonia, it may be dangerous, from its depressant influence on the heart. W. H. Broadbent.

FIBRILLATION, Muscular.—A localised quivering or flickering of muscular fibres. *See* Motion, Disorders of.

FIBRINOUS CLOT. *See* Clot.

FIBRINOUS CONCRETION. *See* Concretion.

FIBROID DEGENERATION.—A morbid change which consists in the substitution of a tissue somewhat resembling fibrous tissue for other structural elements; some pathologists consider this change to be of the nature of a degeneration. *See* Degeneration, and Cirrhosis.

FIBROID PHTHISIS.—A name given to certain cases of phthisis in which a considerable development of fibroid tissue is found to occur in the lungs. *See* Phthisis.

FIBROMA.—A form of tumour composed of fibrous tissue. *See* Tumours.

FIBRO-PLASTIC GROWTH.—A form of new growth, composed of fibro-plastic elements. *See* Tumours.

FICUS UNGUIUM (*ficus*, a fig; *unguis*, a nail).—A disease of the posterior wall of the nail. *See* Nails, Diseases of.

FILARIA SANGUINIS-HOMINIS.—In the article Chyluria a full account is given of the embryo-Filaria sanguinis-hominis, the hæmatozoon which is ordinarily found associated with this disease. Since that article was written, the writer has succeeded in obtaining what is beyond question the mature form of the helminth. On the 7th August, 1877, two living specimens were found—a male and a female—in the person of a young Bengalee, affected with well-marked nævoid elephantiasis of the scrotum, associated with the presence of embryo-filariæ in the blood.[1] The diseased tissues were removed by the late Dr. Edward Gayer, of Calcutta, to whose kindness the writer is indebted for the opportunity of examining them. Unfortunately the specimens were much injured by the needles used to tease the clot in which they were found: the terminal ends of the male could not be found, nor the caudal end of the female, although the fragments of both specimens manifested active movements. They were attenuated, fine, thread-like worms, of a white colour; the cuticle was smooth and devoid of transverse markings.

The fragment of the male specimen measured half an inch in length, and $\frac{1}{186}$″ transversely; it was thinner than the female, but of firmer texture, and manifested greater tendency to coil. The intestinal canal measured $\frac{1}{633}$″ [·039 mm.] across, and the sperm-tube $\frac{1}{1500}$″ [·016 mm.].

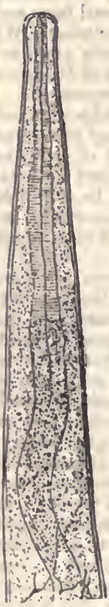

Fig. 18. Anterior end of Filaria sanguinis-hominis. — Mature form × 100 diameters.

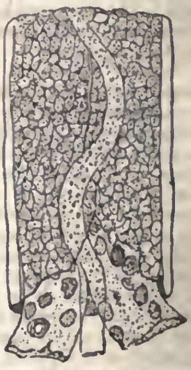

Fig. 19. A portion of the mature Filaria sanguinis hominis, showing uterine tubules filled with ova in various stages of development; also the intestinal tube. × 100 diameters.

The length of the portion of the female worm which had been secured was 1½", and its greatest width about $\frac{1}{100}$". It was packed with ova and embryos in various stages of development; the latter, especially those which were mature, manifested active movements. The head is slightly club-shaped; the mouth does not manifest any very distinctly marked labial sub-divisions, nor are there any chitinous processes evident either before or after death.

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[1] For further details, see *Indian Medical Gazette*, Sept. 1, 1877; *The Lancet*, Sept. 29, 1877; and *Centralblatt für die medicinische Wissenschaften*, No. 43, 1877.

The following measurements may prove useful to future observers:—

	of an in.		mm.
Oral aperture to end of œsophagus	$\frac{1}{55}$	or	·45
Diameter of oral aperture . .	$\frac{1}{3000}$	„	·008
Width of extreme end (anterior)	$\frac{1}{517}$	„	·047
Ditto anterior end at 'neck'	$\frac{1}{545}$	„	·045
Ditto opposite junction of intestine with œsophagus .	$\frac{1}{222}$	„	·112
Ditto about ¼ inch from anterior end	$\frac{1}{153}$	„	·162
Width where packed with ova and embryos	$\frac{1}{100}$	„	·25
Width of uterine tube filled with ova	$\frac{1}{222}$	„	·112
Ditto alimentary tube . .	$\frac{1}{666}$	„	·037

The ova do not possess any distinctly marked 'shell'; from the smallest to the largest nothing but a delicate pellicle can be distinguished as enveloping the embryo in all its stages. The average of six measurements of the least advanced kinds of ova, that is, those in which the outline of the embryo was not distinctly evident, was $\frac{1}{1304}$" [·018 mm.] by $\frac{1}{2000}$" [·012 mm.]; whilst the average measurements of three ova in which the embryos were visible were $\frac{1}{666}$" [·037 mm.] by $\frac{1}{750}$" [·03 mm.]. When the latter, after having arrived at this stage of development, are examined during life, it is in many instances difficult to state whether they are to be considered as freed embryos or not, as the 'shell' has become so attenuated and translucent as only with difficulty to be distinguished. It is possible that when the embryo acquires worm-like proportions the envelope is not lost in this species so long as it continues in the blood.

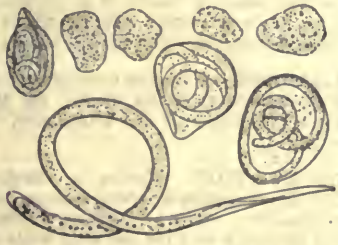

FIG. 20. Ova and embryos of Filaria sanguinis-hominis × 300 diameters.

With regard to the relation of the mature filaria sanguinis-hominis to pathological phenomena nothing very decisive can be said; but when it is considered that the blood of some animals is found occasionally to harbour minute, active organisms, in great numbers sometimes, without appreciable injury, it seems not improbable that the parental forms of nematoid hæmatozoa, rather than the embryos, may be the more hurtful to the animal economy. The lesions induced by the growth of the filaria sanguinolenta in the arterial walls of dogs, to which the writer has elsewhere drawn attention, appear to lend support to such a view.

In 1877, Dr. Cobbold announced that Dr Bancroft, of Brisbane, had discovered specimens of what were believed to be mature forms of the filaria. A dead specimen was found in a lymphatic abscess of the arm; and on a second occasion four living specimens were obtained from a hydrocele of the spermatic cord. They were of the thickness of a hair and from 3 to 4 inches in length. A minute description of them by Dr. Cobbold appeared in the *Lancet* of the 6th October, 1877. The persons from whom the specimens were obtained had not suffered from either chyluria or nævoid elephantiasis, nor were they known to harbour embryo nematodes in their blood.[1]

TIMOTHY RICHARDS LEWIS.

FILARIÆ (*filum*, a thread).—A genus of nematoid worms, not very clearly defined, but which contains a variety of thread-like parasites whose body is of uniform thickness throughout, and at least fifty times longer than it is broad. Under this head are often included several human parasites, such as the *Dracunculus*, or Guinea-worm (*Filaria medinensis*), and the lung strongle (*F. bronchialis*), in addition to a variety of larval or sexually immature nematoids, whose genetic relations are only very imperfectly understood. In the latter category may be placed Bristowe and Rainey's entozoon (*F. trachealis*); Von Nordmann's eye-worm (*F. oculi-humani* or *F. lentis*); the *loa*, infesting the eyes of the Angola Coast and Gaboon negroes (*F. loa*); and lastly, the nematoid hæmatozoon (*F. sanguinis-hominis*) recently described by Lewis in his illustrated memoir. It may be doubted if any of the above-mentioned parasites ought to be included in the genus *Filaria*, as understood by modern helminthologists, but, practically, it is still found convenient thus to speak of them. The Dracunculus will be found described under GUINEA WORM; whilst the microscopic nematoid infesting the blood will be found noticed under the articles HÆMATOZOA, CHYLURIA, and FILARIA SANGUINIS-HOMINIS. T. S. COBBOLD.

FISH-SKIN DISEASE.—A synonym for ichthyosis. *See* ICHTHYOSIS.

FISSURE (*findo*, I cleave).—A narrow and superficial crack or solution of continuity, observed on the skin and mucous membranes, and especially near the line of junction of these structures, as on the lips and anus. *See* ANUS, Diseases of; and CHAPS.

FISTULA (*fistula*, a pipe).—A narrow track or canal leading from a free surface, and extending more or less deeply to some seat of local irritation, or it may be constituting an abnormal communication between two or more cavities, as in the case of vesico-vaginal or recto-vaginal fistula. *See* Abscess.

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[1] The researches of Dr. Manson, of Amoy, confirmed by Dr. Lewis, show that embryo filariæ in the blood are imbibed by the mosquito, or other intermediary host; undergo developmental changes; and are discharged into water with the larvæ of the insect. Infection probably occurs through this medium. Dr. Manson has recently stated (*Medical Times*, June 1881) that the habitat of the parent filaria is in the lymphatic trunks.—ED.

FISTULA IN ANO. *See* Rectum, Diseases of.

FIT.—A popular synonym for a sudden seizure characterised by loss or disturbance of consciousness from any cause, with or without convulsions. (*See* Convulsions, Epilepsy, Hysteria, and Syncope.) The term is also applied to a sudden or acute seizure of certain diseases, such as gout, asthma, and ague.

FLATULENCE (*flatus*, a puff of wind). Synon.: Fr. *Flatulence*; Ger. *Flatulenz*.

Definition.—The undue generation of gases in the stomach and intestines.

Ætiology.—The principal cause of flatulence is fermentation or decomposition of the contents of the stomach and bowels—a condition usually induced by embarrassment of function. Hence it is a common symptom in dyspepsia—especially the atonic forms as met with in the debilitated and the aged—constipation, gastritis, enteritis, hepatic disorders, intestinal obstruction, &c. When flatus is generated too rapidly to be accounted for by fermentation, as in hysteria, hypochondriasis, and other forms of nervous debility, it has been ascribed, but incorrectly, to secretion of gases from the mucous membrane.

Symptoms.—The clinical phenomena vary as flatus is retained or discharged; and with the seat of its formation, whether chiefly in the stomach or intestines. In the former the concomitant symptoms are those of dyspepsia, and in the latter there is usually constipation. As a rule, however, flatulence pervades at the same time more or less all the hollow viscera, and indicates torpor of the digestive organs. It is apt to lead to these further evils:—(*a*) *Pain* from distension or from irregular and forcible contractions of the walls—hence gastrodynia and colic are apt to arise; (*b*) *arrest of the normal movements* of the stomach and intestines, and consequent accumulation within them of fermentable matters, with further generation of gases, leading to paralytic distension; hence dilatation of the stomach and colon, tympanites or meteorism, and aggravation of preexisting dyspepsia or constipation may ensue; and (*c*) *pressure on adjacent organs*, *e.g.* on the heart and lungs, inducing palpitation and irregular action of the heart, precordial anxiety, faintness, vertigo, dyspnœa or even asphyxia.

In tympanites there is a rapid generation of flatus, which overpowers the contractility of the hollow viscera; and the abdomen is round, tense and tympanitic. When this condition is accompanied by fever and diarrhœa, typhoid fever should be suspected; but if fever be absent, while there is bilious or stercoraceous vomiting, probably intestinal obstruction exists—intussusception, internal strangulation, hernia, &c.

Treatment.—(*a*) *Imprisoned flatus should be dislodged* by friction of the abdomen with stimulating liniments, and gentle kneading of the most distended parts; large draughts of hot water; spirit and hot water; ammonia, ether, or spirits of chloroform; aromatic stimulants—ginger, cloves, mint, anise, cajeput, camphor, cascarilla, &c. When flatulence is chiefly intestinal, enemata containing laudanum with assafœtida, turpentine, or rue; and pilula assafœtidæ composita with extractum nucis vomicæ, and an aperient are the most useful measures.

(*b*) *The generation of flatus should be arrested.* Fermentation may be checked by sulphite or sulpho-carbolate of soda, sulphurous acid, carbolic acid, creasote, or charcoal—from the poplar or vegetable ivory—immediately after food, and by correcting and toning the digestive organs. Food likely to ferment or lodge, such as starch, sugar, fruits or vegetables, and warm liquids—especially tea and soups—should be avoided; the meals should be well masticated and solid throughout, and liquids should only be taken sparingly at the close or an hour after. In some cases, however, flatulence is connected with an insufficient supply of fluids, and can only be met by increasing it. Alkalies—carbonate of magnesia, soda, or lime—and bitters, especially strychnia, are often useful in the flatulence of hysteria, hypochondriasis, the very nervous and the aged (Trousseau, Niemeyer); but perhaps the best results follow alkalies with nux vomica and bismuth an hour before, and hydrochloric acid alone or with Liebreich's Pepsin Essenz or other reliable preparation of pepsin after food. It is also essential to see that the action of the liver is healthy. George Oliver.

FLEXION (*flecto*, I bend).—A bending. This term is applied either to the act of bending, as in some methods of treatment, for example the cure of aneurism or the reduction of dislocations; or to the condition in which parts are bent, as the result of disease or of disorder, as when the limbs or certain internal organs are bent upon themselves. *See* Womb, Diseases of.

FLOODING.—A popular term for excessive discharge of blood from the womb. *See* Menstruation, Disorders of; and Pregnancy, Disorders of.

FLUCTUATION (*fluctus*, a wave).—A physical sign consisting in a wave-like or undulating sensation. It is elicited by a peculiar mode of palpation with the one hand while percussion is made with the fingers of the other; and is due to the presence of a fluid in a natural cavity such as the peritoneum, or in an abnormal closed space, such as a cyst (*see* Physical Examination). The term fluctuation as used by the surgeon has a somewhat different signification, being applied to the sensation of the presence of a fluid which may be felt when alternate pressure with the fingers is made, as over the seat of an abscess. *See* Abscess.

FLUKE.—In its original signification this term means anything flat; but, in connection with internal parasites, it refers generally to the common liver-entozoon and its allies, which happen to be more or less flat or leaf-shaped. The liver-fluke belongs to the genus *Fasciola*, though more commonly spoken of as a *Distoma*. Some of the flukes of man, as well as of animals, have a rounded form, quite unlike that shown by the ordinary liver fluke. With one or two notable exceptions, the flukes are destitute of clinical importance. Under this head must also be mentioned a remarkable fluke recently discovered by Dr. Lewis in India, and called by him *Amphistoma hominis.* As there is ground for believing that several allied species (*A. Hawkesii*, *A. Collinsii*, &c.) prove injurious to elephants and horses, it is possible that the human amphistome may be productive of severe intestinal mischief. *See* DISTOMA, and BILHARZIA.

T. S. COBBOLD.

FLUOR } **FLUX** } (Latin).—A flow or excessive discharge from a mucous surface through any of the natural passages, of serum, blood, mucus, pus, or the various secretions. As illustrations of fluxes may be mentioned salivation, bronchorrhœa, biliary flux, diarrhœa, dysentery or bloody flux, cholera, and leucorrhœa or white flux (*Fluor albus*).

FŒTUS, Diseases of the.—Two classes of abnormal conditions are seen in the fœtus, namely:—Those which depend upon some interference with the process of development, such as malformations, monstrosities, &c., and those which are the result of disease. This article treats of the latter only.

1. *Amputation.*—Amputation, partial or complete, of fœtal limbs, may take place, from constriction of the limb by a band of the amnion. An attempt at reproduction of the lost limb is sometimes seen, in the shape of rudimentary fingers and toes, projecting from the stump. That such a stump is the result of amputation is proved by the fact, that the part cut off has been found *in utero.*

2. *Spontaneous fractures and dislocations.*—Fractures and dislocations occur *in utero*, the latter being the more rare. They are due to some condition of the bones and ligaments respectively, leading to undue fragility of those structures; for they are always multiple, and are not accompanied with bruising of the adjacent soft parts.

3. *Tumours.*—New growths are met with in the fœtus—cysts of various kinds, fibromas, lipomas, &c. That most special to the fœtus is a tumour situated over the coccyx, which may be as large as a fœtal head. Such tumours are spheroidal or ovoidal in shape, elastic in consistence, and present rounded inequalities on the surface. On section they are found to consist of strong fibrous trabeculæ, in the meshes of which are numerous small cysts lined with epithelium. It is thought by many that they originate in Luschka's gland. Another special kind of tumour is that known as a *fœtal inclusion*—a swelling usually on the lower part of the trunk, and containing some part of another fœtus, more or less imperfectly developed.

4. *Inflammation of serous membranes.*—This form of disease may occur in the fœtus, such as pleurisy and peritonitis. The morbid anatomy of these changes does not differ from that in the adult. Peritonitis is often found associated with syphilis; and it appears to be almost always fatal to the fœtus.

5. *Visceral Inflammation.*—Inflammation of the lungs has been met with, in the form of grey or white lobular hepatization. It is most frequent in syphilis. Enteritis has also been described. Various malformations of the heart which are met with can be explained by supposing the occurrence of endocarditis during fœtal life; but there is no proof that the fœtus is subject to rheumatism. Virchow describes encephalitis.

6. *Specific Fevers.*—The morbid changes of *enteric fever* have been found in the fœtus. In pregnant women suffering from *intermittent fever*, paroxysms of convulsive movements of the child have been felt to occur as regularly as the attacks of ague in the mother; and the child when born has been found to have a large spleen. Children have also been born with skin-eruptions thought to resemble those of *measles*, *scarlatina*, and *smallpox*. The facts as to the last-named disease are the most numerous and probable. The eruption of variola in the fœtus differs somewhat from that seen after birth, because, the skin of the fœtus being bathed with fluid, no crusts form, and the pustules run a course like those on mucous membranes.

7. *Diseases of the Skin.*—The fœtus is subject to skin-diseases. Pustules of ecthyma; patches of erythematous redness; ulceration of the skin, and syphilitic eruptions have been seen. Intra-uterine ichthyosis is met with. Children have been born jaundiced, but only by mothers themselves suffering from that disease. But women with jaundice do not always bear jaundiced children. Jaundice is not necessarily fatal to the fœtus.

8. *Syphilis.*—Syphilis leads to various lesions in the fœtus, and while it usually proves fatal, the subjects of it that may survive till birth are feeble and badly nourished. Flat tubercles occur on different parts of the skin, especially round the mucous orifices; and pemphigus, affecting chiefly the palms of the hands and the soles of the feet, may be seen. The occurrence of peritonitis has already been mentioned. Yellow indurated nodules, of varying size and number, may be found in the liver, as well as similar nodules in the lungs. A peculiar change has been described in the thymus gland, in which this structure externally appears healthy, but when cut into and compressed exudes a whitish puriform fluid. Other changes have been recorded, affecting the spleen, pancreas, and suprarenal capsules, but they are not distinctive. Changes in the bones have also been described, consisting of an osteo-chondritis, affecting the ends of the long bones, most frequently the lower end of the femur.

9. *Rachitis.*—Rickets is met with *in utero.* The changes it produces are like those seen after birth. It is thought to be one of the causes of spontaneous fractures.

10. *Tuberculosis.*—Tuberculosis sometimes commences in the fœtus, tubercles having been found in the mesentery and in the lungs.

11. *Dropsies.*—Dropsy is met with in the fœtus, sometimes of the serous cavities, of which hydrocephalus is the most common. It is often associated with rickets. Next in frequency comes ascites, and lastly hydrothorax, which is very rare. These affections may destroy fœtal life *in utero*; but they more often lead to death because they render destructive operations necessary before delivery can be accomplished. General anasarca is also met with, and there is reason to believe that it depends upon disease of

the placenta, impairing the excretory function of that organ. It is always fatal, if not before, within a few hours after, birth.

12. *Visceral diseases.*—Hypertrophy of the liver, spleen, or kidneys may occur in the fœtus. Cystic disease of the kidney may be met with, the organ being converted into a mass of cysts containing no trace of secreting structure. Both kidneys are usually affected, and the disease is generally associated with some malformation elsewhere. Hydronephrosis, single or double, along with dilatation of the ureter, or ureters and bladder, has been seen, dependent upon impermeability of some part of the urinary passages. Any of these visceral diseases may form a tumour so large as to impede delivery. None of them can be diagnosed before birth. Concretions of uric acid and urates are not uncommon.

The Causes of Death of the Fœtus.—The various causes of death of the fœtus *in utero* may now be briefly considered. The first of these is *injury*, as when the mother receives a blow upon the abdomen, or has a fall. Such occurrences rarely directly injure the fœtus, although this has been known to happen. When they prove fatal to the fœtus, they do so by leading to hæmorrhage into, or separation of, a portion of placenta, and consequent disturbance of the fœtal circulation. *Poisons* in the mother's blood, such as lead, urea, or carbonic acid (as in the case of heart-disease with cyanosis), may lead to death of the fœtus. *Syphilis* has already been referred to. Epileptiform *convulsions* may destroy fœtal life, either by asphyxia, or by leading to hæmorrhage into the placenta. Extreme *anæmia* and the *cancerous cachexia*, are among the causes of fœtal death. Any kind of disease attended with *pyrexia* will also destroy fœtal life if the temperature rise high enough. A temperature exceeding 105° Fahr. appears to be invariably fatal to the fœtus. Certain *diseases of its appendages* may lead to death of the fœtus, such as fatty degeneration, or œdema, of the placenta; obliteration of the umbilical vessels; or interruption of the circulation in the cord by knots in it, or pressure upon it. It is believed that there are some *diseases of the mother's uterus* which lead to death of the fœtus; but what they are is not known. It is said that some women acquire a habit of having dead children. This means that there are cases in which an apparently healthy woman will repeatedly have dead children, the cause of whose death a skilled observer cannot find out. In other words, there are causes of fœtal death as yet unknown.

The Consequences of Death of the Fœtus. A dead fœtus while retained *in utero*, and thus protected from the air, does not putrefy, but undergoes a process of maceration. The whole body becomes soft and flaccid, its tissues being infiltrated with fluid; but it has no putrid odour. The skin presents bullæ filled with reddish serum, and the epidermis is readily detached with slight friction. The surface is of a cyanotic colour, which after exposure to the air becomes of a more or less bright red; it is not greenish, as is seen in putrefaction. The cellular tissue is infiltrated with bloody serum. The viscera have lost their distinctive tints, and become of a reddish-brown colour. The cranial bones are abnormally mobile, overlapping one another to a greater extent than normal; and the periosteum may be stripped off them. These appearances are much the same, whatever be the cause of death, but they vary in degree according to the length of time which has elapsed since death.

Besides the diseases of the fœtus described above there are others which are not fatal, and the chief interest of which lies in their course and treatment after birth. These are discussed in other articles, and for that reason are not mentioned here. G. E. Herman.

FOLIE CIRCULAIRE (*French*).—This term is applied by the French psychological physicians to a variety of insanity characterised by alternations of excitement and depression. The patient passes through an attack of mania of perhaps an ordinary character but when he appears to have recovered he sinks into melancholia, and thence emerges again to become maniacal and excited. The duration of each stage may vary from weeks to months; sometimes one state will follow the other immediately; in other cases a period of convalescence will intervene, during which the patient appears well, and can hardly be considered insane. Yet the prognosis is extremely unfavourable in all such cases, and it is of great importance in estimating the extent of recovery of a patient that it should be clearly ascertained that the attack is not one of a series following one another in the manner mentioned. G. F. Blandford.

FOLLICLES, Diseases of (*folliculus*, dim. of *follis*, a bag).—The name 'follicle' has been applied to a great variety of different structures, which have in common the shape of a bag or sac, whether circular or elongated in outline; for example—the Graäfian follicles, the lymphatic (Peyerian) follicles of the intestine, and the follicles of the mucous membrane of the stomach, intestine, and uterus. The name has been further extended to include glands somewhat more complex in structure, such as the sudoriparous glands or sweat-follicles, the sebaceous follicles, and the tonsils; as well as the saccular depressions in which the hair and the teeth take their origin. The name *Synovial Follicles* is sometimes given to processes of synovial membrane invaginated in the capsule of a joint.

For an account of the diseases of these various structures, the reader is referred to the several articles under which they are discussed; but so far as the true follicles are concerned, the following may be said to be the principal morbid changes to which they are liable:—Atrophy; Hypertrophy; Obstruction, and Distension; Inflammation; Ulceration; Cystic Disease; New Growths; Tubercle; Acute Specific processes, such as the typhoid; and Parasitic disease.

FOMENTATION (*foveo*, I keep warm). Synon.: Fr. *Fomentation*; Ger. *Bähung*.

Definition.—Fomentation is the application to the surface of the body of flannels, cloths, or sponges moistened with hot water, either pure or containing some medicinal substance in solution.

Action.—The action of a simple fomentation is the same as that of a poultice. By its warmth and moisture it tends to relax the muscular fibres of the skin, and soften the cuticle, thus relieving tension, and diminishing pain and irritation. In the early stages of inflammation it favours resolution, by maintaining the temperature and promoting active circulation through the area which has suffered from the injurious influence which has started the process. In the later stages it promotes and hastens suppuration, by causing dilatation of the vessels, and hastening exudation and cell-multiplication. A fomentation is superior to a poultice in lightness and cleanliness, but unless care be taken it loses its heat more quickly. This disadvantage may be overcome by covering the fomentation with a thick layer of cotton-wool.

Application and Uses.—A fomentation is thus applied:—A piece of coarse flannel, or of spongio-piline, sufficiently large to cover the affected part when folded into two layers, is put into a basin and boiling water is poured upon it. It is then lifted from the basin with a pair of tongs or some convenient instrument, and dropped on the wringer. This is a stout piece of towelling with a stick attached to each end. The sticks then being twisted in opposite directions, as much water as possible is squeezed out of the flannel. It is then immediately placed on the affected part, and covered with a large piece of oiled silk or indiarubber sheet extending at least one inch on each side of it. Over this may be placed a thick layer of cotton-wool, and a bandage. If the flannel be not squeezed sufficiently dry it will wet the bed or clothing. If not sufficiently covered with oiled silk and wool it soon becomes cold. Whatever means may be taken to retain the heat of a fomentation, it can be kept above the temperature of the body only for a few minutes. If, therefore, the full effect of fomentation is desired to be obtained, the flannels must be changed every twenty minutes. In many parts a sponge, or a piece of spongio-piline, wrung out of boiling water forms a most convenient form of fomentation. When the fore-arm or hand is affected, a bath of hot water may be substituted for fomentations. The temperature of the water must be maintained by the repeated addition of small quantities of boiling water.

Fomentations are especially useful in all cases of erysipelas and diffuse cellulitis, and in boils. In peritonitis they are borne more easily than poultices, on account of their greater lightness. Whenever they can be employed they are superior to poultices on account of their cleanliness. They are not applicable to cases in which there is a discharging wound or abscess, as under such conditions the cloths become foul.

Varieties.—If it is desired to add some slight counter-irritation to the warmth and moisture, the fomentation may be sprinkled with turpentine before it is applied. This forms the ordinary *turpentine-stupe*. The sedative action of the fomentation may be increased by sprinkling it with laudanum. The ordinary poppy-fomentation is often used with the same intention. It is thus prepared:—Half a pound of poppy-heads with the seeds taken out is boiled for ten minutes in four pints of water, and the liquid then strained off. The decoction is kept warm over a fire and the flannels dipped in it and applied as before described about every half-hour. The term 'dry fomentation' is sometimes applied to bags of salt, hot bran, or chamomile flowers; or pieces of flannel toasted before a fire and applied hot. These often give relief in cases of intestinal, renal, or biliary colic. Marcus Beck.

FOMITES (*fomes*, fuel).—Substances capable of retaining contagium-particles, and thus of being the means of propagating any infectious disease. The most important fomites are bed-clothes, bedding, woollen garments, carpets, curtains, letters, &c. *See* Contagion.

FOOD. *See* Aliments, and Diet.

FOOD, Ætiology of.—*See* Disease, Causes of; and Digestion, Disorders of.

FORAMEN OVALE, Patency of.—*See* Heart, Malformations of.

FORCIBLE FEEDING.—In the treatment of insanity it not unfrequently happens that we are compelled to administer food by force to patients who, for one reason or another, refuse to take it. The majority of them are melancholic persons who think they ought not to eat, or try to commit suicide by starvation, and many are in a feeble bodily condition when they commence this refusal. Such persons must be fed by force without delay. Strong patients may be allowed a longer time, for many refuse from whim or obstinacy, and hunger will soon overcome their disinclination. Some patients in a state of acute delirium will take no food; they must be fed at once, and it is important that they should be fed without a protracted and exhausting struggle, for they will resist desperately unless completely overmastered. In almost every case feeding should be done early: the sooner it is done, the shorter will be the period during which it will be required. What method is to be adopted? The various plans range from merely feeding with a spoon as one feeds a child to sending food down the œsophagus with a tube passed through the mouth or nose, the patient being restrained in a chair or on a bed by attendants or mechanical restraint. The mode of feeding varies according to the resistance, and no one method is applicable to every case. There is no need to pass an œsophageal tube down the throat of a man whose resistance is passive and easily overcome; on the other hand we occasionally find patients of great muscular strength and indomitable will, who can hardly be fed with safety in any way except by the stomach-tube. Of these we may speak first. In what position are they to be fed, sitting or lying down? If they are to be held by attendants no doubt the recumbent posture is the one in which the latter can exercise most power. But when a man is so strong that, as we are told, five attendants must hold him, a struggle will not be unattended with danger, for the five are not all acting together, and he gets loose now a leg and now an arm, to the great discomposure of the operator: moreover this struggle repeated three times a day soon renders him a mass of bruises. He should be placed in a strong wooden chair, and by sheets wound round his body, arms, and legs he can be fastened to the chair so completely that he is as incapable of movement as if he were paralysed, yet he gets no bruise, and the operator acts upon him free from all inconvenience. Some writers advocate feeding by the nose, and prefer this method to passing a tube through the mouth. But if a long tube is used it is apt to get into the larynx, and if the food is passed into the nose through a funnel or feeder, it is often ejected again. The only advantage of feeding through the nose is that we are not compelled to force open the mouth. This is a work of difficulty if the patient is strong and his teeth perfect, unless we are provided with the screw-key invented for this purpose: with this there is little difficulty, and only bungling will injure the teeth or gums, if the patient is properly secured and the head held by an attendant, not between his knees but in his hands. If the œsophageal tube be of good size it cannot enter the larynx. The wooden termination of the tube must be short, so as to allow of its curving. The operator standing in front passes the tube through the hole of the gag, inclining it to the patient's left, so as to avoid the vertebræ. It may be held by the tongue, but at the first inspiration the hold is relaxed, and it glides down the œsophagus. The food may be poured down it by a funnel or pumped down by the pump. The next class of patients, making less resistance, may be fed by Paley's feeder, a glass vessel with a flattened spout which goes over the tongue: the food is emitted, a little at a time, by means of a spring, and finds its way down the gullet. A certain number of patients may be fed by getting a funnel behind the teeth and pouring food into it; and others by holding the mouth open by means of two spoons, and then pouring food in. The objection to the latter method, and to its many modifications, is the time taken up in the operation, whereby great fatigue and exhaustion are produced. G. T. Blandford.

FORMICATION (*formica*, an ant).—An abnormal subjective sensation referred to the skin, which is described as of a 'creeping character, and as resembling the crawling of ants upon the surface. *See* Sensation, Disorders of.

FOURTH NERVE, Diseases of.—Morbid states of the fourth nerve are shown in spasm or paralysis of the superior oblique muscle which it supplies. Little is known of overaction of this muscle. Clonic spasm in it is seen in rotatory nystagmus. Paralysis is not uncommon. Its usual causes are inflammation of the nerve-sheath from cold; syphilitic affections of the nerve or of its membranes; cerebral tumours &c., pressing on or injuring the nerve at its origin from the valve of Vieussens, or in its course around the crus; aneurism; exostoses or growths in the orbit; and degeneration of the nucleus, in common with the nuclei of the other nerves of the ocular muscles.

Symptoms.—Even in complete paralysis of the superior oblique muscle there is little obvious deviation of the affected eye. Movement downwards is, however, defective, and therefore diplopia exists when the eye is moved below a line which runs obliquely downwards from the healthy to the paralysed side, through the point of mid-fixation. Movements which necessitate a downward position of the head are therefore chiefly interfered with, and it is common for the first discovery of a defect to be that the patient becomes giddy when he goes downstairs, in consequence of seeing two flights of stairs before him instead of one. The chief visible defect in movement of the affected eye (examined alone) is downwards and inwards, because it is when the eyeball is moved in these directions that the superior oblique has most influence on the vertical position of the eyeball. The defect in the rotation of the eyeball is greatest when it is moved downwards and outwards. The diplopia which exists when both eyes look down is homonymous, that is, the image formed by the affected eye is on the same side as that eye. The left eye being higher than the right, its image (the left) appears lower than the right image. The action of the superior oblique being to move the upper end of the vertical axis of the eye inwards, there is in its paralysis an abnormal divergence of the upper ends of the vertical axes, and the double images (being always inverted) will converge; their upper ends being nearer together than the lower. This is due to the obliquity of the false left image, and this obliquity is greatest when the eyeball is moved to the left and downwards, because in this position the rotatory power of the superior oblique is greater, and the obliquity is least in looking inwards and downwards. Thus the convergence of the images is greatest when the difference in height is least, and *vice versâ*. When the paralysis of the superior oblique has existed for some time, a secondary contraction of the inferior oblique may cause crossed diplopia in looking upwards.

Treatment.—The treatment of paralysis of the fourth nerve is in the main that of its cause. When due, as it very commonly is, to syphilis, iodide of potassium in full doses, with or without mercury, is necessary. Smaller doses of iodide with quinine or iodide of iron are also useful for rheumatic paralysis. Blisters to the temple in the early stages are useful. A little, but not much, good may be effected by applying the constant current from the eyelid to the forehead (Benedikt), a few cells only being used.

W. R. Gowers.

FRAGILITAS CRINIUM (*fragilitas*, brittleness; *crinis*, the hair). *See* Hair, Diseases of.

FRAGILITAS OSSIUM.—A diseased condition of the bones in which they are extremely fragile, so that they are liable to fracture from very slight causes. *See* Bone, Diseases of.

FRAMBŒSIA (*framboise*, a strawberry).—Synon.: Yaws; Fr. and Ger. *Pian*.

Definition.—Frambœsia consists of an eruption of yellowish or reddish-yellow tubercles; which gradually develop into a moist exuding fungus without constitutional symptoms, or with such only as result from ulceration and prolonged discharge, namely, debility and prostration.

Ætiology.—This disease is peculiar to the African race, both in their native country and in the West Indies. Yaws are epidemic; they are also contagious by actual contact, and consequently inoculable. The period of incubation of the poison ranges from three to ten weeks, and, except in rare instances, the disease occurs only once in a lifetime.

Symptoms.—The tubercles begin with little or no hyperæmia, and range in size between that of a pin's head and a prominent mass one or two inches in diameter. Some subside without piercing the cuticle, and disappear without causing disorganisation of the skin. When the cuticle is penetrated, the tubercles assume the appearance of a fungous mass of spheroidal figure, yellowish or pinkish in colour, and moistened with a dirty-yellow, fœtid secretion. At a later period the fungus shrinks in size, and is converted into a yellow and brownish scab; at other times the ulceration extends deeply and widely into the tissues. The subsidence of the eruption is succeeded by a pigmented stain, and the healing of the ulcers by a pigmentary cicatrix.

The eruption selects by preference as the seat of its development, the face and neck, the limbs, the feet, and the genital region, and is frequently found around the mouth, the apertures of the nostrils, the eyelids and the anus, where it is apt to present a thick fringe of tubercles or a broad prominent band or ridge.

Course and Terminations.—The ordinary duration of frambœsia extends from two to four months, but frequently this period is prolonged to one or several years. When it is irregular in its development the constitution is apt to suffer, ulcers form around the joints, the joints swell, the discharge from the ulcers is excessive, the exhalations of the body are highly offensive, and the patient is crippled for life, or in some instances relieved only by death.

Treatment.—The treatment of yaws, according to the best authorities, consists in cleanliness, generous diet, the local use of carbolic acid lotions and diluted nitrate of mercury ointment; and the employment of constitutional remedies, of which the most useful are mercury, with sarsaparilla or a decoction of the woods, iodide of potassium, and tonics. Erasmus Wilson.

FRANCE, South of.—The eastern part (Mediterranean Coast) is dry and bracing, with a very clear atmosphere. The chief resorts in it are Cannes, Mentone, Hyères, and Nice. The western part is moist and mild but variable, the principal places in it being Arcachon, Biarritz, and Pau. *See* Climate, Treatment of Disease by.

FRANZENSBAD, in Austria.—Alkaline sulphated waters. *See* Mineral Waters.

FRECKLES.—Synon.: *Lentigines*; *lenticulæ*; Fr. *ephelides*; Ger. *Sommersprossen*, *Sommerflecken*.—A freckle is a pigmentary discoloration of the skin, which has received its Latin or technical name from a resemblance in colour, figure, and size to a lentil. It varies in tint from yellow to olive, from brown to black; and is met with on the exposed parts of the skin, particularly the face, neck, and hands, and occasionally on the covered parts of the body ('cold freckles'). It is usually found in children and women in whom the skin is sensitive and delicate, and has obtained its German synonyms from its greater frequency in the summer season. *See* Pigmentation, Disorders of. Erasmus Wilson.

FREMISSEMENT CATAIRE (*fremissement*, purring; *cataire*, connected with a cat). A physical sign felt on applying the hand over the region of the heart or great vessels in certain morbid conditions; and compared to the sensation conveyed to the hand by the purring of a cat. This sign is more commonly known as 'thrill' or 'purring tremor.' *See* Physical Examination.

FREMITUS (*fremitus*, a loud noise).—A group of physical signs, elicited by placing the hand over the respiratory organs, while the patient speaks (*vocal fremitus*), or coughs (*tussive fremitus*); or in certain morbid conditions when the patient simply breathes (*rhonchal*, and *friction-fremitus*). A fremitus may sometimes also be felt over the cardiac region in connection with the movements of the heart, when the surfaces of the pericardium are much roughened. Another form of fremitus is a peculiar sensation called *hydatid fremitus*, which may be elicited by a special mode of percussion over hydatid tumours in some cases. *See* Physical Examination.

FRICTION.—Synon.: Rubbing; Fr. *Friction*; Ger. *Reibung*.

Definition.—By friction we mean surface-rubbing, as distinguished from *shampooing*, or as it is sometimes called *medical rubbing*, a process of manipulation by which deep pressure is made upon the muscles.

Applications and Uses.—Friction is usefully employed over the surface of a limb, or the trunk, for a variety of purposes. It is especially useful when the circulation is enfeebled, either by the external application of cold, amounting when in a severe degree to frost-bite, or in cases of paralysis. The effect is still further increased by the use of various stimulating liniments and embrocations, more especially when it is desirable to excite a certain amount of counter-irritation over a large cutaneous surface for the relief of congestion or inflammation of internal organs.

Another object with which friction is largely employed in medicine, is to facilitate the absorption and introduction into the system of various remedial agents applied externally, instead of being administered internally by the stomach. By this means gastric irritation and disturbance are avoided, and the effects of the remedies upon the system can be more closely watched and regulated. In this way mercury is frequently introduced into the system by the process commonly spoken of as *rubbing in*, and salivation can be more easily avoided or checked at its commencement than when mercury is administered by the mouth. The part of the body selected for this purpose is that along the inner side of the thigh up to the groin, and mercury, rubbed in, in the form of ointment, every night and morning, will generally affect the system in a few days.

Another instance of friction is to be found in the fattening of children by the process of rubbing in oil—fresh neat's-foot oil is the best—every night and morning, over the chest, abdomen, arms, and thighs. Emaciated children thus treated gain in weight by the absorption of the oil; and not only do they fatten, but their general nutrition and health are improved, often with the diminution of glandular swellings and the disappearance of coughs, so that there is some ground for the belief in the curative influence of this method of medication in incipient phthisis. WILLIAM ADAMS.

FRICTION-FREMITUS.—The form of fremitus produced by the rubbing together of surfaces roughened by various morbid conditions, as of the pleura in breathing, or of the pericardium from the movements of the heart. *See* FREMITUS, and PHYSICAL EXAMINATION.

FRICTION-SOUND.—A physical sign, heard on auscultation, and due to the rubbing against each other of serous surfaces that have lost their natural smoothness and moistness from any cause. *See* PHYSICAL EXAMINATION.

FRIEDRICHSHALL, in Germany.—Sulphated waters. *See* MINERAL WATERS.

FROST-BITE.—A local effect of extreme cold upon any of the tissues of the body. *See* COLD, Effects of Extreme or Severe.

FUMIGATION (*fumigo*, I smother).

DEFINITION.—This is a mode of employing certain medicinal agents which are capable of being volatilised by heat, the vapour being then allowed to escape into an apartment, or to come in contact with articles of clothing and other objects, for purposes of disinfection (*see* DISINFECTION); or being allowed to act upon the surface of the body as a whole, or upon certain parts of it, for therapeutic purposes, either local or general, on being absorbed. The chief agents which are thus used are sulphur and mercury.

MODE OF APPLICATION AND USES.—The mode of using sulphur as a disinfectant will be found sufficiently explained under the article DISINFECTION. The vapour may also be brought with a therapeutic object into contact with the body or any part of it in the dry state, the sulphur being burnt in a suitable apparatus. As a general application it is used for the cure of itch; as a local application in diseases of the throat, and various other affections.

Mercurial fumigation is now commonly effected by means of the moist mercurial vapour bath, in which the skin is exposed to the fumes of mercury volatilized by heat and mixed with steam, in a suitable apparatus. This process is more effectual than dry fumigation, for the moistened skin is more capable of receiving and absorbing the mercurial vapour which settles upon it. It is not desirable to produce profuse perspiration, as this exhausts the patient, and washes the mercurial film from the body.

Various preparations of mercury have been tried, but by far the best is calomel as recommended by Mr. Lee, which is capable of being more completely volatilized than any other form and with a less degree of heat, whilst the amount administered is more accurately known. The quantity used for each bath may be varied from 10 to 30 grains, and given daily or at such intervals as circumstances indicate. The body should be protected from cold after leaving the bath, and night is the best time for its use, as the patient can then go to bed enveloped in the cloak or blanket which has been employed in the process, and upon which much of the vapour has collected. Salivation is readily and often quickly produced by this method, so that the gums must be carefully watched and the dose regulated. The time ordinarily required for the bath is about 20 minutes, but if headache or lassitude be caused, it must not be so prolonged.

The advantages of this practice are that mercury can be introduced into the system without giving rise to the intestinal derangements, loss of appetite, &c., which its exhibition by the mouth sometimes occasions, and its direct action upon the skin often appears to be of service. There is, however, the disadvantage that in some cases the mercurial fumes may cause a syphilitic eruption to inflame and spread.

Mercurial fumigation has been employed for primary syphilis, but it answers best in the secondary stage of the disease, and especially for the dry eruptions. Sometimes it is useful for the tertiary manifestations which resist iodide of potassium, but it should be tried very cautiously in these cases.

In certain cases where, from feeble health or other causes, it is not advisable to influence the system with mercury, the calomel vapour may be directed upon some local parts, such as an ulcerated spot. This local application has been found serviceable in treating intractable sores in advanced syphilis, in severe and obstinate ulceration of the throat, and in some other conditions.

GEO. G. GASCOYEN.

FUNCTIONAL DISEASES.—A class of diseases in which an anatomical change cannot be detected to account for their presence. *See* DISEASE, Classification of.

FUNGI, Diseases due to. *See* PARASITES, Diseases from; and MUSHROOMS, Poisoning by.

FUNGOID (*fungus*, a mushroom).—A term applied to superficial granulations and morbid growths, especially those of a malignant nature, when they sprout rapidly and assume an appearance somewhat like a mushroom. *See* CANCER, and ULCERATION.

FUNGUS-DISEASE OF INDIA.—SYNON.: Madura Foot, Mycetoma; *Morbus tuberculosus pedis*; Fr. *Dégénérescence endémique des os du pied* · *Pérical.*

DEFINITION.—A diseased condition of the hands and feet, occurring in India, characterised by enlargement and distortion of the affected extremity, due to thickening of the cutaneous tissues, with degeneration and subsequent fracture of the osseous structures. Two forms of the malady are described—one, the pale or ochroid form, characterised by the presence of minute globular fatty particles like fish-roe, and, though very rarely, by the existence of minute pink concretions not unlike red-pepper granules; the other, the melanoid or dark form, characterised by the existence of black or dark brown masses, varying in size from that of a grain of gunpowder to a walnut, and composed of fungoid filaments, cells, and pigmentary deposit.

DESCRIPTION.—This remarkable disease of the extremities does not appear to have been observed hitherto beyond the limits of Hindostan, and has rarely been seen to affect any but the natives of that country. No case of a European or half-caste has been recorded as suffering from a typical form of the malady. The foot has been observed to be affected more often than the hand; hence it was common formerly to find the malady referred to as one peculiar to the foot. It has been recognised as a distinctive disease in India for more than thirty years, and was described by Goodfrey, of Madras, in the *Lancet* in 1846, and by Eyre in the *Indian Annals of Medical Science* in 1860. It is to Dr. Vandyke Carter, however, that we are chiefly indebted for what is known of the malady, clinically and pathologically, and his writings date as far back as 1860. His recently published memoir on the disease (*Mycetoma, or the Fungus Disease of India*, 1874) contains a summary of all that had been written regarding it up to the period of publication.[1] The foot or hand affected with the disease presents appearances not unlike what are observed in some of the forms of caries—especially those of scrofulous origin. When it is the foot that is affected, it is found to be considerably increased in circumference, the enlargement seldom extending far beyond the ankle; the foot is prone to run in a line with the leg, and may be everted or inverted. It is not, however, in the aspect presented by the limb that the leading peculiarity consists, but in the character of the discharges from the sinuses, the openings of which are scattered all over the surface of the affected tissue. It is this peculiarity which led Dr. Carter to separate the disease into two forms, (1) the 'pale' or 'ochroid,' the discharge of which consists of whitish-yellow roe-like bodies of about the size of millet-seed; and (2) the 'dark' or 'melanoid,' so called from the dark brown or even black granular bodies that constantly escape through the sinuses, not unlike grains of coarse gunpowder. The first form may be said to present two or three varieties, according to the modified character of the discharges: these will be referred to more definitely farther on. The malady would appear to occur more frequently in Madras, Bombay, and the more westerly and north-westerly parts of India than in Bengal proper. This, however, seems to apply more especially to the dark variety; for, whilst no well-authenticated case of this form has been recorded as having manifestly originated in the last-named province, cases of the pale variety are not unfrequent. So far as the foot is concerned, the pale form is manifestly the one most commonly met with all over India, at least, if any inference may be drawn from the fact, that whilst the writers have had the opportunity of examining two or three hands affected with the dark variety, they have not seen one affected with the pale; nor can they find any account of such a case having been witnessed. The distortion of the hand affected in this manner is very peculiar—it is shortened and thickened, owing to the destruction of the carpus and metacarpus, and the consequent irregular tension of the extensor and flexor tendons.

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Anatomical Characters.—On laying open a characteristic specimen of the disease, the bones are found to be extremely softened, so that they can readily be divided by means of a common knife. The interior of the hand or foot is found to be occupied by a series of sharply defined cavities, some quite isolated, but the majority communicating with one another and with the exterior by a series of complex channels or sinuses containing glairy fluid and solid concretions in various proportions. Both cavities and channels are lined by a dense, glistening membrane composed of white fibrous and elastic tissue. The surrounding tissues are generally in a very fatty condition, and, where the disease is of long standing, are more or less completely blended into an indistinguishable mass. So far a common description is applicable to both forms of the disease; but on proceeding to the consideration of the contents of the cavities, great differences present themselves.

Pale Form.—The pale or ochroid form is capable of subdivision into several varieties, according to the nature of its morbid products. In the commonest and most characteristic variety the cavities and channels contain masses of spherical bodies like fish-roe, of a pinkish-yellow or white colour, surrounded by gelatinous glairy matter. In certain cases, however, the roe-like bodies are almost or entirely absent, and the gelatinous matter and liquid oil are generally diffused throughout the tissues. In a third and very rare variety the section looks as though besprinkled with grains of red-pepper, from the presence of innumerable minute concretions of a bright red hue.

Dark Form.—The appearances presented in the dark form of the disease are strikingly different. Here, in place of the roe-like bodies of the previous form, the cavities and channels contain masses of a dark brown or black colour. These masses vary greatly in size, some not being larger than the normal fat-lobules surrounding them, others attaining to the size of a small orange. The larger masses greatly exceed any of the roe-like masses of the pale variety in size, and their consistence is also much firmer than that of the latter. They are tuberculated on the surface, and closely resemble truffles in appearance. On section, they present a more or less distinctly radiating structure, and the interior is generally somewhat lighter in colour than the tuberculated exterior coating. In some cases they are tightly fitted into the cavities in which they lie, but in others they lie loose and are surrounded by a certain amount of gelatinous matter. The amount of the latter present is, however, much less than in the pale form.

The masses of morbid material in both forms are primarily situated in spaces normally abounding in fat. Long series of them are frequently interpolated among the loculi in the subcutaneous tissue, between healthy fat-lobules; others occupy the interior of the bones; and a third series are developed in the pads of fat lying around muscles and tendons. The muscles and tendons in such cases may frequently be found quite intact, although surrounded by masses of the morbid material. Due to this persistence, fracture and crushing of the softened bones often occurs, and it is on this that the distortion of the affected part is in many cases in great measure dependent.

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[1] Bibl.: Carter, H. V. *Trans. Med. & Phys. Soc. of Bombay*, 1860–62. *Trans. Path. Soc. of London*, vol. xxiv. 1873. *On Mycetoma, or the Fungus-disease of India*, London, 1874. Carter, H. J. *Ann. and Mag. Nat. Hist.*, vol. ix. 1862. *Journal Linn. Soc.* vol. viii. 1865. Berkeley, *Intell. Observ.* No. x., November, 1862. *Journal Linn. Soc.*, vol. viii. p. 128, 1865. *Quart. Journal Micr. Sc.*, New Series, vol. xiv. 1874. *Nature*, November 9, 1876. Bristowe, *Trans. Path. Soc.*, vol. xxii. 1871. Hogg —, *Monthly Micr. Journal*, August, 1871. March, 1872. Lewis and Cunningham. *Eleventh Ann. Report* of Sanitary Commissioner with the Government of India. 1875. *Indian Annals of Med. Sc.*, vol. xviii. 1876 (Reprint). Tilbury Fox and Farquhar, *On certain Endemic Skin and other Diseases of India*, &c., 1876.

Minute characters of the morbid products.—The roe-like particles are composed of a nucleus of granular, waxy consistence, surrounded by a fringe of radiating crystals. They appear to be almost entirely composed of fatty matter, and no traces of the presence of parasitic organisms of any kind can be detected in them. The bright red particles occurring in certain cases of the ochroid form are concretions, consisting in great part of phosphates and carbonates, and containing a considerable proportion of iron. The dark masses present in the other form of the disease are of much more complex structure. In all, or almost all, cases they contain septate fungoid filaments in greater or less proportion. These are sometimes difficult to distinguish, but may generally be detected by allowing portions of the material to soak for some days in liquor potassæ. The proportion which the filaments bear to the entire mass when thus separated, is in any case very small, and in some cases extremely so, for on the completion of the soaking only a very small quantity of colourless flocculi, consisting of masses of branched filaments mixed with empty cyst-like cells, is left behind in the fluid. The latter has assumed a brown colour from the solution of the dark mass. The filaments and cysts (*see* the accompanying figure) in so far as tests have yet determined, are indistinguishable from undoubted fungal elements. They are, as a rule, quite empty, and show no signs of growth, or indeed of life. The basis in which they are imbedded varies greatly in different cases. In some instances it is soft and contains much oily matter, but in the more advanced cases this is almost absent. It is then only soluble by means of alkalis. The ash consists mainly of calcium phosphate and is red, due to the presence of oxide of iron.

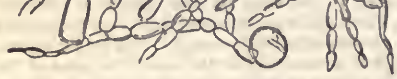

Fig. 21.—Fungoid Filaments and Capsules obtained after prolonged maceration of the black substance in caustic potash. × 500.

The fungoid filaments have never yet been shown to be capable of any further development. All attempts at cultivation have failed in causing them to assume any form by which their true nature and relationships may be determined. They have never given any unequivocal signs of life external to the body, even when exposed to conditions favourable to the growth of fungi as demonstrated by the development of various extraneous moulds upon the surface of the black masses themselves, or on the media in which they were immersed.

Symptoms.—Dr. Carter writes: 'As a rule the local indications of this disease are the same for all its forms; for commonly it is not possible to discriminate the several varieties by simple inspection or bare clinical history of the case.' The statements made by the patients as to the mode of origin and progress of these complaints are very various, but, taken generally, they seem to imply that the symptoms are analogous to those usually observed in deep-seated disease of the osseous and adjoining tissues. Eventually a more or less hard lump is felt in the sole of the foot or palm of the hand, or in several places. Generally one or more abscess-like formations occur, and ultimately several sinuses are established, the latter, as a rule, presenting a peculiar mamillated appearance—the 'tubercles,' apparently, of earlier writers. Along with these changes, enlargement and distortion of the affected member take place, but unaccompanied with severe pain. Discharges set in, more or less offensive, according to the nature of the subjacent degeneration, and the limb becomes not only useless, but a burden to its owner. In this manner the sufferer may go on for from one to fifteen or more years, unless relief be sought in a surgical operation.

Pathology.—The occurrence of the fungoid filaments in the products of the dark variety of the disease, has caused many authors to regard them as the essential cause of it. There are, however, good grounds for rejecting such a conclusion. Had the dark form of the disease been the only one with which we were acquainted, there might have been some cause to regard it as due to parasitic agency. When, however, we find that the pale form, whilst causing all the important lesions present in the other, shows a total absence of all fungoid elements in its products, we are forced to regard such elements as of secondary importance. The only means of overcoming this objection would be a demonstration that the products of the pale form are due to a degeneration of the black matter, in the course of which the fungoid elements disappear. No such demonstration has been given, and, on the contrary, it has been shown that each form is capable of running an entirely independent course, the gradual transformation of the normal fat having been traced in the one case to the production of the roe-like particles, and in the other to that of the black masses in which the fungoid elements are imbedded. Were the pale form the only one known the disease might be described as a mere degeneration of the fatty tissues, with the results consequent on the presence of the morbid products of the process in the surrounding parts; but this explanation, although so far applicable to the dark form, throws no light on the source of the fungoid elements. They are present in masses which are entirely isolated in the tissues, having no communication with one another or with the exterior. There is no evidence of their passage from one cavity to another—on the contrary they are absolutely limited to the contents of the cavities, the membranous walls of the latter and the intervening tissues never showing any traces of a spreading mycelium, or of any other fungal elements.

Assuming the filaments to be of undoubted fungal origin, the facts point rather to their simultaneous and independent development in multiple centres, than to their spread from one to another. The fact of the necessity of a suitable soil or nidus, in addition to the mere presence of germs, in order to secure the development of organisms, is generally accepted. That germs of most various kinds must constantly be introduced into the blood, is a self-evident fact. Putting their introduction by means of the lungs out of the question, their constant introduction from the intestinal canal can hardly be denied. It can be demonstrated that the intestinal contents abound in vegetable organisms—spores, bacteria, &c.—in a living condition. As it is an ascertained fact that solid particles of inorganic matter of far larger size than many of these germs can enter the circulation, it can hardly be denied that the latter may, and indeed must, enter also. So long as such bodies do not meet with conditions favourable to development, they are no doubt destroyed and utilised by the living matter of the blood and other tissues. If, however, they are deposited in a medium favourable to them, they will grow and undergo such development as they are capable of. The morbid products of the disease here described are practically dead material, external and extraneous to the body, and it has been experimentally demonstrated that when removed from the body they form a basis capable of supporting the growth of fungal organisms. Given these two conditions—the constant presence of germs in the circulation, and the possession of a suitable soil for fungi—and the difficulty of accounting for the presence of fungal elements in the latter appears in great part to disappear.

Prognosis.—Both forms of the disease run a very chronic course, and often without very materially affecting the general health of the patient; in some cases, however, great emaciation accompanies the disease. With regard to the duration of the malady, it may be stated that cases have been recorded as having existed for various periods up to twenty-six and thirty years.

Treatment.—There are no instances recorded of a spontaneous cure having been effected, nor have remedial applications proved of material permanent value in either form of the disease. Removal of all the diseased tissue, by amputation of the affected extremity, is the only remedy which meets with general approval. The subsequent treatment resolves itself into that of an ordinary surgical operation.

D. D. Cunningham.
T. R. Lewis.

FUNGUS HÆMATODES (*fungus*, a mushroom; *αἷμα*, blood, and *εἶδος*, like).—A synonym for soft malignant growths, which are exuberant and highly vascular, and therefore peculiarly liable to bleed. *See* Cancer, and Tumours.

FURFUR.—Synon.: Scurf, Dandruff.—A branlike desquamation of the skin, met with in several cutaneous diseases, more especially pityriasis, psoriasis, and ichthyosis. *See* Skin, Diseases of.

FURFURACEOUS (*furfur*, bran).—A term applied to a condition in which the epidermis is shed in the form of bran-like scales. *See* Furfur.

FURUNCULUS (*fervio*, I boil).—A synonym for boil. *See* Boil.

G.

GADFLY.—The popular name for a genus of insects whose larvæ infest man and the lower animals. *See* Œstrus.

GALACTAGOGUES (*γάλα*, milk, and *ἄγω*, I move).

Definition.—Agencies which increase the secretion of the mammary gland.

Enumeration.—The most common galactagogues are:—Mental Emotions; Local Nervous Stimulation; Warmth; good Food; Alcohol; Jaborandi; the fresh leaves of the Castor Oil plant; Tonics; and Electricity.

Action.—When we consider how powerfully mental processes may affect the activity of nerves supplying the secreting structure of glands, we can understand how these may influence the secretion of milk, as of the sweat, the saliva, and the tears. The maternal feelings of joy, as well as the reflex stimulation of the infant's lips, act most rapidly in developing the functions of the breast. Warmth and good diet also play their part in the process. Alcohol in the form of malt liquors, or malt-extract, is a useful adjunct; and so are such tonics as iron, which counteract in some measure the severe drain on the constitutional resources. Little use has yet been made in actual practice of those drugs which are specially credited with galactagogue properties; but we are told on good authority that a poultice made of the fresh leaves of the castor-oil plant, aided by teaspoonful doses of a fluid extract prepared from the same, have a markedly stimulating influence on the mammary secretion. Belladonna is well known to dry up the milk; and jaborandi, which is its antagonist in so many respects, has been shown to have here also a directly opposite effect, and to be a drug of which further use may yet be made when we wish to excite or re-establish the proper functions of the mammary gland.

Robert Farquharson.

GALACTIDROSIS (γάλα, milk, and ἱδρῶς, perspiration).—A term signifying milky perspiration. *See* Perspiration, Disorders of.

GALACTORRHŒA (γάλα, milk, and ῥέω, I flow).—An excessive flow of milk. *See* Lactation, Disorders of.

GALL-BLADDER AND GALL-DUCTS, Diseases of.—These affections may be considered in the following order:—

1. **Catarrh of the Bile-passages.**—This disease very rarely gives opportunities for examination after death. At the time after death that it is customary to make post-mortem examinations in this country, all redness of the duct has usually disappeared; and there are left only swelling and pallor of the mucous membrane, which is covered with a tenacious glassy or purulent secretion. By this swelling and secretion, the bore of the duct is often greatly narrowed; and it can be seen that no bile has passed over it for some days, as all colour has disappeared from the affected part of the tube. In judging of this, however, no pressure must have been made upon the gall-bladder during the earlier part of the examination. These appearances are most pronounced in the common duct and the gall-bladder; they are gradually lost in the hepatic duct and its branches in the liver. The process seems most intense at the duodenal end of the gall-duct, and the orifice of the papilla itself is often found plugged by mucus, an appearance which certainly favours the notion that the catarrh is propagated from the stomach and duodenum. This is believed to be the commonest source of catarrh of the bile-ducts. It is also seen in nutmeg-liver and cirrhosis; and a tendency to chronic catarrh is set up by the presence of foreign bodies in the ducts, such as gall-stones.

Symptoms.—Jaundice is often the first symptom which draws the attention of the patient to his health in a case of catarrh of the bile-ducts, although in a certain number of cases this is preceded by symptoms of gastric disorder, such as vomiting or sense of sickness, loss of appetite, and furred tongue; or, on the other hand, by diarrhœa. The jaundice lasts about three weeks, sometimes as much as six or eight weeks. After this, suspicion should be aroused whether something more than a simple catarrh be not present.

Diagnosis.—The diagnosis depends upon the absence of any physical signs indicating organic change in the liver; and on the presence of gastric symptoms. Thus nearly all cases of simple jaundice are diagnosticated by some physicians as cases of catarrh of the bile-ducts. As the greater number of the patients recover, very few opportunities are given for verifying this diagnosis; but in those which have been examined, plugs of mucus in the ducts have not unfrequently been found. The catarrh caused by gall-stones is lost in the jaundice and pain associated therewith.

Treatment.—The treatment should at first be directed to the gastric symptoms, beginning with a purgative, followed by a course of effervescing alkaline medicines, and restricted diet. Later on, dilute nitro-hydrochloric acid taken before meals is often very useful.

2. **Inflammation and its Results.**—In some cases of typhus and typhoid fever, and in other typhoid states, the gall-ducts and gall-bladder become *ulcerated*, or filled with purulent fluid, or covered with *croupous exudation*. The same thing may happen when gall-stones are impacted in the ducts. The gall-ducts are sometimes *obliterated* by fibrous bands passing over them. Sometimes they suffer a congenital obliteration by the overgrowth of the fibrous tissue around them.

3. **Dilatation.**—The gall-ducts and gall-bladder become dilated whenever there exists an obstruction, either pressing on the ducts from the outside, or formed within them. The first result is dilatation of the ducts behind the obstruction. The gall-bladder becomes much dilated, often filled with a thick green bile. If the obstruction last long, the coloured part of the bile is absorbed, and its place taken by a colourless fluid, either viscid or limpid. This fluid contains neither bile-pigment nor bile-acids, is often albuminous, and contains abundance of mucus. The ducts outside the liver may be enormously distended. It is common to see them as big as the middle finger. Within the liver they are also dilated, but not to so great a degree; and they are more dilated on the left than on the right side. The dilatation of the ducts may become cystic, and sometimes moniliform. The writer has always been able to find columnar epithelium in these dilated ducts. In some cases of long-continued obstruction, the contents of the bile-ducts become colourless; in other cases, purulent; and small abscesses form around the bile-ducts, and open into them. These abscesses may be multiple; or, more commonly, only a single large one is formed. The abscess or the dilated gall-ducts may rupture into the peritoneum, and cause fatal peritonitis.

4. **Cancer.**—Primary cancer of the gall-ducts and gall-bladder is sometimes met with; or they may be affected secondarily.

5. **Foreign bodies** are occasionally met with in the gall-ducts. The most common of all are, of course, *gall-stones*. Much less common are entozoa, such as the *Distoma hepaticum*, *hydatids*, or the two kinds of *ascarides*.

Symptoms.—In all these different morbid states, it is usually only possible to say at the bedside that the large bile-ducts are obstructed; a more complete diagnosis is commonly impossible. Jaundice is an important symptom, as without it disease of the bile-ducts cannot be diagnosticated. It is commonly very intense, the urine being deeply coloured, and the fæces quite colourless. The enlargement of the liver, if present, is commonly uniform, the surface being smooth, and the edges well-defined. The gall-bladder may often be felt at the edge of the right lobe as a rounded tumour; this is then a sure sign of the obstruction of the gall-ducts. In simple diseases of the gall-ducts there is an absence of splenic tumour, of ascites, and of other symptoms of portal obstruction. In many cases, however, diseases of the liver and of the gall-ducts are so intimately bound up together, that they cannot, during life, be separated.

PROGNOSIS.—The prognosis, if simple catarrh of the gall-ducts and gall-stones can be excluded, is unfavourable.

TREATMENT.—The treatment must be conducted on general principles.

6. **Enlargement of the Gall-bladder.**—The gall-bladder cannot be felt in health during life. But it may often readily enough be made out where there exists any obstruction in the common or cystic duct, so that it becomes distended with fluid. It may also be felt when the walls become fibrous or calcified, or the seat of cancer; or when its cavity is filled with gall-stones. A tumour may then be felt under the border of the right lobe of the liver, in the situation of the gall-bladder. When filled with fluid, a rounded, sometimes oblong, sometimes pear-shaped tumour is felt; in other cases it has an irregular shape, or a somewhat rounded outline. A greatly-distended gall-bladder has been mistaken for ascites, and tapped. The diagnosis depends chiefly on the situation of the swelling, and even then the distended gall-bladder may be mistaken for hydatid-disease of the liver-substance or of the omentum, or for a tumour of a neighbouring organ which has pressed against the liver. The difficulty of the diagnosis is much increased if the liver be moved from its natural place, for then the position of the gall-bladder becomes uncertain. Bamberger says he has often mistaken a softened cancerous nodule of the liver for a distended gall-bladder. If it be certain that a fluctuating tumour be the gall-bladder, and no jaundice be present, a diagnosis may safely be made of hydrops cystidis felleæ, or dropsy of the gall-bladder; but if jaundice be present, or if the tumour do not fluctuate but appear solid, there are then no definite rules for diagnosis; all depends upon the surrounding facts of the case. Dropsy of the gall-bladder is not a dangerous disorder, and requires no treatment; while the prognosis and treatment of the other states depend entirely on their respective causes.

7. **Perforation.**—Perforation of the gall-bladder or of the gall-ducts is generally the result of ulceration, due to gall-stones, inflammation, and other causes. Fatal peritonitis ensues if the perforation occur into the abdominal cavity. Frequently, however, previous adhesions have been formed between the biliary reservoir or duct, and the neighbouring organs or the abdominal wall, and the result of this is—

8. **Biliary Fistula.**—This may exist between the gall-bladder or gall-ducts and the surface of the body, the stomach, colon, or duodenum. Very rarely gall-stones find their way into the urinary tract. J. WICKHAM LEGG.

GALL-STONES.—SYNON.: Hepatic Calculi; Cholelithiasis; Fr. *Calculs biliaires*; Ger. *Gallensteine*.

DESCRIPTION.—Gall-stones are seen in man and most of the vertebrate animals, and in some molluscs. They are especially common in oxen. They are found in the biliary passages; most usually in the gall-bladder, or the cystic and common duct; more rarely in the hepatic duct, and in its branches within the liver. They vary in size from fine gravel to concretions five inches long. The largest are commonly single, and then they are rounded or oval in shape. The smaller calculi are usually numerous, being then tetrahedral or wedge-shaped, showing the facets or plane surfaces caused by mutual pressure. They are never lighter than water when first removed from the body. Only after drying do they float. Their consistence when raised to the ordinary temperature of the body becomes much less, so that they can be moulded by the fingers. Their colour varies from white to almost black; most commonly it is brown.

Dr. Thudichum thinks that the nuclei of gall-stones are mostly formed of casts of the hepatic ducts. There is rarely more than one nucleus. Its chemical composition is a compound of lime and bile-pigment, or traces of mucus and phosphatic earths. The chief chemical constituent of human gall-stones is cholesterin; some gall-stones are wholly composed of this substance; most contain 70 or 80 per cent. Other constituents of gall-stones are the bile-pigments, either by themselves, or in combination with lime. Very small quantities of the bile-acids are found, and these are also in combination with lime. It is rare to find gall-stones with any large amounts of carbonate or phosphate of lime, though the ash of nearly all gall-stones shows a large amount of carbonate of lime, the product of the combustion. Traces of copper, iron, and manganese are found in nearly all gall-stones. Lime-salts of the fatty acids are likewise found.

ÆTIOLOGY.—Age has a very great influence in the production of gall-stones; they are exceedingly rare in infancy and childhood, their frequency increases after the age of puberty, and they become still more common after thirty. Women are thought to be more liable than men to gall-stones. In cancer of the liver, gall-stones are certainly very commonly found, while on the other hand in cirrhosis they are scarcely ever seen. Want of physical exercise and indulgence in rich diet seem to favour their production.

PATHOLOGY.—What is the cause of the first formation of a gall-stone? It is not simply concentration of the bile, since the cholesterin and pigment remain in solution so long as the bile is unchanged; but the beginning of decomposition of the bile-acids causes a precipitation. The cholesterin is likewise thrown down when the reaction of the bile changes from alkaline to acid. Gorup-Besanez and Dr. Thudichum have kept bile several months, and found the reaction at the end of that time acid, with an abundant sediment. It is thus probable that the retention of bile in the gall-bladder or gall-ducts favours the growth of these concretions. It is also probable that gall-stones are sometimes dissolved spontaneously, as erosions may sometimes be seen on them; or they may break up, and thus pass out.

SYMPTOMS.—Gall-stones while still in the gall-bladder rarely give any signs of their presence. They are frequently found in the gall-bladders of persons who during life had no symptoms which could be referred to the liver. It is when they begin to leave the gall-bladder, and escape into the cystic and common duct, that symptoms arise of gall-stone colic. They often begin with a dull pain near the liver, with vomiting, rigors, and elevation of temperature; or, quite suddenly, a severe pain in the right hypochondrium comes on, described as shooting, stabbing, burning, &c. The pain extends into the epigastrium, rarely to the left hypochondrium, to the right shoulder, and, according to some, even into the extremities. The pain is very intense, and may give rise to delirium and convulsions in nervous persons, or to hysterical attacks in women. Vomiting is usually present; and, as the attacks most often come on after eating, at first only the food taken is thrown up, and then a colourless mucus. The right hypochondrium is usually very tender, and the muscles are rigid. The pulse is not increased in frequency, being indeed rather below than above the natural number. In violent attacks the pulse becomes very frequent and small, or almost imperceptible; the eyes are surrounded with dark marks; the nose is pointed; the breath is cool; and cold sweats break out over the body. In this state death may occur, but it is a rare event. A few hours after the attack, the conjunctivæ may show a yellow tinge, which will gradually spread from the upper part of the trunk all over the body. The jaundice is more or less intense according to the shape of the gall-stone—whether completely obstructing the duct, or merely causing a hindrance to the passage of the bile. In some cases jaundice may be altogether wanting, as when the stone is in the cystic duct. The jaundice may last an indefinite time. The duration of the attack of colic itself varies; usually not lasting more than a few hours, it may extend over several days. As soon as the gall-stone reaches the duodenum the attacks are over, the stools become dark, and the jaundice begins to disappear. When the gall-stones reach the intestine, they are commonly evacuated with the fæces; some cases have, however, been recorded in which they were so large that symptoms of intestinal obstruction were caused and death resulted.

Diagnosis.—The diagnosis of gall-stones is often more or less difficult. Some physicians think that the diagnosis should not be made unless the concretions be found in the stools; and the search for them should be made by passing the fæces through a sieve. It is agreed by nearly all that it cannot be made if there be no jaundice present. Cancer of the head of the pancreas may readily be mistaken for gall-stones in the common duct.

Prognosis.—It is almost impossible to make a trustworthy prognosis in these cases. The physician can never speak confidently, or feel quite happy when treating a case which he looks upon as one of gall-stones.

Treatment.—The treatment of gall-stones may be discussed under two heads: during the paroxysm of the colic; and between the attacks.

During the paroxysm, the great object of the physician is to relieve the pain. This may best be done by full doses of morphia; and if this be rejected by vomiting, it may be administered hypodermically. The patient may be put in a warm bath and kept there, the heat being maintained by the renewal of the warm water. Should these means fail, chloroform or ether may be inhaled.

Between the attacks of biliary colic a great number of remedies have been proposed: the most popular is Durande's, which consists of three parts of ether and two parts of turpentine: the best plan is to give 10 to 20 minims of this mixture three times a day, enclosed in capsules or pearls. The German physicians have great confidence in the alkaline mineral waters, especially Carlsbad. Some think this due simply to the large amount of water daily ingested, causing a large flow of bile. Others recommend purgatives, as castor oil, or taraxacum; or aqua regia. Emetics have been employed, but they are dangerous on account of the straining which they cause, and which may lead to the rupture of a vessel.

J. Wickham Legg.

GALLOPING CONSUMPTION.—A popular name for phthisis when it runs an acute or rapid course. *See* Phthisis.

GALVANISM, Uses of. *See* Electricity.

GANGLION (*γαγγλιὸν*, a hard gathering). This term is applied to a variety of somewhat different affections, including:—1. The *simple* ganglion. This is a cystic tumour formed in connection with the sheath of a tendon. 2. The *compound* or *diffuse* ganglion, which consists of a chronic effusion into the common sheath of a group of tendons, giving rise to a fluctuating swelling. One variety of this contains the so-called melon-seed bodies. 3. The term is extended by some writers to enlargements of the bursæ mucosæ. *See* Bursæ, Diseases of.

1. **Simple Ganglion.**—Description.—The simple ganglion forms a rounded tumour, occasionally lobulated, situated in the immediate neighbourhood of some tendon. The most common situations are the dorsum of the hand, the dorsum of the foot, the palm of the hand at the root of a finger, and behind the outer or inner malleolus. The tumour varies in size from a pea to a pigeon's egg. It may fluctuate distinctly, or be so tense as to seem absolutely solid. It is not adherent to the skin or to the tendon with which it is in relation. It is painless, but often gives rise to a sense of weakness in the affected part. The wall is composed of a more or less delicate fibrous tissue, fusing with the surrounding areolar tissue, and lined by an imperfect layer of endothelial cells. Its contents are most usually semi-solid, like apple-jelly, but sometimes fluid. They are said to be neither albuminous nor gelatinous, but colloid in character. As to the exact nature of the tumour opinions differ, and probably it is not always the same. It is said to arise in the following ways: 1st. by a hernial protrusion from the sheath of a tendon, the neck of which becomes gradually contracted and finally closed, so giving rise to a cyst in intimate connection with the sheath. 2nd. Gosselin has described small follicles or sub-synovial crypts, which he believes may become dilated, so as to

form ganglia. 3rd. The tumour may be a cyst of entirely new formation.

Treatment.—Painting with iodine is of little or no use. Forcible rupture of the cyst by a blow or pressure sometimes effects a cure; but the best treatment is to puncture the tumour with a clean grooved needle, and to squeeze out the contents, afterwards applying pressure or a blister over the collapsed cyst. This treatment may require to be repeated more than once.

2. Compound or Diffuse Ganglion.—Description.—This disease is almost exclusively confined to the sheath of the common flexors of the fingers. It may consist of a simple dropsy of this sheath, forming an hour-glass-shaped swelling in the front of the wrist, the constriction being caused by the annular ligament; or, in other cases, the tumour may contain melon-seed bodies, which give rise to a sense of soft crackling when it is manipulated. These melon-seed bodies are smooth, oval and flattish in shape, and of a pearly-white colour. They are of almost cartilaginous toughness, and on section present an appearance of concentric lamination. Under the microscope they are found to be composed of very imperfect fibroid tissue. Their origin is somewhat doubtful. They have been supposed to be due, first, to hypertrophy of the fringes, normally found on a synovial membrane, the pedunculated projections so formed being ultimately broken loose by the movement of the tendons; secondly, to the formation of pedunculated warty outgrowths on the synovial membrane, which become free in the same way; thirdly, to fibrinous deposits taking place from the fluid in the ganglion; and, fourthly, to the results of accidental hæmorrhage. When these bodies are abundant, the fluid is usually scanty.

Ætiology.—The cause of this affection is uncertain, but it must be remembered that in many cases it is due to the irritation caused by the earliest stage of disease of the carpus.

Treatment.—The treatment of compound ganglion is unsatisfactory. Iodine is useless. Aspiration followed by the injection of iodine has occasionally been of service. An incision made into each end of the tumour, followed by drainage under antiseptic dressing, is often of use. In extreme cases Syme recommended laying the whole cyst open, and allowing it to granulate. This always left much stiffness in the tendons. When melon-seed bodies are present, they must be removed by incision, and the case treated antiseptically. Marcus Beck.

GANGLIONIC NERVOUS SYSTEM, Diseases of. *See* Sympathetic Nerve, Diseases of.

GANGRENE (*γραίνω*, I corrode).—Synon.: Mortification; Sphacelus; Fr. *Gangrène*; Ger. *der Brand*.

Definition.—Gangrene is the arrest of the functions of organic life in a circumscribed portion of the soft parts of the body, leading to the complete death of the same.

The whole process of death is included under the term gangrene—the result being mortification, or necrosis of the invaded tissue, organ, or limb.

Classification.—*Clinically*, gangrene varies greatly according to its position, cause, extent, the powers of the patient, and the existence of complications. The disease may also be classified *ætiologically* and *pathologically*, into *spontaneous* or *traumatic*, *dry* or *moist*, *chronic* or *acute gangrene*, *senile gangrene*, and *hospital gangrene*. The division into dry and moist gangrene, although convenient, has little pathological significance, being founded on physical characters. Both dry and moist gangrene may arise from similar causes, and coexist even, in different parts of the invaded structures; and it cannot always be predetermined whether a gangrene shall be of the dry or of the moist form. Dry gangrene is usually dependent on senile changes, limited in extent, and chronic in progress; the parts first affected having time to dry up as the disease invades those adjacent, and becoming mummified, hard, and black, resembling the knuckle of a Spanish ham. Moist gangrene occurs when a larger area of living tissue suddenly mortifies, and especially if it have been previously inflamed or gorged with fluid; the dead parts becoming rapidly transformed into a deliquescent putrid mass, infiltrated with gas. To this type belong many different forms of gangrene, for instance, that following the obliteration of the main artery of a limb by a ligature, or its becoming plugged by an embolus, or the form called *spreading traumatic gangrene*, or gangrene affecting an internal organ.

Ætiology.—The causes of gangrene may be local, constitutional, or a combination of both. Amongst *local* causes we find intense inflammation of some organ or tissue, such as pneumonia, noma, cellulitis, anthrax, or phlegmonous erysipelas. Injuries and mechanical violence of various kinds; and extremes of heat or cold, as seen in burns and scalds or in frostbite, also lead to gangrene. Gangrene may be produced either as the direct consequence of the long-continued application of cold, or as the result of the subsequent inflammatory reaction. Local arrest of the circulation, as in a strangulated hernia, an intussusception, or internal strangulation, a ligatured hæmorrhoid, a too tightly bandaged limb, or severe paraphimosis, may lead to gangrene. It may also occur from extravasation of urine or fæces. Continued pressure produces a variety of gangrene called *bedsore*, especially in lowly vitalised parts, and in persons suffering from chronic diseases, or from certain lesions of the nervous centres. *See* Ulcer and Ulceration.

One of the most frequent *constitutional* or *general* causes of gangrene is deficient blood-supply, dependent upon disease of the arteries and heart, the result usually of systemic decay, whence the term *senile gangrene*. Gangrene may occur in the course of certain severe diseases, as diabetes, typhus, typhoid, measles, and scarlatina; embolism being in many cases the immediate cause of the complication. The gangrene due to ergotism is probably induced by the effect of the poison on the blood-vessels. A peculiar form of gangrene sometimes met with in the extremities—the *gangrène symétrique* of the French, is one in which no more definite cause can be found than anæmia, and an extremely feeble circulation. And, finally, there is *hospital gangrene*—

pourriture d'hôpital, a disease seldom met with now except amongst wounded soldiers accumulated in great numbers in foul hospitals near a battle-field.

SYMPTOMS.—The symptoms of gangrene vary with the species, the extent, and the stages of the disease, and with the rapidity of its progress; and also according as it is dry or moist, incipient or complete. The importance of the tissue or organ invaded, and the presence or absence of complications, such as renal or cardiac disease, or of fever, also create differences.

The earliest symptoms are those of diminished circulation, sensibility, and temperature, together with change of colour in the part affected. Pain is one of the primary symptoms, and often precedes the others. In dry, senile, or chronic gangrene, there may in some cases be few symptoms beyond moderate local pain and discomfort, though oftentimes the pain is intense; whilst, when the type is of the moist or acute variety, the symptoms are usually more severe, and have a tendency to lapse into those called the typhoid or septicæmic. Between these two forms there is every intermediate grade of severity. The amount of fever varies at the outset, but it is usually considerable. The patient generally suffers much from pain, restlessness, and want of sleep; the appetite is bad; the tongue is loaded; and the pulse is feeble or intermittent. When the disease becomes arrested, the dead portion of tissue slowly separates and drops off, or is removed; very often, however, the disease steadily progresses, and the patient dies from exhaustion, or more rapidly from the absorption of septic matter.

Such being the principal symptoms of gangrene in general, we may next describe the symptoms of the leading varieties of the disease.

Dry or Chronic Senile Gangrene.—In the dry form of senile gangrene the part is gradually starved to death. The disease generally occurs in the toes, very rarely in the fingers; and is either spontaneous or excited by some trivial cause. A discoloured patch appears on one of the toes, of a dusky reddish-brown colour, which soon becomes dry and black in the centre. The disease spreads very slowly to the adjacent parts. First, a zone of discoloration appears from the blood stagnating in them; then they become livid, red, and inflamed; afterwards darker; and, finally, black and dry. One or several toes may be involved, or the foot in whole or in part. The patient generally dies sooner or later, exhausted by pain, and from general feebleness of the vital powers. Sometimes a line of demarcation appears, the dead parts separate, and recovery follows; but as a rule relapses take place.

Moist or Acute Senile Gangrene.—This form of senile gangrene is more active in its progress, and more rapidly fatal. It is often ascribed to some slight local irritation or injury, such as an inflamed corn or nail. The affected toe becomes dusky-red, swollen, and extremely painful; soon after the dark hue of absolutely dead tissue appears, following closely the zone of inflammation; and this gradually spreads onwards till the whole foot or possibly the leg, if the patient survive, becomes implicated. Beyond the gangrenous area the skin is mottled, and presents all the appearances due to impeded circulation. In this type of gangrene, stasis of the blood and coagulation first take place in the capillaries and extend thence to the smaller arteries. It occurs in elderly persons with feeble circulation, due to fatty heart and atheromatous arteries.

Gangrene from Arterial Obstruction.—The most common form of moist gangrene is that due to sudden arterial obstruction—when the collateral supply cannot establish itself with sufficient rapidity. It is acute, and a large part of the body being at once engaged, the tissues do not, as in dry gangrene, have time to dessicate *pari passu* with the spread of the disease. It may happen after ligature of a main trunk for aneurism; or by the formation of a fibrinous clot upon the roughened wall of an atheromatous vessel, and consequent plugging; or by embolism of some artery. An entire limb may thus be lost. Venous obstruction *per se* does not produce gangrene. In cases due to embolism—a form rare in the upper limbs, but common in the lower extremities, and more especially in the anterior tibial arteries—sudden and severe pain marks the onset of the disease. The temperature of the part rapidly falls; livid discoloration and loss of sensibility ensue; the veins if emptied fill very slowly; the skin mottles; bullæ form filled with turbid fluid; the colour changes from whitish grey to green, olive, or black; and the affected tissue at length becomes a deliquescent putrid mass, often crepitating from gas imprisoned in the meshes of the cellular tissue. The tendons, blood-vessels, and nerves resist the disintegrating process longest.

Gangrene from Inflammation.—Gangrene as the result of intense inflammation is likewise of the moist type. When it supervenes, the tension, pain, and swelling of the inflamed area subside; the part becomes soft and pasty; the colour changes into dusky violet, brown, or black; and all the evidences of rapid decomposition, varying with the part affected, and the acuteness of the inflammation, make their appearance.

Gangrene as a Complication of General Disease.—Gangrene is occasionally met with in the later stages of typhoid fever, or even during convalescence; and usually occurs in the lower limbs, though sometimes in the lungs, or face. It is of vascular origin, and is a most grave complication. In form it may be either dry or moist, and may be of either of two kinds. One is of early occurrence in the progress of the disease, and generally affects the toes symmetrically; the other occurs later, or during convalescence, and is of embolic origin.

Measles is prone in some cases to occasion gangrene, generally affecting the face, the vulva, or the lungs. Scarlatina and some forms of erysipelas are also occasionally followed by extensive gangrene. The disease has been also observed during some epidemics of cholera. Gangrene produced by the prolonged consumption of diseased rye-bread chiefly occurs in the male adult, and very rarely in women or children. Other symptoms of ergotism will then be present, gangrene being a late occurrence. Gangrene from ergotism precisely resembles ordinary senile gangrene. It almost invariably appears in the lower limbs; and when a line of demarcation forms, this generally seems to correspond with the nearest joint. In diabetic gangrene no special vascular deficiency can be traced. The vitality of the tissues seems impaired by the glycosuric condition, and some slight accidental cause provokes a gangrenous inflammation.

Hospital Gangrene.—Hospital gangrene presupposes a wound: the lesion on invasion, ceases to discharge, and becomes covered with a grey tenacious slough extending from the centre towards the edges, which become much inflamed and everted. The patient rapidly lapses into a typhoid condition; and the issue is generally fatal.

Acute Traumatic or Spreading Gangrene.—This form also follows upon an injury, which may be either slight or severe. It is generally seen in one of the extremities, originating in a wound and rapidly spreading towards the trunk—*Gangrène foudroyante.* It is in many cases intimately associated with, and probably induced by, septic infection of the system. It is usually fatal, and scarcely amenable to treatment.

Visceral Gangrene.—The gangrene of internal organs will be found described in connection with the diseases of the several organs.

PROGRESS.—The progress of gangrene dependent on constitutional causes is too often from bad to worse; and a fatal issue may supervene without any attempt at repair. The gangrenous inflammation, preceding the actual death of the part, continually invades fresh tissues; the fever increases; a sallow sunken countenance, with rapid thready pulse, sordes, muttering delirium, tympanites, hiccough, subsultus, scanty loaded urine or even suppression, supervene; the weakness increases; and death, preceded by collapse, takes place.

In other cases, especially those dependent on local causes, there is a tendency to limitation; and the process by which this is accomplished is the same for all kinds of gangrene, in every part of the body. In superficial structures a red band of healthy inflammation will be observed at the junction of the living with the dead part, called the *line of demarcation*; active cell-infiltration takes place; and a separating wall of fibrin and young cells is established in the layer of living tissue nearest to the dead structures. This becomes by degrees converted into an ordinary granulating surface, and the dead tissue is detached and cast off. The time required for this separation varies with the bulk of the dead portion, the nature of the tissue, and the vitality of the individual. The risk of septicæmic poisoning is present throughout the entire course of the disease.

DIAGNOSIS.—The diagnosis of gangrene of external parts cannot be attended with any difficulty; the evidence of its presence being readily appreciated when the symptoms already described make their appearance.

PROGNOSIS.—The prognosis of a case of gangrene will mainly depend on the likelihood of the disease becoming limited, the strength of the patient, and the conditions in which he is placed; which are all at first difficult to determine. The cause of the gangrene, and the presence or absence of organic mischief elsewhere, also exercise a great influence. When the malady is dependent on a constitutional cause, there will be little tendency to delimitation, and a bad prospect of recovery. When the cause is local, and the destruction of tissue neither extensive nor invading a vital part, the prognosis will be favourable. But a local injury, when the conditions are unfavourable, may be followed by a severe and extensive gangrene, or some essential part of the body may become implicated.

TREATMENT.—When gangrene is imminent, our first care should be to adopt means to support the vital warmth of the part, and to encourage and relieve the embarrassed circulation. When the disease is fully developed, our attention must be directed to control as far as practicable the spread of the disease; to favour the separation of the dead tissue; and to keep the parts as clean and harmless as possible. We must also anticipate complications, or combat them when they occur; and support the patient's strength by good food, stimulants, and fresh air, together with opiates sufficient to allay pain. A limited traumatic gangrene is to be treated as an ordinary sloughing wound. If a complete portion of a limb be involved amputation should be performed, as soon as the line of demarcation is established. In gangrene due to arterial obstruction the extremity should be raised to assist the return of venous blood; antiseptic dressings and cotton-wool applied locally; and plenty of bland food administered at frequent intervals. When the whole limb is affected, nature may be assisted by completing the amputation of the part as soon as the limiting line is distinct. In gangrene caused by the ligature or rupture of a main artery, or the pressure of an aneurism, amputation close to the seat of the lesion may at once be performed, as the gangrene cannot extend higher than this point; but even under these circumstances it will often be safer to await indications of a commencing demarcation and then to amputate close to it. In spreading traumatic gangrene early amputation of the affected limb has been strongly recommended; but as this cannot remove the already poisoned condition of the blood, upon which in all probability the gangrene depends, it is clearly a useless measure, as the gangrenous action would invade the stump. In cases where traumatic gangrene is localised and dependent merely upon the violence of the injury, the vitality of the individual will be sufficient to overcome the mischief, unless it be very extensive. A line of demarcation will appear, and then, but not before, will it be proper to amputate, unless the part be otherwise hopelessly injured, or a large articulation opened, when immediate amputation is indicated. For the treatment of gangrene occurring in internal organs the reader is referred to the articles on diseases of the several viscera.

WILLIAM MAC CORMAC.

GARGLE (γαργαρίζω, I wash the throat).—SYNON.: Fr. *Gargarisme*; Ger. *Gurgelmittel.*

DEFINITION. — Gargles are liquids employed for the production of local effects on the throat and pharynx.

MODE OF GARGLING.—This consists in taking about a table-spoonful, more or less, of the gargle into the mouth, throwing back the head, and agitating the liquid by the air expelled through the larynx. With some persons the gargle goes little beyond the uvula and base of the tongue; but if the head be thrown well back, the fluid can be made to pass into the cavity of the pharynx, and may even reach the larynx and vocal cords. The tension of the muscles, in thus throwing back the head, is apt to provoke efforts at deglutition, so that sometimes small portions of the gargle may be swallowed; and occasionally the effort terminates abruptly in the patient jerking his head forwards, and expelling the gargle forcibly through the nose.

Dr. H. Guinier of Cauterets has demonstrated a method of gargling the laryngeal cavity. His instructions are as follows:—1. Slightly to raise the head; 2. To open the mouth moderately; 3. To protrude the chin and lower jaw; 4. To emit the sound of the double vowel *æ*. These four movements open largely the back of the mouth, lift the velum palati and uvula, separate the base of the tongue from the posterior wall, and allow the liquid used for gargling to gravitate into the cavity of the larynx. One expiratory act is the only respiratory movement that is now possible, deglutition is under control, and the gargle bathes the pharynx and supraglottic portion of the larynx.

Uses and Composition.—The use of gargles is contra-indicated in parenchymatous inflammations of the tonsils, and in all cases where movement of the fauces causes severe pain; and where, as in some persons, an inability exists to retain liquid beyond the anterior pillars of the fauces, for these it is more convenient to apply the fluid to the fauces and pharynx, either by injection, or in the form of a medicated spray, or else by aid of a brush or sponge.

Gargles vary in composition according to their object. If prescribed with the view of exercising the muscles of the soft palate and pharynx, and thereby increasing their tone, cold or iced water is generally sufficient. If with the view of reducing and allaying local inflammatory conditions of the throat, solutions of chlorate or nitrate of potash or of borax (two drachms to eight ounces), or of liquor ammoniæ acetatis (one part in four), combined with decoctum lini compositum, thin gruel, or water, and used warm, are the best. When it is desirable to excite the mucous membrane and neighbouring glands to further secretion, and thus reduce local congestion, stimulant gargles are useful, such as the tinctures of capsicum (half-drachm to eight ounces), arnica, myrrh, pyrethrum, and eucalyptus rostrata (two drachms to eight ounces); this class of gargles often relieving the deafness caused by obstruction of the Eustachian tubes, by increasing the pharyngeal secretion. To check excessive secretion astringents, in the form of the salts of iron and zinc, iron-alum, or alum (forty grains to eight ounces), tannin (half-drachm to eight ounces), or rhatany infusion, are advisable. If we require to check ulceration, or to dilute and purify foul or putrid secretions from the throat and tonsils, antiseptic gargles, composed of the solutions of permanganate of potash (two drachms to half-a-pint), of chlorinated soda (one drachm to eight ounces), of sulphurous acid (one part in four), or of glycerine of carbolic acid (half-ounce to eight ounces), will answer the purpose. In cases of syphilitic sore-throat, a gargle of perchloride of mercury (three grains to eight ounces) has been recommended. In many cases combinations of different kinds of gargles are beneficial. Water, barley-water, rose or orange-flower-water, sweetened with a little honey, glycerine, or syrup, constitute the bases of most gargles.

John C. Thorowgood.

GASTEIN, in the Austrian Alps. Simple thermal waters. *See* Mineral Waters.

GASTRALGIA (γαστὴρ, the stomach, and ἄλγος, pain).—Synon.: Gastrodynia; Fr. *Gastralgie*; Ger. *Magenschmerz*.

Definition.—Pain in the stomach, which occurs in various gastric disorders, and which, considered by itself, is not much to be relied on as a sign of disease.

Symptoms.—In acute erythematous gastritis a burning, painful sensation affecting the stomach, and not unfrequently extending up the œsophagus, is felt almost immediately after taking food or a stimulant liquid. In acute catarrhal gastritis pain is seldom complained of. In ordinary chronic gastritis it is usually absent; or, at most, only a slight heaviness or fulness after food forms a symptom of the malady. In what the writer has named 'eczema of the stomach' the pain is very severe, comes on two or three hours after food, and is temporarily relieved by eating. The same kind of pain may be observed whenever there is profuse mucous secretion, but it is less severe than in cases where gastric disturbance replaces eruptions of the skin. The pain accompanying pyrosis is of a spasmodic character, and is relieved by the ejection of a tasteless fluid. Severe pain is a common accompaniment of atonic dyspepsia, occurring in nervous or hysterical persons. It comes on when the stomach is empty, but is often aggravated directly after food, and is relieved by the escape of flatus, and by stimulants. The most severe gastralgia is that accompanying ulceration of the stomach. In this disorder it is referred to one spot, and is likewise often felt in the back. The mere fact that a pain in the epigastric region is confined to one small spot should induce the practitioner to view the case with suspicion. The pain in ulceration is usually absent when the stomach is empty, but comes on from two to ten minutes after food. In other instances a longer period, such as half an hour, elapses; but it is this definite relation to the digestive process that makes the pain of ulceration characteristic of the disease. It is usually said that when the pain comes on directly after food the cardiac region is the seat of the ulcer, and where a longer interval takes place the sore will be found near the pylorus. This, if true as a general rule, is, nevertheless, open to many exceptions; for, as a patient observed, the pain occurred later after taking food in proportion as she improved in health, and the first evidence of a relapse was the shortness of the interval of ease after eating. In cancer the pain is more continuous than in simple ulcer; it is less influenced by the digestive process, and is more diffused. It is, however, no uncommon circumstance to find cancer of the stomach without any complaint of pain. The softer kinds of malignant growth seem to the writer least apt to cause suffering, probably because the peritoneum is less liable in such cases, than in the other forms, to be affected with inflammatory action. Neuralgia of the stomach is a favourite disease with some authors. There is no doubt that the normal sensibility of the stomach is vastly exaggerated under some conditions, but the writer's observation leads him to believe that neuralgic pain affecting the stomach, *independently of other disease*, is a much rarer complaint than is generally supposed (*see* STOMACH, Diseases of). The writer has met with three different forms of pain in the region of the stomach ascribed to neuralgia, which are evidently of a different nature—1. Where severe pain has come on at some period of the day at a certain hour, at a considerable period after the commencement of digestion. In many of these cases it has been evident on inquiry that the apparent periodicity was the result of the punctual disposal of the chief meal of the day. They were, in fact, cases of chronic catarrhal gastritis attended with considerable secretion; most of them occurred in gouty men, and might be classed under the head of eczema, rather than of neuralgia of the stomach. 2. Cases such as the following:—A young lady had suffered for many months from agonising pain in the left hypochondrium, coming on at each menstrual period, and resisting all methods of treatment. In this and other similar cases, it will be found that the seat of the pain is really external, in the intercostal nerve, and not in the stomach itself. 3. Severe attacks of pain in the left hypochondrium and epigastrium in females of a nervous temperament, who had either been born, or had passed most of their lives, in tropical countries. The real seat of the pain in such cases appears to be the colon; there is always constipation; and a mild aperient and tonic treatment is usually effectual in removing or ameliorating the complaint. S. FENWICK.

GASTRIC FEVER (γαστήρ, the stomach). A popular name for a febrile condition attended with prominent gastric symptoms; as well as for typhoid fever. *See* TYPHOID FEVER.

GASTRIC GLANDS, Diseases of (γαστήρ, the stomach). *See* STOMACH, Diseases of.

GASTRIC ULCER (γαστήρ, the stomach). *See* STOMACH, Diseases of.

GASTRITIS (γαστήρ, the stomach).—Inflammation of the stomach. *See* STOMACH, Diseases of.

GASTRODYNIA (γαστήρ, the stomach, and ὀδύνη, pain).—A painful affection of the stomach, generally considered as of a neuralgic character. *See* GASTRALGIA.

GASTRO-ENTERIC (γαστήρ, the stomach, and ἔντερον, the intestine).—This term is applied to those morbid states in which the stomach and the intestine are simultaneously affected. The continuity and similarity in structure of these viscera render them peculiarly liable to coincident disease; and this is more particularly noticed in affections of an inflammatory type (gastro-enteritis), or of a degenerative nature. At the same time, as gastritis may occur and run its course without giving any indication that the intestine is involved, so enteritis may be developed with little or no disorder of the stomach. The same causes appear to determine similar diseases in the stomach and in the intestine; but why at one time both should suffer, and at another time one should escape, is not known. Occasionally it would seem that the entire alimentary canal beyond the œsophagus is attacked at once, and the gastro-intestinal catarrh of children is a good example of this. Sometimes the disorder commences in one part of the canal, and spreads until both the stomach and the intestine are involved. *See* INTESTINES, Diseases of; and STOMACH, Diseases of. W. H. ALLCHIN.

GASTRORRHŒA (γαστήρ, the stomach, and ῥέω, I flow).—An excessive flow of mucus from the lining membrane of the stomach, due to catarrh. *See* STOMACH, Diseases of.

GELATINIFORM CANCER.—A synonym for colloid cancer. *See* CANCER.

GENERAL.—This word, as employed in relation to medicine, has several applications. Thus we speak of a *general disease*, which is a disease affecting the whole system, as distinguished from a local affection. As further examples may be mentioned *general debility*, *general paralysis*, and *general dropsy*. So, with respect to therapeutics, *general treatment* refers to remedial measures intended to affect the organism as a whole. In connexion with the sciences of therapeutics, pathology, &c., the word *general* is intended to express the essential principles of these sciences, as distinguished from their special divisions.

GENERAL PARALYSIS OF THE INSANE.—SYNON.: General Paresis; Fr. *Paralysie générale incomplète*; *Périencéphalite chronique diffuse*; Ger. *Allgemeine progressive Gehirnlähmung*; *Paralytischer Blödsinn*.

DEFINITION.—A gradual loss of the power of coördinated movement, accompanied by gradually increasing mental disturbance and decay.

ÆTIOLOGY.—The subjects of general paralysis are most frequently of the male sex, and between 30 and 50 years of age. It may be brought on by excessive mental labour, by severe anxiety, by alcoholic or venereal excess, or by any prolonged strain upon the mental organisation. It may also be induced by a blow or other direct injury to the head. Hereditary predisposition is probably not without influence upon its production; but this is not so frequently present as in most other forms of insanity. The disease most frequently attacks persons who have previously been apparently in the enjoyment of vigorous health.

ANATOMICAL CHARACTERS.—Authorities are not agreed upon the precise nature of the pathological changes characteristic of this disease. The most frequently described lesions are congestion and thickening of the membranes of the brain; and degeneration of the cortical substance, shown by a fatty or shrunken condition of the nerve-cells, and an augmentation of the connective tissue. The degeneration has been traced by some observers into the spinal cord and the sympathetic ganglia.

SYMPTOMS.—1. *Physical.* The physical symptoms of general paralysis of the insane are first apparent in the muscles of articulation and expression. There is an occasional thickness of utterance, perhaps observable only in the pronunciation of the more complex sounds, and a peculiar convulsive tremor of the upper lip accompanying the least excitement. A similar fibrillar trembling may also be observed in the tongue, when an attempt is made to hold it out. This loss of muscular control gradually spreads over the whole system, its onward course being, however, not infrequently interrupted by very remarkable though generally brief remissions. Before the patient is laid completely prostrate, the affection both of articulation and of gait strongly resembles the failure of coördinate movement produced by drunkenness. In the last stage the patient lies quite helpless; the power of articulation and every kind of voluntary movement are lost; there is also a strong tendency to the formation of bed-sores; and spots of ecchymosis are apt to appear on the application of even gentle pressure. Inequality of the pupils is usual from the commencement of the illness; but they do not often remain long in one condition, sometimes one pupil and sometimes the other being dilated or contracted. A characteristic feature of the disease is the occurrence of congestive or epileptiform attacks, but they are very variable, both in their frequency and in the stage at which they are first observed.

2. *Mental.* These symptoms generally precede the physical, though some cases occur in which the condition of the mind is not such as to attract attention till some time after the motor symptoms have become obvious. Sleeplessness and general restlessness are usually the first indications of the derangement, and with these may be associated transient states of depression and hypochondriacal fancies. Enfeeblement, shown by forgetfulness and incapacity for continuous thought, is generally an early symptom; and in some cases a gradual increase of this enfeeblement, till absolute fatuity is reached, constitutes the prominent mental symptom. A common condition from the commencement is an inordinate disposition to embark in any, even the most impracticable, undertaking that may be suggested. There is always observed a peculiar facility of disposition, generally good-humoured, but liable to be interrupted by fits of passionate excitement. Frequently there is a very remarkable extravagance, both in thought and act. In most cases acute maniacal attacks take place, in which the excitement presents a specially extravagant character. The semblance of probability and coherence found in ordinary acute mania is generally absent. The prevailing ideas are of grandeur, colossal size, infinite number, power, wealth, and rank, all heaped together in wild confusion. Every such maniacal attack marks an appreciable step in the progress of mental decay; and the tendency is always more or less steadily to complete fatuity. In some comparatively rare cases, especially where there is a tendency to phthisis, the mental condition is mainly one of depression. Remarkable remissions of all the symptoms are sometimes met with.

Diagnosis.—The diseases from which general paralysis of the insane requires to be distinguished are paralysis due to cerebral hæmorrhage, embolism, encephalitis, or tumour of the brain: hysterical and tonic paralysis; locomotor ataxy; alcoholic insanity; senile dementia; and muscular atrophy. The diagnosis is generally easy, if attention be paid to the presence or absence of the convulsive tremors in the muscles of articulation at the commencement; the general and progressive course of the loss of coördination; and the peculiar mental facility and extravagance.

Prognosis.—Complete recovery seldom, if ever, takes place in general paralysis of the insane. The ordinary duration of the disease is from a few months to three or four years, though cases of ten years' duration occasionally occur.

Treatment.—In ordinary circumstances the treatment cannot be properly carried out in a private house; removal to an asylum will therefore generally be necessary. Little benefit is to be derived from drugs. The conditions of excitement are held by some to be moderated by small doses of Calabar bean; and turpentine enemata are frequently useful in the epileptiform attacks. The diet ought to be nutritious, but non-stimulating. The food ought to be minced or pulpy, and care should be taken to prevent an accumulation of it in the pharynx, as fatal choking is sometimes produced in that way. If this should be threatened, the tongue should be immediately pulled forward, and the bolus extracted with the finger. On account of the liability to bed-sores, the patient should as long as possible be prevented from lying constantly in bed.

John Sibbald.

GERMS OF DISEASE.—This is a phrase in common use, the acceptation of which is various, and often more or less vague. So far as it refers to actual things or objects, they also are probably diverse in nature, though at present our knowledge of most of them is based rather upon conjecture than actual experience.

As a phrase, 'germs of disease' is most commonly used in the following modes:—

a. A person may be said to inherit the germs of disease when there is reason to believe that the constitutional, general, or local disease from which he is suffering is of a kind which has been common in the family or stock whence he has descended, and when the disease is one which seems prone to manifest itself in this way. It may, in this sense, be said that a person inherits the germs of gout, scrofula, tuberculosis, syphilis, or cancer; and, in either of such cases (with the possible exception of the two latter), no one would, on reflection, be able to find that he meant anything else than that the patient had inherited a certain general disposition, habit, or bodily tendency, in which, under the influence of slight exciting causes, this or that morbid condition should be prone to manifest itself.

b. In a still looser sense, the phrase is sometimes used to signify the mere commencement or initial stage of a certain disease, as when it is said that the germs of a phthisical patient's malady date from a certain catarrhal attack, or that a patient now suffering from a severe brain-affection contracted the germs of his disease in India or elsewhere, on the occasion of some slight sunstroke. Here the expression would be used in a purely metaphorical sense.

c. The phrase is most commonly employed, however, in reference to the real or supposed causes of communicable morbid processes or diseases, either local or general—those which spread either from part to part in the same person, or from person to person in the same community.

In the spread from part to part, as during the 'generalization' of some malignant new-growth, the agency of 'germs of disease' is, perhaps, not unfrequently more imaginary than real. Results are apt to be ascribed to 'infection' where nothing of the kind has been in operation—as when similar perverted tissue-changes may chance to manifest themselves, either simultaneously or consecutively, in different parts of the body, as results of some single or similar underlying cause.

In the spread from person to person of local or general contagious affections, the same possible source of fallacy has to be borne in mind. We must be upon our guard against ascribing too general an influence to 'germs of disease.' In certain cases these may have been in the first place non-existent, as when such a disease has been 'autogenetic,' and in no sense a derivative of antecedent disease of the same kind. This caution is especially applicable in regard to such an affection as erysipelas—which, although certainly contagious, is also on very good grounds judged to be 'generable,' especially during certain states of lowered health induced by renal disease and some other visceral affections. Though not so certainly known, it is by many deemed probable that a similar caution may be necessary in regard to more general contagious affections, such as diphtheria, typhoid and typhus fever, and cholera, which, though certainly contagious, may also be autogenetic. On this subject, however, much doubt and uncertainty still prevail.

The consideration of this third use of the phrase 'germs of disease,' conducts us naturally to the question as to the nature of the things or objects which may be included under the same name, and this again to the modes in which they operate. As these are questions, however, which have already been discussed under Contagion, they will only be very briefly referred to here.

The different kinds of contagia, whilst they are all of them to be regarded as products thrown off from the body of a person suffering from a communicable affection, may in essence be either (1) not-living chemical compounds; (2) cast-off and altered tissue-elements; or (3) cast-off micro-organisms of a low type, either in their 'finished' condition or in a germ-stage.

Whilst it cannot positively be said that we have as yet discovered contagia belonging to the first category, our knowledge is a trifle more definite in regard to the existence of those pertaining to the second and third categories. In what proportion these latter kinds of contagia exist, however, for different communicable diseases, still remains to be discovered.

Such different kinds of 'germs of disease' might take effect in two distinct modes, and only in two, since the probable modes of operation of those belonging to the first and second varieties are not at present capable of being discriminated from one another.

First, we have the mode of action of contagia in the spread of local affections, such as ophthalmias, gonorrhœas, and erysipelatous inflammations. Chemical compounds, or diseased tissue-elements, or both in combination, thrown off from such foci of disease, and falling upon suitable situations in other human beings, are capable of determining inflammations of like kind, in which multitudes of new contagia, also of like kinds, are 'independently' produced—that is, are produced otherwise than by processes of organic reproduction. How far such chemical, or 'contact actions' (not necessarily producing inflammations) may take part in, and lie at the root of the very complex group of morbid processes constituting this or that general contagious affection, or so-called 'specific fever,' is not at present known. The processes must be somewhat of this kind, if the operating contagia are not living organisms; and even where they are of this type, it is possible that the same sort of process may obtain.

Secondly, where micro-organisms (bacilli, micrococci, &c.) are the contagia, they are believed to produce their effects by the continuous multiplication, or 'organic reproduction,' of such independent units in the tissues and blood (one or both) of the individual affected. The multiplication of such units, and the chemical changes in the tissues attendant thereupon, are therefore believed to be the sole and efficient causes of the groups of symptoms and tissue-changes constituting the particular general or local communicable disease, and the myriads of contagious elements produced during its progress are regarded as lineal descendants of those which initiated the morbid symptoms.

In the event of its being true, as some hold, that such living organisms as are met with in the blood, and are believed to be at times the causes of certain of the communicable diseases, can arise 'independently' within the body (by 'heterogenesis' or by 'archebiosis'), the second assumed mode of operation of contagia would have to be more or less completely renounced in favour of the first. The contagia, even in this latter case, might simply set up morbid processes, which, instead of being simple (as in those caused by the pus-corpuscle and its fluids from some seat of virulent inflammation) might be complex, prolonged, and linked together, so as to constitute the morbid processes typical of some particular specific fever. At some stage of this complicated chain of processes, and somewhere (that is, either in some organ or tissue, or in the blood), organisms may arise *de novo*, which, either alone or with their parent fluids or tissue-elements, are again capable of acting as contagia. But the organisms in such a case could not be regarded as direct descendants of the original contagia, and similarly no one would think of regarding the pus-corpuscles met with in a case of purulent ophthalmia or gonorrhœa, as direct lineal descendants of those which may have taken part in occasioning one or other of such diseases.

H. Charlton Bastian.

GIDDINESS (Sax. *gidig*, turning or whirling round).—A synonym for vertigo. *See* **Vertigo.**

GINGIVITIS (*gingivæ*, the gums).—Inflammation of the gums. *See* Mouth, Diseases of.

GLANDERS.—Synon.: Equinia; Fr. *Morve*; Ger. *Rotz*. Its associated condition is named Farcy; Fr. *Farcin*; Ger. *Wurm*; *Hautwurm*.

Definition.—A contagious febrile disease, communicated to man from the horse, ass, or mule, characterised by specific inflammatory lesions of the nasal and respiratory mucous membranes, and of the lymphatic vessels and glands, with general pyrexia, pains in the joints and muscles, and great prostration, usually accompanied by a pustular cutaneous eruption.

The local manifestations vary in order of appearance, and in comparative severity in different cases. In those in which the nasal and respiratory mucous membranes are earliest or most severely affected, the disease is customarily called Glanders; while to those in which the lymphatic system first and especially suffers, the designation Farcy is applied. But no sufficient reason exists for considering glanders and farcy as distinct diseases. They are commonly associated, and whichever set of symptoms may appear first, the other, as a rule, sooner or later follows. Further, it has been proved that the same virus may give rise to either set of symptoms, or to both. And it would seem that the order of appearance is determined in great measure by the mode of communication of the virus, as well as to some extent perhaps by the condition and constitution of the recipient.

Glanders in man is a very rare disease; and it is only within the last sixty or seventy years that its occurrence has been clearly recognised, and its history made out. When it does occur, it proves fatal in a very large proportion of cases. Taking the acute and chronic cases together, 208 out of 245 are recorded as having terminated fatally. Nevertheless out of 2,026,296 deaths in England and Wales during the four years 1871–1874 only 19 are registered as due to glanders.

Ætiology.—There is no evidence to suggest that glanders ever originates in man, whatever may be the case with regard to the lower animals. It is always communicated, and almost always by direct inoculation of virus from a diseased animal. In some few instances the disease has been communicated from man to man. It is scarcely ever met with except among those who are more or less constantly employed among horses, and who are therefore liable from time to time to come in contact with diseased animals, or the morbid discharges from them. The mode of communication can in most cases be easily traced. The rarity of the disease in man, considered in conjunction with its comparative frequency and the rapidity with which it spreads among horses, would seem to indicate that the virus is fixed, and not readily diffusible through the air, and that man is not very susceptible of its influence.

In most cases the history renders it clear that the virus, in semi-liquid or semi-solid form, has been received through some cut or abrasion of the skin or mucous membrane. In some few instances it appears probable that the virus in similar form may have been absorbed through the unbroken mucous membrane or skin. But there is at present no sufficient evidence to show that glanders, any more than syphilis, can be communicated by 'a volatile infecting principle,' although by some it is maintained that such communication may take place. If it were so, the disease would probably spread more frequently and extensively, and become comparatively common.

Symptoms and Course.—However the virus of glanders may have been communicated, a period of incubation, varying from three to eight days, and in some rare instances prolonged even to three weeks or more, ensues before the symptoms of constitutional infection become manifest. The longer the period of incubation the less acute, as a rule, is the course of the disease. The duration of the disease, as well as the order of development of the local affections, varies greatly in different cases. Hence the classification, on the one hand, into cases of *acute*, *subacute*, and *chronic* glanders; and, on the other, into cases of *acute* and *chronic glanders*, and *acute* and *chronic farcy*. But nothing like clear lines of distinction can be drawn between any of these classes.

The earliest constitutional symptoms are a sense of general discomfort, fatigue, prostration, and chilliness, with headache, and obscure pains in the muscles and joints. As the disease advances these pains become more severe, and simulate those of rheumatism. Pyrexia, at first but slight, rapidly becomes established. The pulse is quickened and sometimes full, the skin hot and dry, the tongue foul, the urine scanty and high-coloured; and the patient suffers much from restlessness, sleeplessness, and loss of appetite, often with obstinate constipation. Sometimes the feverishness is intermittent, but more frequently continued, or intermittent at very irregular intervals. Still later rigors occur, more severe than such as may have occurred at an earlier period, followed by profuse sour perspirations and clamminess of skin; the pulse becomes very rapid, weak, and compressible; diarrhœa, with very fœtid stools, succeeds the constipation; the thirst is excessive; respiration becomes more and more difficult and laboured; low delirium, with tremors, is followed by coma; and death ensues from exhaustion. In the acute form, the disease runs its course in an average period of about sixteen days; some cases have terminated fatally within a week; others have been prolonged for four weeks. In the less acute form the duration may be from six weeks to two months. And in the most chronic form, in which all the symptoms are less severe, the duration may extend over several months, and in some cases recovery ultimately takes place.

Local Manifestations.—In association with the constitutional symptoms thus indicated, the following local manifestations present themselves, but, as already stated, somewhat differently in different cases.

The wound or abrasion through which the virus has been introduced, or the spot at which it has been applied (for the wound may have healed), becomes inflamed, tense, painful, and surrounded by spreading erysipelatous redness. The ulcer which appears enlarges, assumes an unhealthy, corroded, chancroid aspect, and discharges dirty sanious and often offensive matters.

The lymphatic vessels of the part become inflamed, and present a knotted, cord-like, and subsequently irregularly nodulated condition—the *farcy-buds* in the human subject. The glands are infiltrated and enlarged, and the whole part is swollen and œdematous. The lymphatic glands and vessels of other parts subsequently become affected, but not perhaps to the same extent as in the horse. Resolution and absorption to a greater or less extent sometimes take place; but much more frequently suppuration of low type, abscess-formation, and the production of foul, ulcerating cavities, with hard irregular edges, and fistulæ follow. At a variable period in the course of the disease, from within forty-eight hours to the end of three or four weeks, an eruption, regarded as characteristic, appears on the skin. This first shows itself as scattered collections of red spots, 'which are very small and resemble fleabites, and soon acquire a papular elevation, subsequently rising above the level of the surface, like small shot, assuming a yellow colour. They lie in a kind of hole in the corium, as if the latter had been punched out' (Virchow). They appear to be due to the deposit of some neoplastic material, which subsequently softens and breaks down. By-and-by they become vesicular (some say from the first they are vesicular), and then rapidly sero-purulent, with inflamed livid bases. When close together these pustules become confluent, and give rise to irregular ulcerated surfaces, with soft, brownish, sloughy coating. Large collections of similar deposit in the subcutaneous tissue give rise to hard, painful, boil-like formations, which breaking down lead to extensive sloughing of the skin and deeper structures, with thick, dirty white, or sanguineous offensive discharge.

The mucous membranes—and first, and especially that of the nose—are sooner or later affected by specific inflammation and ulceration. Whether the inflammatory process begins in them or in the skin is not clearly made out. It probably does so in many instances, but in some cases in man, as commonly in the horse, the disease is probably communicated by application of virus to the mucous membrane of the nose or other part of the respiratory passages, which thus becomes primarily affected.

When the nose is affected (as is always the case in the form of the disease especially called glanders), there is first a discharge of comparatively thin, colourless, 'catarrhal' mucus. This soon becomes thicker and coloured; and there is considerable pain, heat, redness, and œdematous swelling about the nose itself and the adjacent parts of the face. Ultimately the discharge becomes thick, sticky, tenacious, and semi-purulent, of a dirty yellow or brownish colour, and often stained with blood. In all cases probably there is ulceration of the mucous membrane, following tubercle-like deposits in it, and the ulceration sometimes extends so deeply as to lead to perforation of the septum, or partial destruction of the turbinated or palate bones. The ulceration often occurs only in the upper part of the nose, and the mucous membrane of the frontal and other sinuses is liable to be similarly affected. When the lymphatic and cutaneous systems suffer first and especially, the nasal mucous membrane is not affected until towards the termination of the case; and in some instances death has occurred before this affection of the nose has taken place.

Bronchial catarrh with rhonchi heard all over the chest, accompanied by severe cough with profuse expectoration, indicates the implication of other parts of the respiratory mucous membrane. The conjunctiva and the mucous membrane of the mouth, gums, fauces, and especially the tonsils, are often affected to a serious extent; so also is the larynx, hoarseness, pain, and difficulty in speaking resulting therefrom.

Anatomical Characters.—The pathological lesions found on post-mortem examination are such as might be anticipated from the signs and symptoms manifested during life. To these, however, may be added fluidity of the blood; softness and rottenness of the muscles, with hæmorrhagic abscesses in them (considered by Billroth as characteristic); patches of grey hepatization in the lungs, or lobular pneumonia; abscesses in the parotid, submaxillary, and cervical glands, &c.

Diagnosis.—The diagnosis of glanders in man may be difficult in the early stage, particularly if the history be defective, and no external wound appear. But when the disease is fully developed, the signs and symptoms, especially if taken in conjunction with the occupation and history of the sufferer, are sufficiently characteristic. In some rare instances, however, in which the constitutional symptoms have been slight, and the local manifestations have very slowly developed themselves, great difficulty has arisen, and the true nature of the disease has not even been recognised until after death. Rheumatism, typhoid fever, and pyæmia, and, in regard to the more chronic cases, syphilis and tuberculosis, are the diseases with which it is said that glanders may possibly be confounded.

Prognosis.—The prognosis in glanders must be extremely unfavourable. Two or three cases only are on record in which recovery has taken place from the more acute form of the disease. In the more chronic forms, however, the deaths have been only about fifty per cent. The more slowly and less severely the symptoms develop themselves, and the longer the patient survives, the better is the chance of ultimate recovery.

Treatment.—The constitutional treatment should be supporting, stimulating, and soothing, and varied from time to time according to the indications afforded. Quinine in large doses and perchloride of iron may be useful. But at present, although very many drugs have been tried, none has been found having any marked specific effect on the course of the disease. Locally any suspicious wound should be freely cauterized as soon as attention is directed to it. All abscesses and collections of morbid material should, as far as possible, be freely incised, and their contents thoroughly evacuated. The resulting cavities and fistulæ should be frequently and thoroughly washed out with disinfectants, and poultices should be applied. The operator, and those who dress the wounds, should wear indiarubber gloves. Inhalations of iodine or carbolic acid vapour should be frequently practised;

and the nose thoroughly syringed from time to time with disinfectant solutions, as carbolic acid, iodized water, or Condy's solution.

Arthur E. Durham.

GLANDULAR DISEASES.—A general denomination for diseases of glands of all kinds. *See* Bronchial Glands, Lymphatic Glands, and Mesenteric Glands, Diseases of; also the several special glands.

GLAUCOMA (γλαυκὸς, sea-green).—In its modern acceptation, this word is used to include all the conditions, whether acute or chronic, primary or secondary, which are produced by heightened tension or increased fluid-pressure within the eyeball. The word was originally applied only to those cases of heightened tension in which there is a greenish opaque appearance behind the pupil. *See* Eye and its Appendages, Diseases of.

GLEET.—Synon.: Fr. *Goutte militaire*; Ger. *Nachtripper*.

Definition.—A urethral discharge, milky, viscid, scant in quantity, appearing as a drop at the meatus urinarius, or as shreds floating in the urine.

Ætiology and Symptoms.—The causes of gleet are:—(1) Chronic inflammation of patches of the mucous membrane of the urethra, remaining after acute gonorrhœa; (2) Chronic congestion (inflammatory or other) of the prostate; (3) Granular patches and warts; and (4) Follicular sinuses.

1. Chronic inflammation of the urethra. In the first form, which is by far the most common, the interior of the urethra, naturally pale-pink where unaffected, is dull red, or purplish red, or pale and streaky. These red patches are less elastic than the unaffected parts, and frequently, in course of time, develop into bands of stricture-tissue leading to more or less contraction. The most common positions in order of frequency are, first, the first inch from the meatus; then at 2 to 3 inches; lastly at 4½ to 6 inches, or in the bulbous portion of the urethra. Several months, probably always over six, are needed to develop the patches of inflammation into fibrous bands.

Clap has preceded the present discharge some months, or even a year or two, apparently subsiding altogether for one or two months, and returning again without obvious cause. Pain is either absent; or slight smarting or tickling is felt at the parts chronically inflamed, during micturition or at other times. The precise situation of the inflamed patches is ascertained by passing a bullet-sound or bougie (No. 14 or 16, English) along the passage, or the urethrometer, if the meatus urinarius be too small to admit such a bougie. As the bullet reaches an inflamed spot, slight resistance is noted; and the patient feels pain when it passes over the inflamed or rigid patch. Both resistance and pain cease when the patch is left behind. Should the chronic inflammation have existed long enough to produce fibrous bands, the onward passage of the bullet-sound is checked, or arrested wholly if the bands be too short to permit the bullet to slip past. A smaller bullet or diminution of the urethrameter's bulb allows the obstruction to be passed, and denotes the degree to which the normal expansile capacity of the urethra has been contracted.

2. Chronic congestion of the prostate.—Prostatic gleets are caused by (*a*) extension of gonorrhœal inflammation to the prostatic urethra —*chronic prostatitis*; or (*b*) irritation and congestion of a sympathetic kind, excited by masturbation, excessive coitus, stone in the bladder, or piles—the '*irritable*,' or '*relaxed*' *prostate*.

(*a*) In *chronic prostatitis*, with a history of preceding gonorrhœa, there is a scanty discharge, seen only at the meatus when several hours have elapsed since micturition; or there are shreds in the urine. The pain consists of a sensation of heat extending along the whole urethra, often radiating to the buttocks, but felt most *after* micturition. At other times there is dull pain in the perinæum, a sense of weight or fulness of the rectum, rather worse when lying down, and by night than by day. Micturition is performed once or twice, or more times, by night. When micturition is attempted, the urine is often slow to come, and usually a few drops dribble off after the stream ceases. Walking fatigues easily, and brings on the sense of fulness in the rectum. The finger in the rectum generally finds no enlargement, but slight tenderness of the prostate. A bullet-bougie or sound, bent one inch from the point at an angle of 135°, traverses the urethra without causing pain till the bulbo-membranous part is reached. The instrument is there grasped for a few seconds, to pass on again to the neck of the bladder; here, again, pain is felt and resistance made; the latter ceases suddenly as the sound enters the bladder, though the pain still remains. As the instrument is withdrawn, it is expelled rapidly until it is beyond the bulb, where it lies quietly enough, and all pain ceases. The urine withdrawn from the bladder through a catheter is normal, and free from muco-pus.

(*b*) The '*relaxed*,' or '*irritable*,' *prostate* is caused most often by masturbation, or by unsatisfied sexual excitement, which lead to frequent determination of blood to the prostate, without also obtaining that speedy evacuation of the blood which follows the sedative influence of the natural gratification. The gland is turgid, very sensitive, and tender, the crypts and follicles secreting an abnormal quantity of mucus. The swelling of the gland may be sufficient to alter the shape of the urethra; hence micturition may be impeded, and occasionally accompanied by smarting pain. A dull heavy sensation, hardly amounting to pain, is referred to the anus or perinæum; and the pressure of hard fæces during defæcation is often distinctly painful. The passage of a bougie along the urethra causes little pain till the prostate is reached, when the patient may even scream with exaggerated expression of the pain he feels. The instrument is grasped by spasm for a few seconds, when it passes into the bladder, and no more pain is felt. The discharge observed by the patient is transparent, colourless, glutinous, scanty, except when he strains, or is excited by erotic desire, when several drops may come away at a time. In middle-aged men urethral stricture is sometimes also present, and aggravates the prostatic irritation. The reflex and sympathetic derangements attract more attention than the local condition. An almost invariable accompaniment, if not a consequence, is dyspepsia with its various symptoms; very common, also, are aches and pains in the lower extremities, loins, and other parts. There is often great weariness, especially after sexual intercourse. Intellectually and morally the patient is much affected. Dread of impotence, of loss of memory, of insanity, or even of paralysis, is often a leading symptom.

3. **Warts and granular patches.**—Warts, which are most commonly situated just within the meatus, may stud the whole length of the urethra. Near the meatus they are arboriform, lower down sessile or only slightly pedunculated. Identical in structure with the warts on the glans or furrow of the penis, they are ordinarily papillomata.

4. **Follicular sinuses.**—Follicular sinuses, inflamed during acute gonorrhœa, often secrete discharges long after the gonorrhœa is ended. In the anterior urethra rarely more than one or two crypts are thus chronically inflamed; but in the prostatic portion several crypts secrete a thin translucent fluid, and this form may be looked on as one of chronic prostatitis. In cases of hypospadias, at the extreme end of the exposed urethra, there is in many persons on each side of the orifice a natural crypt three-quarters of an inch long. These often continue to discharge thin muco-pus long after gonorrhœa has subsided. Other sinuses, but shorter ones, open in the situation of the lacuna magna of the normal urethra. None of these follicular sinuses ever form indurated patches in the substance of the urethra; hence they never cause stricture. This may, however, sometimes result from the bursting of an inflamed and suppurating submucous gland, which before its evacuation may have projected on the wall of the urethra, and thus temporarily produced a narrowing. The discharge from such a cavity is much more copious than from a simple follicle, and very slow to dry up, though that usually happens spontaneously if there be no stricture to prevent the easy outflow of the urine.

TREATMENT. — 1. *Inflammatory patches.* — When the pain experienced from passage of the exploring sound is acute, the resistance small, and the discharge white and thick, the condition is mainly one of congestion; and the injection of three or four minims of a solution of ten to twenty grains of nitrate of silver to the ounce, by means of a Guyon's bullet-catheter and syringe at the places where pain is felt, is then a useful measure. This may be repeated in three or four days, if needed. If there be cling or hitch as the bullet passes along the urethra, the passage of a full-sized (No. 25 or 26, French) metal sound twice weekly is requisite. When no cling exists, the last remains of the discharge may be dried up by using soluble bougies at night ('*Porte remède Reynal*') for ten to fourteen nights. When congestion has become induration, or even contraction, which does not yield to gradual dilatation, the fibrous band should be divided by a urethratome of suitable shape, until the urethrameter, expanded to the largest size in which it moves freely along the unaffected parts, travels without hitch or cling past the contracted patches.

2. *Chronic prostatitis.*—Usually the cure is slow, and depends much on regimen and diet; with abstinence from alcohol, fatigue, lascivious thoughts, and sexual excitement. To relieve pain and irritation, mild belladonna and opium suppositories may be employed; when the discharge is opaque and tolerably copious, two minims of copaiba in essence of cinnamon and water, or a drachm of solution of sandal-wood oil, with buchu and cubebs, are useful. Locally, when the prostatic tenderness has subsided, cool hip-baths for five minutes night and morning, beginning at 85° F., and gradually lowering the temperature to 50° F., are beneficial. After a week or two the bath may be taken at 50° F., and lowered by ice to 40° F., with advantage. The sitting should not exceed five minutes, but the baths should be continued for several weeks. Counter-irritation is most useful when there is pain and considerable irritation. It should be applied over a large surface by the caustic solution of iodine. It is at best an uncertain remedy.

The '*relaxed*' *prostate* requires great tact and perseverance for its cure. Regulation of the digestion, prescription of suitable occupation, and encouragement of the patient to throw off his mental despondency, comprise the general treatment. Locally, if the prostate be not extremely sensitive, the passage of the steel sound on alternate days is most beneficial. Dreaded as is the first passage of the sound, the relief that follows is so satisfactory that the patient seldom objects, and generally demands its repetition. When the passage of the instrument is really agonising, the patient should be anæsthetised, his bladder emptied by catheter, and ten to twenty minims of a twenty-grain to the ounce solution of nitrate of silver thrown into the prostato-membranous urethra by Thompson's prostatic injector. This may be followed by a subcutaneous injection of one-third of a grain of morphia before the patient recovers his consciousness. He should keep his bed for one or two days afterwards, and his room three or four days more. Repetition is seldom required, as the sound is then well borne. As a completion of the cure, a long voyage and a year spent in Australian or New Zealand sheep-farming are most useful.

3. *Granular patches.*—These are best treated by passing along the urethra a bougie, which has been dipped for three inches or more into an ounce of melted cacao butter holding suspended in it five to ten grains of peroxide of mercury or nitrate of silver. When cold, this bougie may be inserted into the urethra for ten or fifteen minutes, till the warmth of the body has melted off the cacao butter, by which plan the stimulant is directly applied to the granular patch. Again, twenty drops of a thirty-grain to the ounce solution of nitrate of silver may be thrown on to the granulations by a bulbous syringe. These strong injections should be made only when the patient can rest in his room for twenty-four hours afterwards. The pain is sometimes severe, and needs hot baths, opium, and other anodynes, to allay it.

Warts should be exposed by an aural speculum or endoscope, and touched by a wire armed with lunar caustic.

4. *Follicles.*—The follicles can also be reached through the speculum, and a slender wire armed with caustic run into the mouth of the follicle. Usually, when the discharge is due solely to follicles, it is better let alone. The long sinuses met with at the end of the urethra in hypospadias may be first cauterised; and then, if caustic be not sufficient, slit up with a fine knife and canaliculus-director. Berkeley Hill.

GLEICHENBERG, in Austria. Muriated alkaline waters. *See* Mineral Waters.

GLOBUS HYSTERICUS (*globus*, a ball; *hystericus*, connected with hysteria).—Synon.: Fr. *globe hystérique*; Ger. *hysterische Kugel*.—A subjective sensation experienced by hysterical patients, as of choking, or of a ball rising in the throat. *See* Hysteria.

GLOSSALGIA (γλῶσσα, the tongue, and ἄλγος, pain).—Pain in the tongue. *See* Tongue, Diseases of.

GLOSSITIS (γλῶσσα, the tongue).—Inflammation of the tongue. *See* Tongue, Diseases of.

GLOSSO-PHARYNGEAL NERVE, Diseases of.—The glosso-pharyngeal nerve is the special nerve of taste for the back of the tongue and the soft palate, and of common sensation for the same region, and in part for the upper portion of the pharynx, the eustachian tube, and the tympanum. It is also the motor nerve for the stylo-pharyngeus, the middle constrictor of the pharynx, the levator palati, and the azygos uvulæ muscles. It is doubtful whether the fibres for the two latter muscles arise from the roots of the glosso-pharyngeal.

Paralysis.—Very little is known of the precise effects of paralysis limited to the glosso-pharyngeal nerve, since it is very rarely paralysed alone. Sensation in the fauces is certainly lost, and also taste in the back of the tongue and palate, perhaps also to a slight extent in the front of the tongue. The middle constrictor of the pharynx is paralysed, and perhaps also certain movements of the palate and the uvula. From their position, the fibres of origin are commonly damaged in conjunction with fibres of the hypoglossal, spinal accessory, and pneumogastric. The common causes of damage in this situation are meningitis, syphilitic and other growths, and bone-diseases. The nerve may also be paralysed from disease of its nucleus of origin in the medulla oblongata, and then commonly in association with the nerves to the larynx, the tongue, and often the lips (*see* Labio-glosso-laryngeal Paralysis). The sensory part of the nerve may then escape, and only the motor part be paralysed. The causes of paralysis from disease of the nucleus are slow degeneration, softening, hæmorrhage, and probably the effects of diphtheria. In diagnosing paralysis of the levator palati and azygos uvulæ, care must be taken to remember how often the arches of the palate are unequal, and the uvula is oblique, under normal conditions. Defects of movement must be looked for, and especially the unequal dimpling of the base of the uvula in the pronunciation of 'ah!'

Spasm.—Nothing is known of separate spasm in the muscles supplied by the glosso-pharyngeal nerve. In conjunction with the other motor and sensory nerves to the pharynx, it takes part in the production of the spasm of hydrophobia, and in some hysterical phenomena. For over-action in the special sensory function of the nerve, *see* Taste, Disorders of.

Treatment.—The treatment of disorders of the glosso-pharyngeal nerve is never special, but always that of the cause, and is sufficiently described in the several articles which deal with the above-mentioned ætiological conditions.

W. R. Gowers.

GLOSSO-PHARYNGEAL PARALYSIS.—A synonym for Labio-glosso-laryngeal paralysis. *See* Labio-glosso-laryngeal Paralysis.

GLOSSY SKIN is the name given to a peculiar atrophic condition of the skin, seen principally in the hands, in consequence of irritative lesions of the nerves of the forearm. The skin of the back of the hand, fingers, and even that of the palm is thin, smooth, shining, without furrows, and redder than natural—either uniformly or in patches. The skin seems as if it were stretched over subjacent parts, which are firmer than natural. It may be more or less fissured, or even denuded of epidermis in patches. Secretion of sweat may be increased or altered in quality. The parts may or may not be the seat of neuralgic pains. It was thought by Paget (who described this condition in the *Medical Times and Gazette* for May, 1864) to be a very rare affection, but it was observed by Weir-Mitchell and his colleagues, in the late American war, no less than 19 times in 50 cases of partial division of the nerves of the forearm. It may occur also as a sequence of dislocations of the wrist, where the median nerve is compressed or otherwise damaged.

GLOTTIS, Diseases of. — *See* Larynx, Diseases of.

GLYCOSURIA (γλυκὺς, sweet, and οὖρον, urine).—A condition of urine in which sugar is present; generally used as a synonym for diabetes. *See* Diabetes.

GOÎTRE.—Synon.: Bronchocele; Derbyshire Neck; Fr. *Goître*; Ger. *Kropf*; *Struma*.

Definition.—Simple hypertrophy, or cystic, fibroid, or fibro-cystic enlargement of the thyroid gland.

Ætiology.—*a. Locality.* Goître is prevalent in magnesian-limestone districts, for example, Derbyshire—hence the name 'Derbyshire neck.' Amongst the continental countries it prevails in are: France, mostly in Savoy; Germany, mostly in the Black Forest; Austria, mostly in Styria; Northern Italy, mostly about the Alps; Switzerland, mostly in the Valais; and Russia, mostly about the Altai mountains in Siberia.

b. Water-supply.—Whenever goître has arisen without being inherited the cause in far the greater number of cases can be traced to some impurity in the potable water. What this impurity is, has not as yet been satisfactorily determined, although it has been proved that the water used in goitrous districts has percolated through a soil which contains an impurity, which is the cause of the malady. Snow-water was in former days considered to be the cause, but this opinion is met by the statement that goître does not exist in Greenland or Lapland, and that it is prevalent in Sumatra, where there is never any snow. The impurity is stated by many to be due to an excess of lime and magnesia, which theory seems borne out by a geological examination of the localities in which goître is indigenous in England. In the Indian Punjaub, where goitre affects 60 per cent. of the population, 59 grains of lime have been found in a gallon of water, '10 grains being an undesirable proportion' (Professor Frankland). The latest authorities on the cause of goître believe the impurity to be of a metallic nature (probably some form of iron), and have shown that metalliferous earths, it may be said almost without exception, are to be found in the neighbourhood of the magnesian limestone districts, where goître prevails. In many limestone localities also bronchocele is entirely absent. Scotland, Ireland, Norway, and Sweden are comparatively exempt from the disease, although mountain limestone is found largely present in their geological formation. Why potable water is the cause of goître has yet to be definitely determined.

c. *Other causes.*—Epidemics of goître have been notified, as chiefly occurring amongst soldiers in France, probably the result of forced marches through goitrous districts, combined with scarcity of food. In such districts the practice of carrying loads on the head seems largely to increase the ratio of the disease. The notion that goître is indigenous to mountainous districts only is set aside by the fact that in some plains, those of Lombardy for instance, goître is present. Many other theories have been suggested.

Women in this country are much more liable to suffer from bronchocele than men, perhaps on account of their being more frequently water-drinkers, for in India it has been noticed that both sexes suffer alike. During the time of puberty the disease commonly first appears, although it may occur from any time of life up to forty years of age, children having even been born with a thyroid enlargement.

Anatomical Characters.—The whole of the thyroid gland, or both lobes, or one lobe only, may be the seat of the goitrous enlargement. The isthmus is rarely affected by itself. In exceptional cases an accessory lobe is present, and becomes enlarged. The enlargement may be simple soft hypertrophy of the gland, cystic, or fibroid; or cysts may be found interspersed in the substance of a fibroid enlargement. Cysts are formed from the normal follicles of the thyroid, by their distension with colloid material, the epithelial lining degenerating as the cysts increase in size. The cyst-wall is formed by the inter-lobular septa and capsule of the gland. In pure cysts the serous fluid which is secreted from the walls replaces the colloid contents. In the fibroid form the connective stroma increases at the expense of the follicles, and tough bands of nucleated fibrous tissue traverse the organ in all directions, the change generally commencing centrally and extending peripherally. The follicles mostly atrophy, but some may persist in the form of small cysts.

Goîtres in some countries are allowed to reach such dimensions that the inhabitants have to support them in bags. A cystic goître, as a rule, projects externally, but often the fibroid variety does not.

Symptoms and Complications.—The appearance of the swelling, and a sense of fulness in the neck, are often the only symptoms of goître. Added to the sense of fulness, there may be a feeling of dragging or constriction about the throat. More serious symptoms are sometimes present, namely, dysphagia and dyspnœa. The former is rarely present except when the tumour has reached an immense size, or when it presses on the œsophagus, as happens when the lateral lobes meet behind the gullet. Dyspnœa, a more common symptom, may be due to pressure from the goître on the front and sides of the trachea (found more commonly in young people, before the tracheal rings have gained much power of resistance), or on both recurrent laryngeal nerves, causing partial paralysis of the abductors of the vocal cords (crico-arytenoidei-postici muscles); or to a portion of the gland passing behind the trachea, or becoming enlarged beneath the sternum. There is often a temporary enlargement of a goître during the catamenial period and pregnancy; and flooding in childbirth is not uncommon. A tendency to the hæmorrhagic diathesis has been noted. Exophthalmos, with palpitation of the heart, may accompany goître. *See* Exophthalmic Goître.

Cretinism is met with, but rarely, in the goitrous districts of this country. More than half the number of cretins are born of goitrous parents, but a goitrous enlargement need not necessarily be present in a cretin, for instances of cretinism have been reported in which the gland has been entirely absent; still they have the same ætiological connection. When the thyroid gland is absent and cretinism prevails, Dr. Hilton Fagge believes that fatty tumours will be found, almost without exception, in the posterior triangles of the neck.

Diagnosis.—A soft hypertrophy of the thyroid gland can be diagnosed by its general diffusiveness, and the want of consistent hardness.

The presence of a cystic goître can be ascertained by the fluctuation of fluid within its walls. Illumination of the sac for the purpose of diagnosis is of no use. Any doubt can be cleared up by passing a very fine trochar into its centre. Owing to the fact that some cystic goîtres contain a large amount of soft trabecular structure, the fluid withdrawn is likely to be mixed with blood. When the fluid has been entirely withdrawn from a pure cyst, it often happens that blood will be freely discharged from the mucous walls.

A fibroid enlargement of the thyroid gland can be diagnosed by the consistency and hardness of its substance. In some cases, fibroid nodules lie scattered in a general hypertrophy of the gland, and may be of stony hardness. Some difficulty may be experienced in distinguishing between a globular fibroid and a small cystic goître that has thick walls, both of which lie deeply in the neck; but if the exploratory examination be made, as recommended above, the difference can at once be recognised.

The diseases which simulate goître are cancer of the thyroid gland; calculus imbedded in its substance; lymphadenoma; aneurism; and fatty and other tumours of the neck. A leading point in making a diagnosis is to ascertain, by directing the patient to swallow, whether the swelling is attached to the trachea. In the cases of cancer and lymphadenoma, the history and general condition of the patient will give a leading clue. In connection with cancer, it must be borne in mind that a fibroid enlargement of the gland may become the seat of carcinomatous change. When a fibrous goître closely overlies the carotid artery, a forcible pulsation is conveyed through the tumour, simulating an aneurism.

Prognosis.—The prognosis in goître is very favourable. The occurrence of death from suffocation, due solely to the effects of a goitrous enlargement, is extremely rare. It occurs in those countries where little or no treatment is tried, the tumours being allowed to attain an immense size—their weight sometimes reaching several pounds. The disease is more likely to endanger life when the gland passes behind the trachea and completely embraces it. All the varieties of goître are amenable to treatment, but especially the cystic. Goîtres have been known to disappear without any treatment. This result may be due to the removal of the affected person from endemic influences; or it may happen when the enlargement has arisen during pregnancy.

Treatment.—The general rules requiring attention are removal of the patient from a goitrous district, or complete abstinence from drinking water, unless it has been ascertained to be perfectly pure. General medicinal remedies are only of service when the gland is enlarged by fibroid change, and then iodide of potassium (two to three grains twice a day), with or without iron, may be tried. When the hypertrophy is of the simple soft form, blistering, or painting the surface with the tincture of iodine, or the use of iodine ointment, will be sufficient. If the enlargement is fibroid and of some consistence, then injections of the tincture of iodine into, or setons passed through, the substance of the gland, are most useful. Fluoric acid has been given internally, with or without the injections (*Lancet*, March 19, 1881). The injection of ♏xv to ʒj of tincture of iodine should be used twice a week, then weekly, and afterwards fortnightly. The greater number of cases answer well to this treatment, whilst on others no impression can be made. The time the treatment takes depends on the size of the goître; a month is the minimum required for the cure of a very small goître. The process to be followed when injecting is as follows:—Having frozen the skin over the portion decided upon for injection, by means of the ether spray, and care being taken to avoid transfixing any vein or the trachea, the needle of the syringe is pushed into the substance of the goître, and the fluid injected slowly. The best form of syringe for the purpose is one similar to that used for hypodermic injection, made with a screw-piston. Pain in the course of neighbouring nerves is sometimes felt during the injection, for instance in the ear or at the root of a tooth. When the operation is finished, the needle should be rapidly withdrawn, and the skin where the puncture has been made rolled between the finger and thumb, to prevent any escape of the iodine. If the needle be passed well into the substance of the goître, no fear need be entertained of the formation of an abscess. In favourable cases there will be a gradual enlargement of the tumour, with a slight degree of pain, for some eight or twelve hours; after that time the bronchocele will very slowly decrease in size. As a rule, in two or three weeks' time it will be evident whether the injection is to prove effective. By this form of treatment all scars are avoided. The length of time required for its adoption is often an objection, even when improvement is noted; a case occurred in the writer's experience in which the time needed for the completion of the cure was over a year, the neck being reduced from 17¾ to 13½ inches. Setons made of from two to eight lengths of silk form a very serviceable plan for the treatment of fibrous goîtres. In employing either injections or setons it is not necessary for the patient to discontinue his usual employment.

Biniodide of mercury smeared over the enlargement, the patient being then made to sit with his neck exposed to the rays of the sun for many hours, has proved an effectual remedy in India. A Captain Cunningham, the originator of this plan, treated gratuitously about 60,000 natives in two years. He is said to have never produced salivation, and to have rarely failed in effecting a cure. Ligature of the thyroid arteries has only proved of temporary benefit. Division of the isthmus has been advised when dyspnœa is present. A goître may be removed when it endangers life or keeps the patient from work. The operation is one of comparative safety under the antiseptic system, and when each vessel is divided between ligatures.

The treatment of cystic goître is of one kind, and is always successful. The plan consists in emptying the cyst with a trochar and canula, and then injecting a solution of iron (two drachms of the tincture to an ounce of water) sufficient to expand the cavity again. The patient should be kept in bed on account of the rise of temperature, after a successful injection, with the canula plugged, until the third or fourth day, when a suppurative discharge should have been set up. The metal canula should then be replaced by an india-rubber one (made with a middle layer of webbing), the canula being cut shorter as the cyst becomes smaller, and poultices applied until the goître has disappeared. A cure will be effected in one month to four or five months.

During the injection of the iron-solution into cystic goîtres, it may happen that air passes into a vein which has been wounded by the trochar. As this accident has been followed by instantaneous death, the writer, to prevent this accident, uses conjointly the two following plans, taking care to avoid superficial veins:—1. A tape is passed round the neck under the base of the goître, and held tightly by an assistant standing behind the patient, whilst the injection is going on, and for two or three minutes after. 2. The nozzle is fixed at right angles to the body of the syringe, enabling the injection to be made without holding the syringe below the level of the opening into the cyst, and preventing the injection of air. *See* Thyroid Gland, Diseases of.

Pugin Thornton.

GONAGRA, (*γόνυ*, the knee, and *ἄγρα*, a seizure).—An attack of gout in the knee. *See* Gout.

GONARTHRITIS (*γόνυ*, the knee, and *ἄρθρον*, a joint).—Inflammation of the knee-joint. *See* Joints, Diseases of.

GONORRHŒA (*γονή*, seed, and *ῥέω*, I flow).—Synon.: Clap, Blenorrhagia; Fr. *Chaude-pisse*; Ger. *Tripper*.

Definition.—A contagious purulent inflammation, affecting, in men, the urethral mucous membrane and its continuations; in women, the vaginal mucous membrane and its continuations. Occasionally the conjunctival and rectal mucous membranes, to which the nasal has been added on doubtful evidence, are attacked by gonorrhœa. Certain rheumatoid affections and other complications, to be hereafter mentioned, also attend the disease.

Ætiology.—The causes of gonorrhœa are *predisposing* and *exciting*. The chief *predisposing* causes are the lymphatic temperament; great sexual excitement and other fatigue; alcoholic excess; gout; previous attacks, especially an uncured gleet; and lastly, a peculiar proneness to urethritis in certain persons. The *exciting* causes include:—(1) Contagion with (*a*) gonorrhœal pus, or (*b*) acrid discharges not generated by gonorrhœa; (2) excessive irritation of the urethra by prolonged or repeated coitus; (3) masturbation; (4) instrumentation; and (5) the use of injections after coitus.

Gonorrhœa differs so considerably in the two sexes, owing to the diversity of seat of the disorder, that its description may be conveniently divided into two parts.

(A.) Gonorrhœa in the Male.—

Anatomical Characters.—The *seat* of urethritis is at first the mucous membrane of the fossa navicularis, whence it travels onwards, commonly not extending further than to the bulbous or membranous portion of the urethra. The inflammation then dies away gradually, leaving patches of the mucous surface here and there still inflamed. But the inflammation may extend to the submucous tissue, to the glands about the urethra, to the prostate, to the neck of the bladder, and to the epididymis in one direction, or to the bladder or even to the kidneys in another. Renal inflammation nevertheless is most frequently excited by sympathetic irritation, when the neck of the bladder is attacked, and only with excessive rarity by continuous extension along the bladder and ureters. As the inflammation localises itself in the urethra, it penetrates more deeply, reaching the follicles and submucous tissue, and may thus cause thickening and induration of the urethra at these points.

In the acute stage there is general uniform congestion; as inflammation subsides, the general redness becomes patchy, arborescent, and punctiform. The swelling disappears, leaving areas of thickened mucous membrane, fine granulations which develop occasionally into warts, and a plugged condition of the ducts of the submucous and mucous glands, which possibly may cause peri-urethral abscess or subsequent gleet. After a lapse of time the indurated patches may contract, and thereby cause irregularity and stricture of the urethra.

Symptoms.—The length of the interval between contagion and the development of the symptoms in gonorrhœa varies from twelve hours to eight days; but the great majority of claps are evident on the fourth or fifth day after intercourse. Usually early manifestation of inflammation denotes a severe attack. Urethritis from contagion differs in no respect from inflammation otherwise excited, and has no necessary period of incubation.

In the first stage, redness, scanty sticky discharge, and smarting in micturition are the leading symptoms. Febrile disturbance at this early period is most rare. On the other hand, the discharge in many cases precedes all other symptoms. Towards the end of the first week, swelling generally of the penis, especially of the urethra, sets in, accompanied by copious yellowish-green discharge, smarting in the urethra, and aching in the penis, perinæum, and groins. Painful micturition and erections at night are frequent (*see* Chordee); and general febrile disturbance is sometimes present. Naturally the disorder subsides in four or six weeks, by gradual cessation of the symptoms; but it is frequently prolonged or brought back to its first intensity by neglect of the precautions necessary against irritation.

The patients' habits often induce variations from the ordinary course, as regards the amount of discharge and the severity of the symptoms. In all cases relapses or re-kindling of the acutely inflammatory stage are common. The acute stage of the disorder terminates in one of three ways:—Cessation of pain and discharge; cessation of pain, with diminution of the still purulent discharge; cessation of all symptoms, except a minute quantity of thin whitish discharge or *gleet*. This scanty discharge is most commonly caused by chronic inflammation at one or two places, continued after the inflammation has ceased elsewhere. Sometimes a stricture, a small wart, or a relaxed prostate secretes shreds of mucus, and thus causes gleet. *See* Gleet.

Thus the course of gonorrhœa has been divided into four stages:—*Preliminary congestion*, lasting three or four days; *acute increasing inflammation*, lasting ten to twenty days; *stationary* stage, of uncertain duration; and, lastly, *subsiding* stage, also of uncertain duration. The discharge varies from its usual form of yellow pus, being in some cases viscid, like mucus, in others serous and very liquid; in rare instances it is rosy or pinkish for some days.

Diagnosis.—The distinction of urethritis caused by contagion from that excited by other causes is impossible when the history of the patient's antecedents is wanting. Certain complications of gonorrhœa are said to follow urethritis only when that is excited by contagion. This proposition is not so clearly established that it may serve to decide the origin of a given case to be contagious or non-contagious. To distinguish urethritis from urethral chancre is easy: urethral chancre is never more than one inch from the meatus, nearly always situate just within the entry, and the ulcerated surface can be seen if the lips of the urethra be separated, or a short aural speculum be introduced. The discharge also from a chancre is not creamy, but shreddy. The pain in micturition is stinging, but limited to one spot. Syphilis may accompany urethritis, but the disease has its proper initial sore or other characteristic symptoms. Occasionally a slight muco-purulent discharge without pain or much swelling is present during the period of the initial lesion in syphilis. This always subsides spontaneously in one or two weeks. In balanoposthitis (*gonorrhœa externa*) there is no urethral discharge. When the free border of the prepuce is exceedingly small, it may be most difficult to be certain that the discharge does not come from the meatus urinarius as well as from the surfaces of the prepuce and glans. Usually, a thorough syringing under the foreskin will wash away the pus, and permit the meatus urinarius to be watched while the urethra is pressed; if pus oozes forth it is secreted in the urethra. Abscess of the prostate or perinæum may cause urethral discharge, which is distinguished from gonorrhœa by the history and condition of the patient.

Prognosis.—The prognosis of gonorrhœa is favourable if proper precautions be taken early. But in spite of precaution, the disease is sometimes most severe, especially in younglads of lymphatic temperament, or in men of nervous irritable constitution. Gonorrhœa is said also to be liable to run a severe course in persons who suffer from acne. During its continuance any of the complications hereafter mentioned may arise. Further, gonorrhœa has caused death through pyæmia; and more often still it originates anchylosis or destruction of joints, or other painful disablements; while it is the predominating cause of stricture.

Treatment.—The treatment of urethritis may be (1) *abortive*; and (2) *systematic*. *Abortive* treatment is intended to cut short the disease by large doses of specifics, or by caustic injections, before acute inflammation arrives. It is always dangerous, and rarely successful. *Systematic* treatment consists in at first removing all sources of irritation and allaying acute inflammation. Abstinence from alcoholic liquors, sexual excitement, and severe exercise is necessary. Tepid baths and great cleanliness, with support for the penis and testes, are useful. Painful micturition is often relieved by immersing the penis in ice-cold water during the act. A light diet of fish, milk, and vegetables, with salines and laxatives, should be ordered. When the acute stage is passed, the continuance of the congestion is shortened by astringent injections and the administration of copaiba, sandal oil, and cubebs. But these should be withheld while there is smarting, copious greenish discharge, and dull-red congestion of the urethra.

Complications and Sequelæ.—The complications of gonorrhœal urethritis are—(1) Balano-posthitis; (2) Phimosis or paraphimosis; (3) Retention of urine; (4) Lymphangitis and Adenitis (Sympathetic bubo); (5) Hæmorrhage from the urethra; (6) Peri-urethral abscess (*a*) near the glans, (*b*) between the layers of the perinæal fasciæ, (*c*) Cowperitis; (7) Inflammation of the neck of the bladder; (8) Prostatitis; (9) Inflammation of the spermatic cord, epididymitis, and orchitis; (10) Inflammation of the rectal mucous membrane; (11) Conjunctivitis by contact; (12) Sclerotitis and iritis; (13) Rheumatism of the fasciæ, great nerves, or joints; acute synovitis, bursitis, abscess, pyæmia; (14) Stricture; and (15) Warts. Several of these complications are described in special articles, to which the reader is referred; but a few of them require brief notice here.

Stricture, or the development of tough fibrous bands in the submucous tissue in limited areas of the urethra, which prevent the canal from expanding during the flow of urine, is caused by long-lasting congestion and inflammation; the most common seat being the penile portion of the canal, and especially the inch nearest the meatus urinarius, whilst those causing most trouble are commonly at the bulbo-membranous portion. Slowly produced, these contractions seldom attract attention till two or three years have elapsed, and very frequently not until eight or ten years have passed away.

Easily curable, in the early stages, these contractions, by exciting reflex irritation, first of the bladder, subsequently of the kidney, indirectly cause parenchymatous induration and atrophy of the secreting tissue of the latter, and thus seriously affect the nutrition of the body, thereby generating a long chain of morbid changes, which not infrequently end in death.

Retention of urine is produced by gonorrhœa in two ways:—(1) During the acute inflammatory stages by muscular spasm closing the congested mucous membrane at the bulbo-membranous portion. This is of course a temporary evil, though often very painful while it lasts. The bladder should at once be emptied by passing a small (No. 6 or 7 English scale) flexible catheter, and the recurrence of the spasm prevented by saline purges, rest, warm baths, and opiates. (2) In the tightly-narrowed urethra, when stricture has formed, a small amount of local swelling or spasm may block the passage. The immediate treatment consists in passing a catheter fine enough to get through the contraction with the adjuvants just mentioned, and subsequently dilating the contracted parts by one of the various methods employed by surgeons for that purpose.

Hæmorrhage from the urethra is caused by rupture of the blood-vessels of the corpus spongiosum during the violent erections of chordee. Rarely copious or serious, in some cases it has, like hæmorrhage from other trivial causes, been dangerous from its obstinacy. Ice-cold wrappings, notably the india-rubber coil with ice-cold water flowing through it, generally arrest the bleeding speedily. If requisite, a catheter may be passed, and the penis compressed by a bandage tightly wound round the organ.

Inflammation of the neck of the bladder, or, as it is often called, inflammation of the bladder, though real cystitis is rare in gonorrhœa, consists of extension of the mucous inflammation to the neck of the bladder, and is a tedious, often very harassing accompaniment of gonorrhœa. It seldom occurs until the gonorrhœa has lasted two or three weeks, and it may develop at any time during the continuance of that disease. It is denoted by very frequent calls to micturate; great pain during, and especially scalding at the end of micturition, caused by muscular spasm of the deeper peri-urethral muscles; with extrusion along with the last drops of urine of a small quantity of muco-pus or blood. The usual gonorrhœal discharge ceases almost entirely during the attack, but usually returns when the inflammation of the neck subsides. Never dangerous, this affection derives its importance wholly from the great amount of distress, mental and bodily, which it causes. It is best combated by rest, warm baths, anodynes, and very light diet. It is very prone to relapse.

Prostatitis, that is, inflammation of the substance of the prostate, is a severe complication. It causes swelling of the prostate; painful, slow micturition, and often complete retention; a sense of fulness or weight at the anus; and sometimes great irritation of the bowel, with constant desire to defæcate. Prostatitis may cause abscess, and usually leaves enlargement of the organ. If suppuration takes place, pain increases till matter escapes; then sudden relief follows. The abscess most commonly opens into the urethra, and the pus comes away with the urine; but it may open into the rectum, the perinæum, or the bladder.

The treatment consists mainly in allaying irritation and pain by hot baths, fomentations, and opium; and when retention occurs, the regular passage of a catheter is requisite. When fluctuation is evident, abscesses must be opened in the rectum or perinæum. When the abscess has burst spontaneously, it usually closes in course of time, and the discharge ceases altogether or dwindles to a scanty gleet of no importance. Should the discharge continue copious without abatement after several weeks, or the patient suffer much distress, an incision through the perinæum is proper, through which to drain and close the abscess.

(B.) **Gonorrhœa in the Female—Vaginitis.** This may be acute or chronic. The inflammation begins at the fore part of the vagina, extending to the uterus in one direction, and to the urethra in the other. When attacking the vulva, it causes occasionally abscess of accessory parts, for instance, of Bartholini's gland, or of the lymphatic glands. In the cervix uteri and in the urethra it becomes very obstinate.

Symptoms.—These consist, in the acute stage, of swelling of the genitals, heat, or itching, smarting on making water, and aching pains in the back and loins. The mucous membrane becomes dry and bright red. At first the mucus is thin and transparent, but soon becomes thick, creamy, and copious. The mucous membrane is more or less studded with little eminences (*vaginitis granulosa*). The inflammation becomes chronic in from six to ten or twelve days; the pain, swelling, and congestion diminish or cease; the discharge, less creamy, remains plentiful. It is usually secreted in the cul-de-sac, or in the cervix, or some other part less easily cleared than the anterior part of the vagina. These parts, while inflamed, retain a brighter red colour than the rest of the mucous membrane. Not infrequently, when the inflammation has ceased in the vagina, pus can still be squeezed from the meatus urinarius or some of the crypts opening round that orifice, if the finger be drawn forwards along the under surface of the urethra.

The *duration* is extremely variable; if assiduously treated, so that extension to the cul-de-sac or cervix uteri is prevented, the disease has a duration of about three weeks. But when these parts or the urethra are invaded, the duration is most uncertain, the disease lasting often for months or even years. The length of time that the discharge remains contagious is also most uncertain. Probably any discharge, however scanty and serous it may have become, may cause disease if increased by accidental irritation.

Diagnosis.—This depends on the swelling and red congestion in the acute stage, and on partial excoriation and copious discharge in the chronic stage. The distinction between vaginitis from contagion and vaginitis from non-specific irritation is always difficult, and sometimes impossible, being mainly determined by collateral evidence. It generally has a contagious origin if there be pus in the urethra.

Prognosis.—This is favourable. Sometimes the disorder is cured before it becomes chronic; and dangerous complications are very uncommon.

Treatment.—The treatment of vaginitis in the acute stage consists in allaying irritation by rest in bed, warm baths, frequent injections of warm water, or warm but very weak, astringent solutions, and moderate purgation. The habits and health of the patient must be regulated, and all causes of excitement withdrawn. When congestion has subsided, stronger astringent injections should be efficiently applied, so that the whole mucous surface of the vagina, especially that of the cul-de-sac, is thoroughly laved. Alum or tannin should be applied in powder, by means of the speculum, to the deeper parts of the canal.

Complications.—The complications of gonorrhœal vaginitis are various. Among the earliest is *vulvitis*. The labia and clitoris grow red, swell, and a fœtid discharge is secreted. The patches of epithelium peel from the mucous surfaces, producing excoriation and occasionally ulceration of the mucous follicles. Usually, if the parts are kept clean, the irritation subsides in a few days.

Urethritis is the most constant accompaniment of gonorrhœa. Rarely so acute as to cause much irritation, it may produce severe suffering. It begins with itching and smarting at the meatus, which is red and swollen. A purulent or mucous discharge oozes from the passage, unless the patient have just micturated; even then a little can be found in the mouths of two follicles which open close to the meatus. This discharge is very persistent, and is probably a source of contagion long after the disease is cured elsewhere. The treatment of urethritis consists of frequent baths, astringent injections, and copaiba internally. Obstinate chronic discharges may be arrested by caustic solutions, carefully applied.

Acute inflammation of the cervix and os uteri is a frequent consequence of gonorrhœa. The neck of the uterus is swollen, red, and often excoriated about the os, whence a copious discharge issues, at first clear and viscid, then purulent. This subsides to a thin mucus, and either shortly ceases, or more commonly passes into chronic catarrhal flux, which lasts an indefinite time, and long retains its contagious quality. The acute inflammation is best treated by complete rest, warm baths, warm injections, and saline aperients. In the chronic stage its treatment is that of uterine catarrh.

Metritis, perimetritis, and *ovaritis* may also result from gonorrhœa. *See* Ovary, Diseases of; and Womb, Diseases of. Berkeley Hill.

GONORRHŒAL RHEUMATISM.—An affection of the joints associated with gonorrhœa. *See* Rheumatism, Gonorrhœal.

GOOSE-SKIN.—A condition of the skin in which this structure is rough and wrinkled, like that of the goose. It is of a transient character, being due to contraction of the muscular fibres of the skin, producing wrinkling of the integuments, and prominence of the hair-follicles; and is observed as the result of the direct application of cold, or of a shock, and in the early stages of fevers.

GOUT (*gutta*, a drop).—Synon.: Podagra, Chiragra, Gonagra (when the disease affects the foot, hand, or knee respectively); Fr. *Goutte*; Ger. *Gicht*. The name *gout* is supposed to have originated in the idea of the dropping of a morbid fluid into the joints, and is of very ancient date.

Definition.—Gout is a general or constitutional disease, probably depending upon the presence in the system of excess of uric acid, the complaint being, in fact, a manifestation of the *lithic* or *uric acid diathesis, lithiasis*, or *lithæmia*. It may be hereditary or acquired; and is characterised ordinarily by a peculiar inflammation of the joints—*articular* or *regular gout*, attended with the deposit of urates in their structures, affecting usually and especially the smaller joints, and at first more particularly the metatarso-phalangeal articulation of the great toe, but afterwards extending to other joints. Similar deposits of urates may occur in other tissues in course of time; and certain organs of the body are liable to become the seat of functional disorders, or of pathological changes, during the progress of the disease—*non-articular* or *irregular gout*; while it is also often attended with general symptoms. Gout in the early part of its course is usually an *acute* affection, occurring in periodic attacks or 'fits'; but subsequently it tends to become more or less *chronic* and permanent, though even then generally presenting exacerbations from time to time. The gouty diathesis may, however, be present without giving rise to any joint-affection or other evident organic mischief.

Ætiology and Pathology.—The ætiology and pathology of gout are intimately associated, and must be considered in their mutual relations; and there are certain definite points which require to be noticed in this connection.

1. It is necessary to determine the immediate *pathological cause* of the gouty diathesis and its accompanying phenomena. Many views have been advanced, but they all belong to either of two groups, namely, the *humoral* or *anti-humoral*, the former attributing the complaint to some morbid condition of the blood and secretions; the latter to some functional disorder or organic change affecting certain systems of the body, and especially the nervous, vascular, or digestive systems. Loss of nervous tone, a tropho-neurosis, venous and capillary congestion, and plethora of the chylo-poietic viscera, are among the conditions to which gout has thus been attributed. In the writer's opinion an essential element in the development of gout consists in the presence of some special morbific agent in the system; and it is now almost universally admitted that this agent is *uric* or *lithic acid*, which accumulates in the body in abnormal quantity. A variable amount of this substance is being constantly formed in the system during the processes connected with nutrition, but within certain limits, which probably differ in different persons and under different circumstances, it is capable of being eliminated by the kidneys or of being destroyed, and only when the acid accumulates beyond such limits are the gouty phenomena developed. In short, gout may be regarded as a manifestation of the so-called *lithic acid diathesis, lithiasis*, or *lithæmia*. The acid exists in the body as urate of soda, and in the gouty diathesis this salt is present not only in the serum of the blood, but also in the fluid that diffuses from it into all the vascular and non-vascular structures of the body (Bence-Jones). There are several arguments in support of this view:—(1) Gout occurs under circumstances which are known to induce in various ways the presence of excess of uric acid in the system; and, further, the causes which are most liable to bring on a gouty paroxysm are those which temporarily increase this excess. (2) While in the blood of healthy persons the quantity of uric acid present is so minute that it cannot be detected by any ordinary tests, in gout this substance may be obtained from blood-serum, even in a crystalline form, either before or during an acute attack in early cases, or at any time in chronic cases. It has also been found in the fluid contained in blebs raised by blisters, provided they are applied at a distance from the seat of any acute gouty inflammation; in inflammatory effusions in serous cavities; and in dropsical fluids, such as ascites. (3) Along with these indications of the presence of excess of lithic acid in the system, during an attack of acute gout the *absolute* quantity discharged in the urine is considerably diminished; while in chronic cases of the disease it is habitually more or less deficient, and at times may be almost entirely absent. (4) Deposits of urates, especially of urate of soda, are formed in the joints and other structures in gout, and this is the only disease in which such formations are found. Every attack of gouty inflammation is attended with the deposit of urates in the affected tissues, but the quantity is not in proportion to its intensity, and therefore cannot be merely the effect of such inflammation.

Assuming this view of the essential nature of the gouty diathesis to be correct, different theories are held to account for the excess of lithic acid in the system, and they are probably all more or less true in different cases, in some instances the accumulation being explicable in more ways than one. Undoubtedly uric acid is often *formed in excess*, so that it cannot be adequately got rid of by elimination or in any other way. This excessive formation occurs in many cases without giving rise to the phenomena of gout, because so long as the kidneys are in good condition, and the nutritive processes are satisfactorily carried on, the acid is eliminated or destroyed. Again, it is supposed that lithic acid may undergo *imperfect oxidation and destruction* in the body. Both these disorders have been attributed by some writers to a supposed influence of the nervous system. Others attach considerable importance to hepatic derangements in the causation of gout; and here it may be remarked that a distinct connection has been traced in some instances between this complaint and diabetes. Furthermore, the presence of an *undue quantity of other acids* in the blood may in some instances account for lithæmia. If, from various causes, such as deficient action of the skin, excessive consumption of acids or acid-producing food, or the formation of acids in undue quantity during the process of digestion, these acids are present in excess in the blood, from their greater affinity they combine with the alkalies in this fluid, and diminish the alkalinity of the blood-serum, so that it is less able to hold uric acid or urate of soda in solution. *Deficient elimination* is an important cause of lithiasis, and is often associated with other causes. It has been proved experimentally that in birds, if the ureters are tied, uric acid is deposited all through the tissues, but especially in the kidneys. It has been suggested that in some cases of the gouty diathesis the kidneys are congenitally small, and therefore cannot properly excrete even a normal quantity of uric acid, but especially any excess of this substance. Functional disturbances of the kidneys are also liable temporarily to interfere with their eliminating power, being often associated with, and probably due to, excessive formation of urates; while in course of time these organs become the seat of serious organic mischief in gouty cases, which gravely limits their excretory power, and in extreme cases arrests it entirely.

2. We are now in a position to discuss the circumstances under which the gouty diathesis is developed, and the more obvious *causes* with which this condition is associated. There are certain causes which may be regarded as more or less *predisposing*, and these will be subsequently considered; but ætiologically cases of gout may be conveniently arranged into three main groups, according as the disease arises from :—*a. Hereditary transmission. b.* Certain errors in regard to *food* and *drink*; often associated with *deficient exercise. c.* Impregnation of the system with *lead*. In not a few instances, however, it must be remembered that these causes are more or less combined.

a. Hereditary transmission. Gout is one of the most striking examples of a hereditary disease, and once established, it may be transmitted for several generations, even when every endeavour is made to eradicate it; but as the contrary is generally the case, the malady being as a rule more or less intensified by pernicious habits, it becomes in most cases a permanent legacy, handed down from one generation to another. Garrod found that in more than half his cases hereditary taint could be traced distinctly; and the proportion is much greater in the upper classes. It sometimes happens that when gout becomes developed *de novo* in an individual, children born previously are free from the complaint, while those born subsequently are liable to be affected. Hereditary influence may be so powerful that gout arises without any other cause whatever; but most commonly this is aided by indulgence in certain habits to be presently mentioned, perhaps not to an extent which would be considered excessive for people in general, but which is excessive for persons predisposed to gout. This complaint sometimes exemplifies the so-called 'law of atavism,' but this is usually due to the fact that in the generation free from gout every precaution is taken to avoid causes which tend to originate a gouty paroxysm, these precautions being subsequently neglected. The hereditary nature of gout is shown not unfrequently in the age at which the disease reveals itself. Should the predisposition be powerful, the complaint may appear even in children; and the younger the subject who is attacked with gout, the more likely is there to be an hereditary taint. The explanation of the transmission of gout in this manner is a mere matter of theory, and the excess of uric acid in the system has been accounted for in all the ways already mentioned.

b. Errors relating to food, drink, and exercise. In a considerable number of cases gout is originated *de novo*, in consequence of certain errors affecting the diet and habits; or an inherited tendency to the disease is considerably aggravated and promoted in this way. In general terms these errors may be summed up as excessive eating, especially of particular articles of food; undue indulgence in alcoholic drinks; and indolent habits, with deficient exercise. They are frequently associated in the production of gout, and not a few persons who eat and drink to excess, are saved from becoming gouty because they are of active habits, work hard, and take a considerable amount of exercise.

Although all kinds of food may assist more or less in developing the gouty diathesis, those elements which are rich in nitrogen are most injurious, and especially meat. Beef is believed by many to be particularly baneful. The writer has heard vegetarians affirm that meat is the great cause of gout, and that it never occurs when a vegetable diet is adhered to, but for such a statement there is no adequate proof. At the same time it must be acknowledged that this complaint is often in no small degree attributable to the amount of meat which is consumed. Many articles of diet, either from their own nature, or from the manner in which they are cooked, may help in the production of gout, by giving rise to digestive disorders.

The relation of intemperance in the use of alcoholic drinks to the gouty diathesis is highly important, and is abundantly proved by everyday experience. The more potent wines have the greatest influence in causing gout, and portwine has proverbially been regarded as the most injurious of all. Burgundy, madeira, sherry, and marsala are also undoubtedly capable of developing gout, or of keeping up the disease. The lighter wines are much less injurious, but champagne, and especially sweet champagne, certainly often promotes the gouty condition. Hock, sauterne, moselle, and light claret seem to be least injurious, but even these, if indulged in to excess, may in course of time set up, or, at any rate, intensify the gouty diathesis. Malt-liquors stand next to wines as originators of gout, and undoubtedly those who partake very freely of this class of alcoholic beverages are not uncommonly affected. In this way the disease may be usually accounted for when it occurs among the labouring and poorer classes, but it must be remembered that in these persons an inherited tendency to the complaint may exist. Brewer's draymen especially drink large quantities of ale or porter, and the writer has met with instances in which the habitual daily consumption has been acknowledged as averaging from two to four gallons. Spirits are comparatively feeble in their power of producing gout, as is proved by the rarity of the disease in those countries where this class of drinks are chiefly used, such as Scotland. Rum is said to form an exception to this statement. Cider and perry may unquestionably set up gout, if taken to excess, but they are much more powerful when sweet and not properly fermented. Excessive indulgence in a mixture of alcoholic drinks is probably more deleterious than if one is adhered to. The explanation of the differences in the tendency to develop gout exhibited by the various kinds of beverages is not very clear. They do not depend directly upon the amount of alcohol which they severally contain, but the admixture of certain other ingredients with the alcohol renders it far more potent in producing this effect, and the more alcohol then present, the greater is the likelihood of gout being originated. It is not, however, definitely known what these ingredients really are. At the same time it may be affirmed, as regards wines, that their quality has much to do with their tendency to induce gout. Factitious wines and others of inferior quality, as well as those which are very sweet, or which contain much tannin, are most liable to produce this complaint. Drinks which cause a marked diuretic action are less capable of inducing the gouty state than those which have but little of such an action.

The modes in which the errors as regards food and drink induce lithiasis are probably various. They often directly lead to the formation of excess of nitrogenous products, and especially of uric acid, more than can be eliminated or destroyed in the system. Again, overeating and drinking frequently cause undue production of other acids during digestion, which take the place of uric acid, and prevent its elimination. Moreover, these habits disorder the digestive functions, cause congestion of the chylopoietic viscera, interfere with the hepatic functions, and ultimately set up a permanent dyspeptic condition, all of which assist in the development of the gouty diathesis. It has been supposed that indigestion from any cause might originate this condition, but according to the writer's experience this is certainly not the case. Persons who are hereditarily gouty often suffer from dyspepsia, but the disease may appear in such individuals when digestion has always been carried on without the slightest discomfort. Those who indulge in the habits which originate gout *de novo* are generally dyspeptic, as the result of these very habits. *See* DIET.

With respect to deficient exercise, this undoubtedly promotes the development of gout in many cases. Persons who follow sedentary occupations, or who live indolent and lazy lives, are certainly more liable to the disease; and not a few become gouty because they are able to 'keep a carriage,' and thus are deprived of the exercise which they were previously accustomed to take. This cause probably acts by limiting the conversion of uric acid into other waste products, which can be more easily got rid of; and also by increasing dyspepsia, in consequence of the organs which are concerned in the process of digestion doing their work slowly and imperfectly.

c. Another group of cases of gout which originate *de novo*, are those which occur in connection with *lead-impregnation of the system.* Dr. Garrod found among his hospital patients, that about 30 per cent. of those suffering from gout had been subjected to the influence of lead in their various occupations; and in the writer's experience, not only has the relation between lead-poisoning and gout been frequently exemplified, but some of the worst cases of this disease in its chronic forms occurred in persons who were distinctly under the influence of lead. This metal does not appear, however, to originate the gouty diathesis, unless aided by more or less indulgence in alcoholic drinks, though the amount of the latter consumed is usually far less than would alone account for the condition. It has also been found that gouty persons are remarkably susceptible to the influence of lead; and that when this metal is given to such persons for medicinal purposes, it is very liable to bring on a severe attack of acute gout. Garrod's observations seem to show that lead acts by diminishing the excretion of uric acid by the kidneys; and this authority states that the blood of individuals suffering from lead-paralysis always contains an abnormal amount of uric acid, and that the same probably holds good in all cases of lead-colic.

3. **Predisposing causes.**—It is next requisite to notice briefly the predisposing causes of gout. Beginning with *age*, distinct gouty attacks in a large majority of cases make their first appearance in persons between thirty and thirty-five or forty years old. Those which occur under thirty are, with rare exceptions, more or less hereditary. Well-marked gout is exceedingly rare under twenty, but it may occur even in children, being then, however, invariably strongly hereditary. The complaint usually appears before fifty, and becomes progressively less frequent in its manifestation for the first time after this period of life. It is quite exceptional for gout to commence after sixty-five, but it may begin even in extreme old age. The cases in which the disease is developed during or after middle life mainly originate *de novo*, and one of the reasons assigned for the less frequent appearance of the complaint as age advances is, that then people usually become more careful in their mode of living, and more temperate in their habits. With regard to *sex*, males are far more commonly the subjects of well-marked gout than females. This is mainly accounted for by the difference in the habits of the two sexes. It has also been partly attributed to the occurrence of menstruation in females, which acts to some extent as a safeguard, and in these

subjects gout generally appears after the cessation of this function. When strongly hereditary, gout may appear even in young females, of which the writer has seen some well-marked examples.

Bodily conformation and *temperament* have been credited with a predisposing influence, persons of a sanguine temperament, and of corpulent, full-blooded, plethoric habit of body, being supposed to be most subject to this disease, and to have it in its most acute form. These conditions are often produced by the very habits which originate gout, and certainly persons who are gouty by inheritance often do not present any of these characteristics, while those presenting marked contrasts in appearance and temperament seem to be equally the subjects of the complaint. It is not uncommon in individuals of a nervous temperament, thin and wiry in frame, and they are said to be more subject to the irregular and asthenic forms of the disease. *Social position* and *occupation* materially influence the occurrence of gout. Formerly the complaint was met with almost entirely among the higher classes, and it was looked upon as an aristocratic disease. Now, however, it is common enough among the middle classes, chiefly those who are in affluent circumstances; while there are several occupations in connection with which the disease is very prevalent, such as butlers, coachmen, butchers, publicans and barmen, coal-heavers, porters, haircutters, and painters, or others who have to do with lead. It was at one time believed that high mental endowments predisposed to gout; this was obviously a mistake, although excessive mental labour, prolonged worry, and other causes which exhaust and depress the nervous system, do seem to predispose to the disease. As regards *climate*, those climates which are cold or temperate, and especially at the same time damp and changeable, present by far the greatest number of cases of gout, and in most tropical countries this complaint is unknown. This depends partly upon the differences in the nature and amount of the alcoholic drinks employed; partly upon the effect of climate as regards the functions of the skin.

4. Thus far we have been concerned with the pathology and ætiology of the *gouty diathesis*. Now we have to discuss briefly these points in relation to the *local manifestations* of the disease, and especially to the occurrence of *acute attacks*. Athough the presence of excess of uric acid in the system is an essential element in the pathology of gout, such excess is often present, and yet none of its more characteristic phenomena are observed. An individual in this condition is, however, at any time liable to an attack of distinct gout, from the action of certain causes which would have no such effect upon other persons. If from any cause the amount of lithic acid in the blood is suddenly or rapidly increased, an acute attack of articular gout may be expected, or some internal manifestation of the disease. This is believed to be directly due to the action of the urate upon the tissues of the joint, which is supported by the fact that even after the first attack a distinct deposit of lithates is found in them, which increases with each subsequent attack. Two views are held as to the explanation of its mode of action. According to one view the urate merely acts as a local irritant, it being supposed that different morbific agents in the system affect different tissues, and that this one acts specially upon the structures which are found in joints, setting up an inflammatory process. The degree of inflammation is, however, by no means in proportion to the amount of lithates which are deposited; indeed, the contrary is usually the case, for as a case of gout becomes more and more chronic, the deposit often becomes very abundant, though the paroxysms progressively diminish in intensity; while it is often found in other structures besides those connected with articulations, without causing any evident inflammation. The second view is that the acute paroxysm is the result of an attempt on the part of the articular structures to eliminate the morbid material, a chemical process of oxidation being set up in the parts where urates are most able or liable to accumulate, by which they are converted into urea, carbonates, &c., and so got rid of. This process gives rise to congestion, followed by inflammation and its attendant phenomena. It has been proved that the inflammatory process does destroy the urate in the blood of the affected parts, and probably the salt which has actually been thrown out is also partly destroyed. No uric acid can be detected in the fluid of a blister placed directly over an articulation which is the seat of acute gout. According to this theory the gouty paroxysm is to some degree salutary, as it helps to get rid of the excess of uric acid in the system.

It is a well-known fact that gout tends specially to attack the smaller joints, and above all the metatarso-phalangeal joint of the great toe, which is the one usually first affected. This is explained in the following way: in gout it is believed that those tissues are chiefly attacked which are either non-vascular, or which are supplied with but few vessels, and through which the fluids pass with difficulty, especially cartilaginous, fibrous, and ligamentous tissues. Such tissues are found in large proportion in the smaller joints. These are also distant from the centre of circulation, and the blood passes through them in a comparatively feeble and languid stream. They are, moreover, much exposed to the influence of cold and wet. And, lastly, with reference to the metatarso-phalangeal joint of the great toe more particularly, this joint is peculiarly liable to injury from pressure, supporting the weight of the body, sudden shocks, &c. Another point observed in the history of gout is, that during an acute paroxysm several joints are often attacked in succession, while the inflammation subsides in those first affected, often with striking suddenness. This is accounted for by the deposit of urates in different joints successively, and when inflammation is thus excited in them, it tends to subside in those previously affected. Not uncommonly corresponding joints on opposite sides of the body are implicated alternately, probably through their nervous connection in the spinal cord. As gout advances in its progress, the articulations become more and more involved with each attack, because those first involved become, as it were, saturated with urates, and therefore new tissues of the same class are invaded.

An acute paroxysm of gout may come on without any evident *exciting cause* whatever, especially if the disease is strongly hereditary, or has been long established. Under these circumstances outbreaks of the complaint seem to become habitual at certain seasons, or they arise from very slight causes, which need to be less and less obvious as the case progresses. Often, however, some distinct exciting cause can be made out, affecting the digestive organs, the vascular or nervous systems, the functions of the skin or kidneys, or disturbing the system in other ways. The most important are eating or drinking too much, either on some particular occasion, or habitually for a longer or shorter period, until at last a fit of gout terminates the indulgence, it being borne in mind that even apparent moderation may be excessive for a gouty person; indigestible articles of food; neglect of the act of defæcation, or constipation; undue physical work or exertion; exposure to cold or wet, or suppression of perspiration; excessive mental work or worry; emotional causes, sudden, powerful, or depressing, such as sudden joy, a fit of rage, or deep grief; hæmorrhage, acute illness, or other debilitating causes; or injury. The implication of a particular joint may be also due to injury, which may be very slight, such as the pressure of a boot, or the toe being trodden upon. Injury to the knee has caused that articulation to be first affected. As *predisposing causes* of acute gouty attacks, climate and season are highly important. Their characteristics have already been indicated, and undoubtedly gouty paroxysms may often be averted by residence in a warm climate, either permanently or during the colder seasons of the year. Early attacks seem to be most frequent in the spring; then they occur also in the autumn; and subsequently they become more frequent and irregular in their onset. One seizure predisposes to another, and it is a special feature of gout that it tends to recur, this tendency increasing with each succeeding paroxysm, until finally, in many cases, the patient cannot be said to be ever free from the complaint. The occupation of an individual may predispose to the occurrence of gout in particular joints; thus butlers have it in the feet, coachmen and washerwomen in the hands.

It is found in process of time that gouty concretions form in other parts besides in the joints. This is easily explained by the fact that urates tend to deposit in certain other structures which are but slightly vascular, besides those forming part of the articulations. Vascular tissues seem to destroy urates in their passage through them, and thus they are prevented from doing any harm to these tissues. The presence of urates in the blood will account, not only for the chronic gouty state, but also for acute attacks affecting internal organs, or so-called irregular gout. It has been maintained that the development of gout in other structures besides the joints is influenced by the diathesis and habits of the individual, but it is doubtful how far this is borne out by actual experience.

Anatomical Characters.—In its most typical manifestations gout is characterised anatomically by the occurrence of a peculiar form of inflammation affecting certain joints, this being invariably attended with the deposit of urate in connection with their structures. Taking an individual articulation, this is at first the seat of an acute inflammatory process, indicated by the usual signs of increased vascularity and redness, tumefaction, and serous effusion into the interior of the joint, as well as into the surrounding tissues. The results of post-mortem examination show that even in the very earliest period a deposit of urate takes place; and as the attacks become repeated again and again, the signs of inflammation become less and less prominent, while the deposit increases, until at last it may form considerable masses, and infiltrate extensively all the structures entering into the formation of the articulation. The joint then becomes permanently enlarged and distorted, while the ligaments are thickened and more or less stiff or quite rigid, and ultimately complete anchylosis may be produced. The deposit seems to commence in the substance of the cartilage covering the ends of the bones, starting near its superficial or free surface, and gradually extending more deeply, though for a time a thin layer of cartilage lies between it and the cavity of the joint. This deposit at first forms a whitish opacity, but as it becomes more abundant it encrusts the cartilages, and also the inner surface of the ligaments, and the surfaces of fibro-cartilages where these exist. More or less extensive spots or patches become in time distinctly visible, and even the entire surfaces of the bones forming a joint may be covered with a chalky-looking substance. The synovial membrane may also present white points, but the synovial fringes at their margins seem to escape, on account of their vascularity. In the larger articulations the synovial fluid may be thickened, and may even contain separate crystals or tufts of the urate. Subsequently the ligaments and adjoining structures are infiltrated, and it is to this cause that the stiffness or rigidity of gouty joints is mainly due. Distinct masses of deposit may, however, form, and these also interfere with movement. They are known as *tophi* or *chalk-stones*. In course of time the tissues covering a gouty joint may be destroyed, including the skin, the chalky-looking substance being thus exposed, and unhealthy suppuration and ulceration set up.

The opaque white substance characteristic of gouty inflammation is found on microscopic examination to consist of fine crystals, in the form of needles or prisms. They are chiefly arranged in minute clusters, radiating from a centre; and in the cartilages they form a more or less compact network. Chemical examination shows that they are composed of urate of soda.

With reference to the joints which are affected in gout, as has been already indicated, the metatarso-phalangeal articulation of the great toe is the one primarily attacked in a large majority of cases. In rare instances, where an opportunity has been afforded of making a post-mortem examination after only one or two gouty fits have occurred, this joint, on one or both sides, has alone presented any change, even after many years have elapsed since the occurrence of the attacks. As usually seen, however, the disease has progressively involved many joints. In the feet it may implicate all the articulations, but it is a curious fact that the tarso-metatarsal and the phalangeal joints of the great toe generally escape, or are but little affected. Similarly all the joints of the hands and fingers are often involved. The gouty change not uncommonly extends to the larger joints, more especially those of the legs, but the shoulder and hip-joints are but little liable to be attacked. In exceptional cases other articulations are found involved, such as the temporo-maxillary, those of the spinal column, of the pelvis, or even of the larynx.

Coming now to other structures, deposits of urate may occur in various parts of the body, in connection with bursæ, tendons and aponeuroses, sheaths of muscles, the sclerotic coat of the eye, the cartilages of the external ear, eyelids, nose, or larynx, or under the skin. More or less effusion may be present in bursæ at the same time. In a case which came under the writer's notice, and in which there was not the slightest hereditary taint, in addition to numerous *tophi* in the auricles, there was a mass in the bursa over the right olecranon as large as an egg, a smaller one over the left elbow, several distinct deposits over both patellæ, and others in connection with the tendons of the hands, especially the right.

As regards bone, the periosteum is often affected, and some writers have described a deposit of urate in bone itself; but Garrod has not found evidence of its having originated in this tissue. He considers that the periosteal formations sometimes acquire sufficient size to press on the osseous tissue, and to cause its absorption.

The condition of the kidneys induced by the gouty diathesis is of great importance, and these organs probably begin to be diseased at a very early period in the history of a case of gout, for they may be found distinctly affected when there have been little or no external manifestations of the complaint. In the first instance a deposit of urate of soda takes place, probably within the renal tubuli, which afterwards involves their walls, and penetrates to the intertubular tissue. This is seen in the form of white streaks in the course of the tubuli, and of white points at the extremities of the papillæ. The deposit goes on increasing, and a chronic inflammatory process is set up, ending ultimately in the production of the 'granular contracted kidney' (*see* BRIGHT'S DISEASE). Other morbid states in connection with the urinary organs observed in some cases of gout are the presence of calculi, consisting of uric acid, urates, or oxalates; chronic cystitis; or urethritis.

In the course of gout morbid changes of other kinds often arise, affecting different structures and organs, and either occurring as acute events, which may even prove fatal, or being of a chronic nature. These need be only mentioned here, and they mainly include congestion, catarrh, or severe inflammation of some part of the alimentary canal; catarrh of the air-passages, chronic bronchitis, and emphysema of the lungs; fatty disease of the liver; meningitis, neuritis, cerebral hæmorrhage; cardiac changes, including chronic valvulitis and degeneration of the valves, and hypertrophy, followed by degeneration, of the cardiac walls; atheromatous changes in the vessels, hypertrophy of the muscular coat of the small arteries, or arterio-capillary fibrosis; and various diseases of the skin, such as erythema, urticaria, eczema, psoriasis, &c. How far some of these conditions can be attributed to the gouty diathesis, or are merely the result of the same causes which have induced this diathesis, may be fairly disputed. It is worthy of remark that acute inflammation in connection with the heart is not met with in cases of gout, and this has been attributed to the great vascularity of the endocardium and other cardiac tissues, for which consequently the urate has no affinity, or it is destroyed in its passage through them.

The condition of the blood in gout may be here noticed. In early cases the chief deviation from the healthy state presented by this fluid is that during the acute paroxysms the serum contains a distinct excess of uric acid, in the form of urate of soda; and this can be obtained in appreciable quantity, even in a crystalline form. In the intervals the blood is quite normal. When the gouty condition becomes chronic, the excess of uric acid is constant, and oxalic acid can also be frequently detected. In course of time the serum becomes lowered in its specific gravity, its albumen is deficient, and its reaction is less alkaline, in extreme cases becoming almost neutral, owing to the presence of excess of acids. When the kidneys are implicated, urea also tends to accumulate in the blood, and may be obtained in variable quantity. The red corpuscles often diminish in number; and the blood deteriorates in quality as a whole in many cases of chronic gout.

SYMPTOMS.—The clinical history of gout is a very varied one, and the symptoms observed in different cases which are regarded as of a gouty nature are exceedingly numerous and diverse. Whether the phenomena attributed to this disease are always fairly explicable by the presence of excess of uric acid in the system is, to say the least, a matter of considerable doubt. It must ever be borne in mind that the habits which generate gout often give rise to symptoms, and even to definite morbid changes, which cannot justly be looked upon as part of this complaint. Again, the custom which some practitioners adopt, of looking upon every acute illness, particularly inflammation of organs, occurring in gouty subjects, as being due to the lithæmic condition, and of a special nature, and applying the term 'gouty' to every such complaint, is certainly going too far, though it may be acknowledged that gout does often modify their clinical history. It is not easy within a limited space to give even a sketch of the various clinical phases of gout, but before considering the symptoms in detail, it may be well to indicate their general nature. 1. In its typical form gout is in its early stages attended with acute symptoms referable to certain joints, and these tend to recur at intervals, constituting 'fits of gout,' the intervening periods becoming shorter and shorter as the case progresses—*Acute Articular* or *Regular Gout*. 2. These attacks culminate in obvious chronic changes in the affected joints, with corresponding symptoms—*Chronic Articular Gout*—but even then acute paroxysms are liable to arise from time to time. 3. In connection with the acute attacks, and sometimes preceding them, *general* or *constitutional* symptoms are usually observed; and symptoms belonging to this class become permanent in most cases of chronic gout. 4. When gout affects other organs and structures besides the joints, corresponding symptoms are developed, according to the part implicated. In general terms these may be grouped as cases of so-called *Non-articular, Irregular, Misplaced,* or *Anomalous Gout*; and when such symptoms are acute in their character, affecting some internal organ, and coming on during the course of an attack of acute articular gout, the joint-symptoms at the same time subsiding, this constitutes what is termed *Retrocedent gout.* It is supposed to be due to exposure to cold or other causes checking the articular inflammation, the elimination of uric acid being thus interrupted, so that it accumulates in the system. The symptoms thus grouped together may, however, be conveniently subdivided as follows:—(*a*) Those indicating more or less functional disorder of certain organs, varying much in intensity, and either being constantly present, or only coming on at intervals. (*b*) Those due to acute inflammatory affections of organs. (*c*) Those resulting from the chronic changes in tissues and organs induced by gout, and from the deposit of urates in different parts. Having given this outline, we may now discuss the symptoms of gout in some detail, but it will be convenient in doing so to adopt a somewhat different arrangement from that just sketched.

1. **Premonitory Symptoms.**—There are certain symptoms, of a somewhat indefinite character, and not of any marked intensity, which are often met with in gouty subjects, or even in persons who have never actually suffered from declared gout, but which distinctly depend upon the lithæmic condition. These may be regarded as premonitory symptoms, for they frequently give warning that the gouty condition is in process of development, and if duly recognized, enable the patient so to regulate his mode of living as to ward off the disease. Indeed, it will be found on careful inquiry that gouty phenomena, which may be very marked, are commonly noticed from time to time before the first actual fit of gout occurs, and there may even be suspicious twinges or uncomfortable sensations about the toes or fingers now and then. In a large number of cases, however, no definite premonitory symptoms immediately precede the first gouty paroxysm; but in connection with subsequent paroxysms, prodromata are usually marked, so that confirmed gouty patients can predict when an attack is imminent. As to the nature of these symptoms, they vary in different persons, and this is supposed to depend upon individual predisposition. The most obvious are digestive and hepatic disorders, attended with marked flatulence and eructations, heartburn, acidity, and constipation or diarrhœa, with unhealthy stools, the tongue being often large, flabby, and much furred; palpitation or uncomfortable sensations about the heart; catarrh of the throat and respiratory passages, violent fits of sneezing, or asthmatic attacks; derangements of the nervous system, indicated by a liability to headaches, giddiness, noises in the ears, disorders of vision, marked irritability of temper and fretfulness or lowness of spirits, languor, impairment of mental vigour and intellectual hebetude, heaviness or drowsiness, sleep, however, being restless, disturbed, attended with unpleasant dreams, and often with grinding of the teeth, numbness or tingling in the limbs, especially in the fingers or toes, neuralgia in various parts, twitchings, startings in the limbs, or muscular cramps, especially in the calves of the legs; profuse perspirations; certain skin-affections; and changes in the urine. This excretion usually tends to become high-coloured, deficient, and to deposit lithates abundantly, or even lithic acid crystals, though at the same time the quantity of this acid eliminated within the twenty four hours is below the normal. In advanced cases of gout, however, the urine presents very different characters from those just stated, as will be hereafter pointed out, and when habitually depositing urates, it may become pale, watery, and clear immediately before an acute attack supervenes. Some patients are warned of the approach of a gouty fit by feeling unusually well, both physically and mentally.

2. **Acute Articular Gout.**—It is only with the occurrence of the first acute attack of gout that the disease is usually regarded as established. The paroxysm as a rule comes on during the night, while the patient is asleep in bed, and it is said to commence usually between 2 and 5 A.M. The patient is disturbed out of his sleep by uneasiness or pain, generally referred to the ball of the great toe on one side, and the corresponding joint is found to be inflamed, the inflammation increasing in intensity, until it usually becomes extremely severe. In some instances the corresponding joints on both sides are attacked simultaneously, in rapid succession, or alternately. Although, however, in the majority of cases gout first attacks the metatarso-phalangeal articulation of the great toe, it must not be forgotten that it may start in any of the smaller joints of the foot or hand, or even in the middle-sized joints, especially the knee or ankle. Indeed, exceptional cases have come under the writer's notice, which there was every reason to believe were of a gouty nature, and in which the disease implicated several joints at a very early period of its course, the feet, however, being free. In such instances it may be that there is a true combination of rheumatism and gout.

Proceeding now to notice the clinical characters of the joint-affection, severity of the pain is certainly a striking feature in the majority of cases of acute gout, especially in early attacks. When the foot is affected, any attempt to stand causes much pain from the first, and the suffering speedily increases, until it becomes very intense, in some instances almost unbearable. In character it varies, and is described in different cases as burning, throbbing, aching, tearing, plunging, boring, piercing, &c. The pain prevents sleep during the night, but towards morning it tends to diminish, and during the day there is usually comparative ease, an exacerbation again taking place as evening approaches, which goes on increasing towards night. Tenderness is very marked, and is often so exquisite that the patient dreads to be touched, and cannot bear the least movement or jarring of the affected part, or sometimes even the weight of the bedclothes, or the slightest shaking of the room. The objective signs of inflammation in connection with a gouty joint also soon become very prominent as a rule. These are marked redness, which may be very deep and sometimes tends to lividity, while the veins are often enlarged and turgid; considerable local heat, as evidenced to the touch and by the thermometer; and much swelling, the skin covering the part assuming a tense and shining appearance, or even a considerable extent of the limb being œdematous. When several joints in the foot or hand are affected, diffused redness and swelling are noticed. The tumefaction is not only due to effusion into the interior of the articulation, but also into the surrounding tissues, œdema being a marked feature in connection with gouty inflammation. This can be better appreciated when the acute symptoms subside, so that pressure can be borne, which shows the pitting characteristic of œdema, and this may hold on for some time after the other signs have disappeared. However intense the objective signs of inflammation may be, acute gout never ends in suppuration. As they subside, marked desquamation of the skin usually takes place, which is partly due to the intensity of the inflammation, partly to the œdema, the vitality of the epithelium being thus destroyed. As the swelling increases, the subjective sensations generally diminish in severity; but during the progress towards recovery, intense itching is apt to supervene.

An acute attack of gout is almost always attended with more or less *general* symptoms; but it is an important fact that their severity depends upon the extent and intensity of the local manifestations of the disease, and upon the accompanying symptoms. Chills or even actual rigors may be felt at the outset, followed by febrile phenomena, sometimes slight, in other cases considerable, the pyrexia being as a rule strictly secondary or symptomatic. The skin feels hot, and usually perspires, but not profusely; the temperature is moderately raised, presenting no definite variations, though marked remissions are generally observed towards morning; the pulse is increased in frequency; and the digestive organs are much disordered, as evidenced by anorexia, thirst, furred tongue, and constipation. The urine is generally deficient in quantity, and may be very scanty, high-coloured, and concentrated; its acidity is increased; and on standing an abundant deposit of amorphous lithates often forms, varying in colour according to circumstances, being pale-buff, yellowish-red, dark or brick-red, or intense pink if the fever is high. The relative quantity of uric acid in a particular specimen of urine is often increased, but the absolute amount discharged within the twenty-four hours is much diminished. The patient is usually exceedingly restless, and cannot lie with comfort in any position; sleep is much disturbed or altogether prevented; and cramps of the calves of the legs or of other muscles may still further increase his sufferings. All these symptoms tend to increase the constitutional disorder. The temper is generally very irritable, or may even be violent.

The duration of the first fit of gout varies according to circumstances, such as the severity of the attack, the diet and regimen adopted, and probably the kind of treatment which is employed. It usually ranges from four or five days to a week or ten days, but may last two or three weeks or more, there being then commonly intermissions or remissions, and several joints being involved in succession. The termination of the gouty paroxysm may be attended with critical phenomena, such as free perspiration, diarrhœa, or a very abundant discharge of urates. After the attack the patient may not recover his former state of health for some time; but not uncommonly he feels better than before, and as if the system had got rid of some deleterious element. As a rule the affected joints are apparently quite restored after early attacks of gout; but it must be remembered that even after a single fit they are the seat of permanent morbid changes, and these may be distinctly evidenced by more or less deformity or stiffness. Œdema may also remain for a considerable time, especially if the inflammatory condition has been prolonged.

One of the characteristic features of gout is the tendency which it exhibits to recurrence in its acute form. This may not happen if the patient is sufficiently careful, but such an event is of rare occurrence. The rule is for the attacks to be repeated, and to recur with ever-increasing frequency. In not a few instances the second fit does not occur until an interval of two or three years or more has elapsed, but in most this is not prolonged beyond a year. The same interval may be noticed between the next few paroxysms, but as the disease progresses they return twice a year, then more frequently, and at last become more or less constant. At the same time the mischief extends as regards the joints. It may be limited to the great toe for some time, but in successive fits spreads to the other articulations of the foot, to the hands, the ankles and knees, the wrists and elbows, and occasionally even to the hips and shoulders. In short, gout tends in time to involve nearly all the joints indiscriminately, and several may be implicated during a fit. Moreover, those articulations which are repeatedly attacked become more and more disabled and deformed, until a condition of chronic gout is set up. The symptoms in connection with a particular joint tend to diminish in intensity the more often it is affected. As additional articulations become involved, however—and many may be implicated at the same time—the general symptoms often increase in severity, and the patient does not recover in the intervals. The duration of the attacks becomes longer as their frequency increases. The rapidity of the progress of gout is very different in different cases; and the time taken to produce permanent mischief in the joints varies considerably.

It must be borne in mind that variations in the intensity and exact characters of the symptoms of acute gout are observed in some cases.

In feeble persons the subjective and objective symptoms may be comparatively slight, the inflammation assuming an asthenic character, but then the ultimate effects upon the joints are often much worse. Again, the pain in connection with a particular joint depends considerably on its structure, being usually much more marked if its ligaments, or the parts around, are rigid and unyielding. Previous injury or disease affecting a joint may likewise modify the symptoms. Some individuals suffer much more than others, being more susceptible of painful impressions.

3. **Chronic Articular Gout.**—In course of time more and more of the joints become permanently and obviously changed, and prevented from fulfilling their functions properly, so that a condition of chronic articular gout is established, exacerbations still occurring, however—indeed with much greater frequency—but being much less acute in their intensity than in the early stages of the disease, and longer in duration. It need hardly be remarked that there is no distinct line of demarcation between acute and chronic gout. The hands are particularly liable to be much altered by the effects of gouty inflammation. The permanent changes are indicated by the articulations becoming enlarged, deformed, and irregular in shape, often presenting nodulations or bulgings, which may attain a large size, owing to the abundance of the deposited urates. They are also stiff and crippled in their movements, at last becoming quite immovable and rigid, or even completely anchylosed; and being either permanently flexed, extended, or sometimes even bent backwards. The interference with movement and the deformity do not bear any necessary proportion to each other, the one or the other predominating according to the mode in which the deposit of urate of soda has taken place. The more this infiltrates the ligaments and surrounding tendons, the greater becomes the impediment to movement. Gouty concretions in connection with joints feel hard, and by their mere mechanical and irritative effects they are liable to cause damage to the adjoining structures. They may be seen stretching or shining through the skin, and causing it to assume a bloodless appearance, or, on the other hand, rendering it congested and bluish, the veins also being enlarged. Ultimately a gouty abscess may form around the concretions, which opens externally; or the skin may merely give way from the continued pressure. Thus the *chalk-stones* are exposed, and come away either in a liquid form or as solid particles or masses, or occasionally there is a free discharge of pus as well. Ulcers are left, of an unhealthy and atonic character, and usually presenting no disposition to heal. There may be a number of these ulcers in the same individual, on the hands and feet. When bursæ are involved, much deformity is produced. They are easily felt, usually presenting a combination of hardness and fluctuation, due to the presence of concretions and of fluid in the bursal cavity. These signs are chiefly noticed in the bursa over the olecranon. Abscesses may also form in connection with these deposits, and the latter may thus be completely got rid of, the abscess subsequently healing rapidly.

In cases of chronic articular gout the general system necessarily tends to become affected. The patients are generally more or less feeble and wanting in tone; they may be thin and pale or sallow-looking; or plethoric, but with flabby tissues, and presenting signs of languid circulation, with enlarged capillaries about the face. They often suffer from disorders of digestion and other symptoms already described; but not uncommonly, as gout assumes a more chronic form, patients feel better, becoming habituated to the morbid condition of the blood. It is remarkable that those suffering from numerous gouty abscesses often exhibit but little general disturbance, probably because the system is thus rid of the morbid materials. The urine in chronic gout generally becomes abundant, very watery and pale, of low specific gravity, deficient in solid ingredients, especially in uric acid, which at times may be almost completely wanting, or it may be thrown out in an intermittent manner. Deposits of urates are not often observed in cases of advanced chronic gout, except perhaps before the occurrence of an acute exacerbation.

4. **Irregular Gout.**—The clinical phenomena which are recognised as irregular manifestations of gout may assume either an acute or chronic form. They may be observed in persons who are distinctly subject to articular gout; or in those in whom the disease is not so obviously revealed. Moreover, their intensity is often in an inverse ratio to that of the joint-affection, and the two classes of symptoms may exhibit a remarkable tendency to alternation, when the articular symptoms are prominent those connected with other parts being slight or absent, and *vice versâ*. This may be noticed with both acute and chronic symptoms, and the former are particularly liable to arise when, from any cause, during the progress of a gouty fit the joint-inflammation is suppressed suddenly or rapidly—*retrocedent gout*. At other times the internal symptoms seem to be due to a want of development of the external phenomena—*suppressed gout*, and when the latter appear, the former subside.

It must suffice to indicate here the general nature of the symptoms of irregular gout. The acute symptoms are mainly associated either with the alimentary canal, the vascular system, the respiratory organs, or the nervous system. In connection with the alimentary canal, acute dysphagia may occur, attended with spasm of the pharynx and œsophagus. The most important symptoms belonging to this group are, however, those due to some gastric disturbance. This may be of the nature of severe cramp or gastralgia, characterised by a sudden, acute, spasmodic pain in the epigastrium, relieved by pressure, and accompanied with a sense of great weight and oppression; the patient presenting an aspect of much suffering, distress, and anxiety; or being even more or less collapsed and prostrated. In other cases the symptoms are those of acute gastritis, bilious vomiting being prominent. Intestinal colic, or even muco-enteritis, may also occur in connection with gout. The vascular system is not uncommonly implicated. The heart is liable to be disturbed in its action during the attacks of gastralgia, but this disturbance may also be observed independently. It is usually of nervous origin, and may be evidenced in various ways. Thus there may be severe palpitation, the action of the heart being very rapid, irregular, or even intermittent, this being accompanied with most unpleasant sensations over the cardiac region, præcordial anxiety, often a feeling of oppression or constriction, dyspnœa or a sense of suffocation, and much distress, anxiety, and dread of death; the pulse tends to be weak and small, or may be irregular; sometimes the attacks are attended with signs of collapse. In other instances the cardiac disorder is evidenced by very feeble or slow action, with a tendency to syncope. Again, there may be all the phenomena of a severe anginal attack, this probably partly depending upon the circulation in the vessels being impeded. It must be once more noted here that there is no true gouty acute inflammation connected with the heart, although certain chronic changes sometimes observed at *post-mortem* examinations have been attributed to such a condition. Irregular gout affecting the respiratory system is mainly indicated by asthmatic attacks. In some cases there is a marked liability to acute catarrh of the air-passages. Pulmonary congestion is also supposed to be a manifestation of retrocedent gout in some cases, but there is no such special disease as gouty pneumonia. In connection with the nervous system gout may give rise to attacks of severe headache; delirium or even acute mania; epileptiform fits; cerebral or spinal meningitis; acute neuralgia, either external or internal, and especially sciatica, probably due to neuritis; or severe muscular cramps. Apoplexy from cerebral hæmorrhage has been often attributed to suppressed or retrocedent gout, and if the vessels of the brain are diseased, it is possible that there may be some connection between them. Cerebral congestion might also occur in gout, and give rise to a temporary apoplectic attack. Among the acute forms of irregular gout are, for example, skin-affections, eczema, erythema, or urticaria; affections of mucous membranes, such as the conjunctivæ and lachrymal passages; functional renal disorder, with albuminuria, or irritability of the bladder; and local signs of inflammation, associated with the deposit of urates.

Many of the more chronic symptoms associated with gout have already been pointed out, when speaking of its premonitory symptoms, and only certain phenomena need be alluded to here. Chronic skin-diseases are of frequent occurrence, namely, psoriasis, chronic eczema, prurigo, either local or general, and acne. These may alternate very distinctly with articular gout, and they are often intensified by causes which increase the lithæmic condition. In some gouty subjects daily paroxysms of heat and redness of the nose, attended with severe itching and irritation, cause considerable annoyance or distress. Many of these individuals are also liable to chronic catarrh, affecting the throat and the air-passages; and in time they often become permanently asthmatic, the lungs being emphysematous, and dry bronchial catarrh being established. Gravel or urinary calculus gives rise to symptoms referred to the urinary organs; and those indicative of chronic urethritis or cystitis may be present, especially in persons advanced in years. Permanent disorders of sensation, or slight local paralysis may be observed in gout, owing to chronic changes involving particular nerves. Gouty persons are usually very sensitive to pain. Tophi can be seen or felt, provided they are superficial. Those connected with the helix of the external ear are most common; but they should also be looked for in the sclerotic or eyelids, in the nose, and under the skin, in the region of tendinous aponeuroses, especially in the leg or thigh. The writer had the opportunity of observing a case in which an extensive formation of urates occurred in the outer part of the thigh, apparently associated with the fascia lata. These gouty concretions are originally liquid, and if one is punctured at an early period, an opalescent or milky fluid escapes, which on microscopic examination is found to contain an abundance of delicate, acicular crystals; subsequently they become more consistent, and ultimately quite solid and hard, being then made up entirely of these crystals, which are closely aggregated together and interlaced. Taking the ear as an illustration, at first a small elevation appears under the skin of the helix, like a vesicle, having a soft feel. This gradually hardens, until finally a little bead-like or pearl-like body is formed, presenting a whitish colour as seen through the skin. In course of time the cutaneous covering may be destroyed, leaving the little chalk-stone exposed; or this may even become detached, so that only a small depression is left.

5. Symptoms due to chronic organic diseases.—In addition to what has been stated under the preceding heading, it is desirable just to notice separately certain diseases of organs which may be associated with the gouty diathesis. Disease of the kidney is indicated mainly by the changes in the urine, which may be slightly albuminous, or even contain a few casts. Other symptoms of chronic Bright's disease may be present, but it must be remembered that in the form of renal disease associated with gout the symptoms are often very obscure. The chronic cardiac diseases observed in gout are revealed mainly by their respective physical signs; and there may be symptoms, first of excessive cardiac action from hypertrophy, and subsequently of cardiac failure. The vascular changes are evidenced by examination of the arteries; and by their effects upon the circulation. Fatty liver can only be discovered by physical examination.

DIAGNOSIS.—The degree of difficulty experienced in arriving at a diagnosis with respect to gout, is very variable in different cases, whether in definitely fixing upon this disease, or in distinguishing it from other affections. Often the diagnosis is perfectly clear, but in some instances it may be extremely difficult to form a positive opinion. It must be remembered that there may be a distinct gouty diathesis present, and symptoms resulting therefrom may arise, which it is important to recognise, while the joints are quite free from any apparent mischief. It is also desirable to be able to make out any tendency to the development of this diathesis. In most cases, however, the diagnosis has to deal with the nature of an articular affection, and to determine whether this is gouty or not. The chief diseases from which gout has thus to be distinguished are acute or chronic rheumatism, and rheumatoid arthritis. The data upon which a conclusion has usually to be formed with regard to a first attack, are the presence or absence of a hereditary tendency to gout, as well as its intensity; the age and sex of the patient; his social position, occupation, and previous habits; the presence or absence of any obvious cause for the attack, or of premonitory symptoms; the localisation and characters of the joint-affection; the general symptoms; the characters of the urine; the duration of the illness; and the condition of the heart. These different points have already been sufficiently discussed in their relation to gout, but the distinctions presented by acute rheumatism may be briefly indicated. The absence of any hereditary tendency to gout in any doubtful case may be in favour of rheumatism, and possibly this complaint may be hereditary. It occurs most frequently for the first time in early life, from sixteen to twenty years of age, and is not uncommon even in young children. Rheumatism, though more common among males, often attacks females. This complaint is not favoured by the habits which generate or promote gout, and affects all classes of persons, but especially those who from their occupation are liable to be exposed to cold and wet. Such exposure, or some other definite cause originating 'a cold,' usually accounts for an attack of acute rheumatism, and it is not preceded by any particular premonitory symptoms. The joints involved are the middle-sized or the larger ones, several of which are generally implicated in succession during the illness, the rheumatic inflammation exhibiting an erratic character; the local symptoms tend to be less severe than in gout; there is less marked œdema about the joints, and no enlargement of the veins or subsequent desquamation are observed. It must not be overlooked, however, that gout may attack the middle-sized joints. Pyrexia is high as a rule, and is often quite out of proportion to the extent of the articular affection; while profuse acid perspiration is almost always a prominent phenomenon. The urine is simply febrile. The attack lasts a considerable time, perhaps several weeks, if it is at all severe; while during its course some acute cardiac inflammation is liable to supervene. and this may happen even when the joint-affection is but slight. The subsequent progress of gout is important in diagnosis, for its tendency to periodic recurrence is a marked feature in its history, and if the metatarso-phalangeal joint of the great toe is alone inflamed several times in succession, or even if only the smaller joints of the feet and hands are implicated, the diagnosis of gout is tolerably certain. The permanent articular changes induced by gout also become evident in time; as well as, perhaps, tophi in other parts, which should be carefully searched for in any doubtful case, especially in connection with the external ear, the nose, and bursæ. Moreover, the urine presents peculiar changes as the disease progresses, and may give evidence of renal mischief. In very doubtful cases it might be desirable to raise a blister, or even to take a little blood from the patient, and endeavour to obtain crystals of uric acid from the serum.

Rheumatoid arthritis is usually met with in females between twenty and forty years old. There is no hereditary taint, or a history of any such habits as generate gout, but, on the contrary, the patients are generally poor, hard-worked, and badly-fed, and consequently weak and wanting in tone; all joints seem to be equally liable to be affected, both large and small, and the symptoms are not of a very acute character, though the pain may be very severe, but they tend to continue for a long period; the general symptoms are mainly those of debility and anæmia. Rheumatoid arthritis is a disease which tends to progress, involving joint after joint, but it presents no periodicity in its attacks, and often advances without any intermission, as a subacute or chronic disease. Ultimately it often causes much deformity and crippling of the articulations, but this results from a very different pathological change from that which takes place in gout, for there is not the slightest deposit of urates, either in the joints or elsewhere; nor in the most extreme cases can any uric acid be obtained from the serum. The urine presents no special characters; and the kidneys are not diseased.

As exceptional points bearing upon the diagnosis of gout in joints, the following may be mentioned. It has happened that pyæmia beginning in the great toe has been mistaken for gout, but the progress of the case would soon clear up any doubt under such circumstances. Again, articular inflammation from injury might resemble gout; and, moreover, it must be borne in mind that such an injury may really set up gouty inflammation for the first time, so that the joint may not recover properly. In some individuals the ends of the phalanges of the fingers are enlarged, especially terminal ones, and cause nodulations—*digitorum nodi*—which resemble those of gout, and are by some regarded as being of a gouty nature.

The importance of recognising the signs of the gouty diathesis, apart from the joint-affection, has already been alluded to. Equally important is it to be prepared for the acute symptoms in connection with internal organs which occur in this diathesis, whether along with or independent of articular disease. Lastly, in any gouty case the detection of the organic diseases liable to be set up in its course is of great moment in diagnosis, especially renal disease; and also the association with their proper cause of catarrhal affections, skin-diseases, and other complaints, when these are due to gout.

Prognosis.—The first point relating to the prognosis of gout which calls for notice refers to the immediate dangers in any particular case. A simple acute attack of articular gout rarely, if ever, kills the patient. When, however, internal organs are implicated, the matter becomes much more serious, and a fatal result may occur, so that the prognosis must be a guarded one under such circumstances. The danger then becomes much greater if the complaint has been long-established, and if the kidneys or other organs have become structurally diseased. Indeed these diseases of organs themselves are attended with grave dangers, and may give rise to fatal consequences at any time. Again, any acute inflammation occurring in a confirmed gouty subject is the more serious on this account; and the same remark applies to injuries and shocks of all kinds, so that in such cases the prognosis is less favourable than it otherwise would be.

In the next place the future of a gouty patient has to be considered, as regards the prevention of subsequent attacks, or, indeed, the cure and eradication of the disease. It must always be recognised that gout is a recurrent affection, and complete immunity can never be guaranteed, once the complaint has declared itself. At the same time undoubtedly not a few cases have occurred in which there has been but one attack, but this can only be expected under certain conditions. In giving an opinion on this point, the prognosis in any individual case will depend upon:—1. The degree of hereditary tendency to gout. 2. The age of the patient; for the earlier the period at which the disease begins, the less hopeful is the prospect of a cure. 3. The time the complaint has lasted from its commencement; and the frequency and duration of the gouty fits. If gout has become established, and especially if distinct chalk-stones have formed, it is quite impossible to eradicate it. 4. The habits, mode of living, and occupation of the patient. It is only when the patient is prepared to adhere strictly to proper rules of living that a cure can be hoped for. Those who in their occupation are liable to drink much, or who are exposed to cold or wet, are less likely to be cured. It may be remarked here that gouty subjects are less able than others to resist exposure.

Another point bearing upon prognosis refers to the duration of life in gouty persons. If the disease comes on late in life, and the paroxysms only occur at long intervals, while the organs are free from any organic mischief, gout may not appreciably shorten life, and the patients may even enjoy good health up to an extreme old age, provided they are sufficiently careful in their mode of living, and no accidental complications arise. Chronic gout unquestionably does tend to shorten the duration of life, to a greater or less degree in proportion to its severity, and more especially to the indications present that the kidneys, heart, or other important organs are organically diseased. This tendency is now recognised by most life-insurance companies.

It has been supposed that gout is a protection against certain other diseases, such as phthisis and diabetes, and therefore its presence has been in some instances regarded as a benefit, but how far there is any real foundation for this belief is a matter of considerable doubt.

TREATMENT.—It is important at the outset to lay stress upon the fact that, although there are certain well-defined principles applicable to the treatment of gout in its various phases, it is a great mistake to follow a regular routine method under all circumstances, and every case must be considered on its own merits, both as regards the patient himself and his surroundings. It will be convenient to discuss this subject under certain general headings, premising that the administration of medicines is often the least important part of the treatment, and that the habits of life of the patient always need thorough supervision in all their details.

1. **Preventive and Curative Treatment.**—In a number of cases the primary object which should be aimed at is to prevent the development of gout; or to eradicate the tendency to subsequent attacks, if it has once declared itself, and to rid the system of the conditions which induce this complaint. These objects have especially to be kept in view in dealing with individuals who have a marked hereditary predisposition to gout; in cases where it has appeared at a comparatively early period of life, whether as a hereditary or acquired complaint, or where it is in an early stage; and in persons who, from their occupation, known habits, or the symptoms they present, are likely to become gouty. Moreover, even when confirmed gout has been established, preventive treatment may be carried out, with the view of diminishing the number of acute attacks, or even possibly of averting them altogether; and of obviating the implication of organs essential to the well-being of the economy. In order to carry out these objects in any particular case, the patient must intelligently recognise the fact that success in treatment mainly depends upon himself, and upon his willingness constantly to regulate his mode of living according to principles suitable to his condition, which need to be more or less strict in different instances. The general nature of the rules to be adopted will be evident from a consideration of what has been stated in discussing the ætiology and pathology of gout, but they require to be briefly noticed here. The ends sought in carrying out these rules are to prevent an undue formation of urates in the system; to maintain the digestive and assimilative organs in a condition of healthy activity; and to promote the elimination of urates by the kidneys, especially if at any time there appears to be a tendency to their accumulation in the body.

(*a*) *Diet.*—Moderation in the quantity of food is the first point to be attended to in the treatment of the gouty diathesis. It is not necessary or desirable to restrict persons who are gouty to a very low diet, as is sometimes done, especially if they are in any way weak, but an amount sufficient for proper nourishment in each individual case must be consumed, and at no meal should the stomach be uncomfortably filled. The meals must be taken at regular times, and not hurriedly, so as to avoid bolting of the food. Very late dinners, as well as suppers, should be prohibited, but it suits many persons better to dine at six or half-past six o'clock than at midday. The nature of the food is highly important. It is quite unnecessary, and probably would be in most instances injurious, to restrict the patient to a vegetable diet, but a due proportion of animal and vegetable substances should be allowed. At the same time, in persons who have any tendency to gout, an essential part of the treatment often consists in diminishing the amount of meat which they consume, this being far in excess of what is needed, or can be got rid of by the system without injuring it. Indeed, the aim must be to reduce all kinds of nitrogenized food, whether animal or vegetable, to such an amount as the system can satisfactorily dispose of, due regard being had to the proper nutrition and strength of the body, and thus to diminish the waste-products resulting therefrom. As regards the kinds of animal food which are suitable for gouty subjects, white fish, chicken or fowl, game, and mutton are the best forms. Tender and underdone beef may be taken in moderation from time to time. Pork or veal, dried and salted meats, and rich dishes of all kinds, had better be avoided. Such vegetables should be partaken of as are known to be digestible, but those which contain much woody fibre, or which create flatulence, must not be indulged in. There is a notion that celery is beneficial in gouty cases, and the writer has recently met with an intelligent person, who has long been a martyr to gout, and he strenuously affirms that he has derived much benefit from taking celery freely, both in an uncooked form and stewed. Gouty subjects should either abstain altogether from, or only take a very limited quantity of, sugar and saccharine articles of diet. Hence, although digestible fruits may often be taken with advantage in moderation, those which are very sweet must be used with particular caution. Stewed and baked fruits often agree well, but fruit-tarts, and, indeed, pastry of all kinds, should be interdicted. The juice of oranges or lemons is considered beneficial for gouty persons, and perhaps with good reason. It may be laid down as a rule to be invariably followed, that such persons should always limit themselves to simple meals, and not indulge in a number of courses; and that they should avoid everything which their experience tells them is, in their case, indigestible. It has been recommended that salt should be avoided by gouty subjects, so as not to add sodium to the system, for combination with uric acid.

(*b*) *Drink.*—The question of drink demands the most careful consideration and attention in every case in which gout is either threatened or has become established. It may be affirmed that no strict rules can be laid down, applicable to all cases, but there are certain broad principles which have to be borne in mind. An abundance of good and pure drinking-water is to be commended, but it should be taken mainly between meals. It is a good plan for the subjects of lithiasis to take a tumblerful of water before retiring to rest at night. Effervescing potass- or lithia-water may be substituted for ordinary water with advantage, the dissolved salts forming soluble compounds with uric acid, but soda-water must be avoided. Tea and coffee may be taken in moderation, provided they do not disagree. With reference to alcoholic drinks, in a considerable number of instances one of the first objects in the treatment of the gouty diathesis should be the regulation of the use of this class of beverages. This indication is obvious enough when the condition is evidently due mainly to excessive indulgence in these beverages; but even when the patient is temperate, it may be that in his case the amount consumed needs to be reduced or total abstinence enforced, especially if there should be a strong hereditary predisposition to gout, or if the complaint appears in early life. Some patients are undoubtedly better if they take no stimulants whatever; others, however, can take proper kinds in moderation with advantage. It may be laid down as a general rule that malt liquors and all stronger wines are injurious, and should be interdicted. Those which are most suitable are good claret, hock, moselle, chablis, or sauterne. Even these must, however, be only indulged in in strict moderation. A small quantity of good dry sherry suits some gouty patients very well. A little brandy, well-diluted, often agrees better than any other kind of alcoholic liquor; or in some cases whisky or gin may be substituted. Whatever stimulant is selected, it should only be taken at meal-times, and the habit of drinking between meals is strongly to be deprecated. Persons who are distinctly gouty should avoid any excess on every occasion; and even if they do not absolutely abstain, they may find it beneficial to do so from time to time, especially if there should be an abundant deposit of lithates in the urine, or if symptoms should occur which the patient recognises as being of a gouty nature. It is highly important that any alcoholic drink employed by gouty subjects should be sound and of good quality. There can be no doubt but that due attendance to the rules just sketched will prevent the development of gout where it is threatened, and will also check its progress, and avert the occurrence of acute attacks. The difficulty is to persuade patients to carry them out properly.

(*c*) *General hygiene.*—Inadequate exercise is a hygienic error which has frequently to be rectified in the treatment of the gouty state. Sedentary habits must be combated, whether due to the occupation or to indolence; and it must be insisted upon that a due amount of out-door exercise is taken daily, though violent exertion, tending to cause fatigue and exhaustion, must be avoided. Walking and horse-exercise are highly beneficial, especially in the case of those who live rather too freely. Even carriage-exercise is useful, so that the patient may have the benefit of the fresh air. General active habits should be encouraged, and any disposition to undue luxuriousness in the mode of living checked. The patient should retire to rest and get up early. Another point of importance, more particularly with reference to the vocation of the patient, whether professional or other, is that he should as much as possible avoid excessive mental labour, or any great strain upon the mental faculties, but especially worry and anxiety of all kinds. The writer has at present under observation a case in which the influence of these causes in bringing out eczema and other irregular symptoms of gout is strikingly illustrated. It is also important to pay attention to the cutaneous functions, and to protect the surface of the body from the injurious effects of cold. Warm clothing should be worn, in keeping with the weather, and those who can bear it may wear flannel next the skin. With regard to baths, many persons are decidedly the better for using a cold or tepid bath every morning, followed by energetic friction; in other cases the employment of the warm bath at proper intervals, or even of the Turkish bath, answers best. It is certainly beneficial in some instances, either for those who are already afflicted, or those who are threatened with gout, to go through a course of treatment in a hydropathic establishment from time to time, under due medical supervision. Climate demands attention, whenever the circumstances of the patient allow a choice to be made. It may be advisable for gouty patients to reside permanently in some warm and equable climate, or at any rate during the winter and early spring. In this way attacks may often be warded off, and the disease thus prevented from making progress. Those who are obliged to remain in this climate during the inclement seasons should avoid exposure to wet and cold, as well as sudden changes of temperature, and night air. Their bedrooms should be warm and well-ventilated; and during cold weather it may be desirable to keep a small fire burning during the night. Heated and badly-ventilated rooms, as well as crowded places of public resort, must be eschewed.

(*d*) *Medicinal treatment.*—There can be no doubt but that the judicious use of certain medicines may assist materially in warding off or mitigating the gouty condition, and in preventing the occurrence of acute paroxysms. Those which are specially called for in cases of established chronic gout will be presently considered. In the meantime, it may be stated that the digestive functions require particular attention, and medicines which promote these functions are often of the greatest service, if they should be disordered, and especially if there should be a tendency to undue formation of acids in the stomach. A course of alkalies or acids, according to the indications in each case, may prove most serviceable, combined with some simple bitter infusion or tincture. Certain alkalies and alkaline earths are also valuable on account of their power in promoting elimination of lithic acid, by forming soluble salts with this acid, which pass away in the urine, and some of them probably act beneficially in other ways. Those which are most useful for this purpose are salts of potash and lithia, but some practitioners prefer magnesia or lime. The best alkaline salts are the citrate or carbonate, or bromide of lithium may be employed, the urate of lithia being the most soluble of all. Soda-salts should not be used, except when it is desired merely to influence the digestive functions. Either of the salts above-mentioned may be employed from time to time, and they must be taken well-diluted, and on an empty stomach. Magnesia or its carbonate may be given with advantage if there is much acidity, and if the bowels are habitually constipated. Saline aperients are often of great service, and they may be beneficially administered in small doses, freely diluted, and regularly repeated, when they also act on the other excreting organs. In many cases other aperients may be employed at intervals with advantage, but strong purgatives must only be used with much caution, and this especially applies to mercurial preparations, which, if taken too freely, may prove highly injurious to patients who have any tendency to gout. The administration of cholagogues from time to time may be of considerable service. Medicines may be given to assist the action of the skin, if this should be defective, such as liquor ammoniæ acetatis.

(*e*) *Mineral Waters and Baths.* — Certain mineral waters are of the greatest value in the treatment of the gouty diathesis, and they offer the advantage that patients will often use them, habitually or at intervals, when they will not undergo a course of regular medicinal treatment; while the water thus taken internally is itself of service. Many of these agents must, however, be employed only under proper medical supervision, otherwise they may do considerable harm. Space will not permit any lengthy discussion of this subject here, and it must suffice to mention that in different cases the kind of mineral water employed must be varied according to the object desired to be accomplished, and according to the indications presented by the patient, for what suits one may be highly injurious to another. These waters are employed both internally and in the form of baths, some of them belonging to the class of thermal waters. Those chiefly used in gouty conditions are the waters of Bath, Buxton, Harrogate, Leamington, and Cheltenham in this country; Strathpeffer and Moffat in Scotland; and Carlsbad, Vichy, Wiesbaden, Baden-Baden, Ems, Royat, Aix-la-Chapelle, Aix-les Bains, Friedrichshall, Hunyadi Jânos, Pullna, Seidlitz, Homburg, Kissingen, Wildbad, Ragatz, Gastein, Elster, Tarasp, Apollinaris, and similar waters from foreign countries. Some of these may be taken regularly or at intervals, for the purposes which they respectively fulfil; or if circumstances permit, a systematic course of treatment from time to time, at certain of the places mentioned, may be recommended. *See* MINERAL WATERS.

Before leaving the subject of the preventive treatment of gout, it needs to be insisted upon that those who are particularly liable to this disease, whether from their occupation or any other cause, should pay special attention to preventive measures; and also that those in whom the disease has already manifested itself must take every precaution to avoid the known causes of acute attacks, for each attack tends to make matters worse.

2. **Treatment of Acute Gout.**—When a fit of acute articular gout sets in, it is on no account to be permitted to run its course unmodified by treatment, else serious mischief is liable to arise. At the same time it is requisite to refrain from adopting too active measures. Our objects should be to shorten the attack; to restore the affected parts to their normal condition; and to relieve symptoms. In the first place, attention must be paid to the *diet*. The aim should be to make this as low as is compatible with the condition of the patient, especially if the attack presents an acute and sthenic type. In young and strong patients the diet should at first consist of farinaceous substances, a little milk, and abundance of water, barley-water, or toast-and-water. Those who are advanced in years, weak, or broken-down in health, or who have long suffered from gout,

require a more nutritious diet, but it should be easily digestible, consisting of beef-tea and good soups, milk, eggs beaten up, and such articles, the quantities being regulated by the requirements of each case. As the symptoms subside, the food must be gradually improved, fish, fowl, and meat being allowed in succession, but in strict moderation, and due care must be exercised subsequently. If possible, all kinds of alcoholic stimulants should be interdicted, but it may not be desirable to cut them off entirely in some cases, either on account of the previous habits or present condition of the patient, and then it is best to give a definite quantity of brandy or whisky, well-diluted, with the food. For those who cannot take spirits, the writer has found a little good hock or sauterne answer well.

As regards *medicinal* agents, colchicum has long held the most prominent place in the treatment of acute gout, and is regarded almost as a specific. There can be no doubt as to the influence of this drug in relieving the inflammatory symptoms, and shortening the paroxysms of gout, although it is by no means settled how it acts. Its effects must be watched, however, for it does not agree in every case. It has been alleged that colchicum renders the patient more liable to subsequent attacks of gout, but for this notion there does not seem to be any real foundation. The tincture or wine of colchicum may be given in doses of ten to twenty or even twenty-five minims every four or six hours, and either of these may be combined with the citrate or carbonate of potash or lithia, these salts being also of great service in the treatment of acute gout. It is necessary to keep the bowels acting freely by means of suitable aperients, and saline purgatives are of considerable value for this purpose. Other aperients, such as compound rhubarb pill, colocynth, podophyllin, or even calomel or blue pill, may be employed in appropriate cases. Diluents may be given freely, in order to promote the action of the kidneys; and if the cutaneous functions appear to be defective, some mild diaphoretic may be administered, or it may even be desirable to employ the hot-air or vapour-bath. Medicines may be needed for the relief of symptoms, especially pain and sleeplessness, for which Dover's powder or other preparations of opium, chloral, or bromide of potassium may be indicated. In very severe cases hypodermic injection of morphia is of much service.

Venesection ought never to be practised in the treatment of acute articular gout; for although immediate improvement may perhaps be thus produced, the ultimate results are highly unsatisfactory. Even the local removal of blood, by means of leeches applied near an affected joint, is dangerous, and had better be avoided, on account of the permanent local mischief which such a measure is liable to induce.

Local treatment.—The affected parts in acute gout should be kept entirely at rest, and placed in a comfortable position, supported by pillows, and either horizontal or elevated, according to the feelings of the patient. In ordinary cases it is sufficient to wrap up the joints in flannel, or to surround them with cotton-wool completely covered with oil-silk or other impervious material, by which means a kind of local vapour-bath is kept up. If the pain is considerable, local applications must be used, of which the most useful are warm fomentations, to which tincture of opium or belladonna may be added, poppy fomentations, localised steaming, belladonna liniment, tincture of aconite, oleate of morphia, or a solution containing morphia and atropine. Those last-mentioned may be smeared or painted over the surface, or applied by means of lint covered with oil-silk. A blister in the neighbourhood of a gouty joint may be of service, if the attack be asthenic, and also if effusion or much stiffness remain. During recovery, benefit may be derived from careful friction with some stimulating liniment, shampooing, gentle passive movements, douching with salt and water, or the application of a light bandage or elastic support, should there be a tendency to permanent thickening and stiffness, or to œdema and enlargement of the veins.

The acute forms of *irregular gout* must be treated according to their nature, and here it must suffice to offer a few general remarks on the subject. If serious internal symptoms arise, which are distinctly of a gouty nature, and especially if they occur as retrocedent phenomena, it is important to try to excite inflammation in the joints, by means of local heat, friction, and sinapisms. Colchicum may be of service in the non-articular, as well as in the articular form of gout. In painful affections opium or other anodynes are called for; and frequently the administration of alcoholic and other stimulants is indicated, with anti-spasmodics, such as ammonia, ethers, camphor, musk, or belladonna, especially when the stomach or heart is affected. In conditions attended with signs of much depression or collapse, external heat may be applied over the body, or sinapisms to the limbs and over the cardiac region. In the treatment of inflammatory diseases associated with gout much care is required, especially in resorting to depletory measures. The existence of the diathesis must always be borne in mind.

3. **Treatment of Chronic Gout.**—When gout becomes an established chronic disease, the same general rules of treatment are to be observed as in the prevention or attempted cure of the complaint, but they often need modification in particular cases, according to the conditions present. Similar medicines are also indicated, and lithia is particularly valuable, and may even aid in removing gouty deposits; but others may be added to the list, which are suitable in different cases. Thus, colchicum is often of much service, taken habitually or from time to time, in the form of extract at night, or a few minims of tincture or wine two or three times a day, combined with other medicines. Among the many therapeutic agents employed in the treatment of chronic gout under different circumstances may be mentioned benzoic acid or benzoate of ammonia, phosphate of ammonia, phosphate of soda, iodide of potassium, bromide of potassium, carbonate of alumina, lime-juice, guaiacum, ammoniacum, and tonics, especially quinine, tincture or infusion of cinchona, or mild ferruginous

preparations. Undoubtedly most of these are of use in appropriate cases of chronic gout, to serve their special purposes. Symptoms connected with various organs frequently call for attention in this disease, and they must be treated by appropriate remedies. It may be remarked that if diarrhœa should set in in gouty cases, it should not be hastily arrested, as this may be a mode of relief to the system. With regard to the local conditions in chronic gout, it is affirmed that the prolonged use of some of the mineral waters previously mentioned, both internally and in the form of baths, such as those of Aix-la-Chapelle, Aix-les-Bains, and Baden-Baden, may succeed in removing to some extent deposits of urates, and in diminishing stiffness and thickening of joints. For these purposes local measures may also be of service in some instances, provided the morbid changes are not too far advanced, namely, occasional blistering or application of iodine; the prolonged use of wet bandages; friction with liniments; shampooing and passive movements; or systematic compression by means of some plaster. Solutions of alkalies or alkaline carbonates, and especially of carbonate of lithia, have been kept applied to gouty joints and other parts for a long time, under the belief that deposits of urates may be thus dissolved. In the writer's experience no such effect has ever been thus produced, although the constant application of moisture may be useful. Superficial accumulations of urates should not be interfered with unless they become troublesome, when it may be desirable to puncture the skin, and let the contents out. The propriety of removing large masses by operation may come up for consideration, but this should only be attempted if there is every probability that they can be entirely removed without any difficulty, and if the patient is in a fit state for the operation. When abscesses or ulcers form, they come under the treatment of the surgeon; but it may be observed that simple dressings usually answer best in these cases, and they may sometimes be advantageously dressed with solution of carbonate of potash or lithia. It must not be attempted to heal them up too rapidly, as the discharge may be a relief to the system, and it may even be necessary to enlarge the opening of an abscess. Under any treatment it is by no means an easy matter to induce gouty sores to heal.

The treatment of the various chronic organic diseases which are liable to arise in the course of gout must always be kept in mind, but the reader is referred to other appropriate articles for a consideration of this part of the subject.

Frederick T. Roberts.

GRAND MAL. (Fr.)—A term applied to epilepsy when it assumes the form of a severe convulsive attack. *See* Epilepsy.

GRANULAR KIDNEY.—A morbid condition of the kidney, in which this organ is the seat of fibroid change, and as a result becomes contracted, hard, and granular. *See* Bright's Disease.

GRANULAR LIVER.—A synonym for cirrhosis of the liver, in which the organ presents a granular appearance, on its surface and on section. *See* Liver, Diseases of.

GRANULATION (*granulum*, a little grain). In medical pathology, granulation is synonymous with tubercle in its isolated form, the individual tubercles being called 'grey' or 'yellow' granulations, according to their appearance. *See* Tubercle. In surgical pathology, the term granulations is applied to small vascular prominences, consisting of embryonic tissue, growing on the surface of wounds or ulcers, and by which the healing process is carried on—whence the expression 'healing by granulation.' When granulations assume the appearance of an exuberant growth they constitute what is called 'proud flesh' (*see* Cicatrization, and Ulcer.)

GRANULIE (French).—A synonym for tuberculosis. *See* Tuberculosis.

GRAVEDO, (*gravis*, heavy).—A synonym for common catarrh; so applied on account of the sensation of weight in the head present in that affection. *See* Catarrh.

GRAVEL. — Definition. — The deposit in, and escape from the urinary passages of gritty particles with the urine.

Ætiology.—The same causes which produce dyspepsia are frequently productive of lithic acid gravel, such as indolent habits, excess of food and drink—especially of nitrogenous and saccharine articles, and the too free indulgence in the use of fermented liquors. Endemic causes connected with climate and the nature of the drinking water, hereditary predisposition, and many slight or serious organic diseases, may explain the appearance of gravel in those, and especially in women, who commit no dietetic excess, or who are total abstainers. *See* Oxalic Acid Diathesis, Phosphatic Diathesis, and Uric Acid Diathesis.

Varieties.—Gravel may be composed of (1) lithic acid and its compounds; (2) oxalate of lime; (3) phosphate of lime; or (4) the triple phosphate of lime, magnesia, and ammonia. By far the most common form of gravel, and that which alone need now be considered, is the lithic acid. This, owing chiefly to its great insolubility, is frequently deposited in the kidney and bladder, and is seen in the newly-passed urine in the form of the well-known reddish-brown crystals, often described as resembling Cayenne pepper grains. The supernatant urine is generally clear, rather dark in colour, and of a distinctly acid reaction.

Symptoms.—The passage of uric-acid crystals or gravel frequently causes no subjective symptoms, and is consistent with perfect health. Sometimes, however, it gives rise to, or is accompanied by, both general and local disturbance of function. The general symptoms are those of dyspepsia, namely, flatulence and heartburn after meals, eructations, headache, muscular cramp, depression of spirits, and a sense of malaise. Locally, there is dull aching in the lumbar region, not increased by movement; frequent micturition; a sense of heat and irritation at the neck of the bladder and along the urethra, especially during and after voiding water; and sometimes the appearance of a faint cloud of mucus or a slight tinge of blood in the urine.

TREATMENT.—From what has been said, it follows that the most important points in the treatment of gravel are strict limitation as to the *quantity* of food; the avoidance of highly-seasoned, very rich, or sweet dishes; the preference for vegetable rather than for animal food; abundant exercise in country air; and the absence or very sparing use of alcoholic liquors. Medicinally there may be given diuretics, to increase the quantity of the urine and facilitate the escape of gravel; pure water, alkalis, and alkaline waters freely diluted, to act as solvents of uric acid; and saline aperients and saline waters, to promote digestion and assist in ensuring the free action of the liver and alimentary canal.

W. CADGE.

GRAVES' DISEASE.—A synonym for exophthalmic goître, to which the late Dr. Graves of Dublin called special attention. *See* EXOPHTHALMIC GOÎTRE.

GREEN-SICKNESS.—A popular synonym for chlorosis, applied on account of the greenish colour of the skin sometimes present in that disease. *See* CHLOROSIS.

GRIPPE (Fr.)—A French synonym for influenza. *See* INFLUENZA.

GROWTH, Disorders of.—*See* ATROPHY, HYPERTROPHY, and MALFORMATIONS.

GRUTUM.—A term applied to small, hard, white globules developed from the epidermis, and commonly met with on the face, especially on the eyelids, cheeks, and temples. They are called grutum, from bearing some resemblance to oatmeal *grits*; and have likewise been named *milium*, as comparing them in size and roundness of figure to millet-seeds. Other of their synonyms are *miliary tubercles* and *pearly tubercles*.

ERASMUS WILSON.

GUINEA-WORM.—SYNON.: Dracunculus; *Filaria medinensis*. Supposed by some persons to be the 'fiery serpent' of Mosaic history.

DESCRIPTION.—The Guinea-worm is a nematoid parasite, usually measuring from one to three feet in length, and having a breadth of about one-tenth of an inch. Examples have been described as reaching six feet in length. In the adult condition it infests the feet and legs, as well as other parts of the body that are much exposed. The female only is known, but its more or less finely pointed and subulate tail has often caused it to be described as the male parasite (by Owen and others). The anatomy of the worm has been described by Busk, Carter, and Leuckart, and more particularly by Bastian, who has also thrown much light upon the structure and development of the embryos as they are found within the body of the parent worm (*Linn. Trans.* 1863, p. 101 *et seq.*) The discovery of the viviparous mode of reproduction of the dracunculus is probably due to Jacobson, whose observations were subsequently verified by Owen, Busk, Bastian, the writer, and also by Robin, Carter, Davaine, and Moquin-Tandon. As regards the development of the worm outside the body of the parent, the only observations of importance are those of the Russian traveller, Fedschenko. According to the deceased *savant* (as verbally communicated to the writer during his visit to England), the escaped embryos of the Guinea-worm perforate the skin of minute aquatic crustaceans (Cyclops). Here, after a period of only twelve hours, the embryos undergo a first change of skin, parting with their long fine tails, which eventually become comparatively blunt and forked. At the expiration of one month and six days they acquire their highest larval stage of growth within the Cyclops, traces of the reproductive organs being already seen; and thus, along with the intermediate hosts, as young males and females, they are transferred to the human stomach. Fedschenko expressed his belief that it was either in the stomach or in the intestine that they subsequently copulated, producing a progeny after the manner of Trichina; the males perishing and passing away per anum, whilst the females migrated through the tissues towards the surface of the body. Whether or not this view be correct, Fedschenko's discovery of the fact that the dracunculus needs to pass through the body of an intermediary bearer loses none of its practical and scientific interest. In Dr. Bastian's opinion the young dracunculi are the product of a non-sexual process. It should not be forgotten that Dr. Carter, who is a great authority on all matters connected with the natural history of the guinea-worm, has stated that in a school of fifty boys bathing in a pond, the sediment of which swarmed with microscopic tank-worms (*Urobales palustris*), no less than twenty-one were attacked with dracunculus *during the year*; whilst the boys of other schools, bathing elsewhere on the island of Bombay, were, with one or two individual exceptions, not affected. Facts of this kind long led the writer and others to suppose that sexual maturity was attained prior to the entrance of the worms into the human bearer. Thus, the writer has stated it to be probable (*Entozoa*, 1864, p. 388) that 'the sexes associate in muddy waters during the monsoon, after which act the males perish, whilst the females are left to find their opportunity for a mode of direct entrance into and further development within the human body.' It is clear that some waters are more infested by young guinea-worms than others. It is also tolerably certain that human infection is due to the passive immigration of the parasites. We fear, however, that the notion of ingress in a direct manner through the ducts of the skin must now be abandoned. Its former acceptance appeared to be in entire harmony with the data supplied by Indian army surgeons and other observers.

The geographical distribution of the guinea-worm is limited to inter-tropical climates, being, for the most part, confined to certain districts of Asia and Africa. It occurs also in the island of Curaçoa and in Brazil. [On this subject *see* Dr. J. F. da Silva Lima's Memoir in *The Veterinarian* for February, 1879.] It is endemic in its action, all races of mankind, without reference to age or sex, being liable to be attacked in the guinea-worm districts.

TREATMENT.—Clinically speaking, the mode of treatment pursued at the present day does not differ materially from the old method adopted by the Persian surgeons, who extracted the worm by gentle and continuous traction, winding the exposed end of the worm round a small stick of ivory, bone, or wood. If the parasite be ruptured, local and even severe constitutional mischief is apt to ensue. *See* DRACUNCULUS.

T. S. COBBOLD.

GUMMA (Lat., gum).—A growth occurring in syphilis, so named on account of its supposed superficial resemblance to gum. *See* SYPHILIS.

GUMS, Diseases of.—*See* MOUTH, Diseases of.

GURGLING.—A physical sign heard on auscultation of the chest or abdomen in certain conditions, due to the movement of gas and fluid within a cavity, whether normal or abnormal. A gurgling sensation may also be felt at times in the intestines, as over the cæcum in typhoid fever. *See* PHYSICAL EXAMINATION.

GUTTA ROSACEA (*gutta*, a drop; *rosacea*, rosy).—A synonym for Acne rosacea. *See* ACNE.

GYMNASTICS (γυμνός, naked). *See* EXERCISE.

GYNÆCOLOGY (γυνή, a woman, and λόγος, a word).—This term in its literal sense means a doctrine or discourse concerning women. In medical language, it comprehends the study of the diseases peculiar to women. *See* WOMEN, Diseases Peculiar to.

H

HABIT OF BODY.—This expression signifies the sum of the physical qualities of an individual, and is sometimes used synonymously with *constitution*. Thus we speak of a *full* habit, a *spare* habit, and an *apoplectic* habit.

HABITS. *See* DISEASE, Causes of; and PERSONAL HEALTH.

HÆMACYTOMETER (αἷμα, blood, κύτος, a cell, and μέτρον, a measure).—DEFINITION.—An instrument by the aid of which the number of corpuscles contained in a given volume of blood can be ascertained.

DESCRIPTION.—All methods employed for this object consist in making a definite dilution of a certain quantity of blood, and counting the number of blood-corpuscles in a certain volume of this dilution. Vierordt, who originated the method, drew uniform lines of diluted blood upon a slide, and, after it was dry, counted the corpuscles in a certain length of line. Cramer substituted for these lines what may be termed a capillary cell; and Potain and Malassez employed a capillary tube, and a microscope provided with an eyepiece ruled in squares. Hayem substituted for the tube a cell, the depth of which gave one dimension of the volume of dilution, while the lines upon the eyepiece furnished the others. The writer's instrument is an adaptation of Hayem's, with certain modifications; the diluting apparatus is similar, but of different capacity, and the lateral dimensions of the volume of dilution are obtained, not by a microscope-eyepiece, but by lines engraved upon the glass slide at the bottom of the cell. The instrument can thus be used with any microscope, an important convenience in practical use. The alteration in the capacity of the diluting measures facilitates the counting, and provides a much simpler mode of statement of the result. The apparatus, which is made by Hawksley, consists of (1) a pipette graduated to 995 cubic millimeters for measuring the diluting solution (2) a capillary tube for measuring the blood, containing five cubic mm.; (3) a small glass jar and stirrer for making the dilution; and (4) the cell for counting, ·2 mm. deep, and ruled at the bottom in squares, each ·1 mm. in length and breadth. The slide bearing the cell is fixed on a small metal plate, to which two springs are attached; these keep the cover-glass in position when applied.

Various solutions have been employed for making the dilution. That which the writer has found to answer best, as differentiating most clearly the red and white corpuscles, consists of sulphate of soda, 104 grains; acetic acid, 1 drachm; distilled water, 6 ounces.

In using the hæmacytometer, a drop of the dilution is placed in the centre of the cell; the cover-glass and springs are applied; and in a few minutes the corpuscles have sunk to the bottom of the cell, and are seen lying within the squares. The dilution of 5 cmm. of blood in 995 cmm. of solution is 1 in 200; each square contains the corpuscles from a volume of dilution ·2 mm. in one, and ·1 mm. in each of the other dimensions—that is, 2 cubic ·1 mm., or the ·002 part of a cubic mm. But the dilution being 1 in 200 this volume of dilution contains just ·00001 cm. of blood. The number of corpuscles in a square, multiplied by 100,000, is thus the number in a cubic millimeter of blood—the common mode of statement. In order to limit error, the number of corpuscles in ten squares should be counted, and this number multiplied by 10,000 is the number per cubic millimeter. The average number in health is about 5,000,000. Blood of normal richness, then, contains about 50 corpuscles per hæmacytometer square. Therefore the number in two squares of the instrument will always represent the proportion of the corpuscular richness to normal blood(=100)—that is, the percentage proportion to normal. It is, therefore, convenient to take the volume of blood represented by the two squares (·00002 cubic millimeter) as the standard volume, or 'hæmic unit.' For instance, it is found that the blood diluted presents in ten squares 375 corpuscles or 75 in two squares ('hæmic unit')—that is, 75 per cent. compared with the normal. To learn the number per cubic millimeter we have only to multiply 375 by 10,000, = 3,750,000. In counting the white corpuscles, if they are not in considerable excess, it is most convenient first to ascertain the number of red corpuscles per square, and note how many squares are contained in a field of the microscope. If then the focus is raised so that the corpuscles are becoming indistinct, the white ones, from their higher refracting power, will appear like bright points, and the number in a series of fields can easily be counted. For example, the number of red corpuscles per square has been found to be 40, and the field contains 15 squares, that is, 600 corpuscles per field. Ten fields contain 15 white corpuscles; the proportion of white to red will, therefore, be 1 to $\frac{600 \times 10}{15}$ = 1 to 400.

With this apparatus we may readily ascertain, within a small limit of unavoidable error, the corpuscular richness of the blood, an important element in many morbid states, such as anæmia; and we can thus ascertain the indications for, and observe the effect of, therapeutic agents. It is, however, very desirable in these cases to ascertain also the richness of the corpuscles in hæmoglobin (*see* HÆMOGLOBINOMETER). The instrument may also be employed for ascertaining the globular richness of milk or other liquids.

W. R. GOWERS.

HÆMATEMESIS (αἷμα, blood, and ἐμέω, I vomit).—SYNON.: Fr. *Hématémèse*; Ger. *Blutbrechen.*

DEFINITION.—Vomiting of blood, dependent on a variety of morbid conditions.

ÆTIOLOGY AND PATHOLOGY.—Hæmorrhage into the stomach may arise—1. From the laying open of an artery. 2. From venous or capillary congestion of the mucous membrane. 3. From causes affecting the blood itself, so that it tends to transude through the vessels under pressure of the circulation.

1. The most frequent cause of hæmatemesis is an ulcer of the stomach. It occurs, according to the late Dr. Brinton, in about one-third of all the cases of gastric ulcer that come under treatment. The bleeding usually takes place shortly after a meal, and the quantity rejected varies greatly. In some cases, it is so small that it may require careful examination to discover it; whilst in others enormous quantities are vomited, and often also passed through the bowels. The splenic artery is most frequently the source of the bleeding, but it may arise from the coronary, the superior pyloric, or, more rarely, from the blood-vessels of some of the neighbouring organs, such as the pancreas, liver, or spleen, to which the stomach has become attached, and which may happen to form the base of the ulcer. It is not necessary that the ulcer should be of large size to produce hæmorrhage. Although it is most apt to occur in chronic cases, instances have been recorded in which a large vessel had been laid open by an ulcer so small as to require careful search for its detection. It must be borne in mind that extensive bleedings may take place without any vomiting, and the source of the fatal illness be overlooked. Such cases are not of infrequent occurrence, and warn the practitioner that he should be on the alert, whenever signs of hæmorrhage present themselves, and that he should not rely too much on the absence of pain and vomiting. In cancer of the stomach profuse hæmorrhage is less common than in simple ulcer; the larger vessels being probably compressed by the new growth, which ordinarily commences in the submucous tissue immediately above them. But a constant oozing of blood is, on the contrary, more common than in simple ulceration. This blood, acted on by the gastric juice, constitutes the 'coffee ground' vomiting of the older authors. Its occurrence used to be looked upon as pathognomonic of malignant disease, but it is now known that its presence only shows that the bleeding has taken place slowly and in small quantities at a time. Occasionally profuse hæmorrhage takes place from the rupture of an aneurism into the stomach; and in a case which came under the writer's notice at the London Hospital, fatal vomiting of blood resulted from the perforation of the aorta by a fish-bone that had become impacted in the œsophagus.

2. Congestion of the portal system is a very frequent cause of hæmatemesis. The most marked and fatal cases of this kind occur along with plugging of the vena portæ or its large branches with blood-clots or cancerous matter. Such cases are very rare, and vomiting of blood, arising from venous congestion, ordinarily results from cirrhosis, chronic congestion, and other diseases of the liver, in which the portal circulation is obstructed. More rarely the like occurrence is observed in persons suffering from diseased heart, especially where there is narrowing of the mitral orifice. In such cases, there is generally a co-existence of chronic catarrhal gastritis, and in all probability the bleeding takes place from the hæmorrhagic erosions so common in that condition. In one form of this disease enormous quantities of mucus are discharged. Sometimes there is considerable bleeding in these cases, but they are distinguishable from ulcer by the absence of pain; by the vomiting being only occasional; and also by the fact that the blood-stained vomit generally follows a profuse evacuation of colourless mucus, and is always of a dark colour. In females thus affected the catamenial discharge is generally profuse; and the attacks of vomiting do not necessarily coincide with the menstrual periods. It has always been held that hæmatemesis may replace the menstrual discharge. Without denying this, the writer has never met with a well-marked case of the kind. Hæmatemesis due to acute congestion is also a constant result of irritant poisoning.

3. Hæmatemesis also arises from causes affecting the blood, and predisposing it to ooze through the walls of the veins or capillaries. It occurs in this way in purpura, yellow fever, and in some cases of typhus. In jaundice, where bleeding

from the gums and other mucous membranes is so often observed, life may be suddenly destroyed by hæmatemesis. Occasionally a hæmorrhagic tendency manifests itself suddenly, without apparent cause, as in a case observed by the writer, in which a woman, about fifty years of age, was affected with severe bleeding from the nose, followed by excessive menstrual discharge, on the cessation of which profuse hæmatemesis took place, from which she sank. She had no jaundice nor other apparent cause for her illness, and after death the most careful scrutiny failed to detect disease in any organ. To this class of causes we should probably refer the hæmatemesis occurring in acute atrophy of the liver, and in pyæmia, as, in all probability, the oozing of blood through the vessels arises from changes effected in its chemical or physical composition.

SYMPTOMS.—Generally the patient in hæmatemesis is suddenly attacked with faintness, accompanied by a feeling of weight at the pit of the stomach, the countenance is pale, the pulse feeble and compressible, and in some cases actual syncope occurs. This state terminates by vomiting, and a greater or less quantity of blood is rejected from the stomach. When a large blood-vessel has been laid open, and the bleeding has taken place rapidly, the blood may be florid; but generally the hæmorrhage goes on so slowly that time is given for the action of the gastric juice upon it, and consequently it is of a dark colour. It is not often that the stomach is completely emptied, or perhaps the bleeding persists in small quantities after the vomiting has ceased, so that the stools are generally of a dark or pitchy character, from the admixture of blood that has passed into the intestines. The hæmorrhage may cease soon after the stomach has been emptied, or the vomiting of blood may recur from time to time, or—and this is very apt to occur in gastric ulcer—months or years may elapse before it again takes place.

DIAGNOSIS.—In some cases, when the blood has been slowly effused into the stomach, there may be difficulty in determining whether the dark colour arises from bile or blood. The microscope or spectroscope will be enough to settle this point; or the liquid may be boiled with alcohol, and tested for the biliary salts. It is not always easy to ascertain whether the blood has come from the lungs or from the stomach, as the patient is sometimes so much alarmed that he cannot say whether it was brought up by coughing or vomiting. As a general rule, the blood from the lungs is florid, mixed with mucus, alkaline, and frothy; that from the stomach of darker colour, intermixed with particles of food, and in masses. Again, hæmoptysis is generally preceded by symptoms referable to heart or lungs, such as cough, expectoration, and dyspnœa; hæmatemesis by the symptoms indicative of gastric or hepatic disease, such as those described above.

PROGNOSIS.—As a general rule this is favourable in hæmatemesis, more especially in first attacks. Dr. Brinton calculated that death resulted from this cause in only 3 to 5 per cent. of the cases of gastric ulcer; and it is still less frequently fatal where it proceeds from hepatic congestion or cirrhosis. Still, the possibility of the bleeding arising from flooding of the portal vein, from the opening of a large artery, or from the bursting of an aneurism, should be kept in view, and the patient carefully watched.

TREATMENT.—Where a large quantity of blood has been ejected from the stomach, the treatment must be prompt and decided. The patient should be maintained in a recumbent posture, and kept perfectly quiet. All food must be forbidden, and pieces of ice placed in the mouth to suck. If faintness be present, it is better not to give brandy, which almost always brings on vomiting, but to apply ammonia to the nostrils; or, if necessary, an enema containing brandy may be given.

The best styptics are gallic acid, alum, and acetate of lead. The gallic acid may be given in 10-grain doses, along with 10 or 15 minims of dilute sulphuric acid, and should be repeated frequently. Alum may be prescribed in infusion of roses; and the acetate of lead in 2-grain doses in the shape of a pill, or combined with acetic acid. Oil of turpentine is also used. Where the bleeding is slight, and there is good reason to believe it arises from portal congestion, the best treatment is to give a small dose of calomel, followed by sulphate of magnesia and dilute sulphuric acid in infusion of roses every three or four hours, until purging is produced.

For some days after severe hæmatemesis, the strictest quiet should be maintained; and, in the case of ulcer of the stomach, opium should be used, and the diet most carefully regulated; if rendered necessary by persistent bleeding, nutritive enemas should be substituted for food by the mouth, and all purgatives avoided. When the hæmorrhage has arisen from portal congestion, a free action on the intestinal canal should be commenced in a few days after the cessation of the hæmorrhage, so as to diminish the amount of blood in the venous system of the alimentary organs.

S. FENWICK.

HÆMATHIDROSIS (*αἷμα*, blood, and *ἱδρῶς*, sweat).—Bloody sweat. *See* PERSPIRATION, Disorders of.

HÆMATHORAX. *See* HÆMATO-THORAX.

HÆMATIN.—*See* HÆMOGLOBIN.

HÆMATINURIA, PAROXYSMAL (hæmatin; and *οὖρον*, the urine).—SYNON.: Hæmoglobinuria.

DEFINITION.—A paroxsymal affection of the system; manifesting itself by changes in the urine; caused sometimes by malaria, and sometimes by other conditions not yet determined; consisting in no anatomical change as yet recognised; and characterised by the occasional occurrence of constitutional disturbance, with discharge of dark, blood-stained urine.

ÆTIOLOGY.—The most important extrinsic cause of the tendency to this disease is malarious poison, the most important cause of the paroxysm is exposure to cold or wet; but the tendency may exist without malarial poison, and the attack may occur apart from any special exposure. Amongst intrinsic causes, sex is evidently important, for the disease is almost confined to males. It may occur in children, and may occasionally recur during a period of years.

Anatomical Characters.—The disease not being fatal, there is no evidence as to the existence of any anatomical change in the kidneys.

Symptoms.—Hæmatinuria is paroxysmal, but not distinctly periodic. It may commence in childhood or during adult life. The attacks may occur once, twice, or thrice a day, on alternate days, once a week, or quite irregularly. The paroxysm may commence abruptly without any premonitory symptom, but is more commonly ushered in by a feeling of uneasiness in the loins and limbs, by shivering, and general chilliness. Sometimes it is preceded by slight jaundice, furred tongue, and other symptoms of gastric catarrh; and sometimes albuminuria precedes by a few hours or a day the occurrence of hæmatinuria. The more abrupt attacks frequently terminate by the discharge of the peculiar urine, and the next urine is normal, or nearly so. In some cases albuminuria lingers for a time after the discoloration has passed off. The characters of the urine are very peculiar. Its colour is like porter, or like muddy port wine; its specific gravity ranges from 1015 to 1035; it is acid, or faintly alkaline; highly albuminous; sometimes it contains excess of urea; and throws down a copious sediment. This contains very few or no blood-corpuscles, but an immense amount of granular blood-pigment, with numerous tube-casts—hyaline or epithelial, often loaded or coated with amorphous granular matter, and with minute crystals of oxalate of lime. The colour is not due to blood-corpuscles, and it is said not to be due to hæmatin, but to hæmoglobin. In some cases the urine is less affected, being merely albuminous, and not depositing pigment. It may be doubted whether this condition should be admitted to the same category as the disease under discussion, but cases which have come under the writer's observation seem to show that it is entitled so to rank.

Diagnosis.—The only diseases with which intermittent hæmatinuria is likely to be confounded are hæmaturia, and renal calculus or gravel. From the former it is distinguished by the abundance of the blood-pigment, and the extreme rarity of blood-corpuscles; from the latter by the short duration of the attacks, the presence of the characteristic deposit, with the fact that the pains affect both loins, not merely one. It is sometimes important to distinguish the milder forms, in which merely albuminuria occurs, from congestion or from commencing inflammatory Bright's disease. It is not always possible to distinguish these during the early hours of the attack; but the amount of general disturbance, the state of the tongue, the slight jaundice, the suddenness of the onset, and the absence of dropsy, generally suffice to make it clear.

Prognosis.—The prognosis is good in paroxysmal hæmatinuria, as to the individual paroxysm. The tendency to the disease is also not unfrequently got rid of. It has not proved fatal in any case. But it appears sometimes to usher in, or to constitute, an early symptom of Bright's disease—the cirrhotic form.

Treatment.—As the paroxysm is spontaneously recovered from, little need be done, excepting with the view of alleviating the discomfort of the patient. He should go to bed and be kept warm, and have abundance of warm drinks. In respect of diminishing or removing the tendency to the malady, various remedies have been found useful, among which may be mentioned quinine, tincture of cinchona, iron, arsenic, and chloride of ammonium.

T. Grainger Stewart.

HÆMATOBIUM (*αἷμα*, the blood, and *βίος*, life).—A synonym for hæmatozoon. *See* Hæmatozoa.

HÆMATOCELE (*αἷμα*, blood, and *κήλη*, a tumour).—Synon.: Fr. *Hématocèle*; Ger. *Blutgeschwulst.*—Definition.—The swelling occasioned by effusion of blood in the sac of the tunica vaginalis, or in a cyst connected with the testicle.

Ætiology and Symptoms.—The extravasation of blood in hæmatocele may take place in a healthy state of the parts, or it may succeed or be combined with hydrocele. In both cases it may be occasioned by a blow, or by violent efforts made in straining, especially in old persons, or when the blood-vessels are diseased. It may happen also from the accidental wound of a vessel in tapping a hydrocele. The blood effused, if small in quantity, mixes with the fluid of the hydrocele, occasioning slight enlargement without disturbance. If it be large in quantity, coagula are formed; inflammation is excited in the tunica vaginalis; and plastic exudation occurs on its inner surface, sometimes forming layers, and rendering the sac extremely dense and firm.

The testicle preserves the same relation to the remainder of the tumour as in hydrocele, being situated at its posterior part. Its position, however, is liable to similar alterations as occur in hydrocele, which are very difficult of detection, owing to the great thickening of the parts.

Diagnosis.—A hæmatocele may be distinguished from a hydrocele by the absence of transparency; the obscure character of the fluctuation; the heavy feel of the tumour when balanced in the hand; and the sudden and accidental mode of its occurrence. In old chronic cases, in which the tunica vaginalis and its envelopes have become much thickened and indurated, the tumour possesses so firm a character, and feels so heavy and solid, that it is very liable to be mistaken for a chronic enlargement of the testicle; and the diagnosis, at all times difficult, in some instances cannot be satisfactorily made out by the most experienced hands. The records of surgery furnish many cases in which castration has been performed owing to a mistaken diagnosis. When doubt exists, it should be removed by the introduction of a trochar or by an incision before any serious operation, such as castration, is undertaken.

Treatment.—When hæmatocele succeeds a hydrocele, the blood, if small in quantity, mixes with the fluid of the hydrocele without producing irritation. The tinged fluid may be removed by tapping, and the operation can be repeated afterwards at intervals until the fluid is free from discoloration. Even when inflammation arises, if the sac be tapped and tension removed, and the patient be kept at rest, with ice applied to the part, the inflammation may subside. When, however, the blood effused is large in quantity, and when the inflammation is acute and threatens suppuration, the tumour should be punctured at its upper part, a director introduced, and the sac freely laid open by incision. This must be done with care, so as to avoid wounding the testicle. A chronic hæmatocele with a very thickened sac must be cut into in the same way; and lateral portions of the sac may be excised, so as to lessen the wound for healing. The practitioner must bear in mind that the testicle is sometimes situated in front, as in cases of inversion, and is then very liable to injury in the operation of incision, and even in tapping.

Encysted hæmatocele.—Encysted hæmatocele implies an effusion of blood in the sac of an encysted hydrocele; and the treatment is the same as that required for ordinary hæmatocele.

Hæmatocele of the Cord.—Blood may also be effused in the areolar tissue of the spermatic cord, constituting *diffused* hæmatocele of the cord; or in a cyst in the cord, constituting *encysted* hæmatocele of the cord. Such cases are very rare.

T. B. Curling.

HÆMATOIDIN.—*See* Hæmoglobin.

HÆMATOMA (*αἱματόω*, I fill with blood).—A peculiar form of bloody tumour, or a collection of extravasated blood that has undergone certain changes. It is observed more especially in connection with the ear, the scalp, and the meninges. *See* Cephalhæmatoma; Hæmatoma Auris; Meninges, Cerebral, Hæmatoma of; and Tumours. The term is sometimes also applied to fungus hæmatodes.

HÆMATOMA AURIS (*αἱματόω*, I fill with blood; *auris*, of the ear).—Synon.: The Insane ear; Fr. *Othématome*; *Hématome de l'oreille des aliénés*; Ger. *Othämatoma*; *Ohrblutgeschwulst von Geisteskranken.*

Definition.—An affection of the auricle, which occurs almost, if not quite exclusively, in the insane, and consists in the effusion of blood or bloody serum between the cartilage and its perichondrium, to such an extent as to form a distinct tumour.

Ætiology.—In most of the few cases of hæmatoma auris which have been published to show that this disease may occur in the sane, the description given of the patients rather points to their insanity than otherwise. It is most common in cases of general paralysis and mania (acute and chronic), but also occurs in melancholia, dementia, and idiocy. It is about four times as frequent in men as in women; and more often affects the left ear than the right. Sometimes both ears are affected, but seldom at the same time. There would seem to be, in many or all of the insane, a morbid condition of the vessels or other tissues of the auricle, which predisposes to the occurrence of hæmatoma. If this condition be present to a sufficient degree, the disease may arise spontaneously; in other cases a very slight injury may be sufficient to cause it; whilst in others very considerable violence is necessary for its production.

Symptoms and Course.—The disease first makes itself evident by the appearance of a swelling of about the size of a horse-bean; this is almost always upon the anterior surface of the pinna, and usually in the neighbourhood of the fossa of the antihelix. The skin over the tumour is generally of a reddish or bluish-red colour, but may be unaltered at first; the temperature of the ear is sensibly raised; the swelling is very painful and tender; there is no extravasation of blood from the cutaneous vessels; and the tumour is not œdematous. At this stage, the effusion which has taken place between the cartilage and its perichondrium consists of dark red fluid blood. In rare cases the swelling does not increase further; the inflammatory symptoms subside after about a week; absorption gradually takes place; and only a slight thickening remains. More usually the tumour increases and may attain the size of a hen's egg; it becomes tense, elastic, distinctly fluctuating, and hot; and is often of a bright red colour. Its prominent anterior wall, consisting of skin, cellular tissue, and perichondrium, is felt to be thinner and less resisting than the posterior, which contains the ear-cartilage. In certain cases, however, owing to the brittle cartilage having split up, and portions of it having adhered to either wall, both walls present irregularly alternating characters. The time which a hæmatoma takes to attain its largest size varies from a week to a month; it then generally involves the whole of the concha, occluding the external auditory meatus; the folds of the auricle are lost, with the exception of the helix (which appears as a band running round the tumour), and the dependent lobule. The weight of the tumour causes the whole ear to fall somewhat forwards and outwards. Sometimes, especially in the presence of constant or repeated irritation, the inflammatory stage may last many weeks, and the deformity which always results from the affection is thereby greatly increased. Unless subjected to violence, it very rarely happens that the tumour opens spontaneously, although its tense and inflamed appearance often seems to indicate that such an occurrence is imminent. If rupture does take place, suppuration ensues; portions of cartilage come away; the cavity closes very slowly; and great deformity results. The most common course is for the inflammatory symptoms gradually to subside. The anterior wall becomes firmer, owing to a new deposit of cartilage upon its inner surface; the sense of fluctuation is gradually lost; and the tumour slowly diminishes in size, often yielding a somewhat doughy sensation to the touch. Occasionally, at this stage, some gaseous contents have been observed in the cavity. The colour of the skin over the tumour becomes gradually more dusky; it then passes into yellow and, later on, into an unnatural pallor. As the fluid contents become absorbed, the tumour becomes harder and smaller; folds again appear in the auricle, but do not correspond to the original ones; and the pinna remains permanently thickened, puckered, and often nodular.

Anatomical Characters.—Many of these have been given above in explanation of symptoms, and do not require to be repeated. A shrivelled auricle, which has previously been affected by hæmatoma, presents, on section, two distinct layers of cartilage; these are of varying thickness, and separated from each other by vascular fibrous tissue, which often contains within it other small isolated plates of cartilage, and sometimes also small portions of bone. The fibrous tissue is the organised product of the original effusion; the two layers of cartilage have been developed upon the inner surfaces of the perichondrium; the loose portions of cartilage and bone which are occasionally seen, are developed from the fibrous tissue. It used to be supposed that the bone (which is soft, vascular, and contains well-developed Haversian systems) resulted from ossification of the ear-cartilage; but the writer has shown elsewhere (*Brit. Med. Journal*, Oct. 1873) that this is not the case.

PROGNOSIS.—The local affection is in no way dangerous, but it always leaves behind it a permanent characteristic deformity of the auricle. The sense of hearing is only affected by the occlusion of the auditory meatus; but this condition very rarely persists after the acute stage. The occurrence of hæmatoma auris affects the prognosis of the mental disease unfavourably, but does not necessarily indicate the approach of a fatal termination to the case.

TREATMENT.—Protection of the part from injury is usually all that is necessary. Cooling applications might be useful if inflammation were excessive. The tumour should not be opened; nor should a portion of the anterior wall be removed, as has been recommended; these procedures only lead to suppuration. It is useless to empty the cavity by aspiration, as it fills again with great rapidity. The treatment by pressure is very painful, and yields no good result.

CHAS. S. W. COBBOLD.

HÆMATO-PERICARDIUM (*αἷμα*, blood; *περὶ*, about; and *καρδία*, the heart).—An extravasation of blood into the sac of the pericardium. *See* PERICARDIUM, Diseases of.

HÆMATO-THORAX (*αἷμα*, blood, and *θώραξ*, the chest).—An extravasation of blood into the pleural cavity. *See* PLEURA, Diseases of.

HÆMATOZOA (*αἷμα*, blood, and *ζῶον*, an animal).—This term is of general application to all kinds of animal parasites dwelling in the blood and blood-vessels; but its employment is often restricted to certain of the nematoid entozoa, which display this habit in a more marked degree than the other parasites are wont to do. All classes of helminths are liable, at some time or other in the course of their lifetime, to take up their residence in the blood, but in the case of the *Tæniæ*, or rather of their *proscolices*, this period is of very short duration. One or two species only of fluke-worms or trematodes play a similar *rôle* in man, the most important being the *Bilharzia*, which gives rise to an endemic hæmaturia at the Cape, and elsewhere in Africa (*see* BILHARZIA). Our knowledge of the nematoid hæmatozoa dates at least as far back as the time of Ruysch (1665) who was acquainted with the strongyles which produce aneurism in the horse and other solipeds; whilst more than half a century later the subject received additions from the writings of Schulze (1725) and Chabert (1782); and subsequently from the memoir by Rayer (1843). About the latter period also the observations by Grube and Delafond 'on a verminiferous condition of the blood of dogs, caused by a great number of hæmatozoa of the genus *Filaria*,' excited much attention; but until quite recently it was not so much as suspected that similar microscopic filariæ infested the human body. In 1872 Dr. Lewis announced the important discovery of the existence of nematoid worms in the living human subject also. *See* CHYLURIA; and FILARIA SANGUINIS-HOMINIS.

T. S. COBBOLD.

HÆMATURIA (*αἷμα*, blood, and *οὖρον*, urine).—SYNON.: Fr. *Hématurie*; Ger. *Blutharnen*.

DESCRIPTION.—Hæmaturia is a symptom of many different morbid conditions of the system, and of the urinary tract. The quantity of blood discharged in the urine varies greatly, and the appearance of the urine corresponds. Sometimes it is dark, loaded with clots; sometimes it is merely smoky, or of a faintly pink hue. It is albuminous, and corpuscles (often altered by soaking in the urine) may be discovered by the microscope, sometimes becoming swollen, sometimes shrunken. The following are the best tests for detecting the presence of blood in the urine.—1. *Guaiacum.* When equal parts of tincture of guaiacum and oil of turpentine are shaken together to make an emulsion, and the urine is cautiously added, an intense blue colour is produced if blood be present. 2. *Spectrum analysis.* Very minute quantities of blood in the urine show absorption-lines between Frauenhofer's lines D and E in the yellow and green of the spectrum. *See* SPECTROSCOPE.

The blood in hæmaturia may be derived from the urethra. If so, it precedes the stream of urine, sometimes forms a long thin clot, and may escape in the intervals of micturition. Sometimes it is derived from the prostate gland or the bladder. When it has lain in the bladder and been poured out in considerable quantity, it is often in clots; and when the urine is voided, the first part is frequently clear, the last loaded with blood. Blood may also be derived from the ureter or the pelvis of the kidney. Sometimes clots in the form of moulds of these structures may be recognised. At other times the blood is derived from the substance of the kidney, and then is intimately mixed up with the urine, which frequently exhibits bloody tube-casts.

ÆTIOLOGY AND PATHOLOGY.—Urethral hæmorrhage is due to local inflammation or rupture of vessels. Prostatic hæmorrhage may be due to malignant disease, to tumours, to inflammation, or to scrofulous affection of that organ. Vesical hæmorrhage results from malignant disease, from simple villous growth, inflammation, ulceration, tubercular disease, or the irritation of calculus. Hæmorrhage from the ureters or pelvis of the kidney may be due to the presence of calculi, or to unexplained causes. Hæmorrhage from the kidney may be due to cancer, tubercle, suppurative nephritis, or to the irritation of crystals or amorphous concretions within the uriniferous tubules. Hæmorrhage occurs also in all the forms of Bright's disease, especially in the early stage of the inflammatory form, and the advanced stage of the cirrhotic. It results moreover from over-doses of turpentine and cantharides, and from rupture of the kidney. Sometimes it is a manifestation of purpura hæmorrhagica, more rarely of scorbutus; and occasionally it occurs in the course of, or as a sequel of eruptive or continued fevers. It is also occasionally vicarious. Renal hæmorrhage occurs in Egypt, Mauritius, and other localities, in consequence of the presence in the pelvis of the kidney of a minute parasite, the Bilharzia hæmatobia; or of the presence in the blood of the Filaria sanguinis-hominis. *See* BILHARZIA; CHYLURIA; and FILARIA SANGUINIS-HOMINIS.

TREATMENT.—The treatment of hæmaturia must vary according to the lesion to which the hæmorrhage is due, but where the symptom is so urgent as to demand treatment for itself, the most important points to be attended to are rest; free relief of the bowels; the application of ice-bags over the source of the hæmorrhage; along with the internal administration of astringents, especially gallic acid, ergot of rye, perchloride or pernitrate of iron, turpentine, or acetate of lead, with or without opium. If these do not succeed, the subcutaneous injection of ergotine is often efficacious. Surgical interference may be required for relief of symptoms due to coagula. T. GRAINGER STEWART.

HÆMIC ASTHMA.—A form of asthma, dependent upon an abnormal condition of the blood. *See* ASTHMA.

HÆMIC MURMUR.—A murmur connected with the condition of the blood, as in anæmia. *See* ANÆMIA; and PHYSICAL EXAMINATION.

HÆMIN.—*See* HÆMOGLOBIN.

HÆMOGLOBIN (*αἷμα*, blood, and *globus*, a ball). SYNON.:—Hæmatoglobulin; Hæmatocrystallin; Cruorin (Stokes).—This substance, which is of great physiological interest, is of an extremely complex nature, being a compound of two bodies, the one a proteid known as globulin or globin; and the other a nitrogenous derivative called hæmatin. These two substances are combined in the proportion of 87·5 per cent. of globulin to 12·41 per cent. of hæmatin (Schmidt); and the provisional formula of hæmoglobin, according to Hoppe-Seyler, is $C^{600}\ H^{960}\ N^{154}\ Fe\ S^{3}\ O^{179}$. If we estimate the red corpuscles as forming about 32 per cent. of ordinary blood, hæmoglobin may be considered as forming 13 to 14 per cent. of the same blood.

Hæmoglobin presents a singular exception to the general law of diffusion, inasmuch as, though it readily crystallises, it will not diffuse through membrane as such without decomposition. A considerable variety in the shape of the crystals is met with in different animals; in man they occur as elongated prisms.

The most important property of this compound is its affinity for oxygen. In some obscure manner this gas enters into a loose combination with hæmoglobin, forming *oxy-hæmoglobin*; and is then conveyed by the red corpuscles throughout the body; separating again from its conveyer in the tissues. The hæmoglobin thus deprived of its oxygen is known as *reduced hæmoglobin*, and is of a purplish colour, whilst the oxy-hæmoglobin is of a scarlet tint. It is thus that the difference in colour between arterial and venous blood is mainly to be accounted for. It is to be noted that whatever be the nature of the combination that exists between the oxygen and its carrier, it is such that the gas retains its properties as a gas, and the union may be roughly compared to a mere solution of the gas in a fluid. The recent experiments of Malassez, Hayem, Gowers, and others have furnished us with means of estimating within very reasonable limits the quantity of red corpuscles contained in any sample of blood (*see* HÆMACYTOMETER); and further by a comparison of its colour with that of a solution of known strength the percentage of hæmoglobin in it may be ascertained with tolerable accuracy (*see* HÆMOGLOBINOMETER). We are as yet unacquainted with the variation in its amount in the majority of diseases, but a very considerable diminution, even to the extent of 25 per cent., has been met with in chlorosis. Whether with the alteration in quantity of hæmoglobin there is any change in its composition is uncertain; from the improvement following the administration of iron in certain cases of anæmia it would seem that there may be. As regards the iron constituent of this compound, amounting to ·4 or ·5 per cent., it has been suggested, although on no very good grounds, that the oxygen-carrying property is due to this element. It is noticeable that in some of the lower animals copper has been met with, taking the place of iron.

From a pathological point of view, hæmoglobin is chiefly of interest in respect to its derivatives, which are easily obtained by the action of heat, acids, alkalies, &c., and also on account of the relationship that exists between this substance and the various pigments met with in the body. The chief derivatives of hæmoglobin, namely, hæmatin, hæmatoidin, and hæmin, will now be described.

Hæmatin.—$C^{68}\ H^{70}\ N^{8}\ Fe^{2}\ O^{10}$ (Hoppe-Seyler). Hæmatin may be obtained from red blood corpuscles by treatment with alcohol, acidulated with sulphuric acid.

Hæmatin is an amorphous dark-brown powder. A solution gives a characteristic absorption-band in the spectrum, different from those produced by hæmoglobin. It gives a green solution when boiled with caustic potash.

Hæmatoidin (*αἷμα*, blood, and *εἶδος*, appearance). ($C^{17}\ H^{18}\ N^{2}\ O^{3}$).—Hæmatoidin may be prepared from hæmatin by the action of acids, which remove the iron. This substance is crystalline (rhombic prisms or needles), and of a red or greenish-red colour; a fact which shows that the colour of hæmoglobin is not dependent on the iron. It is of considerable pathological interest, being frequently found in old clots, and in the cavity of ruptured Graafian follicles; it is the cause also of the staining so often seen in the neighbourhood of extravasations of blood, varying from lemon-yellow up to reddish black.

Hæmin ($C^{68}\ H^{70}\ N^{8}\ Fe^{2}\ O^{10}\ 2\ HCl$).—Hæmin, which may be prepared from dried hæmoglobin by treatment with glacial acetic acid, in the presence of an alkaline chloride, is a hydrochlorate of hæmatin. It crystallises tolerably readily in needles or rhombic plates, and thus becomes an easy means of detecting the presence of blood in stains of a doubtful nature.

The relationship of hæmoglobin, hæmatin, hæmatoidin, and hæmin to the pigments of the body is of the greatest interest. It would seem that the hæmoglobin is the source of all—biliary, urinary, &c. Bilirubin is closely allied to, if not identical with, hæmatoidin; and a play of colours—the result of oxidation—may be obtained from the latter when treated with nitric acid, similar to that produced by the bile-pigments under the same condition. The injection of hæmoglobin into the blood is followed by the presence of bile-pigments in the urine, and an increase of bilirubin in the bile. Melanin, the black pigment often found in connection with new-growths, especially with those of a malignant character, also appears to be directly drawn from hæmoglobin. The colouring matter of the blood is obviously associated, in some way other than that of its oxygen-carrying function, with the nutrition of the tissues, in connection with the obscure but unquestionable influence of pigments. W. H. ALLCHIN.

HÆMOGLOBINOMETER (Hæmoglobin; and *μέτρον*, a measure).—DEFINITION.—An instrument for the clinical estimation of the amount of hæmoglobin in blood.

DESCRIPTION.—The promotion of hæmoglobin may be ascertained by estimating the amount of iron in the blood, or the amount of dilution necessary to obscure a certain absorption-band in the spectrum (*see* SPECTROSCOPE). Neither of these methods is, however, available for clinical use. Simpler methods have therefore been contrived, which proceed by comparing the colour of diluted blood with that of solutions of carmine and picro-carmine. By this combination the tint of blood and even its spectrum may nearly be obtained (Malassez). Coloured discs have been employed for the same purpose (Hayem). In these methods a given dilution of blood is made, and this is compared with the tint of the standards. In the hæmoglobinometer designed by the writer (and made by Hawksley) the blood is progressively diluted until it reaches the tint of a standard the colour of which corresponds to a dilution of 1 part of healthy blood in 100 of water. The degree of dilution necessary to make the two correspond represents the amount of hæmoglobin. The apparatus consists of two tubes of exactly equal diameter, and a capillary pipette, holding 20 cubic mm., for measuring the blood. One tube is filled with a standard, consisting of glycerine jelly coloured to the required tint. The other is graduated, each division being equal to the volume of blood taken (20 cubic mm.), so that 100 divisions equal 100 times the volume of blood. The dilution is made by a pipette stopper, and the number of degrees of dilution necessary indicates the percentage proportion of the hæmoglobin of the blood examined to normal blood. For example, the blood of a patient being progressively diluted, is found to reach the tint of the standard when the amount of water added corresponds to 45 degrees of dilution; the blood examined therefore contains 45 per cent. of the normal quantity of hæmoglobin. W. R. GOWERS.

HÆMOPERICARDIUM. *See* HÆMATOPERICARDIUM.

HÆMOPHILIA (*αἷμα*, blood, and *φιλία*, predisposition for).—SYNON.: Hæmorrhaphilia; Hæmorrhagic diathesis; Bleeders; Fr. *Hémophilie*; Ger. *Bluterkrankheit*.

DEFINITION.—A congenital disease, often hereditary, characterised by a tendency to immoderate bleedings, whether spontaneous or traumatic, and to obstinate swellings of the joints.

ÆTIOLOGY.—Men are far more liable than women to this disease; the proportion being about eleven to one. Women who suffer from hæmophilia show much less typical specimens of the disease than men, and rarely die from hæmorrhage, although floodings and profuse menstruation are common.

The best-ascertained cause of hæmophilia is hereditary predisposition. No other cause is known with anything like certainty. In a bleeder family, the disease descends to the boys through the mothers, the women remaining quite healthy and apparently free from all disease. The fathers do not seem to transmit the disease to their sons; at least, instances of this are rare. The women of bleeder families are remarkably fertile. Some have thought this disease to be more common in Germany, but this is probably owing to the greater attention paid to the disease in that country. Cases have been met with in the Indian Archipelago, North America, the Scandinavian kingdoms, and elsewhere. The disease is not limited to the Aryan races, as the Jews, a Semitic nation, are singularly liable to it.

ANATOMICAL CHARACTERS.—No morbid appearances have yet been found after death with any constancy. The blood-vessels examined with the microscope have shown no change. The blood is apparently unaltered. Yet it is most probably the vessels which are at fault; as in most of the other hæmorrhagic diseases about which much is known, the vessels have been found diseased. The swellings of the joints appear to be due to the extravasation of blood within the articulation.

SYMPTOMS.—The first signs of hæmophilia are commonly seen during the first year of life; but sometimes they are delayed until the beginning of the second dentition. Cases on record of a much later appearance of the first symptoms are not trustworthy. It is very rare for bleedings to be noticed at birth. There is nothing about the subjects of hæmophilia, when not suffering from bleeding, to distinguish them from ordinary persons. They look well; and nothing amiss can be discovered by physical examination in chest or belly. It is stated, also, that the boys have often good ability and do well at school.

There are three well-marked *degrees* of hæmophilia. The first is the most typical and characteristic, in which there is a tendency to every kind of hæmorrhage, traumatic or spontaneous, interstitial or superficial. The swelling of the joints is well-marked. This degree is scarcely ever seen in women; but it is the most common among men. In the second degree, spontaneous hæmorrhages from the mucous membranes only are present. The third degree, in which the tendency is little marked, is seen only amongst the women of bleeder families; and shows itself only by spontaneous ecchymoses.

Hæmorrhage. — Spontaneous bleedings are sometimes preceded by prodroma. These are symptoms of unusual fulness and plethora. The mucous membranes supply the blood in this case; in childhood bleeding from the nose being the most common, and also the most fatal, although bleedings from the bowel, mouth, or chest may also occur. There is only one known instance of death from hæmaturia. The traumatic bleedings vary much in intensity, even in the same individual. Death has followed division of the frænum of the tongue, vaccination, leeching, and the extraction of a tooth. This last is a very common cause of death, and ought never to be undertaken in hæmophilia. If abscesses be opened, furious bleeding commonly takes place; and the same occurs if a blood-tumour or extravasation of blood be interfered with.

The bleeding is nearly always capillary, and may kill in a few hours or after some weeks. The quantity of blood lost is sometimes enormous. After the bleeding the patients are extremely anæmic; and this state may last for months.

Besides superficial bleedings, interstitial hæmorrhages, ecchymoses, and blood-tumours may be observed, whether spontaneous or traumatic. A bruise which a healthy person would not feel may fill the connective tissue of a limb with blood; or the bleeding may be circumscribed, and form a tumour instead.

Swelling of the joints.—This chiefly affects the larger joints, the knee being most commonly attacked. The joint, most commonly after some injury, becomes swollen and painful, and apparently filled with fluid; there is fever; and this state may last for many weeks, and is very apt to relapse during convalescence.

Diagnosis.—The diagnosis of hæmophilia is often easy. If a boy have suffered repeatedly from early infancy from abundant bleedings—especially traumatic—and from joint-affections, there can be no doubt of the diagnosis. It is made more certain by the existence of hereditary predisposition. In women the diagnosis must be made with more care, as they are subject to a hæmorrhagic disorder which first appears about puberty, but which is not hereditary.

Prognosis.—The prognosis is bad as regards complete recovery, though not so serious with respect to life as was formerly thought.

Treatment.—In the treatment of the bleedings of hæmophilia, styptics are of little use. The spontaneous form should not at first be interfered with; but the traumatic may often be stayed at its first onset by the judicious use of compression. The tincture of perchloride of iron seems the best internal remedy. In the last resort, transfusion may be had recourse to. In the intervals of hæmorrhages, meat diet, cod-liver oil and steel, and residence in a warm climate, are the most appropriate remedies. All surgical or medical procedures by which blood is drawn must be strictly avoided. There are, however, only two instances on record of disagreeable consequences following vaccination. Marriage should be forbidden, especially to women who do not themselves suffer from the disease, but belong to bleeder families.

The joint-affection must be treated chiefly by rest and the application of splints.

J. Wickham Legg.

HÆMOPTYSIS (αἷμα, blood, and πτύω, I spit).—Synon.: Pneumonorrhagia; Bronchorrhagia; Fr. *Hémoptysie*; Ger. *Bluthusten*.

Definition.—Blood-spitting having its source in pulmonary or bronchial hæmorrhage.

The restriction of the term hæmoptysis, as thus defined, has the sanction of long usage and convenience. Hæmorrhage from an aneurism opening through the lung or air-passages would not strictly be included in such a definition.

Spitting of blood when it arises from other and less important sources comes under the denomination of *false* or *spurious* hæmoptysis.

Ætiology and Pathology.—The causes of hæmoptysis in the widest sense of the term, and having regard to its pathology, may be thus enumerated:—

I. Hæmorrhage from the pulmonary artery or its radicles.

1. Rupture or wound of the lung from external violence.

2. Active hyperæmia of the lungs—inflammatory, vicarious, or induced by violent effort or excitement. The active hyperæmia may be primary as regards the lungs; or may supervene or be attendant upon disease already present in them.

3. Mechanical hyperæmia of the lungs, secondary to heart-disease, or embolism of one of the pulmonary branches, or to pressure from tumours, such as enlarged bronchial glands (*see* Bronchial Glands, Diseases of).

4. Necrotic division of vessels in the course of softening of tubercular or other consolidations in destructive lung-diseases—phthisis, tuberculosis, cancer.

5. Aneurismal dilatation or simple erosion of branches of the pulmonary artery, exposed in the course of excavation of the lung, or ulceration of the bronchial mucous membrane.

6. Primary atheroma of the pulmonary artery within the lung.

II. Hæmorrhage from the bronchial capillaries.

Capillary hæmorrhage from the bronchial mucous membrane.

III. Hæmorrhage from the aorta, or one of its great branches.

Aneurism rupturing through the lung or into a bronchus.

Details respecting the pathology of these several forms of hæmoptysis will be found under the headings of the principal diseases giving rise to them. There are a few additional remarks, however, that should be introduced here.

The pathology of hæmoptysis occurring in early phthisis—of which it is one of the most frequent symptoms—is still somewhat obscure. Besides the active hyperæmia above referred to, that is, the inflammatory congestion that constitutes the first stage of some kinds of phthisis, and tends to recur at different periods of the disease; besides also the necrotic division of vessels, or their aneurismal dilatation, which more especially account for the hæmorrhage occurring in the later stages of the disease; there are other conditions present in early phthisis which probably have much to do with the occurrence of hæmoptysis. The minute blood-vessels are importantly concerned in the very earliest stage of phthisical lung-disease in one or other of three ways:—

(*a*) Their walls become the seat of nuclear proliferation, and hence become softened; and (*b*) these vessels become more or less extensively blocked, not merely as the result of the inflammatory *stasis* which may affect their capillaries, but by the pressure of surrounding tubercular growth. (*c*) It is very possible that in the ill-developed lungs of small-chested people, who inherit a tendency to consumption, the vessels are also morbidly frail, and are apt to give way in any temporary hyperæmia. Some persons are remarkably subject to irregular distribution of blood; they are liable to chills, cold extremities, and transient flushings; and a *pulmonary blush* is as conceivable as a temporary flush elsewhere, and would favour the occurrence of hæmorrhage.

It has been alleged that the hæmoptysis occurring in all stages of phthisis frequently has its source in hæmorrhage from the bronchial tubes, and that this bronchial hæmorrhage may give rise secondarily to phthisis, or may, when it occurs in the course of that disease, set up fresh centres of mischief in the lungs by inhalation of blood to distant portions. In the entire absence of reliable pathological grounds for this view, and in the abundance of anatomical evidence, clinical experience, and weight of authority in favour of the pulmonary origin of hæmoptysis, we are, in the opinion of the writer, justified in believing that decided hæmoptysis originating in hæmorrhage from the bronchial mucous membrane is exceedingly rare, excluding, perhaps, syphilitic ulceration of the bronchi. Blood inhaled to distant portions of lung may, however, as shown by Dr. Reginald Thompson, undergo changes resulting in fresh pulmonary destruction.

Description.—The quantity of blood brought up in hæmoptysis varies from a mere streak to two or three quarts. When blood is expectorated in large quantity, it is pure and unmixed; and either dark and venous, or bright arterial. The first and last portions are usually more or less aërated. If in small quantity, the blood is most generally bright and frothy, it may be only a speck or two upon the sputum, or it may be in several mouthfuls of pure aërated blood. It commonly happens that this mitigated and more characteristic hæmoptysis precedes the rarer attack of profuse hæmorrhage that may prove instantly fatal. Hæmoptysis is sometimes scanty, dark, and clotted, usually from a small portion of blood having been detained in the lung before being expectorated.

In decided hæmoptysis the shock to the system is always great. The patient is alarmed and anxious, especially on the first attack. The sense of weakness and prostration is, indeed, often prolonged after the attack—not necessarily a severe one as regards quantity of blood lost—has ceased. The face is often flushed, the extremities cold. The temperature is usually depressed; after a few hours it becomes normal, and it may continue so, or it may rise in the course of forty-eight hours or within five days. This elevation of temperature may depend (*a*) upon return of the previous fever after being temporarily checked by hæmorrhage; (*b*) upon the cause which has also produced the hæmoptysis; or (*c*) upon the secondary consequences of the hæmorrhage. It has been clearly shown that the inhalation of blood into the bronchial tubes and pulmonary alveoli sometimes sets up broncho-pneumonia, and thus may give rise to fresh centres of phthisical disease. The later the rise of temperature up to the fifth day, the more reason we have for regarding it as due to secondary pneumonia.

Anatomical Characters. — These depend very much upon the nature of the disease which has preceded the hæmoptysis. In cases of death from hæmoptysis there are the usual appearances —pallor of organs, empty and contracted ventricles, &c.—of death from hæmorrhage. The bronchial tubes of both lungs are found to contain clots. The healthy portions of lung are found inflated from obstructions in the bronchi, impeding the exit of air; they are generally pale, but beautifully speckled by pink spots, marking the lobules into the air-cells of which blood has been inhaled. If death take place several days after profuse hæmoptysis, any blood which remains in the bronchi is dark and disorganised, and patches of consolidation may sometimes be found, having for their centres the stained appearance attributable to inhaled blood. More or less bronchitis is also noticeable. It is rare to find fatal hæmoptysis without the presence of cavities, which are also, more or less, filled with blood-clot. In almost every instance of fatal hæmoptysis in phthisis, sufficient diligence will discover either an aneurism of a pulmonary vessel within a cavity, or ulcerative erosion of an exposed vessel. The writer has found such a condition in fifteen cases at various ages, including one infant seven months old.

Significance of Hæmoptysis.—No modification in our views respecting the nature of phthisis can lessen the significance of hæmoptysis as being one of its most important positive signs. Thus regarded, it is a warning that may sometimes save, and very often prolong life, by drawing our early attention to a condition that might otherwise remain too long concealed; but, lightly considered and carelessly treated, it is but the precursor of destructive disease.

Diagnosis.—Genuine hæmoptysis can rarely be mistaken by a skilled observer present at the attack. The gurgling in the bronchi, the loose cough, and repeated expectoration of *bright frothy* blood are quite characteristic. The blood is distinctly expectorated with cough, not vomited; and its quality is distinctly fresh, not changed. In hæmatemesis, with which hæmoptysis is sometimes confounded, the blood is brought up by vomiting; is more or less mixed with the contents of the stomach; and, save when the hæmorrhage is very rapid and abundant, presents a dark grumous appearance, owing to the action of the gastric fluid upon it (*see* Hæmatemesis). It may, too, be observed that the blood does not come from the nose, unless a small quantity be projected through the nostrils with the spasmodic cough. If, as often happens, no medical attendant is at hand at the moment of the attack, the appearance of the blood is usually sufficient for diagnosis; and if the hæmoptysis have been at all copious, any further expectorations for the next few hours are sanguineous. The fact of this sanguineous colouration of the sputa having existed for some hours, or a day or two after an hæmoptysis, is positive evidence of the hæmoptysis having been genuine. In cases of *very copious* hæmorrhage from a large pulmonary branch, the blood brought up is dark and venous.

It is very important in investigating the cause of hæmoptysis to be as gentle as possible in physical examination. We can listen to the lungs in front and to the heart without moving the patient or requiring him to breathe deeply; we can make a note of the temperature; and at the time we should do no more.

The throat should always be examined in doubtful cases of hæmoptysis, as the blood will sometimes be found to have issued from an ulcerated tonsil, or even from enlarged vessels on the posterior wall of the pharynx. *Spurious hæmoptysis*, however, may be defined as *the escape of a blood-stained mucus from the throat or gums.* In cases of spurious hæmoptysis there is usually distinct evidence of a morbid condition of these parts. The mucous membrane of the fauces is relaxed; the gums are spongy, and often bleed when the teeth are brushed in the morning. Sometimes this condition of gums arises from insufficient attention to the teeth; carious stumps and much tartar round the teeth causing irritation and sponginess of the gums. The patients are usually anæmic and short-breathed, and often complain of morning cough, but there is no evidence of lung-disease. The blood-stained mucus is usually ejected in the morning, on waking, and often escapes from the mouth during the night, staining the pillow. On examination, it is found to be a pink, watery mucus, uniformly stained, and containing comparatively few blood-corpuscles.

TREATMENT.—Absolute rest is the first thing to be observed in the treatment of all attacks of hæmoptysis. The patient should lie down with the head and shoulders raised by pillows. He should not talk. The room should be kept quiet and cool; the bed-clothes should be light, but sufficient; and warmth should be applied to the feet. A little ice in the mouth, or some iced water to sip, will ease the cough and tend to check hæmorrhage. The patient must, if possible, be reassured as to the absence of present danger, and the shock to the system allayed without the use of stimulants. Sometimes opium may be usefully given for this purpose, due regard being had to the habits and idiosyncrasies of the patient. Astringent medicines are not always needed in hæmoptysis, especially in attacks in which the hæmorrhage is presumably capillary; they may, however, be given in such cases in small doses. To be really useful in hæmoptysis, astringents must be given in full doses. Those most used are acetate of lead, four grains, every three or four hours; alum, twenty grains, with dilute sulphuric acid, thirty minims, every four hours; gallic acid, twenty to thirty grains every half-hour or hour, for two or three doses, followed by ten-grain doses every three hours; oil of turpentine, thirty minims every two hours in sweetened mucilage or in milk, for a couple of doses, then in half or third doses; liquid extract of ergot in half-drachm or drachm doses, every two or three hours; ten- or fifteen-minim doses of the pernitrate or persulphate of iron solution, or thirty or forty minims of the perchloride freely diluted. Of the above-mentioned astringent remedies, alum and sulphuric acid, gallic acid, and ergot are the best in the greater number of cases. Acetate of lead is less applicable to cases of lung-hæmorrhage than in bowel or kidney lesions. Ergot is to be preferred in those cases in which we infer that a considerable vessel has given way. It may also be given in the form of ergotin—½ to 2 grains hypodermically; but thus given it sometimes causes much local inflammation. Oil of turpentine is certainly one of the most powerful of astringents in pulmonary hæmorrhage, and may be usefully held in reserve. When freely administered the condition of the urine must be carefully noted. Cases of hæmoptysis only rarely occur in which it is well to give the iron astringents. As a rule they tend to increase pulmonary congestion; but in some cases, in which hæmoptysis has a tendency to continue after the patient has been brought to a state of profound anæmia from the first outburst, they may be usefully given, their effect being carefully watched. Digitalis is a drug sometimes of great value in hæmoptysis; it is best adapted to those cases in which there is much excitement of circulation. In cases, for instance, in which the hæmoptysis has been determined by intemperance, or in full-blooded people by effort, tincture of digitalis in twenty- or thirty-minim doses may be given. In such cases, in which the portal system is usually congested, sulphate of magnesia and dilute sulphuric acid may be combined with the digitalis, and given every four or six hours for a couple of days or so. In the treatment of hæmoptysis it is usually necessary to counteract the effect of the astringent upon the bowels by purgatives or laxatives. An enema may be necessary to enable the bowels to act easily and without straining. The use of the bed-pan must of course be enjoined.

Counter-irritation is of great value in the treatment of many cases of hæmoptysis, chiefly in those cases in which the hæmorrhage is not great, and occurs in the course of phthisis, being due either to local pulmonary congestion, or to active hyperæmia of the walls of a cavity. Blisters are, as a rule, best avoided in copious hæmoptysis during the stage of shock. Continuous cold to the chest is decidedly to be deprecated. The intermittent application of cold may sometimes be employed, but is a measure of doubtful expediency.

The temperature and pulse of the patient should be carefully watched during an attack of hæmoptysis, and for a few days afterwards.

The diet must at first be restricted to cold nutritious fluids; stimulants, except in special cases, must be interdicted.

The treatment of *false* or *spurious hæmoptysis* depends upon its cause. In most cases the cause being anæmia, with a relaxed and morbid condition of mucous membranes, an acid preparation of iron containing some chlorate of potash and glycerine will speedily cure the malady. When the gums are spongy, the addition of finely powdered kino or catechu to a chalk or charcoal tooth-powder, or the addition of some glycerine of tannin to the tooth-water will prove efficacious. Astringent gargles will suggest themselves in fitting cases; and fruit and vegetables must be added to the diet. R. DOUGLAS POWELL.

HÆMORRHAGE (αἷμα, blood, and ῥήγνυμι, I burst forth).—SYNON.: Fr. *Hémorrhagie*; Ger. *Blutfluss*.

DEFINITION.—The escape of blood from any part of the circulation, and its discharge from the body.

When blood escapes from any of its natural reservoirs, it is either extravasated into the neighbouring organs or cavities, or flows from one of the surfaces or orifices of the body. In the latter case only is the term 'hæmorrhage' strictly applicable (*see* EXTRAVASATION). This distinction, however, is not always carefully observed; and such expressions as 'cerebral hæmorrhage,' 'hæmorrhage into the pericardium,' and 'hæmorrhagic eruptions' are applied in connection with what are more correctly called *extravasations* of blood.

ÆTIOLOGY.—Hæmorrhage is almost always due to a solution of continuity of some part of the circulatory system, whether by injury or by disease. Hæmorrhage from the external surface of the body is, with few exceptions, the result of wounds or other form of injury; but ulceration—either simple or malignant—frequently lays open a vein or an artery, and aneurism of the great vessels, and even of the heart, may also give rise to external bleeding. Hæmorrhage from internal organs, on the contrary, is most frequently the result of disease, as, for instance, ulceration or aneurism, or of circulatory disturbance, such as congestion. Great excitement or severe exertion is one of the chief determining causes of hæmorrhage, by producing great or sudden rise of the general blood-pressure, whether by cardiac disturbance or by obstruction of the terminal vessels, and may even lead to the rupture of healthy vessels. Local disturbances of the blood-pressure give rise in the same way to congestion or hyperæmia, and finally to hæmorrhage. The principal causes of hæmorrhages of this class are diseases of the heart, of the great vessels, of the respiratory organs, and of the liver, and sudden variations in the atmospheric pressure or in the temperature; and such hæmorrhages are also in some instances undoubtedly of a *vicarious* nature. Certain conditions of the blood are believed to predispose to hæmorrhage, as, for example, in scurvy, purpura, the malignant fevers, chronic Bright's disease, and alcoholism. There is, probably, however, a lesion of the vessel-walls in some of these diseases. A peculiar condition of body is known as the *hæmorrhagic diathesis* or hæmophilia; the subjects of which exhibit, amongst other forms of debility, a remarkable tendency to profuse hæmorrhage from trivial causes. *See* HÆMOPHILIA.

SEATS AND VARIETIES.—Bleeding from the surface of the body, whatever its origin, is simply called *hæmorrhage*, and its exact source and situation are otherwise defined. On the other hand, when blood escapes by any of the natural openings of the body, and is derived from an internal organ, the hæmorrhage is described by a special name. Hæmorrhage from the nose is called *epistaxis*; from the ear *otorrhagia*; from the stomach *hæmatemesis*; from the respiratory tract *hæmoptysis*; and from the urinary tract *hematuria*. Blood passed *per anum*, after undergoing certain changes to be referred to immediately, is called *melæna*. *Menorrhagia* and *metrorrhagia* are the names given to profuse bleeding from the genital organs in the female, at the menstrual period and at other times, respectively.

DESCRIPTION.—The local phenomena that characterise hæmorrhage from the external parts of the body, vary with the source of the blood. If it proceed from an artery of considerable size, it escapes in the form of a jet, which is strengthened at each beat of the pulse as an active spurt. Blood discharged from an opened vein either flows in an abundant continuous stream, or wells up from the depth of the tissues in which the vessel lies. Capillary hæmorrhage is generally much less profuse, and is most frequently seen in the form of oozing. Blood proceeding from internal organs is variously discharged by the several outlets. Sometimes it is immediately expelled, especially if in quantity; or it may escape even when in small quantity, owing to gravitation, as in hæmorrhage from the nose. Most frequently the blood is retained for a time, and then, acting as a foreign body, is ejected; for example, in bleeding from the stomach, bowels, or bladder.

Characters.—Blood flowing from the surface of the body usually presents its familiar characters. The colour of the blood will be scarlet when it is derived from an artery; purple, with a tendency to become scarlet on the surface, when it flows from a vein; and of a tint intermediate between these two colours when the hæmorrhage is capillary. In all cases, the blood coagulates more or less abundantly around the seat of hæmorrhage.

In hæmorrhage from internal organs, on the contrary, the blood is frequently coagulated; more or less mixed with the fluids of the part; or otherwise altered during its transit. The following are the principal changes that blood undergoes in its passage towards the several outlets of the body:—

Blood flowing from the *external ear*, or from the *anterior nares*, is frequently thin and watery, if the hæmorrhage have lasted for any length of time. Blood discharged from the *posterior nares* is often coagulated, black, and mixed with thick mucus. In hæmorrhage from the *mouth*, the blood may be derived from that cavity; from the fauces; from the respiratory passages; or from the upper portion of the digestive tract—especially the stomach. When the blood flows from some part of the *mouth*, such as the gums, tongue, palate, or cheeks, it is more or less intimately mixed with frothy saliva and mucus. In hæmorrhage from the *respiratory passages*, or from the *stomach* through the mouth, the ejected blood varies extremely in different instances. Hæmorrhage from the genito-urinary tract is also specially described. Hæmorrhage from the bowels is not peculiar, if the source of the blood be near the anus, or if the bleeding be very profuse; taking the form sometimes of a gush of fresh, warm blood, at other times of a mere red streak upon the fæces. If the blood be derived from a higher part of the intestines, the appearace of it, when discharged, will be different. Generally it is so far altered by the action of the various intestinal contents, as to be converted into a black tarry-looking mass (*see* MELÆNA). Less frequently, the bleeding may be so profuse as to fill a considerable portion of the bowel, and clots of blood may then be passed, as in some cases of hæmorrhage in typhoid fever. The peculiar characters of *menstrual* blood are described elsewhere. Hæmorrhage from the *uterus* in large quantity consists of unaltered blood, whether coagulated or not.

Course and Terminations.—Hæmorrhages caused by wounds are generally most profuse at first; and, unless they prove fatal speedily, or are artificially arrested, gradually cease. On the contrary, hæmorrhages due to disease are frequently insignificant at first, and increase in amount; or they recur again and again in variable quantity.

Many natural causes contribute to the arrest of hæmorrhage, the most important being—weakening of the force of the heart by the loss of blood; the contraction of the coats of the vessels at the seat of lesion; the coagulation of the blood—first around, and then within the open vessel; the pressure of the extravasated blood in the surrounding tissues; and the increased coagulability of the blood after the flow has continued for some time. The relief of the local disturbance of pressure by the occurrence of the hæmorrhage, is alone sufficient in many instances to arrest the flow.

Effects.—The effects of hæmorrhage are chiefly exerted upon the system generally; and they are therefore remarkably uniform, whatever may be its locality. The circumstances that more especially affect the intensity of the effects or symptoms are two, namely, the amount of blood lost, and the rapidity of the flow. When hæmorrhage is at once free and persistent, syncope rapidly ensues, probably accompanied by convulsions, and ending speedily in death unless the bleeding either spontaneously cease, or be artificially arrested. The sudden loss of one half of the total amount of blood in the body (say five pounds) is said to be sufficient to cause death. On the other hand, enormous quantities of blood may be lost without a fatal result if the hæmorrhage be slow, or frequently repeated with considerable intermissions. The condition of the subject of the hæmorrhage then becomes one of anæmia (*see* Anæmia). More moderate bleedings frequently repeated produce faintness, and may cause a certain degree of pallor, which shortly disappears. Moderate hæmorrhages from certain situations, for example from the nose, rectum, or even the lungs, may sometimes relieve congestion, and be attended with great relief and benefit.

Local effects do, however, occur in some forms of hæmorrhage. Hæmoptysis may be accompanied by inhalation of blood, and lead to inflammation or more complex disease of the lungs. Hæmorrhage into the uriniferous tubules causes plugging of these, and discharge of blood-casts. Blood retained in the generative or in the respiratory passages occasionally becomes decomposed. The special symptoms of the several forms of hæmorrhage are described under the head of each.

Treatment.—The treatment of hæmorrhage from external parts is a subject of purely surgical interest; but it may be said that, in cases of emergency, moderate pressure with the finger or other means, on the seat of the bleeding, is generally practicable and successful. Hæmorrhage from internal parts requires special treatment according to the particular organ from which it is proceeding. The reader is, therefore, referred to the several articles on Epistaxis, Hæmatemesis, Hæmaturia, Hæmoptysis, Melæna, and Menstruation, Disorders of; as well as to the articles on Hæmostatics, and Styptics.

J. Mitchell Bruce.

HÆMORRHAGIC (*αἷμα*, blood, and *ῥήγνυμι*, I burst forth).—Associated with hæmorrhage. The word is applied to certain inflammatory products or to effusions when they contain blood, as in *hæmorrhagic peritonitis*; and to varieties of certain diseases in which extravasations or hæmorrhages from free surfaces occur, for example, *hæmorrhagic small-pox*, *hæmorrhagic measles*, and *hæmorrhagic purpura*.

HÆMORRHAGIC DIATHESIS. *See* Hæmophilia.

HÆMORRHOIDS (*αἷμα*, blood, and *ῥέω*, I flow).—Synon.: Piles; Fr. *Hémorrhoïdes*; Ger. *Hæmorrhoiden*.

Description.—The hæmorrhoidal veins distributed to the lower part of the rectum are very liable to become dilated and varicose, giving rise to a disease termed *hæmorrhoids* or *piles*. When the plexus beneath the mucous membrane within the external sphincter is thus affected, the hæmorrhoids are said to be *internal*. When the veins beneath the integuments outside the muscle are enlarged, the hæmorrhoids are called *external*. Internal and external hæmorrhoids very frequently co-exist.

External Hæmorrhoids.—We may distinguish two kinds of external piles:—(1) A *sanguineous tumour*. (2) A *cutaneous excrescence* or outgrowth.

(1) The *sanguineous tumour* consists of a softish elevation of the skin near the margin of the anus, of a rounded form, and a livid or slightly blue tinge. On cutting into it, we find a dark-coloured coagulum enclosed in a cyst.

(2) The *cutaneous excrescence*, or second form of external piles, consists of a flattened prolongation of skin, due to hypertrophy of the epidermis, papillæ, and cutaneous layers. It is generally the result of the first form, a projecting fold left after absorption of the coagulum having undergone further growth. Often there is only a single broad flat excrescence at the side of the anus; but sometimes there are two, one on each side; and occasionally there are several encircling the anus. Similar excrescences occur as the result of irritating discharges from the bowel, and are common in stricture and chronic ulceration of the rectum.

Internal Hæmorrhoids.—Internal piles seldom attract attention until they have become so developed as to protrude at the anus in defæcation. They then exhibit a remarkable diversity of appearance, according to their number, size, and condition. The protrusion may consist of only one large pile, found usually towards the perineum, especially in women. More commonly there are three distinct prominent growths, differing in size, one at each side of the anus, and a third in front—the latter, the perineal, being the largest. In old cases they may be more numerous—as many as four or five. The distinction between them is commonly well-marked, but not always, for the piles sometimes merge into each other, so that the protrusion forms nearly a circular prominence. The aspect of extruded piles depends much upon their condition, whether congested, inflamed, or constricted by the sphincter. In an inactive state, and in a relaxed condition of the sphincter, they form softish tumours of a granular appearance, presenting just at the orifice of the anus; but when protruded and congested, they constitute large tense tumid swellings, of a deep red colour and smooth surface, which readily bleed. When hæmorrhoids are of large size, the integuments at the margin of the anus become everted, and form a broad band girting the base of the tumours. The skin thus everted is liable to be mistaken for external piles, and to be excised in operations—an error very likely to be followed by serious contraction of the anus.

Ætiology.—Hæmorrhoids are a disease of middle and advanced age. They rarely occur before puberty; and but few persons in after-life altogether escape them. All circumstances which determine blood to the rectum, or which impede its return from the pelvis, tend to produce this disease. There is in many persons a natural predisposition to the complaint, which may be hereditary. But a predisposition is most frequently acquired by sedentary habits, indulgences at table, and excitement of the sexual organs. Hæmorrhoids, though a common disease in both sexes, occur more frequently in males than in females. Few women bear children without becoming in some degree affected by them; but the urinary and genital disorders of the other sex, combined with freer habits of living, leading to congestion of the liver, are still more fertile sources of piles.

Symptoms.—The symptoms produced both by external and internal piles vary greatly in different subjects, and in different stages of the complaint.

External piles cause a feeling of heat and tingling at the anus. A costive motion is followed by a burning sensation, and the excrescence becomes swollen and tender on pressure, so as to render sitting uneasy. This congested state of the pile may pass off; or it may lead to inflammation accompanied with considerable enlargement of the hæmorrhoid, forming an oval tumour, red, tense, and extremely tender. The inflammation may subside or go on to suppuration. When the matter is discharged, a clot of blood escapes with it, the abscess closes, and the dilated vein is usually obliterated, the pile being reduced to a small flap of integument. External piles rarely give rise to bleeding.

Internal piles, when slight, may exist for years, causing little inconvenience besides slight bleeding after a costive motion; with occasionally a feeling of fulness, heat, and itching just within the anus. If only small, they protrude slightly with the mucous membrane in defæcation, returning afterwards within the sphincter. When of large size, the piles always protrude at stool, and require to be replaced, the patient usually pushing them up with his fingers. In a lax state of the sphincters, and in a loose hypertrophied condition of the mucous membrane from which they spring, hæmorrhoids come down, even when the patient stands or walks about, so as to prove exceedingly troublesome, and to interfere with his taking walking exercise. In consequence of the irritation from pressure and friction to which the protruding piles are liable, their mucous surface becomes tumid and abraded, and furnishes a free mucous discharge tinged with blood, which soils the linen. They are often so sore that the patient is obliged to keep the recumbent posture, the pressure in sitting causing more or less uneasiness.

Persons subject to piles frequently suffer no inconvenience from them until irritated by an unusually costive motion, or by a smart purgative; or when, under the excitement of wine, the growths become congested and inflamed, and cause spasm of the sphincter muscle. Then they have what is termed an 'attack of piles'—that is to say, they experience a sensation of heat, weight, and fulness just within the rectum, followed by considerable pain at stool, and sometimes irritation about the bladder. These symptoms, which are often attended with febrile disturbance, arise from inflammation and swelling of the piles, which afterwards subside, but seldom without leaving some enlargement of the growths. The formation and increase of piles seem indeed to arise chiefly from a determination of blood to the rectum. This is greatly promoted by stimulating drinks, so that some patients never suffer from the complaint except after indulging in this way. They are then rendered sensible of an afflux of blood by a sense of heat or intolerable itching at the anus.

Strangulation.—When internal piles of some size protrude at the anus and are not returned, they are liable to be constricted and strangulated by the external sphincter. The contracted muscle impedes the return of blood, and occasions inflammatory swelling of the piles, which may become strangulated and mortify. In this way hæmorrhoids of large size have been known to slough off, the patient being relieved of the annoying complaint by a sort of natural process. An occurrence of this kind is attended with a good deal of pain and suffering, but is free from danger. In general, the extremities only of one or two of the larger growths perish, and the patients, though experiencing relief, are by no means cured of the disease.

Hæmorrhage.—One of the most common symptoms of internal hæmorrhoids, indeed that from which the name of the complaint is derived, is hæmorrhage, which occurs when the bowels are evacuated. The bleeding varies greatly in amount. Sometimes the motions are merely tinged with a few drops of blood; in other instances the quantity lost is considerable, several ounces being voided at stool. The bleeding may be irregular, occurring only after costive motions, or in certain states of health; or it may take place daily, going on even within the bowel, and producing the usual symptoms of derangement from continued losses of blood, such as blanched complexion, loss of strength, quick small pulse, and even œdema of the feet. The character of the bleeding also varies, being sometimes venous, sometimes arterial. There are persons who are liable to discharges of blood from the hæmorrhoidal veins, either at regular periods, or when, from good living or want of exercise, the habit is fuller than usual. In these cases from three to six ounces of blood, or even more, pass away at stool, following the evacuation; and the blood which is voided is of a dark colour and evidently venous. Such discharges must not be rashly interfered with. They relieve congestion of the liver and kidneys, help to ward off attacks of gout, and prevent fits of apoplexy; so that in many persons they are rightly regarded as safety-valves. But the bleeding which most commonly occurs from internal piles is undoubtedly arterial, taking place from arteries enlarged by disease. The vessels on the spongy surface of the mucous membrane readily give way when blood is determined to the part in defæcation, or when abraded by the passage of hard fæces. An artery of some size, exposed by ulceration, continues to pour out blood, weakening the patient and giving rise to the symptoms above described. Sometimes a small artery on the prominent part of a protruded pile may be observed pumping out blood. That hæmorrhage of this character is good for the health, is quite a mistaken notion; and it is important that the practitioner should distinguish the bleeding taking place as a consequence of local disease, from that which arises from a constitutional plethora or congestion of the internal organs.

Treatment.—When piles are small and cause but little inconvenience, the treatment is very simple. Persons with this complaint should take wine in great moderation, if at all; and in most instances they would do well to abstain entirely from stimulating drinks. Many individuals never suffer from piles except after taking a glass of spirits and water, or a few glasses of wine. Such persons should become water-drinkers. Active exercise in the open air should be taken daily, and the patient should avoid sitting too long at the desk, because it is by prolonged sedentary occupation and the neglect of the rules of health that hæmorrhoidal complaints are induced. Chairs with cane seats are to be recommended. The bowels must be carefully regulated, so as to avoid hard and costive motions, as well as frequent action. Irritating the rectum by active and repeated purging is more hurtful even than constipation. On the other hand, when the liver is congested, or its secretions are sluggish, and when the bowels are costive, a mild cathartic, by clearing the intestines, especially the colon, unloads the congested vessels, and relieves the piles. Lenitive electuary, rendered more active when necessary by the addition of tartrate of potash, may be taken at bedtime; or the compound liquorice powder of the Prussian pharmacopœia, Carlsbad salts, or the foreign mineral waters—the Pullna, the Friedrichshall, or the Hunyadi-Jànos—taken in the morning fasting, answer well with many persons, and ensure a comfortable relief. Half a pint of cold spring water injected into the rectum, in the morning after breakfast, has a very beneficial effect on the hæmorrhoids, by constringing the vessels, and softening the motions before the usual evacuation. The relief afforded by this treatment, combined with care in the mode of living, is often remarkable. Ordinary venous bleeding may be stopped in this way. If necessary, iced water, or an astringent injection, such as a solution of tannic acid or infusion of rhatany, may be used; or an astringent suppository. When the bleeding is arterial, injections are not so successful, and operative treatment often becomes necessary. When there is a slimy discharge from the surface of an exposed internal pile, benefit may be derived from the daily application of tannic acid, mild citrine ointment, or the solid sulphate of copper.

External piles, when large and troublesome, and internal piles when of such a size as to protrude at stool and to be subject to inflammation, ulceration, and frequent bleeding, can be removed only by operation. T. B. Curling.

HÆMOSTATICS (αἷμα, blood, and στατὸς, stopped).

Definition.—Internal remedies and local applications which arrest hæmorrhage.

Enumeration.—The chief hæmostatics are:—The Ligature; Pressure; Rest; Cold; the Actual Cautery; Astringents; and the whole class of Styptic drugs.

Actions and Uses.—When taken in their widest sense, it is evident that hæmostatics must include all the various means which have been devised to stop bleeding. Externally we must vary our plan of treatment according to circumstances. No surgical principles are better founded than those which enjoin us to tie a wounded artery, and to apply pressure to a vein; and for the absolute arrest of hæmorrhage from any readily accessible part a most powerful aid has lately been provided in Esmarch's elastic bandage. When the bleeding depends on general capillary oozing, the application of ice may often prove effectual; and where this fails, recourse must be had to some of the numerous articles of the pharmacopœia, already referred to, which are endowed with styptic properties. (*See* Styptics.) An example of the successful application of a hæmostatic is the arrest of uterine hæmorrhage by means of injections of perchloride of iron.

In the case of undue hæmorrhage from a leech-bite, if milder remedies, such as pressure, do not succeed, we may apply the solid nitrate of silver, or include the bleeding point in a loop of twisted suture. Absolute rest is essential for the successful treatment of hæmorrhage; and the regulation of the diet and of the bowels is equally to be attended to. For the details of treatment in each particular form of hæmorrhage, the reader is referred to Hæmatemesis, Hæmophilia, Hæmoptysis, Melæna, &c.

Robert Farquharson.

HÆMOTHORAX. *See* Hæmato-thorax.

HAIR, Diseases of.—Aberrations of the hair from the normal and healthy standard may be comprised under three heads—*quantity*, *quality*, and *direction*.

Alterations in quantity.—As regards quantity of the hair, there may be either *excess* or *diminution*.

Excess of hair.—Excess may be the consequence of multiple development from the follicles, leading to the production of a greater number of hairs than usual; or it may result from excessive growth, which brings into view the usually invisible hairs of the body, more or less generally or partially. Of the latter kind are the hairy men and women of whom so many instances are recorded; and the abnormal growth of hair on parts of the body where its presence is normally but little perceptible, for example, on the face of women, in the form of moustache, whisker, or beard. The hair of the head, as well as that of the beard, sometimes attains an excessive length. Moreover, hair may be abnormal in situation as well as in growth, as seen in the varied examples of pilous nævi.

Diminution of hair.—Diminution may present itself as shortness in length from slowness of growth, or numerical deficiency from arrest of growth; and the latter may proceed onwards to baldness more or less complete. *See* BALDNESS.

Alterations in quality.—Alterations of quality of the hair are manifested by variations in its *physical conditions*, alterations of *colour*, and pathological changes of *structure*.

Physical conditions.—The hair, normally smooth, lustrous, soft, and elastic, may become rough, dull, harsh and rigid, or brittle.

Colour.—Alteration in colour of the hair usually ranges between the lighter tints of childhood and the darker hues of the adult, and the arrest of pigmentation which gives rise to the greyness of every period of life and the hoariness of old age. Absence of pigment, complete or partial, is sometimes congenital. Alterations of the colour of the hair occasionally take place during the course of a serious illness; or the hair may become blanched in the space of a few hours from mental disturbance. There is another aberration of colour of the hair, which consists of an alternation of brown and white in narrow segments, extending from end to end of the hair—a kind of 'ringed' or 'banded' hair. A few examples of this peculiar change in the hair have been preserved and recorded.

Structure.—Aberrations in structure of the hair are shown by its atrophy or attenuation; by its defective consolidation; by a pathological alteration of its elementary constituents; and by the morbid changes induced by syphilis. It is not uncommon to find the hair dwindled to a mere vestige of its original bulk; and, when this takes place, it is apt to break off near the point of attenuation, and present the appearance of a club-shaped stump. Broken hairs of this character, with filamentary pedicles, are found at the circumference of a spot of alopecia areata. Or the hairs may be fragile in texture, and break partially through at short distances, so as to give a speckled appearance to the hair-shaft. This change is generally met with in the thick hairs of the whiskers and beard, and is termed *trichoclasia* or *fragilitas crinium.* In tinea the formative cells of the hair retain their elementary fœtal form, or proliferate in the substance of its shaft, rendering it brittle and causing its destruction; the cell-proliferation constituting the trichophyton among the parasitic fungi. In syphilis, the hairs of the whiskers and beard have been found swollen, as though varicose, and discoloured from imperfect cell-development.

Alterations in direction.—Altered direction of the hair is met with on the edges of the eyelids, where the hair may grow inwards and press against the cornea, so as to give rise to conjunctivitis; this form of affection being termed *trichiasis.* The matting or felting of the hair in *plica polonica* may likewise be ascribed to misdirection, though in a different sense, namely, as resulting from neglect.

ÆTIOLOGY AND PATHOLOGY.—Numerical quantity of hair can be considered pathological only when that quantity interferes by its *excess* with the comfort and convenience of the individual. This can rarely occur when the hair is produced in normal situations, and grows to excessive length, the remedy being obvious. But when it is developed on the face of the female in the form of moustache, whiskers, or beard, it is then an annoyance very nearly approaching to that of a disease. This is still further increased when the greater part of the body becomes invested, as sometimes occurs, with a thick, hairy covering. An excess of pilous growth is, in general, a mere augmentation of a natural function; occasionally, it appears to be the result of a substitutive function, as in sterile females, or when the procreative power is exhausted through age; and at other times, as in pilous nævi, it is due to abnormal organisation of the affected skin.

Diminution of quantity of hair, and arrest of pilous growth, must in every instance be due to aberration of nutrition, and atrophy of the formative papillæ of the hair. This may be the consequence of debility, however induced, whether by age or disease. Very commonly the hair breaks away from the papilla without undergoing any previous alteration of figure. At other times it becomes attenuated and starved before it eventually drops off. Sometimes the nutritive power is simply suspended; while at other times it is completely arrested, temporarily or permanently, and gradually or on a sudden. After serious illness the hair is apt to fall off; not unfrequently this occurs after puerperal confinement; dropping off of the hair is known to be a frequent concomitant of syphilis; and it presents the characteristics of a nerve-lesion in *alopecia areata.* In cases of universal baldness the skin is soft, pulpy, and feeble; deficient in colour as well as in firmness and tone; and smooth from the absence of papillæ.

Alteration of *colour* of the hair is generally attributable to variations in quantity, and modification of pigment. But in cases of sudden blanching of the hair, the apparent whiteness has been found to depend on the rapid development of a gaseous fluid within the substance of the hair, obscuring the pigmentary granules to which its colour is due. This has likewise been observed to be the case in the instance of ringed or banded hair.

Alterations of *structure* of the hair are for the most part due to modifications of development and growth of its constituent cells. The elementary cells may be produced in greater or less quantity, changing the bulk of the hair; they may be more or less abundantly and completely converted into hair-fibre; they may retain permanently their undeveloped or cell-character.; or they may become the subject of an abnormal proliferation within the shaft of the hair. As the firmness, elasticity, and pliancy of the hair are due to the perfection of its development, so the opposite qualities are referable to abnormal development. The shaft of the hair often varies in its diameter; the medullary space equally varies; it may be fractured completely, as in ringworm; or partially, and with slight force, as in *trichoclasia*. The hair of ringworm is made up of round cells and proliferating cells, with a deficiency of fibrous structure; hence it dries and shrivels up as though withered, or breaks off close to the head, leaving behind short stumps. When syphilis attacks the hair, its structure is likewise rendered brittle.

TREATMENT.—The therapeutical treatment of the diseases of the hair may be summed up very briefly. Where the hair is in excess it must be removed; where it is deficient it must, if possible, be restored; and where its structure is altered, it must be repaired by renovating the health of its formative organ, the skin.

Contrivances for removing the hair are termed depilatories; they act for the most part by destroying and dissolving the hair. Their application requires caution, on account of their irritant qualities, and they are open to the objection of being merely temporary in their effects. The only trustworthy depilatory is the razor. *See* DEPILATORIES.

For defect of growth in length, as also in quantity, we must have recourse to tonic or stimulant remedies. Tonics, such as arsenic, quinine, and iron, improve the nutritive power of the skin; and stimulants for external application arouse the energies of the tissues of the skin, more especially those of the blood-vessels and nerves. The usual stimulants adopted for this purpose are ammonia, cantharides, mustard, the various stimulating liniments, and acetic acid. *See* BALDNESS.

For the purposes of fashion or convenience, the colour of the hair may be discharged by solutions of oxygen, notably the peroxide of hydrogen; and also by alkalies, with more or less injury to the hair. It may be restored artificially by the various hair-dyes, which are either temporary or permanent. Of the former kind are the permanganate of potash, and the black oxide of lead; and of the latter the black oxide of silver.

Alterations of structure of the hair due to debility of the skin require the aid of constitutional tonics and local stimulants. Where ringworm is the cause of the morbid change of the hair, there is a chronic inflammation to be subdued, as well as a feebleness of nutritive power to be repaired. In the fall of the hair from syphilis, the specific remedies for that disease are required.

Aberration of direction of the hair may be corrected by avulsion with the forceps; and the felting of the hair in plica polonica may be prevented by ordinary care and attention.

ERASMUS WILSON.

HALL, in Austria. Common salt waters. *See* MINERAL WATERS.

HALLUCINATION (*hallucinor*, I blunder).—A false perception of an organ of sense, for which there is no external cause or origin (*see* ILLUSION); as when a man in total darkness thinks he sees an object. Hallucinations of all the senses occur, the most frequent being those of sight and hearing. They may be found in persons not insane, but indicate a disordered state of brain.

HANGING, Death by.—Hanging is the effect of suspension of the body by the neck by means of a ligature or noose, the constricting force being the weight of the body, wholly or in part, or the weight multiplied by the distance through which the body falls. The mode of death varies according to these circumstances. With a long drop, the method now usually employed in judicial hanging, and particularly if the knot is under the chin, death is not unfrequently due to fracture, or displacement, of the cervical vertebræ, and injury to the medulla oblongata. Death may also occur, without such anatomical lesion of the cervical vertebræ, from shock or syncope, or, as it is termed by Casper, neuro-paralysis.

When death does not occur in either of these ways, it is the result of asphyxia from occlusion of the air-passages, or rather of asphyxia in combination with coma, caused by compression of the cerebral blood-vessels. Though compression of the carotids and jugulars may be maintained for a considerable time without a fatal result, if the trachea is open below the point of constriction, whereas death speedily ensues if the air-passages are also occluded, yet death may result from the disturbance of the cerebral circulation alone, and the two causes always operate conjointly in every case, in varying proportions.

PHENOMENA.—When death is not instantaneous, as in cases of injury to the medulla, or from neuro-paralysis, convulsive movements of the type seen in asphyxia may continue for some minutes after suspension, and the heart may continue to beat for a considerable period after all other vital movements have ceased.

Subjects who have been partially hanged have described various sensations, more or less pleasurable, similar to those of cerebral congestion and narcotic stupor.

POST-MORTEM APPEARANCES.—The appearances found after death by hanging are not uniform or constant; and there is no single sign invariably present diagnostic of death by hanging. Indicative of suspension, but not necessarily of death so caused, is the mark of the cord on the neck. Usually it is above the hyoid, passing obliquely upwards behind the ears, and losing itself in the occiput. But the position may vary according to the tightness of the noose before suspension, or the position of the head and direction of the pressure. It is generally single, but if the cord should have been twisted twice round the neck, two marks may be found, one circular and the other oblique. The characters of the mark differ somewhat according to the texture and thickness of the ligature. Usually it is a shallow groove or furrow of a whitish or brownish hue and parchmenty consistence, occasionally abraded, rarely ecchymosed; but it may have livid edges or a chocolate tint. The appearances may vary in different parts of the same mark. The subcutaneous cellular tissue is compressed and silvery. Occasionally minute extravasations are seen in the deeper layers of the skin. The middle and internal coats of the carotids are sometimes lacerated; and where the momentum has been great, lacerations of the cervical muscles, fracture of the larynx, rupture of the thyrohyoid ligaments, and fracture or dislocation of the cervical vertebræ, with injury to the medulla and effusion into the spinal canal, have been found. All the appearances usually found in the neck in cases of hanging may be produced by suspension of the dead body, especially if the legs are pulled forcibly downward.

The face is sometimes, but not commonly, distorted and expressive of suffering. Usually it is placid and pale, though if the body have hung for some time, it becomes very livid. The eyes are sometimes very prominent, and the pupils are usually dilated. Frothy mucus may be found at the mouth and nostrils. The tongue is pressed against the teeth and indented, or it may be clenched between the jaws. The base of the tongue is injected. The hands are often tightly clenched, the nails even being driven into the palms. Erection, or semi-erection, of the penis in men, with expulsion of semen or prostatic fluid, and vascular turgescence of the genitals in females, with sanguinolent effusion, are frequently observed. Expulsion of the contents of the bladder and rectum is likewise common. The condition of the brain varies. Congestion is sometimes pronounced, at other times not very marked. The mucous membrane of the larynx and trachea is congested, and mucous froth is present. The lungs are at times pale and distended; at other times collapsed. The condition of the heart and venous system characteristic of asphyxia is common. Marked redness of the mucous membrane of the stomach, simulating irritant poisoning, has been occasionally noted. The determination of the fact of death by hanging depends on a consideration of these various phenomena, and the absence of other causes of death.

Accident, Suicide, or Homicide?—Hanging is rarely homicidal. It signifies great disproportion of strength between the assailant and the victim; and, therefore, in the absence of this condition, there will be injuries indicative of a struggle. Apart from collateral circumstances, homicide can only be argued from the presence of such injuries as could not have been self-inflicted, or caused accidentally during the act of suspension. Occasionally hanging is accidental, as in foolish experiments and insane imitation. It is not necessary that the body should be entirely off the ground to cause death by hanging. Many instances are recorded of suicide by hanging in most extraordinary positions calculated to throw the greater part of the body-weight on the noose.

Treatment.—This is rarely called for, except in accidents or attempted suicide. The body must be cut down, and artificial respiration employed. Venesection may be had recourse to for relieving cerebral congestion. *See* Artificial Respiration; and Resuscitation. D. Ferrier.

HARROGATE, in Yorkshire. Saline, chalybeate, and sulphur waters. *See* Mineral Waters.

HASTINGS, on the South-East Coast of Sussex. A mild climate. Mean winter temperature, 39° Fahr. Exposed to the east, but sheltered from the north. *See* Climate, Treatment of Disease by.

HAUT MAL (Fr.)—A synonym for epilepsia gravior. *See* Epilepsy.

HAY FEVER.—Synon.: *Catarrhus æstivus*; Bostock's catarrh; Hay asthma; Fr. *Asthme d'été*; Ger. *Frühsommercatarrh*.

Definition.—A catarrhal affection of the mucous membrane of the eyes, nose, mouth, pharynx, larynx, and bronchi, accompanied by dyspnœa; induced by the action of the pollen of various plants, chiefly of the graminaceæ; prevalent during the hay season, but subsiding at its close; and varying in severity according to certain atmospheric conditions, and the amount of pollen present in the air.

Ætiology.—Hay fever exists in Europe generally, but it is by far most common in England, where the annual number of cases is double that of any other country. It prevails more among men than women, probably because the former are most exposed to the atmosphere; and inhabitants of towns visiting the country are more liable to attack than the country people themselves. It has been ascribed by some writers to the sun's heat in the summer months, also to certain odours, vegetable and animal; but the experiments of Mr. C. H. Blackley show it to be due to the specific influence on certain mucous membranes of the pollen grains of the following natural orders of plants:—Ranunculaceæ, Papaveraceæ, Fumariaceæ, Cruciferæ, Violaceæ, Caryophyllaceæ, Geraniaceæ, Leguminosæ, Umbelliferæ, Rosaceæ, Liliaceæ, Compositæ, Graminaceæ, and others, both exotic and native. Pollen was applied to the mucous membrane of the (1) nares, (2) larynx, trachea, bronchial tubes (by inhalation), (3) conjunctivæ, (4) tongue, lips, and fauces; and in all these cases it produced the symptoms of hay fever, the pollen of grasses being most potent. Amongst these secale cereale, or rye, exercised most marked effects, though greater influence is generally attributed to anthoxanthum odoratum.

It has been found that large quantities of pollen float in the air during the summer months; and that the number of cases of hay fever depends on the amount present, which increases in warm damp weather, decreases when it is very dry and hot, and often nearly disappears after heavy rain. Cold weather reduces the number of sufferers by checking the inflorescence of plants. The higher strata of the atmosphere appear to contain more than that immediately overlying the soil, and Mr. Blackley found the greatest number of pollen-particles at between 1,000 and 1,500 feet above the earth's surface, whither they are probably carried by aërial currents. The number of pollen-grains present reaches its maximum in June, when Mr. Blackley collected 880 in a day on a square centimetre of glass. The size and forms of the pollen-grains vary greatly in the different species, but this does not seem to influence their action, which appears to depend on the pollen-sac absorbing moisture from the contiguous mucous membrane and bursting, when the minute granules it contains are thus extruded, and cause irritation.

SYMPTOMS.—An attack of hay fever generally occurs without any premonitory disturbance, immediately on the application of the pollen to the mucous surfaces, for instance, when the person enters a hay-field. The first symptoms are itching of the parts with which the particles come in contact, beginning with the hard palate and fauces, and then extending to the nostrils, the eyes, and face, though, if the wind be strong, the eyes may be first attacked. The catarrhal stage follows, marked by violent fits of sneezing, and running from the eyes and nose, with occasional pains in the head and in the frontal sinuses; then the submucous tissue of the nares swells; and in a short time both nostrils become blocked and impervious to air. A change to the recumbent position, however, if the patient lies on one side, will often reopen the uppermost nostril, while the other, from the force of gravity, becomes still more occluded. The sneezing will continue without fresh application of pollen, as at night, when the subsidence of the swelling restores, or even exaggerates, the sensibility of the Schneiderian membrane. The alæ nasi become red and inflamed, and occasionally bleed. The discharge after this becomes less in quantity, inspissated and puriform, and finally subsides. In the eyes, the swelling of the submucous tissue causes closure of the lachrymal canals and nasal ducts, and considerable injection of the conjunctival capillaries is apparent. Sometimes, but rarely, œdema of the eyelids follows. Similar to the nose-symptoms are those occurring in the throat, some swelling taking place in the pharynx, which gives rise to partial closure of the Eustachian tubes, and hence to a certain degree of deafness. Slight feverishness is occasionally present, the pulse quickening to 100, and the temperature slightly rising; but in a large number of cases pyrexia is entirely absent. The changes which take place in the mucous membrane of the air-passages give rise to asthmatic symptoms, such as tightness of the chest, difficult and wheezy breathing, with prolonged expiration, and some dry cough, followed, at the close of the attack, by expectoration.

The catarrhal symptoms are, however, more characteristic than the asthmatic, which are not invariably present.

The liability to attack lasts generally from three to four weeks in summer, but its duration depends on the presence of the exciting cause, which, if not removed, may cause the malady to last for months. A fall of rain will diminish the disorder by clearing the air of pollen; exercise, which increases the number of respirations and, therefore, of pollen-grains inspired, will render it more severe; while each attack makes the individual more susceptible to this subtle influence, and, consequently, augments the probability of other seizures. As a rule, hay fever has no complications, and passes away completely on the removal of the exciting cause. Constant recurrence of the attacks has been noticed to lead to deafness, owing to catarrh of the Eustachian tubes.

DIAGNOSIS.—The diagnosis of hay fever from other affections is easy, as the occurrence of the catarrhal symptoms only in summer separates it from an ordinary 'cold in the head'; while their combination with dyspnœa in hay fever prevents it being mistaken for spasmodic asthma arising from other causes, in which there is usually no catarrh.

PROGNOSIS.—The prognosis is favourable if the patient be removed from the exciting cause, as the asthmatic symptoms seldom, if ever, lead to pulmonary emphysema, or to any permanent change in the bronchi.

TREATMENT.—The most obvious course in the treatment of hay-fever, but not always the most easy one, is to avoid exposure to pollen. Mr. Blackley notices that a small amount of this material might exist without giving rise to hay fever, but if ten grains of pollen were detected on the glass slide exposed to the air for twenty-four hours, symptoms were sure to appear in persons liable to it. Sufferers from this complaint should avoid hay-fields, hay-ricks, and much exposure and exertion in the country during the hay season, and should remain to a great extent within doors; but where circumstances admit, change to the seaside is highly desirable, and it generally effects a speedy cure. Even on the coast some care must be taken to select a locality free from vegetation; for if the wind blows from the land, where hay-grass be flowering at the time, an attack may be induced. Choice should be made of a seaside place backed with high cliffs, and where the prevailing winds are from the sea. Of other localities, high mountain stations, where there is more grazing than hay-growing, and closely inhabited cities with few parks or grassy squares, are to be preferred. Cotton-wool and other respirators available are sometimes used with advantage.

The medicinal treatment consists in first combating the general predisposition to the complaint by tonic measures; and, secondly, in allaying the local irritation.

The first object is best achieved by shower baths, and by such tonics as iron, quinine, nux vomica, sulphate of zinc, and arsenic. Lotions of sub-acetate of lead or sulphate of zinc applied to the eyes and inner surface of the nostrils give some relief; but the writer has found the most successful results from the use of the spray-apparatus, containing solutions of carbolic acid (eight grains to an ounce), sulphurous acid (equal parts with water), sulphate of quinine (two grains with acid to an ounce), and tannic acid (four grains to an ounce). The spray may be applied to all the irritated surfaces—eyes, nose, throat, and larynx—with great relief. C. THEODORE WILLIAMS.

HEADACHE.—SYNON.: Cephalalgia; Fr. *Douleur de tête*; Ger. *Kopfschmerz*.—Pain or uneasiness in the head is very variable in its nature, and produced by a great number of causes. It is present at some period or other in the course of most acute, and many chronic diseases; and may be associated or not with organic change in the brain, or in other organs of the body.

SYMPTOMS.—Headache presents many varieties. It may be slight or most intense; superficial or deep-seated. It may be more or less confined to particular parts, as the forehead, the temples, the occiput, or vertex. Sometimes the pain is limited to one spot, producing the sensation as if a nail were being driven into the head, when it is called *clavus*. It may extend over one side of the head, as in hemicrania or megrim; or be generally diffused. Headache presents every variety of character—dull, sharp, cutting, &c. Its accession may be sudden or gradual; and the paroxysms may be of the shortest possible duration, or may extend over hours, days, or months. The pain may be simple, or associated with various perverted sensations, such as giddiness, tingling in the limbs, disordered hearing, or disturbances of vision.

Varieties.—For practical purposes headaches may be arranged in the following order:—

1. *Structural headache*, or headache dependent upon disease within the cranium.
2. *Congestive headache.*
3. *Nervous* or *sick headache*—hemicrania or megrim.
4. *Toxæmic headache.*

1. *Structural headache.* This may be due to any of the many forms of disease of the brain, or of its membranes, such as meningitis, cerebral softening, abscess of the brain, cerebral tumour, &c.; or it may be premonitory of cerebral softening. It is nevertheless often wanting in these disorders, and the locality of the pain, when present, by no means corresponds with that of the lesion. As a rule the pain of organic disease is fixed and habitual, though sometimes, as in abscess or cancerous tumour, it may be of an intermittent character. If there be sickness associated with it, the sickness occurs without any apparent gastric disorder, and the pain continues after the sickness ceases. Stooping and even the recumbent posture aggravate the pain, whilst it is lessened by elevating the head. If organic disease be suspected, the collateral symptoms must be carefully scrutinised and weighed. It rarely happens that organic disease needs to be inferred from pain alone.

2. *Congestive headache.* Many forms of headache depend upon a greater or less degree of congestion of the vessels of the brain; the congestion being either active or passive.

Active congestion may be caused by hypertrophy of the left ventricle of the heart, general plethora, catamenial irregularities, mental or emotional excitement, and other conditions. The pain in such cases is of an obtuse character, affecting the whole or a part of the head, particularly the forehead and occiput. It is accompanied with a sense of pulsation in the ears, flushed face, glittering eyes, and giddiness on stooping.

Passive congestion may be produced by dyspnœa, by asthma, by valvular defects in the heart, or by defective action of the liver, bowels, and skin; it may be the after-effect of drunkenness; or may result from any cause which can produce a state of debility in the vessels of the brain, such as general anæmia, exhaustion from fatigue, loss of blood, leucorrhœa, or that following over-excitement, mental exertion, or bodily fatigue—causes which all favour congestion. When the headache is induced by anæmia or debility, the pain is most generally across the forehead or at the top of the head.

3. *Nervous* or *sick headache*, *hemicrania* or *megrim.* This disorder is discussed in a separate article. *See* Megrim.

4. *Toxæmic headache.* The headache which attends all fevers and inflammatory disorders, though due in some measure to cerebral congestion, is chiefly caused by the action of the blood, altered in character and elevated in temperature, on the nervous elements of the brain. In uræmia likewise the headache which frequently precedes or accompanies the other symptoms pointing to the existence of renal disease, results from the morbid condition of the blood. So also in some persons, breathing the impure air of a crowded room, or the products of the combustion of gas, will, by the imperfect decarbonisation of the blood, speedily produce a headache.

Besides the above varieties of headache, pain about the head external to the brain may be produced by *rheumatic* affections of the scalp, with tenderness of the skin and rheumatism in other parts; by *syphilitic* affections of the periosteum or bone; by *inflammation* of the scalp, commencing erysipelas, &c.; and by trigeminal and other varieties of *neuralgia.* From neuralgia headache may be discriminated by its mode of accession; by the generally longer duration of the attack; and by the more complete intermissions.

Treatment.—The treatment of headache must necessarily depend upon the peculiarities of each individual case. In organic or toxæmic headache the disease with which it is associated, and not the symptom itself, will of course be the object of consideration, and the treatment will be found discussed in connection with these special morbid states. The same remark applies to many forms of congestive headache, such as those produced by disease of the heart, asthma, &c. If catamenial irregularities or uterine disorders are the exciting cause, these must be treated by appropriate measures. If anæmia or debility be present, then in the intervals between the paroxysms, iron in some form, either alone or in combination with quinine or some vegetable bitter, must be given. During the paroxysms a little sal volatile, a cup of soup or strong tea or coffee, or some weak alcoholic stimulant may be of service. Where anæmia is not a prominent symptom, or when the disorder assumes a periodical or intermittent character, quinine alone, in doses of two or three grains twice or three times a day, may be given; and if this fails to afford relief, arsenic is often of signal service. Great benefit is frequently afforded in the latter cases by the administration during the paroxysm of alcohol. Except when the headache is associated with general plethora or active congestion, strong purgatives are to be avoided, and the bowels are to be regulated by the mildest aperient which will answer the purpose. The patient's habits and mode of life must also be strictly regulated; and care must be enjoined as to diet, sleep, clothing, and exercise, especially if the headache be associated with dyspepsia. If dyspeptic symptoms are prominent, or if the pain be connected with a gouty diathesis, then these disorders must be treated with their appropriate remedies.

If during the paroxysms the head be hot and the face flushed, warm or cold lotions, iced water, or eau-de-Cologne may be applied; a warm douching may be useful in some cases. Occasionally in severe attacks a few leeches may be placed on the temples with advantage, or a blister to the nape of the neck, but never if the face be pale, and the pulse feeble. Compression of the temporal arteries with a pad, sustained pressure around the head, or holding the arms high above the head, will sometimes relieve severe headache.

The treatment of sick-headache is discussed under the article Megrim. P. W. Latham.

HEALTH, Maintenance of. *See* Disease, Causes of; Personal Health; and Public Health.

HEARING, Disorders of.—These disorders may be grouped under three classes, namely:—(*a*) *Partial or complete loss of hearing*, or *deafness*; (*b*) *Exalted hearing* (so-called); (*c*) *Perverted hearing* or *Tinnitus.* They may be due to various conditions quite independent of any actual disease of the auditory apparatus, and only such causes of disordered hearing will be considered in the present article as are not due to changes in the conducting portion of the ear, which can be demonstrated by the different methods of examination, or to recognised affections of the nervous apparatus connected with hearing. These will be found discussed under the article Ear, Diseases of.

(*a*) *Partial or complete loss of hearing.*—Perhaps the deafness due to accumulations of cerumen, which so frequently interfere for a time with the hearing of persons whose ears are free from disease, should be regarded as disordered hearing, rather than as a symptom of a pathological condition. As nothing more energetic than careful syringing is required to remove such obstructions, it will be sufficient to observe that in this proceeding the nozzle of the syringe should be directed along the roof of the external canal. Amongst a very large number of people with the organs of hearing in an apparently healthy state, some few will be found upon whom, throughout their lives, certain notes produce no response. They will not, for example, be able to hear the sounds made by grasshoppers, or the singing of some birds—the call of a partridge, for instance; and in most persons, as age advances, the very high notes are lost. To prove this, it is only necessary to blow one of Mr. Galton's whistles in a room full of people, when a considerable proportion of the assembly will fail to catch the high notes, which are distinctly heard by the rest; and although this failure is also noticeable in many nervous affections, all other sounds will perhaps be heard quite normally by these individuals. Emotional influences play a very large part in the destruction or suspension of hearing, and this is especially observable in the case of women. The unexpected sight of a dead husband, hearing of the death of a dear friend, the proposal of a severe surgical operation on a relative, a quarrel, an alarm of thieves, and witnessing a carriage accident, have each within the knowledge of the writer been followed by intense and sudden deafness, which has only been partially recovered from. The same effect has been noticed with men who have been subjected to prolonged mental strain, in connection with literary work, or during commercial crises. It has been recorded that a deaf and dumb child has suddenly recovered hearing, after the discharge from the bowels of eighty-seven lumbrici, and a large number of oxyurides (*Journal of Med. Society*, 1844). Complete loss of hearing, extending over several months, was on one occasion followed by perfect hearing in a girl of fifteen, on the first appearance of menstruation. The temporary effect of quinine and salicylic acid on the hearing is well known, but when quinine has been administered in large doses, and for a long period, this special sense is not unusually injured permanently. Amongst the diseases which often induce a lasting deafness, without any perceptible local change in the conducting portion of the ear, may be included mumps, many of the fevers, and diphtheria; for although in the two latter examples the middle ear often suffers, this is not always the case, and the immediate cause of the deafness must be sought in the products of inflammation which have been left within the cranium. The same explanation is probably also the correct one in those instances where children lose for ever all hearing power, after cerebral excitement or congestion. Habitual and obstinate constipation is sometimes attended with loss of hearing, which returns after the action of purgative medicine. A clot of blood within the cranium, whilst causing hemiplegia of the opposite side, may destroy the hearing of the same side as the effusion; and a case is on record in which closure of the cerebro-spinal foramen gave rise to this symptom.

(*b*) *Exalted hearing.* — What is termed *exalted hearing* will generally, on careful examination be found to be not so much a definite change in the capacity of the hearing apparatus to receive impressions, as an inability on the part of the patient to receive such impressions without an undue effect on the nervous centres being produced. Thus in many inflammatory states of the brain or its membranes this symptom is often a prominent one. It is also not uncommonly met with in hysterical and nervous persons.

(*c*) *Perverted hearing.*—Attendant on most of the above examples, and closely allied to deafness, is the often persistent tinnitus; but there are conditions in which this distressing symptom is the chief and solitary trouble. Thus tinnitus, with a feeling of pulsation in the ear, is occasionally the first warning of an intracranial aneurism; whilst a furious tinnitus and the hearing of strange noises sometimes precede an attack of acute mania. Patients who have been the subjects of malarial fevers and sunstroke often complain of tinnitus; and, as in all cases of disease of the ears, when present it is the most intractable of symptoms, so it is when the ears have not been the seat of any malady or injury.

Treatment.—Insomuch as all the above states of disordered hearing may strictly be said to be due to causes which are in themselves abnormalities of one part or another of the organism, it is to these that the treatment will naturally be directed rather than to alterations in hearing which in truth are merely symptoms. *See* Ear, Diseases of; and Tinnitus. W. B. Dalby.

HEART, Diseases of.—The study of this class of diseases has reference to the immediate pathological changes which occur in the heart itself, and to the consequences or results of these changes upon its function, that is to say, upon the circulation of the blood. The latter portion of the subject will be found discussed under the head CIRCULATION, Diseases of Organs of; and it will therefore be necessary in this place to summarize only the morbid changes which affect the heart itself, and this merely as an introduction to the full description of those changes contained in the articles which follow here, or which will be found in other parts of this work.

1. The heart may be *displaced*, *misplaced*, or *malformed*. 2. Its various textures, including the coverings, the lining membrane, the valves, and the walls, are liable to *acute* and *chronic inflammation* and their effects. 3. The organ itself may be increased in size, either by general *dilatation* of one or of more of its cavities, or partially, as by *aneurism* of the walls; or by the addition to its volume, by *hypertrophy* of its *muscular* structure, of the *fatty* tissue which exists beneath the pericardium, or of the *connective tissue* which binds the muscular fibres together. 4. Its volume may be diminished by simple or general *atrophy*; or by the walls of one or more of its cavities being wasted and thinned. 5. Its walls are liable to various forms of *degeneration*—more especially *fatty*, *granular*, *calcareous*, and *pigmentary*. 6. They may be the seat of *fibroid disease*; and of various *morbid growths*, such as *cancer*, *tubercle*, and *syphilitic formations*, or *hydatids*. 7. *Congestion* and *hæmorrhage* may occur in the walls of the heart. 8. These are liable also to such injuries as *rupture*—whether spontaneous or as the result of violence; and to various kinds of *wounds* and their effects. 9. And lastly, the reader will find discussed under the head of *functional disorders* of the heart, certain disturbances in its action and sensibility which cannot be clearly referred to any structural lesion.

HEART, Abscess of. *See* HEART, Inflammation of; and HEART, Pyæmic Abscess of.

HEART, Aneurism of. — DEFINITION. — A depression or a sacculus formed in the walls of the heart, communicating with one or more of its cavities.

The term aneurism of the heart has not been always used in this sense. It was first applied by Lancisi and subsequently by Bouilleau to every dilatation of the heart, whatever its cause or its character. The first case of the disease, as the term is now understood, was published by Galeatti in 1757. In this country, Dr. Thurnam, Dr. Peacock, and others have treated the subject fully. In France aneurism of the heart has been described specially by Breschet and by Pelvet; whilst in Germany, Lobstein, Löbl, and Hartmann have written upon it at length. A full account of the researches of these and several other writers will be found in the work of M. Pelvet—*Des Anévrysmes du Cœur*, Paris, 1867.

ÆTIOLOGY AND PATHOLOGY.—The essential condition which leads to aneurism of the heart is a change in a portion of the heart's texture, by which the resisting power of the affected part against the pressure of the blood from within the cavity is diminished. Under such circumstances a simple depression, corresponding to the weakened spot, may be first formed on the inner surface of the heart. This gradually continues through the cardiac wall towards the external surface, where the resistance becomes less, and where a pouch or sac is then formed, communicating with the cavity of the heart, it may be by a neck. The weakened condition referred to is attributable in different instances to inflammation of the substance of the heart, whether acute or chronic; to syphilitic or other growths; and to fatty degeneration.

(*a*) *Inflammation* of the heart, affecting either the endocardium or the substance of the heart itself, may lead to ulceration and softening; and both conditions have been found in connection with aneurism. Inflammation may also lead to the formation of pus in the walls of the heart; and cases are recorded in which, the contents of the sac thus formed having been discharged into the circulation, the cavity became converted into an aneurismal pouch (Dr. Wilks, *Path. Soc. Trans.*, vol. xii.). Cases of aneurism of this character may be regarded as originating in *acute* inflammation of the heart.

In a still larger number of cases, in which the endocardium and pericardium, as well as the muscular walls, are involved, we find a development of fibroid tissue—a cirrhosis, as it were, of the heart, as the result of *chronic* inflammatory action. In these cases the fibroid tissue is stretched at each systole of the heart, and it returns less and less to its former dimensions, owing to its want of elasticity. Thus by degrees the portion of the heart affected yields and is pushed outwards, forming a sac of a more or less globular shape.

(*b*) *Growths* in the heart, whether syphilitic, or tuberculous, undergoing the process of softening, may lead to the formation of aneurism, as in the conditions just described.

(*c*) *Fatty degeneration* may give rise to the formation of aneurism. First, a circumscribed spot of softened tissue in the wall of the heart, the result of fatty degeneration, yields without rupture, to the pressure of the blood from within, and thus allows of the formation of an aneurismal pouch. Secondly, partial rupture may take place in the muscular wall, and hæmorrhage occurring at this point, constitutes what is called 'cardiac apoplexy' (*see* HEART, Hæmorrhage into the Walls of). The clot thus formed undergoes the changes usual in extravasated blood; and a cyst results, which may ultimately communicate with one of the cavities of the heart. Meriedec Laennec, who wrote on aneurisms of the heart, believed that this form of disease was almost exclusively thus developed.

With reference to the relative frequency of the various causes of cardiac aneurism, just enumerated, the writer finds that out of a total of 56 cases, the histories of which were collected by himself, in 21 the walls had undergone fibroid changes; in 6 there was fatty degeneration; in 3 the disease was the result of ulceration; in 2 cases it appeared to have originated in abscess; and in 24 the materials were not sufficient for arriving at an accurate conclusion.

Age.—With regard to the age at which this disease occurs, in 51 of the 56 cases just alluded to the oldest was eighty-two, the youngest a child of twelve. Two cases occurred between ten and twenty years of age, 9 between twenty and thirty, 8 between thirty and forty, 7 between forty and fifty, 7 between fifty and sixty, 10 between sixty and seventy, 6 between seventy and eighty, and 2 between eighty and ninety years of age.

Sex.—Of the 56 cases, 39 were males and 17 females.

Anatomical Characters.—Keeping in view the several conditions just described, under which aneurism of the heart can occur, we may expect to find a corresponding variety of morbid appearances. On laying open the pericardium in cases in which aneurism of the heart exists, adhesions which are more or less universal or which may be limited to the seat of the disease, are very frequently found. The heart itself is generally enlarged; and where the aneurism projects externally it is altered in shape, so much so in some instances that the organ looks like a double heart. The sac may project from the walls as a rounded or conical tumour; or, as in an instance that came under the notice of the writer, it may assume the appearance of an elongated sac winding round the base of the aorta. Again, no appearance of anything abnormal may be observed until the heart is laid open, when a depression or an opening may be discovered in the walls of the ventricle, or in the septum. In some instances more than one pouch is formed, in communication with the cavity of the heart by a separate or by a common opening. The size of the tumour may vary from that of a small bean to that of an average-sized cocoa-nut. The opening leading into the pouch may be the widest part of the sac, the aneurism being a mere depression like a watch-glass or half-an-egg; or there may exist a constricted or defined neck, leading to a tumour bulging from the walls. The size of the opening may vary from a couple of inches across, to one capable of admitting only a probe. The neck is, in a few cases, described as hard and cartilaginous; in others, as being smooth and regular, or jagged and irregular. The walls of the tumour may be formed by the dilated and thin walls of the heart; or by the walls considerably thicker than natural, and altered in texture. A very usual condition to find is that the walls of the sac consist, proceeding from within outwards, of endocardium; fibroid tissue, with or without portions of muscular tissue; and pericardium. This condition was described as occurring in eleven cases. In eight cases the walls were said to consist only of the endocardium and pericardium, with fibroid tissue between; but it was found that at the base of the tumour, in all these cases, all the layers of the heart-tissue were present, and that it was only towards the apex of the swelling that the muscular layers disappeared. In three cases the walls of the aneurism were said to be composed of a thin membrane, which appeared to consist of endocardium and pericardium only. In three cases the walls were of cartilaginous consistence, with bony plates interspersed in the tissue. The thickness of the walls of the sac varied from that of paper to three lines or more. In fourteen cases the wall of the tumour was strengthened by the adherent pericardium. The aneurismal cavity in the majority of cases was lined by smooth membrane; but in a few instances, apparently of acute formation, the walls consisted of muscular fibres, torn and separated by the blood which had been extravasated amongst them. The contents of the sac are generally in the form of blood-clots or layers of fibrin, the outermost layers of which may be more or less organised and adherent to the wall.

Seat.—Of the 56 cases already alluded to, 52 were in the left ventricle, 3 in the right ventricle, and 1 in the right auricle. Of the 52 cases in which the aneurism was situated in the left ventricle, 22 occupied the apex, 11 the base, and 17 were in intermediate situations. Several cases have been recorded, in which the aneurism was situated in the muscular septum between the ventricles; in the 'undefended space;' or at the base immediately below the aortic valves. A case of the last-named form was recorded by the writer in the third volume of the *Transactions of the Pathological Society*. These two last forms are generally associated with endocardial inflammation and ulceration.

Symptoms.—In 13 of the 56 cases referred to, the aneurism was not discovered until after death; no mention being made of signs or symptoms of its previous existence. In the remaining cases, symptoms, more or less marked, indicative of heart-disease were present. These symptoms were chiefly—pain, dyspnœa, lividity of the surface, palpitation, and irregularity of the pulse. In 10 cases murmurs were heard, accompanying or replacing the sounds of the heart. We thus see that the symptoms of aneurism are such as may exist in common with other lesions of the heart; and it is extremely doubtful, except in presence of some special circumstances indicative of this condition, whether we have at our command the means of diagnosing the existence of cardiac aneurism. The writer not long since saw, with Dr. Holman, of Reigate, a case of grave heart-disease, in which extended dulness to the left and below the usual situation of the apex-beat, with a feeble impulse in the same situation led to a suspicion of the probable existence of cardiac aneurism.

Progress, Duration, and Terminations.—Pathological testimony fully justifies the inference that certain cardiac aneurisms—such as those which originate in inflammatory softening, ulceration, or the opening of cysts into the cavities of the heart—are acute in their formation. But the like evidence further testifies that the formation of most other aneurisms, and the progress of all, are of a slow or chronic character. Still, it would seem to be difficult if not impossible to determine the duration of the disease in any given instance, inasmuch as many cases, for example, have been found in the *post-mortem* room, which had not given rise to any special symptoms; whilst in other cases the pre-existence of heart-disease before the formation of aneurism rendered it equally impossible to fix a date for the development of the latter special disease.

Death may result from the disturbance of the heart's action, induced by the presence and extent of the disease; from the aneurism opening into the pericardium; or from its burrowing in the wall of the heart, and opening into another cavity of the organ different from that in which it originated. Lastly, one or two cases are recorded in which a cure of the disease had apparently been effected by the walls of the sac becoming indurated or calcified.

Diagnosis and Prognosis.—Seeing how extremely obscure the clinical history of these cases is, it would be impossible to speak more definitely either as to the diagnosis or the prognosis of the disease than has been done under the preceding head.

Treatment.—The treatment of cardiac aneurism must be such as would be adopted in any other form of grave heart-disease, and according to the circumstances of each case. We can only seek to mitigate the more urgent symptoms, whether local in the heart itself, or more generally affecting the distant organs.

R. Quain, M.D.

HEART, Apoplexy of. *See* Heart, Hæmorrhage into Walls of.

HEART, Atrophy of.—Definition. — A diminution in the size and weight of the heart as a whole; or a diminution in size of one part of the heart in relation to the whole organ.

Ætiology.—The causes of atrophy of the heart are either *general* or *local*. With respect to the *general* causes of atrophy, the heart is found reduced in volume together with the other organs of the body, in cases of marasmus, of phthisis, of syphilis, cancer, &c. Probably one of the smallest hearts on record—one which weighed but $3\frac{1}{18}$ ounces—was found by Dr. Church in the body of a woman aged forty-seven, who died of cancer of the pylorus, after an illness characterised by 'gradual starvation' of more than seventeen months' duration. With reference more especially to phthisis, as affecting the size of the heart, an analysis of 171 cases made by the writer at the Brompton Hospital, showed that this organ was below the average weight in 54·4 per cent. Diseases of a subacute character, such as typhoid fever when protracted in its course, may lead likewise to wasting of the heart. The heart is also occasionally congenitally small.

The *local* causes of atrophy of the heart are chiefly two, namely (1), pressure by pericardial adhesions upon the heart in certain cases of generally impaired health, by mediastinal tumours, by fatty growth beneath the pericardium, and other conditions; and (2) interference with the circulation in the coronary arteries, as in the conditions just enumerated, or as a result of malformation or of disease of the vessels themselves.

Partial atrophy of the heart, when it occurs, is generally referable to insufficient blood-supply from vascular disease or local pressure; or to fatty infiltration.

Anatomical Characters.—The heart in simple atrophy presents a general uniform diminution in size, as regards both its walls and its cavities; and in its weight. In local atrophy, a portion of the cardiac wall, more or less extensive, or of one of the divisions or cavities of the heart, may be found to be below the ordinary dimensions. The colour of the atrophied heart may be normal; it is frequently pale; and it is occasionally of a deep reddish-brown. The pericardium, not shrinking proportionately with the muscular substance, may present a puckered, opaque, and œdematous aspect, 'like a withered apple' (Laennec); and for the same reason the coronary vessels may be tortuous and prominent. The consistence of the walls is generally firmer than natural; and the muscle may be even tougher, except where the atrophy is due to the presence of fat, in which case the fibres are friable, and on microscopical examination present the appearances of fatty degeneration. In *simple* atrophy of the heart, the muscular fibres undergo diminution in volume; and they may also be actually reduced in number. Atrophy of individual muscular fibres is also found as the result of interstitial fatty or fibroid growth; and this when extensive has been somewhat erroneously named '*yellow* atrophy.' Another variety, which is most frequently found in the marasmus of old age, is known as *brown* atrophy of the heart. In such cases the muscular tissue is of a dark or dirty reddish-brown colour, which proves on microscopical examination to be due to the presence of numerous shining yellow or brown pigment-particles within the muscular fibres, and specially abundant either around the nuclei or between the ultimate fibrillæ.

Symptoms.—The symptoms and signs of atrophy of the heart are those which might be expected to result from diminished size and power of that organ. The characteristic phenomena are those of feeble circulation. The physical signs are chiefly diminished præcordial dulness; a feeble impulse, the apex-beat being within and above the usual situation; diminished area of audible sounds; and a small, weak pulse.

Diagnosis.—The above signs and symptoms, in association with general wasting, afford sufficient grounds for the diagnosis of atrophied and feeble heart. Emphysema, pericardial effusion, and other causes of diminished cardiac dulness and weakness of impulse, must be excluded by the ordinary modes of investigation. There are no special means by which *partial* atrophy of the heart can be diagnosed, except, possibly, that the presence of this condition may be assumed where the functions of the organ are disturbed in the absence of valvular or other of the more common forms of cardiac disease, sufficient to explain the symptoms.

Treatment.—The treatment of atrophy of the heart is the treatment of the primary disease upon which it depends, so far as is possible.

R. Quain, M.D.

HEART, Calcification of. *See* Heart, Degenerations of.

HEART, Cancer of. *See* Heart, Morbid Growths in.

HEART, Cirrhosis of. *See* Heart, Fibroid Disease of.

HEART, Congenital Misplacement of.—Synon.: *Ectopia Cordis* (Breschet), *Ectocardia* (Alvarenga).

The heart is occasionally found to occupy a wrong position, and such misplacement may either be within the cavity of the thorax, or external to it.

1. Of the *internal* malpositions—*ectopia cordis*

intrathoracica or *ectocardia intrathoracica*—the most common is that to which the term *dextiocardia* has been applied, in which the heart is in a very similar position on the right side of the chest to that which it should occupy on the left. This condition may coexist with transposition of the other viscera of the body, or it may occur alone. Instances of the former kind have long been placed on record, cases having been met with in Rome in 1643, in Paris in 1650, and in London in 1694. When the heart is misplaced, the aorta generally follows an irregular course, crossing the right bronchus and passing down to the right side of the bodies of the vertebræ; and the right carotid and subclavian arteries are given off as separate vessels, while the brachiocephalic trunk is situated on the left side. In some instances, however, the vessels at the arch are not transposed; whilst in others the aorta, after passing over the right bronchus, crosses the spine and follows its usual course to the left of the bodies of the vertebræ. In cases of transposition the heart itself may be well-formed; or it may be very imperfectly developed.

In another kind of misplacement, *mesocardia*, the heart is situated more in the median line than natural—a position which it occupies in the fœtus at the earlier periods. Cases have also been recorded in which the organ occupied a transverse, and an antero-posterior direction.

2. Of the *external* misplacements, those in which the heart is situated external to the thoracic cavity—*ectopia* or *ectocardia extrathoracica*—the most common is that in which, from deficiency of some part of the sternum, the organ lies in front of the chest—*ectopia cordis* or *ectocardia pectoralis*. In other cases, from deficiency in some portion of the diaphragm, the heart is placed in the abdomen, either lying in the cavity, or, if the integuments are partially defective, in a sac in the præcordia—*ectopia cordis* or *ectocardia abdominalis*. In a third form the heart lies at the root of the neck—*ectopia cordis* or *ectocardia cephalica*. Of these forms, examples are related or referred to in the memoirs of Breschet and Alvarenga, and various others have been published since the appearance of the memoir of Breschet.

Symptoms, Duration, and Terminations.—When the heart is well-formed, its malposition within the thorax does not necessarily cause such interference with its functions as to be productive of symptoms, or materially to curtail the duration of life. Indeed, cases are on record in which the heart and other viscera have been transposed in persons who had never presented any signs of disorder of the circulation, and who lived to very advanced ages. When, however, the organ is also defective, and especially when the displacement is external to the thoracic cavity, life is usually only of short duration—though some remarkable cases of external displacements are on record, in which the patients survived to advanced ages.

Malformation of the Pericardium.—Closely allied to the cases of misplacement of the heart are those in which the organ, though occupying its natural position, is not covered by the pericardium, but lies in contact with the lung in the left pleural cavity. Of this form of anomaly various instances are recorded—the first undoubted case of the kind being probably that represented by Dr. Baillie, in 1778. The defect seems to consist in the pericardium, which is apparently reflected from the external coat of the aorta, not being prolonged so as to cover the front of the heart and become attached to the diaphragm. The imperfectly developed membrane is represented by a kind of loose fold, or pocket, which is found on the right side or upper part of the heart.

Effects.—This condition does not seem materially to interfere with the functions of the organ. Cases are recorded in which the subjects lived to middle age; and the writer has himself seen it in a man who died of heart-disease at seventy-five. T. B. Peacock.

HEART, Congestion of.—Attention was first directed to this morbid condition of the heart by Sir William Jenner (*Medico-Chirurgical Transactions*, vol. xliii. p. 199). The coronary veins, like the veins of other parts, are subject to engorgement, when the flow of the blood from them into the right auricle is interrupted. The most common cause of this is dilatation and distension of the cavities of the right side of the heart, which conditions are themselves usually due either to emphysema or to valvular disease of the heart. Disease of, or pressure on, the trunks of the coronary veins may be regarded as less frequent causes of the same result.

Anatomical Characters.—Congestion of the heart is recognised, when recent, by the fulness of the veins on the surface of the organ; œdema of the loose connective tissue at the base; and ecchymosis of the pericardium and endocardium. The pericardial sac contains some serous or sero-sanguinolent effusion; and the mouth of the coronary sinus may be found to be dilated. When the congestion is slight, gradually developed, and of long standing, the venous fulness gives rise to an increased formation of connective tissue in the walls of the heart, which become, in consequence, tough and indurated; whilst the dilatation of the cavities, with which the congestion is associated, is rendered permanent by the same cause. When divided with the knife, the cardiac walls do not fall inwards; their substance feels like a piece of leather; and the section has a smooth homogeneous appearance. Microscopically, the connective tissue seems to be increased in quantity; and the muscular fibres are in a condition of granular, fatty, and pigmentary degeneration.

Congestion of the heart possesses no direct clinical relations. J. Mitchell Bruce.

HEART, Connective-Tissue Hypertrophy of.—Definition.—An excessive development of the connective tissue which exists between the muscular fibres of the heart, causing an increase of the volume of the organ.

Anatomical Characters.—In connective-tissue hypertrophy the heart is enlarged more or less uniformly as regards the walls of its several cavities, and usually greatly, weighing in some instances as much as forty ounces. The thickness of the walls is increased, as in simple hypertrophy; and their density and consistence are such that they present a firm, tough, leathery character. When cut the edges do not collapse, but continue stiff and prominent. The colour of a heart in this condition may vary from pale buff to deep purple, according to the amount of connective tissue and of blood present in the vessels. Microscopically there is seen —not the usual limited amount of intermuscular fibrillar tissue and connective-tissue cells, but a decided hyperplasia of these elements, in the form of connective tissue, of which all stages of development may sometimes be observed, from the round and spindle-shaped cell to the perfect bundle of fibrillæ. Between the individual bundles of connective tissue lie the muscular fibres, which are also hypertrophied, but which are more or less compressed, and are occasionally in a condition of granular or fatty degeneration.

There is a certain amount of anatomical resemblance, but a very clear pathological distinction between this form of heart-disease and the change described by Sir William Jenner as fibroid disease of the heart resulting from congestion (*see* HEART, Congestion of). Connective-tissue hypertrophy may also to some extent be compared with the fibrosis described by Sir William Gull and Dr. Sutton as existing in the walls of arteries and other tissues.

ÆTIOLOGY.—Cases of hypertrophy of the heart have been described by several writers in which there was disease neither of the valves, vessels, nor kidneys to account for it, and which the writer believes to be due to the pathological changes here described. A remarkable specimen is preserved in the museum of St. George's Hospital, consisting of a heart weighing forty and a half ounces, which was removed from the body of an under-butler, in the post-mortem examination of whom nothing was found which could satisfactorily explain the occurrence of the enlargement. The writer is indebted to Dr. Whipham for an opportunity of examining this specimen, which was found by his friend, Dr. Mitchell Bruce, to possess the microscopical characters above referred to. This and similar cases exhibit no appearance of chronic inflammatory action, and thus differ altogether from examples of that form of fibroid degeneration which is described under a separate heading (*see* HEART, Fibroid Disease of). In the cases now described there is a simple hyperplasia of connective tissue, the origin of which cannot be fully explained. In Germany similar enlargement of the heart is said to have been more especially found in gourmands, and hence it derived a characteristic appellation. The existence of connective-tissue growth being thus determined, the effect of its presence on the muscular tissue is obvious. The connective tissue, surrounding, as it must do, the muscular fibres, interferes with their free action, to overcome which there will be a natural tendency to increased action, and consequent hypertrophy of the muscular fibres themselves. It is very probable that it is to these two processes going on simultaneously that the great increase in the size of the heart is due.

SYMPTOMS AND DIAGNOSIS.—In a remarkable case recorded by the late Dr. Hyde Salter, which the writer believes to have been of the nature here described, acute or severe cardiac dyspnœa and hæmoptysis, from which the patient had suffered for several weeks, were the most prominent symptoms. The heart-sounds were natural, except that the first was dull and defective. The pulse was 84. The symptoms increased in severity, and were aggravated by excessive epistaxis. The patient died after being in hospital for fourteen days. At the *post-mortem* examination the heart was found to be of great size, and there was no disease either of the valves or of the vessels or of the kidneys to account for it. In the case of the butler in St. George's Hospital, it is recorded that he continued going about until within a few days of his death. These and some like cases indicate that we can do little in the way of diagnosis beyond recognising the presence of cardiac hypertrophy by the usual signs; and if the hypertrophy be considerable, and if there be no valvular disease and no kidney disease, we might not be far wrong in considering that the hypertrophy was caused by increase of some other element than that of the muscular fibres.

TREATMENT.—If the opinion be correct that this form of disease finds its origin in excessive alimentation, it would be well to place the patient in such circumstances as would prevent this, giving attention at the same time to other hygienic conditions. The more aggravated symptoms of cardiac disease must be treated on general principles. R. QUAIN, M.D.

HEART, Coverings of, Diseases of. *See* PERICARDIUM, Diseases of.

HEART, Degenerations of.—The degenerations that affect the heart may be enumerated as follows:—1. Fatty; 2. Parenchymatous; 3. Albuminoid; 4. Pigmentary; 5. Cartilaginous; 6. Calcareous; and 7. Vitreous. The condition which has been called 'fibroid degeneration' of the heart is described under the heads of HEART, Fibroid Disease of; and HEART, Syphilitic Disease of.

1. **Fatty.**—This form of degeneration of the heart being of special importance is discussed in a separate article. *See* HEART, Fatty Degeneration of.

2. **Parenchymatous.**—SYNON.: Granular degeneration; Cloudy Swelling; ? Parenchymatous inflammation.

ÆTIOLOGY.—This form of degeneration of the heart is generally met with in the acute specific fevers, especially typhus, typhoid fever, diphtheria, and septicæmia; and is probably referable to the action either of the poison or of the high temperature attending the disease-process upon the muscular substance.

ANATOMICAL CHARACTERS.—The disease generally attacks the heart as a whole. The organ appears somewhat enlarged, extremely soft—flabby as well as friable, and of a dirty grayish-red colour. The pericardium is ecchymosed, dull, and swollen, and the epicardial fat has more or less completely disappeared. Microscopically, the muscular fibres are found to be dull and granular, swollen, and variously ruptured; their striations are indistinct; and the addition of acetic acid removes many of the granules from the fibres, whilst it brings more distinctly into view a few fatty globules, and frequently an increased number of pigment-particles.

Symptoms.—Inasmuch as parenchymatous degeneration of the heart is usually but a complication of some acute specific disease, the condition of the patient is one of great febrile prostration with cardiac asthenia. The physical signs, which are regarded as more distinct evidence than the symptoms of the condition of the heart, are —feebleness, advancing to complete absence, of the apex-impulse, or more rarely palpitation; and progressive weakening, and finally loss of the first sound. The pulse has been described as corresponding with the condition of the heart, except in some cases where it is imperceptible, although associated with cardiac palpitation.

Course and Terminations.—The course and terminations of granular degeneration of the heart are inseparable from those of the primary disease. In typhus the average date of the appearance of the symptoms and signs just described is the sixth day of the fever, and they usually cease on the fourteenth day. A large proportion of cases prove fatal at or before that time.

Prognosis.—The existence of this kind of degeneration of the heart adds seriously to the gravity of a case of fever; and the danger increases with the rate and weakness of the pulse, and the feebleness of the cardiac impulse and first sound. The return of the latter under treatment justifies a favourable prognosis.

Treatment.—The treatment of parenchymatous degeneration of the heart is in no respect different from that of the fever in which this condition originates. The appearance of the characteristic symptoms and signs of the cardiac affection is, however, to be regarded as an important indication for the use of alcoholic stimulants, which are, as a rule, well borne in such cases, and act very beneficially.

3. **Albuminoid.**—This kind of degeneration has been said, with a certain amount of possibility, to have been found in the heart. It is certainly excessively rare.

4. **Pigmentary.**—Pigment-granules, in the form of shining yellow particles, are almost invariably found in the muscular fibres of the heart in chronic cardiac disease. In certain cases of atrophy known as 'brown atrophy,' as well as in the granular degeneration just described, these pigment-particles are decidedly increased in number, and collected towards the axis of the fibres. A somewhat similar appearance is seen in the heart in jaundice.

The condition is of purely pathological interest.

5. **Cartilaginous.**—Portions of the myocardium have frequently been described as 'cartilaginous' or 'fibro-cartilaginous,' but it would appear that in these instances the muscular tissue was replaced by dense firm fibroid tissue only. *See* Heart, Fibroid Disease of.

6. **Calcareous.**—Calcification of pericardial adhesions is not very rare; and in some of the recorded instances of this condition, plates of the same material have been found projecting into the substance of the heart, appearing as if formed within the myocardium. Besides this class of cases, instances of true deposit of calcareous particles within the individual muscular fibres have been described. This appears in the form of small, pale, gritty deposits, taking the place of the normal muscular tissue on the surface, in which, on microscopical examination, the muscular fibres were found to have become solid and opaque, whilst hydrochloric acid or sulphuric acid removed the opacity with the evolution of gas, the addition of the latter acid also producing gypsum crystals. It is probable that in other recorded instances, the calcareous particles were situated outside the muscular fibres, and may have been the products of a caseous nodule, whether syphilitic or 'tubercular' in origin.

This form of disease appears to possess no special clinical relations.

7. **Vitreous.**—Vitreous, waxy, or colloid degeneration, as described by Zenker, occurs in the myocardium, as it does in the voluntary muscles. J. Mitchell Bruce.

HEART, Dilatation of.—Definition.—Dilatation of the heart may occur in two forms. in the one it involves only a limited portion of the cardiac walls and constitutes an aneurism; in the other there is uniform enlargement of one or more of the heart's cavities, and dilatation in the usual acceptation of the word is present. To this latter condition, however, the names 'aneurism' and 'passive aneurism' of the heart were formerly applied. Dilatation is probably always associated with hypertrophy.

Ætiology.—The occurrence of dilatation implies that the walls of the heart which yield, are too weak to resist successfully the internal pressure to which they are exposed. This defective relation may be due either to actual enfeeblement of the heart's walls, which renders them unequal to the task normally devolving on them; or to excessive blood-pressure, which even the healthily-constituted walls are unable to withstand. The enfeeblement of the heart may be a consequence of fatty or other degeneration; or, as is probably more frequently the case, may be inherent but unconnected with visible textural disease. The excessive blood-pressure may be dependent on actual obstruction to the circulation which the heart is called upon to surmount; or on undue rapidity of action which (other things being equal) implies an unwonted expenditure of force. As a matter of fact, however, dilatation and hypertrophy are generally if not always associated; and the processes by which these combined conditions are attained are more complicated than the foregoing statement might lead one to suppose. It will be convenient, therefore, to consider certain cases *seriatim*.

1. In obstructive disease at the aortic orifice; in general stricture of the minute systemic arteries, such as occurs in connection with contracted granular kidneys; and indeed in all cases in which resistance is offered to the free discharge of blood from the left ventricle, progressive hypertrophy of the walls of that ventricle takes place. But the hypertrophy is complicated even from the beginning with dilata-

tion. The hypertrophy, at any rate at first, is simply compensatory, and may be taken as a measure of the excess of resistance which the heart is called upon to overcome. The dilatation, however, is in no sense compensatory, and is probably to be regarded as a measure of the inability of the walls to cope successfully with the extra work required of them. It is, moreover, obvious that the occurrence of dilatation, by increasing the area of resistance to the endo-ventricular blood-pressure, increases *pro tanto* the muscular effort requisite for the propulsion of the blood into the aorta; and by enlarging the capacity of the ventricular cavity and consequently the amount of blood to be discharged from it, on that account also throws additional labour on the muscular walls of the ventricle. Thus the hypertrophy and dilatation react on one another; and the hypertrophy, which was probably at first simply compensatory of the mechanical obstacle to the discharge of the normal contents of the ventricle, ends by becoming —or rather striving to become—compensatory not only of this but of the virtual weakness of the heart which dilatation entails.

2. In regurgitant disease at the aortic orifice, hypertrophy and dilatation of the left ventricle also take place. But in this case, while the hypertrophy probably reaches a higher degree of development than in simple obstruction, dilatation preponderates from first to last; and the ventricle attains larger dimensions than in perhaps any other form of disease. But to what are the hypertrophy and dilatation due in this case? There is no impediment to the escape of blood through the aortic orifice, and therefore *primâ facie* no need for compensative hypertrophy. There is no doubt that here hypertrophy waits on dilatation. The first effect of regurgitation is, that during diastole the ventricle becomes more rapidly and completely filled with blood than it does under other circumstances, and that the subsequent contraction of the auricle tends to distend it unnaturally with blood. The result is that, on the principles above enunciated, the walls of the ventricle have to encounter a larger area of pressure, and to expel a larger amount of blood than natural, and hence are called upon to make excessive effort, and hypertrophy ensues. Thus the tendency to dilatation causes the tendency to hypertrophy; and both acting continuously promote the progressive increase in the capacity of the ventricular cavity, and in the thickness of the ventricular walls.

It is probable in both cases, but more especially in the latter of them, that ere long the ventricle fails to expel the whole of its contents into the aorta at each contraction, and that the retention of this residual blood becomes an important factor in promoting dilatation.

3. The effects of continued violent action of the heart, whether caused by nervous influence or by muscular effort are much the same as those of obstructive disease. For both increased rapidity of contraction, and increased amount of blood to be expelled at each beat, other things being equal, imply increased expenditure of force; and the persistence of either or both of these conditions, therefore, the supervention of hypertrophy and dilatation.

4. The above discussion relates especially to dilatation and hypertrophy of the left ventricle. But, *mutatis mutandis*, it applies with equal force to dilatation and hypertrophy of the other sections of the heart. Thus, in mitral valve disease, the left auricle undergoes hypertrophy and dilatation—the dilatation preponderating in regurgitant disease of the valve, the hypertrophy preponderating in obstructive disease.

5. In pulmonic valve disease the right ventricle becomes hypertrophied and dilated—the dilatation being greatest where there is pulmonic regurgitation, the hypertrophy being greatest where the disease is obstructive.

6. In tricuspid valve disease the right auricle suffers, becoming chiefly dilated in the presence of tricuspid regurgitation, chiefly hypertrophied when there is obstruction. And thus, also, just as when the systemic circulation is impeded the left side of the heart suffers, so when the pulmonic circulation is obstructed, the right side of the heart undergoes enlargement.

In all cases, therefore, hypertrophy and dilatation seem to result concurrently; but whether the one or the other condition preponderates, depends partly on the particular nature of the cause to which the hypertrophy and dilatation are due, partly on the inherent strength or weakness of the cardiac walls. In all cases, too, the other cavities of the heart, besides that primarily and directly implicated, suffer according to their position from the effects of the greater or less work which sooner or later is cast upon them.

The temporary dilatation which is described as occurring in acute febrile disorders, such as typhus, is due mainly to enfeeblement of the cardiac walls.

Anatomical Characters.—In dilatation of the heart, the cardiac walls may be either thinner or thicker than natural, or may retain their normal thickness. It is a question, however, whether, excepting in the case of partial dilatation or aneurism, dilatation ever takes place independently of hypertrophy; for even as regards the auricles, where dilatation with attenuation is chiefly observed, there is reason to believe that the attenuation is not commensurate with the extension which accompanies it, and consequently that the total bulk of muscular tissue is increased. When dilatation is associated with no apparent change in the thickness of the walls, hypertrophy is of course present.

It must be mentioned, however, that it is often very difficult to determine on *post-mortem* examination the true relation between the thickness of the cardiac walls and the capacity of the cardiac cavities. For their apparent relation is largely dependent on the condition of the cavities at the moment of death, as to systole or diastole; and on the state of the heart as to cadaveric changes at the time of *post-mortem* examination.

The form which the heart assumes in dilatation is the same as that which it assumes in hypertrophy, and indeed as the two conditions are probably always associated, it is needless to endeavour to establish any distinction between them in this respect. If the dilatation be general, the form of the heart remains unchanged, but its size is uniformly augmented.

If the left ventricle be mainly affected, the heart appears not only enlarged but elongated, the left ventricle taking more than its due share in the formation of the cardiac apex. If the right ventricle be specially implicated, the heart becomes enlarged in its transverse diameter; it is more rounded in its contour as seen from the front than it should be; and its apex is obtuse, and either bifid, from the fact that the apices of both ventricles take an equal share in the formation of the cardiac apex, or formed wholly by the right ventricle. If the auricles be dilated, they constitute large masses on both sides of the root of the aorta and pulmonary artery.

The walls of the dilated heart vary not only in thickness but also in quality. Thus they may be preternaturally firm or preternaturally soft; they may be healthy in structure, or may present more or less degenerative change.

Consequences of Dilatation.—Dilatation of the ventricles, especially if it be considerable, is apt to disarrange the mechanism of the auriculo-ventricular valves. It was shown many years ago by Mr. Wilkinson King that even in mere temporary distension of the right ventricle a kind of safety-valve action of the tricuspid valve took place, in consequence of which regurgitation of blood was permitted from the ventricle into the auricle. And since his time it has been clearly demonstrated, both by clinical and by *post-mortem* evidence, that established dilatation of the right or left ventricle is liable to be attended with persistent regurgitation of blood through the corresponding auriculo-ventricular orifice. The defaulting valve under these circumstances has a natural aspect; but careful examination shows either that the orifice has undergone dilatation in company with the ventricle—the valve itself presenting no corresponding increase, or that there is a want of relation between the size of the musculi papillares and chordæ tendineæ on the one hand, and the capacity of the ventricle on the other, which interferes with the due closure of the valve.

It is obvious that if regurgitation becomes established, the usual consequences of regurgitation will presently ensue; namely, in connection with affection of the left side of the heart, dilatation and hypertrophy of the left auricle, and subsequently congestion of the lungs and pulmonary apoplexy; and in connection with affection of the right side of the heart dilatation and hypertrophy of the right auricle, fulness of the systemic veins, anasarca, nutmeg liver, and congested, indurated kidneys. It is also obvious that, even if no regurgitant condition be developed, dilatation of heart, which implies feebleness of heart and imperfect circulation, must ultimately induce the ordinary remote consequences of heart-disease. A further consequence of dilatation and other cardiac affections attended with feeble circulation is the formation of thrombi during life, both in the heart itself, and in other parts of the vascular system. Mr. Wilkinson King has demonstrated that dilatation of the left auricle may cause compression of the left bronchus.

Symptoms.—Since dilatation of the heart rarely if ever exists alone, but is associated with hypertrophy, valve-disease, degenerations, and other conditions, it is almost impossible to make any definite statement with regard to the signs and symptoms by which its presence may be recognised. Still there is no doubt that dilatation is one of the most important factors of heart-disease, clinically considered; and that its supervention materially affects the patient's condition, and prospect of life. Dilatation implies weakness, and as a rule over-distension of the implicated cavities with blood, which probably never becomes wholly expelled.

The *physical signs* of dilatation are necessarily in many respects the same as those of hypertrophy. The præcordial dulness is increased in area—the extent and form of this area, and the situation of the apex-beat, being determined by the general size of the heart, and the relative dimensions of its component parts. In proportion, however, as dilatation preponderates over hypertrophy, the impulse of the heart becomes weak, and possibly to some extent diffused. In extreme dilatation, as in extreme weakness from other causes, the sounds of the heart, and especially the first sound, are enfeebled. And it may be asserted that generally the tendency of dilatation is to shorten the first sound, and to give it the characters of the second sound. It has nevertheless been observed over and over again that it is in the concurrence of hypertrophy and dilatation that the cardiac sounds are apt to attain their greatest intensity. The feebleness of the heart's action is generally attended before long by more or less irregularity; and even in the absence of valve-disease, a mitral or tricuspid systolic murmur, implying regurgitation, is apt to be established.

The symptoms of dilatation are to a large extent those of cardiac obstruction, and more especially of mitral disease. The patient complains of weight, oppression or uneasiness in the cardiac region, with probably a sense of fluttering there, and of a tendency to sighing respiration. He becomes short-breathed, and may have extreme dyspnœa. His face is apt to become livid; his surface pale or ghastly; his extremities cold and blue; and his pulse weak and irregular. Dilatation of the systemic veins arises sooner or later; and subsequently general anasarca, pulsation of the veins in the neck, epigastric pulsation, and pulsation of the liver, together with the other usual consequences of heart-disease. The chief of these are—congestion of the lungs, with pulmonary apoplexy, cough, and expectoration of blood; congestion, enlargement, and tenderness of the liver, with jaundice; and congestion of the kidneys, attended with the discharge of scanty, high-coloured, heavy urine, containing albumen and possibly blood. Other symptoms referable to the nervous and digestive organs, which need not be enumerated, are also liable to supervene.

The symptoms will vary, of course, according as the left or the right ventricle is mainly affected. In the former case we are liable to have at first irregularity and feebleness of pulse with tendency to faint; then pulmonary complications; and at a later period, symptoms referable to the systemic venous circulation. The latter case is one of considerable interest; because in a large number of instances it is, in its most marked form, a consequence of emphysema of the lungs, or of other analogous conditions, and moreover is apt to come on very rapidly. Under these circumstances, there is necessarily much dyspnœa, but the systemic venous and capillary systems speedily become over-loaded; extreme cyanosis often develops rapidly; and, before long, all the other symptoms referable to disease of the right side of the heart become established: namely, pulsation of the veins in the neck, epigastric pulsation, pulsation of the liver, general anasarca, with perhaps petechial extravasations, jaundice from nutmeg liver, and albuminuria from congestion of the kidneys.

Prognosis.—There is no doubt that some degree of dilatation of the heart, and more especially of the right ventricle, may arise, either from over-exertion, or from functional disturbances, and in connection with pulmonary disorders. But such dilatation is for the most part temporary or remediable; and only by continuance of its cause becomes established and a matter of serious importance. In the same way there is no doubt that the dilatation which comes on in the course of organic disease of the heart or lungs, or of other organic diseases which influence the action of the heart, is remediable within certain limits by due attention to the conditions under which it arises. Nevertheless it is certain that the presence of dilatation of the heart in connection with other diseases, more especially those of the heart, lungs, or kidneys, is a grave source of danger; and that in the great majority of cases it is of fatal omen, aggravating the patient's cardiac symptoms, and hastening his death.

Treatment.—The treatment of dilatation of the heart merges in that of the other cardiac conditions with which it is associated, and in that of other diseases in the course of which it may have supervened. It may be stated, generally, however, that the treatment is that of cardiac debility, and of distension of the heart with blood.

The chief indications, therefore, are rest of mind and body; avoidance of exposure to cold and wet; the exhibition of ample nutritious and readily digestible food; due attention to the action of the bowels, kidneys, and skin; and the employment of medicines likely to regulate and strengthen the action of the heart. For the last purpose digitalis in small doses is universally acknowledged to be of great value. And it is in most cases desirable to combine the digitalis with iron, or some vegetable tonic. Ammonia and other diffusible stimulants are often called for, and are of great service. In cases where there is much lividity, and evidence of stagnation of blood in the right side of the heart, removal of blood by venesection may be of use.

When the dilatation is due to pulmonary disease, this of course requires primary and especial treatment. J. S. Bristowe.

HEART, Displacements of.—Besides the displacements of the heart that occur as the result of disease, there are certain changes of position which this organ undergoes in health. The most important of these physiological displacements of the heart are—first, its vertical movements in respiration; and, secondly, the alterations in its situation corresponding with changes in the bodily posture. The present article, however, will deal only with the former class, or abnormal displacements of the heart.

Ætiology.—The heart may be congenitally displaced—a condition which is described under the head of Heart, Congenital Misplacement of. These cases being excepted, the causes of displacement of the heart may be arranged in two classes—namely, (1) conditions that exert *pressure*; and (2) conditions that exercise *traction* upon the heart.

(1) The heart is *pressed* or pushed out of position by effusions of fluid—inflammatory, serous, or bloody—into either pleural cavity; by pneumothorax of either side; by intrathoracic tumours—whether mediastinal (including aneurism and abscess), pulmonary, or parietal; by hypertrophous emphysema, or other causes of enlargement of the lungs; by extensive pneumonic consolidation; or by abundant pericardial effusion of any kind. Certain conditions of the abdominal contents produce a similar effect, for example—gaseous distension of the stomach and intestines; enlargement of the liver and other solid organs; abdominal tumours of all kinds; the pregnant uterus; and ascites, when considerable. Hernia of the abdominal viscera through the diaphragm, and abscesses connected with the diaphragm, also cause displacement of the heart.

(2) The heart suffers *traction*, or is drawn out of position during absorption of pleuritic effusion with imperfect expansion of the lung, on either side; by the contraction of pleuro-pericardial adhesions, of pulmonary cirrhosis, or of cavities in phthisis; in collapse of either lung from pressure on the main bronchus; and in some forms of deformity of the chest from curvature of the spine.

Mechanism of Displacement.—The causes just enumerated constitute in each instance what may be called the *displacing force*. When this force belongs to the first or *pressure* class, it acts against the surface of the pericardium and heart that is opposed to it, and presses or pushes it, *a tergo*, away from its own seat, in the direction of least resistance. Thus the heart is, speaking broadly, pushed towards the left by effusion into the right pleural cavity; towards the right by similar disease on the left side; downwards by tumours in the region of the base; and upwards by gaseous distension of the stomach.

On the other hand, when the displacing force is of the nature of *traction*, the heart is drawn *a fronte*, that is, towards the seat of the force. Thus, when a cavity in a phthisical lung is contracting, the pericardium and heart, as well as the walls of the chest, are displaced towards the healing area. It must be observed, however, that in this class of cases, actual traction, in the strict sense, is rare, and that the displacing force is, in reality, the atmospheric pressure; the heart and the other organs being 'sucked' towards the potential vacuum, in the same way as water is 'drawn' into a syringe. Still, in a very small number of cases, the pericardium does actually become involved in a healing process in the lungs; and it and the heart are dragged towards the cicatrix.

Besides the displacing force, there are at work in dislocation of the heart certain other agencies, which contribute to the result, whether their effect be to increase or to diminish that of the chief cause.

a. The weight of the heart manifestly favours displacement in different directions, according to the posture. Thus, in the erect posture, it favours downward, and limits upward displacement. However, the weight of the heart is comparatively insignificant, and may be practically disregarded.

b. The resistance, positive or negative, of neighbouring parts must be taken into account. The heart when disturbed from its position will move in the direction of least resistance. Thus it cannot be displaced to any extent either forwards or backwards; but is moved with comparative ease towards either pleural cavity. The resistance inferiorly is greater under the right half of the diaphragm than under the left. On the other hand, the resistance around may become negative; for example, in left pleural effusion the corresponding half of the diaphragm is pushed downwards, and the accompanying downward displacement of the cardiac apex is thus increased.

c. The heart is attached at its root; and, speaking broadly, this is a fixed point, at the right and upper extremity of the long cardiac axis. This attachment will limit and otherwise modify displacements of the heart in all directions, especially downwards. Round this point as a centre, and with the long axis as the radius, the apex of the heart will describe an arc of a circle, cutting the surface of the chest in the left axilla, the left submammary region, the epigastrium, the right submammary region, and the right axilla.

d. The tendency that the heart has to rotate or roll on one or other of its axes is also affected by its attachment at the root. If the heart lay free in the pericardial cavity, there would be no limit to such rotation under the influence of pressure or of traction. The base being fixed, rotation is greatly limited, and does not occur to any extent except around the longitudinal axis; the left ventricle, for example, being rotated more forwards or more backwards, as the case may be. Rotation round the transverse-horizontal and the antero-posterior-horizontal axes is very limited.

ANATOMICAL CHARACTERS AND EFFECTS.—The only essential change that the heart is found to have undergone in displacement is an alteration of its relations to the surrounding parts. The softer parts of the cardiac wall, however, such as the auricles, are sometimes compressed to a moderate degree. The pericardium is partly dislocated and partly stretched. The great vessels at the base of the heart and at the root of the neck may be elongated, shortened, twisted, or bent, according to the particular form of displacement; and the circulation within them impeded. The neighbouring organs are variously displaced and compressed. One of the effects often seen after displacement is permanent fixation of the pericardium and heart in their new position, for example, in the pleural cavity, on the disappearance of the original cause.

The effects of displacement of the heart upon its functions differ greatly in the two classes of dislocation to which we have referred:—

In displacement due to *pressure*, the heart is compressed between the displacing force and the resistance in other directions, and the dislocation is generally rapid. Fortunately, in most cases of such displacement the resistance is slight; and the heart, if healthy, suffers little or no real compression of its substance or cavities between the two forces, the mobile and compressible lung especially yielding before it. But if the heart be diseased—and especially if its walls be weak, degenerated, or dilated—moderate compression may cause embarrassment of the cardiac action and even fatal paralysis; and the rapidity or even suddenness with which displacement generally occurs when due to pressure—for example, in pneumothorax, is another and perhaps the principal cause of this embarrassment.

On the other hand, when the heart is *drawn* out of its normal situation towards a phthisical cavity, or towards either pleural cavity from which an inflammatory effusion is being absorbed, the displacement occurs, not because there is want of space, but because there is excess of space within the thorax. The process is also very gradual. The effects, therefore, upon the functional activity of the heart may be said to be few, though the unusual pulsation may be a source of inconvenience, and even of anxiety to the patient. In very rare cases, the heart and pericardium when thus displaced, may be involved in the fibrotic process going on in the lung or pleura, and the adhesions thus established may ultimately interfere with the cardiac action.

SYMPTOMS.—In displacement of the heart, special symptoms are frequently slight or altogether wanting; or they are inseparable from the symptoms of the original cause. This may be said to be almost invariably the case when the displacement is due to gradual traction, as in phthisis. In the pressure class of cases, on the contrary, there are frequently developed, and that rapidly or suddenly, symptoms due to compression of the heart, such as a sense of distress, stifling, and pain over the præcordium or at the epigastrium, or even true angina; dyspnœa, perhaps amounting to orthopnœa; palpitation; blueness of the surface; and irregularity and feebleness of the pulse. When the displacement is due to upward pressure from gaseous distension of the stomach and intestines, the above symptoms may be associated with flatulence or 'spasms,' and are relieved by the erect posture, eructation, vomiting, and the administration of carminative and absorbent remedies. If this condition be not removed within a short time, it may become aggravated, pass into a state of collapse, and end in death.

VARIETIES AND PHYSICAL SIGNS.—The varieties of cardiac displacement, according to the direction in which the dislocation occurs, may, for clinical purposes, be said to be as follows:—towards the *left*, towards the *right*, *downwards*, *upwards*, *backwards*, and *forwards*. It must be observed, however, that this is only a broad general classification, and that the heart is very rarely displaced in an absolutely horizontal, or in an absolutely vertical plane. The exact direction taken in each variety will now be described, as well as its special causes, and the physical signs by which it may be recognised.

1. **Displacement towards the Left.**—This, the most common variety of marked cardiac dislocation, is most frequently caused by contraction of the left lung from any of the conditions already enumerated, and effusions into the right pleural cavity. Right pneumothorax, and tumours connected with the right side of the chest, with the mediastinum, or with the right lobe of the liver, are less common conditions that lead to the same result. The distance towards the left to which the heart is dislocated varies, the extreme limit being probably the vertical axillary line. During its progress towards the left, the heart is rotated around its longitudinal axis, so that the right ventricle is more exposed anteriorly; and the apex is moved, at first somewhat downwards, and afterwards upwards.

The visible and palpable impulse is found to the left of its normal situation, and either lower or higher than it, or on the same level with it, according to the degree of displacement. In some cases due to contraction of the left lung, the impulse may be found in any one or in all of the left intercostal spaces from the base to the apex of the heart, and of different rhythm in the different spaces. If the displaced heart be the seat of valvular disease, thrill may be felt in an unusual situation, for example, in the left axilla. The area of percussion-dulness is altered in outline, being invaded on the right side either by the dulness due to effusion there, or by resonance due to pneumothorax or to encroachment of the right lung-border; whilst it is either transposed towards the left axilla, or blended with unnatural dulness over the left lung. The cardiac sounds are reduced in loudness over the normal præcordium, whilst they are unnaturally loud towards the left axilla and up the left front. Structural murmurs if present are similarly transposed, as regards the seat of their greatest intensity and the lines of their convexion. A systolic murmur may be developed at the base of the heart from distortion of the great vessels.

2. **Displacement towards the Right.**—This form of dislocation of the heart is the result of effusion into the left pleural cavity; of contracting processes connected with the right lung or pleura; of left pneumothorax; and of tumours of the left side of the chest or in the mediastinum. The heart may be displaced towards the right side until the impulse is found in the axillary region. During its lateral movement, the heart is rotated on its longitudinal axis in such a manner that the left ventricle is more exposed; and, at the same time, the apex is first depressed towards the epigastrium, and afterwards raised towards the right axilla, as the displacement increases.

The physical signs correspond closely with those enumerated under left displacement—the two sides being, of course, exactly reversed. The cardiac impulse is most frequently transferred to the epigastrium and the region between that and the right nipple. A new area of pulsation is sometimes developed in the second and third right interspaces, close to the sternum, and indicates the displaced position of the right auricle, if præsystolic, or of the aorta, if systolic and followed by palpable shock in diastole. The description of the auscultatory phenomena, as regards both sounds and murmurs, does not require to be repeated.

3. **Displacement Downwards.**—This is an exceedingly common form of cardiac displacement, though seldom extreme in degree. It is the constant result of hypertrophous emphysema of the lungs; and may also be caused by the downward pressure of tumours at the base of the heart, such as aneurism, and by collapse of the stomach and intestines. Displacement of the heart downwards is limited by the diaphragm, and by the attachment of the pericardium and great vessels at the root of the heart. At the same time the apex may either move somewhat towards the left in its descent if the downward pressure be uniform, as in emphysema; or it may ascend somewhat towards the left if the pressure be exerted chiefly upon the base.

The ordinary cardiac impulse is generally quite imperceptible in this form of displacement, on account of enlargement of the lungs; or it is greatly weakened, and situated in the sixth left space, or lower, to the left of its normal position. A new area of systolic pulsation is perceptible in the epigastrium, generally well marked, and connected with the right ventricle. The præcordial dulness is usually completely replaced by pulmonary resonance; or, more rarely, confused by the dulness of some form of mediastinal tumour. The cardiac sounds are feeble, or absent, over their usual seat; and are heard, instead, over the epigastric triangle and the lower left cartilages.

4. **Displacement Upwards.**—The many abdominal causes of this form have been already mentioned, as well as the symptoms due to compression of the heart which characterise it when so produced. The heart, as a whole, is moved upwards in the chest, and at the same time the apex passes more or less towards the left, and the right ventricle may become somewhat more exposed anteriorly.

The cardiac impulse is elevated until it is found on the nipple-level, or even higher; or it is lost, along with the area of percussion-dulness, behind the inferior border of the left lung. The sounds of the heart are transposed upwards and weakened. The displacement of the cardiac apex towards the left axilla in pericardial effusion is described elsewhere. *See* PERICARDIUM, Diseases of.

5. **Displacement Backwards.**—This variety of displacement of the heart is very uncommon; and when it does occur, is generally referable either to abundant pericardial effusion, or to backward curvature of the spine (kyphosis) in the dorsal region. A certain amount of backward displacement is, however, not so rare in extensive excavation of the left lung, in association with other forms of dislocation. The base of the heart is then the part most transposed into the left paraspinal groove, and the apex is tilted somewhat forwards as well as elevated.

The physical signs of backward displacement are those of the cause of the malposition rather than any that can be referred to the condition itself.

6. **Displacement Forwards.**—Displacement forwards is also very rare, although it is frequently simulated by bulging of the præcordium in enlargement of the heart. The chief cause of it is the presence of a tumour in the mediastinum—especially aneurism of the descending aorta, or enlargement of the bronchial glands. The amount of actual transposition is necessarily exceedingly small, the anterior border of the lungs being compressed or pushed aside, but the further progress of the heart forwards being arrested by the anterior wall of the chest.

The physical signs are, therefore—increase of the area and strength of pulsation and of percussion-dulness over the præcordium; bulging of the same in young subjects; and increased loudness of the cardiac sounds in that situation.

7. **Complex Displacements.**—It has already been indicated that displacements of the heart, strictly speaking, occur almost without exception in more than one of the directions described; and they may all, therefore, be said to be generally more or less complex. Dislocation at once upwards and towards either side is especially common, as the result of contracting processes in the apex of the lung.

Diagnosis.—After the full account that has been given of the several forms of displacement of the heart, there ought to be no great difficulty in diagnosing them from each other, as well as from the conditions which simulate them. These must be carefully remembered. The chief of these are:—(1) physiological displacements, already referred to; (2) cardiac enlargement, especially when attended with bulging of the præcordium; (3) pulsating tumours of the chest and abdomen, particularly aneurism of the aorta; (4) adhesion of the pericardium; and (5) atrophy of the lungs from any cause.

Treatment.—The rational treatment of displacement of the heart would be to remove its cause; but when the cause is of the nature of traction, treatment is very rarely called for, even if it were possible. In displacement due to pressure, on the contrary, treatment is often urgently indicated, perfectly practicable, and highly successful. The unpleasant sensation of pulsation complained of in some instances of displacement—for example, in phthisis—is frequently relieved by an assurance on the part of the physician that the palpitation is of no import; and by the application of a simple plaster, containing iron, belladonna, or opium. J. Mitchell Bruce.

HEART, Embolism of. *See* Heart, Thrombosis of.

HEART, Fatty Degeneration of.—Synon.: Fr. *Dégénérescence graisseuse du Cœur*; Ger. *Fettige Metamorphose des Herzens.*

Definition.—The process by which the muscular fibres of the heart are converted into a granular fatty matter. The term is also used to express the state of the heart in which this change has been accomplished.

Ætiology and Pathology.—The process by which the protein elements of animal bodies, including muscular fibre, are converted into granular fatty matter, as well as the circumstances under which this change occurs, have been already so fully discussed under the head of Fatty Degeneration, that it is unnecessary to repeat what will be found there. It will suffice to say here, that when the process of nutrition is interfered with in the tissue of the heart, this change takes place, and is best illustrated in the *local or limited* form of disease, which occurs when the coronary circulation is obstructed. This is seen in cases of thickening or calcification of one of the trunks, or of the branches of these vessels, and is more marked by reason of the fact that the coronary arteries do not freely communicate with each other. The fatty change is found to occur in the more *diffused or general* form in those diseases in which the vital powers are lowered, as in certain forms of chronic cachectic disease, in poisoning by phosphorus, or after loss of blood. In certain other conditions, such as acute specific fevers, the tissue of the heart becomes softened, and under the microscope presents a granular appearance, which is believed by some pathologists to be an incipient stage of fatty degeneration. We might also refer to the more or less diffused form of fatty degeneration which takes place in cases of enlarged heart, the result, not, as Rokitansky supposed, of a disturbance of the nervous functions, but of the fact that these enlarged hearts require a larger supply of the materials for nutrition than can be furnished to them by the coronary arteries, which in such cases are frequently themselves diseased, both at their origin and in their course. Lastly, fatty degeneration of the heart is found to occur after delivery in some instances, in which the organ had become enlarged during pregnancy.

Certain other circumstances connected with the origin of the disease require to be mentioned here. In reference to *sex*, the disease is more frequent in males, in the proportion of nearly two to one. With respect to *age*, in his original memoir on this subject, the writer found that nearly one-half of all the cases observed were over sixty years of age. In the late Dr. Hayden's valuable work on *Diseases of the Heart*, the proportion stated of cases under sixty years of age shows a larger number of young persons whose hearts have undergone this change as a result of wasting disease—a result which is evidently due to the greater care with which microscopical examinations of the heart have been made in recent times. As regards social position, of thirty-three cases formerly noted by the writer, the subjects of the disease are stated to have belonged to the higher ranks in nine cases; to the middle class in eight cases; and to the lower class in sixteen cases. This enumeration contrasts with the proportion in which fatty growth appears on the heart; seven of fifteen cases belonging to the first class; six to the second; and only two to the third. Fatty degeneration and fatty growth on the heart are thus seen to occur under very different conditions. The latter is the result of the accumulation in the blood of the elements of fat: the former is the result of decay and disintegration.

Anatomical Characters.—In fatty degeneration the heart is found to be enlarged in about two-thirds of the cases recorded both by Dr. Hayden and the present writer. It is not unfrequently simply dilated. To find a fat heart of an average size, or even occasionally below it, is not a very exceptional occurrence. The colour of the heart's substance is pale, sometimes as pale as 'a dead leaf,' but more generally it is of a yellowish-brown or buff, or muddy pink colour. This discolouration is generally seen in spots or patches; and though the whole heart may be pale, the spots being still paler when seen beneath the endocardium, give the tissue a mottled look. The same appearance may be seen beneath the pericardium, and in the substance of the heart. With the progress of disease the spots run together, giving portions of the walls a uniform buff-coloured character, whilst the rest of the organ retains its ordinary aspect. The consistence also varies from that of mere flabbiness or softness, to such a condition as permits of the tissue being torn like wet brown paper. The organ then feels like a piece of wet chamois leather, or a wet glove. In other cases the heart retains in appearance much of its ordinary solidity, but the tissue breaks down on pressure, as does a lung consolidated by pneumonia. This is a state which more frequently occurs in hypertrophied hearts. In addition to these changes in size, colour, and consistence, others have to be noted. The fibrous character of the heart's structure, even to the naked eye, disappears; in some cases the tissue resembles that of a fatty or boiled liver. In other instances the cut or torn surface has a granular appearance, not unlike that of the lung in an early stage of grey hepatization. These different appearances may in a great measure be due to the greater or less fluidity of the oily matter present, as well as to the extent and degree to which the disease has advanced. Further varieties in appearance may be caused by the presence of a greater or less quantity of blood, or of its colouring matter, in the heart's texture or in its cavities, by which the lining membrane may in the latter case be dyed of a deep purple colour.

Microscopical characters.—The microscopical characters of this disease will be found so fully described under the head FATTY DEGENERATION, that it is needless here to do more than refer the reader to that article.

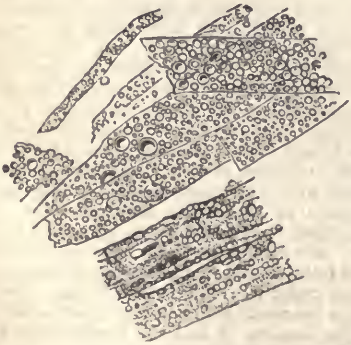

FIG. 22. Fatty Degeneration of the Heart. × 400 diam.

All parts of the heart's fibres are subject to fatty degeneration, but not equally so. It is most frequently found in the left ventricle; next in the right ventricle; then in the right auricle; and least frequently in the left auricle. It is generally more evident in the columnæ carneæ, and in the inner layers of the muscular walls, than elsewhere.

EFFECTS.—Of the *structural* lesions occurring in the heart when the seat of fatty change, one of the most important is *rupture*, which was found in twenty-five out of sixty-eight cases of fatty or softened heart, the histories of which were collected by the writer. Partial rupture leading to the formation of what has been called *cardiac apoplexy*, is another condition which has been described. The clot in such cases, if it lose its colour, may produce an appearance like an encysted abscess; and a consecutive false aneurism of the walls of the heart may be thus formed, as well as by simple yielding of a portion of the softened cardiac wall. The involvement of the columnæ carneæ may lead to imperfect action of the valves. Valvular disease itself is not often present in connection with fatty heart. Dr. Henry Kennedy, in a recent interesting work on this subject, points out that the valves are affected only about once in nine cases; and he further shows that, when the valves are affected, it is chiefly the aortic valves that are involved.

Of the effects of fatty degeneration upon the *functions* of the heart, the most prominent are those which exhibit the deficient powers of the organ. *Coma*, preceded or not by giddiness, has been described by several writers in connection with feeble powers of the circulation. Dr. Adams of Dublin has mentioned as many as twenty attacks in one of his cases of fat heart; and the writer has noticed the occurrence of even more frequent seizures. *Syncope*—'cardiac syncope'—is a term very frequently used by the older writers; and it is a term which may be well applied to the condition of faintness which is frequently found in connection with fatty heart. In some cases the feeling of syncope amounts to nothing more than a simple sense of faintness—that the patient must fall if he do not lay hold of something. In other instances this symptom is accompanied by a feeling of impending death; and such patients do frequently die. In the cases collected by the writer, thirteen out of thirty-three died of what he proposed to call *syncope lethalis*, or 'fatal syncope;' and it would be possible, no doubt, now greatly to extend the number of cases that have proved fatal in this way. Death may result in such cases from cardiac failure, as indicated by a flabby heart containing blood in the left ventricle; or, where there is a less amount of degeneration, by irregular action or spasm, with emptiness of the ventricles.

Pain is another effect. It may occur independently of, or be associated with syncope—*syncope anginosa*. *See* ANGINA PECTORIS.

The *respiration* is considerably affected, in all cases of fatty degeneration, either as simple breathlessness, especially on exertion, or in that peculiar form which has been called *Cheyne Stokes respiration*.

SYMPTOMS AND DIAGNOSIS.—There is no doubt that many cases occur in which fatty degeneration is found in the heart after death, where its presence during life had not been suspected. This is more especially the case in those examples of exhausting disease in which the heart participates. In such cases the requirements of the system may not be out of proportion to the powers of the heart; and death may come on slowly and insidiously without our attention being attracted to the state of this organ. In a second class of cases, in which the heart suffers from some local cause, as, for example, from disease of the coronary arteries, whilst the system generally maintains its powers more or less fully, the balance between the system and the heart is lost, and diagnostic evidence of the change that has occurred in the central organ, sufficiently clear and pointed, may be traced without difficulty. Amongst the symptoms of the disease we then observe various modifications of the phenomena of drowsiness and coma; faintness and syncope; disordered respiration; pain in the region of the heart; and disturbed pulsation. For example, the patient complains in the earlier stages of being easily exhausted, particularly by mounting heights; he feels, he says, faint on reaching the top of the stairs; though not giddy, he feels he must fall; though not breathless or fainting, he sighs deeply and seeks the air. Any unusual excitement, a heated or a close atmosphere, produces the like effects. At the same time there is often experienced an uncomfortable feeling of choking or fulness in the chest. In the intervals the individual may be fairly well.

As the disease advances, the attacks become more frequent and severe, and often disturb and distress the patient at night. The temper is observed to become irritable. The expression of the features frequently appears anxious, and the countenance sallow. Copious perspiration from very slight causes, sometimes coldness of the extremities and swelling of the ankles, appear amongst the incidents of the disease. The pulse is generally affected; but how must no doubt depend in a great measure upon the part of the heart affected, and on the extent and degree of the disease. In the writer's opinion, intermittence and irregularity are the more frequent alterations; weakness is another; and slowness—often remarkable—is a third. Quickness of the pulse, more especially when it increases with age, has been dwelt upon by Dr. Kennedy as a symptom deserving of attention in the diagnosis of fatty degeneration. The irregularity may be constant. The writer has seen it present during the slight disturbances above described; and he has seen it disappear altogether when the patient was in tolerable health, to return as the effect of any depressing cause, the more marked because that cause may be far too inefficient to affect a sound heart.

The breathing is always more or less affected in cases of fatty degeneration of the heart. In some instances it is represented as a sense of choking or suffocation; the person feels as if he were breathing through a sponge. The difficulty in some instances is so slight as scarcely to be regarded; in others so severe that the smallest effort, particularly in mounting ascents, is most painful. A peculiarity sometimes observed is that the ascent of a gentle height is distressing, while the person can read aloud without inconvenience. A character of the respiration first described by Dr. Cheyne of Dublin, and afterwards by Dr. Stokes, is by some regarded as diagnostic of fatty degeneration of the heart. It is thus described by Dr. Stokes: 'A form of respiratory distress peculiar to this affection (fatty degeneration of the heart), consisting of a period of apparently perfect apnœa, succeeded by feeble and short inspirations, which gradually increase in strength and depth until the respiratory act is carried to the highest pitch of which it seems capable, when the respirations, pursuing a descending scale, regularly diminish until the commencement of another apnœal period. Dr. Hayden, in writing on this subject, mentions a case in which during the period of apnœa there was no change in the heart's action; a second case in which the action of the heart and the pulse underwent no change during the period of apnœa and dyspnœa; whilst in a third case, during the paroxysm of dyspnœa, the heart's action was remarkably irregular. It should be stated with regard to this symptom that, though frequently present, it is by no means characteristic of fatty degeneration only. It is by some said to be more frequently associated with disease of the aorta. Various explanations of this phenomenon have been given. Dr. Little (*Dublin Journal of Med. Sci.*, No. 91) believes that it is due to derangement of the dynamic adjustment between the right and left ventricles of the heart. Dr. Hayden (*op. cit.*) connects it with atheromatous or calcareous change with dilatation of the arch of the aorta, involving loss of elasticity in its walls. The late Professor Laycock thought (*Dublin Journal of Med. Sci.*, July 1873) that this phenomenon depended upon 'sentient palsy of the respiratory centre,' or 'a paresis of reflex sensibility of the mucous membrane of the lung.' *See* RESPIRATION, Disorders of.

Another phenomenon, said to be diagnostic of fatty degeneration of the heart, is arcus senilis—a pearly crescentic opacity of the upper and lower portions of the circumference of the cornea, which must be distinguished from the opaque annulus which occasionally surrounds the entire cornea. Mr. Canton was the first to describe the nature of this change as fatty degeneration. It is quite true that when fatty degeneration is present in the cornea it may possibly be found in the muscular fibres of the heart and in the arteries. Still it by no means follows that the degeneration must exist in any particular part or organ; and therefore this appearance in the cornea cannot be regarded as at all pathognomonic of fatty degeneration of the heart.

As the disease progresses still farther, the symptoms become more marked; the various effects of feeble and languid circulation show themselves; angina may perhaps become fully developed; or the patient may be cut off suddenly by one or other of the effects connected either immediately or remotely with the lesion itself. Of eighty-three cases of 'fatty disease' of the heart collected by the writer, sixty-eight died suddenly.

Physical Signs.—The physical signs that characterise fatty disease are not many. They are—a feeble impulse of the heart, proportionate to the extent and the degree of the disease; a feeble muffled first sound, under like conditions, sometimes scarcely audible. When the heart is enlarged, the impulse will be extended, and so likewise will be the dulness. A murmur may be present, as suggested by Rokitansky, from degeneration of the columnæ carneæ. The second sound is often distinct and clearly accentuated, as compared with the first.

Diagnosis.—The diagnosis of the presence of this degenerative change in the absence of any alteration in the size of the heart must be founded upon a consideration of the symptoms and physical signs above described. When the heart is hypertrophied or dilated only, the presence of fatty degeneration is more difficult of diagnosis by its physical signs. We must then seek to trace how far the usually well-marked signs of hypertrophy of the organ are modified by those we have described as being present in, and characteristic of, fatty degeneration. The same observations will apply to dilatation or thinning of the walls. This special condition has its own well-marked phenomena, which will be found described elsewhere (*see* Heart, Dilatation of). These signs will be more or less modified in proportion to the degree and extent of any fatty change that may be present.

Progress, Duration, and Terminations.—It is impossible to determine the duration of a disease the date of origin of which is in most cases very obscure. Still there are grounds for believing that persons with a certain amount of degenerated tissues in their hearts have gone on living during periods extending over thirty or forty years. On the other hand, death has occurred from fatty degeneration of the heart, determined *post mortem*, in which the entire absence of symptoms until a few months before the fatal event justified the opinion that the duration of the disease had not much exceeded the period just mentioned. When fatty degeneration occurs as the result of phosphorus-poisoning, or of certain exhausting diseases, the progress of the change, which can be determined, is rapid. In such cases, the morbid process is not confined to the heart alone, and therefore when death occurs, it cannot well be attributed solely to the condition of this organ.

Death from fatty disease of the heart is frequently sudden, the proportion being as five to one compared with other modes of death, this disease existing to a noticeable extent. The immediate causes of death are those which have been already alluded to when treating of the *effects* of the disease, namely, syncope, coma, and rupture of the heart; the first and last of these contributing nearly the whole number of those that die suddenly. Such facts indicate very strongly the necessity of avoiding any mental excitement or physical exertion which might lead to these results. Here it might also be well to remember, with reference to the administration of anæsthethics, that chloroform has an especially depressing effect on the heart's action, and that when the heart's power is enfeebled by the disease which we are here describing, a very small dose of this anæsthetic, which would have little or no effect on a healthy heart, may prove fatal. This opinion was first expressed by the writer many years ago, and it has been fully confirmed by numerous cases of death which have occurred during the administration of chloroform.

Prognosis and Treatment.—The prognosis of fatty degeneration of the heart will depend in a great measure upon a knowledge of its cause and its extent. In cases where the disease originates in constitutional causes, such as in phosphorus-poisoning, and in cases where it is of the nature of involution—for example, after parturition—there is good ground for believing that, the cause being removed, the effect will cease, and a fairly healthy condition of the organ be restored. On the other hand when the coronary arteries are obstructed, and degeneration is thereby set up, or when nutrition generally is impaired, and all the tissues are more or less undergoing this change, the prognosis must be in the highest degree unfavourable, more especially so if in the latter case the patient cannot be placed in a condition by which this degenerative tendency may be counteracted. The treatment consists in the adoption of all the measures calculated to improve the general health—such as pure fresh air, wholesome food, and temperance, together with moderate exercise, either carriage, riding, or walking, if it can be accomplished without causing pain or breathlessness. Everything which may tend to lay stress on the heart's action, such as walking uphill or making efforts, or mental excitement, should be avoided. With reference to drugs, such tonics as can be best tolerated by the patient might be given. We may mention iron—especially dialysed iron—phosphorus in small doses, and strychnia. Special attention must be paid to the condition of the excretory organs, such as the kidneys and liver, which are liable to become congested when the cardiac action is feeble. Lastly, it may be said that in cases of syncope, in addition to the administration of the usual stimulants, galvanism applied from the back of the neck to the præcordium by the interrupted current, has in a few instances been known by the writer to be useful. For further information on the subject of Fatty Degeneration of the Heart the reader may consult the complete and very valuable article by Dr. Hayden in his work on Diseases of the Heart; and a memoir by the writer in the 33rd volume of the *Medico-Chirurgical Transactions* (1850). R. Quain, M.D.

HEART, Fatty Growth on.—Synon.: Fr. *Hypertrophie graisseuse du Cœur*; Ger. *Fettige Infiltration des Herzens.*

Definition.—The growth of fat on the surface and in the substance of the heart, in quantity sufficient to interfere with its functions, and thus to constitute a disease.

Ætiology.—In our inquiries concerning the cause of this condition, we are met with the problem, still to be solved, Why are certain individuals, and certain parts of the body, more prone to the formation of fat than other persons and other parts? We can ascertain with some degree of certainty the circumstances which promote the formation of fat in general; and observations collected by the writer and others show that when fat is thus formed throughout the system, the heart is likely to partake largely of the accumulation. We may accordingly refer to the article OBESITY, in which the causes of fatty growth in general will be found discussed.

Of fifteen cases of extreme fatty growth on the heart collected by the writer, eleven occurred in very fat individuals, and only one in a person who was described as being 'thin.' Age seems to exert a decided influence upon the formation of fat upon the heart. It is very scanty in infancy, and is rarely present in any quantity before the thirtieth year. Corvisart, however, quotes from Kercking the case of a child whose heart seemed wanting, so great was the quantity of fat in which it was embedded. Of the fifteen cases just referred to, thirteen were above fifty years, and one only under that age. Males, according to the same data, are more liable to accumulation of fat on the heart than females, the respective numbers being as twelve to three.

ANATOMICAL AND PATHOLOGICAL CHARACTERS. A certain amount of fat-tissue, which is not inconsistent with health, occupies a definite position in the structure of the heart. It is seen most abundantly in the groove between the auricles and the ventricles; and as the distribution of this tissue bears a relation here, as in other parts, to that of the blood-vessels, it first appears in the course of the primary branches of the coronary arteries; then in the course of the secondary branches—that is, in the groove over the septum, which marks the boundary between the ventricles; and, lastly, it follows the distribution of the small lateral branches. These branches are more superficial over the right ventricle than over the left; hence the former is found always and more abundantly covered with fat. A fringe of fat is also found at the apex of the heart; and frequently around the margins of the auricles. A mass of superabundant fat will of itself be sufficient to press on and embarrass the action of the heart; but fat rarely exists in this abundance on the surface of the organ without insinuating itself between, and encroaching on, the muscular fibres. In this way the muscular portions of the walls of the organ become thinner and thinner, until the columnæ carneæ may appear to arise from a mass of fat. This state constitutes what was once regarded as fatty degeneration of the heart, and which has also been called 'fatty metamorphosis;' but it is in many cases nothing more in reality than a simple hypertrophy of fat. In parts of hearts which are less affected, that is, where fat is not very abundant, simple striæ of yellow tissue will be observed lying amongst the muscular fibres—an appearance often found in the auricles.

Microscopical appearances.—When a portion of heart suffering from fatty growth in a high degree is examined with the microscope, it will be found that where the growth is most advanced, that is, towards the external surface, very few muscular fibres can be seen, and that the very wide intervals between them are occupied by fat-cells. (See Fig. 23.) Proceeding inwards, the muscular fibres become more evident; the fat-cells become fewer; and, finally, we reach the muscular fibres beneath the endocardium, with a few fat-cells lying here and there amongst them. It is worthy of note that the fibres, though overwhelmed by fat, may still retain their organisation. In all cases, however, the course and direction of the fibres are more or less modified and distorted. The fact that the fibres still exist, though concealed, affords an explanation of the persistence of the heart's action in those instances in which the muscular walls appear to a greater or less extent replaced by fat. It might also be mentioned that small masses of fatty tissue sometimes appear beneath the endocardium, varying in size from that of a pin's head to that of a pea. The writer has seen these little fatty tumours in cases where there was a considerable, but not an excessive, amount of fat upon the surface of the heart.

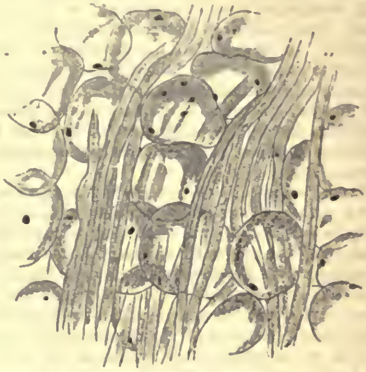
FIG. 23. Fatty growth in the substance of the Heart. × 400 diam.

EFFECTS.—The fat accumulated on the heart and in its substance, may be supposed to act mechanically; and by its pressure upon the muscular fibres, on the nerves, and on the blood-vessels, to impede the function of the organ, embarrass its nutrition, and produce those effects which may be briefly enumerated as—a languid and feeble condition of the circulation, with a sense of uneasiness and oppression in the chest; embarrassment and distress in breathing, drowsiness, even coma; syncope, perhaps angina pectoris, it may be death. Rupture of the heart sometimes results. Such an enumeration of evils, in which there is no evidence of any other lesion of the heart's texture, save an accumulation of fat, would suffice to render this condition a source of very grave import, but we cannot always be quite clear on the subject, because in the particular cases quoted we cannot be certain that some degeneration of the muscular fibres did not co-exist. It would be well, therefore, not to dwell too much on such effects as proceeding from and dependent on fatty growth alone.

DIAGNOSIS.—The presence of an excessive deposit of fat about the heart must, in a great measure, be a matter of inference during life. Where one or more of the effects mentioned above as having been noticed in cases of this kind, are present; when the pulse is small and weak; when the first sound of the heart is feeble, and the impulse weak; when the extent of dulness on percussion is increased; and when these phenomena occur in a fat person, it may be inferred that the heart is too fat.[1] But, on the other hand, it must not be overlooked that these symptoms and signs may be found in cases of fatty degeneration of the walls of the heart, in cases where the amount of fat-tissue is but moderate. Nay, more, as already stated, both conditions are often present in the same heart, thus rendering distinctive diagnosis impossible. It is said that the presence of water in the pericardium may be confounded with the presence of fat upon the heart; but the history and general features of the case in the former condition should be sufficient to prevent all difficulty in the diagnosis. *See* Pericardium, Diseases of.

Treatment.—The treatment of fatty accumulation on the heart is so intimately associated with the subject of the formation of fat in general, that this point can be discussed with more advantage in its wider relations (*see* Obesity). Whilst the treatment directed to this point is being carried out, we can do little more for the heart itself than aim at giving strength to the portion of its texture still available for duty—by tonics, steel, quinine, phosphorus, &c.; secondly, by lightening as far as possible the work which the heart has to do; and thirdly, by attending to the excreting organs, so as to prevent congestion there, and consequently embarrassment to the weak heart. R. Quain, M.D.

HEART, Fibroid Disease of.—Synon.: Chronic Myocarditis.

Definition.—A morbid condition in which the muscular fibres of a portion of the walls of the heart are replaced by fibroid tissue.

Ætiology.—Fibroid disease of the heart is met with most frequently in middle-aged male subjects. The disease is supposed to be occasionally but an extension between the muscular bundles of a chronic process that has commenced with endocarditis or pericarditis. The cause of this, which is generally rheumatism, is then regarded as the cause of the fibroid growth; but in reality it is more probable that in such cases the serous inflammation is the result, and not the cause, of the fibroid change. Fibrosis is sometimes the consequence of acute interstitial myocarditis. In a considerable number of cases of fibroid disease, and in most of the cases of so-called 'fibrinous deposit,' the change is probably syphilitic in its nature. In other instances it appears to be senile, and to be associated with degenerative changes in the vessels, or chronic disease of the kidneys. Increase of fibrous tissue in the myocardium may also be the result of prolonged moderate congestion of the coronary veins. Very frequently no evident cause of the disease can be discovered.

Anatomical Characters.—Our knowledge of the pathology of this disease is in a great measure due to the remarkable number of cases that have been described in the *Transactions of the Pathological Society*, the first specimen of which was presented by Dr. Quain in the year 1850. Fibroid disease of the heart occurs most frequently in the walls of the ventricles. It is met with under several different forms. In rare instances, which are best described as cases of *connective-tissue hypertrophy* of the heart, there is an uniform increase of fibrous tissue between the muscular fibres throughout the whole organ (*see* Heart, Connective-Tissue Hypertrophy of). In other instances, the disease appears as a local thickening of the connective tissue underneath an opacity of the endocardium or of the pericardium, whence septa run outwards or inwards between the muscular bundles. Most frequently, however, it presents the appearance of a *fibroid patch*, generally situated near the apex of the heart, replacing the muscular substance throughout its whole thickness, and over a greater or less extent of surface, even to as much as a considerable portion of one ventricle, and consisting of dense, firm, inelastic, greyish-white fibrous tissue. Smaller patches, nodules, scars and streaks may be found in the deeper parts of the myocardium. The apices of the papillary muscles, again, may become fibroid, especially in chronic valvular disease. Polypoid tumours, composed of fibrous tissue, have been met with on the endocardial surface of the heart, that is, projecting into one of the cavities; more especially into the left auricle. Possibly the detachment of such a polypus may be one mode of origin of the 'fibrinous balls' or 'concretions' occasionally found lying free in the auricular cavities. Fibroid and 'fibrinous' formations due to syphilis are described in the article Heart, Syphilitic Disease of.

Microscopically, fibroid disease of the myocardium presents a concomitant increase of the connective-tissue elements, and decrease by atrophy of the muscular fibres. Occasionally, in an early stage, as well as at the margins of the older patches, round and spindle-shaped cells and bundles of young fibrillæ have been observed. The latter increase in size and in number, press upon the intervening muscular fibres, and finally unite and form bands or patches of ordinary fibroid tissue. Meanwhile, the muscular fibres gradually become attenuated, granular, or fatty; and at last they disappear by absorption, or patches of them may be imprisoned within the fibroid growth.

The effects upon the heart of fibroid changes in its walls vary with their situation and extent. If a large portion of the wall of one cavity is fibrotic, irregular patchy dilatation of the chamber ensues. Localised fibrosis, especially if it commence beneath the endocardium, gives rise to aneurism of the heart, by the yielding of the diseased area to the intra-ventricular pressure (*see* Heart, Aneurism of). Deeper or more limited patches or lines of cirrhosis cause irregularity or puckering of the cardiac walls; and valvular insufficiency may result from this, or from fibrosis and functional disturbance of the papillary muscles. Lastly, fibroid disease occasionally involves the conus arteriosus in an annular form, giving rise to constriction and the formation of so-called 'cardiac stenosis.'

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[1] Dr. Henry Kennedy, of Dublin, in a recently published special monograph on *Fatty Heart*, states that the points upon which the diagnosis of fatty growth on the heart mainly turn are the following:—'First, a large full pulse, beating at the natural standard of frequency; secondly, evidence derived from percussion of the heart's dulness being more extended than natural; thirdly, the possible presence of a soft systolic murmur over the aortic orifice, occupying the first sound of the heart only, and leaving the second normal; and, lastly, the condition of the individual as to his being fat or otherwise' (p. 39). The present writer hesitates to agree with Dr. Kennedy as to the condition of the pulse generally, and certainly this description will not apply in the cases of those persons of small frame, with small arteries, who often become obese and present symptoms of fat-heart after the middle period of life.

Symptoms.—The symptoms of fibroid disease of the heart vary greatly in different instances, according to the extent, situation, and other conditions of the growth. When the fibrosis is very limited, few symptoms can be expected to be present. In the majority of cases in which a considerable portion of the cardiac wall has been found diseased, the symptoms have been described as those of 'ordinary heart-disease'; namely, dyspnœa on exertion; præcordial pain or distress; occasional palpitation; small, weak, or irregular pulse; dropsy; and visceral complications. As a rule, no endocardial murmur has been present; but fibrosis of the papillary muscles may sometimes give rise to the signs of incompetence of the auriculo-ventricular valves. The symptoms of cardiac aneurism and of syphilitic disease of the heart, as well as those of connective-tissue hypertrophy, are elsewhere described.

Course and Terminations.—The course of fibroid disease of the heart is generally chronic, although urgent symptoms are sometimes observed a short time only before death. Attacks of pain, palpitation, and dyspnœa may occur and subside long previous to the last fatal illness. The development of cardiac aneurism, and its possible terminations, will modify the course of the disease. Sudden death may occur, with or without previous cardiac symptoms, and must be regarded as a special mode of termination of fibroid disease of the heart. Otherwise the cases generally end by pulmonary complications, dropsy, and exhaustion.

Diagnosis.—Fibroid disease of the myocardium has to be diagnosed from chronic valvular disease; from enlargement due to extracardiac causes, such as renal disease, gout, or emphysema; and from fatty degeneration. Under all circumstances, an accurate diagnosis is extremely difficult, if not impossible. The presence of a murmur does not exclude fibrosis, as the valves may become secondarily involved; and valvular disease is not always attended by a murmur. The other cardiac lesions mentioned must be excluded in the ordinary way.

Prognosis.—When fibroid disease of the heart is attended with symptoms sufficient to establish a diagnosis, the prognosis is unfavourable as regards life, although it may not be immediately so.

Treatment.—This consists in relieving and supporting the heart by every possible means, especially by rest and cardiac stimulants, such as alcohol and ether. Iodide of potassium may be given with benefit in some cases, especially if there be a history of syphilis. Digitalis will have to be administered with great circumspection.

J. Mitchell Bruce.

HEART, Functional Disorders of.

Definition.—A disturbance in the functions of the heart, with or without pain; having origin in causes other than inflammation, or structural changes in the heart itself; and for the most part paroxysmal in character.

This definition comprises various disorders in the dynamical functions and sensibility of the heart, from the slightest disturbance of only momentary duration, to urgent symptoms of considerable persistence.

Ætiology.—The frequency of the occurrence of functional disorders of the heart, and the similarity of many of the symptoms exhibited to those met with in organic diseases, as well as the fact that these functional disorders may coexist with organic disease, thus greatly exaggerating the apparent gravity of the latter, render it important to accurately determine how much of the disturbance may be due to the one or to the other of these causes.

To estimate the *immediate* or *proximate* cause of functional disturbance of the heart, regard must be had to its structure; and how this is nourished, and its motions regulated. For adequate and equable dynamical movement, the primary requirement is a healthy development of muscular structure. Weak muscular fibre, apart from degenerations by disease, becomes a predisposing cause of feeble and irregular action. But as the regular recurrence of the muscular contraction and expansion must, moreover, be ascribed to the agency of the cardiac ganglia, the vagus nerve, and the nerves and ganglia of the sympathetic system, all nourished and excited by the blood, any abnormal conditions of these have also their effect. Interference with the functions of these several nerves may so modify the action of the heart as to cause deficiencies of power of every variety and extent, giving rise to illustrations of abnormal contractility and irritability, which the heart exhibits in common with all other muscles. But the heart further possesses the distinguishing feature of rhythmical action. There are cogent grounds for the belief that this is not only due to the intrinsic ganglionic system of nerves; but, as errors of rhythm are certainly induced by such causes as improper diet, dyspepsia, the presence of worms, constipation, injuries or deformities of the chest, and diseases of the lungs, there can be no doubt that the heart is also liable to reflex irritation of the pneumogastric and sympathetic nerves. The rhythmical action is also shown by experiment to be dependent on the blood, whether venous or arterial; for without a supply of blood rhythmical action ceases. The healthy action of the heart, and the controlling energy of its nerves, greatly, if not entirely, depend on the supply of healthy blood; and any failure of the supply, whether in quantity or quality, shows itself by disturbance in the functions of the heart. Moreover, the muscular substance of the heart itself is nourished by the blood circulating in the coronary arteries, and thus becomes susceptible to the quality and condition of the blood so distributed; hence a blood too rich in fibrin or red globules, and thereby inducing plethora, frequently causes over-action of the heart and palpitation, whilst in anæmia a deficient amount of blood induces a weak and often excited and irregular action. The predisposing causes, in addi-

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tion to those already named, may, therefore, be classed thus:—(1) Those conditions acting through or upon the nervous system, such as the general exhaustion of the nervous system, all forms of reflex irritation, venereal excesses, vain longings, purposeless occupations and amusements, protracted mental exercise, abstinence from adequate repose, &c. (2) Those conditions acting upon the general blood-supply of the body, and consequently affecting the special blood-supply of the heart, such as the turgid and plethoric states of gross feeders, depraved states caused by bad and deficient diet, and all forms of blood-disorder, as anæmia, gout, scurvy, &c. To these must be added the special temperament and personal peculiarities of the individual, a congenital or superimposed want of vigour, general debility, deformities of the ribs and spinal column, a small weak heart, uterine irritation, hysteria, adynamic fevers, and the special sanitary influences under which the individual is placed. Amongst the immediately exciting causes may be named mental shock or distress; protracted and unusual physical exertion; various articles of diet, as tea, coffee, &c.; tobacco in excess; many medicines, as aconite and digitalis; as also prolonged abstinence, exposure to cold, and notably blows on the epigastrium.

Symptoms.—A paroxysmal attack of a functionally increased impulse is often accompanied by a series of nervous sensations—such as a feeling of choking, at times amounting to a true *globus hystericus*; flushing of the face; heat and pain of the head, with a sensation of a whizzing, or rushing upwards of the sounds of the heart; dimness of vision, with photophobia; and a tendency to syncope, and to clammy perspirations with cold shivering. The voluntary muscles may refuse to act, so that the gait becomes tottering, or the patient grasps adjacent objects to steady himself, yet there is neither paralysis nor vertigo. The respiration, though not generally embarrassed, may become irregular and oppressed, presenting the phenomena of a short inspiration with a prolonged expiration; but if the paroxysms have been induced by a congested state of the right heart from using undue exertion, independently of any frequency of cardiac impulse, the breathing may be accelerated and accompanied with dyspnœa, or even apnœa, and a short dry cough. Illustrations of this class of symptoms often occur in those of sanguine and nervous temperaments; and may be the result of violent and too protracted exercise, of emotional excitements, or of the over-indulgence in stimulants or food when associated with lives of idleness and inactivity. Should the increased impulse be associated with rhythmical disturbance, there is for the most part consciousness of the existence of such states, more especially on the first ingress of the attack, so that it becomes a source of much anxiety and even of terror, inducing the self-conviction of the existence of organic disease. The head-symptoms also become more marked, and associated with local pains and *tinnitus aurium*; whilst the breathing is marked by sighing, and often becomes lessened in frequency. The irregular form of nervous palpitating heart is often associated also with hæmic diseases, and with nervous affections, as chorea, masturbation, &c. When such diseases as scurvy or chlorosis exist, the attacks become less paroxysmal and more persistent; there is more pectoral complication, even to dyspnœa; the headache is sometimes so bewildering that the mind becomes alarmed with vague apprehensions of danger, which give rise to general restlessness; the integuments over the region of the heart, as well as of the face, and even of the extremities, may become puffy and œdematous, especially in cases of extreme chlorosis, with enlargement of the thyroid gland and exophthalmos, where the morbid conditions inducing these may also possibly cause the irregular palpitation.

When functional disorder occurs with a diminished impulse, the general symptoms group themselves under anxiety and lowness of spirits, or actual despondency, with mental and bodily incapacity for exertion; flatulent dyspepsia, with cold clammy extremities; anorexia, or, may be, depraved appetite; exhaustion, with tendency to faintness; and, should irregularity of cardiac action be very marked, there may be a sensation of præcordial pain. Males are more subject to this form of functional disorder than females, and it chiefly occurs in persons having a normally small and feeble heart, or where a state of general nervous debility is superimposed.

When the distinctive feature of functional disorder is rhythmical error, and this is appreciable to the patient, the special symptom is that of extreme anxiety, even to the fear of impending death; occasionally a single intermission is so prolonged as to induce the impression that escape has only occurred by a miracle. These alarms often induce a palpitation not belonging to the rhythmical disorder. But if the rhythmical error be associated with a deficiency of systolic force, temporary paralysis of the heart's action or syncope may be induced, and in some extreme cases the functions may be weakened even to extinction. Such forms of disorder occur in those having normal but weak hearts; in the dyspeptic; in the gouty, especially if an attack is impending; and in those whose habits and occupations involve exhaustion of the nervous system. They are a characteristic of old age, but may be sympathetically induced in the young; and may be observed in the course of many diseases, such as tuberculosis, rheumatism, liver-affections, or when malignant disease is making its ravages.

Præcordial pain is by no means an unusual symptom accompanying functional affections of the heart; it may aggravate the urgency of these disorders, yet appears to be little influenced by them. The pain does not march *pari passu* with the irregularity or strength of the impulse. The pain may be persistent, while the associated disease may be paroxysmal; and in this respect it differs from *præcordial anxiety*, which is essentially paroxysmal, and acquires urgency from the symptoms with which it may be associated.

Physical Signs.—The physical signs referring to the cardiac action may be conveniently separated into the following groups, although in practice they will be found mingled or associated with each other:—(1) Increased or diminished *impulse*, connected or unconnected with increased rapidity or rhythmical irregularity; (2) *rhythmical disturbance*, with intermissions, the impulse being normal or diminished; (3) increased or diminished *frequency*, the rhythm and force being normal.

(1) The cases in which an *increased impulse* is the distinctive feature of the heart's disturbance present many varieties, chiefly referable to force and regularity; but to the simple forms of increased and accelerated impulse there is so very frequently added rhythmical disturbance, that this complication is perhaps the one most usually occurring. The rhythmical disturbance may occur both in the force and the rapidity of the systolic contractions, or it may result in a true intermittence, or occasionally the irregularities thus induced may be so great as to defy definite appreciation, save as a tumultuous whole. On palpation, the impulse, abrupt in stroke, presents the characteristic of a sudden bound, now strong, now failing, sometimes so rapid as to communicate the impression of a fremitus or agitation, then a pause, or true intermittence followed by hurry, or more evident irregularity. On auscultation, the sounds are more difficult of appreciation than in simple palpitation; they are loud and clear, and sometimes so exaggerated and pronounced as to be audible both in the mammary and epigastric regions. But whether the exaggerations of sound and impulse be more or less, they will be found to act in unison with each other; the impulse and sounds increase together and diminish together. When there is an unusual amount of irregular functional excitement in systole, there may be occasionally heard, as a passing not permanent occurrence, a reduplication of the second sound, very rarely of the first; and usually the first portion of the divided or cleft sound is the most accentuated. This reduplication, though it may be met with in active inflammatory diseases, is chiefly the concomitant of functional disorders of the nervous heart only, and it rarely or never occurs in chronic diseases of the heart. The pulse is generally sharp and jerking; it does not always beat in unison with the systole of the heart; if there be plethora, it has a force and fulness not otherwise observable; and if there exist congestion of the right ventricle, it becomes contracted and diminished in force.

In cases where the *impulse is diminished* in effort, the special characters are somewhat negative; the impulse and sounds being feeble, but otherwise normal, unless the systole be excited by mental shock or any undue bodily exertion, when irregularity and increase of impulse, with some slight sharpness of the sounds, take place. The first sound may suggest, rather than have, a sharp ringing tone; while the second is prolonged.

(2) With respect to errors in *rhythmical action*, separately considered, it must here be noted that the chief and characteristic errors may be classified under the distinct heads of irregularity and intermittence. Irregularity may be in the force or in the frequency of one or more beats, and presents the many varieties which a want of normal uniformity may suggest: the minute and particular enumeration of these is rather satisfying to curiosity than instructive. It is sufficient to say that every variety of irregular frequency may occur; while, with certain beats, force may be increased or diminished. Sometimes there appears to be a kind of order in rhythmical disorders, that is, short series of varying irregularities may regularly succeed each other; there may be a fluttering or trembling, or that vibratory or vermicular motion to which the term 'thrill' has been given. True intermittence is not so frequent as irregularity; but when intermittence does occur, it is generally associated with irregularity. These disturbances may be only momentary or of long duration, slight or considerable; but, however this may be, their character is determined by the irregularity of the systole, or the prolonging of the period of intermission.

The physical examination of this form of functional disorder shows no marked peculiarities, excepting those of systolic irregularity. To the ear is revealed irregularity in the recurrence and duration of the sounds, from the slightest appreciable pause to the most rapid and confused trembling, with very manifest alterations in tone and pitch. The sounds generally are intensified, the first sound being sometimes heightened to the extent of a sharp knock; whilst the second, save in intensity, is not materially altered. In extreme cases there may be so much ventricular irregularity as to induce in place of sounds an ill-defined fremitus; and so much force as to produce a metallic ringing, with a rubbing murmur on the systole. Thus the impulse of the heart, which in health is rarely appreciable, and its friction never, respectively become so to the touch and to the ear; and the abnormal sounds may exist to such an extent as to entirely obscure the first sound.

Occasionally there is met with an appreciable rhythmical disturbance in the pulse, which is not found to exist in the heart—*false intermittence*. The heart only indicates irregularity of power; and as there is occasional failure of force in the already weak systolic contractions, the impulse is not communicated to the artery at the wrist. These false intermissions accompanying irregularity most frequently occur when the heart is oppressed by flatus in the neighbouring viscera, or is excited by injurious articles of diet, as tea, or by the use of tobacco, &c. The sensation communicated to the patient is that of a disagreeable flutter or 'tumbling over' of the heart, which tends to alarm, although habit may to a certain extent ameliorate the terror.

Rhythmical irregularity occasionally appears as a normal condition, having a life-long existence. Some cases are marked by an extension of the pause, with unsteadiness of the systolic impulse; others by its apparent extinction, so that there exists a rapidity of beats defying all analysis. There is in these cases usually a small weak heart, with systolic impulse devoid of energy. Both these classes of cases present the remarkable feature of losing much of their distinctive irregularity when under the influence of a febrile attack; the slow pulse becomes quicker and more steady, the rapid one less frequent and more distinct; but the feeling is, nevertheless, not so comfortable as when the heart's action is in its state of normal irregularity.

(3) Functional disorder occasionally assumes the form of either increased or of diminished *frequency*, while the force and rhythm remain normal. Each of these conditions may be congenital and proper to the individual, or may be the result of abnormal influences. The functionally fast beat is generally induced by other diseases, as fever, diabetes, tuberculosis, &c., and is indicative of injury to normal innervation. The slow and drawling beat is generally met with where the nerve-power is healthy, but the heart itself is weak or fatty; or there is a perverted innervation under the influence of digitalis, aconite, or injury to the ganglionic system—a blow in the epigastrium offering a familiar example.

Inorganic murmurs are frequently heard in functional disorders of the heart, and more especially in those cases of hæmic disorder where the systolic impulse is increased, with rhythmical irregularity. These murmurs have the special characters usually attached to such sounds. They are systolic, basic, and chiefly heard in the præcordial region, with conduction in the course of the great vessels. There is no apex-murmur; but at the apex, synchronously with the murmur, the first sound is clearly defined, with a metallic ringing sound. The tone of these murmurs is musical, cooing, soft, of low pitch; the seat is in the aortic valves, and, as a rule, they are always accompanied with palpitation: this palpitation may be persistent, while the murmurs are not so. It is remarkable how large may be the amounts of blood drained from the system, and the frequency of the discharges, provided there be no diseased condition of the blood itself, without inducing the presence of a murmur. But under these circumstances, though there be no murmur, the first sound is usually flapping in character, and the second ringing in tone. The murmurs in chlorosis and spanæmia, and, when they occur, in ichorrhæmia and leukæmia, have their seat for the most part in the pulmonary valves, and are not traceable in the course of the larger arteries; they are also generally associated with the venous hum to be heard in the jugular veins.

Complications and Sequelæ.—The several functional disorders of the heart are often complicated with other diseases—many external to the heart, and some of the heart itself. The more prominent of the former are disorders of the nervous system and of the blood. Many of these have been already referred to. For the most part, those associated with a perverted innervation are examples of irritability, and exhibit rhythmical disorder, with pain. Hæmic diseases induce the simpler forms of palpitation; anæmia, gout, and dyspepsia induce palpitation with rhythmical disorder; spanæmia and chlorosis induce all these disorders, with murmurs superadded. The diseases of the heart with which functional symptoms of disorder are often found complicated are mainly degenerations of the walls, or valvular diseases. In all these cases the amount and urgency of the functional heart-disease is no indication of the urgency of the disease with which it may be complicated.

Are there any distinct morbid states or other sequelæ traceable to functional disorder of the heart? This may be a difficult question to answer dogmatically. Doubtless frequent and prolonged attacks of functional disorder are seen to occur without inducing any such. On the other hand, the long continuance of functional disorder is often marked by a depreciation of mental and bodily vigour. More specific organic changes are generally found to be due to some one or other of the diseases with which the functional disorder has been in its course associated.

Diagnosis.—In order to make a correct diagnosis, the first consideration is to ascertain the entire absence of organic disease; and, if it be present, whether it is adequate to cause the full amount of the symptoms exhibited. Supposing this to have been done, if the agitation of the heart is not only excessive, sudden, and apparently increased in strength, even to violence, but has often the features of spasm rather than the calmness of rhythmical order; while the sounds are *pari passu* increased in sharpness and intensity, and diffused over a larger area than is proper to them; and the pulse does not partake of the simulated force of the heart—the presence of an excited functional impulse may be assumed. The concurrence of some symptoms usually associated with organic disease, as dyspnœa or even apnœa and œdema, may, as has been shown, be due to the presence of chlorosis. So also where there is a deficient impulse, if the heart have its normal position and dimensions; if the sounds though weak be natural in tone and quality, in the absence of any abnormal physical disease, it may be concluded the cause is functional only. The same may be said of rhythmical irregularities. When any of these symptoms are associated with hæmic murmurs, the character of the murmur, its seat, and its persistency must be considered in connection with the absence or the presence of hæmic diseases. The symptoms of each of these several forms of functional disorder have been so fully described that there is no need to repeat them here. It must, however, be always borne in mind that the absence of the physical signs of disease is not always conclusive of there being no structural lesion, for there may be lesions, and important ones too, that do not yield evidence of their existence. The occurrence of the secondary changes, the immediate result of various congestions, is often an indication that the heart-symptoms are due to the presence of organic disease; still it is not always so, for congestions of the lungs and liver, and œdema, may be the consequence of spanæmia or of other morbid conditions of the blood. Hence, when these are present, the symptoms exhibited by a disordered heart may not be due to structural disease; and the same may be said of the effects of muscular exercise and of position, for either or both of these may distress if there be present any anæmic condition or an intercostal neuralgia. Nor, on the other hand, does the occasional subsidence of urgent symptoms, so frequently the case in functional disorder, absolutely affirm the conclusion that there is no organic disease; for occasionally in the latter the normal rhythm and force of the heart may reassert themselves; but then in these cases there remain the other characteristics of the organic affection. Frequent examination and an accomplished experience will generally lead to a just diagnosis.

Prognosis.—The prognosis of functional disorders of the heart, for the most part, is favourable. Where there are baneful constitutional tendencies, or complications with other diseases, the prognosis must not, however, be always so considered. In the leucophlegmatic temperament the paroxysms may be severe and abiding, and generally distressing to the nervous system. If the symptoms be so urgent as to distend the right heart, the liver may become loaded, and dropsy may ensue. In this temperament mental shocks may induce palpitation, irregularity, and syncope, whence may ensue not only permanent heart-affection and eventually disease, but even immediate death. When functional disorder is the concomitant of scurvy or anæmia, the prognosis is not always favourable. Still in the young and middle-aged there is good chance of ultimate recovery; for if these diseases be subdued the functional disorder subsides. When occurring in the aged, or in those having a constitutional tendency to hypochondriasis, or when associated with organic diseases, or excited by inflammations of the endocardium, a less favourable prognosis must be given. Functional rhythmical irregularity, for the most part, does not indicate danger, but it may do so if associated with some obscure structural lesion. Nevertheless, cases of simple functional disorder, so severe as apparently to indicate an immediately fatal termination, prove, for the most part, manageable, and result in a restoration to health. The freedom of the heart from all agitation and other indications of disease, before and after an attack, is due to its being a normal and uninjured organ; and though liable during an attack to the morbid influences of spasms and congestive loading, it still may be a healthy organ. This holds whether the paroxysms be short or prolonged, occurring rarely, or frequently recurring. They are distressing but not dangerous.

Treatment.—Treatment should have reference primarily to the paroxysm, and then to its exciting causes, the indications being, first, the mitigation of the symptoms; and, secondly, the prevention of their recurrence.

Treatment of the paroxysms.—Towards the former, it should be ascertained, where possible, whether the attack be essentially due to irritability in the heart itself, or whether it have its origin in some co-existing excentric cause. The constitutional tendency and the exciting causes should be well considered; for the treatment of apparently similar attacks under the widely opposite causes of a plethora or an anæmia must be varied accordingly. Slight cases subside of themselves; but in more persistent attacks, for the most part, relief is obtained by warm carminatives or stimulants, or by antispasmodics, as ammonia, camphor, ether, assafœtida, musk, valerian, or sumbul. Where irritability of the heart itself is the cause of the attack, it is generally best met by sedatives, as opium, hyoscyamus, hydrocyanic acid, and in some cases digitalis. If the attack be due to derangement of the stomach, as from the presence of the gouty acids, an alkali may be useful. In extreme cases, and where head-symptoms supervene, the extraction of a small quantity of blood by leeches or venesection may be useful. The mental or moral treatment is of the greatest moment. A confident and cheering prognosis conduces to recovery, and prevents the nervousness which exhausts and tends to prolong the disorder.

Treatment between the paroxysms.—The paroxysm being allayed, it is then well to examine carefully into the state of health, so as to ascertain if there be any of those disordered conditions which may probably have been its exciting cause. Dyspepsia is to be relieved, the liver is to be set right, the uterine functions are to be restored to regularity, loaded bowels relieved, plethora subdued; spanæmia and chlorosis strengthened into health, exhaustion compensated for, and debility counteracted; and the over-worked must seek renovation in travel and cheerful recreation. In persons prone to these disorders many precautions should be observed. The young and the plethoric must avoid extremes of diet and exercise; the food should be moderate in quantity and unstimulating in quality; and exercise should be unfatiguing, and chiefly taken in the open air. Hot and ill-ventilated rooms, and the postponement of sleep by late hours, should be especially avoided. A careful mental discipline should be observed; and this must be sought in a healthy exercise of the brain, and restraining, by a well-ordered intellectual culture, the tendency to vain imaginings and emotional passions. The constitutionally nervous and irritable in mind must sedulously avoid exciting situations, as well as exhaustion by overwork. The sluggish and hypochondriacal must resist the temptations to inaction, seeking to overcome these tendencies by exercise; by cold bathing, more especially by means of the shower-bath; and, if the bowels be confined, by the judicious use of aperients. As all the varieties of functional disorder of the heart are peculiarly under the influence of a morbid will, it becomes of the first importance that the medical attendant should generally encourage and cheer; and as soon as careful investigation has satisfied the requirements of a just prognosis, further investigations by the stethoscope should be avoided. Empirical investigations tend to prolong the disordered action, and perhaps so to impress the imagination as to forbid recovery.

Thomas Shapter.

HEART, Hæmorrhage into the Walls of.—Synon.: Cardiac Apoplexy.

Definition.—Extravasation of blood into the substance of the heart.

Ætiology and Pathology.—Blood is extravasated into the substance of the heart in various pathological conditions, but as these are described under their respective headings, it will not be necessary in this place to do more than refer to them.

Rupture of the heart is the most frequent origin of hæmorrhage into the walls of the organ.

The blood in these cases may be derived from the cavity of the ventricle, and forced between the muscular fibres at each contraction. More rarely, a partial rupture of the wall may occur, unconnected with the cavities, and hæmorrhage take place into the seat of the lesion from one of the coronary vessels or their branches, constituting what has been called *cardiac apoplexy*. In both classes *fatty degeneration* is generally the cause of the rupture.

The formation of false consecutive *aneurism of the heart* may be attended with hæmorrhage into the walls; an abscess, blood-cyst, hydatid-cyst, or gumma having burst or made its way into one of the cavities.

The *coronary arteries* may be the source of the hæmorrhage; for instance, in rupture of coronary aneurism; in cases of cancerous ulceration of their walls; and in embolism or thrombosis of their lumen, leading to infarction.

Ecchymosis of the heart is a form of hæmorrhage belonging to a different category. It is generally met with in association with parenchymatous degeneration of the heart, for example in the acute specific fevers; with that form of fatty degeneration which is produced by certain poisons, such as phosphorus and arsenic; and with other pathological states in which ecchymoses occur in the viscera generally, as in purpura and scurvy, and especially in cardiac and pulmonary disease.

In cases of non-fatal hæmorrhage into the walls of the heart, the blood undergoes the changes usual in extravasations, and gives rise to the collections of pigment-particles which are sometimes found between and upon the muscular fibres; to blood-cysts; or to collections of puriform matter.

Hæmorrhage into the myocardium possesses no special clinical relations.

J. Mitchell Bruce.

HEART, Hydatid-Disease of.—A considerable number of cases have been recorded, in which hydatids, in the wider sense of the term, have been found in the human heart. According to Dr. Cobbold, 3·5 per cent. of all cases of hydatids in man occur in this situation.

Anatomical Characters.—Hydatid-cysts of the heart are either simple or multiple, the latter being the more common of the two forms. They are situated in the myocardium of either side of the heart; but tend naturally by enlargement to project either into the pericardial sac or into one of the cardiac cavities, in the form of a prominent cystic tumour. In this condition they have generally been found *post mortem*; but it is probable that in other cases the parasite may undergo degenerative changes in the heart, as in other organs, without its existence being suspected during life or discovered after death. In other instances, the hydatids rupture or are dislodged from their seat in the cardiac wall—either inwards or outwards, or in both directions at once. In the first event, the parasite or its contents or fragments become impacted in the cardiac cavities or orifices, or give rise to embolism of the great vessels or of a distant branch. Rupture of a cyst into the pericardial sac causes pericarditis; and rupture both internally and externally has given rise to hæmopericardium.

Hydatids of the heart are frequently associated with the same disease in other viscera. The appearance and structure of the entozoon do not require to be described here. *See* Hydatids.

Symptoms.—In several cases of this disease, the subjects have died suddenly during exertion, or, as in a case recorded by Dr. Wilks, after a hearty meal. These persons were not known to have suffered previously from symptoms referable to the heart. In other instances, the ordinary phenomena of chronic cardiac disease were present, including endocardial murmurs; but it is not certain that these were always due to the presence of the hydatids in the heart. A sudden fatal termination will be the result of internal rupture and embolism, or of hæmopericardium, as described above.

Diagnosis.—Hydatid-disease of the heart does not appear to have ever been suspected during life. Cardiac symptoms and signs, or sudden death, occurring in an individual known to be suffering from hydatids of other viscera, would suggest that the heart was also affected.

Treatment.—The disease cannot be said to have any special interest therapeutically.

J. Mitchell Bruce.

HEART, Hypertrophy of.—Synon.: Fr. *Hypertrophie du Cœur*; Ger. *Hypertrophie des Herzens.*

Definition.—Hypertrophy of the heart, in a wide acceptation of the term, may be said to express an increase in the size and weight of the organ, due to an excessive development of some one of the constituent elements of its walls. In the sense in which it is generally used, however, hypertrophy of the heart signifies an excessive development of the muscular substance only.

Such hypertrophy may be regarded as a conservative process; and is not intended to include those changes in the size of the heart in which the connective and fatty tissues are in excess.

Varieties.—The varieties of hypertrophy of the heart were first carefully described by M. Bertin in 1811, who demonstrated that the change in hypertrophy is the result of an increase of nutrition. He described three forms, which most succeeding writers have referred to, namely:—(1) *Simple Hypertrophy*, in which the parietes of the compartments are thickened, the cavities retaining their natural dimensions; (2) *Hypertrophy with Dilatation* (*Excentric Hypertrophy*), in which the cavities are increased in capacity, while the parietes are either of natural or of augmented thickness; (3) the so-called *Concentric Hypertrophy*, or *Hypertrophy with Diminished Cavities*, in which new material was supposed to be added, chiefly in the interior of the ventricular walls. Cruveilhier and Budd pointed out that the condition called concentric hypertrophy is the result, not of hypertrophy, but of a powerful contraction of the organ suddenly arrested, as it were, by death. Budd found that the hearts of persons who had died a violent death presented this so-called concentric hypertrophy; but that such hearts became relaxed, and showed the normal size of cavities and thickness of walls, after maceration. Rokitansky and Bamberger acknowledge the rarity of concentric hypertrophy, but think it does sometimes occur. It is said to have been found in the right ventricle in some cases of congenital malformations. Hypertrophy may affect only one compartment of the heart, or more than one, but the organ is seldom enlarged throughout. The ventricles are much more frequently hypertrophied than the auricles, and the left ventricle more frequently than the right; but the right auricle more frequently than the left auricle—which last shows the change very seldom.

Ætiology and Pathology.—The heart being a muscular organ, whatever calls forth increased frequency and force of its action induces hypertrophy of its muscular tissue. The great causes of this hypertrophy are certain obstructive conditions in the circulatory apparatus, which will be noticed in detail. But many circumstances might be enumerated as *predisposing* causes. Thus, males, from the nature of their occupations, are twice as prone to cardiac hypertrophy as females. In advanced age degenerative vascular changes are apt to induce this result.

Dr. Quain (*Lumleian Lectures*, 1872) has classified the *exciting* causes of hypertrophy under three heads:—*nervous*, *mechanical*, and *nutritive*. 1. Amongst *nervous* causes are those emotional conditions that produce frequent palpitation, and prolonged mental excitement or strain. The immoderate use of strong coffee, tea, or spirituous liquors might come under this head. 2. Amongst *mechanical* and physical causes are all those obstructive conditions to be afterwards specially examined. Violent athletic or other exercises, which notably accelerate the contractions of the heart, or produce excessive blood-pressure, may be mentioned here. It has been pointed out that great muscular exertion with the arms is specially prone to cause hypertrophy, as in the case of hammermen, &c. Prolonged working in a bent or constrained position is also mentioned as a cause. In fact, any prolonged impediment to the free action of the heart, or to the onward current of the circulation, tends to cause hypertrophy of the heart. Thus, in addition to valvular lesions, pericardial adhesion is an important cause. Diseases of the vessels, by diminishing their elasticity and increasing the friction, displacements of the heart, and deformities of the chest or spinal column, by twisting or constricting the aorta, are all causes of some obstruction to the blood-current. The heart becomes enlarged in pregnancy—but resumes its ordinary size by involution—as the womb itself does. A very important cause of cardiac hypertrophy is chronic Bright's disease. Aneurisms also sometimes induce hypertrophy, for the physical reason that the resistance encountered by a liquid flowing through a tube is increased by the presence of any abrupt dilatation and contraction of the calibre of the tube. Conditions of the lungs associated with persistent obstruction to the passage of blood through them (emphysema, asthma, phthisis, compression from hydrothorax, &c.) may induce hypertrophy of the right side of the heart. Hypertrophy also follows upon dilatation, because additional force is required to propel the larger volume of blood, apart from any valvular lesion. So mere plethora may tend to cause hypertrophy, which also ensues upon the distension of the cardiac walls which results from myocarditis. 3. With regard to the *nutritive* causes of hypertrophy of the heart, the state of the local nutrition and the nutritive quality of the blood have both to be taken into account. Rich nitrogenous food, and the use of ferruginous medicines, will favour hypertrophic changes. With the increase of the muscular structure there is proportional enlargement of the coronary arteries, so that the hypertrophied organ has an increased blood-supply.

The most important *conditions of obstruction* connected with cardiac hypertrophy are the following:—(*a*) *Stenosis of the aortic valves* is a common cause of hypertrophy of the left ventricle. The opening is not only narrowed, but is also rendered more rigid, and thus increased force is necessary to propel the blood. Along with the valvular lesion there may also be, especially in advanced life, a loss of elasticity and a roughening of the inner coat of the aorta from degenerative changes—conditions which increase the mechanical strain upon the left ventricle. (*b*) *Aortic regurgitation* often induces so great enlargement of the left ventricle, from hypertrophy and dilatation, that the heart in such cases merits the name *cor bovinum*. The back-flow of blood increases the intra-ventricular pressure, tends to dilate the cavity, and calls forth augmented efforts of ventricular contraction. (*c*) *Aortic aneurism* is usually instanced as a cause of cardiac hypertrophy, and we gave above the physical explanation of this result. But, as a matter of fact, many cases of aortic aneurism have been recorded not accompanied by cardiac hypertrophy, though some degree of this change is usually expected. Of course, other tumours, by pressing upon any of the great arterial trunks, may induce cardiac hypertrophy. (*d*) *Chronic Bright's disease* (contracted kidney) is a very important cause of left-heart hypertrophy, the hypertrophy being often of the purest type, without dilatation. This change is the result of the great increase of blood-tension produced by the resistance offered to the blood in the small arteries through the whole body, as well as in the kidneys. (*e*) As the result of *mitral stenosis*, the left auricle becomes somewhat thickened and dilated; and the further backward blockage of the blood produces pulmonary engorgement, and hypertrophy with dilatation of the right-heart. (*f*) Similar results follow the more common lesion—*mitral incompetency*. Blood regurgitates at each ventricular systole into the left auricle, which has thus to sustain the ventricular impulse in addition to the pressure from excessive fulness. Hypertrophy and dilatation of the left auricle, engorgement of the lungs, and hypertrophy with dilatation of the right-heart, are the natural consequences. Indeed, hypertrophy of the right ventricle is almost always associated with dilatation, and the double change is, in almost every case, consequent upon pulmonary obstruction, which may be caused by primary changes in the lungs themselves (see *g*), but is far more frequently secondary to left-heart disease (mitral lesions). (*g*) In *emphysema*, *fibrosis*, and *consolidated* or *compressed conditions of the lungs*, the impediment to the pulmonary circulation induces hypertrophy with dilatation of the right ventricle. *Diseases* of the *pulmonary orifice* are very rare; so, too, is *tricuspid stenosis.* (*h*) But *tricuspid regurgitation* is common as a result of dilatation of the right ventricle; and this, in its turn, causes dilatation, usually with considerable hypertrophy, of the right auricle. General systemic venous obstruction follows upon right-heart blockage; and Hope says that venous retardation may work backwards through the capillaries to the minute arteries, the consequent increased resistance in which may induce left-heart hypertrophy.

Anatomical Characters.—The fundamental anatomical change in cardiac hypertrophy is an increase of the proper muscular tissue of the heart. There is no growth of new tissue different from the normal heart-muscle; there is simply an increase in the number of muscular fibres in all respects similar to those normally occurring in the organ. Along with the hypertrophy of the muscular tissue, there may be also more or less increase of the connective tissue between the muscular bundles; and this fibrous hyperplasia may be excessive, as Dr. Quain has pointed out, constituting a so-called 'false hypertrophy,' in which the colour of the cardiac walls varies from the natural to a light grey hue. There may be hypertrophy of only one part of the cardiac walls, abnormal thinning being found in other parts. The organ may be greatly enlarged from general dilatation, without any notable thickening of the walls; but the capacity of the chambers should always be carefully noted in estimating the degree of hypertrophy, as there may be a greatly augmented *extent* of wall, although its actual thickness seems normal. Simple hypertrophy is nearly always the first condition, preceding hypertrophy with dilatation. The greatest cardiac enlargements result from left-sided hypertrophy. Some examples of *cor bovinum* have attained the enormous weight of 40 oz. The wall of the left ventricle may become thickened to one or even one-and-a-half inches, instead of the normal six or seven lines; and the thickest part is usually about the middle of the ventricles. The interventricular septum is not so liable to hypertrophy as the rest of the ventricular parietes. The right ventricular wall may be thickened to the extent of one inch, instead of the normal two-and-a-half lines, and its greatest thickness is at its base. The columnæ carneæ of the right ventricle are even more liable to hypertrophy than the wall. In dilatation with hypertrophy the columnæ carneæ become stretched and attenuated. The substance of an hypertrophied left ventricle can generally be torn with ease, whilst that of an hypertrophied right ventricle is usually tough and leathery. The auricular walls are rarely thickened to more than twice the natural thickness, and are almost always dilated considerably if hypertrophied at all. In marked hypertrophy, the heart presents a change of configuration, becoming more globular, and having the apex tilted up. If the enlargement is mainly on the right side, the sphericity of the organ is a marked characteristic, and its long diameter has a tranverse direction in the chest. Of course, other pathological conditions, as valvular lesions, or the results of endocarditis or of pericarditis, may also be present. In true hypertrophy the coronary arteries become enlarged. There may sometimes be found accumulations of fusiform involuntary fibres, which have not developed into the higher state of striped fibres.

Symptoms and Signs.—Precise physical signs are all-important in establishing a diagnosis in cardiac enlargements, and it is always expedient at once to ascertain which chamber or chambers is or are affected. It must not be forgotten that simple hypertrophy may exist without producing symptoms attracting the attention of the patient, and that there is a natural tendency to some degree of cardiac hypertrophy with the advance of age. *Dyspnœa.*—In moderate hypertrophy without complication, there is usually easy and natural breathing when the patient's body and mind are at rest. But mental excitement or bodily effort at once induces more or less of temporary dyspnœa. In some cases the due expansion of the lungs may be mechanically impeded by the increased volume of the heart. In excentric hypertrophy with dilatation, more especially when the right cavities are thus affected, pulmonary congestion and œdema are very usually present, and then marked dyspnœa is a prominent and distressing symptom. *Cough.*—In simple hypertrophy there may be an occasional dry irritating cough, and in young phlethoric women a wheezing cough may be complained of. In right-side enlargements when pulmonary obstruction and dropsical effusions supervene, cough is, in most cases, a very frequent and painful addition to the other sources of discomfort to the patient. *Hæmoptysis and other hæmorrhages.*—Hæmoptysis from capillary engorgement is common, being generally active and sudden. Niemeyer points out that, in left-heart hypertrophy, there is often active distension, and sometimes rupture, of the branches of the bronchial arteries. In left hypertrophy, too, the cerebral arteries are specially liable to give way. In right-side enlargement with pulmonary obstruction, the blockage may influence the vessels of the liver and the portal system generally, so as to produce hæmatemesis or melæna. Epistaxis may also be due to cardiac enlargement. *Palpitation* is a common symptom in all organic diseases of the heart, and is often very marked in cardiac enlargements. The least excitement, bodily or mental, may induce a greater or less degree of this symptom. Especially in excentric hypertrophy with dilatation, most distressing paroxysms of palpitation are apt to occur from time to time. Besides bodily and mental excitement, other conditions, such as indigestion, flatulence, or an overloaded stomach, readily call forth this symptom. When there is much dilatation, the palpitation may be irregular and intermittent, and is then more particularly a very alarming symptom. *Pulse.*—In simple hypertrophy the pulse is stronger, fuller, tenser, less compressible than natural, and *dwells* longer under the finger, the hypertrophied walls requiring more time for contraction, and contracting with greater force than normal. When dilatation relatively exceeds the hypertrophy there is diminished strength, but more fulness, and sometimes marked slowness of the pulse. In aortic obstruction with left hypertrophy the pulse is strong, incompressible, small, and sustained.

In aortic regurgitation it feels as if liquid balls passed under the finger. In mitral obstruction it is frequently small and irregular. In mitral regurgitation it is irregular in size (not necessarily in rhythm). In enlargement of the right ventricle the pulse, as a rule, is small, weak, and perhaps intermittent or irregular. When atheroma of the vessels is associated with cardiac hypertrophy, the pulse is bounding. In the mere hypertrophy of old age it is full and slow, but not very incompressible. Certain *cerebral symptoms* ought to be mentioned in connection with the other more direct signs of cardiac hypertrophy. A feeling of fulness, or perhaps of throbbing, may be felt in the head after great muscular exertion or mental excitement. In pronounced cases there may be headache, ringing in the ears, vertigo, muscæ volitantes, and disturbing dreams. The bright and shining, or perhaps the blood-shot, condition of the eyes, is an indication of the hyperæmia of the cerebral vessels.

Hypertrophy of the Left Ventricle.—Simple hypertrophy of this portion of the heart does not usually produce much disturbance of respiration, but palpitation is a prominent symptom, and cerebral complications are, as we have seen, by far most frequent in this form of cardiac change. On *inspection*, the præcordium sometimes shows a bulging, more especially in young subjects, whose sternal cartilages are less resistant. Walshe says there may be some convexity of the cardiac region from the third to the seventh cartilages, and that the interspaces are rendered wider, but do not bulge. In simple hypertrophy the area of impulse may be seen to be enlarged, and to be located more to the left and lower down than normal. On *palpation* the apex-impulse may be felt to be greatly augmented in force, and to extend perhaps over the fourth, fifth, and sixth interspaces. When there is very great hypertrophy of the left ventricle, without pericardial adhesion or much dilatation, the apex-beat may be felt, powerful and well-defined, even in the seventh or eighth intercostal space. Dr. Walshe describes the sensation as a slow heaving, or a pushing forward as if against an obstacle. The duration of the heaving impulse is in proportion to the degree of hypertrophy. The impulse is often strong enough to visibly move the bed-clothes, and even to raise the head of the auscultator by the impact against the stethoscope. Of course a larger portion than usual of the heart's surface impinges against the chest-wall. With coexistent valvular lesions, a vibratory jarring sensation may be felt on palpation; and with pericardial adhesions the impulse may be a sort of jogging motion.

In hypertrophy *with dilatation* the impulse is less powerful, but is seen and felt over a wider area than in simple hypertrophy. The contractions are felt more like sharp blows or shocks, and the vibrations are conveyed to greater distances, in some cases extending to the top of the chest-wall. With great dilatation the pulse may be very slow, weak, and compressible. On *percussion*, the areas of both the superficial and the deep cardiac dulness are found to be increased, especially towards the left. In excessive hypertrophy with dilatation, the dulness may extend from the upper border of the third rib down to the eighth rib, and from an inch to the right of the sternum to the anterior axillary line. Dulness may also be detected in the left back. Emphysema and possible consolidation of the lungs must be borne in mind in marking out the area of cardiac dulness. On *auscultation*, the systolic sound is less clear and defined than normal in simple hypertrophy; it is prolonged in proportion to the degree of hypertrophy, and is muffled in character, as the muscular sound is excessively pronounced, and obscures that of the auriculo-ventricular valves. When there is much hypertrophy, the first sound may be of a metallic character. The post-systolic silence is shortened, and the second sound is loud. When there is dilatation with hypertrophy the first sound is more audible and distinct, and the second sound is louder.

Hypertrophy of the Right Ventricle.—In enlargements of this ventricle, *inspection* may reveal a rounded smoothness of the epigastrium, with perhaps some bulging of the ensiform and lower left costal cartilages. The apex-beat may be seen to be very diffused, extending towards the tip of the ensiform cartilage. Facial lividity is frequently seen; and jugular pulsation may be observed when there is tricuspid regurgitation. *Palpation* over the lower part of the sternum detects an impulse, which feels as if immediately under the hand, and wants the heaving character of the impulse of a hypertrophied left ventricle. Epigastric pulsation is often very pronounced. The liver-pulsation in such cases may result either from venous regurgitation, or from right systolic action exerted through the diaphragm. On *percussion*, the inferior line of dulness is found to extend lower down and farther towards the right than normal, sometimes reaching an inch or more beyond the right sternal edge. The dulness may be continuous with that of the liver. On *auscultation*, the first sound is more distinct than natural, and seems quite superficial. The second sound is also louder, and its reduplication is not uncommon.

Hypertrophy of the Auricles.—It is always difficult to speak very definitely of the condition of the auricles during life. They are never hypertrophied without being also dilated, and such states are uniformly connected with lesions of the auriculo-ventricular valves. Dulness due to an enlarged *left auricle* may extend up to the second left intercostal space; that due to an enlarged *right auricle* may be found in the third and fourth interspaces at the right sternal edge. Jugular pulsation may be found along with right auricular enlargement, which itself can hardly ever occur without an abnormal condition of the right ventricle.

Complications and Sequelæ.—Simple hypertrophy of the heart may go on quietly for a long time, just balancing the obstructive influence, and giving rise to no other form of disease. But when there is dilatation as well as hypertrophy, then palpitation, dyspnœa, venous congestion, and serous effusions are the ordinary results. Diseased conditions of the arteries may occur simultaneously, or may be induced by the long-continued additional strain put upon them by a hypertrophied heart. Cerebral hæmorrhage often occurs in connection with an hypertrophied left ventricle, as in Bright's disease; although there are very frequently other factors, besides the mere excessive propulsive power of the heart, in the production of apoplexy. Pulmonary and general congestion and œdema are the usual attendants of mitral lesions with right-side enlargements. Pulmonary hæmorrhagic infarction (the so-called 'pulmonary apoplexy') generally results from embolism of the branches of the pulmonary artery, and takes place in connection with right-side enlargement. Sanguineous exudation in the tract of the bronchial mucous membrane may occur in left-heart hypertrophy. Persons suffering from cardiac hypertrophy are apt to be gravely affected by acute febrile diseases, because the resultant acceleration of the heart's action increases the embarrassment of the organ. Of course, hypertrophied cardiac walls are subject to the fatty degenerative changes described elsewhere. As has been alluded to already, the chief result of right-side dilatation is obstruction to the venous return. The hepatic circulation and the portal system generally are, in particular, rapidly overfilled, the whole venous system being ultimately affected. The kidneys likewise suffer. The natural results, in addition to characteristic changes in the chronically congested organs, are serous effusions into the cavities and subcutaneous areolar tissue.

Diagnosis.—An extended area of dulness; displacement of the apex-beat; and a slow, heaving systolic action, with augmented force of impulse, are the chief diagnostic physical signs of cardiac hypertrophy. In *young and thin people* the last of these signs may seem to be present, but the accompanying conditions readily exclude hypertrophy, especially the non-extension of the cardiac dulness. An *emphysematous left lung* may mask hypertrophy when present; and *lung-consolidation* might, though only for a moment, suggest it when absent. In *pericardial effusion* the triangular shape of the area of dulness, with the apex of the triangle upwards, is a distinctive feature; there would, moreover, be the history of an acute disease, with lancinating pain, dyspnœa or suffocative sensations, and other symptoms not found in mere enlargement of the heart. *Pleuritic effusion* or *aneurism* would be still more readily discriminated. The differential diagnosis between left-heart and right-heart enlargements has been sufficiently discussed in speaking of the symptoms and signs. *Dilatation* as distinguished from hypertrophy, is characterised by the feebleness and diffuseness of the apex-beat, which may even be quite imperceptible; by the great irregularity and intermittency of the heart's action; and by the general signs and symptoms of a feeble circulation.

Prognosis.—Simple, uncomplicated hypertrophy, as in the young, and in athletes, is not incompatible with long life, if the cause be removed in time. According to the extent and degree of complication, whether in the form of valvular lesions or co-existent pulmonary disease, the prognosis will be unfavourable. When the cardiac change is itself producing secondary lesions, as degenerations of the arterial coats, when dilatation is advancing, and when there is Bright's disease, the prognosis becomes very unfavourable.

Treatment.—Hypertrophy being in itself a conservative change, protective from worse results, the primary object is to remove, if possible, the cause of the hypertrophy. To aim merely at reducing the hypertrophy, irrespectively of its cause, as by lowering the nutrition, would gravely favour the worse evil of dilatation. General therapeutic principles, and the morbid conditions accompanying the hypertrophy, must therefore be carefully attended to. All mental and bodily exertion which excites the circulation must be scrupulously avoided. All alcoholic stimulants should be interdicted, and no more wine allowed than such as may seem to benefit digestion. The diet should be carefully selected, nitrogenous food being generally necessary. The digestive organs must be sedulously looked after, not only because good nutrition is very important, but also because flatulence and dyspepsia directly embarrass the heart's action. Mild saline and aloetic aperients should be given. Diuretics will be necessary if there is a tendency to dropsy, and in all cases great attention must be paid to the removal of congestion when it affects important organs, and the restoration of their functions when affected, more especially of the liver and the kidneys. When there is great excess of cardiac action, direct cardiac sedatives, as digitalis, hydrocyanic acid, conium, and belladonna, are called for. When there is dilatation and feebleness of texture with the hypertrophy iron and digitalis are the chief remedial drugs.

J. R. Wardell.

HEART, Inflammation of.—Inflammation of the heart may affect either the lining membrane, or the substance or walls of the organ; and the subject will be best discussed under the separate heads of *Endocarditis* and *Myocarditis*. Inflammation of the investing membrane of the heart is described in the article Pericardium, Diseases of.

I. Endocarditis. Synon.: Fr. *Endocardite*; Ger. *Endocarditis*.

Definition.—Inflammation of the lining membrane of the heart.

Inflammation of the endocardium may be either acute or chronic. The acute form alone will be discussed here; chronic endocarditis being referred to under the head of Heart, Valves of. Diseases of.

Ætiology.—Endocarditis generally occurs in association with acute rheumatism; less frequently with the other acute specific febrile diseases, such as scarlet fever, measles, erysipelas, pyæmia and septicæmia—including puerperal fever; and much more rarely with typhoid fever and variola. Occasionally it is observed in the course of pregnancy, and after parturition; in acute and chronic Bright's disease; and in syphilis. Wounds and other injuries of the heart, such as rupture of the valves, may also lead to endocarditis; and local inflammation of the endocardium is frequently the result of the unnatural contact of one part of it with another during the cardiac revolution, as, for example, by growths from the walls or valves, or by unnatural blood-currents. It also occurs in chorea, perhaps from the last of the causes just enumerated.

Age is an important predisposing factor in the ætiology of acute endocarditis, the occurrence of which as a complication of acute rheumatism is certainly most frequent in young subjects, and declines as age advances. Women are also more subject to rheumatic endocarditis than men.

The localisation of the endocardial inflammation appears to be determined chiefly by pressure and tension, rather than by any peculiarity of the membrane itself, or of the blood in contact with it. Thus the left ventricle is almost the sole seat of the disease in the adult, and the right ventricle in the fœtus; whilst endocarditis is rarely seen beyond the boundaries of the valves, that is, the parts most subjected to strain. In the same way, chronic endocarditis is usually due to increased pressure within the heart, as in chronic Bright's disease, and in conditions that entail prolonged severe strain upon the valves during exertion. A similar cause is at work in pregnancy.

In a certain number of instances of the *ulcerative* form of endocarditis, the origin of the disease has been traced in connection with the presence of an ulcerating surface or foul wound in some part of the body, most frequently in the female genital organs *post partum*.

Anatomical Characters.—Inflammation of the endocardium affects chiefly the valves and the chordæ tendineæ, and especially the lines of contact or the surfaces of the valves exposed to the force of the blood-current. The endocardium of these parts at first appears slightly swollen, velvety, soft, and of various shades of red; whilst the lines or points of contact of the valves present warty enlargements of a similar character, which are known as 'vegetations.' As the process advances, the inflamed areas become more opaque and firm; and a fibrinous deposit is entangled with their surface. When the endocarditis has gone thus far, resolution is probably rare; and the most common result is what is known as 'chronic valvular disease,' that is, that the affected parts are left opaque, puckered, and thickened by growth of connective tissue, whilst the vegetations develop into firm fibroid or even cartilaginous-like bodies. As a consequence of these changes, the valves may become much altered in size and shape, and the ostia contracted and irregular, so that the mutual adaptation of the parts is greatly disturbed. Other results of inflammation are not uncommon in the progress of endocarditis, such as adhesions between the neighbouring structures, and ossification or calcification of the altered tissues. Laceration of the valves and rupture of the chordæ tendineæ during the stage of diminished resistance, ulceration, suppuration, and the formation of aneurism are rarer events.

The microscopical appearances of inflammation of the endocardium correspond with the naked-eye characters. In the early stages, the proper tissue of the endocardium is swollen by hyperæmia, œdema, and the appearance between its fibres of a number of leucocytes; the latter rapidly multiply to form the bulk of the vegetations; and the surface presents various thicknesses of deposited fibrin, which in its turn may become organised. The further development of the new cells into connective tissue gives rise to the opacity, thickening, and puckering of the valves, and to the formation of permanent vegetations.

The effects of these changes upon the functions of the valves and their appendages are described in the article Heart, Valves of, Diseases of. Particles of fibrin, and even of the vegetations are occasionally detached from the endocardium and give rise to embolism.

In a special form of the disease, which is known as *ulcerative endocarditis*, the morbid appearances are at first not unlike those described above as characterising the early stage of the ordinary affection; but the process pursues a different course, and becomes mainly destructive in its nature. The edges or surfaces of the valves then present spots or patches of loss of substance, having an eroded appearance, and an irregular base, covered with granular matter, and fringed by vegetations. These diseased areæ may advance to actual perforation, burrowing abscess, or aneurism. Microscopically examined, the patches prove to be areæ of ulceration, and the granular matter of their base has been found by Virchow and others to contain organisms, which were seen at the same time in the capillaries of distant parts of the body.

Symptoms.—The symptoms of endocarditis are inseparable from the symptoms of the disease with which it is associated, and the diagnosis of it is made almost entirely from the presence of physical signs. Thus fever probably precedes the advent of endocarditis, in every case; and it cannot be said that the simple uncomplicated disease in any respect affects either the pyrexia or any other element of the same. Local symptoms are almost equally rare, unless the endocarditis leads to serious lesion of the cardiac valves. As long as these remain sound, and the disease is acute and does not involve deeper structures, pain in the heart, præcordial distress, syncope, shortness of breath, and other symptoms of heart-disease cannot be said to occur at all frequently in endocarditis. The cardiac contractions are necessarily increased in frequency; and palpitation and dyspnœa may occur on movement. It is otherwise when the inflammation has lasted so long as to render the valves incompetent, or to obstruct the orifices; or when the myocardium is attacked, and dilatation ensues. The symptoms just enumerated then make their appearance, as well as those of secondary involvement of the lungs, of the circulation, and of the system generally.

Ulcerative endocarditis, unlike the ordinary form of the disease, is manifested by severe and striking symptoms, although amongst these the phenomena of cardiac inflammation are comparatively subordinate to those of general infection. It is on this account that ulcerative endocarditis has only recently been definitely recognised as a distinct form of disease, the condition of the endocardium *post mortem* having apparently been disregarded in the presence of serious lesions of the other viscera, of the blood-vessels, and of the blood itself. Commencing with a sudden rigor, in the course of acute rheumatism, during the puerperal state in women, or in a case of chronic valvular disease, ulcerative endocarditis either resembles a simple continued or typhoid fever from first to last, or assumes a markedly pyæmic character. In the former case, gastro-enteric symptoms and splenic enlargement may be strongly marked; whilst in the second case, vomiting and diarrhœa, jaundice, albuminuria, and various eruptions, with pyrexia of a pyæmic or remittent type, are prominent phenomena. In both forms the case steadily progresses towards a fatal termination. A loud systolic murmur is generally present from the first, and may point to the heart as the primary seat of disease; but in ulcerative endocarditis, as in simple endocarditis, special local symptoms are rare.

Physical Signs.—The physical signs of acute endocarditis are—increased extent and frequency, with variable strength, of the visible and palpable impulse; moderate increase in the area of præcordial dulness; and various alterations in the cardiac sounds. At the beginning of endocarditis, the first sound at the left apex is frequently heard prolonged and hollow, or muffled; and, as the process advances, this alteration of character may gradually pass into a murmur, which is at first indistinct, but afterwards well-formed. If the aortic valves are affected, the second sound may similarly lose its characters, become dull, and finally be converted into, or be complicated with, a murmur. The most frequent murmur in acute endocarditis is mitral systolic; aortic murmurs are decidedly less common; and mitral præsystolic murmur is very rare. Various inorganic murmurs may appear, and either disappear or continue during the course of the disease.

Complications.—Endocarditis is itself always a complication of the diseases previously mentioned. Myocarditis and pericarditis may be correctly regarded as complications of endocarditis, when the inflammation begins in the lining membrane of the heart. According to some authorities, clots may form in the heart in endocarditis, and give rise to very urgent symptoms (*see* Heart, Thrombosis of). Embolism may arise from detachment of fragments of coagula or vegetations; and this condition, and the development of pyæmic symptoms are essential elements in the course of the ulcerative form of the disease. Congestion or inflammation of the lungs frequently occurs in association with endocarditis, and so may albuminuria.

Course, Terminations, and Sequelæ.—The course of simple endocarditis is very uncertain, and varies with the course of the original disease with which it is associated, as well as with the complications. If acute rheumatism be checked in a few days, inflammation of the endocardium may be expected to be also arrested. In a considerable number of cases, however, endocarditis passes on to chronic valvular disease. For example, the late Dr. Sibson found that seventeen out of seventy cases of endocarditis with mitral systolic murmur ended in established valvular disease, and less than a half of the cases with diastolic basic murmur.

Simple endocarditis very rarely proves fatal; but the ulcerative form is believed to be uniformly so in the course of a few days, or it may be weeks. On the other hand, simple endocarditis, being by far the most common cause of valvular disease of the heart, leads indirectly to much suffering, and, as a rule, ultimately to death.

Diagnosis.—The diagnosis of endocarditis depends upon the discovery of the development of an endocardial bruit of organic origin during the course of one of the diseases already named. From functional murmurs the bruits of valvular inflammation may be diagnosed under different circumstances—first, by their locality, which is most frequently the mitral area; secondly, by their time, diastolic or præsystolic murmurs being always organic; and, thirdly, by their association with pericardial friction. The special characters of inorganic murmurs are described elsewhere. Chronic valvular disease may be diagnosed from acute endocarditis by the presence of cardiac enlargement and other well-known signs; of marked cardiac symptoms—especially pain and dyspnœa; and of visceral complications. Much more difficult of diagnosis is acute endocarditis occurring in the course of chronic valvular disease. Change of the character of the murmur, if this have been observed previously, may lead to the suspicion of fresh inflammation, but cannot establish the diagnosis of its existence, which may not be discoverable. The diagnosis of the precise seat of endocarditis on the various valves is discussed in the article Heart, Valves and Orifices of, Diseases of.

It is often impossible to diagnose *ulcerative* endocarditis from typhoid fever or pyæmia respectively, according to the form that it assumes; unless the ætiology of the case, the precise character of the pyrexia, and the occurrence of metastases be very carefully regarded, along with the development of a murmur at one or more of the cardiac orifices, and possibly of pericarditis.

Prognosis.—The immediate prognosis of acute endocarditis is generally favourable, and may be safely estimated by the absence of local symptoms. The remote prognosis, on the other hand, as regards both life and health, is exceedingly bad, inasmuch as endocarditis so frequently ends in chronic valvular disease. The probability of this result of acute inflammation of the valves is frequently difficult or impossible to estimate. A feeble, soft, and smooth murmur, or a feeble and grave murmur, is much more likely to disappear than a loud extensive well-defined bruit. The probability of the disappearance of diastolic basic murmurs may be best estimated by the absence of the effects produced by aortic incompetence upon the heart and vessels.

Treatment.—The treatment of acute endocarditis has to be discussed under three heads, namely, first, preventive; secondly, immediate; and thirdly, subsequent treatment.

a. Preventive treatment.—When a patient is suffering from any disease which may become complicated with endocarditis, and especially if he be suffering from acute rheumatism, every means must be adopted to prevent, as far as possible, the occurrence of this complication. Thus, in acute rheumatism it is all-important to check at once the intensity of the disease by recourse to salicylic acid or its salts, and other means; for experience shows that endocarditis, when it does occur in acute rheumatism, generally makes its appearance within the first week. Again, the duration of the primary disease must be curtailed if possible, inasmuch as endocarditis, although it generally appears early, may possibly occur at any period of the disease. Thus the medicinal preventive treatment of endocarditis in these cases resolves itself into the medicinal treatment of acute rheumatism. Another point of equal importance in the prevention of endocarditis is diminution of the cardiac activity. We have seen that the pressure within the heart is an important factor in the causation of endocarditis; and this pressure must be reduced by diminishing the work to be done by the heart, without lowering the cardiac power. Rest must therefore be enforced in the recumbent posture —an end which is usually already secured by the presence of acute rheumatism of the joints. The personal comfort of the patient must be zealously attended to, and pain relieved, so that restlessness and irritability may be avoided, and for this purpose carefully selected anodynes may be necessary. Stimulants must be cautiously ordered; the bowels should be regularly and fully moved; and the various secretions are to be kept as active as possible.

b. Treatment during an attack.—When endocarditis has actually made its appearance, the various means just insisted upon must be enforced as rigorously as before, so as to diminish the intensity of the inflammation, and to limit the extent of surface involved. Rest is still of the first importance. The medicinal treatment of the original disease—especially of acute rheumatism—must be persevered in. Local applications to the præcordium, such as cataplasms, or, in cases of sthenic inflammation, leeching, are often of great service. The administration of stimulants will require the greatest care; excitement of the heart, on the one hand, being avoided, and, on the other hand, digitalis, ammonia, or alcohol being employed, if symptoms of cardiac distress supervene. Equal caution is demanded in the use of anodynes which may be indicated to relieve distress connected with the joints; and local applications, such as cotton-wool, poultices, aconite, and belladonna, should be employed in preference to opium, chloral, and other cardiac depressants.

In *ulcerative* endocarditis, quinine in large doses, and salicylic acid are the remedies which appear to promise most success; and all the ordinary measures for support in fever must be persevered with.

c. Treatment after an attack.—When the primary disease, such as rheumatism, has subsided, and the restoration of the various functions indicates that convalescence has commenced, the physician must not forget the state of the endocardium that has recently been inflamed, which is probably still in a condition of great physical weakness, and the seat of new cell-growth. Instead of urging the patient to sit up and walk about under these circumstances, as must have been frequently done under the 'rival methods' of treating acute rheumatism, we should recommend a very gradual return to exercise, and the most jealous avoidance of actual exertion. There can be no question that, at this stage, rest for several weeks is of more importance than medicinal treatment. At the same time various tonic and other remedies should be employed.

II. **Myocarditis.**—Synon.: Carditis; Fr. *Myocardite*; Ger. *Myocarditis*.

Definition.—Inflammation of the walls of the heart.

This disease may be either acute or chronic; but the latter form, which is attended with the formation of fibroid tissue in the myocardium, is described under the head of Heart, Fibroid Disease of. Pyæmic inflammation of the substance of the heart also constitutes such a special form of disease that it is treated separately (*see* Heart, Pyæmic Abscess of). Acute myocarditis alone, therefore, has to be considered in the present article.

Ætiology.—A certain amount of myocarditis is sometimes associated with acute endocarditis and pericarditis, and depends upon the same causes; the most frequent being acute rheumatism. In a small proportion of cases, rheumatic myocarditis appears to occur independently of inflammation of the lining or of the covering membrane. In the great majority of recorded cases of localised myocarditis ending in abscess, the cause of the disease was altogether obscure. It has been observed most frequently in males, and before the twenty-fifth year of life. Exposure to cold, severe exertion, and local injury are mentioned amongst exciting causes, but with questionable correctness.

Anatomical Characters.—Acute inflammation of the myocardium generally involves the connective tissue as well as the muscular fibres; but in a few instances the latter alone have been found affected, constituting so-called *parenchymatous myocarditis*.

The ordinary form of the disease is characterised by the appearance of leucocytes between the muscular fibres of the heart. In one class of cases, the inflammation is moderate in intensity but diffused in extent, affecting one or more layers of muscle underlying the endocardium or pericardium, which are also inflamed; in another class of cases, the inflammation is more active, and proceeds to the formation of abscess, whilst it is, as a rule, comparatively localised.

In the first or diffused form, the myocardium, as it is seen through its inflamed covering, appears of a mottled opaque buffy colour, and is somewhat swollen and softened. The microscopical characters consist chiefly in the appearance of leucocytes and inflammatory effusion in the intermuscular connective tissue; swelling, opacity, nuclear proliferation, and rupture of the muscular fibres, followed by fatty degeneration and atrophy of the same; and the ordinary inflammatory changes of the vessels of the part. Beyond this stage, unless the case prove fatal, the diffused form of myocarditis passes into a chronic condition: and it ends either in fibroid disease with a moderate amount of atrophy, by development of the inflammatory products and atrophy of the affected fibres; in fatty degeneration; in calcification; or in cardiac aneurism.

Suppuration of the heart, on the other hand, generally takes the form of swollen yellowish-white patches or abscesses, surrounded by dirty-red or ecchymosed tissue, boggy or pulpy to the finger, and containing on section a small quantity of variously-coloured puriform matter, consisting of pus and muscular débris. In the same cases a great part of the walls of the heart may be in a condition of parenchymatous degeneration; and in some recorded instances the whole of the cardiac tissue is described as infiltrated with pus. Abscesses resulting from acute localised myocarditis are generally very small, varying from the size of a pea to that of a nut. They may either burst externally into the pericardial sac, or internally into one of the cavities or through one of the valves, leading to pyæmia, and to the formation of an acute cardiac aneurism; or the pus may make its way both externally and internally, and lead to fatal hæmorrhage into the pericardium. In other cases the pus undergoes the usual changes, and becomes inspissated or cheesy, or calcification takes place.

In both forms of interstitial myocarditis the left ventricle is most frequently the seat of inflammation.

Symptoms.—The principal symptoms of acute rheumatic myocarditis are restlessness and urgent dyspnœa; severe pain and distress referred to the præcordium; and palpitation, which gradually passes into irregularity and greatly increased frequency, and finally into complete cardiac failure. The pulse corresponds. The countenance is anxious and pale, or cyanosed. The mind is fearful and distressed at first, and delirium frequently supervenes before death, especially in young subjects. Vomiting is not uncommon.

The *physical signs* are generally associated with those of endo- and peri-carditis; but when uncomplicated may be described as—violent cardiac impulse at first, which rapidly loses in strength and regularity, while it increases in frequency; a somewhat increased area of cardiac dulness; and short sharp sounds, afterwards becoming duller and more feeble.

When these symptoms and signs make their appearance, they generally run their course rapidly, and end in death. In a small number of cases they as rapidly disappear.

The symptoms of localised suppurative myocarditis leading to abscess are not unlike those just recorded. There are the same distressing symptoms locally, with restlessness and anxiety, passing on to delirium, and ending in collapse. Rigors have been observed in some cases; and a peculiar pustular eruption on the skin in other cases. The physical signs also are not special; excepting that a murmur may be suddenly developed by rupture or perforation of part of the wall or of a valve.

The majority of cases of abscess of the heart prove fatal by asthenia; but the other terminations of abscess mentioned above will be attended by their respective symptoms, and the possibility of sudden death is especially to be noted.

Diffuse *parenchymatous* myocarditis is clinically known only as a cause of sudden death.

Complications.—The complications of acute myocarditis have already been sufficiently indicated, such as, first, ætiologically, pericarditis, endocarditis, acute rheumatism, and other causes of these forms of inflammation; and, secondly, pathologically, rupture of the cardiac walls or valves, acute cardiac aneurism, hæmopericardium, embolism, and septicæmia.

Course and Terminations.—The course of acute interstitial myocarditis, as already stated, is generally rapid, extending from a few hours to eight days in different cases. Death occurs, in the great majority of cases, from the effects of cardiac failure, if the inflammation be extensive or proceed to suppuration. The formation of acute aneurism by internal rupture, the production of pericarditis by external rupture, and other complications will variously modify the progress and termination of cardiac abscess. Simultaneous rupture both externally and internally causes sudden death.

Diagnosis.—The diagnosis of acute myocarditis is extremely difficult. Occurring in connection with acute rheumatism, it has to be distinguished from endo- and pericarditis. The absence of murmur and of the characteristic signs of pericarditis, along with symptoms of cardiac failure and severe local phenomena, such as pain, distress, dyspnœa, and finally collapse, should generally serve to establish the diagnosis of inflammation of the walls of the heart. It cannot be said that cardiac abscess has ever yet been diagnosed; but the careful consideration of all the points in the case, and the sudden development of a murmur indicative of rupture of portion of the wall, or of a valve, may hereafter ensure greater success. In the event of the development of the last-named sign, and of septicæmia or embolism, cardiac suppuration would have to be carefully diagnosed from ulcerative endocarditis. In children, acute myocarditis has to be distinguished from acute meningeal inflammation, an object which may be effected by the careful observation of the signs and symptoms connected with the heart.

Prognosis.—The prognosis of myocarditis, when it is either so extensive or so intense as to give rise to unequivocal symptoms, is extremely unfavourable.

Treatment.—The two principal indications of treatment in acute inflammation of the substance of the heart are to support and strengthen that organ, and to relieve the pain and distress. Local anodynes, especially in the form of the preparations of belladonna and poultices; and stimulating 'counter-irritants,' such as mustard cataplasms, will conduce to fulfil the second indication. Such relief is the first essential, if rest is to be secured. The patient must be spared the very smallest exertion. Food must be given in small quantities, and be easily digestible and highly nutritious; the bowels must be kept open; and the flow of urine should be as free as possible. Alcoholic stimulants will be urgently called for; and palpitation may be regarded as an indication of the necessity for these, as much as weakness of the impulse. Digitalis, ammonia, and other cardiac stimulants should be given cautiously, at the same time, so as to strengthen the cardiac action, whilst diuresis is encouraged.

J. Mitchell Bruce.

HEART, Malformations of.—Synon.: Fr. *Affections Congénitales du Cœur;* Ger. *Missbildungen des Herzens.*

Classification and Description.—The cardiac anomalies of development may be classed as follows:—

I. Those dependent on arrest of the process of development at an early period of fœtal life, so that the organ retains its most rudimentary form, the auricular and ventricular cavities being still single or presenting only slight indications of division, and the primitive arterial trunk being retained, or the aorta and pulmonary artery being very imperfectly evolved.

II. Those in which the defective conformation occurs at a more advanced period, when the auricular and ventricular partitions are already partly formed, and the aorta and pulmonary artery more or less completely developed. Such are the cases in which, with imperfect separation of the ventricles and auricles, the arterial or auriculo-ventricular passages are constricted or obliterated, and the origins of the aorta and pulmonary artery are misplaced.

III. Cases in which the development of the organ has progressed regularly till the *later periods of fœtal life*, so that the auricular and ventricular septa are complete, and the primary vessels have their natural connections, but in which there are defects which prevent the heart undergoing the changes which should ensue after birth: such are the premature closure of the foramen ovale, the non-development of the ductus arteriosus, or the occurrence of slighter sources of obstruction at the arterial or auriculo-ventricular passages or in the course of the aorta.

IV. Cases in which there is some irregularity in the formation of the valves, or in the connections with the vessels, or in the vessels themselves, which, though not immediate sources of obstruction, may become so during the progress of life, so as to lay the foundations of subsequent disease.

I. Cases of the first class are of very infrequent occurrence, and are the more rare according to the extent of the imperfection. The first case of simply biloculate heart was placed on record by Mr. Wilson, in the *Philosophical Transactions*, in 1788, and the specimen is preserved in Dr. Baillie's museum, in the possession of the Royal College of Physicians. The anomaly was found in the body of a child, which survived for seven days. From defect in the diaphragm, the heart lay in a sac on the upper surface of the liver; and the organ was found to consist of an undivided auricle and ventricle, and a single artery, evidently the primitive arterial trunk, which first gave off a vessel which furnished the branches to the lungs, and the vessels to the head and upper extremities. The coronary arteries arose by a common trunk from the aorta before its final division. Since the publication of this case, others have been placed on record illustrating the gradual advancement from the simple to the more complicated forms—the ventricle becoming more completely divided, the septum of the ventricles being more fully developed, and there being two vessels given off from the ventricle, though in some cases one of these may be abortive, or if there be only a single vessel, that being shown by the origin of the coronary arteries from its commencement to be really the aorta.

II. Of the second class, the examples which have been described are much more numerous. In cases of this kind the auricles and ventricles are fully formed, though the septa which divide them are incomplete, and there is usually more or less displacement of the origins of the primary vessels, so that the aorta more especially may come to arise partly or almost entirely from the right ventricle; or the points of origin of the vessels may be transposed, the aorta arising from the right ventricle, and the pulmonary artery from the left. Cases of the former description, in which the septum of the ventricles is incomplete, and the aorta misplaced to the right, are almost always found to coexist with some obstruction to the passage of the blood from the right ventricle, either (1) from smallness of the pulmonary artery; (2) from imperfection of the valves; (3) from constriction at the outlet of the right ventricle, or at the end of the conus arteriosus or infundibular portion of the ventricle; or (4) from constriction at the commencement of the conus or point of union between that portion of the ventricle and the sinus. A case of the second description was published by Sandifort, in 1777, and one occurred to Dr. Hunter in 1761, but was not published till 1763. The fourth form of obstruction, or that occasioned by constriction between the sinus and the infundibular portion of the right ventricle, has only recently been explained, though cases of the kind have for some years been placed on record. It is indeed probable that the existence of a very decided partition in this situation led to the idea entertained by some of the older pathologists, that the heart occasionally had three ventricular cavities. The abnormal septum is partly formed by hypertrophy of the muscular structure, and partly by the endocardium becoming thickened; and in some cases very decided obstruction is so caused. The defect is generally developed at an early period of fœtal life. The septum of the ventricles is therefore incomplete, the defect being at the posterior part, so that the aorta comes to arise from the sinus of the right ventricle, while the pulmonary artery takes its origin from the infundibular portion, which seems to constitute a distinct cavity. The heart thus, as pointed out by Mr. Grainger, bears an almost exact resemblance to the condition of the organ in the turtle. In the turtle there are two aortic ventricles and one pulmonic ventricle; the right aortic and the pulmonic ventricle being the analogues of the sinus and infundibular portion of the right ventricle, and being in connection, while the left aortic ventricle is distinct.

Much more rarely there has been found an entire obliteration of the orifice or trunk of the pulmonary artery, the first case of this description of anomaly having also been published by Dr. Hunter at the same time as the former case. Much more rarely the defect in the ventricle has been found in connection with obstruction or obliteration of the right auriculo-ventricular, the left auriculo-ventricular, or the aortic aperture. Where the septum of the ventricles is incomplete, the defect generally exists at the base, at the part which has been termed the *undefended space*—the space which intervenes between the contiguous sides of the left and posterior semilunar segments, where on the left side the muscle is naturally deficient; and in this way a connection may exist between the left ventricle and right auricle or ventricle, either immediately above or below the right auriculo-ventricular opening. More rarely the septum between the left ventricle and the conus arteriosus of the right ventricle is defective; and still more rarely an aperture exists at a lower part of the septum. The portion of the septum dividing the left ventricle from the sinus of the right is termed by Rokitansky the posterior—that between the left ventricle and conus arteriosus, the anterior septum. With the defects now mentioned, the auricular septum may also be incomplete, or the foramen ovale may be still open, or the ductus arteriosus pervious. Indeed, when the pulmonary artery is much contracted or impervious, one or other of the former conditions necessarily exists, and the ductus arteriosus becomes the means by which the blood is conveyed to the lungs, though occasionally there are compensatory branches derived from the aorta or one of the large vessels also distributed to the lungs.

The transposition of the aorta and pulmonary artery also occurs at an early period of fœtal life. The first case of the kind recorded was related by Dr. Baillie in 1797; the specimen is figured in his plates, and still exists in the museum in the possession of the Royal College of Physicians. In this anomaly the septum of the ventricles is generally defective, and the two fœtal passages open, and the organ may indeed be very defective in conformation. The heart also is often misplaced in the chest. Another form of defect is that in which the descending aorta is given off from the pulmonary artery through the ductus arteriosus. This condition is apparently the result of imperfect development of the isthmus aortæ between the origin of the left subclavian artery and the point of entrance of the duct, so that an adequate supply of blood cannot be conveyed from the ascending into the descending aorta. Generally the condition coexists with defect of the septum of the ventricles, as in two cases formerly in the possession of Sir Astley Cooper, and now contained in the museum of St. Thomas's Hospital, described by Dr. Farre in 1814. In some instances of this kind the portion of aorta between the left subclavian artery and the duct is imperforate, and yet in others, as in a case related by Steidelle and referred to by Hein in 1816, there is no connection between the two portions of the aorta, the ascending part giving off the vessels to the head and upper extremities, the descending portion being wholly derived from the pulmonary artery. This form of defect is closely allied to the cases which are occasionally seen in after-life, in which there is constriction or obliteration of the isthmus aortæ beyond the left subclavian artery, the circulation being maintained through collateral channels.

III. The third class of cases consists in the premature closure of the foramen ovale; or the non-development or disappearance, at an early period of fœtal life, of the ductus arteriosus; or in diseased conditions of the valves, which prevent the heart undergoing the changes which should ensue after birth.

The first condition is of very rare occurrence. The first case recorded was related by Vieussens in 1715. In these cases the blood during fœtal life being all transmitted through the right cavities and the pulmonary artery and duct, those portions of the heart are unduly developed, while the left side of the organ becomes atrophied. In the second class of cases the heart is defectively developed, and the right ventricle gives origin to the aorta, and often also vessels are distributed from the aorta to the lungs, while the ordinary pulmonary artery may be very small in size, or may be entirely absent. In a case of this kind, described by Dr. Ramsbotham, the pulmonary artery is said not to exist; but by examination of the specimen preserved in the London Hospital Museum, the writer has ascertained that this is not correct. The artery exists as a very small vessel, but the scanty supply of blood to the lungs which it furnished was complemented by small vessels from the aorta. In cases which are not of uncommon occurrence, and may be classified with the malformations now spoken of, but which are closely allied to the next class, there exists some source of obstruction to the transmission of the blood from or into the right ventricle, which determines the imperfect closure of the foramen ovale, or the patency of the ductus arteriosus. The obstruction in these cases generally depends on disease of the pulmonic valves, or obstruction at the end or beginning of the conus arteriosus, or at the right auriculo-ventricular aperture.

IV. The fourth class of malformations consists of defects, of a slighter description, of the valves, or narrowing of the orifices, or of the isthmus aortæ.

The semilunar valves may be excessive or defective in number. The former condition probably does not materially interfere with the functions of the heart—the latter often does so, and especially when, as is very frequently the case, the valves become the seat of disease in after-life. If there be only two valves, one of them imperfectly representing two distinct segments, there is great liability to incompetence. If there be only one valve, representing three imperfect segments, obstruction is almost necessarily occasioned.

It is probable that the cases in which the tricuspid valve is found represented by a kind of membranous diaphragm, stretched across the orifice and perforated in the centre, and some of the so-called cases of button-hole mitral, are also of congenital origin.

It is not considered necessary in this article to refer to many examples of these different forms of malformation, or to allude to other of the less important deviations from the natural conformation of he heart. The subject will be found more fully treated of in the works of Dr. Farre[1] and Gintrac[2] and Freidberg,[3] in the papers of Dr. Chevers,[4] and in the writer's own work.[5] The more recently published cases also are abstracted in the treatise of Taruffi,[1] and numerous examples of different forms of malformation are given by Rokitansky.[2]

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[1] *On Malformations of the Human Heart.* London, 1814.

[2] *Observations et Recherches sur la Cyanose, ou Maladie Bleue.* Paris, 1824.

[3] *Die angebornen Krankheiten des Herzens etc.* Leipzig, 1844.

[4] *Collection of facts illustrative of Morbid Conditions of the Pulmonary Artery.* London, 1851, and *Medical Gazette,* 1845 to 1851.

[5] *Malformations of the Human Heart.* Second edition, 1866.

Mode of Formation.—It is probable that all the different forms of irregularity in the development of the heart are due to arrest of development, occurring at different periods of evolution, so that the heart retains the forms proper to it at such stages. The cause to which this arrest is to be ascribed can rarely, however, be traced in cases where the defect is great, such as those of biloculate heart, or where the vessels are transposed with or without very marked imperfection in the organ itself. These defects must be ascribed to the imperfect evolution of the double set of cavities, and of the pulmonary artery and aorta from the primitive trunk and branchial arches. In the less marked defects, however, the irregularity can often be traced to a source of obstruction to the transmission of the blood through one or other of the apertures or vessels. Such obstruction is much the most common in connection with the right ventricle and pulmonary artery. In cases of this kind the septum of the ventricles is deficient, so that the aorta arises wholly or in part from the right ventricle. Dr. Hunter, in the paper before referred to, when describing a case of obstruction of the pulmonic orifice with defect in the septum of the ventricles, suggested that the imperfection in the septum was probably caused by the pulmonic obstruction. Meckel, however, adopted the view that the primary defect was in the septum of the ventricles, and that the pulmonary artery became more or less abortive from being thrown out of the course of the circulation by the ready outlet afforded for the blood from the right ventricle into the aorta. The former view seems, however, to afford the more satisfactory explanation, and is in accordance with the almost constant occurrence of disease of the valves in these cases. According to the view of Meckel, the pulmonary artery should simply be small, as when the ductus arteriosus is absent, like the case of Dr. Ramsbotham before referred to, but such a condition is very rarely found. The excess in the number of the semilunar valves might seem to afford an example of redundant development, but this condition also probably depends on arrest of development; though, as we do not clearly understand the mode in which these valves are developed, it is impossible to express a very decided opinion as to the cause of the apparent excess.

Symptoms and Diagnosis.—There cannot generally be much difficulty in recognising a case of malformation of the heart during life. Not only in cases of a very marked kind is there generally a complete history of the condition of the subject during its short life, but the symptoms are also very characteristic. The child is very markedly cyanotic; the cheeks, lips, hands, and feet are excessively livid; the fingers and toes are clubbed; the nails are incurved; and the patient is liable on any excitement, or on exposure to cold, to attacks of dyspnœa, often followed by convulsions. There are also often present difficulty of breathing, cough, and expectoration of blood; with palpitation, and often pulsation of the vessels of the neck. If also there be any obstruction at or near the pulmonary orifice, there will be a harsh systolic murmur heard in the course of the pulmonary artery; and if there be a defect in the septum of the ventricles, the murmur will be heard probably also in the course of the aorta. Often there are unhealthy ulcerations about the fingers, toes, and anus or vulva. If the case do not attract notice till late in life, there will probably be less marked signs of obstruction to the circulation, and possibly they may be entirely absent, and there may be no history of the patient's previous condition. In cases of this kind the probability will be that if there is a murmur at the pulmonary artery there is some defect at or near the orifice of that vessel, with or without an aperture in the septum of the ventricles or an open state of the ductus arteriosus. The former condition is so rare as the result of disease in after-life, that if the signs point to pulmonic valvular disease, its congenital origin may safely be surmised. The open foramen ovale and ductus arteriosus could probably not be diagnosed with any certainty, though cases have occurred in which peculiar murmurs noticed during life were supposed to be so produced. It might be supposed that when so small a proportion of the blood is subjected to the influence of the air, as in some of these cases, the temperature of the patient would not reach the natural standard, but the most careful observation of the temperature of children labouring under congenital cardiac cyanosis has generally failed to detect any marked difference between them and other children of about the same age.

Cyanosis.—There are few subjects which have excited more discussion than the causes of Cyanosis or *Morbus Cæruleus*. Morgagni, in 1761, when describing the case of a girl who had obstruction at the orifice of the pulmonary artery with an unclosed foramen ovale, expressed the opinion that the general congestion was probably the cause of the remarkable lividity which had been noticed during life; and Dr. Hunter, in 1783, in describing a case of pulmonic obstruction with imperfection in the septum of the ventricles, ascribed the lividity to the intermixture of the venous and arterial currents of blood. These views have since received support from various writers. The view of Morgagni has been maintained by Louis, and that of Hunter by Gintrac. It has been very fully shown that there is no just and constant relation between the intensity of the cyanosis and the amount of intermixture, and indeed that very marked cyanosis may exist without any intermixture; while on the other hand in all cases of marked cyanosis there are present causes capable of producing great venous congestion. The writer is, therefore, of opinion that the evidence is very greatly in favour of the correctness of the views of Morgagni and Louis, that the cyanosis results from stasis of the blood, though probably other causes conduce to the intensity and peculiarity of discoloration. Thus, probably, the defect must be congenital, or, at least, of very long duration, so that the smaller vessels may become greatly dilated; the integuments must be thin, so as to allow the colour of the blood more readily to be seen, and lastly—probably also from the very small portion of the blood which can be subjected to the influence of the air—the whole mass is of an unusually dark colour, and so the intensity of the lividity is increased.

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[1] *Sulle Malattie congenite, etc., del cuore.* Bologna, 1875.

[2] *Die defecte der Scheidewände des Herzens.* Wien, 1875.

Duration and Terminations.—The duration of life in the subjects of the different forms of malformation varies greatly, according to the degree of the defect in the heart. In cases in which the organ presents a very rudimentary condition, life can only be prolonged for a few hours or days; while in the slighter forms of defect the patient may survive to puberty or to manhood or womanhood, or even to more advanced age. Thus, in cases of contraction of the pulmonary artery, without other defect in the organ, cases are on record in which patients lived to 44 and 63; when, with the pulmonic disease, the foramen ovale was unclosed, the subjects have reached 40 and 57. Where the septum of the ventricles was deficient, nine patients are stated to have lived to between 20 and 30. Where the ductus arteriosus was still open, patients lived to 13½ and 19 years; but of course these ages are the extremes, and by far the largest proportion of the subjects die much younger. When the pulmonic orifice or artery is impervious, but few patients survive for more than two years, but cases are on record in which 9 and 12 years of age were attained; the age being greater according to the facility afforded for the transmission of the blood from the right side of the heart, as when the septum of the ventricles was imperfect, than when the ventricles were completely separated.

Transposition of the aorta and pulmonary artery is a defect incompatible in any of its forms with the prolongation of life for any lengthened period. Four cases are, however, on record in which the patient survived to between 2 and 3 years of age—the imperfection of the septum of the ventricles tending in these cases also to the prolongation of life.

The most common causes of death in cases of malformation of the heart are affections of the brain and lungs, hæmoptysis, &c.; and, if the patient survive for a sufficient period, tuberculous affections. Notwithstanding the very great obstruction to the circulation, dropsical symptoms do not generally arise to any marked degree.

Treatment.—It is scarcely necessary to speak of the treatment of these cases. It must consist in protection against cold; in the maintenance of bodily and mental quiet; and in the use of a nutritious and easily digestible diet.

T. B. Peacock.

HEART, Morbid Growths in.

— The various forms of morbid growth that have been met with in the heart may be thus enumerated in the order of their frequency:—1. Malignant disease; 2. Lymphomatous or lymph-adenomatous growths; 3. Non-malignant tumours; and 4. Cysts. Fibroid growths, syphilitic gummata, and tubercle, as well as hydatids affecting the heart, are discussed separately under their respective heads. Calcareous, cartilaginous, and osseous changes of the myocardium are noticed in the article Heart, Degenerations of.

1. Malignant Disease of the Heart.

—Cancer, although the most common of the new formations found in the heart, is still very rare in this situation, and is a subject chiefly of pathological interest.

Ætiology.—Malignant disease of the heart is, with very few exceptions, always secondary; and the primary growth may have its seat in any part whatever of the body. Occasionally the heart becomes involved by continuity, the lungs and mediastinum being the seat of the primary disease. Cases have occurred at all periods of life, from infancy to old age; but at least one-half of the subjects have been in the middle period of life. The disease has been most frequently found in males.

Anatomical Characters.—Carcinoma, epithelioma, and sarcoma, including colloid cancer and melanosis, have all been found in the heart in different instances. Any part of the organ may be affected, and the right side appears to be more frequently invaded than the left; but the disease is generally multiple. The morbid growth generally presents itself at or upon either of the surfaces of the heart, rather than in the substance of the myocardium. In these situations there appear one or more masses of malignant disease, which are generally easily distinguished from the cardiac tissue around; and which possess the ordinary characters of such formations, according to their respective forms, encephaloid being the most common, and epithelioma by far the most rare. Any difficulty in the recognition of the disease is removed by section and microscopical examination. The extent of cardiac wall involved by the growth is sometimes great. When the masses of malignant disease project externally, they are frequently associated with pericarditis, either local or general. Prominent nodules in the interior of the heart may cause local endocarditis; and in other instances the valves and their appendages may be so involved that incompetence results. In very rare cases malignant disease of the heart proceeds to ulceration.

Symptoms.—Of thirty-six cases of malignant disease of the heart, the histories of which were collected by Dr. Quain, in thirty either there were no symptoms present, or they were not recorded. In one of the remaining six cases, the subject of the disease, a man of thirty seven, in whose heart a single large mass of encephaloid cancer was found *post mortem*, had been subject to attacks of excruciating pain in the præcordial region, to dyspnœa, palpitation, and vomiting; and death occurred suddenly. Pain in the chest and oppression, not referable to other causes, are recorded in two other cases; and in the fourth there were anginal seizures. In cases of cancer of the heart spreading from the mediastinum or lungs, dyspnœa, cough, and pain are necessarily frequent symptoms.

With respect to the physical signs of malignant disease of the heart, tenderness on percussion over the præcordium (in association with local pain), pericardial friction, and endocardial murmurs due to involvement of the valvular apparatus in the new growth, appear to be the only phenomena that have been specially observed.

The disease naturally ends in death; and in more than one instance this termination was sudden, and perhaps directly due to the affection of the heart.

Diagnosis.—This condition has probably never been diagnosed during life. The appearance of true cardiac pain, or of any of the physical signs just mentioned, in the course of a case of cancer, would, however, be strong evidence that the heart was secondarily involved.

Treatment.—The treatment of malignant disease of the heart is necessarily limited to the relief of any symptoms that may be present, and does not differ from the treatment of cardiac distress from other causes.

2. **Lymphoma of the Heart.**—Lymphomatous or lymphadenomatous growths have been met with in the heart in several cases in which the disease was general, but this affection of the organ cannot be said to have any clinical importance.

3. **Non-Malignant Tumours of the Heart.** These growths are also of purely pathological interest, and are amongst the very rarest of morbid appearances in connection with the heart. *Myomata* have been recorded as instances of this class of diseases. *Lipomata* lying under the endocardium are referred to in the article Heart, Fatty Growth on.

4. **Cysts of the Heart.**—The occurrence of true cysts in the myocardium (hydatids, abscesses, hæmatomata, and softening gummata being excluded) is doubtful.

J. Mitchell Bruce.

HEART, Palpitation of.—Synon.: Fr. *Palpitation du Cœur*; Ger. *Herzklopfen.*

Definition.—Abnormal movement of the heart, whereby the force of the systolic contractions is increased to such a degree as to give rise to a sensation of discomfort or distress on the part of the patient.

Ætiology.—The *immediate* or proximate cause of palpitation is an over-stimulation of the excitability of the muscular structure of the heart, induced by functional errors of the cardiac ganglia and of the vagus, or of those nerves which, proceeding from the ganglia of the great sympathetic, supply the heart. It is therefore a true neurosis. The disordered action of these nerves may be induced either directly or by reflex action; but in either case the phenomena as regards the heart are the same, namely, the morbid activity of a normal function, which must be here considered as independent of any accompanying organic lesion.

The *predisposing* and *exciting* causes of palpitation of the heart are various. The chief *predisposing* causes are to be found in the nervous and excitable temperaments; general debility; inanition; exhaustion, whether bodily or mental; early age; hysteria; venereal excesses; and in deterioration of the blood, as occurs in gout, scurvy, chlorosis, or spanæmia. Amongst the *exciting* causes may be classed violent exercise; mental shock, emotion, and all forms of sudden excitement of the nervous system; dissipation; injurious articles of diet; and dyspepsia.

Symptoms.—Palpitation may be found in the form of (1) a single action; or (2) a series of actions, which may become prolonged, and of such a character as to be esteemed chronic. The single abnormal beat not unfrequently occurs during a first sleep, and the patient is wakened by a consciousness of it. Sleep may then return, and the attack subside without other inconvenience; or it may be associated with a feeling of weight, fulness, anxiety, sinking, or even pain of the præcordia. More frequently, however, the attacks are prolonged and paroxysmal, recurring with an accelerated and uncertain frequency, and varying rapidity. In the patient the act of palpitation causes various and widely different sensations. There may be a mere occasional flutter, or a slightly increased action continuing for a time; or there may be increased action attended with great rapidity, and such violence that the heart appears forcibly to strike the chest-walls, diffusing its influence over the whole sternal region, and even at times agitating the whole body (a phenomenon probably due to an associated general nervous agitation); or the heart, again, may seem to the sufferer to rise, as it were, into the throat. With these several forms there may be the accompanying symptoms of choking—the *globus hystericus*; vertigo; tinnitus aurium; impaired vision, with a feeling of distension of the eyeballs; a copious secretion of pale limpid urine; a clammy coldness of the extremities; fear of death; partial unconsciousness; or actual syncope. Paroxysms such as these may be preceded by a somewhat prolonged state of cerebral disturbance, as evidenced by heat of brow and vertex, headache, and an inaptitude to think or regulate the thoughts; and as there is generally a self-consciousness of the abnormal action of the heart, the anxiety on this account serves to impress the mind with so much fear and inquietude, as to tend to increase and prolong the disorder that has induced them.

Physical Signs.—The physical examination of the heart shows the apex-beat to be normal in position, but diffused and much exaggerated in force. The area of dulness, as a rule, is not enlarged upwards, but it may be temporarily enlarged, under certain circumstances, towards the right side. The sounds, always exaggerated, at times become very much so, and usually with a sharp metallic ring. Occasionally a kind of remitting humming sound is superadded, and may be heard even by the patient; but this is never constant. Sometimes the sounds are heard over a great extent of surface; but this extent is no measure of their intensity, for they may not be loud, but abnormally clear and distinct only. Occasionally there is a pericardial rubbing accompanying the mitral apex-shock, simulating the friction-sound of pericarditis, but there is never true friction-sound. The basic second sound, more frequently than the first, presents the metallic ring. Sometimes it becomes lower-pitched and less clicking than in an ordinary paroxysm of palpitation; and may even, as also the first sound, so lose sharpness and abruptness as to assume somewhat of the character of a soft murmur. The aorta, carotids, and large arteries also throb, and have an excited impulse. The smaller arteries are not sensibly affected. The pulse at the wrist is often no indicator of the amount of action exhibited by the heart. Sometimes it has the character of being sharp and jerking, without force; or, should the right side of the heart become loaded with blood, it may be small and soft, and weak. On the subsidence of a paroxysm, the ventricular impulse may drop to its natural force and frequency, and the sounds be unaccompanied by any exaggerations. Nevertheless, though the attack may have subsided, there may be some slight irritability of the heart's action perceptible for some short time afterwards.

Diagnosis.—Though the diagnosis of palpitation of the heart in some cases may present difficulty, yet, in the absence of evidence of structural lesion, an increased impulse presenting the above distinctive characters may be assumed to be functional in its origin, and not dependent on any organic disease of the heart itself. We have, in fact, to do with an exaggeration, sometimes highly marked, of the natural nervous susceptibilities of the heart; and this nervous increase of impulse, even when only slight, is usually more appreciated by the patient, more painful, and more a source of anxiety than is that attending organic disease, especially in its earliest stages.

Treatment.—The treatment of palpitation should in every case be directed to remedy or to remove the exciting cause of the attacks, and to render the nervous system less susceptible. In the simpler forms that which is prophylactic is all that is necessary. In more marked attacks general care, with quiet, may be sufficient; or the administration of an alkali with warm restoratives. In the protracted and severer forms of attack, besides ether and ammonia, digitalis, aconite, colchicum, chloral hydrate, and the bromides may be occasionally resorted to.

T. Shapter.

HEART, Pyæmic Abscess of.—Definition.—Abscess of the heart occurring in pyæmia.

Ætiology.—Abscess of the heart has been most frequently observed in cases of pyæmia following acute necrosis of bone or diffuse periostitis, and less frequently after phlebitis, chronic or acute arthritis, urethral stricture, chronic abscess, and cancerous ulceration. In eleven out of fourteen cases, the histories of which were collected by Dr. Quain, the age of the patients was seventeen years or under; and twelve out of the same fourteen cases were males. In other words, pyæmic abscess of the heart has been most frequently found in cases following injury to a bone or to a joint in boys. In older subjects it has been associated with pyæmia secondary to one or other of the diseases just mentioned. In a few cases no primary disease was discovered.

Anatomical Characters.—Pyæmic disease of the walls of the heart has been most frequently observed in the left ventricle, towards the base and in the papillary muscles. In the great majority of cases, pericarditis co-exists, and very frequently endocardial inflammation also. The pyæmic foci are generally multiple; and appear at first as small, slightly elevated, yellowish or buff-coloured, softened patches, projecting either on the external or on the internal surface of the heart, and covered with inflammatory deposit. On section, these patches either present an appearance of diffused yellowish softening, or contain one or more collections of dark dirty puriform matter, with ragged, ill-defined boundaries, as if formed by destruction of the discoloured tissue around, and varying in size from that of a pea to that of a pin's head.

Microscopically examined, the yellowish patches prove to be portions of the myocardium which are infiltrated with pus and granular matter; the muscular tissue itself being in a condition of granular or fatty degeneration. The puriform material represents an advanced stage of the same change, consisting of granular matter and other muscular débris, blood, and frequently pus-corpuscles. The several stages of the pyæmic process have been found side by side in some cases; and embola have been discovered in the branches of the coronary arteries, where they may have served as the foci of the abscesses. The walls of the heart are sometimes in a condition of softening throughout. Pyæmic abscess of the heart occasionally bursts; and the contents either make their way into the left ventricle—producing cardiac aneurism, and perhaps giving rise to further embolism and pyæmic disease—or into the pericardial sac.

Symptoms.—Whatever the symptoms of pyæmic abscess of the heart may be, they have in recorded cases been completely obscured by the general symptoms of pyæmia, and by the local symptoms and signs of pericarditis. Thus, the patients are described as presenting a febrile, typhoid, or pyæmic appearance, an anxious look, dyspnœa, and præcordial pains; pericardial friction has been generally discovered over the heart. Delirium probably occurs more frequently than in ordinary cases of pyæmia, but may be referable to the accompanying pericarditis. The *physical signs* found in these cases are chiefly those of acute pericarditis. Sometimes an endocardial bellows-murmur may be heard, due either to valvular lesion, or to the formation of an acute aneurism of the cardiac wall.

Course and Terminations.—The cases of pyæmia in which the heart has been found *post mortem* to be involved, have generally proved rapidly fatal, the patients dying from exhaustion. Rupture of the abscess in either direction may tend to accelerate the fatal termination; but complete rupture of the wall in both directions, with sudden death from hæmo-pericardium, as in non-pyæmic abscess of the heart, does not appear to be on record.

Diagnosis.—In every case of pyæmia the physical condition of the heart should be regularly investigated; and there should no longer be any risk of acute inflammation of the heart or pericarditis being mistaken for meningitis or simple delirium. Pyæmia with multiple arthritis and involvement of the heart is more difficult of diagnosis from ordinary acute rheumatism with cardiac inflammation; and mistakes in such cases have not unfrequently occurred. The history of the case, including the evidence of a definite injury, however slight, is of the greatest value; but a careful consideration of all the facts of the case alone can prevent mistakes. The only difficulty that remains in the diagnosis of pyæmic abscess of the heart is the determination of its existence in the presence of pericarditis, which is rarely absent. For this purpose the facts of the ætiology of the case are more important than the symptoms; and especially the occurrence of an injury to the periosteum of a youthful subject as the original cause of the pyæmia. As a matter of fact, the symptoms, either general or local, appear never to have suggested the diagnosis of pyæmic abscess of the heart.

PROGNOSIS.—If a diagnosis of abscess of the heart can be made in pyæmia, the only possible prognosis that can be given is one of speedy death.

TREATMENT.—The treatment of pyæmia affecting the heart cannot be said to differ in any important respect from that of ordinary cases of the disease (*see* PYÆMIA). The accompanying pericarditis will call for local treatment.

J. MITCHELL BRUCE.

HEART, Rupture of.—The heart is liable to rupture from external injuries, and from causes acting from within. The latter are called spontaneous ruptures, and these only will be considered here. Spontaneous ruptures may affect either the walls or the valves. The latter form of lesion will be found discussed under the head of HEART, Valves of, Diseases of.

ÆTIOLOGY.—Rupture of the walls may be said never to occur spontaneously when the heart is healthy. The following have been enumerated by different writers as the diseased conditions of the heart's walls that *predispose* to rupture:—a thin or atrophied condition, simple softening, a 'gelatiniform' condition of the walls, apoplectic or hæmorrhagic effusion into the walls, abscess, ulceration, and fatty degeneration. The writer finds from a table of 100 cases of rupture, the histories of which he has collected from different sources, that the heart had undergone fatty degeneration in 77; in 6 the walls were described simply as being softened; in 1 there was rupture of an aneurismal dilatation; in 1 there was bursting of an abscess; in 12 the heart is said to have been healthy in texture, or not to have been examined; but in most of these latter cases mention is made of the previous existence of endocarditis, or of changes in the coronary arteries, fully justifying the impression that there was disease of the texture of the heart.

The influence of *age* in relation to rupture of the heart can be distinctly traced. For example, of the 100 cases just referred to, 63 were above the age of sixty years. Arranged in decades, the cases stand thus:—2 were between ten and twenty; 1 between twenty and thirty; 3 between thirty and forty; 6 between forty and fifty; 13 between fifty and sixty; 33 between sixty and seventy; 24 between seventy and eighty; 6 were over eighty; and in 2 the age is not stated. With respect to *sex*, of 98 out of 100 cases in which it is mentioned, 54 were males and 44 females.

The *exciting* cause of rupture of the heart is usually some mental excitement or physical effort; but the accident may occur when the subject of it is at rest, or pursuing the ordinary avocations of life.

ANATOMICAL CHARACTERS.—*Seat.* In 76 cases out of the 100 to which we have already alluded, the left ventricle was the seat of the rupture; and in 43 of these cases the lesion was in the anterior wall. The right ventricle was found ruptured 13 times, nine instances occurring in its anterior wall. The right auricle was ruptured seven times; the left auricle twice; and a rupture was found in the septum four times. These results correspond remarkably with those of other writers on the subject. Elléaume (*Mon. des Hôpit.*, 1858) in 55 cases found the rupture 43 times in the left ventricle, seven times in the right ventricle, three times in the right auricle, and twice in the left auricle.

On examining a heart in which rupture has occurred, the torn part is found to present different characters in different cases. The lesion may be *complete*, causing perforation of the walls; or it may be *incomplete*. In *complete* rupture the opening is sometimes barely sufficient to admit a probe, whilst in other instances it may be two or three inches in length. The rent is sometimes longer externally, and sometimes it is longer internally. There may be but one, or there may be more than one, rupture; and in the latter case the ruptures may or may not communicate with one another. In *incomplete* rupture the injury may be confined to the internal surface, or to the external surface, or it may occur in the substance of the walls. The edges of the rent are ragged, irregular, and sometimes ecchymosed. The irregularity of the edges is due to the manner in which the muscular fibres are torn, whether across or split longitudinally. This description refers more correctly to rupture in a heart that is the subject of fatty degeneration. The appearances are different when the rupture is secondary to an abscess, or to ulceration, or to certain other causes presently to be described. In such cases the lesion has been described as a rent, tear, ulceration, or perforation. The condition of the heart in the majority of cases of rupture has been already referred to in this article under the head of *Ætiology*. Ecchymoses are sometimes found in the vicinity of the lesion. The pericardium generally contains an effusion of blood, which often surrounds the heart with coagulum, leaving the sac filled with serum, to the amount, it may be, of thirty ounces, as in an instance which came under the writer's notice.

MECHANISM.—Rupture of the heart is doubtless nearly always the result of a strain or of pressure acting upon the muscular walls. The walls of the healthy heart are sufficiently strong to resist any ordinary force to which they are exposed. But when they are softened by degeneration, or are very thin, as is sometimes the case in the auricles or the right ventricle, they may give way before the pressure to which they are exposed during muscular efforts or strains, or even in the ordinary action of the organ. Thus, when a part of the wall of the heart is weakened by softening or other cause, this spot may be, as it were, torn across by the contraction of the healthy fibres among which it is situated. Or again, when the walls of the heart are thick, it may be that the outer surface, being strained over the contents of a distended ventricle, as would be the outer surface of an overbent hoop, gives way, tears, and the opening gradually extends from without inwards. These facts enable us to understand why rupture is more frequent in the left than in the right ventricle. A further explanation is to be found in the fact that the left ventricle is more frequently than the right the seat of fatty degeneration, from causes elsewhere alluded to (*see* HEART, Fatty Degeneration of). There is yet another way in which softening leads to rupture. A softened spot occurs in the substance of the heart, and into it hæmorrhage takes place, constituting what is termed *apoplexy of the heart.* At times this hæmorrhagic softening may yield either externally or internally, and give rise to rupture. Lastly, the writer has seen more than once a small spot of softening with loss of substance occurring on the internal surface of the ventricular wall, most frequently in the left; this softening and breaking down of tissue gradually insinuates itself amongst the muscular fibres, until finally perforation of the outer wall of the heart occurs.

SYMPTOMS.—The symptoms of rupture of the heart may be described as those which are premonitory; and those which occur at the time of the accident. The former are such as indicate a diseased condition of the organ—namely, breathlessness on exertion, palpitation, more or less irregularity of pulse, and faintness. In some instances recorded these symptoms were so slight as hardly to attract attention; in others so severe as to cause intense suffering. In the majority of the cases noted in the table referred to, no mention is made of any preceding symptoms, death being sudden. In several cases it is distinctly stated that no symptoms preceded the fatal attack.

The occurrence of the lesion itself, when the patient has lived long enough to describe his sensations, has always been marked by intense cardiac suffering, more or less distress in breathing, restlessness, rapid and irregular pulse, faintness, pallor, coldness of the skin, sometimes vomiting, and by various nervous symptoms. When life is prolonged beyond a few minutes, there may be more or less intermission in the progress of these symptoms; but the whole attack is marked by anguish more or less severe. The duration of the attack itself from the first fatal seizure varies remarkably. In 71 out of the 100 cases alluded to, death was sudden, occurring within one or two minutes. One patient, however, lived eight days, 1 six days, 1 three days; 5 lived over forty-eight hours, 3 lived under twenty-four hours, and 19 under twelve hours.

The special symptoms indicative of a fatal seizure are, in addition to those already mentioned, severe præcordial pain, dyspnœa, vomiting, cyanosis, pallor, loss of consciousness, and convulsions. These symptoms, or some of them, were noted in 44 out of the 100 cases; and in 24 of these the patient lived for more than five minutes after seizure, and in some of the cases for more than twelve hours. These cases, doubtless, are instances in which the muscular fibres are torn apart layer by layer successively. In the other 20 cases the patient was seized with severe pain, and then expired; or with dyspnœa and some of the other symptoms mentioned above, and lived but a few seconds.

The *physical signs* of complete rupture having occurred, so far as can be ascertained, are merely—a greater or less amount of dulness in the region of the heart; the impulse diminished; the sounds muffled, distant, or imperfectly developed; and the pulse weak and intermittent.

COURSE AND TERMINATIONS.—The difference in the progress of the fatal malady depends much upon the seat of the rupture, on the size of the opening, and on the rapidity with which the extension of the laceration takes place. In the cases in which the septum is torn, there is no external hæmorrhage, and life is prolonged until the patient dies from disturbance in the functions of such an important organ as the heart. (*See* a case reported by Dr. Peacock, *Pathological Transactions*, vol. v.) The progress of the symptoms is also influenced by the direction and course of the rupture. If the torn fibres overlap from the inside or from the outside, the injury penetrates slowly through the cardiac wall, and the fatal progress is also slow. (*See* cases recorded by the writer in the *Pathological Transactions*, vol. iii., and also in vol. xii.; and a case by Dr. Peacock in vol. xvii. of the same *Transactions.*)

PROGNOSIS.—As far as is known, rupture of the heart is always fatal. Still it is possible that such an accident, owing to the small size of the opening, its incomplete character, and its occlusion by a coagulum, may not prove fatal. Numerous instances are recorded of severe wounds of the heart, the subjects of which have survived. Ollivier has collected 29 such cases, only two of which proved fatal within forty-eight hours, the others living from four to eight days. Cases are recorded in which persons have survived many years severe wounds of this important organ. These cases, however, differ from those of rupture in this particular, that they occur in the healthy organ, whilst spontaneous rupture occurs in the heart when it is seriously diseased (*see* HEART, Wounds of).

TREATMENT.—In the way of treatment of rupture of the heart little can be done. The patient's sufferings may perhaps be relieved by the hypodermic injection of morphia, or by the use of other sedatives. Perfect rest should, if possible, be maintained.

R. QUAIN, M.D.

HEART, Softening of.—This term was formerly applied to several conditions of the heart in which the consistence of the cardiac tissue was diminished, whilst the process to which it was due was obscure or anomalous. It is probable that under the name of softening of the heart there were especially included instances of acute myocarditis, parenchymatous degeneration, and fatty degeneration. In the present more advanced state of cardiac pathology, it seems desirable that the expression 'softening,' while retained to express a familiar physical condition, should cease to be employed as a classifying term—that is, to designate any specific anatomical state.

J. MITCHELL BRUCE.

HEART, Syphilitic Disease of.—Syphilitic disease of the heart is by no means a rare condition, having been found in a large number of instances in which the specific nature of the lesion was determined with certainty; whilst, in another series of cases, similar anatomical appearances were present, although the existence of syphilis was not ascertained. Syphilitic disease of the heart is therefore of much pathological interest; but it cannot be said that a great deal is known as yet with respect to its clinical history.

Ætiology.—There appears to be nothing of importance known as to the causes of the localisation of syphilis in the heart. The congenital as well as the acquired form of the disease has been met with.

Anatomical Characters.—This morbid condition presents two leading appearances *post mortem*. The first is the well-marked syphilitic *gumma*, which closely resembles the same form of growth as it is met with, for example, in the liver and testicles. Gummata of the heart appear as pale yellow patches in the cardiac wall, or as yellowish nodules which are found on section. They present a variety of appearances, according to their age. When young they are firm or even scirrhoid; elastic, and homogeneous; creak on section; and are very slightly succulent: but when older, they become soft and cheesy, like a mass of 'yellow tubercle.' In either form the masses are not isolated, but pass continuously into the myocardium, either directly, or through the medium of soft vascular connective tissue, so that they have generally been described in this country as 'infiltrations' or 'deposits.' The superjacent endocardium or pericardium is vascularised and dull in the early stage of the nodules; opaque and thickened in the more advanced. The masses or nodules occur in various numbers in different instances, but are generally multiple. They may be found in any part of the heart. Gummata most frequently become caseous in the centre, as described; and they may then soften more completely and discharge inwards, leading to acute cardiac aneurism and ulcer of the wall; but more frequently the cheesy products are in a great measure absorbed, leaving a puckered fibroid patch behind.

The second form of syphilitic disease of the heart is the *fibroid patch*. This is sometimes well-defined and localised, and in such instances it represents the stage of full development of an area of ordinary syphilitic interstitial inflammation. In other specimens, the fibroid patches appear as irregular masses of indurated fibroid tissue, occupying part of the wall of the heart, and sending septa into the depth of the myocardium, whilst the endocardium and pericardium that correspond to them are opaque, thickened, and puckered. The syphilitic nature of such patches may be determined by the presence of specific lesions in other viscera.

A form of the disease intermediate between the two forms just described is one in which the outer zone of the gumma has undergone development into fibroid tissue, and the caseous centre remains as a 'fibrinous' mass.

The microscopical characters of syphilitic growths do not require to be described here. In the heart, the primary seat of the disease is the intermuscular tissue; the muscular fibres lying imbedded in the gummatous products or in the fibroid growth being either healthy in appearance, or fattily degenerated and broken up.

Syphilitic endarteritis (*obliterans*) may also occur in the vessels of the myocardium, and give rise to infarction of the walls of the heart.

Amongst the occasional effects of syphilitic disease of the heart are chronic aneurism of the walls; distortion of the ostia and of the valves and their appendages; and, more frequently, adhesion of the pericardium. Some of the other viscera present, as a rule, evidence of syphilitic disease.

Symptoms.—The subjects of syphilis of the heart may, from a clinical point of view, be divided into three classes. The first class of patients suffer from some one or other of the ordinary symptoms of chronic cardiac disease, such as dyspnœa, cardiac distress, palpitation, pulmonary complications, and general dropsy; whilst the physical signs are those of cardiac enlargement, and perhaps of valvular incompetence. Præcordial uneasiness, syncopal attacks, and remarkable infrequency of the pulse, have been prominent features in several recorded cases.

The second class of subjects of this disease die suddenly, after few if any complaints referable to the heart.

The third class die of syphilitic marasmus, and may or may not present some evidence—by physical signs or otherwise—that the heart is not sound.

In many of the cases, other symptoms of visceral syphilis—for example, phenomena connected with the brain and nervous system—have been prominent.

Diagnosis.—Well-defined symptoms or physical signs, such as those just mentioned, connected with the heart, occurring in a syphilitic subject, would, in the absence of other more probable causes, such as a history of endocarditis or Bright's disease, furnish considerable grounds for the diagnosis of specific cardiac disease.

Prognosis.—If such a diagnosis were positively made, the prognosis would be more favourable than it is perhaps in any other form of chronic heart-disease, inasmuch as the condition might be successfully removed by treatment.

Treatment.—Anti-syphilitic remedies, especially iodide of potassium, should be freely tried, along with the other remedies indicated on general principles. J. Mitchell Bruce.

HEART, Thrombosis of.—Synon.: Heart-clotting; Fr. *Thrombose cardiaque*; Ger. *Gerinnungen im Herzen*; *Herzpolypen*.

Definition.—Coagulation of the blood within the cavities of the heart during life.

Ætiology.—Thrombosis of the heart is most frequently due to local arrest of the movements of the blood, comparatively or absolutely, within its cavities. Such arrest is itself generally referable to weakness of the cardiac contractions, whether associated with dilatation secondary to valvular or pulmonary disease, or due to some primary affection of the muscular walls. The peculiar saccular condition of the extremities of the auricular appendages, and the trabecular arrangement of the columnæ carneæ of the ventricles, as well as the distance of the same parts from the main blood-currents, determine the favourite localisation of the thrombosis. Roughening of the endocardium is another cause of thrombosis, but one which is to be considered less common than the causes already mentioned, unless the fibrinous coagula of endocarditis, or vegetations, be regarded as thrombi, which, in the strict sense of the term, they partly are. Possibly certain conditions of the blood may contribute to the occurrence of cardiac thrombosis. Finally, thrombi once formed tend to promote the further progress of the condition.

Anatomical Characters.—Coagula found within the heart are of two kinds, which have been termed *active* and *passive*, according as they are formed during life, or at or after death, respectively; and the characters of the former, with which alone we are here concerned, cannot be understood until those of the latter have been briefly described.

Passive coagula are found in the heart in most necropsies, occupying the track of the principal blood-currents. Frequently they appear as black or red blood-clots, occupying the auricles principally, and moulded in their cavities. In other cases they take the form of masses of firm whitish fibrine, cleaving with some tenacity to the endocardium, but not truly adherent; matted with the chordæ tendineæ and columnæ carneæ; and projecting some distance into the pulmonary artery. Or, thirdly, passive coagula may be a combination of the two previous forms, the upper part (according to the position of the body) being decolourised or fibrinous, and the deeper part resembling more an ordinary blood-clot. In certain cases these passive clots are peculiar. In phthisis and other diseases proving fatal by very slow exhaustion, they are remarkably firm and fibrinous, and closely matted amongst the chordæ tendineæ—appearances which seem to indicate that coagulation was slowly proceeding for some time before the heart had finally ceased to beat. In anæmia they are jelly-like and translucent. In leukæmia they are soft and creamy in appearance, and yield, when broken up, a puriform fluid. In the acute exanthemata these passive clots are soft and friable; and in many cases of these and of other forms of acute disease and of sudden death, no coagula are found in the heart, which contains only fluid blood.

Active coagula—the result of thrombosis of the heart—are, on the contrary, situated in the saccular appendages of the auricles, at the apex of the ventricles, and in the recesses behind and between the columnæ carneæ—in other words, as far as possible from the track of active blood-currents. In these situations they may be seen projecting in the form of fleshy knobs or globes, with their free surface smooth and rounded. Their deep surface is adherent to the endocardium, from which, however, it can generally be separated without much difficulty, leaving behind it a discoloured mark. If the thrombus be incised, it will be found to be laminated in structure, somewhat after the fashion of an onion, the colour of the section being greyish-brown or yellowish, with irregular patches of red and black. In most instances the centre is less firm than the periphery; and usually it is of a fluid consistence, in the form of a foul, sanious, puriform substance.

If the process of thrombosis have been proceeding for some time, these formations may extend in all directions, embrace the columnæ carneæ, coalesce in front of them, and finally may fill up a considerable portion of one, or even of more than one, cavity. The thrombi are generally friable; but sometimes they gain in firmness by the deposit of lime-salts within them; and at other times it is possible that they become detached and form into the 'fibrinous balls' which have occasionally been found lying free in the cavities of the auricles. Cardiac thrombi may, in part at least, be reabsorbed. They frequently give way during life; and portions of them, as well as of their puriform contents, are conveyed into the circulation, causing embolism and pyæmia.

It may be added that *embolism* of the heart has frequently been found—thrombi or simple clots, sometimes of remarkable size, having been carried from the veins, and arrested in the heart or in the mouth of the pulmonary artery.

Symptoms.—The clinical phenomena associated with true cardiac thrombosis may be best described as those of the last stage of chronic disease of the heart. Præcordial distress and restlessness; irregularity and feebleness of the pulse; œdema and coldness of the extremities; pulmonary congestion, infarction, and œdema; dulness of expression, and sopor, broken by low weak delirium; with other symptoms, as well as with the signs of cardiac failure and imperfect emptying of the cavities in systole—all these phenomena are associated with the process of active coagulation within the heart. It would not, however, be correct to describe these phenomena as symptoms directly referable to the thrombosis. All that can be said is, that in such a case thrombosis is probably going on and increasing the embarrassment and the gravity of the condition. An unusual degree of cyanosis appears in some instances. The symptoms of arterial embolism may suddenly make their appearance from detachment of particles of the clots; and, if the puriform contents find their way into the circulation, septicæmia may result.

The dislodgment *en masse* of a large venous thrombosis, and the impaction of the same, or of a 'fibrinous ball,' in one of the ostia of the heart have caused sudden death in several cases.

Passive coagulation.—It should be added that the appearance of the 'passive' form of coagulation within the heart, which has been already referred to as a post-mortem process, or one occurring *in articulo mortis*, has been otherwise interpreted by some authorities, who regard passive coagula as formed *ante mortem*, and as giving rise to severe symptoms by the embarrassment which they produce in the circulation. The symptoms caused by this condition are said to be—great præcordial pain and distress; tumultuous action of the heart, passing on to irregularity, flickering, and finally arrest, whilst the pulse is very feeble; urgent dyspnœa; cyanosis hæmoptysis; coldness of the extremities; deepening stupor; and coma ending in death—in short, the congeries of symptoms which would be referred by most authorities to failure of the muscular walls of the heart, the coagulation being regarded by the latter as only another result of the same condition.

DIAGNOSIS.—In the presence of the very serious and complex conditions with which cardiac thrombosis is usually associated, the question of its existence can hardly be said to occur to the physician as a point of great importance. An unusual degree of cyanosis, especially if it be progressive, favours the recognition of this state; and in the absence of valvular disease, the occurrence of embolism or pyæmia would tend to confirm it.

TREATMENT.—The treatment of cardiac thrombosis consists in the treatment of its cause; and nothing is demanded or can be done for the former which is not indicated for the relief of the latter.

Those authorities who see in 'passive' coagula the evidence of rapid *ante-mortem* thrombosis, recommend the use of stimulants, and even of certain drugs which are supposed to have a solvent effect on fibrinous deposits, especially ammonia. J. MITCHELL BRUCE.

HEART, Tuberculosis of.—Independently of the pericardium, the heart itself is believed to be rarely the seat of tubercular disease. Grey miliary tubercles have been found in the connective tissue of the wall of the heart, in some cases of acute general tuberculosis. In other instances the 'tubercle' has been of the yellow or cheesy kind, in the form of small nodules lying at various depths in the muscular tissue beneath the pericardium; the latter also being frequently affected, as well as the lungs, intestines, and other organs.

There appears to be no evidence that tuberculosis of the myocardium gives rise to definite symptoms, or that it can be recognised during life. J. MITCHELL BRUCE.

HEART, Valves and Orifices of, Diseases of.—CLASSIFICATION.—The diseases of the valves and orifices of the heart which produce mechanical disorders of the circulation, by establishing abnormal relations between those parts, are of two kinds—*obstructive* and *regurgitant*. Valvular disease, on the one hand, is said to be *obstructive* when narrowing of an orifice presents an obstacle to the passage of the blood-current—a condition better named *stenosis*. On the other hand, when the blood regurgitates or flows back through an orifice, in consequence of imperfect closure of the valves, due either to valvular changes or to widening of the orifice, the condition is called *regurgitation* or *insufficiency*.

Aneurism of the valves of the heart will be discussed separately. *See* HEART, Valves of, Aneurism of.

ÆTIOLOGY.—Each of the orifices may be affected with one or both forms of disease, but the frequency with which the several orifices are attacked varies. The results of organic disease are chiefly met with in the left side of the heart, and are due to local inflammation—endocarditis and its consequences; or to chronic degenerative changes, such as atheroma. In adult life the valves of the left side are more frequently affected than those of the right, because they have to bear a much greater pressure; but in fœtal life, when the condition is reversed, the right valves suffer more. Endocarditis is commonly of rheumatic origin, and attacks the mitral more frequently than the aortic valves; the former having to sustain the full force of the ventricular systole, while the latter only bear the force of the aortic recoil. In addition to rheumatic fever, the chief diseases which tend to develop endocarditis are—pyæmia, puerperal fever, the exanthemata, chronic renal disease, and syphilis. The aortic valves are more commonly affected than the mitral by chronic endarteritis extending from the aorta, the chief causes of which are gout, old age, syphilis, and the abuse of alcohol. These facts explain why mitral affections (commonly rheumatic) occur mostly in early life, and aortic affections in later life. Valvular lesions are more common in men than in women, from the strain of the heart incidental to more laborious occupations. Strain helps to swell the greater proportion of disease of the aortic valves, which are liable to rupture from effort; but similar accidents may occur to the mitral valve and its tendinous cords.

ANATOMICAL CHARACTERS.—The pathological changes in the valves and orifices of the heart, which cause valvular defects, are mostly the results of acute or chronic endocarditis. In the acute form, the valvular defect is caused by the growth of vegetations which prevent the action of the valve-segments; or by softening and ulceration of the valve-structure, which lead to valvular aneurism and perforation, or to loss of substance and consequent insufficiency. The more chronic form of inflammation produces thickening of the valves from overgrowth of the connective tissue, with subsequent calcareous degeneration and retraction from shrinking of the hyperplastic connective tissue; or adhesion of the valve-segments causing stenosis.

Aortic stenosis is generally the result of thickening and calcareous degeneration of the valves, or of deformity of the valves from vegetative growths, which obstruct the free passage of the blood from the ventricle. Sometimes it is due to adhesion of the valves preventing their elevation, and causing them to form a diaphragm with a narrow central aperture. More rarely it is caused by contraction of the fibrous ring of the aortic orifice, or by endocardial thickening producing contraction immediately beneath the valves.

Mitral stenosis results most frequently from thickening and rigidity of the valves, which adhere at their edges to each other, so as to form a diaphragm between the auricle and the ventricle. This diaphragm is usually funnel-shaped, with a button-hole aperture sometimes not larger than a goose-quill. In these cases the tendinous cords of the valve are shortened, and their muscles thickened. In some cases the valves are smooth and thin; in others they are thickened, studded with vegetations, rough and calcareous. This latter state may cause stenosis, without any funnel-formation, as may also fibrinous clots or polypi obstructing the orifice. In many cases of mitral stenosis, the valves are also insufficient.

Aortic insufficiency often depends on dilatation of the aortic orifice, due to softening of the aortic coats, with little or no change in the valves, which are incapable of closing the enlarged orifice. Vegetations, thickening, retraction, calcareous degeneration, adhesions, perforations, loss of substance, and rupture of the valve-segments by effort are all causes of aortic insufficiency. In rupture of the valves, a full description of which was first given by Dr. Quain (*Edin. Monthly Journ.* 1846), the valve-segment is torn from its angles of attachment, and its free edge retroverted towards the ventricle. This accident happens more frequently in cases where the valves were previously diseased, and in such cases further laceration may occur.

Mitral insufficiency is due to thickening, retraction, or deformity from vegetations of the valve-curtains; adhesion of the curtains to each other or to the ventricular wall; and calcareous degeneration. In some instances, one of the valves is perforated or torn; and sometimes the tendinous cords are shortened and thickened, or ruptured as the result of degeneration, preventing the normal action of the valve-curtains. In rarer cases associated with dilated ventricle, the papillary muscles are so weakened by degeneration that they can no longer aid in the closure of the orifice. Dilatation of the left auriculo-ventricular orifice is also a cause of mitral insufficiency.

Valvular defects on the right side of the heart are due to similar changes. They arise chiefly during fœtal life, when the right cavities have to bear greater pressure. In adult life these defects are generally associated with diseases of the lungs, which cause increased tension in the right cavities, leading to their dilatation.

Combined valvular lesions are not infrequent. The most common are stenosis and insufficiency of the aortic valves, and the same morbid changes of the mitral valves. In the last stages of both forms of aortic valve-disease, the mitral valve becomes insufficient, either from chronic endocarditis, or from dilatation of the ventricle and of the auriculo-ventricular orifice. Mitral stenosis is not very frequently associated with aortic insufficiency, but is more commonly connected with some degree of narrowing at the aortic orifice. Tricuspid insufficiency is usually met with in the last stages of diseases of the left heart.

Symptoms.—Valvular diseases of the heart produce a series of morbid phenomena, which are connected together by a necessary sequence. Each and every form of valvular defect impairs the perfection of the heart as a pumping machine, and disturbs the normal relations between the contents of the arteries and of the veins. Wherever the valve-mischief is, and whatever its nature, it robs the arterial circulation and enriches the venous. In front of the lesion there is less blood; behind it there is more. In aortic valvular diseases, the first effects are increase of the blood-pressure in the left ventricle, and lessened blood-pressure in the aorta; next, from the difficulty which the auricle has in emptying all its contents into an overful ventricle, there is produced increased pressure in the left auricle and pulmonary veins. Mitral valve-lesions cause similar results: first, increased pressure in the left auricle, less pressure in the left ventricle, and consequently lessened pressure in the aorta; with a gradual increase of pressure extending from the left auricle to the pulmonary veins. Aortic affections thus act first on the arterial, and secondly on the pulmonary circulation; while mitral lesions affect the pulmonary vessels more immediately. The final results of the two forms are, however, identical, and may be stated in the form of a law, namely, that all valvular diseases of the heart tend to lessen the quantity of blood in the arterial system, and to produce overfulness and stasis in the veins. From this there follow various associated visceral disorders. These disorders, however, vary greatly in the period of their occurrence, and in the intensity of their manifestations. This result is due to the more or less perfect way in which the original valvular defect has been compensated for, by changes in the power of the cardiac muscle and in the capacity of the cardiac cavities. These changes often suffice to maintain fairly the normal balance between the arterial and venous contents, thus *compensating* for the valve-lesion; and the process by which this is effected demands careful consideration.

Compensation.—Compensation is effected differently, according to the form of disease. It may be stated generally, that it consists in hypertrophy of the cavity immediately behind the defect. Now hypertrophy means increased contractile power, and this means better filling of the arteries, and consequently increased arterial tension. Thus it makes up for the valvular incompetency, which tends to lessen arterial tension. When the increased power of the ventricle exactly balances the effects of the valvular mischief, the compensation is complete.

In *aortic stenosis*, hypertrophy of the left ventricle is the mode in which compensation is effected; the obstacle to the blood-current is overcome by increased power.

In *aortic insufficiency* there is some dilatation of the ventricle as the primary result of the lesion. This is counterbalanced by greater hypertrophy, and as long as the dilatation does not progress, the insufficiency is compensated for. A sufficient excess of blood is thrown into the aorta at each systole to allow for the regurgitation during each diastole, and thus the balance is maintained, though not always equably.

In *mitral lesions* the left auricle is dilated as the primary consequence of the condition of the valves; hypertrophy follows, but is insufficient to prevent increased fulness of the pulmonary veins. This impedes the circulation in the lungs; and increased tension in the pulmonary artery soon begets the necessary hypertrophy of the right ventricle. It is by means of this increased power of the right ventricle, that the blood is driven through the lungs in spite of the defect in the left heart, and pulmonary stasis is prevented; and the blood entering the left auricle under greater *vis a tergo*, the compensation of the valvular defect is effected. The compensation, from the nature of the means on which it depends, is manifestly less perfect than in aortic lesions.

On the *right side of the heart* similar modes of compensation are observed.

The basis of the salutary changes just described is increased cardiac nutrition; and consequently a free coronary circulation is a necessity. Conditions which interfere with this prevent compensation, and so diminish the duration of life. Wherever the compensation begins to fail, dilatation of the cavities and vessels behind the lesion commences. This may, however, be checked, and the power of the heart restored for a time. Sooner or later, however, changes in the nutrition of the cardiac muscle, in the vessels, and in the general nutrition, bring on failure of compensation. The cardinal symptom in such cases is weakened contractile power of the heart, or *asystoly* (Beau). In this state, the cavity chiefly affected has no longer power to expel its contents fully into the vessels, and consequently becomes gradually and increasingly distended. Failing compensation in aortic valve-disease manifests itself by dilatation of the left ventricle, and the development of secondary mitral insufficiency. Similar retro-dilatation marks the failure in mitral cases, only here it is the right ventricle which dilates, and tricuspid insufficiency and general venous stasis are added to the pre-existing pulmonary engorgement.

The earliest *symptoms of failing compensation* are attacks of palpitation from very slight exertion or excitement, or during sleep. Irregularity of the pulse soon follows, if it have not previously existed. This is especially the case in mitral disease. The irregularity is due not so much to true cardiac intermission as to abortive contractions, which do not reach the wrist; or to contractions unequal in force or in the quantity of blood expelled. The pulse is small, unequal, irregular, and compressible. In aortic valvular disease true intermissions occur, and are of grave import. With failing cardiac power there usually supervene cardiac oppression, anginous attacks from distension of the cavities of the heart, and faintness and giddiness from cerebral anæmia.

Visceral complications.—The most important of the associated disorders of chronic valvular disease, depending on defective contraction of the heart, are the visceral congestions.

In the *lungs*, the habitual engorgement of mitral diseases produces a hyper-secretion of mucus and a state of chronic catarrh. The blood-vessels also undergo changes from the excessive intra-vascular pressure, and become dilated, varicose, and atheromatous: whence œdema and hæmorrhage arise. In mitral stenosis especially, grave and frequent attacks of hæmorrhage, with laceration of the pulmonary substance, are liable to occur. The lungs, from repeated attacks of this kind, undergo brown induration. The varicose condition of the vessels in the alveoli interferes with oxidation, and so aids in the deterioration of blood, which the other visceral congestions favour.

In the *liver*, the general venous stasis is felt by the obstruction to the passage of blood from the hepatic veins into the inferior cava. Passive congestion ensues, and 'nutmeg liver' results. This term 'nutmeg liver' refers to the rough changes in the viscus, the dark congested centre of each lobule being surrounded by a paler area. In course of time the compression of the central cells of each lobule by the distended veins leads to atrophy; the liver, from being large, shrinks in very chronic cases to half its size; and the condition may, like true cirrhosis, lead to ascites. The passive congestion in the liver, as in the lung, causes catarrh of the tubes, and may thus be productive of jaundice. Amongst other symptoms associated with the hepatic congestion may be mentioned hæmorrhoids and epistaxis.

The *spleen* is a very easily distended organ, and suffers like the liver, but frequently before it; and this may partly account for the pain which is often complained of beneath the left ribs. In long-standing cases the spleen becomes tougher, and the capsule opaque and thickened; while hæmorrhagic infarcts are common.

From the hepatic congestion there naturally follows distension of all the other radicles of the portal vein: hence the congestion and chronic catarrh of the *stomach* and *intestines*, which impede digestion and assimilation, and so reinforce the other causes producing the cachexia of chronic valvular disease.

In all cases of valvular disease, when the mechanical effects extend to the general circulation, the function of the *kidneys* is more or less disordered. The first stage of general circulatory trouble is lessened arterial tension; this makes itself felt in the Malpighian tufts, and is manifested by scanty, dense, high-coloured urine. When the more advanced circulatory trouble—namely, general venous stasis—is developed, a further change takes place in the urine. The arterial anæmia keeps it still scanty and dense, but the venous stasis in the kidney leads to the transudation of serum—a dropsy of the kidney as it were; and consequently albumen appears in the urine. Long-continued venous congestion ends in structural changes, which, as elsewhere, consist in connective-tissue hyperplasia and degenerative (rarely fatty) changes in the tubules. These renal changes sometimes add uræmia to the patient's ailments.

In the *brain*, decided alterations are not found, except when a detached vegetation produces embolism and its special phenomena. The brain-substance is, however, generally œdematous, and the membranes are thickened. Delirium is an occasional symptom in heart-disease, and when present to any degree is of evil import. The blood-vessels of the general circulation are frequently affected with atheroma in hypertrophy of the left ventricle, and it is these degenerative changes which favour the occurrence of apoplexy.

General dropsy.—The mechanical impediments to the circulation which produce these several visceral congestions, also manifest themselves in the general dropsy which is common in the last stages of heart-disease. The dropsy begins as a puffiness of the ankles at bed-time. The general venous stasis, thus first indicated, advances slowly and surely, if not checked, to general anasarca, and even to dropsy of the serous cavities. The increased venous tension, and the hydræmia of blood-deterioration are the causes of this serous transudation, which shows itself first in the feet, the most dependent portions of the body, where the pressure of the blood-column is naturally greatest. The horizontal posture, by distributing the pressure, is sufficient at first to disperse the œdema of the ankles. General anasarca is much more frequent in mitral than in aortic lesions.

In some cases a solid form of œdema is observed. This occurs mostly in the last stages of valvular affections, and is due to thrombosis of venous trunks, in which, the circulation being much impeded, coagulation easily takes place. The termination of the external jugulars is a common site for such thrombosis; and the left innominate vein, from its transverse position, and from its emptying almost at right angles to the current in the superior vena cava, is, in the writer's experience, more commonly obstructed than the right. Solid œdema is consequently seen more frequently on the left side of the head and neck and in the left arm, than on the right side.

Defective compensation.—The phenomena just described are associated with valvular diseases of the heart, as the consequences of partial or defective compensation. These conditions are more or less developed according to the individual case, and consequently give rise to symptoms in varying degrees. These symptoms will now be described.

Palpitation is intimately related to the state of cardiac nutrition and innervation, and has no special connection with any form of valvular disease. Cardiac pain, varying in intensity from mere uneasiness to the agony of angina, is most common in aortic cases, and is associated with endarteritis, or with dilatation of the left ventricle, or is a neuralgia of the cardiac plexus. In mitral affections, pain arises from over-distension of the left auricle, and its pressure on neighbouring parts, and later on from dilatation of the right ventricle. Dyspnœa may be present in any form of valvular disease, but it is often absent from the earlier history of aortic cases, while some dyspnœa is always present in mitral cases. This difference is due to the absence of pulmonary congestion in aortic affections, whilst it is more or less present from the first in mitral affections. The dyspnœa is a breathlessness rather than a difficulty of breathing. It is panting and gasping in its character, with acceleration of the rate. It is aggravated by any movement, and often compels the patient to sit upright (orthopnœa). Headache, vertigo, dreaming, night-frights, and sleeplessness are other symptoms, which depend on disordered cerebral circulation. Sleeplessness is one of the most distressing of all symptoms, and can only be relieved when the dyspnœa is lessened. Other more special symptoms will be found in certain cases, and will be traceable to the disturbances in the circulation, which the particular form of valvular disease has engendered.

Physical signs.—The physical signs associated with valvular affections may be said to be—first, those of alteration in the size of the heart; and secondly, those of mechanical disorders of the circulation; together with one or more endocardial murmurs. The persistence of a murmur is the cardinal sign, and if the murmur be either diastolic or præsystolic in its rhythm it is of absolute value. A systolic murmur may be caused by poverty of blood—anæmia, especially at the base of the heart. But in such a case—that is, in hæmic murmur—there is no cardiac hypertrophy, as indicated by increased cardiac dulness, though there is often nervous overaction of the heart. There is no accentuation of the pulmonary second sound, inasmuch as there is no extra fulness of the pulmonary blood-vessels from obstructed circulation. The pulse in anæmia is generally quick, ample, and compressible, but, withal, jerky; while with an organic systolic murmur it is generally slow, rising gradually under the finger, and not very compressible, (aortic stenosis), or small, irregular, and unequal (mitral insufficiency). The clinical methods of investigating valvular lesions are mainly inspection, palpation, percussion, and auscultation. The signs of each form of valve-disease are stated below; and on these the special diagnosis rests.

DIAGNOSIS.—In *Aortic stenosis* there is often some prominence of the præcordial region, and a steady forcible impulse is perceived below and to the left of its normal position. A thrill, systolic in time, may often be felt at the base of the heart. On auscultation, a loud, frequently rough, rasping, sometimes musical, murmur is heard with the first sound at mid-sternum, and also at the second right intercostal space. The murmur, commencing with the first sound, extends to the succeeding second sound, which is often not very distinct. The murmur is audible all over the upper part of the thorax, especially on the right side; is conducted along the great vessels to the left vertebral groove, and it may be even to the lower dorsal vertebræ; and is occasionally heard at the apex of the heart. The pulse is regular, slow, retarded by the narrowing of the aortic orifice, and slowly developed under the finger. The sphygmogram (*see* fig. 82) shows the line of ascent to be oblique or broken, instead of nearly vertical; the summit is generally blunt; and the line of descent shows small or no secondary waves, and ill-developed dicrotism. Aortic stenosis when moderate, requiring only hypertrophy of the left ventricle for its compensation, is often very perfectly remedied by this change, and produces little or no disorder of the circulation. When the stenosis is great, epileptiform and syncopal attacks may occur, and lead to sudden death. When the compensation fails, the mitral valve often yields, from the dilatation of the left ventricle, and degeneration of the papillary muscles. Then the pulmonary second sound becomes accentuated; the pulmonic circulation is embarrassed; and dyspnœa, bronchial catarrh, pulmonary hæmorrhage, œdema, and cyanosis supervene.

In *Aortic insufficiency*, inspection discovers a more forcible and diffused impulse, lower than natural, sometimes as low as the seventh intercostal space, and outside the nipple line. The præcordial region may be bulging from the violent action of the heart; pulsation may be seen in the upper intercostal spaces at the right edge of the sternum; and a thrill may sometimes be felt there. The great vessels of the neck pulsate visibly. The area of cardiac dulness is increased in all directions, but mainly vertically. On auscultation, a murmur is heard, replacing and following the second sound, of a blowing or hissing character, rarely rough. It is usually loudest at mid-sternum and in the second right intercostal space; and it is conducted upwards to the right clavicle, but mainly downwards to the xiphoid cartilage. It is not heard at the back of the chest. It may be conducted to the apex of the heart rather than to the ensiform cartilage; and this occurs, in the writer's opinion, when the posterior or mitral segment of the aortic valves is the incompetent one, as the regurgitant current then falls on the mitral valve, and the murmur is thus conducted to the apex. The second sound may be wholly lost at the base of the heart, being replaced by the murmur; but in some cases it is audible—this being due either to normal closure of one or two aortic segments, or to the propagated pulmonic second sound. If audible in the carotids, the second sound is aortic, and is of some value as indicating partial competency of the valves. The second sound is often audible at the apex. The first sound at the base is almost always modified, being generally murmurish and often obscured by a systolic murmur, due to slight obstruction from thickening of the valve-segments, and the vigour of the ventricular systole. In some cases there is no distinct first sound audible at base or apex; its absence being possibly due to noiseless closure of the mitral valve by the intra-ventricular blood-pressure before the systole occurs. In the majority of cases the insufficiency is no doubt associated with some stenosis, and the murmur is double; a short rough systolic portion, with a softer, longer, and more hissing diastolic portion. This double murmur might be well called the *up* and *down* murmur of aortic valve-disease: the two descriptive words indicating the length, and, to some extent, the characters of its component parts.

The signs connected with the pulse in aortic insufficiency are very significant. As the pulsations of the aorta are visible to the right of the sternum, so the arteries often beat visibly all over the body, even to the radial, temporal, and dorsal arteries of the foot. The ophthalmoscope has shown the same phenomenon in the central artery of the retina. This remarkable movement of the arteries is due to two causes:—first, to the hypertrophy and dilatation of the left ventricle, which throws an excessive quantity of blood into the vessels at each systole; and, secondly, to the sudden collapse of the arteries, due to the aortic insufficiency. The arterial recoil during the ventricular diastole is not opposed, as in health, by the resistance of the perfectly closed aortic valves, and, consequently, the blood-column is not sustained, and the arteries collapse. These locomotive features in the pulse are generally increased by elevating the arm. The pulse is sudden, short, large, regular, rapidly collapsing, and vibratory. The sphygmographic tracing brings out these characters: the line of ascent is vertical and lofty; the summit is sharp and pointed; the line of descent falls rapidly, and is broken by a series of secondary waves due to vibratory conditions, but has an ill-developed dicrotism. The post-dicrotic portion of the tracing falls rapidly, from the absence of a sustained blood-column. The longer and more oblique this portion of the tracing, *cæteris paribus*, the less copious the regurgitation (*see* fig. 81).

Aortic insufficiency often lasts for many years without producing any obvious disturbance of the systemic and pulmonic circulations; hence the absence of dyspnœa and œdema. The hypertrophy and dilatation of the left ventricle, which form the compensation, suffice to prevent ill effects. At each systole the dilated ventricle throws sufficient blood into the aorta to allow for the reflux, and to maintain a fair arterial tension. Thus the compensation is perfect. In many cases, however, if the reflux is free, and the coronary segments of the aortic valves are affected, the coronary arteries, which are mainly filled by the arterial recoil, are deprived of the full force of the blood-wave, and the nutrition of the heart consequently suffers. This is the great source of failing compensation, and the mal-nutrition of the cardiac muscle soon leads to dilatation of the ventricle, secondary mitral insufficiency, and atrophy.

When the hypertrophy is excessive, as it is in some cases, there are flushings of the head and face, headache, vertigo, and violent arterial action all over the body.

In *Mitral stenosis* there is rarely any prominence of the præcordial region; and in its earlier stages neither increase of the cardiac dulness, nor alteration in the position of the impulse. The impulse, when regular, is fairly distinct, but it is often very irregular and is associated with a thrill, which precedes, runs up to, and terminates in the impulse. In advanced cases, the area of cardiac dulness is increased laterally; the impulse is diffused, and may be seen in the epigastrium; and the left auricular systole may be noticed, if the chest be thin, in the third left intercostal space. The sounds heard on auscultation in this lesion vary. The pathognomonic sign is a murmur preceding the systole, and ending with its commencement. This is best called the *præsystolic* murmur (also 'auricular systolic'); and is produced when the contracting auricle forces blood under high pressure into the ventricle. It is the passage of a stream of blood in a state of high tension into blood already in the ventricle which causes the murmur. The first portion of the blood passes from the auricle into the ventricle noiselessly; and it is only when a stream of higher tension is forced into it by the true auricular systole that the murmur is developed. The murmur is, therefore, short in most instances, occupying the last part of diastole; runs up to the first sound; and ends abruptly in it. The position in which the murmur is best heard in its typical præsystolic form is at the left apex itself or a little above—that is, lower than a mitral regurgitant murmur. The funnel-like shape of the mitral valve-curtains in these cases accounts for this, as the button-hole aperture through which the blood passes is closer to the apex.

The murmur in this form is not heard far from its seat of production, is soft and puffing, but may be harsh. It fills commonly only the last part of the diastolic period. In some cases the murmur is longer, rougher, more rolling or grinding, and ends abruptly with the first sound, which is very flapping in tone, and might easily be mistaken for the second sound conducted. The careful observation of the impulse or of the carotid pulse with the finger while auscultating, is necessary in order to avoid the error.

A special peculiarity of the præsystolic murmur is its variability: it is the only organic murmur which disappears and reappears as the heart-conditions change. For instance, a murmur, inaudible while the patient is at rest, is developed by a little exercise; or again, an irregular tumultuous action of the heart masks all murmur, which becomes distinct as the heart steadies down under the action of digitalis. In other cases there is no distinct murmur, but only a slightly prolonged and rough or grinding first sound. In cases of mitral stenosis there is accentuation of the pulmonary second sound, from the greatly increased tension in the lesser circulation; there may also be a doubling or reduplication of the second sound at the base. This reduplication is a sign of great value in cases in which the prolonged or grinding first sound is the only sign. The reduplication of the second sound is due to a want of synchronous closure of the pulmonic and aortic valves, from their altered relative tension. A doubling of the first sound is sometimes noticed, probably due to retarded closure of the mitral valve, from lessened fulness of the left ventricle.

The rhythm of the heart is frequently greatly disordered in mitral stenosis, and also in mitral insufficiency. A few beats occur regularly, or nearly so, and then a series of very small hurried ones follows, to be again succeeded by stronger and better pulsations. These irregularities are referable to the varying charges of blood on which the ventricle contracts. The over-distended right cavities and the left auricle contract rapidly to expel their contents, but the narrowed mitral orifice does not allow a full charge to pass into the ventricle; the diastole is too short for this purpose; and the wave of contraction passes on to the ventricle from the auricle, producing a series of small ineffective pulse-beats, each representing the small charge sent into the aorta. When the series of ineffective contractions ceases, the next diastole is longer; and the succeeding systole sends, as the sphygmograph shows, a fuller charge into the arteries. During the small irregular beats the præsystolic murmur is often indistinguishable, but is again heard with the succeeding slower and more effective beats. This irregularity in the heart's rhythm, however, is not present in all cases of mitral stenosis. In some instances the heart's action and the pulse are regular. The sphygmograph in such cases records a small pulse of low tension, with a little inequality in the volume of the beats; this inequality is often increased by exercise. In other cases the pulse-tracing is small, irregular, and unequal in its pulsations, and marked by true and false intermissions (*see* fig. 84).

In the earlier stages of mitral stenosis the face may be pale, and the congestive symptoms which mark mitral insufficiency are absent till the later stages. This form of valvular lesion gives rise more commonly than mitral insufficiency to hæmorrhagic infarction in the lungs; but in other respects the pulmonary and systemic circulations suffer in the same way as described in the other form of mitral disease.

In *Mitral insufficiency* inspection discovers some slight prominence of the præcordial region, with increased impulse, the apex often beating to the left of the nipple line. The area of cardiac dulness is augmented mainly in a lateral direction, from the hypertrophy of the right ventricle. On auscultation, a murmur is heard with the first sound, and following it; loudest at the apex; loud along the left edge of the heart; but absent or not so distinct over the right heart and at the base. The murmur is propagated towards the left axilla, and is audible in most cases in the left vertebral groove. The murmur is usually loud, blowing, and distinct in its character, keeping the same tone throughout. The true first sound is generally obscured by it, but in some cases may be heard through it, and is then due to the partial closure of the mitral, or to the action of the right auriculo-ventricular valves. The pulmonic second sound is commonly accentuated. The pulmonic first sound has in some cases a murmurish character, due probably to the vigour of the right ventricular systole.

The radial pulse in cases of fairly perfect compensation is regular, but quick, small, weak, and easily compressible; and the sphygmograph shows low tension, and an inequality in the size of the pulsations. In cases of less perfect compensation, it becomes irregular and intermittent. In all cases the pulse-beat is weak in comparison with the vigour of the ventricular systole (*see* fig. 83).

There is no unusual fulness of the superficial veins in the earlier stages of mitral insufficiency. Later, when the right cavities become over-distended, the veins of the neck become full and may even pulsate. This is very distinct when the tricuspid valve gives way. In all cases slight exertion is sufficient to induce dyspnœa; and there is an ever-present tendency to bronchial catarrh, from the congested state of the lungs. When asystoly comes on, the murmur becomes less distinct; the heart's action is rapid, irregular, and tumultuous; the accentuation of the pulmonary second sound is lost; dyspnœa becomes orthopnœa; and cyanosis, œdema, and hæmorrhagic infarction of the lungs, with general and visceral dropsy close the case.

Many cases of mitral regurgitation obtain fairly perfect compensation; but the disease, like mitral stenosis, of necessity entails some dyspnœa on exertion, and keeps up constantly an engorged state of the pulmonary vessels.

Valvular affections of the right heart, arising from disease, are rare. Those of the *pulmonic valves* are very rare; cases are on record, however, of pulmonary stenosis, and a few of pulmonary insufficiency. In the first case the systolic murmur is loud and superficial, and is heard loudest at the third left costal cartilage close to the sternum, and in the second left intercostal space; it is not usually conducted across the sternum, nor upwards to the right clavicle, as is an aortic murmur. A diastolic pulmonic murmur is soft and blowing; and is heard loudest in the same situations, and downwards towards the ensiform cartilage.

The *tricuspid valves* are more frequently affected. Tricuspid insufficiency is indeed a common sequence of disease of the left side of the heart. Structural changes in these valves are, however, rare. Tricuspid insufficiency does not always produce a murmur; when present this is soft and short, and is heard nearer the middle line than a mitral murmur, at the base of the ensiform cartilage. The pulsations of the cervical veins may indicate the lesion when the murmur is absent.

Tricuspid stenosis causes a præsystolic murmur, harsh in character, loudest at the base of the ensiform cartilage and towards the left edge of the sternum, not propagated towards the left heart, and not audible at the back of the chest, though faintly conducted along the sternum to the base of the heart. A præsystolic thrill may be present. Mitral stenosis has been observed in association with this lesion, and two præsystolic murmurs may be made out in such cases.

The physical signs and the diagnosis of *combined valve-lesions* remain to be described. The mitral and aortic valves may each be affected with stenosis and insufficiency, from a single attack of endocarditis, or from one lesion arising as a consequence of the other. The double aortic murmur, above described, indicates the aortic combination; but it must be always remarked that the systolic murmur in these cases may exist with little or no actual stenosis.

In the double form of mitral disease, either defect may exist alone at first, and afterwards be associated with the signs of the second. In some cases the præsystolic murmur may fail to be heard, and a systolic murmur may alone be audible; in other cases, there is a prolonged apex-murmur which slightly changes tone; in other cases, again, a short grinding præsystolic murmur is followed occasionally, at an interval, by a soft, blowing, systolic one. The combination of aortic with mitral disease may be recognised by the presence of their special murmurs.

Prognosis.—It is very difficult to state general rules of prognosis in valvular affections of the heart, as so much depends on the peculiarities of each case. There are, nevertheless, certain broad rules. As regards origin, rheumatic inflammation is less serious than degenerative change, which occurs later in life, and is necessarily progressive. Accidental rupture is the gravest form of origin. The valve affected is also a prognostic element; but any attempt to arrange cases in order according to the seat of the valvular defect, must be open to so many exceptions that it must not be too much trusted. Speaking generally, however, tricuspid lesions are gravest, mitral less so, and aortic—especially aortic stenosis—probably least so. When the heart fails, and asystoly supervenes, the prognosis is worse, however, in aortic cases than in mitral.

Aortic cases are often free for years from any grave symptoms. When the murmur is conducted to the left apex, the prognosis is more favourable, as, the aortic segment affected being non-coronary, the muscle of the heart is not robbed of its blood. The presence of the second sound over the carotids is favourable. The pulse-tracing also affords valuable aid in prognosis, as it gives, by the size of the dicrotic wave and the obliquity of the line of descent, a rough measure of the amount of insufficiency. There is much more risk of sudden death in aortic cases than in mitral.

In mitral lesions the dangers arise from the pulmonary complications; embolism is more common than in aortic affections. Mitral cases can be rescued from asystoly more commonly, and die of advanced cardiac cachexia, generally with dropsy. Under favourable conditions of life, requiring little physical exercise and causing no emotional excitement, both forms of mitral disease are compatible with many years of life. When they are conjoined, the prognosis is more unfavourable. In cases of sudden insufficiency, produced by rupture of the valve-curtains or of the tendinous cords, death may occur very rapidly from the disturbance of the circulation.

The whole question of prognosis turns principally on the state of the myocardium. So long as this is sound, compensation may be maintained; the moment degeneration sets in, asystoly and all its evil train of symptoms come on. Thus asystoly coming on gradually, without any previous overstrain of the heart, is always most grave. Each successive attack becomes graver, and the visceral congestions which accompany it more stubborn. Albuminuria is a good index of the gravity of the congestion, and is serious in proportion to the frequency with which it has occurred. In some cases a copious flow of limpid urine is a very grave symptom. Dropsy of the extremities, and of the cavities more especially, is bad, as indicating failure in the peripheral circulation. Next to the cardiac muscle, the state of the peripheral vessels is most important; thus, atheroma and other conditions, such as febrile attacks, add to the danger by interfering with the circulation. The general nutrition of the patient suffering from valvular disease also enters into the prognostic problem. There is a cachexia proper to the end of heart-cases, which is due to the gradual deterioration of the nutritive fluids by the long-continued visceral congestions which hinder assimilation and excretion. Blood is less perfectly made and less perfectly purified; hence the steady deterioration of cardiac cachexia, which is always of evil import as regards duration of life. Valvular diseases are, however, in numerous instances compatible with many years of life. In some the healthy expectation of life may be attained; and, in many, years of comparatively active life are enjoyed. In the poor, the prognosis, as to duration, is not favourable; but in the well-to-do, all observers see many cases extending over a great number of years.

Treatment.—Valvular affections of the heart, whether the result of rheumatic inflammation or of degenerative change, are, as a rule, incurable. Some few cases of rheumatic origin lose the signs of valvular disease, and are practically restored by the after-processes (for example, contraction) in the inflamed valve; and some few cases also of mitral insufficiency, associated with dilated left ventricle, are cured by treatment. These exceptions are, however, few; and as we cannot repair the valve-mischief, in the vast majority of cases our treatment must be directed to aid the compensatory hypertrophy, and to check the development of the consequences of the defect. The maintenance of the nutrition of the substance of the heart is, therefore, the main object of treatment; just as the state of the nutrition of the heart is the key to the prognosis. On this account the general regimen of heart-cases is very important.

General regimen.—The diet should in all cases of valvular disease of the heart be unstimulating but sustaining, consisting of a good proportion of albuminous food (underdone meat, eggs, and fish), with wine in moderate quantity, and some chalybeate water. There should be no unnecessary excitement of the heart, either by exercise or emotion. All athletics and violent efforts should be avoided by the young, especially in mitral cases. In aortic cases, steady exercise without strain is beneficial. The residence should be so situated as to avoid the necessity of exertion, sudden changes of temperature, cold, and damp. The chief object of the regimen should be to prevent anæmia; hence plenty of fresh air is essential. Tobacco is injurious. In early life over-exertion and exposure to cold—in adult life, emotional, sensual, and dietetic excesses, are the chief dangers. The propriety of marriage must be considered in each case on its merits. Women, as a rule, should not marry; when affected with mitral disease they are often barren. To men marriage is more generally permissible.

Medicinal treatment.—The therapeutics vary according to the stage of the cardiac disease. The mechanical defect of a valve first makes itself felt by palpitation and præcordial pain; these symptoms pass away when compensation is effected, but till then require treatment. In cases of mitral disease, tincture of digitalis (♏x doses) relieves the palpitation; chloric ether is also a useful adjunct. In aortic cases, ether, diffusible stimulants, small doses of opium and belladonna, with the local application of belladonna to the præcordial region, are valuable remedies.

The præcordial pain, mostly retro-sternal, may, when severe, require a few leeches or cupping, but generally yields to mild counter-irritants, such as turpentine or mustard. Internally, the bromides are useful; when the pain occurs paroxysmally, ethereal preparations and ammonia act well.

When the compensatory changes in the heart are effected, the palpitation and pain decline, and the chief indication is to keep up the nutrition of the heart by the hygienic rules above given, and by the administration of preparations of steel, combined with arsenic, strychnia, quinine, and mineral acids. Chalybeate waters are also useful adjuncts. The syrup, infusion, and tincture of the prunus virginica are preparations of value in some cases after the use of digitalis. The secretions should be carefully watched, and the bowels opened freely every day, so as to avoid straining, and to relieve the portal circulation. The quantity of urine should be daily noticed, as it is a capital index of the state of arterial tension. Patients in whom the most perfect compensation exists, are, nevertheless, in a state of imminent trouble, for an exaggeration of a physiological act or emotion may disturb the unstable equilibrium of their health. In most cases the compensation breaks down sooner or later; and then begin the symptoms depending on pulmonary congestion and general visceral engorgement, with the consequent impoverishment of the blood. Dyspnœa marks the beginning of these troubles; anæmia and dropsy the close. The pulmonary congestion soon manifests itself by bronchial catarrh, which requires expectorants in various combinations, while friction, poultices, and counter-irritation are applied to the chest-walls. In capillary bronchitis with rapid pulmonary congestion, it is sometimes necessary to bleed from the arm to relieve the over-distended cavities of the right side of the heart. Nauseating doses of ipecacuanha, or actual emetics of sulphate of zinc, are sometimes very useful.

For the general visceral congestions our chief remedies are, firstly, diuretics; and, failing these, hydragogue cathartics. Of diuretics, the salts of potash, squills, broom, chimaphila, spirits of nitrous ether, juniper and digitalis are the most useful. The hydragogue cathartics, which relieve the over-distended portal vessels primarily, and the general circulation secondarily, are also most valuable; of these the compound powders of scammony and jalap in 20- to 40-grain doses; bitartrate of potash in electuary, ʒj to ʒij, every morning; sulphate of magnesia; pilula scammonii composita; elaterium; senna; and gamboge are the most trustworthy. By the judicious use of an occasional purgative, and the administration of a suitable diuretic, aided by cupping, poultices, and sometimes a small blister over the loins, combined with rest and stimulants, the worst cases of dropsy from cardiac failure are often saved.

For the dyspnœa and the insomnia, two of the worst symptoms, we have a remedy of great power in the subcutaneous injection of morphia in doses of one-sixth of a grain upwards. This remedy acts often like a charm, and may be used even in the worst cases of both mitral and aortic disease, but always with caution. Albumen in the urine does not necessarily contraindicate its use. In some cases chloral and bromide of potassium, alone or in combination, are valuable remedies for the insomnia, but they must be given cautiously. The bromides may also be prescribed with other sedatives for the dyspnœa. The compressed air bath in some cases also relieves the last symptom.

Dropsy, like the visceral congestions with which it is associated, requires the use of diuretics and hydragogue cathartics. When these fail, the swollen limbs may be sometimes punctured with benefit. Continued friction of the limbs, by stimulating the vessels, will often cause considerable anasarca to disappear. The drug on which main reliance must be placed when general dropsy supervenes is digitalis. This remedy has so great a share in the therapeutics of heart-disease, and a knowledge of its action is so important, that it must be discussed separately and last. Whatever views may be held as to the physiological action of digitalis, its greatest triumphs are seen clinically in the treatment of valvular diseases, when cyanosis, distended jugulars, dyspnœa, congested viscera, dropsical limbs, scanty urine, tumultuous heart-action, and quick, irregular, and failing pulse, indicate asystoly. This assemblage of symptoms is mostly seen in mitral cases, and it is precisely in this class that the drug is most valuable. Under its use 'the pulse grows in force, fulness, and regularity; the arterial tension rises; the pulmonary congestion diminishes; the kidneys, before inactive, wake up to their work; and the advancing dropsy recognises its master and beats a sullen retreat.' In mitral stenosis these good results are due not only to the increased vigour given by the drug to the contractile power of the heart, but also to the fact that by its slowing action the diastolic period of each revolution is lengthened, and the time thus increased during which the over-full auricle can force its contents through the narrowed mitral orifice into the left ventricle. Digitalis here not only obtains a better filling of the ventricle, but a more effective discharge of its contents when filled; and thus, under its use, beat by beat, the general and pulmonary venous congestion is relieved. In mitral insufficiency it is almost equally potent. In both forms certain of its good effects would seem to be due to some influence, probably through the pneumogastric nerves, in producing contraction of the pulmonary blood-vessels. It is perhaps this property which makes it valuable in pulmonary hæmorrhages independent of heart-disease.

In aortic valvular diseases digitalis is not so valuable a remedy. In these cases the assemblage of symptoms mentioned above is not met with, except sometimes in the later stages, when the mitral valve is secondarily affected, and the case is not one of pure aortic disease. In these compound cases the drug is valuable, especially in combination with stimulants. In aortic insufficiency alone, the slowing action of the digitalis produces evil by increasing the length of the diastolic period of each revolution, during which the regurgitation takes place. The force it may give to the systole is no gain in the face of this slowing action, inasmuch as the aortic recoil gains in the same proportion as the ventricular systole, and thus forces blood back into the ventricle with increased vigour during the lengthened diastole. It is important in aortic insufficiency to encourage the frequency of the cardiac action; hence these cases are so constantly the better for bodily activity; and so, when the toning effects of digitalis are required, it should always be given in combination with ether and ammonia, to keep up quick action of the heart, and to prevent the vertigo and syncope which may otherwise occur. When there is excessive hypertrophy in cases of aortic insufficiency, digitalis is useful sometimes in quieting palpitation, reducing excessive frequency, and lessening headache and vascular excitement. Caffeine and veratrum viride also relieve these symptoms; but a few drops of nitrite of amyl inhaled from cotton-wool are more rapidly and surely beneficial than any other remedy. In aortic stenosis digitalis is rarely required. The simple mode of compensation makes these cases require little treatment. Digitalis is sometimes useful in combination with stimulants to give vigour to the myocardium, and check the tendency to dilatation. If it slows the action of the heart notably, its effect becomes hurtful. Nux vomica often prevents this.

In combined valvular lesions, the predominant lesion must be the guide in the use of digitalis; but it may be given advantageously whenever the general signs of venous stasis are present. The diuretic power of the drug is one of the best tests of its beneficial action. Relying on this test, the writer often gives digitalis for weeks, nay, months at a time, and obtains improvement in the nutrition of the heart which lasts long after its discontinuance. Digitalis effects this improvement by increasing the vigour of the coronary circulation, and thus builds up new heart-muscle to compensate a valvular defect.

The preparations of digitalis which may be used are, the powder in ½- to 1-grain; the tincture in ♏x. to xxx.; and the infusion in ℥j to ℥vj doses. As a diuretic in cases of dropsy, the old combination of squill, digitalis, and blue pill is invaluable.

BALTHAZAR FOSTER.

HEART, Valves of, Aneurism of.—DEFINITION.—A valvular aneurism is a circumscribed pouching or sacculation of one of the valve-segments.

DESCRIPTION.—Two forms of aneurism of the valves of the heart are met with. In the one, the whole thickness of the valve is dilated by the blood-pressure to form the pouch; in the other, one of the lamellæ being ulcerated by endocarditis, the blood pushes the remaining lamella before it to form a sac. The second form, which is sometimes called 'acute valvular aneurism,' occurs most commonly in ulcerative endocarditis. Valvular aneurisms vary in size, from a pea up to a pigeon's egg. The orifice is almost invariably towards the greatest blood-pressure—those on the mitral valve opening towards the left ventricle; those on the aortic valves towards the aorta. They are usually rounded in shape, but may have irregular prolongations between the lamellæ of the valves. Valvular aneurisms are sometimes multiple. The valves of the right side of the heart are seldom affected. The mitral valves are the seat of the larger aneurisms, and are twice as often aneurismal as the aortic valves.

Valvular aneurisms terminate commonly by early rupture, giving rise to perforation and consequent insufficiency of the valve, and often leading to considerable laceration. Rupture occurs more rapidly in aneurism of the aortic valves. Mitral aneurisms occasionally become chronic, and filled with coagulum; and aortic valve aneurism may also be found filled with solid clot.

SYMPTOMS.—The clinical history of this form of disease is defective. When seated on the mitral valve, aneurisms usually give rise to no signs until the perforation and laceration of the valve suddenly develop the murmur of mitral insufficiency. An aneurism of one of the aortic segments causes a soft systolic murmur over the valves, which one day, as the sac ruptures, is supplemented by the murmur, and accompanied by the symptoms of aortic insufficiency. The phenomena of this accident are similar to those of sudden rupture of an aortic valve.

BALTHAZAR FOSTER.

HEART, Wounds of.—Synon.: Fr. *Blessures du Cœur*; Ger. *Herzwunden.*

The subject of wounds and other injuries of the heart belongs more properly to the domain of Surgery, but being in several respects of much medical interest, it requires to be briefly discussed here.

Ætiology and Anatomical Characters.—Wounds of the heart may be punctured, incised, or lacerated; and inflicted with a variety of weapons or other sharp bodies, as well as by projectiles, especially bullets. Traumatic ruptures and contusions form another considerable class of injuries of the heart, which chiefly result from falls, crushing accidents (for example, being 'run over'), and blows. Injuries of the heart due to the entrance of foreign bodies, such as a needle or a bone, may be inflicted in some rare cases from the interior of the œsophagus or stomach; the most remarkable case of this kind being one of wound of the pericardium from behind by the point of a sword which a juggler had attempted to 'swallow.'

Post mortem, the chest-wall generally presents evidence of the wound that has been inflicted. The pericardium rarely escapes injury; its sac is found to contain blood in recent cases, or effused lymph or pus when life has been preserved for a few days or more. The walls of the heart at the seat of injury present different appearances, according to the precise nature of the lesion. Punctured and incised wounds may be of all sizes; take either a direct or an oblique direction through the muscular fibres; and are generally penetrating. Bullet-wounds cut away a portion of the heart, whether at the borders or from the thickness of the organ. Traumatic ruptures present special characters (*see* Heart, Rupture of). In all the varieties of injury of the heart, the wound is found plugged with blood-clot, the edges being either infiltrated or ecchymosed and torn. In cases that do not prove rapidly fatal, the usual signs of inflammation, or healing, and even cicatrization, are found in the heart; or aneurism of the cardiac walls may be developed as a result of the latter. The valves and their appendages are frequently incised or otherwise injured. In some cases a portion of the weapon, projectile, or foreign body may be found in the heart. The ventricles—and especially the right ventricle—are the parts of the heart most commonly injured. The great vessels, lungs, and the arteries of the chest-wall, may also be wounded in different instances.

From these appearances it is evident that wounds of the heart may prove rapidly fatal by loss of blood, by shock, or by compression of the heart resulting from hæmorrhage into the pericardium; whilst, at a later stage, pericarditis, myocarditis, and secondary hæmorrhage may be expected to supervene.

Symptoms, Course, and Terminations.—In about one-third of recorded cases of injury of the heart, either death is immediate—fainting, convulsions, and the other symptoms of syncope, as well as those of shock, being the prominent phenomena, along with external hæmorrhage; or the patient drops dead after a few moments, during which time he may have undergone considerable exertion. In a second class of cases, the symptoms of syncope or of shock occur immediately, but death does not at once ensue. The patient then lies in a state either of unconsciousness or of complete prostration. In the latter event he complains of a sense of great debility, præcordial oppression, dyspnœa, and suffocation; the surface is cold, pallid, and trembling; vomiting may occur; and there is usually hæmorrhage from the region of the heart. Death occurs after minutes or hours, either from exhaustion due chiefly to continued or repeated loss of blood, or from compression of the heart. In a third series of cases, the course is more protracted. The patient, after suffering from the symptoms just enumerated, but in a less degree, passes through the various phases of constitutional disturbance commonly observed in severe wounds, complicated, however, with pericarditis, myocarditis, and repeated hæmorrhage; and dies of exhaustion after an illness of weeks or months. Lastly, in a small proportion of cases, the patient survives the various accidents and complications just described, and the wound of the heart heals; but it sometimes happens that symptoms of aneurism of the cardiac walls, or of incompetence of the valvular apparatus, are developed as the result of the lesion.

Diagnosis.—Wounds of the heart can usually be diagnosed without difficulty by the situation of the external injury, and the severity of the symptoms. Similar symptoms may, however, follow injuries of the great vessels in the neighbourhood of the heart, or of the arteries of the walls of the chest, if the hæmorrhage be profuse; but unless there be almost complete certainty that a vessel within reach is the only seat of the bleeding, the diagnosis should be left undecided, and all dangerous interference avoided.

Prognosis.—Injury of the heart is generally to be regarded as certain to end in death; but it should not be forgotten that as many as 12 per cent. of recorded cases are said to have recovered. Some very remarkable instances have occurred of recovery after very severe injury to this organ; for example, a case in which a bullet was lodged in the substance of the heart for twenty years. (*See British Medical Journal*, March 23, 1867.) The prognosis may be broadly estimated by the severity of the immediate symptoms. Traumatic rupture of the heart is said to have invariably proved fatal.

Treatment.—In wounds of the heart, the hæmorrhage must be at once arrested by the usual surgical means; immediate death must be prevented by cautious stimulation; and the patient must be kept in such a condition that, whilst life is preserved, the danger of inflammatory reaction in the region of the heart, and of fresh hæmorrhage, is reduced to a minimum. It is on this account that restorative measures are to be guardedly employed at first, and resorted to in the further progress of the case only when urgently indicated. Absolute rest of body and mind is indispensable. Nervine and cardiac sedatives, such as bromide of potassium, morphia, chloral-hydrate, and belladonna, may be of great service when used with judgment.

J. Mitchell Bruce.

HEARTBURN. — Synon.: Cardialgia. —

Heartburn is a hot or scalding sensation, usually referred to the cardiac orifice of the stomach, but in some cases diffused over the whole abdomen. It is frequently accompanied by eructations of a very acid character; and the fluid rejected from the stomach produces a sensation of scalding in the throat and œsophagus.

Ætiology.—Heartburn exists in a very marked degree in dilatation of the stomach, being produced by the decomposition of indigestible food retained in this organ. It constantly accompanies chronic catarrhal gastritis, the retained mucus enclosing particles of food in a state of decomposition, which set up fermentation in the materials of each meal as soon as it is swallowed. Heartburn is common in the later period of pregnancy, probably because the stomach is so displaced that it is unable properly to expel its contents.

Treatment.—This sensation is best treated by antacids, such as chalk, magnesia, alkalies, and alkaline waters. In some cases powdered charcoal relieves it. The diet for persons that suffer severely from heartburn requires careful regulation. All articles of food containing much fat, sugar, or starch, should be avoided. The use of tobacco should be interdicted; the writer has frequently seen obstinate cases kept up by smoking and chewing. Alcoholic stimulants should be used very sparingly, the least likely to do harm being brandy mixed with Vichy or potass water. The writer has obtained good results by substituting gluten bread for the ordinary baker's bread, and where this could not be taken, has found advantage from the use of äerated or some other kind of unfermented bread. Some women who suffer severely from heartburn when pregnant find relief from eating lettuce.

S. Fenwick.

HEART-CLOTS. *See* Heart, Thrombosis of.

HEAT, Ætiology of. *See* Disease, Causes of; and the following article.

HEAT, Effects of Severe or Extreme.—(*A*) **Constitutional Effects of Severe Heat applied generally.**—The constitutional or general effects of exposure of the whole body to high temperatures vary with the source and degree of heat, the slowness or rapidity of transition from lower temperatures, and the length of exposure; as well as with the age, constitution, habit and health of the body; and they are liable to be more or less modified or obscured by various concomitant circumstances and conditions, such as the barometric pressure, the hygrometric state, and the purity or impurity of the atmosphere.

The range of temperature within the limits of which life can be maintained appears to be greater in the case of man than in that of most of the lower animals, in virtue of greater power of accommodation to external influences, without undue elevation or lowering of the temperature of the body. But in every case any such combination of external circumstances as causes the temperature of the body to rise 10° to 15° above the normal standard speedily proves fatal.

Artificial heat.—Numerous observations and experiments show that in *dry air* exposure to very high temperatures can be borne, during periods varying with circumstances, without danger or even serious inconvenience, the temperature of the body being kept down within safe limits by evaporation from the surface and from the lungs. Thus, in Dobson's experiments, a temperature of 210° was sustained during twenty minutes; Blagden exposed himself during eight minutes to a temperature of 260°; Chantrey's workmen were accustomed to enter a drying oven in which the thermometer stood at 350°; and Chabert, the 'Fire King,' is said to have frequently exposed himself to a temperature of from 400° to 600°. Glass-workers, metal-founders, gas-stokers, engineers in steamboats—especially in the tropics—bakers' oven-builders, and others constantly carry on their work in temperatures of from 120° to 160°, or even higher, to say nothing of the blasts of radiant heat to which some are from time to time exposed. In *moist air*, evaporation from the surface and its cooling influence being diminished or prevented, much lower temperatures speedily become insupportable. Berger was unable to remain in a vapour bath the temperature of which had risen from 106° to 120°, although he had easily borne a temperature of 230° in dry air for five minutes.

The effects upon the temperature of the body, pulse, respiration, &c., recorded by previous observers, are, in the main, supported by the recent careful experiments of Dr. Fleming in the Turkish bath.[1] He found that exposure during an hour to a temperature commencing at 170° and lowered to about 130°, caused the temperature of his body (taken by a specially devised thermometer in the mouth), to rise rapidly during the first ten minutes from a normal average of 97·65° to 99·2° (a rise of 1·6°); and then more slowly until the end of fifty minutes, when the highest point 101·3° (a rise of 3·7°) was reached. His pulse rose during the first ten minutes from 78 to 91 beats in the minute, and like the temperature attained its maximum—115, at the end of fifty minutes. His breathing first diminished in rapidity from 22·5 to 20·8, and then increased to 25·4 in actual rapidity, but maintained a diminished ratio to the pulse. The arterial tension seemed to be increased by the greater rapidity of the heart's action, combined with the gorged state of the capillary circulation. The quantity of material eliminated during the hour amounted to forty-four ounces. The proportion of chlorides in the urine passed after the bath (3·65 in the 1,000) was little more than half that in the sweat (6·05) collected during the bath, and much less than in the urine previously passed (5·68). The proportion of urea in the urine was slightly increased, and the sweat contained 1·55 in the 1,000.

The effects felt by those exposed to great heat vary with the temperature, the length of exposure, and the collateral circumstances. A sensation of warmth, at first agreeable, is succeeded by one of oppressive and then painful heat, until this is again relieved by the establishment of copious evaporation from the surface. Pleasant stimulation, and some degree of excitement of the nervous and muscular systems, are quickly followed by languor, lassitude, listlessness, feelings of exhaustion, indisposition to mental effort or muscular exertion, dizziness, tendency to sleep, faintness and unconsciousness, sometimes accompanied or preceded by convulsions. If relief is not afforded death ensues. If timely relief is afforded, more or less speedy and complete recovery may be brought about.

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[1] *Journal of Anatomy and Physiology*, July 1879.

Symptoms and conditions closely or exactly resembling those of sunstroke, may be produced by exposure to an artificially heated atmosphere, or to blasts of radiant heat from fires or furnaces. If the symptoms have been severe and persistent, or if the sufferer has been exposed to repeated attacks, permanent damage to the health, and especially to the nervous system, almost certainly results, in spite of apparent temporary recovery. In many cases general debility and deterioration, in some cardiac troubles, and in others insanity, have been recorded as the persistent after effects.

Bernard, Delaroche, and others have shown that animals exposed to temperatures of from 130° or lower, to 150° and upwards, quickly die.

The *post mortem* examination of animals so killed showed that the heart had entirely ceased to beat at the moment of death, and that neither it nor the muscular coat of the intestines could by any means be stimulated to contract again. The muscular fibres of the heart examined microscopically appeared rigid and coagulated (Kühne and Ranvier). Further, the blood in both arteries and veins was dark coloured. *Rigor mortis* set in very early, and general decomposition very speedily commenced. It would thus appear that (apart from sudden shock to the system generally) *the cause of death* from exposure to high temperatures is to be found in the effect produced on the muscular system of organic life, and especially on the heart. The cardiac myosin coagulates at 115°; and at a temperature considerably short of this its condition must be seriously affected.

Anatomical Characters.—The *post mortem* appearances met with in the human subject in cases in which death has been attributed to the general effects of heat have not been uniform. The following case, however, recorded by O. Speck[1] is noteworthy. A girl, æt. fourteen, the subject of chronic disease of many of her joints, was, on the advice of a quack, wrapped in a sheepskin warm from the carcase, laid in bed, surrounded with hot loaves fresh from the oven, and covered by the clothes. In about an hour she complained of pains, especially in one arm. She soon fell asleep. It was noticed that her chest rose and fell strongly. She perspired freely, and the sweat was frequently wiped off. She became very pale, and about three hours after the commencement of the treatment she expired, without having recovered, or at any rate manifested, consciousness. On *post mortem* examination the next day (the weather being cool and dry) advanced decomposition was found; the blood being black and fluid, and the blood-vessels, cavities, and tissues generally full of gas. The heat of loaves fresh from the oven, such as were put round the child, was found to be 185°.

Treatment.—The *immediate* treatment to be adopted in the case of those suffering from exposure of the whole body to heat consists essentially in removal into a cooler atmosphere; quiet rest in the recumbent position; fanning; cool or even cold affusions or sponging, especially over the head and spine—the effect, however, being carefully watched; and the administration of cool or lukewarm fluid in small quantity at a time, with some stimulant. Copious draughts of cold water in a highly heated state of body are liable to give rise to dangerous or even fatal results. Bleeding is not to be recommended.

The *after treatment* must be conducted on general principles, and determined by the condition of the patient, and the indications afforded in the particular case.

Climatic and Solar Heat.—The effects of climatic heat experienced on transition from temperate to tropical regions are as follows:—1st. The average temperature of the body rises ·5° to 1° according to Davy and Crombie, or to a somewhat greater extent according to others. The daily fluctuations of bodily temperature in health in India correspond to those in England. The normal temperature of native Indians is about half a degree higher than that of Europeans (Crombie). 2nd. The pulse is quickened according to most observers, but Rattray says this is incorrect. 3rd. The breathing becomes slower and less deep, falling from about sixteen to about twelve or thirteen per minute. Less carbonic acid and less water are thus exhaled. 4th. The skin acts much more freely, its excretion being increased by about 24 per cent. (Rattray). The continued hyperæmia and over action of the skin, however, are liable to be followed by congestion and obstruction of the sweat follicles, giving rise to 'prickly heat.' 5th. The urine is diminished in quantity, and in amount of urea and chlorides. The experiments of Becher (confirmed by those of Forbes Watson) showed a constant relation between the temperature, and the urea and chloride of sodium got rid of by the kidneys. As the temperature rose from 50° to 70° an increase was found; but with a further rise from 70° to 90° an almost equally constant diminution occurred. 6th. The appetite, especially for animal food, is diminished, and the digestive powers seem lowered. 7th. Lassitude, languor, want of vigour, indisposition to exertion, and a sense of exhaustion of mind and body are experienced in degrees varying with circumstances; the depressing effects being most felt when the heat is not only great but continuous day and night, and when the atmosphere is moist.

The effects of the radiant heat of the sun, as distinguished from those of atmospheric heat, are not well made out. It would appear probable, however, that a physiological effect adverse to perspiration is produced by the direct rays (Parkes), and that thus, as well as from rapid evaporation, the skin gets dry, and becomes liable to certain structural changes, such as the formation of pigment, &c.

Exposure to the direct rays of the sun, or to great or continued heat in the shade, especially under unfavourable atmospheric and general conditions, may give rise to heat-fever (Causis), heat-apoplexy, or one or other of the forms of sunstroke. *See* Sunstroke.

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[1] *Vierteljahrschrift für gerichtliche Medicin*, 1874; p. 249.

(*B*) **Local Effects of Severe Heat: Burns and Scalds.**—The local effects of heat vary with the degree, the length of exposure, the medium of application, and the part acted upon. *Burns* result from 'dry,' *Scalds* from 'moist' heat.

Symptoms.—A comparatively slight degree of heat causes vascular turgescence, redness, tingling, pain, and tenderness, which soon subside. Desquamation of the epidermis may follow, but no permanent trace of injury is left. A higher degree causes severe burning pain, and great redness of surface, followed by effusion of serum beneath the cuticle (vesication.) Complete restoration without scar is usually effected. Still higher degrees of heat or longer exposure cause intense pain, and immediate destruction, or consecutive destructive inflammation, of the true skin to a greater or less depth. Sloughing and suppuration follow, and permanent scarring results. Violent heat and prolonged exposure cause complete disintegration and charring of the structures especially acted upon, followed by destructive inflammation and sloughing of others to a still greater depth and extent. Loss of parts and more or less serious deformity and scarring necessarily result. The separation of sloughs, and the processes of repair after severe burns, take place slowly; and as a rule the patient suffers much more acutely, and during a much longer period, than after other forms of injury involving equally extensive destruction of tissue.

The *constitutional* effects of burns and scalds vary with the superficial extent and situation, rather than with the depth of the injury. Thus an extensive burn or scald over the abdomen affecting only the skin is much more likely to prove fatal than a deep burn of one of the extremities, penetrating even to the bone, but of comparatively small superficial area. If more than half the surface of the body is affected the sufferer rarely recovers.

Death may result from shock to the system, either immediately on receipt of the injury, or after a period of from two or three to forty-eight hours or more. During this time the sufferer remains in a state of collapse or prostration, with pallor of complexion, lowness of temperature, coolness of breath, small or imperceptible pulse, dryness of tongue and mouth, and sometimes delirium, rigors, or convulsions. In such cases, *post-mortem* examination shows only congestion of the viscera, and especially of the brain. In some instances, characterised by painfully laboured and frequent efforts at respiration, tumultuous, irregular, feeble and very frequent action of the heart, and great præcordial distress, death would appear to be due to cardiac thrombosis, rather than to simple nervous shock (Brown). In many severe cases the blood has been found on microscopical examination altered in appearance, the red corpuscles being separated into 'numerous little bits' (Ponfick and Schmidt). And it is readily conceivable that such destruction of corpuscles may give rise to severe symptoms, or even cause death.

In about forty-eight hours, more or less, if the immediate effects of the injury have been survived, the stage of reaction and inflammation sets in. The patient revives, and some degree of general pyrexia becomes manifest. The pulse becomes quicker and fuller; the temperature rises; and the burnt part begins to discharge pus, usually of an offensive odour. Thirst, with dry red tongue, want of appetite, vomiting and constipation, followed by diarrhœa—sometimes with blood in the evacuations—are commonly experienced during the ensuing period; and inflammation of internal parts often occurs, although the special signs and symptoms afforded may be obscure. The pleuræ and lungs, the peritoneum, and the gastro-intestinal mucous membrane (particularly that of the duodenum) are especially liable to be affected. Evidence of inflammation of one or more of these parts, and not uncommonly of ulceration of the duodenum, is afforded on *post mortem* examination in cases in which death has occurred during this period. It has been suggested that capillary embolism, from the presence of disintegrated blood in the vessels, may cause in some cases the lesions of the internal organs (Brown).

In the course of about a fortnight after the injury, as a general rule, the sloughs will have separated, the acute symptoms will have subsided, and granulation and suppuration will have been established. But a low form of chronic inflammatory mischief in the internal organs may still be going on, and lead to fatal result; or the patient may sink, worn out by suffering, and exhausted by the profuse discharge from the suppurating surface, or by persistent diarrhœa, accompanied or not by blood in the motions. Sometimes the kidneys are affected, and blood or bloody casts may be found in the urine. Pyæmia, erysipelas, or tetanus may occur and cause death; but there would not appear to be any special liability to these diseases after burns or scalds.

Treatment.—*Local treatment.*—Slight superficial burns of small extent require little in the way of treatment. Immersion in cold water according to some, in hot water according to others, or exposure before the fire, affords the readiest means of obtaining immediate relief. Afterwards the part may be covered with flour, starch, oxide of zinc, bismuth, or collodion, and wrapped round with cotton-wool to protect it from the air and from accidental irritation. In cases in which there is vesication, the blisters should be pricked, the serum evacuated, and the cuticle left to form a natural protective covering, which may be advantageously strengthened and kept in position by a layer of collodion. But the punctures should be left open. Lint soaked in oil, or smeared with vaseline or some such material, should be applied, and the whole covered with cotton-wool. A mixture of chalk or whitening and vinegar, of the consistence of thick cream, is said to form an excellent application in such cases, speedily relieving pain, and helping to constitute a good protective covering.

Severe and extensive burns and scalds demand in their treatment the most careful management, and the greatest possible patience, gentleness, and firmness; for even if life be preserved, the most pitiable disfigurements and deformities are liable to result from cicatricial contractions, unless proper preventive measures are perseveringly carried out. So soon as may be after the injury, the clothes should be removed from the patient with the greatest care—being cut away piecemeal if needful, and not removed in such way as to tear off epidermis or scorched or charred parts. The whole burnt surface should then be covered as quickly as possible with the dressing considered best, and enveloped in thick layers of cotton-wool lightly bandaged on. Different dressings have been advocated from time to time, but probably there is none better, or more generally and readily applicable in hospital practice at any rate, than Carron oil (a mixture of equal parts of linseed oil and limewater). The addition of a little carbolic acid is advantageous. A less disagreeable application may be made by substituting olive or almond oil for linseed oil. White lead, putty made thin by addition of oil, calamine ointment, carbolised oil, solution of carbonate of soda, carbolic lotion, flour, and starch, are among the other materials that have been recommended. Whatever the material selected, it should be slightly warmed, and applied very thickly spread on broad strips of lint in such way as to facilitate future dressing bit by bit, and so as to avoid extensive exposure of raw surface. The first dressing should be allowed to remain undisturbed as long as possible—until, indeed, the offensiveness of the discharge, or the discomfort of the patient, indicates the necessity for its removal. The earlier dressings, however gently carried out, occasion so much suffering to the patient that—in the case of children especially—it is often desirable to administer chloroform. Poultices are sometimes useful in aiding the separation of sloughs. Any needful washing or cleansing is best done by aid of the steam spray-producer, a weak solution of carbolic acid or of borax being used. When suppuration is established, and the surface clean, the application may be varied according to the indications afforded. Calamine or zinc or lead ointment, with or without the addition of some anodyne; and lotions of lead, morphia, and glycerine, or of sulphate of zinc, are amongst those commonly employed. Iodoform, with extract of hemlock and spermaceti ointment, has been strongly recommended as tending to soothe pain, to deodorise the discharge, and favour healing. Exuberant granulations may be treated with nitrate of silver in solution, or by the application of the solid stick. When the granulating surface is in a healthy state, cicatrisation may be very materially expedited by skin-grafting.

During cicatrisation, and even for some time afterwards, it is of the greatest importance to keep all parts in such position as that there shall be as little deformity as possible from growing together of surfaces, and contraction of scars. This is to be effected or attempted by position, by mechanical apparatus, and by the application of strips of adhesive plaster and bandages in manner determined by the circumstances and conditions in each particular case.

Constitutional treatment.—In the early stages, alcoholic stimulants, or ammonia, and external warmth are especially requisite, and such light nourishment as can be taken. Opiates or other anodynes, as chloral or bromide of potassium, are to be administered according to the indications afforded, for the purpose of allaying pain and soothing the nervous system. When suppuration is established, a full allowance of good nourishing food, with some alcoholic stimulant, should be given, and such tonics as seem most suitable. Small doses of opium at regular intervals often prove very beneficial. The complications that may arise, such as affections of the internal organs, &c., must be treated in accordance with general principles, but all depressing medicines as a rule should be avoided.

Arthur E. Durham.

HEAT, Therapeutics of.—Principles.—The primary effect of external heat applied *locally* to the animal body is that of an excitant or stimulant. There occurs redness with turgescence of the small vessels, in the part to which the heat is applied, along with slight augmentation of temperature, and pain. Increased beyond a certain degree, heat ceases to be a stimulant, its prolonged action causing greater pain, exhaustion, depression, and, if the action be very intense, decomposition of the organized tissues. *See* preceding article.

Experiments have shown that by increased heat the electric currents in the nerves are destroyed. It may therefore be assumed that the nerves become less able to conduct impressions either to or from the brain, and that heat may act as a sedative to painful nerves.

Moderate heat applied generally, that is, to the whole body, produces a number of important physiological effects which are fully described in the preceding article, to which the reader is referred.

Applications and Uses.—Heat is employed in the treatment of disease as a general or local stimulant, a local depressant, a caustic, or a counter-irritant; and that in the form either of *dry* or of *moist* heat.

Dry heat.—The primary exciting and stimulating action of heat may be made available to rouse the nervous and vascular systems. The use of the hot air bath (Turkish Bath), and that of the sand-bath are discussed in the article on Baths. In some parts of the South of France, baths of hot sand (*arena calida*) are used in the treatment of rheumatism, paralysis, and spasm; the sand acting as a stimulant and sudorific. To restore the circulation, bottles of hot water are placed in the axillæ, and against the feet and thighs, in cases of collapse of the system, with coldness of the extremities and great failure of circulation, as in the treatment of collapse from the shock of an injury, or from such diseases as cholera, or of the apparently drowned.

Dry heat may also be applied to the abdomen, in the form of tins or bottles of hot water, or bags of heated salt or sand, to relieve painful spasm and colic. Hot water enclosed in an india-rubber bag is sometimes of service to allay undue irritability of the spinal nerves. The therapeutical application of heat as a counter-irritant will be found described elsewhere. *See* Counter-irritants.

Moist heat.—Heat and moisture together tend to cause relaxation of the tissues, thus removing the tension and pain due to inflammation. Moist heat is employed locally in the form of the local vapour bath, fomentations, and poultices. *See* FOMENTATIONS; and POULTICES.

Moist heat is applied to the surface of the body generally, chiefly in the form of the vapour bath. *See* BATHS.

JOHN C. THOROWGOOD.

HEAT-STROKE.—A synonym for sunstroke. *See* SUNSTROKE.

HECTIC FEVER (*ἑκτικός*, habitual).—SYNON.: Fr. *Hectique*; Ger. *Hectisch.*

ÆTIOLOGY.—The variety of fever thus named has long received special recognition, inasmuch as it presents certain prominent and peculiar features, as regards its course and attendant phenomena. It occurs in association with some wasting and exhausting disease, especially when this is accompanied by a profuse and constant drain from the system, and more particularly when there is chronic suppuration, with an abundant discharge of pus. Hectic fever is most frequently noticed in cases of pulmonary phthisis, in a large proportion of which it appears in various degrees during some part of their course, chiefly in the advanced stages. Other conditions deserving of mention in connection with which it may supervene are empyæma, especially if there is an external fistula, tubercular ulceration of the intestines, chronic purulent discharge from the kidney, hepatic abscess, chronic dysentery, and any form of external chronic abscess attended with much discharge. Fever of a hectic type sometimes occurs in cases of acute inflammation; and it is occasionally observed in chronic affections unattended with suppuration, such as cancer and lymphadenoma. Pathologically it seems to be connected with the absorption of pus or other morbid products into the blood. *See* FEVER.

SYMPTOMS.—Hectic fever is established gradually, becoming more and more distinct, until it assumes its typical characters. It is more or less paroxysmal, being at first indicated by slight pyrexia towards evening and during the night, the temperature being a little raised, and the pulse hurried. During the day there is no fever at this time, but as the case progresses it becomes constant, though exacerbations occur at night, and, it may be, also in the morning, the paroxysms thus occurring either once or twice within the twenty-four hours, and the pyrexia being remittent. In typical hectic there is a complete febrile cycle, beginning with chills or even a distinct rigor, followed by considerable heat of skin, the temperature continuing to rise, and ending in more or less profuse perspiration, especially about the head and chest, sometimes so abundant as to saturate the bed-clothes or even the bedding. Patients often feel subjectively very hot, the palms of the hands and soles of the feet having a burning sensation. The pulse tends to become very frequent and quick, and is easily hurried and excited, being at the same time weak, soft, and compressible. Not uncommonly a bright red or pink spot appears on each cheek during the paroxysm, known as the *hectic flush*, and this may contrast markedly with the general pallor of the face, the eyes being also bright, clear, and sparkling. The mind is unaffected, and the mental faculties may be unusually bright and vivid. After a febrile exacerbation the urine may present excess of lithates. Hectic fever does not always show all its typical features, and even in the same case variations are noticed in the precise characters of the paroxysms. It is usually accompanied with other symptoms due to the disease with which it is associated; while it itself tends to cause wasting and debility, as well as a sense of exhaustion after each attack. In most instances a fatal termination ultimately ensues, but if the condition upon which hectic depends is curable, recovery may take place.

TREATMENT.—The first principle in the treatment of hectic fever is to attend to, and cure, if possible, the condition upon which it depends, and especially to diminish or stop suppuration. General tonic treatment will also help in preventing the paroxysms. These may be directly checked in appropriate cases by full doses of quinine, salicine, or other antipyretics, given before the usual time for their occurrence. Sponging the skin freely may also prove of service in some instances. The treatment of hectic in phthisis runs into that of night-sweats, and can be more conveniently discussed under that disease. *See* PHTHISIS.

FREDERICK T. ROBERTS.

HELIOSIS (*ἡλιόω*, I expose to the sun).—A method of treatment for certain diseases, which consists in exposing the patient to the rays of the sun. The term is also employed as a synonym for sunstroke. *See* SUNSTROKE.

HELMINTHIASIS (*ἕλμινς*, a worm).—The condition of system upon which the development of worms in any part of the body depends. The term is also applied to the diseases characterised by the presence of worms.

HELMINTHICS (*ἕλμινς*, a worm).—Of or belonging to worms. A synonym for anthelmintics. *See* ANTHELMINTICS.

HELMINTHS (*ἕλμινς*, a worm). — This term is often employed in preference to one or other of the various synonyms with which it is regarded as equivalent (worms, intestinal worms, vermes, entozoa, internal parasites, and so forth). Thus, Von Siebold (who speaks of the Helminths as forming a *class* of animals, nearly all of whose members are parasitic) admits that the only character common to the greater part of the whole group is their peculiar mode of life. The study of the helminths forms what is often called the science of *Helminthology*. In accordance with professional custom, it has been thought desirable, in the present work, to speak of the helminths as constituting the class ENTOZOA, under which heading, therefore, more detailed references are given. T. S. COBBOLD.

HEMERALOPIA.—The etymology of this term is uncertain, and its real meaning has never been definitively settled. Some writers derive the word from *ἡμέρα*, *the day*, and *ὤψ*, *the eye*, and in conformity therewith, use it to signify *day-sight* or *night-blindness*, that is, a state of vision in which objects are seen by day-light or by strong artificial illumination, but become more or less invisible when in deep shade or in twilight. Others, on the contrary, employ the term in the opposite sense of *day-blindness* or *night-sight*, deriving it from ἡμέρα, ὤψ, and ἀ, priv. or ἀλαός, *blind*. It is used in the latter sense in this work, and may, therefore, be defined as a disorder of vision, in which objects cannot be seen well or without pain by daylight or by strong artificial light, but are more clearly or comfortably seen in a deep shade or by twilight. *See* Vision, Disorders of.

HEMIANÆSTHESIA (ἥμισυς, the half; ἀ, priv.; and ἀισθάνομαι, I feel).—Paralysis of sensation affecting one side of the body. *See* Sensation, Disorders of.

HEMIANALGESIA (ἥμισυς, the half; ἀν, without; and ἄλγος, pain).—Insensibility to painful impressions, affecting one side of the body. *See* Sensation, Disorders of.

HEMICRANIA (ἥμισυς, the half, and κρανίον, the head.)—Pain limited to one side of the head. The term is, however, generally used as synonymous with megrim. *See* Megrim.

HEMIOPIA
HEMIOPSIA } (ἥμισυς, the half, and ὤψ, the eye).—A derangement of vision in which only one half of an object is seen by one eye. *See* Vision, Disorders of.

HEMIPLEGIA (ἥμισυς, the half, and πλήσσω, I strike).—Paralysis of motion of one side of the body; sometimes applied to loss both of motion and of sensation. *See* Paralysis, Motor.

HEPATALGIA (ἧπαρ, the liver, and ἄλγος, pain).—Strictly this word signifies pain in connection with the liver. It has, however, been specially applied to a supposed neuralgic pain referred to this organ, coming on in paroxysms, and said to be of a severe character in some instances, so as to simulate hepatic colic. Whether there is any such affection is exceedingly doubtful, and probably in cases of supposed hepatalgia the neuralgia is either superficial, or there is some tangible but undiscovered cause for the pain, connected with the liver or some neighbouring structure.

Frederick T. Roberts.

HEPATIC DISEASES. *See* Liver, Diseases of.

HEPATISATION (ἧπαρ, the liver).—A term applied to the condition produced by acute inflammation of the lung, in which the pulmonary substance becomes solid and friable, resembling somewhat the liver in its physical characters. *See* Lungs, Inflammation of.

HEPATITIS (ἧπαρ, the liver).—Inflammation of the liver. *See* Liver, Inflammation of.

HEPATOCELE (ἧπαρ, the liver, and κήλη, a tumour).—Hernia of the liver. *See* Liver, Displacements of.

HEREDITARY (*hæres*, an heir).—This term, as used in relation to medicine, is applied to the transmission of constitutional conditions, or of diseases, from parent to offspring. *See* Disease, Causes of; and Predisposition to Disease.

HERMAPHRODITE (Ἑρμῆς, Mercury, and Ἀφροδίτη, Venus).—A term applied to an individual in whom the formation of the sexual organs is such as to give rise to the impression that both the male and the female organs are present. *See* Malformations.

HERNIA (*hernia*, a rupture).—Definition. This word is used in surgery to express the protrusion of any viscus from the cavity in which it is naturally placed. In this article, however, the observations are exclusively restricted to protrusions of the viscera of the abdomen through the walls of that cavity, and it is only intended to give a mere outline of the subject, its full discussion being beyond the scope of this work, as it is mainly connected with surgery.

General Remarks.—Hernial displacements take place in both sexes and at all ages. The most striking objective sign of the existence of a hernia is a fulness or swelling in one or other of those regions of the abdomen where, from the anatomical construction of its walls, the tissues are weakest. When the parietes are defective, in consequence of local disease or injury, visceral protrusions may occur at those spots; and also, as the result of congenital malformation in both sexes, a fruitful cause of hernia being the non-closure of the vaginal process of the peritoneum at birth, or a patulous state of the umbilical aperture. Such a protruded viscus forms a hernial swelling or tumour. The tumour is composed of a sac, its contents, and the tissues outside the sac. The sac is composed of a prolongation of the peritoneum in most cases; and its orifice, neck, or abdominal aperture constitutes, with the tissues around it, a frequent cause of impediment to replacement or 'reduction' of the hernia. The hernia may be a part of any abdominal viscus, but those most mobile are usually displaced. Thus, in the majority of cases, either the omentum or small intestines, together or singly, form the hernia. The tissues outside the sac are those which exist in the region where the tumour is formed, and they are frequently described as the coverings of the sac.

Every hernial tumour possesses a neck, body, and fundus.

The first or earliest objective symptom of a hernial protrusion is an unusual fulness, as, for example, in the groin in a case of inguinal hernia. This swelling is transient, appearing and disappearing in relation to the actions or posture of the individual. When pressed with the finger the swelling disappears; but it is readily reproduced if the patient contracts the abdominal muscles, and then with the finger an impulse is felt, produced by the protruding viscus. By slow degrees the bulk of the swelling increases, until, if no support or 'truss' be used, very large tumours are formed.

Classification.—The most practical classification of hernial protrusions is based upon the usual triple division of the abdomen into regions, namely, the epigastrium, mesogastrium, and hypogastrium.

1. Protrusions in the epigastric region are very rare. They are (*a*) *Diaphragmatic*; and (*b*) *Epigastric*. The first is due either to relaxation of the

tissue of the diaphragm muscle, or to its laceration. In some cases congenital deficiency of the muscle is the primary cause; in others the natural openings in the muscle become dilated. Signs of this hernia are very obscure; but when the protrusion depends upon laceration of the muscle, the occurrence of a recent injury may excite suspicion, when associated with abnormal sounds in the thorax.

Epigastric hernia escapes at the region formed by the cartilages of the false ribs on either side of the linea alba. It is very rare, and as the abdominal orifice of the sac is usually large, the hernia is easily reduced.

2. The hernias in the mesogastrium are (*a*) *Ventral*; (*b*) *Umbilical*; and (*c*) *Lumbar*. The term *ventral* is given to any hernial protrusion escaping through abnormal openings in the walls of the abdomen, to which no special name is given. They are seen in the region of the linea alba, above the umbilicus, but most frequently below; in the line of the linea semilunaris; and even opposite the muscular walls. Commonly of traumatic origin, their nature is clearly shown by the ready manner in which the protruded viscus can be pressed back into the abdomen. They sometimes ensue upon the weakening of the walls after distension, or upon the loss of tissue following abscess.

Umbilical hernia is met with at all ages and in both sexes. It forms a tumour at the site of the umbilibus in the first instance, and gradually descends over the linea alba as its bulk increases. Very soon after birth this variety of hernia appears. The protrusion takes place at the umbilical ring, and pushing before it the peritoneum, an acquired hernial sac is formed. To prevent, therefore, the development of the sac in infancy, and to assist the closure of the ring in the linea alba, a slightly convex disc of cork, enclosed in washleather, should be strapped over the umbilical aperture. The prognosis of infantile umbilical hernia is favourable, for the aperture closes with age, and the tissues continue firm.

In adult life this kind of hernia is frequent in fat individuals. The tumour often acquires enormous proportions. Its contents consist of small intestine and omentum, with not uncommonly a portion of the transverse colon. Accumulations of fæcal matter therein often give rise to obstruction, and the symptoms arising in consequence of this state more or less resemble those of strangulated small intestine. A correct diagnostication of their cause may usually, however, be arrived at from the history of the attack, the comparative mildness of the malady, and the alleviation of the symptoms by exciting the action of the bowels. The contents of this form of hernia, when of long standing, often become adherent or bound by bands to the sac, in which state they remain permanently irreducible.

When the protruded viscus can be entirely reduced within the abdominal cavity, a suitable, well-fitting truss should be worn constantly, and, if irreducible, one adapted to the circumstances of the case must be used.

Lumbar hernia takes place in the loins. It is a very rare variety, and usually occurs as the result of an injury.

3. The herniæ in the hypogastrium are the most numerous and the most common. They include (*a*) *Inguino-scrotal* or *Inguino-labial*, *above* Poupart's ligament; (*b*) *Femoral*, *below* Poupart's ligament; (*c*) protrusions through the apertures of the pelvis in front, beneath the horizontal ramus of the pubes—*Obturator*; (*d*) beneath the arch of the pubes—*Perineal*; (*e*) *Pudendal*; (*f*) *Vaginal*; and (*g*) behind, through the ischiatic notch—*Ischiatic*.

Inguinal hernia is seen at all ages and in both sexes. The following varieties are described—the *oblique* or *external*; and the *direct* or *internal*. In the first, the orifice of the sac is outside the course of the internal epigastric artery; in the second it is internal to the same vessel. When the protrusion forming an inguinal hernia does not descend below the inguinal canal it is termed a *bubonocele*; but when it occupies the scrotum or labium it forms an *inguino-scrotal* or *inguino-labial* tumour. The essential difference between the inguinal hernia of youth and of middle age is due to the constitution of the sac which encloses the protrusion. From infancy to early adult life protruding viscera escape from the abdomen into a serous sheath, continuous with the parietal peritoneum, the vaginal process of that membrane, which extends into the scrotum or labium. In middle life and afterwards the parietal peritoneum is thrust through the apertures or weak points in the abdominal walls by the protruding viscus. In this way two distinct kinds of hernial sac are formed; the first being due to a congenital defect; the second, to a mechanical and acquired cause. In practice, it is very important to bear these distinctions in mind. In the first kind a truss is applied to prevent the passage of the viscus into the sheath, in the hope that by this means its walls may unite and its orifice contract—in fact, to assist nature in accomplishing that condition the failure of which permits the protrusion to take place. But, in the second, a truss is used to prevent the protruding viscus pushing the peritoneum before it and so forming for itself a sac. Thus, if the development of the sac be arrested, there can be no hernial tumour.

Inguinal herniæ occupy the inguinal canal, and are, therefore, in relation with the spermatic cord of the male and the round ligament of the female. They escape from the canal through the external abdominal ring into the scrotum or labium. The neck of the tumour is always therefore above Poupart's ligament, and to the inner side of the external pillar of the external abdominal ring. This anatomical fact constitutes the main distinction between inguinal and femoral hernia.

Femoral hernia forms a tumour at the inner and upper part of the thigh, immediately below the pubic attachments of Poupart's ligament. Those structures are in immediate relation with the neck of the sac. The protrusion escapes at the femoral aperture, the site of the entrance of the lymphatic vessels of the thigh to the abdominal cavity. The neck of the sac is therefore to the inner side of the sheath of the femoral vessels, although, in proportion to the bulk of the tumour, its body may overlie it, and even extend upwards above Poupart's ligament, and outwards towards the crest of the ilium. The sac of a femoral hernia is always an acquired formation. Hence the importance of wearing a truss after observing the slightest indication of a femoral protrusion. For if the yielding, relaxed, parietal peritoneum be supported at the crural aperture by a well-adjusted pad, a visceral hernia must be avoided, as there will be no sac into which it can escape. In other words, arrest the development of the sac and there can be no hernia.

To discriminate between a femoral and an inguinal hernia, place the index finger upon the spinous process of the pubes; if the neck of the tumour is to its outer side, and the whole length of Poupart's ligament can be traced above it, a femoral hernia exists. Should precisely the converse conditions be ascertained, the tumour will depend upon an inguinal protrusion. Another method for diagnosis is the direct and careful examination of the site of the femoral aperture. If it is clearly and distinctly tangible and well-defined, it cannot be occupied by a hernial protrusion.

This hernia is most common in the adult female. It has been developed before ten years of age, is rare between that age and twenty, but very frequent in persons between twenty and forty years old. Prolific women are more frequently the subjects of this hernia than the single and sterile.

Obturator hernia escapes from the pelvis through the thyroid foramen, and traverses the canal normally occupied by the obturator nerve and vessels. It is rarely met with. A fulness, rather than a tumour, is produced by the protrusion at the inner or pubic region of the thigh, beneath the pectineus muscle, and accompanied by a peculiar numbness and pain, which may be traced to the distribution of the filaments of the obturator nerve. The lives of patients have been lost in consequence of overlooking these herniæ; the cause of death being only ascertained *post mortem.*

Perineal, pudendal, vaginal, and *ischiatic* hernias are very rarely seen. The name assigned to each indicates the locality in which the tumour is formed, and for a special description of them, the reader must be referred to monographs on the subject of this article.

Effects and Treatment.—We must next, as briefly as possible, describe generally the various morbid conditions which the hernia itself may undergo, and the means by which fatal consequences from such conditions may be averted.

All hernial protrusions are reducible or irreducible; that is, they can be restored to their normal situation, or they may be permanently confined to the region in which they are protruded.

The treatment of all reducible herniæ consists in the employment of means to prevent the escape of the protrusion. To effect this object various kinds of bandages or trusses have been devised. Each kind of hernia requires its special form of truss, and every individual should, as far as practicable, obtain a truss well fitted to his or her configuration. The essentials of a good truss consist in the spring having sufficient power to support the hernia and prevent its escape, while it should not be so strong as to injure the structures about the abdominal rings. The pad should be firm, of a shape suitable to the case, and of a size not inconvenient to the wearer.

The irreducibility of a hernia depends on its bulk, adhesions, and special anatomical conditions. Under such circumstances special bandages must be employed.

But other much more important morbid states of the protruded viscus than the above, cause impediments to the reduction of a hernia, namely —1, constriction by the tissues around the orifice of the sac; 2. accumulation of fæcal matter in the protruded viscus; 3, inflammation of the hernia; and 4, strangulation when a part of the alimentary canal forms the hernia.

1. Those herniæ—for example, the inguinal —which pass through openings in the muscular walls of the abdomen, are liable to constriction from contraction of the muscular tissue. Inguinal herniæ of long standing, and more than ordinary bulk, are very prone to become irreducible in consequence of muscular contraction. Such cases are well adapted to illustrate the effects of anæsthetics, and their influence on muscular irritability. If the patient be placed under the full influence of chloroform, the abdominal muscles become relaxed, and the hernia quickly reduced.

2. Those hernial protrusions formed of large intestine, such as occur at the umbilicus, frequently become irreducible from accumulations of stercoraceous substances. In these cases enemata, and even purgative medicines, frequently relieve the symptoms.

3. Inflammation excited in an omental protrusion may cause temporary and even permanent irreducibility. Local and constitutional symptoms of a rather severe type sometimes attend such cases. The usual methods adopted to induce resolution must be employed.

4. A morbid state of the protruded bowel termed *strangulation* has next to be described. A patient the subject of this state remains in the greatest danger to life so long as the exciting cause, the constriction of the bowel, exists. Hour by hour that danger increases, and although rare instances of recovery might be quoted after the continuance of strangulation for many hours, the majority of patients die because the intestine was not liberated early enough. A hernia is described as strangulated when subject to a constriction which at first impedes, and sooner or later arrests the circulation of the blood in its capillary vessels. The passage of stercoraceous material is necessarily stopped. The local and constitutional symptoms are strikingly characteristic. Very frequently the first symptom is vomiting, unaccompanied by any alvine evacuation. The vomiting continues, and is excited by ingesta. This state is probably due to mere obstruction of the alimentary canal, but it ought always to excite the anxious solicitude of the medical attendant, to ascertain whether the patient has any outward signs of a hernial tumour. He must examine those regions at which protrusions commonly occur, and never rest content with the statements of the sufferer. At first the pulse is not affected in a very marked way, but as vomiting continues the heart beats more

rapidly, whilst the pulse becomes weaker and contracted. The surface, especially that of the extremities, becomes cold; the countenance aged and anxious; the visage, lips, and hands shrivelled and bluish; the prostration extreme. The tumour is painful when touched, and it may have increased in size and become tense. All these facts indicate progressive morbid changes in the tissues of the strangulated bowel, as well as in that part of the alimentary canal above the hernia. Besides the mere act of vomiting all ingesta, the characters of the fluid vomited must be carefully noted. Usually, at first, it is the food last swallowed, more or less digested and mingled with bile; in the second stage it becomes yellowish and greenish; and at last it is stercoraceous, that is, offensive to smell, of a brownish colour and frothy, and often in great quantity. Now the only treatment of these urgent symptoms consists in the liberation of the bowel by surgical means. In the mean time palliatives may be employed, opium administered by the mouth, enemata injected, local applications of ice used, and gentle taxis applied.

John Birkett.

HERNIA CEREBRI. *See* Brain, Malformations of; and Skull, Diseases of.

HERPES (*ἕρπω*, I creep). Synon.: Fr. *Herpès*; Ger. *Flechte.*

Definition.—A term applied to an eruption of vesicles on an inflamed patch of integument.

Ætiology.—A *predisposing* cause of herpes is the gouty or rheumatic diathesis. It is often *excited* by chill or by irritation of a mucous membrane—of the air-passages in the case of herpes labialis, and of the urinary passages in herpes præputialis.

Varieties and Symptoms.—The commonest forms of this disease are *herpes zoster*, *herpes labialis*, and *herpes præputialis*; to which may be added *herpes facialis*, *herpes collaris*, *herpes cruralis*, and so forth. In herpes labialis and præputialis, the inflamed patch is generally single; but in the other forms the patches may range from five to ten in number, and vary in size from a small blotch, scarcely an inch in diameter, to one of three or four inches. The patches follow the course of distribution of the nerves; and on the trunk of the body form a kind of festoon, extending from the spine behind to the middle line in front. This is especially the case in herpes zoster, likewise called *zona* and *shingles*, where the blotches, following the course of one or more intercostal nerves, form a half belt or circle around the waist. The eruption of herpes is unilateral. It has a regular course of from ten to twenty days.

The vesicles of herpes are developed in groups, ranging in number from two or three to twenty or thirty, and in size from that of the head of a pin to that of a small pea. The fluid contained within them is at first transparent; it then becomes opalescent, opaque, purulent, and sometimes purplish from admixture with blood; and finally the eruption terminates in a scab more or less dark-coloured, and more or less deeply imbedded in the skin, which often leaves at its fall a permanent cicatrix.

Herpes is accompanied with a burning, tingling, and pricking sensation, and occasionally with severe neuralgic pains. The neuralgia may either precede or follow the eruption; and occasionally it is intense and of long duration. *See* Dr. Sangster; *Lancet*, vol. i. 1882.

Treatment.—The treatment of herpes is both constitutional and local. In slight cases, as the eruption runs a regular course, and tends to spontaneous cure, no *constitutional* treatment is necessary. If thought desirable, treatment should be restricted to regulating the digestive and assimilative functions; strengthening nerve-power; and, where severe pain or neuralgia is present, administering quinine or sedatives. *Locally*, dredging with flour or some absorbent powder affords relief; and especially the application of a lotion of oxide of zinc and lime-water. Over these should be placed a sheet of cotton-wool; and the latter must be kept in place by means of a light bandage. In very painful cases, the subcutaneous injection of morphia may be required, or the application of anodyne liniments.

Erasmus Wilson.

HETEROLOGOUS (*ἕτερος*, other, and *λόγος*, nature).—A word used to characterise any morbid product, whether fluid or solid, which is different in composition or structure from the normal fluids or solids of the body.

HETEROMORPHOUS (*ἕτερος*, other, and *μορφὴ*, form).—Applied to new formations which are different in form and structure from the normal tissues.

HETEROTOPOUS (*ἕτερος*, other, and *τόπος*, a place).—Misplaced. A term applied to the appearance either of a normal tissue in an unnatural situation—for example, of hairs on mucous surfaces; or of morbid growths in unusual places—for instance, of epithelioma in nervous tissue.

HICCUP or HICCOUGH.—Synon.: *Singultus*; Fr. *Hoquet*; Ger. *der Schlucken.*

Description.—Hiccup, according to physiologists, is a sudden spasmodic descent of the diaphragm accompanied by a spasmodic closure of the glottis, the characteristic noise being caused by the incoming column of air striking against the partially closed glottis. The assumption of a spasmodic closure of the glottis in hiccup seems scarcely warrantable. Normally the descent of the diaphragm in each respiratory act is accompanied by a contraction of the posterior crico-arytænoid muscles, which causes an outward rotation of the arytænoid cartilages, and a dilatation of the glottic aperture. The diaphragmatic and the laryngeal acts keep time together, and in health the rhythm of sixteen or eighteen to the minute is maintained. If, however, the diaphragm give a sudden descending jerk irrespective of any respiratory need, as is the case in hiccup, and this jerk occur at a time when the dilators of the glottis are not acting, a noise will be produced by the rush of air through the insufficiently widened glottic aperture. It seems certainly possible to account for the noise of hiccup by the mere fact of the descent of the diaphragm occurring when the glottis is not properly open. The noise is not a constant phenomenon, and during an attack of hiccup it never occurs during ordinary inspiration, or without the spasmodic action of the diaphragm, although the latter phenomenon may occur without the former.

Ætiology.—Hiccup may be produced by any irritation of the phrenic nerve—its origin, its course, or the ultimate twigs which are distributed to the under surface of the diaphragm. Undue distension of the stomach by being overfilled with food or drink, or by an accumulation of wind due to faulty digestion, is the most common cause of hiccup. Its occurrence from this cause is far more common in children than in adults. Convulsions and muscular spasms generally are more easily caused in the young, and hiccup in this respect follows the ordinary rule. Hiccup is produced by direct, or by reflex irritation. With many persons the introduction of hot spiced or peppery foods into the stomach immediately produces hiccup, and the writer knows one or two persons in whom hiccup is produced by the passage of hot fluids through the pharynx. It is a frequent symptom in peritonitis when the peritoneal covering of the diaphragm becomes affected. It sometimes occurs in cases of cancer of the stomach; occasionally, perhaps, from overdistension of the organ, but more often from an extension of the cancerous disease to the peritoneal surface of the stomach. It is occasionally a troublesome symptom during convalescence in cholera, and is often accompanied by eructations of wind, and sometimes by vomiting. If hiccup occur with any persistency in the course of typhoid fever, it is often an indication of perforation and the onset of general peritonitis. Although most frequently a symptom of gastric or abdominal disturbance, hiccup occasionally occurs as a true neurosis. It may accompany hydrocephalus or meningitis, and is then due probably to an implication of the cerebral origin of the phrenic nerve. Cases of obstinate hiccupping in hysterical subjects have been recorded, and cases of paroxysmal hiccup have been observed by Liveing, Prichard, and others, which have been regarded as instances of modified epilepsy.

Treatment.—The treatment of hiccup will depend upon the cause. An emetic to empty the stomach, or a stimulant to increase its natural peristaltic action, will often give relief. If we can succeed in producing a forcible action of the diaphragm, we may often succeed in curing it, as it were, of the trick of spasmodic action. Attempts to count a hundred without drawing breath, or to hold the breath for a minute, are familiar remedies for hiccup, and, by producing a feeling of suffocation, and necessitating a violent descent of the diaphragm, they are often successful. Warm applications or counter-irritation applied to the diaphragmatic region or over the cervical spine, may occasionally give relief. Pressure upon the trunk of the phrenic nerve by means of the finger applied over the scalenus anticus muscle, is said also to have given relief occasionally in obstinate cases. Amongst the drugs which have been recommended for the relief of hiccup are chloroform (administered internally), either alone or combined with opium, camphor in the form of a spirit solution, in doses of twenty drops and upwards, valerianate of zinc, belladonna, bromide of potassium, musk, antacids, and in very severe cases morphia administered hypodermically. G. V. Poore.

HIPPURIA (*ἵππος*, a horse, and *οὖρον*, urine).—The condition of the urine in which it contains hippuric acid in excess. *See* Urine, Morbid Conditions of.

HISTRIONIC SPASM (*histrio*, an actor). A synonym for facial spasm, so called on account of the contortions of the face to which this affection gives rise. *See* Facial Spasm.

HIVES.—A popular term for chicken-pox. *See* Chicken-pox.

HOARSENESS (Sax., *has*, having a rough voice).—Roughness of the voice, due to disease or disorder connected with the larynx. *See* Voice, Disorders of.

HOBNAIL LIVER.—A name given to a cirrhotic liver, when it presents small prominences on its surface, resembling hobnails. *See* Liver, Cirrhosis of.

HODGKIN'S DISEASE.—A synonym for Lymphoma. *See* Lymphoma.

HOMBURG, in Germany. Common salt waters. *See* Mineral Waters.

HOMICIDAL INSANITY. *See* Criminal Irresponsibility; and Insanity, Impulsive.

HOMOLOGOUS (*ὁμὸς*, like, and *λόγος*, nature).—In pathology this term is applied to new growths presenting the same structure as normal tissues, such as fatty or fibrous tumours.

HOOPING-COUGH. *See* Whooping Cough.

HORDEOLUM (*hordeum*, a barley-corn). A synonym for stye. *See* Stye.

HORN-POX.—A popular term for a variety of chicken-pox. *See* Chicken-pox.

HORNS.—Synon.: *Cornua*. Definition.—Horns are epidermic and epithelial formations, consequent on hypertrophy of the horny product of the integument.

Description.—Horns generally occur singly. Sometimes they attain a size of several inches in length and in circumference. They have been met with on all parts of the body, more particularly on the scalp, the face, the glans penis, and the glans clitoridis.

Pathology.—When the inspissated product of the follicles of the skin, consisting of laminated epithelium and sebaceous matter, is exposed to the air, it dries, becomes hard and transparent, and is in fact converted into a mass having most of the properties of horn. This is the principal source of the horns of the integument—an accumulation of the contents of a follicle; the protrusion of that substance through the dilated aperture of the follicle, sometimes through a large opening resulting from atrophy or ulceration; its dessication by the atmosphere; and its growth by continued additions to its base. Being essentially the protrusion of a soft substance through a constricted aperture, the surface of the horn will be modelled in figure by the shape of that aperture; in consequence of desiccation, its shaft will be smaller than its base; and it will be liable to be bent or twisted in the operation of protrusion. Hence these horns are generally curved or twisted, and have been compared to the beak of a bird, or the horn of the goat. A section of the horn affords similar evidence of its manner of formation and growth, it being always laminated in structure.

Another kind of horn is sometimes met with on the glans penis and clitoridis, and is the product of hypertrophy of the papillæ. This form of growth is fibrous in structure, like a wart, which in fact it closely resembles; whilst in the same situation concreted masses are occasionally formed, constituted by a combination of both processes, namely, papillary hypertrophy and accumulation of follicular substance. There is, however, an important difference between the two kinds of horn, the sebaceous and the epidermic, namely, that the former is the mere result of increased activity of function, whilst the latter is the consequence of hyperæmia or inflammation.

Treatment.—Horny matter being susceptible of disintegration by moisture, the sebaceous horn may be so thoroughly softened by envelopment in a waterproof covering, or by a poultice, as to be easily broken away at its base. The follicular bed from which it has been removed may then be cleared by a small scoop, when the sac will contract and close. Sometimes it may be thought desirable to sponge the surface with a solution of chloride of zinc or sulphate of copper; but operation by the knife seems quite uncalled for. In the instances of epidermic and epithelial horn, however, it will be necessary to have recourse to caustics, especially potassa fusa; and when the case evinces great obstinacy, or where an epitheliomatous degeneration is suspected, the use of the knife becomes essential.

Erasmus Wilson.

HORRIPILATION (*horreo*, I bristle up, and *pilus*, a hair).—A sensation of chilliness and creeping, the hairs appearing to stand on end.

HOSPITALS.—The subjects having relation to hospitals will be treated of under the following heads:—I. Hospitalism; II. Hospitals, Administration of; III. Hospitals, Construction of; IV. Nursing; and V. Nurses, Training of. The reader is referred to these several articles.

HOSPITALISM.—The term 'Hospitalism' was introduced into medical literature by Sir J. Simpson (*Edinburgh Medical Journal*, March, 1869), but, as far as the writer can see, no exact definition of it was given by its author. It, however, was evidently intended to signify 'the hygienic evils which the system of huge and colossal hospital edifices has hitherto been made to involve'—to use Sir J. Simpson's own words. These evils appeared to him so evident, and so necessarily connected with the size of the hospital, that he taught (and in fact the sole object of his papers was to teach) that our system ought to be revolutionised—'hospitals changed from being crowded palaces, with a layer of sick on each flat, into villages or cottages, with one, or at most two patients in each room—the village constructed of iron instead of brick or stone, and taken down and rebuilt every few years.'

Mr. Erichsen has, to some extent, accepted the teaching of Sir J. Simpson, though he allows that some of it is very questionable. His tract on the subject of Hospitalism has the advantage of being written in a more sober style than Sir J. Simpson's, and also of putting the question in a clearer light.

By the term, he says, 'is meant a general morbid condition of the building, or of its atmosphere, productive of disease. . . . Doubtless,' says Mr. Erichsen, 'all the septic diseases that are met with in hospitals may be encountered in the practice of surgeons out of these institutions, but they are unquestionably infinitely more common in hospital than in private practice, and their causes are certainly different.'[1] The writer believes, on the contrary, that if a hospital be properly managed there is no general morbid condition of the building—that there is no reason for thinking that septic diseases are more common relatively in hospitals than out of them, and that their causes are identical wherever they occur.

And if the term Hospitalism is to be taken in the sense in which Sir J. Simpson evidently intended, that is, as meaning to convey the idea that there is an inevitable tendency to the generation of septic disease in large hospitals, that that tendency becomes greater as the size of the hospital is increased, and that it increases as the hospital grows older, the writer has no hesitation in saying that there is no such thing as Hospitalism. No doubt the aggregation of the sick and wounded in hospitals is a cause of danger, and much care and vigilance is required to keep hospitals healthy. But the dangers are in no sense peculiar to hospitals. The surgical affections which spring up in hospitals—erysipelas, phagedæna, pyæmia, and allied affections—all of them prevail in private practice, and, as far as has been shown, prevail equally.[2] Further, although the perfect publicity of our hospital practice enables us to obtain tolerably accurate data for a comparison of the experience of the smaller and larger hospitals of this and other towns, no one has ever seen the least reason for believing that the smaller are in any respect healthier than the larger, while several of the hospitals that have been longest built are renowned for their healthy condition, and in many large hospitals, parts of which are ancient and other parts modern, the former, if equally or better constructed, are (under similar conditions of cases and management) as healthy or more healthy than the parts more recently built.

The subject is not one which can be passed over as dealing with an insignificant question, or one of verbal interest only. The doctrines which Sir James Simpson taught led him to deprecate altogether the construction of any hospital of considerable size, and to advocate some extravagant scheme for substituting small detached temporary sheds for our present permanent hospitals. The same views led Mr. Erichsen to say that when a hospital had become, as he phrased it, 'pyæmia-stricken,' it ought to be destroyed,[1] while similar ideas have led others, such as Dr. Farr and Miss Nightingale, to question whether hospitals had not destroyed more lives than they had saved. Such doctrines should not be passed over in silence, since they exercise a great influence on the public, on whose co-operation the efficiency of our hospital system is to a great extent based. And certainly a theory which has received the support, however qualified, of so eminent a hospital surgeon as Mr. Erichsen, cannot be considered as of no importance.

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[1] *On Hospitalism*, p. 37.

[2] It is not, of course, meant that pyæmia, for instance, is seen as often in private as in hospital practice, because its causes are less often met with in the former than the latter; but, if due allowance be made for this obvious consideration, there is much reason to acquiesce in the conclusion to which Sir J. Paget's ample experience has led him, that pyæmia is just as frequent in private as in hospital practice (*Clin. Soc. Trans.* vol. vii. p. lvi.). Erysipelas seems to be more frequent and more fatal at the present time in London private practice than in hospitals

It is therefore necessary to point out to the reader that the theory, as so stated (and stated quite correctly after Sir J. Simpson's writings), is utterly disproved by the experience of all well-managed hospitals, both before and after the introduction of the antiseptic method of dressing wounds. It must be noticed, in the first place, that the basis of the theory was entirely what is called 'statistics,' that is, a hasty inference from figures, showing the results of a large number of cases on either side. Now nothing is more dangerous than to draw conclusions from such figures, which are quite unsupported by any histories of the cases on which they are founded.[2] The success of a surgical operation depends more on the antecedents of the operation than on its consequents, and the healthiness of hospitals depends far more on other circumstances than on their construction, size, or age. Nay more, the success of surgical operations does not necessarily vary with the healthiness of the hospital. In the healthiest hospital a careless surgeon, house-surgeon, or nurse may make havoc of the major operations while all is going on well with the general run of patients.

For all these reasons, any one of which would be sufficient, the conclusions of Sir J. Simpson are to be utterly repudiated, and to be considered the more mischievous because, while they allege imaginary causes of danger, they thereby conceal those which are real and certain, and necessarily induce surgeons and managers of hospitals to overlook details, attention to which is always followed by success in the treatment of grave surgical cases, and by a condition of hospital hardly if at all inferior to the best circumstances under which private practice is carried on.

The writer must not be misunderstood, as if he thought the details of hospital-construction unimportant. The principles of construction which are now accepted for the building of a hospital will be found at pp. 647–652; but it has been shown to demonstration that, provided wards be well, but not excessively, ventilated, and kept perfectly clean, and provided the beds are far enough apart, the precise ground plan of the hospital matters little—that the doctrines so much insisted on by the French writers on hospitals as to the superiority of the 'pavilion plan,' as to the unhealthiness of upper storeys and so on, and which have been adopted as if they were unquestionable truths by many writers on the subject, have led to much waste of money on buildings too scattered for hospital service, which have turned out to be no healthier than the more compact and convenient structures which they superseded. But we ought not, in reaction from these exaggerations, to undervalue the importance of good ventilation, good aëration, proper isolation of beds, and, above all, scrupulous cleanliness, in hospital wards. These essentials being secured, the writer is persuaded that a hospital may be just as healthy with thirty wards as with three, with twenty patients in each ward as with two, and with five storeys as with one. Far more important, and far too little thought of, till within the last few years, is the amount of attention given to the personal care of the patients. This is particularly the case in the treatment of open wounds. Everyone who has been much in hospitals must have often seen, and especially abroad, surgeons, dressers, and nurses hurry from one patient to another, hardly washing or wiping their instruments, still less their hands, and using the same dressing materials for one case after another. Surgical practice cannot be safely carried on in this way, however healthy in itself the hospital may be. The first care of a surgeon in charge of hospital-wards ought to be to impress upon all his assistants, and never to forget in his own person, that the success of surgical practice depends more upon minute care in the dressing of cases, than on all other matters put together. Our surgical wards have become far more healthy since the introduction of antiseptic surgery;[1] and that this must be largely due to the increased care in the minutiæ of surgical treatment which has followed on the discussion of this method is proved by the fact that it is as conspicuous in some of those who reject as those who follow Mr. Lister's teaching.

If it were not true that the septic diseases, or erysipelatous diseases, which interfere so much with the success of operations in our hospitals, depend in a very large proportion of cases on the method of dressing the wound and not on matters conveyed by the atmosphere, how could the success of the so-called 'open method' of dressing wounds be explained? In this method the wound is left freely exposed to that hospital air which is, we are told, charged with deadly miasma. The size of the wards, number of beds, &c., are all of course unchanged; but care is taken to see that the wound is well drained of all putrefiable discharges, and kept perfectly clean. If Sir J. Simpson's theory were true, we ought to have an increased mortality following on the freer exposure to this deadly atmosphere. On the contrary, the perfect drainage of the wound, and the care taken to keep it free from all putrefying matters, are followed by results which can hardly be surpassed. Thus Dr. James Wood, of the Bellevue Hospital, New York, relates, that in wards which had been recently vacated on account of an outbreak of puerperal fever, he treated fourteen successive cases of unselected amputation of the limbs successfully, by merely leaving the flaps ununited, the raw surfaces exposed to the air, but carefully drained, and all putrescible matters continually removed;[1] and this is only one of many proofs which have recently been given of the fact that there are many other plans of treating wounds besides that which is specially designated 'antiseptic,' under which, conjoined with proper construction and general management, a hospital may be as healthy as a private house.

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[1] *On Hospitalism*, p. 98.

[2] The writer lays less stress on the total absence of any guarantee for the accuracy of Sir J. Simpson's table of cases in private practice, and is willing, for the sake of argument, to assume that the figures are correct.

[1] The late Mr. Callender stated it as his deliberate opinion that the great surgical operations are ten times more successful in hospitals now than they used to be in the past generation.

This statement, which is made after long experience, and with a conscientious conviction of its truth, by no means asserts that it is *as easy* to keep a hospital healthy as a private sick-room, or, in other words, that the aggregation of the sick and wounded involves no dangers. Such a doctrine would be absurd; but the dangers are the same in kind, and the precautions required are the same, with a single exception. Hospitals, like private houses, must be kept well-aired, well-drained, scrupulously clean, properly, but not excessively, lighted,[2] and so forth. The great difference in the precautions required to ensure the salubrity of hospitals and private houses is, in one word, to guard against direct infection, and this may occur in two ways. Surgically, infection is carried directly by careless dressing—and every hospital surgeon must have remarked that as he himself is more watchful and careful, and as he has the good fortune to be surrounded by more careful assistants, his cases do better; and in the present healthy condition of most of our large London Hospitals, such precautions of themselves suffice to raise the success of surgical practice to the same level as it reaches in private houses. The second way in which infection may be carried is by direct proximity or contact. This is more important in medical cases, and the obvious danger of the spread of infectious fevers has led the managers of most of our general hospitals to exclude such diseases from their wards as small-pox, scarlet fever, and typhus, while other affections are admitted, which, though contagious, are so in a less degree, as typhoid fever, erysipelas, diphtheria, &c. Enough, or more than enough, has been done in this direction—that is, the public safety might be as well consulted if typhus and scarlet fever cases were still admitted (as before the institution of special hospitals for such cases they used to be) into the wards of our general hospitals in small numbers, and under strict precautions. Anyhow, it appears that there is little if any evidence of spread of disease from such cases reputed to be infectious as are still to be found in our general hospitals. Hearing that some distinguished surgeons teach confidently that pyæmia and erysipelas are usually propagated by contagion, the writer has often watched the progress of such cases when originating in hospital or admitted from without, but has never been able to verify any spread of the disease from them, though he does not deny the possibility of such an occurrence.

To sum up the whole matter—the writer would define the term 'Hospitalism' as expressing the danger which exists in hospitals of contamination from the aggregation of patients — and would add that the extent to which such contamination prevails has been greatly exaggerated by theoretical writers; that, as far as the general atmosphere of the ward is concerned, the danger may be, and appears in all well-managed hospitals really to be, obviated by ventilation and cleanliness; and the more immediate danger from the contiguity of patients cannot be shown to produce any appreciable effect, while the danger of contamination of wounds by putrefying materials demands constant vigilance to counteract it; but with such vigilance seems to be so far counteracted that hospital practice is, for anything we know, as successful as private practice in similar cases. This is not an entirely satisfactory result, inasmuch as practice in a hospital, where every patient is under the strictest regimen and surveillance, ought to be much more successful than private practice, where the conditions are very different in these respects; but we are making rapid advances towards this desirable and perfectly attainable end.

T. HOLMES.

HOSPITALS, Administration of.—The administration of a hospital should be so framed as to enforce the necessary economy consistent with the due supply of the requirements for the sick.

Governing Body.—The administration is in the hands of a governing body, which usually consists of a committee or board, with an officer in direct communication with them, who acts as their representative. The governing body provides for the general supervision and discipline of the establishment, and for the financial arrangements. In this body is vested the appointment and removal of all members of the staff of the hospital. It makes all general regulations after consultation with the professional department, as to internal economy, admission and discharge of patients, distribution of beds, dietary and other matters. It takes steps for raising the funds to support the hospital, and regulates the expenditure.

Governor or Treasurer.—The active representative of the governing body is generally termed Governor or Treasurer. He exercises a general supervision over the structure and the discipline of the establishment. The chief executive officer immediately under the governing body is called the *Steward*, or sometimes the *Secretary*. He has the control of all servants not included in the nursing staff—such as porters, ambulance-men, engine-man, bath-assistants, and other male attendants. He sees that all structural appliances are in good order, and that cleanliness and discipline are maintained throughout the building. He controls the issue of all orders for the supply of goods, provisions, fuel, &c., and watches that they are used with a due regard to economy. He countersigns all orders for payment after they are passed by the treasurer, and is responsible for the hospital accounts. He sees that the records of admission, discharge, and death are duly kept by the professional staff. He is responsible for the safe custody of clothing, money, and property brought in by the patients, till their discharge. He has charge of the correspondence.

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[1] *New York Medical Journal*, Jan. 1876.

[2] Most of our hospitals are too light, and too destitute of the means of excluding the light. No doubt a flood of light in the ward is very useful in detecting dirt, but it sadly interferes with the repose which many medical and surgical cases require.

Clerk, or Assistant Steward.—The secretary or steward is assisted by an assistant or clerk. This latter receives all provisions and stores, sees that they are correctly delivered, and is responsible for their safe custody until distributed to an authorized person. He sees that the diet-tables are prepared from the prescription papers, and that the articles of food supplied to patients are strictly in accordance with the diet-table, or else specially ordered by the physician or surgeon.

Professional Staff.—The professional staff directs the proceedings to be taken for the well-being and cure of the patients. It consists of the consulting and visiting physicians and surgeons; the assistant physicians and surgeons; and the resident and house-physicians and surgeons, and assistants continually present in the hospital.

Medical Committee.—The professional staff forms a medical committee with a specified quorum. This committee is consultative only, and advises the governing body on all matters concerning the medical and surgical departments of the hospital, the admission and discharge of patients, the distribution of beds, the dispensary, the in-patients, out-patients' department, and the students. The medical committee, moreover, puts forward recommendations for the purchase of instruments, apparatus, and medicines. The committee provides for a descriptive record of cases admitted into the hospital; and for the efficient instruction of students.

Physicians and Surgeons.—The physicians, surgeons, assistant physicians and assistant surgeons undertake the charge of the wards and out-patients' departments, and attend at the hospital at fixed times. The physicians and surgeons order the diet of the patients, and no article of diet which does not appear in the diet-table is supplied unless specially ordered by them.

Resident Medical Officers.—The resident medical officers control the treatment of patients in the absence of the physicians and surgeons; and have a disciplinary control over the dressers and clinical clerks. They decide on the admissibility or otherwise of applicants for relief, when not admitted directly by the physicians and surgeons, as well as on the wards in which the in-patients are to be placed. and are responsible for their care until seen by the physicians and surgeons. They visit the wards and dispensary, according to the regulations, to see that the patients are duly attended to. They superintend the conduct of the assistants of the medical officers, and of the dispenser and his assistants, of pupils (if any), and of patients; give notice of any misconduct of the nurses and servants to the matron or lady superintendent; and inform the governor or secretary, the physician, surgeon, and governing body, of any matter requiring their attention. They are responsible that the records of cases are properly made out. In most cases, however, this duty is now performed by *registrars.*

Dispenser.—The dispenser acts under the resident medical officer, subject to regulations laid down by the governing body.

Nursing Department.—The nursing department is under a trained matron, who should be lady superintendent of the training school, and head of all the women employed in the hospital.

Matron or Lady Superintendent.—The whole responsibility for nursing, internal management, care of linen and housekeeping, and the discipline and training of nurses is vested in the trained female head of the nursing staff, by whatever title she be called. To the governing body of the hospital she is responsible for the conduct, discipline, and duties of her nurses. To the governing body and the physicians and surgeons in charge of wards she is responsible for the care and cleanliness of the wards, for the care and cleanliness of the sick, and for the linen. She is responsible to the medical officers that their orders about the treatment of the sick are strictly carried out. To fulfil these responsibilities, she has the power of engaging, appointing, and dismissing all nurses, female servants, and probationers, subject, of course, to the general control of the governing body. The nursing establishment cannot be made responsible on the side of discipline to the medical officers, or the governor of a hospital. Simplicity of rules, placing the nurses in all matters regarding management of sick absolutely under the orders of the medical staff, and in all disciplinary matters absolutely under the lady superintendent or matron, to whom the medical officers should refer all cases of neglect, is very important. Any remissness or neglect of duty is as much a breach of discipline as drunkenness or other bad conduct, and can only be dealt with to any good purpose by report to the matron. But neither the medical officer nor any other male head should ever have power to punish for disobedience. His duty should end with reporting the case to the female head, who is responsible to the governing authority of the hospital, as all her nurses and servants are, in the performance of their duties, immediately responsible to the matron only. If the matron or lady superintendent does not exercise the authority entrusted to her with judgment and discretion, it is then the legitimate province of the governing body to interfere and to remove her.

The matron resides in the hospital where her nurses and probationers are at work.

In a hospital of, say, above 300 beds, and with a training school of, say, above twenty probationers (which all such hospitals ought to include), the trained matron should have three trained representatives or assistants—one in the training school as mistress of probationers or home-sister; and two in the hospital,—one by day as assistant matron (or superintendent), and one by night as night superintendent of nurses; and of these two the night representative is the more important. Besides the trained assistant matron (superintendent) who should have such inspection of the wards as the matron may commit to her, the matron will require one linen-assistant and housekeeper, who might also have the charge and inspection of the nurses' rooms, if the trained assistant matron has not time. She should 'mother' the ward-maids, and have some 'gathering' for them.

Nurses and Servants.—Under the matron there should be distinct grades of nurses, and distinct duties for each grade:—1. Trained chief nurses (ward sisters.) 2. Trained nurses (day). 3. Trained nurses (night), at least equal in pay and status to the day-nurses. 4. Probationers in training. 5. Ward-maids, and nursemaids for children's wards. 6. Dormitory and stairs women. 7. Female cook, and her assistants under the housekeeper. The hospital cook in a large hospital would probably be a man, and under the steward. The sisters, nurses, and probationers would require a female cook, under the matron. All women employed in the hospital should reside in the hospital.

Night Superintendent.—The (trained) night superintendent of nurses should be in charge of the night-nursing, in communication with the ward sisters, as well as of the night-nurses; should see that the ventilation and temperature of the wards is maintained—directed by the medical staff. She must be one qualified not only to have charge of nurses and have some 'gathering' for night-nurses by day, but to train probationers told off to accompany her at night, to their own benefit and hers.

Assistant Matron.—The assistant matron is to have special charge over the nurses' rooms, to see that the nurses rise in time to wash themselves, strip their beds, empty their slops, and have breakfast, before going on duty; that later they make their beds and put their rooms in order; that they never wash their own clothes in their own rooms, but all nurses' washing should be done for them; that they go quietly to bed at night, and lights be put out at a certain hour; that their rooms are always clean, in order, wholesome and cheerful. Without this constant supervision what is necessary for the nurses' health is not done; the same for night nurses is yet more important. Nurses' meals should always be presided over by some such authority.

The hospital night nurses should have two hot meals in the common dining room, it might be in the probationers' home, say at 9.30 a.m. and 9.30 p.m., ready and prepared for them. And sisters, staff nurses, and ward-maids should have, though at different hours—as all cannot be absent from the wards at once—dinner and supper, each set together in a common dining-room, away from the ward air. No nurse should have to prepare her meals for herself.

Laundry.—In small and moderate-sized hospitals, when there is a laundry attached to the hospital, the supervision should be under the lady superintendent or matron. In large hospitals, it would be advisable for the laundry, which should in all cases be in a building entirely detached, to be worked independently, under the general supervision of the governor or secretary.

Chaplain.—The religious care of the patients is generally provided for by the appointment of one or more permanent chaplains, or by visits and religious services of other ministers whom the patients may desire to attend them; subject, however, to the opinion of the medical attendant, as to how far the state of health of the patient will admit of such visits, and to the visits being made at such times as do not interfere with the discipline of the hospital.

DOUGLAS GALTON.

HOSPITALS, Construction of.[1]—A hospital or infirmary is a building intended for the reception and treatment of sick and injured persons, under conditions favourable for their recovery.

A hospital must be so constructed and arranged as to enable a limited staff of medical men, nurses, and assistants to minister to the necessities of a large number of sick, and to promote their speedy restoration. The conditions essential for such objects are as follows:—

(1) *Pure air.* There should be no appreciable difference in purity between the air inside the wards and that outside the building.

(2) The air supplied should be capable of being *warmed* to any required extent.

(3) *Pure water* should be supplied for internal use, and sufficient also to ensure the removal of impurities to a distance from the hospital.

(4) The most perfect *cleanliness* within and around the building should be enforced.

These conditions depend on—

(1) *The site of* the proposed hospital.

(2) *The form* of the rooms or wards in which the sick are to be placed, so as to ensure purity of air and convenience of nursing; these rooms forming the principal *units of hospital-construction.*

(3) The *distribution of these units,* and of the other accessories, which combined constitute the hospital.

1. Sites of Hospitals.—The local climate should be healthy, and there should be a free circulation of air over the district. Town sites should be avoided as far as possible. When necessarily placed in a town, a space free from buildings should be reserved on all sides. There should be no nuisances, damp ravines, muddy creeks, undrained or marshy ground, near the site, or in such a position that the prevailing winds would blow effluvia arising from them over the hospital. The site selected for a hospital should not receive the drainage of higher ground, and the natural drainage outlets should be sufficient. There should, if possible, be no buildings near a hospital except those connected with its object. The number of sick to be allowed per acre will depend practically upon the arrangement of the buildings in which they are lodged.

2. Form and Distribution of the Parts of a Hospital.—The structural arrangements of a hospital should be such as to secure free circulation of air.

THE WARD.—The basis upon which the structural arrangements rest is *the ward.* The administration, means of access, and discipline must be made subsidiary to the question as to how the sick are to get well in the shortest possible time, and at the least expense; and this, so far as the structure is concerned, is mainly determined by the form of the wards.

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[1] This article has reference more especially to permanent general hospitals. The principles apply equally to special temporary field or other institutions for 'the cure of the sick.'

Size.—The size of a ward depends upon the number of patients which it should contain, and upon the cubic space and floor space which should be allotted to each patient. The disciplinary and economical dispositions in a hospital require that each head nurse should have the patients allotted to her placed under her immediate eye. Economy of labour requires that the hospital should be so laid out as to enable the largest number of patients to be nursed by a given number of nurses. The *number* to be placed in a ward therefore depends upon the number which can be efficiently nursed; and the form of the ward must be as much calculated to facilitate nursing, as to ensure free circulation and change of air. From twenty to thirty-two beds have been taken as the unit for ward-construction. In hospitals where cases of more than ordinary severity are likely to be received, it would be necessary to diminish the size of the wards on grounds of health. Small wards containing one or more beds are also required for isolating certain cases or for various necessary objects.

Form of ward-construction. — The general form of ward-construction is mainly governed by the question of the renewal of air. The air within an inhabited space, enclosed on all sides, is vitiated by the emanations proceeding from the bodies of those who inhabit it, and especially by the effect on it of their respiration. In all sickness, and all surgical cases, wounds with discharge, or sores, these emanations are greater in quantity, and more poisonous in quality, than from persons in health; whilst, at the same time, most cases—medical and surgical—are more susceptible to these emanations. Stagnation in the movement of the air leads to rapid decomposition of these emanations. If they diffused themselves uniformly throughout the space, which in fact they do not, ventilation would be comparatively simple, and, whatever the cubic space, the air would attain a permanent degree of purity, or rather impurity, theoretically dependent upon the rate at which emanations are produced, and the rate at which fresh air is admitted. Hence the same supply of air would equally well ventilate any space; but the larger the cubic space, the longer it will be before the air in it attains its permanent condition of impurity, and the more easily will the supply of fresh air be brought in without altering the temperature, and causing injurious draughts. The amount of air which should be removed, and its place supplied with fresh air, is at least 3,000 cubic feet per patient per hour; but this must depend to some extent upon the emanations of the patients, which vary with the diseases or injuries they are suffering from. The ventilation of each ward should be kept independent of other wards or rooms.

Means of ventilation. — The change of air may be effected in various ways. For instance, the air may be drawn out by a fan; or it may be removed by a shaft, whose action depends on the difference of the temperature of the air in the shaft and that in the outer atmosphere. Of this the ordinary fireplace is one example; a caldron of water kept boiling for the use of the hospital by a steam pipe is another; a sunlight is a further example; and a heated shaft connected with flues led from holes in the wall near the patients' beds, through each of which air is drawn into the shaft, is another method. Theoretically it is thus quite possible so to arrange the ventilation mechanically that a specified quantity of air at a fixed temperature shall be brought into the ward by day and by night. Practically, however, hospitals dependent upon such means alone for ventilation, require an attention which they can rarely or never receive, and, except under favourable circumstances, are not healthy.

The emanations from the body do not uniformly diffuse themselves; they hang about as the smoke of tobacco may be said to do. In wards into which a fixed quantity of air is forced, there is not even a uniform degree of impurity; consequently it is necessary, in order to ensure the purity of the air of a ward, that means should exist for absolutely sweeping out at intervals all the impure air from it, and starting afresh with pure air. This is best effected by the direct action of currents of fresh air brought in by open windows placed on opposite sides of the wards. The distance between windows for this purpose must not be too great to prevent their efficient action in moving the air. Twenty-four feet is a good width, but opposite windows for such an object should in no case be more than from thirty to thirty-five feet apart. The space between the windows should not be obstructed by walls or partitions. The number of patients—that is to say, the sources of impure emanations—placed between opposite windows, should be limited to two rows. In the daytime, and when the weather admits of open windows, a ward with windows opening on both sides can easily be kept fresh; but for other seasons it is necessary to provide openings for the escape of impure air, and for the admission of fresh air which shall not cause draughts.

For the purpose of removal of air, shafts carried up from near the ceiling-level to above the roof are convenient, the lower ends being louvèred to prevent patients feeling down-draughts which may occasionally prevail. The most powerful engine of ventilation for drawing out the air is an open fire-place.

In order to prevent the temperature of the ward from being lowered by the extraction of air, that is, to maintain an equable temperature, and to prevent draughts, air warmed to a moderate degree should replace that removed by the fire-place or by other openings. Means for the admission of air in an upward current should be provided direct from the open air, independent of the windows and doors; for this purpose tubes with bends, which favour the collection of dirt, are objectionable. Sherringham's ventilators, which are easily cleaned, placed between the windows near the ceiling answer well; they admit the air without perceptible draught, and also frequently act as outlets when open on the leeward side of a ward. The external air may be warmed as it enters by being made to pass over hot-water or steam tubes. Openings, if placed close to the floor under the beds, should be capable of being easily and securely closed. All openings for the admission of fresh air should be so placed as to be easily examined and cleaned throughout their whole length, and this should be done at least once a year.

Superficial area.—The next most important element in the question of ward-construction is the superficial area to be allotted to the patients, which is even more important than cubic space, for on this depends the distance of the sick from each other, the facility of moving round the sick, shifting beds, cleanliness, and other points of nursing. If there be a medical school attached to the hospital, the question of area has to be considered with reference to affording the largest amount of accommodation practicable for the teacher and his pupils without their breathing up the patients' air. A ward with windows improperly placed, so as not to give sufficient light, or where the beds are so placed that the nurse must necessarily obstruct the light in attending to her patients, will require a large floor-space, because the bed-space must be so arranged, and of such dimensions, as to allow of sufficient light falling on the beds. In well-constructed wards with opposite windows, the greatest economy of surface-area can be effected, because the area can be best allotted with reference both to light and to room for work. In a ward 24 feet in width, with a window for every bed or every two beds, a 7 ft. 6 in. bed-space along the walls would probably be sufficient for nursing purposes. This would give 90 square feet per bed, and there should be as little reduction as possible below this amount for average cases of sickness, but this space is much too small for surgical, fever-, or lying-in wards, which should also be for a much smaller number. The Herbert Hospital, without a medical school, has 99 superficial feet per bed; St. Thomas' Hospital, with a medical school, has 120 superficial feet per bed. The bed-space should be larger if the locality is less healthy.

The area allotted to patients practically settles the cubic space, because wards should not be less than 12 feet high, though as a rule they need not exceed 14 feet in height.

In a good situation, and for ordinary cases of disease, those spaces which are enough for nursing and for ward-administration would, with good ventilation, be sufficient for all sanitary purposes; but for such cases as typhus or other epidemic diseases, operations, and bad surgical diseases, a larger space and area would be required. When severe cases of this class come into an ordinary hospital, the simplest plan is to leave the bed vacant adjacent to that occupied by the patient.

Lying-in wards should never contain more than from one to four beds. In recent French hospitals these wards contain one bed each, and the only access to them is from an open verandah and through a small ante-room. Ovariotomy, and other operations of the highest risk, should be performed in a one-bed ward. When space permits, a room may be provided for the use of patients when convalescent, and able to be temporarily absent from the wards. The same observation applies to grounds for outdoor exercise. But separate convalescent hospitals or homes are better, both for health and discipline. If hospitals are provided for special infectious diseases, every patient should be placed in a separate hut-ward. Cleanliness and abundance of fresh air is the best safeguard against infection.

Materials.—With a view to economise heat in winter, and to keep the rooms cool in summer, the walls should be hollow, and all wards should be ceiled, unless the roof is constructed of a good non-conducting material. The best lining for a hospital-ward would be an impervious polished surface, which on being washed with soap and water, and dried, would be made quite clean. Plaster, wood, paint, and varnish all absorb the organic impurities given off by the body. Parian cement polished is the best material at present known for walls, but it is costly, and it can only be applied on brick or stone walls, and not on woodwork, because, being inelastic, it is liable to crack. Cracks in a hospital ward are inadmissible, as they get filled with impurities, and harbour insects. The numerous joints required for glazed bricks, or tiles, render the use of these questionable for wards. In default of Parian cement, the safest arrangement is plaster lime-whited or painted, which should be periodically scraped, and be then again lime-whited or painted.

The *floor* should be as non-absorbent as possible, and for the sake of warmth to the feet it must in this country be of wood. Oak, or other close hard wood, with close joints, oiled and beeswaxed, and rubbed to a polish, makes a very good floor, and absorbs little moisture. The joints should be like those of the best parqueterie, affording no inlet for dirt. There should be no sawdust, or other organic matter subject to decay, under the floor. When a ward is placed over another, it is essential that the floor should be non-conducting of sound, and that it should be so formed as to prevent emanations from patients in the lower ward passing into the upper wards. Practically, with care, a well-laid oak floor, with a good beeswaxed surface, can always be kept clean by rubbing.

There should be as little *woodwork* as possible in a ward, besides the floor; and what woodwork there is should be varnished, so as to admit of easy washing and drying. The cleanest and most durable material is varnished light-coloured wainscot oak or teak.

The form of the *windows* must be considered, in their aspect of affording light as a necessary means of promoting health, of affording ventilation, of facilitating nursing, and of enabling the patients to read in bed. Light can always be modified for individual patients. In order to give cheerfulness to the wards, and to renew the air easily, the windows should extend from within 2 feet or 2 feet 6 inches from the floor—so that the patients can see out—to within 1 foot from the ceiling. An end window to a long ward is an element of cheerfulness, and materially assists the renewal of the air at night. It is essential to cleanliness that every part of the ward should be light. One superficial foot of window-space to from 50 to 55 cubic feet of space, will afford a light and cheerful room, but this depends much on aspect and upon the walls being light-coloured. To economise *heat* in wards, it is desirable to make the windows of plate glass; double windows of ordinary glass would secure the same object and facilitate ventilation, but they are troublesome to clean, and give a gloomy appearance to a room. The best form of sash for ventilation in this climate is the ordinary sash, opening at top and bottom; but windows made in three or four sections, each of which falls inwards from an axis at the bottom of the section, possess many advantages for hospitals.

Ward offices.—The Ward offices are of two kinds:—

1. Those which are necessary for facilitating the nursing and administration of the wards, as the head-nurse's room and ward-scullery.

2. Those which are required for the direct use of the sick, so as to prevent any unnecessary processes of the patients taking place in the ward; as, for instance, the ablution-room, the bath-room, the water-closets, urinals, and sinks for emptying slops. There should, in addition to the bath-room here mentioned, be a general bathing-establishment attached to every hospital, with hot, cold, vapour, sulphur, medicated, shower, and douche baths. Hot and cold water should be laid on to all ward-offices in which the use of either is required, because of the economy of labour in the working of the hospital. For the same reason, when the wards are on two or more floors, lifts should be provided to carry up coals, trays, and patients. The ward-offices should have ample window-space. There should be no dark corners or closed spaces under sinks. Nothing should be kept in these offices which is not in constant use, and everything in use should be open to inspection. All fittings should be light-coloured, so as to show dirt.

1. The *head-nurse* or *sister's room* should be sufficiently large to contain her bed, and to be also her sitting-room. It should be light, airy, and well-ventilated. It is necessary to discipline that it should be close to the ward door, and that it should when practicable have a window looking into the ward. If the head-nurse has two wards to supervise, her room should be placed between the two, with a window opening into each.

There should be a *ward-scullery* to each ward, and so situated as to be under the head-nurse's eye. The scullery should be supplied with efficient, simple apparatus for its purposes; there should be a small range for ward-cooking, so that the nurse can warm the drinks, prepare fomentations, &c. Shelves or racks should be provided. There should also be a small larder, with free circulation of air, for temporarily keeping provisions fresh. In the scullery, or adjacent to it, a hot closet should be provided for airing clean towels and sheets. Foul linen should not be retained near the wards, or in the hospital building. It should all be placed in baskets, on wheels, and conveyed as soon as possible to the laundry. Ward sweepings and refuse should similarly be placed in movable receptacles, and taken out of the building with as little delay as possible; structural provision for the retention of these in or near the hospital is undesirable.

2. The *ablution-room, water-closets, &c.*, ought to be as near as possible to the ward, but cut off from it by a lobby, with windows on each side, having its ventilation and warming distinct from that of the ward and that of the ward-offices, so as to prevent the possibility of foul air passing from the ward-offices into the wards. The ward-offices will be most conveniently placed at the end of the ward farthest from the entrance and nurse's room; and distributed at each side, so as to enable the ward to have an end window. In this arrangement the ablution-room would be on one side of the ward, and should contain a small bath-room with a fixed bath of copper, supplied with hot and cold water. A lavatory table of impervious material, such as slate or common marble, with a row of sunk porcelain basins with outlet tubes and plugs, each basin supplied with hot and cold water, should be placed in the same compartment as the bath, but separated from it by a partition and door. There should also be room for a portable bath for each ward; and there should be a sink on the floor level for running off the water from the bath after it has been used.

On the other side of the end window of the ward would be placed the *water-closets.* These should never be against the inner wall, but always against the outer wall of the compartment in which they are placed. A pan of a hemispherical shape, never of a conical shape, with a syphon, abundantly supplied with water to flush it out all round with a large forcible stream, is the best contrivance for the water-closet of a hospital. The urinal should be of a shape to be easily cleaned. The sink for slops, bed-pans, expectoration-cups, &c., which should have a compartment of its own adjoining the water-closets, should be a large, deep, round, pierced basin of earthenware, with a cock extending far enough over the sink for the stream of water to fall directly into the vessel to be cleaned, and with an ample supply of water in a full stream; this sink should be so arranged as to be flushed out like a water-closet pan, and it should be so placed as to make it unnecessary for male patients to pass the nurse on their way to the w.c. There should be a special receptacle near the sink, ventilated to the outer air, for keeping chamber utensils, &c., for the examination of the medical officer.

Walls of ablution-rooms and water-closets should be covered with white glazed tile, slate (enamelled or plain), or Parian cement; plaster is not a good covering for them on account of their liability to be splashed, and of the necessity for their being frequently washed down. There should be separate private water-closets for the nurses; and also water-closets for the patients when in day-rooms or recreation-grounds. The ablution-room and water-closets should be supplied with plenty of fresh air, warmed when necessary, and abundance of light, so as to ensure there being no dark corners. Three water-closets per ward will suffice for a ward of thirty-two beds, but two at least will be required for even a twelve-bed ward.

The water supply should provide, in addition to pure water for general consumption, a service of distilled water for dressings and suchlike purposes.

3. **Aggregation of Ward-Units in the Construction of a Hospital.**—The principles upon which these units of hospital-construction, or, as they are generally termed, pavilions, when so constructed, should be aggregated, are as follows:—

(1) There should be free circulation of air between the pavilions.

(2) The space between them should be exposed to sunshine, and the sunshine should fall on the windows, for which purpose it is desirable that the pavilions should be placed on a north and south line.

(3) The distance between adjacent pavilions should not be less than twice the height of the pavilion reckoned from the floors of the ground-floor ward. This is the smallest width between pavilions which will prevent the lower wards from being gloomy in this climate; where there is not a free movement of air round the buildings, this distance should be increased.

(4) The arrangement of the pavilions should be such as to allow of convenient covered communication between the wards, without interfering with the light and ventilation, and therefore the top of the covered corridor uniting the ends of pavilions should not be carried above the ceiling of the ground-floor wards. Each block of wards, that is, each pavilion, should have its own staircase.

(5) No ward should be so placed as to form a passage-room to other wards.

(6) As a general rule, there should not be more than two floors of wards in a pavilion. If there are three floors or more, the distances between the pavilions become very considerable because of the rule already mentioned, which ought to be absolutely observed, which regulates the distance at which the pavilions must be kept apart. Besides, when two wards open into a common staircase, there is, with every care, to some extent a community of ventilation: this will prevail even if the staircase be furnished with permanent openings to the outer air. When there are as many as four wards one over the other, the staircase becomes a powerful shaft for drawing up to its upper part, and thence into the ward, the impure air of the lower wards. Similarly, heated impure air from the windows of the lower wards has occasionally a tendency to pass into the windows of the wards above. For the same reason the upper floor over the wards should not be used as a dormitory for nurses. Similarly if there is a basement under sick wards, it should not be used for any purpose, such as cooking, or for the reception of perishable stores, from which smells could penetrate into the wards; and it is best not to continue the staircase into the basement, for with every care the basement will always form a receptacle for ground air, which should be kept out of the hospital if possible.

There is a limit to the numbers which should be congregated under one roof. This limit will depend very much on the nature of the cases. In town hospitals, a double pavilion should not contain above 80 to 100 beds.

The size of any given hospital ought not to be determined by increasing the number of beds in any one building, but by increasing the number of units or wards. So far as the sick are concerned, they would be better placed in single detached wards; or, for convenience of administration, in wards all on one floor—opening out of a common corridor. But on town-sites the cost of land makes it absolutely essential to build hospitals as compactly as possible; moreover, economy in the current expenses will be best secured by a building with wards on two or more floors, provided with lifts and other labour-saving appliances.

In addition to the larger wards, it is necessary, as already stated, to have a few wards of one or two beds each for special cases.

Corridors should connect the pavilions on the level of the lower floor of wards only. They should be kept as low as possible, so as not to impede the circulation of air between the pavilions; they should be lighted by windows on both sides, opening widely, or removable in warm weather; and they should be provided with ample means of ventilation, and with fresh warmed air in cold weather, so as to prevent draughts.

The *staircases* should be treated similarly as to light and ventilation, and it is desirable to cut off the connecting corridors from adjacent staircases by swing-doors. These arrangements prevent draughts, and cause the passages and staircases effectually to cut off the ventilation of one pavilion from that of another.

The staircases for patients should be broad and easy; the rise of each step should not exceed four inches in height, and the tread should be at least one foot in width; there should be a handrail on each side, and a landing after every six or eight steps provided with seats. The patients in their beds may be wheeled on to the roof of the corridors between the pavilions, or on to a broad balcony outside the end window of the ward, in fine weather.

4. **Administrative Buildings.**—The necessary subsidiary accommodation may be briefly described.

Operating rooms, dispensary, and school.—These should include examining room, surgery, drug store, and operating theatre; the latter having roof-light from the north, and being of easy access to the surgical wards; there being one theatre for male, and one for female patients. Special wards for such cases as ovariotomy should contain but one bed. A dead-house and post-mortem room, with ample means of cleanliness, should be provided, quite outside, and detached from the hospital. Where a school is to be established, the necessary lecture-rooms, laboratories, dissecting-rooms, &c. should be kept entirely separate from the building for the sick.

All rooms should be plain, and without projections or ornaments, which form a resting-place for dust.

Officers' quarters.—Apartments for the resident physician and surgeon; matron, nurses, and servants should not, if practicable, be placed under the same roof with the sick. All the rooms should be light and airy. The resident physicians and surgeons should have each a bed-room and sitting-room, with proper convenience adjacent; and a dining-room for joint use.

The dispenser, if resident, requires a bed-room and sitting-room. An office is required for the steward (purveyor or financial officer); and a room for meetings of the governing body. Each ordinary nurse should have a separate bed-room; neither bare, tarnished, nor dismal; where she may obtain pure air while she sleeps—the night nurses' bed-rooms being apart, where they may not be disturbed by noise. There should be bath and closet accommodation near; but women should each be allowed a washstand and foot-bath in their own room. The head-nurse or 'sister' sleeps in her own room, overlooking her ward; but if there is no common-room, she would have better health if a small sitting-room, as well as bed-room, could be given her off her ward. The head-nurses or 'sisters should have a dining-room, and also a comfortable well-furnished sitting-room. They will work better in their wards if they themselves are made comfortable. For sisters and nurses now-a-days are, or ought to be, educated women. It is most undesirable that they should seek necessary amusement all out of doors. Nurses should dine in the sisters' dining-room, but at a different hour; and in a large hospital there would probably be required an additional dining-room for ward-assistants. In hospitals with an establishment for training nurses, which every large hospital ought to have, the probationers or pupil nurses (in a proportion not exceeding one to every ten or twelve patients) would live in a 'home' under the hospital roof, and under the direction of the hospital matron.

The 'Home' should consist of:—1. Class-room and nurses' library, large, airy, and convenient. 2. One or two dining-rooms, in which sisters and nurses might also dine, and pantry adjoining. 3. Two rooms and an office for the 'home sister' (classmistress). 4. One separate bed-room for each probationer, sufficient to contain press, table, chair, book-shelf, washstand, bedstead, and arm-chair.

Each floor should have a bath-room and other conveniences. Bed-rooms for probationers on night-duty should be cut off from the noise of the 'Home.' There should also be provided:—one sick room; one visitors' room; and servants' offices and bed-rooms for cook and other necessary servants.

Stores for bedding and linen, kitchen and provision stores.—The kitchen and all those stores between which and the wards there is a constant movement, should be as central as possible, so as to save labour; but the kitchen should be carefully cut off from the corridor connecting the pavilions. Attached to the kitchen should be a good scullery, larder, and serving conveniences. There should be a large, well-aired, well-lighted, well-warmed, well-arranged linenry and mending room. The hospital laundry should be detached from the hospital. Special care should be taken to make the laundry buildings airy and very light, with ample means of ventilation for removing the steam, which is heavily charged with organic impurity, and with ample space for the washers. They should have separate drying and ironing rooms.

Out-patients' department.—These hospitals which afford out-door relief require a dispensary for out-door sick. This should always have an entrance separate from the hospital, and should never be under or near a ward, or in the space between adjacent wards. It is placed in proximity to the hospital, for the convenience of the medical men, and medical school (if any), and in order to be near the drug-store and apothecary's shop; but it should be entirely detached, with a free air-space between, and no direct communication be possible.

The out-patients' department requires a large airy waiting-room, with separation of sexes, and separate closet accommodation for males and females, which, without great care, may (even when detached) become a nuisance to the sick wards; a consulting room for each of the physicians and surgeons; to which should be attached a small lavatory and all necessary convenience for the complete examination of patients. The out-patients' department of Children's Hospitals requires more care, and more ample space in waiting-rooms, because each patient is brought by its nurse. The entrance and exit should be through different doors.

In every large hospital should be provided a well-ventilated chapel, capable of being well warmed.

The position and general construction of the administrative buildings should be made quite subservient to the accommodation for the sick, and to the broad general principle that these buildings should not interfere with the circulation of the air round, or the light of, the wards.

Douglas Galton.

HUM, VENOUS.—A continuous murmur heard in the veins, generally observed in cases of anæmia. *See* Anæmia; and Physical Examination.

HUMID (*humidus*, moist).—Moist—in contradistinction to *dry*. Applied to râles (*see* Physical Examination); to characterise a variety of asthma attended with expectoration (*see* Asthma); and also to particular climates. *See* Climate.

HUMORAL (*humor*, a humour).—Of or relating to the humours. Chiefly used as a term for a pathological doctrine—the *humoral pathology*—which associates all diseases with morbid states of the fluids of the body (*see* Blood-disease). The word is also sometimes employed as synonymous with *humid*, when applied to asthma.

HUNYADI JÀNOS, in Hungary. Sulphated waters. *See* Mineral Waters.

HYDATIDS (ὑδατὶς, a drop of water).—Synon.: Fr. *Hydatide*; Ger. *Blasenwurm.*

General Remarks.—This term is now restricted to those bladder-worms which are larval forms of the so-called *Tænia echinococcus*—a minute tapeworm residing in the dog and wolf. Formerly all the bladder-worms were apt to be spoken of as hydatids, and thus we had the *Hydatis cellulosæ*, *H. erratica*, *Hydatigena granulosa*, and so forth. They were also frequently called *acephalocysts*, and thus, following Laennec, we had the *Acephalocystis granulosa*, *A. exogena* and *endogena* of Kuhl and John Hunter, *A. surculi-*

gera, &c. Again, they were as often characterised as various species of *Echinococcus*, whence we had the *Echinococcus hominis*, *E. veterinorum*, *E. polymorphus*, *E. granulosus*, and so on. At length, all these numerous forms of hydatid were reduced to a very few types, and now we are all agreed that there is only one true larval species, although it is liable to assume a practically endless variety of shapes.

That the minute tapeworm (*Tænia echinococcus*) is really the sexually mature condition of the ordinary hydatid, as known to physicians and surgeons, was first experimentally proved by Naunyn, who, in 1864, fed two dogs with liver hydatids, previously ascertained to contain heads (*scolices*). The first dog, destroyed twenty-eight days afterwards, yielded a negative result; but the second dog, killed thirty-five days subsequent to the feeding, contained numerous examples of *Tænia echinococcus* in the sexually mature condition.

By feeding dogs with fresh and perfectly formed hydatids we have thus obtained the minute tapeworm which selects for its abode the upper part of the small intestine. Conversely, hydatids may be reared by feeding animals with the eggs of the *Tænia echinococcus*. It appears that the formation of all true hydatids, whether developed in mankind or in animals, results from the ingestion of the tape-worm eggs. The eggs may be swallowed either with food or drink. In this way, impure water is doubtless the most common source of hydatid disease. All open waters, if dogs abound in the neighbourhood, are liable to be contaminated with the fatal germs. The careless drinking of unfiltered or insufficiently filtered water may lead to hydatid infection.

The formation of hydatids, after the eggs have been swallowed, is a very slow process. What we know on this point is principally due to the researches of Leuckart; but our knowledge of the intimate structure of the perfected organism, as such, has been very carefully worked out by a number of observers, amongst whom, after Leuckart, stand the names of Rasmussen, Naunyn, Heller, Von Siebold, Eschricht, Wagener, Küchenmeister, Erasmus Wilson, Busk, and Huxley. In this connection also, particular mention must be made of the researches of Virchow, who was the first to make us acquainted with the true nature of the multilocular form (*Echinococcus multilocularis*) which has also been investigated, amongst others, by Luschka, Leuckart, and Heller. In the more purely pathological and statistical aspects of the subject, the writings of Rokitansky, Schleisner, Wunderlich, De Haen, Krabbe, Klencke, Livois, and Davaine hold a conspicuous place; whilst clinically we have space only to particularise the memoirs of Murchison, Begbie, Cleghorn, Macgillivray, Robertson, Dougan Bird, and especially Hearn (*Kystes Hydatiques du Poumon*; Paris, 1875). From the above statement, it will readily be understood that the literature of the subject is of very great extent; but those who desire an exhaustive knowledge of the subject should also consult Dr. Albert Neisser's admirable compilation (*Die Echinococcenkrankheit*: Berlin, 1877). In this place it is only intended to offer a brief account of the general structure of hydatids, with a *résumé* of the facts of their distribution and prevalence in particular countries, and their occurrence in the organs of the body selected for residence. Remarks on treatment, and on the hygienic bearings of the subject will fitly close the article.

Description. — Pathologists recognise three varieties of hydatid, namely, the exogenous, endogenous, and multilocular. The first of these is sparingly found in man, but very common in the lower animals. The second is rare in animals, but frequent in the human subject. The third variety is found in man, very rarely; Professor Bollinger having also found it in the liver of a calf (*Deutsch. Zeitsch. f. Thiermed.*; 1876). The precise mode of origination and growth cannot be discussed here. Practically, it is of little moment which of the various hypotheses we accept; nevertheless the subject is of the highest interest when viewed from a physiological standpoint. Whilst there is rarely any difficulty in determining the character of ordinary hydatids, whether of the exogenous or endogenous kind, the multilocular form is very apt to be overlooked or misinterpreted. It has been mistaken for alveolar colloid, with which latter product, as remarked by Virchow, it has nothing whatever in common. There is reason to believe that some of the so-called examples of cirrhosis of the liver are neither more nor less than multilocular hydatid growths. Professor Heller, of Kiel, has called our attention to several preparations in the London Museums, which he thinks may be of this order, but the writer has not found opportunity to examine them microscopically. Condensing Leuckart's description, which we have ourselves verified from the examination of a specimen kindly supplied by Heller, it may be said that the essential characters of this growth are marked by a tough, well-defined fibrous limiting capsule, consisting of a dense stroma, whence bands of connective tissue pass off in every direction, penetrating the entire growth, and leaving small interstices. These interstices or alveoli are irregular in shape, lined with vesicles that are filled with a gelatiniform plasma, occasionally containing also the so-called echinococcus-heads. Here and there small blood-vessels may be seen, and also collapsed bile-ducts, but no trace of any true glandular parenchyma of the organ affected.

Ordinary hydatids, whilst presenting variable shapes according to the nature of the organ occupied, commonly exhibit a thick investing capsule derived from the tissues of the infested part. Within this capsule or cyst we first come upon a thick, homogeneous, laminated, elastic membrane, which, if withdrawn, displays a peculiar tremulous motion, coiling upon itself wherever it happens to be divided by the scalpel. This is the so-called cuticular, structureless layer, or *ectocyst* of Huxley. Within this outer layer, and closely applied to it, lies the delicate *endocyst* of the same authority. This is a thin, soft, comparatively non-elastic, granulated membrane, forming the essentially vital part of the bladder-worm. From this inner membrane buds are produced, and these gemmæ become transformed into echinococcus-heads both in a direct and indirect manner. Commonly they form broad capsules containing numerous heads, some of which, by a process of eversion, may be seen projecting into the general cavity of the mother-hydatid. At other times by a process of what is termed proliferation, daughter and even grand-daughter hydatids are formed within the original maternal hydatid, and these smaller hydatids (constituting an agamogenetic bladder-worm progeny) in their turn produce echinococcus-heads within them. The precise mode of origination of these buds is still a subject of dispute, notwithstanding the remarkable investigations of Leuckart, Naunyn, and Rasmussen. Neither of the two former authorities believes that the *heads* can be formed in a direct manner from the endocyst, as described and figured by Huxley. The question as to the existence of cilia on the endocysts and brood-capsules is also unsettled. Cilia have been noticed by Owen, Lebert, and Whittell. These various authorities aver that they occur outside the so-called echinococci. Huxley looks upon them as having a connection only with the water-vascular system, whilst Leuckart entirely failed to detect them anywhere. We are not here called upon to pursue this part of the subject further, but may remark in passing that the little sacs now termed brood-capsules by Leuckart and others were well known to Erasmus Wilson, who figured them in 1845, and also to Busk, who previously spoke of them as 'granulations' (1844).

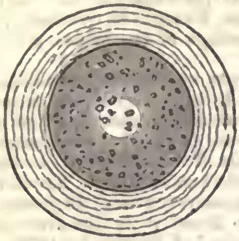

FIG. 24. Hydatid of four weeks' growth, showing ectocyst and endocyst. × 60. After Leuckart.

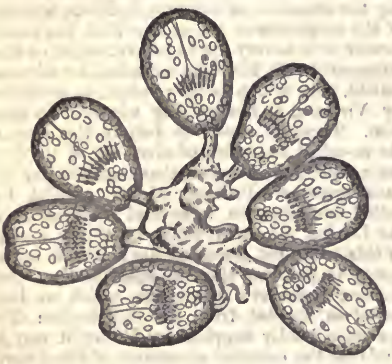

FIG. 25. Group of Echinococci, with their hook-crowns inverted. × 180 diam. After Busk.

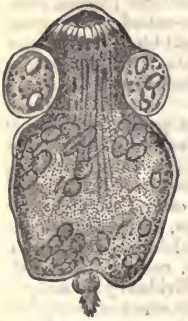

FIG. 26. The so-called *Echinococcus head*, showing hooks, suckers, cilia, and corpuscles. × 250 diam. After Huxley.

OCCURRENCE.—The prevalence of hydatids in any country bears a strict relation to the degree of intimacy subsisting between its inhabitants and the dogs employed by them for domestic purposes. If in this respect Iceland holds pre-eminence; the explanation is not far to seek. As remarked by Krabbe, it is not necessary to suppose that the Icelanders actually devour the excrement of dogs, although, to be sure, canine fæces, according to Schleisner, figure amongst the remedial agents employed by quacks and empirics. It is sufficient for the purpose of infection that the natives and their dogs share the same habitation, that the animals are fondly caressed, that they feed off the same plates (which they are often encouraged to lick clean, in order that their masters may be spared the trouble of having them washed), and that they sleep with the peasants in the same bed. Thus, as Krabbe says, either through carelessness, ignorance, or indifference on the part of the natives, the eggs of the hydatid-forming tapeworm have abundant opportunity of gaining access to the human bearer. To a certain extent, as Krabbe observes, this close relationship and high degree of infection are forced upon the poor people by the rigours of the climate, and insufficient resources of the country. Nevertheless, it is clear that a very large amount of echinococcus-disease exists in countries where there is comparative freedom from these disadvantages. The circumstance that the germs are far too small to be seen by the naked eye, and that they may be distributed by various possible agencies (long after they have either been passed with the fæces, or have been dispersed by the semi-independent and sexually ripe proglottides), is alone sufficient to ensure infection, provided the necessary sanitary precautions are not adopted. Open natural waters, however pure and sparkling they may look, are apt to contain hydatid germs in all countries where dogs abound. Thus it is that cattle become infected; not alone indeed by drinking foul water, but also by grazing in districts where the eggs of the *Tænia echinococcus* are dispersed by winds, rain, and even insects flying away from the germ-infected fæcal matter on which they had previously settled for repast. Of course, direct contact with infested dogs renders infection almost a matter of certainty. Anyone who has witnessed the migration of tapeworm proglottides on the surface of the bodies of cats and dogs, will readily understand how it comes to pass that the mere act of coaxing a dog's back is sufficient to convey numerous germs to the hand, whence they may be transferred to the lips and mouth of the human bearer. It is fortunate, indeed, that in European countries our *Tænia echinococcus* is comparatively rare in the dog. But for this circumstance, hydatids might become almost as prevalent amongst the peasantry of our own country as they are known to be in Iceland. Probably the next most infested territory is that of Victoria (Australia). On this point the writer has collected much convincing evidence; recently confirmed by Dr. David Thomas, of Adelaide. According to one local authority, not only has the disease been more or less prevalent in the Victoria colony for many years past, but it is 'greatly on the increase in the human subject.' It would be easy to multiply statements bearing out the same truth, but the subject is too special for detailed treatment, and it has been dealt with, at some length, in the writer's general treatise (*Parasites*; London, 1879). Those, also, who desire to obtain a general notion of the frequency of hydatids in England would do well to reflect upon the amount of collateral evidence supplied by the numerous specimens preserved in the museums of the metropolis and elsewhere. In the face of facts, patent to all, it must be obvious that the amount of hydatid disease now existing everywhere, is susceptible of being greatly diminished by the introduction of appropriate sanitary regulations. In what these regulations consist may be readily gathered from the circumstances connected with infection. To some extent, Iceland has already moved in the matter, following the counsel of Dr. Krabbe.

SITUATIONS.—The relative prevalence of hydatids in particular organs of the body is a matter of great concern, clinically and hygienically. The writer has been at some pains to open up this subject, and from the data collected independently by Davaine and himself, the results obtained may be relied on as approximately correct. Reduced to the lowest number of practically available or useful terms, our statistics stand as follows:—

Organs affected.	Davaine.	The writer.	Total.
Liver	165	161	326
Abdomen, pelvic cavity, and spleen	26	45	71
Lungs	40	22	62
Kidneys and bladder	30	23	53
Brain	20	22	42
Bones	17	16	31
Heart, and pulmonary vessels	12	13	25
Miscellaneous	63	25	92
Grand total	373	327	700

Notwithstanding certain apparent differences, the results separately obtained by Davaine and the writer show a remarkable correspondence. Thus, in the case of those organs respecting which no dispute could well arise as to the real seat of the disorder, the results are tolerably uniform. This is seen in the case of the liver, brain, heart, and bones. Even in those instances where the results do not appear to correspond, the explanation of the discrepancies is very simple. One example will suffice to illustrate this point. The twenty-six abdominal cases credited to Davaine's record are all placed by him under the heading of 'Pelvis,' whilst all those cases placed by the writer under the abdominal series not only include hydatids of the pelvic cavity, but also two from the spleen and nineteen from the peritoneum and intestines, besides others.

As the facts thus stand, it is instructive to notice that the liver cases comprise nearly 46½ per cent. Comparatively recent computations by Dr. Albert Neisser, based on 983 cases, afford a percentage of 45·765 for liver cases. It is especially worthy of remark also that no inconsiderable proportion of the bladder-worms occupy organs of vital importance to the host. If, in reference to sanitation, statisticians would obtain an adequate conception of the cause of the fatal power of hydatids, they should look close into this matter. Let them note the fact that in 6 per cent. of all the cases collected by Davaine and the writer the entozoon occupied the brain; in about 3½ per cent. they took up their residence in the heart; and probably in not less than 15 per cent. of all the other cases they operated to bring about the death of the human bearer. The writer is of opinion that (excluding the cases cured by surgical interference) the echinococcus-bladderworm proves fatal to 25 per cent. of all the human victims it attacks. Animal-bearers, on the other hand, comparatively rarely succumb to hydatid invasion. (For further details see *Lancet*, Jan. 19, 1875, p. 850; *British Medical Journal*, 1875; and the writer's treatise on *Parasites*, 1879, pp. 121–141.)

DIAGNOSIS.—Many cases of hydatids present extreme difficulty in respect of diagnosis, especially those occupying the cavity of the chest. To diagnose hydatids of the brain, heart, and kidneys is rarely possible, unless very strict attention be paid to the symptoms, and to the conditions under which the patient has been living. In kidney cases, the escape of small vesicles with the urine, would, of course, help to decide the matter. In heart-cases it is rare that any premonitory symptom of the affection shows itself. Under ordinary circumstances, where these and certain other organs are out of the question, the presence of a fluctuating tumour, without any concomitant inflammatory symptoms, especially if it be seated in the region of the liver, would to most of us at once suggest the likelihood of the occurrence of an hydatid growth. Much has been said of Piorri's 'hydatid fremitus,' which, however, scarcely differs from the ordinary impulse communicated by fluid matter within any other kind of tumour. Speaking generally, the accidental discharge of one or more acephalocysts constitutes the most common and absolutely certain means of diagnosis. That these formations are frequently discharged by the natural outlets of the body is well known to every practitioner; and not unfrequently has the scalpel of the surgeon evacuated them, when their presence was not so much as suspected by the operator. How constantly their presence within the viscera is altogether overlooked is a matter well known to every pathologist connected with our large hospitals.

TREATMENT.—The treatment of hydatid-disease may naturally be spoken of under three heads, namely, *surgical*, *medical*, and *prophylactic* or preventive.

Surgical.—With the first method we have of course little to do here, but in respect of diagnosis it is obvious that the surgeon must often require the assistance of the physician. In the matter of operative treatment, the writer has elsewhere taken occasion to comment, incidentally, upon the remarkable amount of success obtained by Dr. MacGillivray, at the Bendigo

Hospital. (See his records given from time to time in the *Australian Medical Journal.*)

Medical.—As regards the success of medical treatment, the opinion long ago expressed in the writer's Introductory treatise still holds good (*Entozoa*, 1864, p. 285). As then stated, 'a great deal of nonsense has been written about the efficacy of particular drugs,' but, making allowance for the advantages secured by aspiration and electrolysis, we think that the words spoken by Dr. Todd in 1851, are still very near the truth:—'I know of no cure for hydatids but the evacuation of them. There is a popular notion that salt will kill the hydatid. Iodide of potassium has also been frequently tried, but I have never seen any real benefit from the use of these remedies.' Since Dr. Todd's time, the employment of several other drugs has been warmly advocated by different physicians, amongst whom the names of Dr. Leared, Dr. Hjaltelin, and Dr. Bird stand out most prominently. According to the two first-named observers *kamala* has the power of destroying hydatids. If, however, anyone will take the trouble to peruse Dr. MacGillivray's record of his efforts to obtain proof of the alleged curative properties of kamala, when administered internally, they will at once perceive that this much over-praised drug has 'no influence whatever on the disease.' In like manner, the writer fears that the alleged virtues of turpentine in this respect, as advocated by Australian practitioners, will turn out to be an entire mistake. It is all very well to speak of turpentine and certain other well-known anthelmintics as powerful tæniafuges; but it is quite another thing to assert that these drugs can destroy bladder-worms by the ordinary mode of oral administration. As stated in the early part of this article, the essentially vital part of the hydatid is the granular endocyst, and to reach this the poison must not only penetrate the more or less dense capsule of connective tissue, but also the laminated ectocyst. If the advocates of kamala had reflected on the enormous quantity of the drug necessary to produce any sensible effect on the hydatid, they would probably not have attempted its employment. In like manner, notwithstanding what has been said of the power of turpentine, in respect especially 'of its property of accumulating in the system,' we must express ourselves as exceedingly sceptical as to the likelihood of turpentine being of any more curative value than kamala when prescribed internally. In regard to the successful employment of iodine and other drugs for the purposes of injection, after evacuation of the fluid contents of hydatid cysts, there can be no doubt as to the good results frequently obtained; nevertheless, as M. Boinet and others long ago pointed out, certain precautions are necessary, especially when dealing with growths occupying the neighbourhood of serous cavities. In this connection Davaine's *Traité des Entozoaires* should be consulted, and also Hearn's clinical work, which, so far as hydatids of the thoracic cavity are concerned, is thoroughly exhaustive and reliable. We are entirely in accord with Hearn, who affords us a true criterion of his estimate as to the value of drugs when he incidentally remarks that the medical treatment of hydatids in no way affects the prognosis.

Prophylactic.—The prophylactic treatment of hydatids deserves the most serious attention of those interested in the advance of State medicine. As all the circumstances favourable to the production of the echinococcus disorder are now well known, it clearly follows that the malady falls within the category of those endemics which admit of being either largely checked, or altogether stamped out. There is no need to recapitulate the ætiology of the subject at any length, and the writer can only again insist upon the adoption of those measures which he has sought to enforce for many years past. He has recommended that boiling hot water should be thrown over the fæces of dogs, not only in kennels, but in all places where the excreta are exposed. To attempt to collect and burn the fæces would be too troublesome a process, and not so effective, since a large number of the invisible eggs scattered on the ground or flooring would inevitably escape. In this view, the late Dr. Leared's proposal that every dog should be efficiently purged with an anthelmintic and cathartic at certain intervals is worthy of attention. Dr. Leared further advised that the excreta should be buried; but the writer's plan of destruction of the germs by boiling water seems more effective and more easy of accomplishment. Professor Leuckart, in an elaborate but popularly written article, embodying a review of all the more important facts of helminthological study in relation to the public health (*Unsere Zeit*, 1862, s. 654), gives an admirable summary of the sanitary bearings of the subject in the following terms:—'In order to escape the dangers of infection, the dog must be watched, not only within the house, but whilst he is outside. He must not be allowed to visit either slaughter-houses or knackeries, and care must be taken that neither the offals nor hydatids found in such places are accessible to him. In this matter the sanitary inspector has many important duties to perform. The carelessness with which these offals have hitherto been disposed of, or even purposely given to the dog, must no longer be permitted, if the welfare of the digestive organs of mankind is to be considered. What good results may follow from the adoption of these precautions may be readily gathered from the consideration of the fact that, at present, almost the sixth part of all the inhabitants annually dying in Iceland fall victims to the echinococcus epidemic.' The Leipzig helminthologist next dwells upon the conditions already shown to be so eminently favourable to the production of the disorder, and concludes by remarking that 'cleanliness is one of the most important preservatives against infection.' Without doubt this is so; but, as a matter of fact, no amount of care in this respect will ensure immunity from hydatid disease. Occasionally, though happily very rarely, the most delicately nurtured persons, who have all their lifetime lived, as it were, in the lap of luxury, fall victims to the malady. One such case, that of a lady, was not very long ago brought under the writer's notice by an eminent practitioner, who tapped the abdominal tumour, at first suscessfully, but on a second occasion with a fatal result to the patient. The explanation of the occasional occurrence of hydatids in high life is not far to seek. The act of drinking a glass of water from some doubtfully good or unfiltered source, or, still more probably, the partaking of salad (derived from some market-garden source, and not properly cleansed before being sent to table), is quite sufficient to account for infection. A single invisible germ or echinococcus-ovum thus transferred to the stomach of the human host, is capable, after a lengthened interval, say of a year, of presenting itself as an hepatic tumour of considerable dimensions. What obtains thus infrequently amongst well-to-do persons in life, must necessarily happen more commonly to those whose occupations naturally bring them more directly in contact with the ordinary sources of infection. In a paper, 'On the comparative prevalence of different forms of entozoa infesting the dog' (*Linn. Soc. Journ.*, 1867) the writer has called attention to the desirability of instituting special investigations in reference to the frequency of the occurrence of the hydatid tapeworm in the dog in England. By adopting, both at home and in our colonies, the admirable mode of procedure initiated by Krabbe in Iceland and Denmark, a large amount of valuable information, available for sanitary guidance, could not fail to be obtained. Hundreds of dogs are annually destroyed in this country, yet no public officer, possessing a practical knowledge of the subject, has ever examined their carcases with the view of ascertaining the prevalence or otherwise of parasites within them. The amount of good which has already been accomplished by private efforts (not unattended with personal sacrifices) in this direction is by no means inconsiderable. These efforts have led to the discovery of the causes of several destructive epidemics. In respect of the sexually mature echinococcus tapeworm, Dr. Krabbe has shown that no less than 28 per cent. of Icelandic dogs are infested. His investigations have thus furnished us with a striking result, which, to the thoughtful and cultured sanitarian, readily explains the extraordinary prevalence of hydatids in that country. *See* Acephalocysts; Bladder-worms; and Echinococcus.

T. S. Cobbold.

HYDATIDS, UTERINE. *See* Mole.

HYDRÆMIA (ὕδωρ, water, and αἷμα, the blood).—A watery condition of the blood. *See* Anæmia; and Blood, Morbid Conditions of.

HYDRAGOGUES (ὕδωρ, water, and ἄγω, I drive).—Synon.: Fr. *Hydragogues*; Ger. *Wassertreibende Mittel*.

Definition.—Purgative medicines which cause a copious watery discharge.

Enumeration.—Hydragogue purgatives include:—Bitartrate of Potash, Buckthorn, Colchicum, Colocynth, Croton Oil, Elaterium, Gamboge, Hellebore, Jalap, Podophyllin, and Scammony.

Action.—It has been supposed by some writers that the action of the drugs included in the present class is due only to the increased peristaltic action which they produce. This, however, is not the case, as certainly some, if not all, of those just enumerated, induce a free secretion of fluid by the intestinal mucous membrane, while at the same time they stimulate the peristaltic action of the bowel, and cause the evacuation of this watery fluid.

Uses.—Hydragogues are chiefly employed for the removal of fluid from the body, in cases either of general anasarca or of dropsical effusion in serous cavities. They may be employed to assist the action of the kidneys when this is insufficient; and it has been observed not unfrequently, when the secretion of urine has previously been deficient, that it becomes greatly increased after a free discharge of fluid has taken place from the bowels, in consequence of the administration of a hydragogue cathartic. *See* Purgatives.

T. Lauder Brunton.

HYDRARGYRIASIS (*hydrargyrum*, mercury).—The state produced by the introduction of mercury into the system. *See* Mercury, Poisoning by.

HYDRARTHROSIS (ὕδωρ, water, and ἄρθρον, a joint).—Effusion of a serous fluid into a joint. *See* Joints, Diseases of.

HYDROA (ὕδωρ, water).—A term used by Hippocrates, and expressive of a sweat-eruption. By the Latins the condition was named *sudamina*, and in modern times it is called *miliaria*. The term hydroa has also, with doubtful propriety, been applied to the larger vesicle of herpes; and more recently to herpes, or rather, pemphigus iris.

Erasmus Wilson.

HYDROADENITIS (ὕδωρ, water, and ἀδήν, a gland).—Description.—This affection was first described by Verneuil and Bazin as a minute phlegmon of the sweat-gland, resulting in a flat pustule, and met with chiefly in those situations where the sudatory glands are most largely developed, for example, in the axilla, on the areola of the nipple, and at the verge of the anus. Hydroadenitis occurs singly or in crops. It first becomes developed into a small tubercle; and, when pus forms, it breaks upon the surface, and the tubercle subsides. The disease has been attributed to irritation from friction, discharges, or absence of cleanliness; and is said to be favoured by an unhealthy constitution.

Treatment.—After the more obvious indications of improvement of the general health and removal of local irritants have been attended to, it has been recommended to paint the affected part with the liniment of iodine.

Erasmus Wilson.

HYDROCARDIA (ὕδωρ, water, and καρδία, the heart).—An effusion of serous fluid into the pericardial sac. *See* Pericardium, Diseases of.

HYDROCELE (ὕδωρ, water, and κήλη, a tumour).—Synon.: Fr. *Hydrocèle*; Ger. *Wasserbruch*.

Definition.—A swelling produced by a collection of fluid in connection with the testicle or spermatic cord.

Description.—The principal forms of hydrocele of the testicle are the *vaginal*, the *congenital*, and the *encysted*.

Vaginal Hydrocele.—Description.—This is a chronic dropsical effusion into the sac of the tunica vaginalis. The fluid is a pale-yellowish serum, which in old cases is often loaded with cholesterine. The quantity varies, but seldom exceeds twenty ounces. The writer has removed as many as forty-eight ounces. The testicle is usually situated at the back part and rather below the centre of the sac; but its position may be altered by adhesions; and, in cases of congenital inversion, the testicle is in front of the sac. In old hydroceles the sac is often greatly thickened by deposition of lymph on the tunica vaginalis, and its conversion into fibrous tissue, which is sometimes the seat of calcareous deposits. It is generally single, but often occurs on both sides. Vaginal hydrocele forms an oval or pyriform swelling, which fluctuates; has a smooth, even surface; and commences at the lower part of the scrotum, very gradually and without pain. When examined by transmitted light it is found to be translucent, except at the back part, where the testicle is situated. Owing to the tunica vaginalis remaining unobliterated for some distance along the cord, the swelling occasionally assumes an elongated form, and extends up towards the inguinal canal. A hydrocele sometimes varies in size, becoming larger and more tense during the day than when the patient first rises in the morning.

Ætiology.—Hydrocele is a common disease, especially in warm climates; and occurs at all periods of life, but is most common in middle age.

Diagnosis.—The circumstances—that the swelling commences below; that the spermatic cord can be detected above the tumour; that the testicle cannot be felt; and that the tumour receives no impulse on coughing, and does not vary in size on pressure—are signs distinguishing a hydrocele from an inguinal rupture. When the sac is much thickened, so as to obscure fluctuation, and prevent the passage of rays of light, the tumour may be mistaken for a hæmatocele, or disease of the testicle, and the diagnosis is difficult.

Treatment.—In *infants*, vaginal hydrocele usually disappears under the application of weak tincture of iodine. Acupuncture, causing the fluid to escape into the areolar tissue of the scrotum, is the only operation that is required.

In the *adult* external remedies are of no use. It is usual to resort at once to operative treatment, *palliative* or *radical*. The *palliative* operation consists in puncturing the tumour with a trochar, and evacuating the fluid accumulated in the tunica vaginalis. The hydrocele usually returns in the course of two or three months, and then the operation must be repeated, or the patient must undergo *radical* treatment. This may be effected by incision or excision of the sac; by the passage of a seton; or by injection of the sac with a stimulating fluid. The latter is the plan commonly resorted to; and the fluid almost invariably employed is the tincture of iodine. The only apparatus required, in addition to a medium-sized trochar, is a glass syringe. The writer generally injects about a drachm of strong tincture, which he leaves in the sac. It causes considerable pain, extending to the loins; but all suffering may be prevented by ether or chloroform inhalation. The iodine acts as a stimulant, stirring up mild inflammation, and causing a rapid return of swelling, which gradually subsides until the patient is cured. Compression with strapping helps the absorption. In double hydrocele, injection may be performed on both sides at the same time. Injection rarely fails to cure the hydrocele. If it does not succeed, recourse can be had to the seton; or, in cases of thickened sac, to incision or excision.

Congenital Hydrocele.—In children, the original communication between the cavities of the peritoneum and of the tunica vaginalis sometimes fails to be obliterated; and fluid accumulated in the sac constitutes the variety termed congenital hydrocele. The communication is usually small in size.

Diagnosis.—Congenital hydrocele is easily distinguished from ordinary hydrocele by the absence of a defined boundary on the upper part of the tumour; by the impulse received on coughing; and by pressure causing the disappearance of the swelling, and rendering the testicle perceptible. It is distinguished from a reducible hernia by the fluctuation and transparency of the swelling; by the absence of gurgling accompanying its disappearance on pressure; and by the slow return of the swelling on the patient assuming the erect posture.

Treatment.—Congenital hydrocele is readily cured by the gentle pressure of a truss on the inguinal canal, so as to occasion obliteration of the neck of the sac, after which the fluid usually becomes absorbed.

Encysted Hydrocele.—In this form of hydrocele fluid is effused into an adventitious cyst distinct from the vaginal sac, developed in the areolar tissue beneath the visceral portion of the tunica vaginalis investing the head of the epididymis. As the cyst enlarges, the epididymis becomes flattened and displaced to one side, whilst the testicle is found either in front or at the bottom of the cyst. The fluid contained in the sac differs from that of vaginal hydrocele in being less in quantity, perfectly limpid and colourless, and nearly free from albumen. The fluid sometimes contains spermatozoa in great abundance, rendering it opaque and milky-looking. Their presence is owing to the rupture of one of the tubes of the epididymis, and the escape of semen into the sac of the hydrocele.

Diagnosis.—An encysted hydrocele is distinguished from vaginal hydrocele by the position of the testicle at the bottom of the tumour; and generally by the colourless character of the fluid evacuated.

Treatment.—When large in size, so as to be inconvenient, encysted hydrocele may be treated in the same way as vaginal hydrocele, and injection is attended with the same success.

Hydrocele of the Cord.—Hydrocele occurs in the spermatic cord in two forms—*diffused* and *encysted*.

The *diffused*, which is very rare, is simply an œdema of the areolar tissue of the cord.

Encysted hydrocele of the cord arises from a collection of fluid in the unobliterated funicular process of peritoneum, which is carried down in the natural transition of the testicle. It produces a small swelling in the cord, of an oval form, above and distinct from the testicle, more or less transparent, and quite movable. The swelling, when small, is of no importance; and it seldom requires treatment. *See* Testes, Diseases of.

T. B. Curling.

HYDROCEPHALOID DISEASE.—This term is one which has been applied to a set of symptoms, ill-defined in their mode of grouping, occasionally met with in delicate children soon after they have been weaned. The symptoms may in some cases have been due to reflex disturbance of the nervous system induced by improper food; they may appear as the sequence of some exhausting disease, such as a prolonged diarrhœa; or they may be concomitants of a pneumonia in its initial stages. In each of these, as well as in other allied conditions, there may be a febrile elevation of temperature; combined, in the first place, with undue irritability and extreme restlessness, whilst later on signs of mental sluggishness and stupor may supervene. Such symptoms are apt to be met with where, in addition to a depression of the vital powers, there is a reflex disturbance of brain-functions. The condition was specially described by Marshall Hall, by whom the above name was given. It may be well, therefore, to quote from his own description:—

'This affection may be divided into two stages: the first that of irritability; the second that of torpor. In the former there appears to be a feeble attempt at reaction; in the latter the powers appear to be more prostrate. These two stages resemble in many of their symptoms the first and second stages of hydrocephalus respectively.

'In the first stage the infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched or on hearing any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered.

'If through an erroneous notion as to the nature of this affection, nourishment and cordials be not given, or if the diarrhœa continue, either spontaneously or from the administration of medicine, the exhaustion which ensues is apt to lead to a very different train of symptoms. The countenance becomes pale, and the cheeks cool or cold; the eyelids are half-closed, the eyes are unfixed and unattracted by any object placed before them, the pupils unmoved on the approach of light; the breathing, from being quick, becomes irregular and effected by sighs; the voice becomes husky, and there is sometimes a husky, teasing cough; and eventually, if the strength of the little patient continue to decline, there is a crepitus or rattling in the breathing. The evacuations are usually green; the feet are apt to be cold.'

But in such groups of symptoms there is nothing distinctive; and the term hydrocephaloid, which is now seldom heard, might be discarded. Its use can scarcely be justified merely on the ground that the symptoms met with under such conditions are apt to be occasionally confounded with those which usher in the commencement of acute hydrocephalus. We do not diminish the difficulties — already sufficiently pronounced — besetting the early diagnosis of this latter affection, by endeavoring to group together under one name a set of symptoms which, on different occasions, have no other common bond than that they are apt to occur in delicate children, the tone of whose nervous system has been lowered, and thereby rendered more irritable than natural. We should be really better without such a name, especially now that bleeding and lowering treatment are no longer in vogue for the amelioration of the grave organic affection with which the states in question may occasionally be confounded. H. Charlton Bastian.

HYDROCEPHALUS, Acute (ὕδωρ, water, and κεφαλή, the head).—A synonym for Tubercular Meningitis. Tuberculosis *plus* a meningeal inflammation is the generating condition; and acute hydrocephalus is only the occasional, though very frequent, concomitant. *See* Meningitis, Tubercular.

HYDROCEPHALUS, Chronic.—Synon.: Water on the Brain; *Hydrops Capitis*; Fr. *Hydrocéphale*; *Hydropisie du Cerveau*; Ger. *Der Wasserkopf*; *Hirnwassersucht.*

Definition.—A gradual accumulation of serous fluid within the lateral and third ventricles of the brain; causing them to become more or less distended, and the head enlarged; occurring principally in infants or very young children; and leading to restlessness, irritability, or convulsions, followed by dulness, drowsiness, motor weakness or actual paralysis, together with failure of mind and of the special senses.

The essential condition in this malady is the intra-ventricular effusion. The cases in which the fluid has been found outside the brain and within the arachnoid sac are, in all probability, merely examples of the disease in which intra-ventricular effusion having previously been well-marked, the distended corpus callosum, or, it may be, the floor of the third ventricle has given way, and allowed the fluid to pass beneath the arachnoid. The so-called extra-ventricular form of the disease is, therefore, in the majority of cases, merely a secondary and altogether accidental condition.

As a sequence of a large arachnoid hæmorrhage, serous fluid may also be found within the arachnoid cavity; this, however, is a condition which has no real title to be mentioned under the head of chronic hydrocephalus, as some writers have done. And the same remark applies to those accumulations of serous fluid which take place beneath the arachnoid, as a sequence of wasting or atrophy of the cerebral hemispheres, one or both. The collection of fluid in such cases is to be regarded as a simple sequence of the atrophy, and is of itself unproductive of morbid symptoms.

Ætiology.—Two principal groups of causes are appealed to as productive of chronic hydrocephalus. In certain cases the affection is believed to be *idiopathic*, due to an 'essential dropsy,' occasioned by an inflammatory affection of the lining membrane of the ventricles. In other patients, however, this affection is distinctly secondary or *symptomatic*, and then may be caused by one or other of two principal sets of conditions. Thus (1) it is often occasioned, as writers of the last century pointed out, by the pressure of scrofulous or other tumours upon the 'straight sinus,' producing mechanical congestion of the great veins of Galen as well as of their radicles on the walls of the lateral ventricles, and, as a consequence, an increasing dropsical condition of the ventricles themselves. (2) More rarely it seems to be produced or to remain as a sequence of an attack of acute hydrocephalus. This latter mode of origin is admitted by some authors, and denied by others. It is at least a possible mode of origin, although one which is difficult to be established with certainty. By far the largest percentage of cases probably belong to the first set of the 'symptomatic' category.

The disease is sometimes congenital, and may be so far developed during uterine life as to cause great difficulties in parturition—frequently necessitating the sacrifice of the life of the child. At other times the enlargement of the head begins to show itself soon after birth, or at some period before the end of the first or second year. Or it may reveal itself later still in childhood; much more rarely during adolescence; and more rarely still in adult life.

Congenital 'microcephalism' must not be confounded with hydrocephalus. It is true that in certain small-headed infants, having the cranium malformed and the sutures ossified, an excess of fluid may be found within the head; but then the fluid in these cases is situated outside the atrophied brain, and not within the ventricles. The two conditions are, in fact, totally opposite in nature.

Anatomical Characters. — Three different states, in regard to size of head, have been described as existing in this affection:—(1) where the head is smaller than natural; (2) where the head is of natural size; and (3) where the head is more or less considerably enlarged.

Those of the first category ought not to be included at all. They are the cases of 'microcephalism' above referred to. Those of the second category could never be diagnosed with any degree of positiveness during life; and it may, indeed be questioned whether such cases exist to any large extent, except as more or less transitory stages of instances of the disease pertaining to the third of the above categories.

Of course, in all the cases in which the head ultimately becomes enlarged from the presence of an excess of fluid within the lateral and third ventricles, there must have been a stage during which these ventricles were merely full of fluid, and during which pressure-symptoms were more or less marked—even without the existence of actual enlargement of the head. Such symptoms alone, however, do not often form a sufficiently precise combination to enable us to do more than entertain a vague suspicion that we may have to do with a case of chronic hydrocephalus. We mostly need the objective sign of enlargement of the head, to enable us to arrive at a positive diagnosis of this disease; but as soon as this sign declares itself to a well-marked extent, there are few affections of the brain which can be diagnosed with more certainty than the one which we are now considering.

Even the cases in which the head is distinctly enlarged differ amongst themselves, since in some of them (*a*) both sutures and fontanelles are widely open; whilst in others (*b*) the sutures, and perhaps the fontanelles, are completely closed. It seems probable that the latter may represent conditions into which some of the former pass, when the disease lapses into a chronic and stationary condition.

Owing to the separation of the cranial bones in young infants, this disease, when it occurs in them, soon becomes associated with an actual enlargement of the head, which increases rapidly. In consequence of the distending pressure from within, caused by the increasing size and fulness of the ventricles, the bones entering into the formation of the vault of the cranium become separated from one another, though the bones of the face remain unaltered. The frontal, parietal, the superior part of the occipital, and a small part of the squamous portion of the temporal bones become expanded and thinner than natural, at the same time that they are separated from one another—especially in the regions of the anterior and posterior fontanelles, and of the sagittal suture. In such regions, when the enlargement is extreme, a sense of fluctuation is often recognisable. The forehead becomes prominent and overhanging, whilst the eyeballs are depressed; and as the face remains unaltered or even becomes emaciated, it seems altogether unnaturally small, and thus contributes to produce a most characteristic appearance ('facies hydrocephalica'), which is often intensified by the old-looking, and more or less blank, expressionless, aspect of the face.

The cranial bones are often very thin, but occasionally they may be unusually thick throughout—even in young children.

The circumference of the head, even of a young child, may in hydrocephalus easily reach 24 to 30 inches or even more. Where the enlargement becomes extreme, the weight of the head is so great that it cannot be maintained in the upright position. It has to be supported by the hand or some artificial support; or else the child does not attempt to rise from the recumbent position. The size attained by the head in certain cases has been comparatively enormous; thus, in an altogether exceptional case, recorded by Cruikshank, it is said to have measured, in a child sixteen months old, no less than 52 inches in circumference, and the amount of fluid contained within the cranium was found to weigh as much as twenty-seven pounds.

The fluid is generally slightly albuminous; possesses some saline constituents; and has a specific gravity ranging from 1,006 to 1,014. Its composition agrees pretty closely with that of dropsical fluids generally.

In the great majority of cases, as already stated, the fluid is contained within the more or less distended lateral and third ventricles of the brain. The upper and lateral parts of the cerebral hemispheres, as well as the corpus callosum, become thinned and distended, so as to resemble a mere bag, the walls of which are represented externally by pale unfolded and much flattened convolutional matter, and internally—next the fluid itself—by the lining membrane of the ventricles. This latter has become much thicker and tougher than natural; it may also be more or less granular on the surface; and often shows an increased number of distended vessels. These appearances are, however, not to be taken as an indication of the inflammatory origin of the malady, as some observers seem to suppose. They may be found, as the writer has seen, well-marked, in cases where the effusion and distension has been the result of a mere mechanical congestion, produced by pressure upon the commencement of the straight sinus, owing to a tumour in the middle lobe of the cerebellum. On the other hand, some years ago the writer examined the head of a hydrocephalic child who died in University College Hospital, in whom the most careful search revealed nothing that could have produced mechanical congestion, and in which there was, moreover, no sign of anything like an inflammatory condition of the walls of the greatly distended lateral ventricles. To fall back upon the hypothesis of an 'essential dropsy' was felt to be far from satisfactory. Such a phrase cannot indeed be regarded as conveying any real explanation of the condition in question.

The shape of the ventricles and of the compressed ganglia about the base are, of course, greatly altered. The foramen of Munro may be half an inch or more in diameter. The optic and olfactory tracts and lobes are also often much altered by pressure.

The brain-substance may be even tougher than natural, because the long-continued mechanical congestion, which exists in so many cases, favours the overgrowth of the neuroglia; and, indeed, it would appear probable that in some instances the overgrowth of this mere connective substance is well-marked. For, notwithstanding all the pressure upon and distension of the brain-substance, this rarely shows signs of atrophy. It is rather the reverse. The mere brain alone of a hydrocephalic child, after the fluid has been evacuated, commonly weighs more than the brain of a healthy child of the same age. Thus in an instance that came under the writer's notice, the brain of a child five years of age weighed rather more than 52 oz.

In those cases in which during life the fluid has escaped from the ventricles through a rupture in the corpus callosum, the brain has been found more or less flattened and collapsed in the lower part of the enlarged cranium, whilst the escaped fluid occupies the arachnoid cavity above it.

Symptoms.—Chronic hydrocephalus begins to manifest itself in various ways, and also, as above stated, at various ages. The great bulk of the cases are either congenital, or commence before the fifth month. But in certain rare instances, the head may begin to enlarge long after the union of the sutures, in early adult life, or even beyond middle age.

As to modes of commencement, at least four, pretty distinct from one another, may be encountered. (1) The disease may be ushered in by a period of fretfulness and irritability, with or without the occurrence of convulsions and strabismus, before any enlargement of the head is detected. Or (2) slow enlargement of the head may be noticed as the first event. In some cases, this enlargement not only sets in, but may continue for months, till notable increase in size has taken place, and yet the child may exhibit no morbid symptom whatever. The writer has seen a well-marked instance of this in a child whose head had been enlarging for eighteen months (the process beginning when it was a year old), and in whom, though the head was twenty-four inches in circumference, no other morbid signs or symptoms presented themselves. (3) Chronic hydrocephalus may supervene in a child after a fall, through the intermediation of cerebellar disease. The writer had under his care a little girl four years old, who, after falling from a table and striking the occiput severely, suffered for from twelve to eighteen months from symptoms indicative of cerebellar disease, after which the head began to enlarge, and hydrocephalus became the apparently dominant condition. Complete blindness ensued, then convulsions set in, and in the midst of one of these the patient died. A tumour of the middle lobe of the cerebellum was found, *plus* all the signs of a well-marked hydrocephalus. (4) The disease may occur as a sequence of an attack resembling acute hydrocephalus (tubercular meningitis): that is to say, a child appears to suffer for a time from what is regarded as tubercular meningitis; the symptoms then undergo some mitigation; they become more or less chronic; and ultimately the head begins to enlarge, as it does in chronic hydrocephalus. There is some doubt about the real nature of the starting-point in this mode of origin. The initial symptoms may not in reality have been those of tubercular meningitis. The chronic disease and its symptoms may occasionally be initiated in an acute manner.

It may be easily imagined that the subsequent course of the symptoms in persons suffering from chronic hydrocephalus, beginning in these various ways, may also be subject to great variations.

As the head enlarges, or as the pressure within increases, sensations of weight or pain may be experienced. The child may show increased fretfulness and irritability; or its manner may become more dull and heavy than natural. At other times there is no noticeable change in these respects.

In the 'symptomatic' forms associated with tumours, there is apt to be vomiting of a very obstinate and paroxysmal character, together with continuous pain, marked by exacerbations. Convulsions, either unilateral or general, may also occur, as well as paralysis of one or other of the ocular muscles. In such cases, too, in comparatively early stages, ophthalmoscopic examination will frequently reveal optic neuritis, which has a tendency to go on to white atrophy, with the production of more or less complete blindness.

In later stages of the disease mental action becomes increasingly impaired, there is loss of memory, dulness, and a great tendency to sleep during the day. There may be marked weakness or actual paralysis of limbs. Children affected to this extent often keep to the recumbent position, having at last no power of sitting up, or even of raising their head from the pillow. The appetite sometimes remains good; at other times it becomes much impaired, and a gradual emaciation ensues. Blindness, more rarely deafness, loss of smell, and impairment of other senses tend gradually to reveal themselves after a time.

Complications.—In all cases where the hydrocephalus is itself symptomatic of some primary intra-cranial disease, interfering with the proper return of blood from the ventricles and central portions of the brain, the symptoms resulting from this latter state of things are necessarily complicated with others immediately produced by the original morbid condition. Hence the very great variations encountered in the grouping of symptoms in different cases.

Diagnosis.—Some remarks have already been incidentally made upon this subject under the head of *Anatomical Characters.*

Where the head becomes distinctly enlarged, with widely separated sutures and open fontanelles, there can be scarcely any room for doubt about the diagnosis. But before the head is distinctly enlarged, the diagnosis of chronic hydrocephalus with any degree of certainty is impossible. In many cases also where the head is only slightly enlarged, and the sutures are not opened, it may be very difficult, for a time, to pronounce an opinion as to whether or not an infant or young child is hydrocephalic. Natural variations in the size of the head are considerable; and it may also be enlarged from rickets, or from that very rare condition known as 'hypertrophy of the brain.' Even great thickenings of the bones of the head have occasionally given rise to uncertainties in regard to diagnosis. But in all these cases, in order to enable the practitioner to arrive at a trustworthy opinion, the particular form of the head has to be considered, together with the sum-total of the various symptoms which may have preceded or accompanied its increase.

Whether in any particular case we have to do with an instance of 'idiopathic' or of 'symptomatic' hydrocephalus, often cannot be settled; but in others it can be decided by reason of the existence of a set of symptoms distinctly pointing to the presence of an intracranial new growth.

Prognosis.—Hydrocephalus often proves fatal in the course of a few months; or it may be less rapid, entailing death only after a year or two. Its progress is variable, however. Remissions and stationary conditions are apt to occur, chequered by periods in which there are distinct exacerbations of all the symptoms.

Occasionally one of these stationary conditions becomes prolonged, and the individual may live for years. Some hydrocephalic subjects have subsequently lived on to the age of twenty, thirty, or even forty years. In a few exceptional cases a cure seems to have been effected, either naturally or under the influence of remedial agencies.

Death may take place in convulsions; from slow exhaustion with emaciation; or from intercurrent pneumonia or some other acute disease.

Treatment.—Very little, unfortunately, can be done, in the majority of cases, to produce decided or lasting improvement. This is especially so in those instances—only too numerous—in which the hydrocephalus is due to some scrofulous or other tumour interfering with the return of blood from the ventricles.

Blistering of the scalp, with mercurial inunctions, formerly much lauded, may do a great deal more harm than good; and the same may be said in reference to pressure of the enlarged head by strapping or bandages. This latter is a barbarously coarse method of treatment, which has happily fallen into disuse. Blistering may do good in some cases, but it should be cautiously had recourse to.

The general health of the child must be maintained as much as possible, by the aid, if necessary, of tonics and cod-liver oil. Purgation and diuretics may also be had recourse to. Iodide of potassium may be given internally in gradually increasing doses, as even young children bear this remedy well. Bromide of potassium will also help, perhaps, to mitigate vomiting and convulsions, when these are urgent symptoms.

It may be worth while in suitable cases to try the effect of greatly diminishing the amount of fluids taken, so as to reduce the fulness of the vascular system. The writer has had reason to believe that this method is well worthy of being attempted, where other means have failed, and where there is any chance of being able to carry it out.

Puncture of the head has been much lauded, and practised by many, but with an amount of failure and fatality that has caused the method almost to have fallen into disuse. If in any given case we could be reasonably certain that the hydrocephalus belonged to the 'idiopathic' variety (if there really are such cases), the method might be had recourse to, with much more chance of success than if it were occasioned by some mechanical pressure, which persists and prevents the return of blood from the central parts of the brain. Puncture of the head can scarcely be compared with puncture of the chest, because (even apart from the greater risks attaching to the former operation), a puncture of the chest in a case of pleurisy has a fair chance of being actually curative, whilst puncture of the head in hydrocephalus, in the majority of cases and for the reason above indicated, could only be palliative. Still the cases of this disease are so grave that where the sutures are opened, where the patient's condition is rapidly getting worse, and death seems otherwise inevitable, the question of performing the operation, at least once, ought to be entertained as a barely possible means of affording relief.

H. Charlton Bastian.

HYDROMETRA (ὕδωρ, water, and μήτρα, the womb).—Dropsy of the womb. *See* Womb, Diseases of.

HYDRONEPHROSIS (ὕδωρ, water, and νεφρὸς, the kidney). Synon.: Dropsy of the kidney; Fr. *Hydronéphrose*; Ger. *Hydronephrose.*

Definition.—A chronic disease of the kidney caused by obstruction of the ureter; consisting in dilatation of the pelvis, and commonly of the ureter, with more or less extensive atrophy of the substance of the organ; usually affecting one kidney, sometimes both; characterized clinically by the presence of a soft fluctuating tumour in the renal region, but most distinctively by sudden discharge of urine with collapse of the tumour; and resulting, if not relieved, in complete destruction of the kidney.

Ætiology.—Among the most common causes of hydronephrosis are obstruction of the ureter at its lowest part, in consequence of pressure by new formations, particularly carcinoma of the uterus; the impaction of calculi of various kinds; and tumour of the ovary. More rarely it is induced by new formations in the bladder; stricture of the urethra; the pressure of the pregnant, prolapsed, or retroflexed uterus; and exceptionally it is met with without apparent cause. In such cases it is to be referred to some contraction, due to inflammation or other cause, which has disappeared. The condition is also sometimes congenital, being due to malformations, such as impermeable ureter, or valve-like obstruction to the passage of urine downwards. From whatever cause the obstruc-may spring, accumulation of urine takes place behind it, leading to gradual distension of the organ. *See* URETERS, Diseases of.

ANATOMICAL CHARACTERS.—In the earlier stage of hydronephrosis there is simple dilatation of the pelvis of the kidney. As the disease advances, the dilatation increases, the organ becomes more and more distended, and the ureter often becomes so dilated or elongated as to present the appearance of a bluish-white tube, as large as or even larger than the inferior vena cava. Coincidently with this distension the substance of the kidney atrophies. At first the apices of the cones become flattened and wasted, but gradually the renal substance becomes more involved, until at length, in old-standing cases, scarcely any trace of it remains, and the kidney is represented by a large lobulated bag, whose fibrous walls are distended by clear fluid. Commonly one kidney only is affected, especially when extreme dilatation exists, but in some instances both kidneys are involved. There is a case on record where the whole abdominal cavity was occupied by an enormous tumour, containing sixty pounds of fluid.

SYMPTOMS.—In the slighter cases of hydronephrosis there are no symptoms of such a kind as to attract attention. This condition is often an unimportant complication of other serious diseases. In the more severe cases there are no constitutional symptoms, but the local changes are well-marked. There is a tumour situated in the lumbar region, extending upwards, downwards into adjacent regions, or forwards towards the anterior abdominal wall. The colon is usually in front of the tumour, and always displaced and compressed, so that constipation frequently coexists with hydronephrosis. The mass is often lobulated, always undulating in character; and frequently fluctuation may be detected. The most conclusive evidence of the condition is afforded by the discharge of a large quantity of urine, generally of low specific gravity, and often containing mucus, coincidently with the disappearance or diminution of the tumour. It sometimes happens that the obstruction is permanently removed, and dilatation alone remains as evidence of the old obstruction. Hydronephrosis, when double, sooner or later proves fatal by suppression of urine or uræmia. When only existing on one side, it has proved fatal by pressure upon neighbouring parts; by the supervention of impaction of stone in the kidney of the opposite side; or from other causes.

DIAGNOSIS.—The distinction of hydronephrosis from ascites may be sometimes difficult when the disease affects both sides. The diagnosis is partly to be made by observing the effects of change of posture, hydronephrosis being much less influenced thereby than ascites. The history and mode of origin of the affection also afford indications. From hydatids of the kidney it is sometimes impossible to discriminate hydronephrosis, but the history of the case and the characters of the urine often afford a clue. If there be tumour on both sides, it is extremely unlikely to be hydatid. From ovarian tumour the diagnosis is to be made by the history of the case; the position of the mass; its relations to the colon; and by vaginal and rectal examination. From perinephritic abscess hydronephrosis is distinguished by its being less hard, and by the absence of pain and fever.

PROGNOSIS.—The prognosis is always serious; but if one of the kidneys be sound it becomes enlarged, and does double work, and so long as this condition continues, the patient may suffer little inconvenience.

TREATMENT.—Careful manipulation of the tumour is often useful in extreme conditions; and tapping with the aspirator may be employed.

T. GRAINGER STEWART.

HYDROPATHY (*ὕδωρ*, water, and *πάθος*, a disease).—A synonym for hydrotherapeutics. *See* HYDROTHERAPEUTICS.

HYDROPERICARDIUM (*ὕδωρ*, water; and *pericardium*, the pericardium).—An accumulation of serum in the pericardium, either dropsical or inflammatory. *See* PERICARDIUM, Diseases of.

HYDROPHOBIA (*ὕδωρ*, water, and *φόβος*, fear).—SYNON.: Rabies; Dog-madness; Fr. *Lyssa; la Rage*; Ger. *Hundswuth*; *Wasserscheu*.

DEFINITION.—An acute disease, produced by the inoculation of a specific animal poison; manifesting itself by symptoms due to disturbance of the central nervous system; and almost invariably proving fatal.

ÆTIOLOGY.—Never spontaneous in man, the sole cause of hydrophobia is inoculation with the poison of a rabid animal, almost invariably with the saliva, the inoculation being commonly effected by a bite. In about nine-tenths of the cases, the disease is contracted from dogs; in most of the remainder from cats; in very few cases from foxes or wolves. It has been acquired from a wound received during the dissection of a rabid animal. It is probable, although not certain, that inoculation with the blood of a rabid animal will produce the disease. The poison is not *known* to be present in any other secretion than the saliva. Commencing decomposition is said to destroy its activity, but it is probable that the dried saliva will retain its virulence for a considerable period.

Inoculation takes place more certainly by a bite on an uncovered part of the body, as on the hands and face, than by a bite inflicted through the clothes. It may occur without a bite, as by a lick upon an abrasion. It has followed the scratch of a cat, probably by the animal's saliva being thus inoculated. A healthy dog has communicated the disease by a bite given immediately after it had been fighting with a rabid animal, the saliva of which, no doubt, was hanging about its jaws. The disease has resulted from the teeth being used to loosen a knot upon a rope with which a rabid dog had been tied.

It has been asserted that the disease may arise from the bite of a healthy dog, but this is improbable. Cases are on record, however, in which the disease has followed the bite of a dog, which did not at the time, or for several weeks afterwards, present the recognised symptoms of the disorder. It seems possible that in rare cases rabies may affect a dog as a mild and insignificant malady.

When no preventive measures are adopted, at least half, perhaps two-thirds, of persons bitten escape. The immunity may be due partly to the bites being inflicted through clothes; partly to individual insusceptibility, which has been found to exist in animals as well as in man. When preventive measures are adopted as soon as possible, the proportion of those who escape is much greater.

More males than females suffer, the proportion being three to one. So, too, in dogs. The largest number of cases occur in the middle period of life, doubtless from greater exposure to the cause. Children, however, often suffer, being helpless and bitten about the face. Most cases are contracted from straying or pet dogs.

The *period of incubation* is longer than that of any other acute specific disease, and is singularly variable. It is rarely less than a month, the shortest on record having been about twelve days. The average period is six or seven weeks. In about half the cases it is between one and three months. In some cases it is longer, reaching six, nine, or twelve months. Cases have been recorded in which two, three, five, and even ten years intervened. Most authorities believe that such cases were either not true hydrophobia, or were due to a second unknown infection. If we admit, however, as we must do, that twelve or eighteen months may elapse, we can scarcely deny the possibility, or even probability, of longer periods. It is as hard to explain an incubation period of one year as of five years.

ANATOMICAL CHARACTERS.—General fluidity of the blood, such as is met with after death from acute septic diseases; redness of the throat and pharynx, and occasionally of the salivary glands; together with, in some cases, evidence of congestion of the brain and spinal cord, constitute the chief morbid appearances visible to the naked eye. The microscope has shown that there is evidence of inflammation (congestion and leucocytal infiltration) in the salivary glands (Coats); and that minute changes in the nerve-centres are almost constantly to be found (Clifford Allbutt, Hammond, Benedikt, Coats, and the writer). Of eight cases examined by the writer, the minute changes in seven were distinct, and in character and position so far characteristic that, given the fact of an *acute* disease, a *post-mortem* diagnosis might, in the vast majority of cases, be made with certainty by the microscope. The essential change consists in the accumulation of leucocytes around the vessels, and their infiltration into the adjacent tissue; this change having a special distribution, being either confined to, or most intense in, the region of the medulla which is contiguous to the lower part of the fourth ventricle, that is, the neighbourhood of the respiratory centre. Here we have also the convulsive centre, and the centre for deglutition. The change is most intense in the hypoglossal, glosso-pharyngeal, and vagal nuclei and their neighbourhood. There is little or no change in the upper part of the medulla, corpora quadrigemina, cerebellum, or basal ganglia. In the convolutions a similar but slighter alteration is present in some cases. It may occur throughout the grey matter of the cord, but is here usually slight, and often absent. In the most affected regions, traces of *ante-mortem* clots and even of inflammation of the walls of the minute vessels may be found in some cases. Perivascular areas of disintegration are common; but such frequently occur apart from hydrophobia or any other disease. Minute extravasations are common, partly mechanical. The only change in the nerve-elements themselves consists in a granular degeneration of the ganglion-cells of the regions chiefly diseased. In the dog the changes are quite similar in characters and distribution.

SYMPTOMS.—During the period of incubation of hydrophobia there are commonly no symptoms. Vesicles under the tongue were formerly described, but their occurrence has not been confirmed. Occasionally pain and discomfort have been felt in the seat of the wound, explicable, in part, by the attention directed to it. Mental depression has been noted, also probably due to anxiety regarding the possible consequence of the bite.

The onset of the acute symptoms is commonly attended by no local disturbance, sometimes by pain, rarely by actual inflammation, in the wound. The first evidence of the impending disorder is usually malaise, mental depression, disturbed sleep, and some discomfort about the throat, with a difficulty in swallowing, especially liquids. The attempt occasions some spasm in the throat, which soon, if not at first, involves the muscles of respiration, causing a short, quick inspiration, a 'catch in the breath,' resembling that due to an affusion of cold water. In a few hours this increases to a strong inspiratory effort, in which the extraordinary muscles of respiration take more part than the diaphragm; the shoulders are raised; the angles of the mouth are drawn outwards. The saliva, which is abundant and viscid, cannot be swallowed. It hangs about the mouth, and the patient is annoyed by his efforts to get rid of it. As the intensity of the spasm increases, so does the readiness with which it is excited. The mere contact of water with the lips, or cutaneous impressions, as a draught of air, will bring on a paroxysm. The distress it occasions leads to a mental state which increases the readiness with which the spasm is produced. The mere sight of water, or the sound of dropping water, will cause it (hence the name), and even analogous visual impressions, as a sudden light or the reflection from a looking-glass. Thus the respiratory spasm excited by swallowing liquids, which is, as it were, the key-note of the disease, extends on the one hand to widely-spread muscular spasm, and on the other to mental disturbance. In each of these directions the symptoms develop. The spasm, from being limited to the muscles of respiration, may become general and convulsive (tetanoid or co-ordinated) in character; still excited by the same causes. The mental distress passes into disturbance, in which the balance of reason is lost, continuously or during the paroxysms. In the frenzy, the horror of the distress is transferred to the attendants by whom any discomfort may have been occasioned, and during the paroxysms the patient may attempt to bite them, and even others. Consciousness may so far remain that in the intervals he may beg those whom he regards to keep away. The saliva is ejected with force, and the patient hawks it up with a noise 'like a dog.' The sight of a dog has been known greatly to intensify the disturbance; and this, strangely enough, in cases in which the sufferer had no suspicion of the nature of his affection. The delirium may, in some cases, be continuous and violent. As the mental disturbance increases, the respiratory spasm and convulsion may lessen, or the latter may persist to the end.

Vomiting is common, and is often an early symptom, a greenish-brown liquid being ejected. Priapism or nymphomania occasionally occurs. The temperature is usually raised two or three degrees. Albumen is often present in the urine; and sometimes sugar.

DURATION AND TERMINATIONS.—The duration of hydrophobia is usually from one to four days; sometimes it lasts six, eight, or ten days. In the rare cases which have recovered, the duration of the acute affection has been from four to ten days, although slight spasmodic symptoms have lasted for a longer time, as does the spasm of whooping cough.

The common cause of death is exhaustion from the attacks of fury and convulsion, often aided by manifest cardiac failure, which may occur early, and be out of proportion to the general asthenia. Sometimes the patient has died asphyxiated in a paroxysm of respiratory spasm; partly, perhaps, from spasm of the glottis.

VARIETIES.—The relative degree of the above-described symptoms varies in different cases. The mental disturbance, or general muscular spasm, may, respectively, predominate over the respiratory throat-spasm, even in the early stages, and may impress a special character on the attack, so that it resembles in the one case a primary mental affection, in the other general convulsive affection, as tetanus.

PATHOLOGY.—We know nothing of the nature of the poison of rabies. It has been thought that it is not at once generalised, but develops in the wound, and subsequently affects the system. The symptoms indicate a primary action on the nerve-centres, especially on the respiratory region of the medulla, spreading more widely, in its ultimate action, in the medulla and to the brain and cord. The vascular changes, from their variability and occasional absence, are probably secondary effects of the disturbed action of the nerve-centre, produced by the poison carried by the blood.

The first effect of the poison is probably to lessen the 'resistance' of the medullary centres. Their action becomes spasmodic; is excited with undue readiness, especially by reflex influences; and spreads too widely. The secondary vascular changes may have their own effects. They are, as in other functional diseases, somewhat random in distribution within the affected area. By the infiltration of leucocytes, the tissue may be broken up, and what are practically minute points of suppuration may result. If the part damaged is important, grave consequences may ensue. The nucleus of the pneumogastric is often so damaged, and thus we can understand the occurrence of cardiac failure. The changes in the convolutions and the spinal cord are probably proportioned to the mental or tetanoid symptoms respectively. The mental excitement no doubt acts upon and increases the irritability of the medulla (Putnam). Conversely, the disturbance of the latter may help to determine the *direction* of the mental disturbance due to the poison.

DIAGNOSIS.—The symptom of greatest diagnostic value is the respiratory spasm excited by attempts to swallow, increasing until it resembles a convulsive action, and accompanied after a time by mental disturbance. In certain diseases of the throat and chest, especially œsophagitis and pericarditis, a reflex throat-spasm may occur, but in such cases there are commonly pain or other obtrusive signs of the local affection. When the mental disturbance occurs early, the affection may be confounded with acute mania: the association with slight respiratory spasm is still the most important diagnostic indication. In cases (if such occur) in which this symptom is absent, the diagnosis is a matter of great difficulty, and can only be made by the history of the antecedent bite, the rapid course of the disease, and its association with other convulsive phenomena and with salivation. From tetanus, hydrophobia is distinguished by the late period after the bite at which the symptoms develop; the absence of trismus and of continuous spasm; and the presence of paroxysmal respiratory spasm, of aversion to liquids, and of mental disturbance. Too much weight must not be given to the general character of the convulsive symptoms, if other signs of the disease are present, since there is probably a tetanoid form of hydrophobia, in which general spasms occur early; but they intermit, and are excited by attempts at deglutition, and there is no trismus. Organic brain-diseases accompanied by delirium and convulsions, occurring after a bite, have been mistaken for hydrophobia, as in a case in which the nature of the disease was only discovered when, after exhumation, meningeal hæmorrhage was found. Here also the respiratory spasm is absent.

Mere mental excitement, directed to the disease, may determine symptoms of dysphagia somewhat resembling the genuine disease—'spurious hydrophobia' as it has been termed. After a period of anxiety regarding the consequences of a bite, spasm in the throat is felt in swallowing. The patient's fears are intensified, the symptom increases, and even the medical attendant may be deceived. The spasm, however, is not of the respiratory character of genuine hydrophobia. Recovery commonly ensues on the mind being tranquillised, or by the application of some remedy in which the patient has confidence. It must be remembered that in some cases of genuine hydrophobia the influence of the patient's mental state has been very clearly traceable even in the early symptoms.

The distinction of genuine from spurious hydrophobia is often rendered difficult by the fact that the latter usually follows suspicious bites, and that the former may be distinctly intensified by the patient's nervous fears. The untypical character of the spasm in the spurious disease (mere dysphagia); the fact that an effort removes this difficulty, and that once overcome it does not return; the stationary condition; the absence of mental symptoms beyond anxiety; and the disappearance of the symptoms when this is removed, are the important guides.

Prognosis.—Hydrophobia is practically fatal, but not certainly so; and the patient personally should unquestionably receive the 'benefit of the doubt.' Cases differ in the intensity and rapidity of their course; and the less rapidly the symptoms are evolved, the greater is the hope, slight though it still is, that an exception to the common fatality may be obtained. The prognosis is better the longer the spasm remains limited; it is worse if there are general convulsions, mental disturbance, and signs of exhaustion or of disproportionate heart-failure.

Treatment.—Adequate measures against the spread of rabies would undoubtedly lessen, perhaps entirely prevent, the occurrence of hydrophobia in man; but the discussion of these is beyond the scope of this article (*see* Rabies). When a person has been bitten by a suspicious or doubtful animal, the circulation in the part should, if possible, be at once arrested by a tight ligature above the place; the wound should be washed; and then it should be allowed to bleed freely. It may probably be sucked with impunity if the mouth is rinsed with water, or better still with vinegar and water, after each act, and if there are no abrasions in the mucous membrane. The act has been supposed to be dangerous; but all experience is opposed to this. Poisons have to remain for some minutes in contact with a mucous membrane before they are absorbed, and during the act of sucking there is a flow from the mucous membrane into the mouth, which must be opposed to absorption. As soon as possible the wound should be cauterised. Of chemical caustics, nitrate of silver, freely applied at once, is probably effectual. If any time have elapsed, nitric acid or liquid carbolic acid is preferable. The actual cautery, applied deeply and freely, is an efficient and ready means. If practicable, free excision of the bite is wise; and should not be neglected, even though the cautery has before been used, if there is any doubt as to the thoroughness of the application.

The methods adopted for the treatment of the developed disease have been numerous. All so-called 'specifics' have been proved to be useless. An attempt has been made to eliminate the poison by administering large doses of mercury, and by diaphoresis. The two have been combined in the mercurial vapour bath. Two or three cases are on record in which this method has been successful; many in which it has been powerless. Of late it has been but little tried.

Attention has been lately directed to curara as a remedy for hydrophobia. First recommended half a century ago by an Englishman (Sewell), it was tried in small doses and failed. Niemeyer suggested larger doses, and in a case by Offenburg it was apparently successful; and since then another case, in America, has recovered under its use. In many cases it has failed—in all cases in this country up to the present time. It is recommended that it should be used in injections of from $\frac{1}{16}$ to $\frac{1}{3}$ of a grain, repeated every quarter or half an hour, until the severity of the paroxysms is lessened. This point may not, however, be reached until general muscular paralysis is imminent or produced, and then artificial respiration may be necessary until the effect has passed away. As often as this is the case, and the spasms recur, another injection must be given. In hydrophobia there is remarkable tolerance of the drug, poisonous doses (one grain repeated) of active curara having in one case been without any effect (Curtis). This is, perhaps, a hopeful fact, as it indicates that curara has an action to which the changes in the central nervous system are opposed.

Sedatives have been the remedies commonly employed, and of these the best are chloral and morphia. One case (probably genuine), in which morphia and calabar bean were used, recovered (Nicholls); and one in which chloral was employed lived for ten days (Sansom). The effect of the two on the respiratory centre in animals suggests their joint use. The morphia should be given by hypodermic, the chloral by rectal injection. Chloroform is useful in moderating the paroxysms, but appears somewhat inferior to chloral. Other sedatives—Indian hemp, &c.—have appeared of inferior value.

Cold affusions to the cervical spine and head were used in India in two cases which recovered, the throat and spine being blistered with nitrate of silver, and chloroform administered. Ice to the spine has been tried without effect. Tracheotomy was recommended by Marshall Hall in one case. Death from *laryngeal* spasm, is, however, too rare to justify the measure.

In all cases tranquillity is of the greatest importance. Every excitant of spasm should be avoided; the patient being kept in a dim still room, and friends as much as possible excluded. Next in importance is nourishment, which should be given by the rectum, if spasm is excited by the attempt to swallow. Restraint, which may be necessary, should be as little as possible, but it should be effectual.

The saliva of persons suffering from hydrophobia has been proved to be capable of communicating the disease to animals. Hence the attendants should be cautioned to have no uncovered abrasion on the hands, and to wash from the eyes or face any saliva which may have been spit on them; and if they are bitten by the patient, the wound should be treated as if it had been inflicted by a rabid animal. These precautions remove all danger; and any anxiety the subjects may feel may be relieved by the assurance, that of the thousands of persons who have attended on patients with hydrophobia, no authentic instance has ever been recorded in which the disease was contracted either by attendance during life, or inspection after death. W. R. Gowers.

HYDROPS (ὕδωρ, water).—A synonym for dropsy. *See* Dropsy.

HYDRORHACHIS (ὕδωρ, water, and ῥάχις, the spine).—A collection of fluid in the spinal canal. The term is commonly used as a synonym for spina bifida. *See* Spina bifida.

HYDROTHERAPEUTICS (ὕδωρ, water, and θεραπεύω, I treat).—SYNON.: Water-cure; Hydropathy; Fr. *Hydrothérapeutique*; Ger. *Wasserheilkunde.*

It would be out of place were we to enter here into a description of the sources and the composition of the numerous varieties of water used for hygienic and dietetic purposes; but we may refer to Dr. Parkes' instructive *Manual of Practical Hygiene.* We intend to divide this article into (1) a short sketch of the history of the water-cure or hydrotherapeutics; (2) notes on the internal use of water, and on the more common hydrotherapeutic procedures; and (3), a consideration of the morbid conditions suitable for hydrotherapeutic treatment.

History of the Water-cure.—Although the old Greek and Roman physicians occasionally employed water internally and externally in the treatment of disease, the systematic water-treatment seems to have gained ground for the first time in the 15th and in the beginning of the 16th century in Italy and France, and again after a period of oblivion in the 17th century, especially in England (Floyer, T. Smith), and in the beginning of the 18th century in Germany (F. Hoffmann). The next important scientific application we owe to J. G. and J. S. Hahn, who, towards the middle of the 18th century, treated febrile diseases with cold sponging, and were so convinced of the beneficial result, that one of them when attacked with typhoid fever subjected himself to this treatment. It fell, however, again into neglect, until towards the latter part of the 18th century, when Wm. Wright, James Currie, W. Jackson, and others resuscitated the cold water treatment in fevers, and strengthened their reasoning by thermometric observations. In spite of the results obtained, not only in England but also in Germany, amongst others by Reuss, Frohlich, Brandis, and Horn, the method was again falling into disuse, when, soon after 1820, a small farmer, Vincent Priessnitz, of Graefenberg, in Silesia, began to treat every kind of ailment, chronic as well as acute, with various hydrotherapeutic procedures, and added to the external applications the abundant internal use of water, combined with active exercise, and a very simple diet; prohibiting at the same time all alcoholic beverages, and also tea and coffee. Priessnitz gradually made considerable changes in his method of treatment. For the original packing during several hours in dry woollen blankets covered with feather-beds, and followed by cold affusions, he substituted packing in wet linen sheets during several hours, followed by a full bath or a douche; and at a still later period, he frequently employed cold wet packing of only 15 or 20 minutes' duration, repeated several times on the same day; he introduced also the method of rubbing the whole body with a cold wet or dripping sheet instead of the full bath, and made extensive use of partial baths, as hip or sitz baths, baths for the hands, the arms, the feet, wet abdominal belts, and wet compresses over different parts of the body. Priessnitz seemed to search for a universal method applicable to all cases. One of the guiding ideas was that disease of the most different nature was caused by an acrid humour in the blood, and that the skin was the organ through which this humour was to be removed. Though the success of such treatment, combined with active exercise in a healthy mountainous country, and simple diet, was considerable in many cases, the indiscriminate, too energetic, and protracted use often led to unfavourable results, and the system was beginning to be regarded as a species of quackery, when, about thirty years ago, some establishments were placed under the superintendence of regularly educated physicians, who studied the physiological effects of the different forms of bathing, and modified them with regard to duration, temperature, &c., according to the requirements of individual cases, combining pharmaceutical remedies with hydrotherapeutic procedures when required. Thus a more or less modified water-cure has at last become a branch of rational medicine, at least in France and Germany; and a new impulse has been given to it lately, by the employment of various forms of baths in the treatment of fevers. In this country there is as yet, very little systematised relation between the special hydrotherapeutic and the general medical treatment; and the experience gained at hydrotherapeutic establishments is not communicated and discussed in our medical societies, and scarcely ever in the general medical journals. This is much to be regretted, for there can be no doubt that hydrotherapeutic measures might be more widely introduced with great advantage into our hospitals, as well as into our private practice; but this is not likely to be the case so long as the medical profession has not fuller opportunities for studying the effects of water treatment. The fault may lie to some degree in the nature of most of the establishments for the water-cure; but this might be remedied if more establishments were to be erected under the guidance of superior members of the profession—establishments where the usual medical treatment would in suitable cases go hand in hand with hydrotherapeutic management.

Internal Therapeutic Use of Water, and the more Common External Hydrotherapeutic Procedures.—The dietetic necessity of water is well known; life cannot exist without it; all our tissues contain an indispensable proportion of water; we constantly lose a large amount by respiration, and by all excretions; all the internal functions of tissue-change are dependent on a certain quantity of water; this want is supplied by the solid and fluid food which we take, water included; while temporary excess of supply leads to increased discharge by the excretions, and temporary deficiency to a diminution of the water of the excretions. An increased ingestion of water further leads, for a time at least, to an increased removal of the products of retrogressive tissue-change; the tissues and the blood itself are, so to speak, washed out by it; and, as the consequence of the increased removal of the used-up material, the body is enabled to take in a larger amount of new substance, and hence we observe not rarely increase of weight as the effect of plentiful water-drinking, if not carried to excess as regards quantity and time; the secretions of the urine, bile, saliva, and pancreatic juice, appear to be increased by the abundant internal use of water, as well as the perspiration; though the latter to some degree requires the concomitant influence of high external temperature or bodily exercise.

Water has also an important share in all internal courses of mineral waters. Used by itself, it can exercise some good influence in cases of gout and gravel, in hæmorrhoidal complaints, imperfect secretion of bile, and constipation from sluggish peristaltic action. As, however, excessive water-drinking, according to Priessnitz's original plan, is apt to cause dyspeptic troubles, water is now, in general, used internally only either for dietetic purposes, or to assist in other courses of treatment.

The *external use* of cold water admits of a very great variety of applications, and a corresponding variety of effects on the body. The two main effects of the different forms of cold baths are *abstraction of heat*, with its further influences on the functions of the body; and *stimulation of the cutaneous nerves*, and through these of the nerve-centres. Both effects are usually combined, but in some forms of bath, the stimulation or the *exciting effect* preponderates; in others the abstraction of heat, with its *calming* or *depressing influence.* Hence the different forms of baths, or rather hydrotherapeutic procedures, may be divided into *stimulating* and *calming*, but it is to be borne in mind that there is no strict line of distinction. With this limitation we may regard as *stimulating*—the *full* cold bath of short duration, the stimulating action of which is increased by motion of the water, be it natural or artificially imparted; the rapid wash-down, either by means of a large sponge, or by means of a wet sheet, with or without friction; the spouting of the back, and the pail-douche; the needle-bath or circular shower-bath; the different forms of the rain-bath, and the usual shower-bath; the great variety of other douches; and the running or flowing sitz-bath. The immediate effects of these stimulating forms, in a constitution endowed with a certain amount of reactive power, are exhilaration, increased activity of circulation and muscular force, and improved appetite and digestive power. By altering the duration of the bath, and the temperature of the water, the effects may be considerably modified, and thus adapted to different conditions.

The more *calming* forms are—the wet sheet-envelope, entire or partial; the impermeable wet compresses; the full cold bath of long duration and without motion; the sitz, the shallow, and foot baths without motion; and the full bath of higher temperature. Depression through abstraction of heat exceeds the stimulation in these forms: diminution of nervous irritability, of sensation and mental activity, and of the frequency of the pulse and energy of circulation; a feeling of lassitude; and a tendency to sleep, are the principal effects. These forms can, however, be modified, and the effects vary in proportion. Thus the wet sheet-envelope allows ample variation by using warm or cold water, by using the sheet dripping or wrung out, by making the sheet fit tightly round the neck, by moving the sheet to and fro, by frequently changing the sheet, &c. The calming and stimulating form may be further combined by using, first, the wet sheet-envelope, or the woollen blanket-envelope, for a sufficient period to produce perspiration; and then a more or less cold bath or shower-bath of short duration. The physician has, indeed, infinite varieties of application at his disposal, to be used according to necessity.

Powerful and most important hydrotherapeutic helps are the different vapour- and hot air-baths (Russian, Roman, Turkish baths), combined with douches and baths of various temperatures. These kinds of baths are, however, treated of in another article. *See* BATHS.

A plain nourishing diet, without or with only a limited amount of stimulants; outdoor exercise in proportion to the strength of the individual; and in some cases active or passive gymnastics, are likewise to be regarded as valuable adjuvants in the hydrotherapeutic treatment of chronic diseases; for muscular exercise means not only increased action, oxidation, excretion, and development of muscle, but also increased general circulation and respiration, increased inhalation of oxygen, and increased production of heat, so necessary in the cold water-cure. There is also no reason whatever why pharmaceutical remedies should not be combined with the water-cure treatment—a method which, as already mentioned, is frequently adopted in the best establishments.

Therapeutic Effects, and Morbid Conditions Suitable for Hydrotherapeutic Treatment.—The principal results of well-adapted courses of cold water treatment are:—improved nutrition and action of the skin; increased tone of the nerve-centres; regulation of the circulation; amelioration of the sanguification and nutrition; and acceleration of the retrogressive tissue-changes. It is essential for such successful results that the organism be able to stand a certain amount of abstraction of heat; that it be capable of more or less energetic reaction; and that the digestive and assimilative organs be able to take up a fair amount of nourishing material, which is required by the increased demand on the body.

Acute febrile diseases.—Amongst the oldest therapeutic uses of the cold bath, though it has only lately been more extensively revived, is the employment of different forms of cold baths in acute febrile diseases, attended with a high degree of pyrexia. The moderately cold or the cooled-down bath, as proposed by Dr. von Ziemssen of Munich, is the form principally employed; but cold affusions, the shower-bath, the wet envelope frequently changed, cold compresses, the application of ice in substance, washing with iced water, and iced enemas are likewise applicable; and the liberal internal allowance of cold water forms an important part of the dietetic management of this class of diseases.

Typhoid fever.—Typhoid fever is the disease in which this treatment, with numerous modifications, has been most generally adopted. As soon as the temperature of the patient reaches 102·0° to 103° Fahr., he is placed in a bath of about 90° Fahr., and the temperature is gradually cooled down, by the addition of cold water, to 80° or 60° Fahr., according to the patient's power of reaction. The patient is kept in the bath generally from 10 to 15 or 20 minutes, when slight shivering often manifests itself. The patient's temperature, measured in the rectum, is usually reduced by this procedure about 1½° to 5° Fahr., not immediately, but within the first hour after the bath. As often as the temperature may again reach 102·0°

to 103°, the patient is again placed in the bath. Thus, during the height of the pyrexia three to five baths may be required in twenty-four hours, while later on about two are usually sufficient, and often only one. Instead of the bath gradually cooled-down, a bath of a temperature between 60° and 90° Fahr., may be given, according to the condition of the individual patient. The frequent and careful use of the thermometer is an essential element in this method of treatment, which may be, as it often is, advantageously combined with the administration of alcohol, quinine, and other remedies. The earlier the baths are commenced, the greater seems to be their influence in mitigating the severity of the disease and its sequelæ, and in shortening its duration. In the numerous accounts of German physicians (Brand, Ziemssen, Zimmermann, Jürgensen, Liebermeister, &c.) it is claimed that the mortality is considerably less with this than with the expectant or any of the other usual modes of treatment.

Hyperpyrexia.—A still bolder use may be made of the cold-water treatment, in those rarer cases of hyperpyrexia occasionally occurring in the course of rheumatic fever, when the temperature rises to 108° Fahr. and more; and where very cold and prolonged baths, the application of ice-bags, &c., appear to be the only means of saving life. (*See* Dr. Wilson Fox, *Treatment of Hyperpyrexia*; the writer's case in the *Clinical Society's Transactions*, vol. v.; and several other papers in the *Clinical Society's Transactions*.)

Scarlet Fever.—In scarlet fever we have found warmer baths (80° to 98° Fahr.) more generally applicable than quite cold or cooled-down baths, though in cases attended by a high degree of pyrexia and brain-symptoms these are preferable.

Hectic fever.—In hectic fever, connected with various chronic diseases, the effect of hydrotherapeutic treatment is less decided, and not yet sufficiently tested.

Digestive derangements of the most different kind, associated with *sluggish venous circulation* in the abdominal organs—conditions which may be grouped together under the term *abdominal venosity*, tendency to hæmorrhoids, to hypochondriasis, &c., are often the objects of the water cure, which may be useful by stimulating the physical and psychical energy of the nervous system, as well as the nutrition and tissue-change, by invigorating the skin. Habitual constipation from this cause is often relieved by the hydrotherapeutic belt. In this class of cases the common salt waters, and the alkaline sulphatic waters are more frequently used, and are often preferable; they may, however, be advantageously combined with judicious hydrotherapeutic treatment.

Chronic metallic poisoning may be treated in some cases with equal benefit, if there is sufficient reactive power, at cold water establishments, as at the thermal sulphur and simple thermal spas. The external hydrotherapeutic procedures aiming at increased perspiration and tissue-change, are in this class aided by the abundant internal use of water, in order to wash out the tissues, and especially the liver.

Skin-weakness or *atony of the skin* is often the cause of frequently recurring attacks of diarrhœa with neuralgic pains, of tendency to catarrh of the respiratory mucous membrane, and of rheumatism. . Gently stimulating hydrotherapeutic appliances, with gradually increasing energy, are here mostly useful, unless, as in impeded convalescence, the reactive power is so reduced that the gaseous thermal salt baths and mountain-air are preferable, while in others sea-air and sea-baths are successful competitors of the water-cure.

Hysteria.—In hysteria and hysterical affections the water cure has obtained many good results, not by the internal use of water, but by the milder forms of baths. Functional hyperæsthesia and anæsthesia, hemicrania, spinal irritation, intercostal neuralgia, and other forms of neuralgia depending on imperfect nutrition and tissue-change, are likewise often benefited.

Organic diseases of the nerve-centres are not suitable for treatment in cold water establishments, excepting occasionally for palliative purposes.

Rheumatism and gout.—In *muscular rheumatism* the original supporters of the water-cure considered their plan as infallible, but this is by no means the case. The diaphoretic methods, namely, the woollen blanket-pack and the wet sheet-envelope, often prove useful; but we know also of many failures in even good establishments. The exposure to all weathers during the cure ought certainly not to be imitated by such invalids, and the access of cold air to the wet body is to be more carefully avoided than it often is. The course must not be prolonged too much at one time, but may be repeated after an interval of months, which may be spent with advantage at sheltered seaside localities, at moderate elevations, with the help of pine-leaf baths, or at one of the gaseous thermal saline spas.

Rheumatic and *gouty swellings* of joints require great care in their management. The enfeebled invalid is rarely a fit object for the water-cure; but the stimulating local compress, more or less impermeable, is a useful element in the treatment of such cases.

Milder cases of *gout* may expect benefit from the usual hydrotherapeutic treatment, in so far as it aims at increased retrogressive tissue-change, and invigoration of the nervous system, especially if this treatment is associated with great moderation in the use of stimulants, and also of food in general; but local packing not rarely causes fits of gout. The more serious forms of gout are too much complicated with various defects of constitution to encourage us in recommending cold-water treatment.

Chronic affections of the skin.—In some diseases of this kind, such as prurigo, urticaria, eczema, and local perspirations, a more or less modified hydrotherapeutic treatment is an important adjuvant.

Syphilis.—The favourable results obtained in syphilis, or rather in the often complicated conditions of *lues*, have greatly contributed to the reputation of the water-cure; but the latter is only an excellent adjuvant to pharmaceutical treatment in these cases, in a similar way as the sulphur waters are; and many of the cures of so-called *lues* may be regarded as cures of *mercurialism*.

Catamenial irregularities are not rarely treated at hydrotherapeutic establishments. Profuse menstruation is often checked by the regular use of the cold hip-bath of short duration, namely, three to five minutes; in insufficient menses, on the other hand, warm hip-baths of ten to fifteen minutes' duration are frequently useful, combined in some cases with the wet sheet-envelope; and dysmenorrhœa is likewise occasionally treated with advantage by the partial wet sheet-envelope.

This list of morbid conditions which may be more or less benefited, might easily be increased; and this is not astonishing if it is considered that hydrotherapeutic treatment can be infinitely modified and adapted to the powers of the constitution; and that it may be assisted by varying hygienic, climatic, dietetic, and pharmaceutical influences; for there does not exist any antagonism between hydrotherapeutic and other rational treatment, the former being, in fact, only part of the latter. Hence, however, it is also evident that the treatment in well-arranged hydrotherapeutic establishments ought to be under the guidance of the most intelligent physicians, just as is the case at all the best spas; indeed the physician at such an establishment ought to be of a very superior kind, possessing in a more than usual degree the gift of recognising all the individual peculiarities of the constitution, especially the amount of reacting power, adapting the principal remedy to every individual case, and combining other elements of treatment with hydrotherapeutic management wherever this is necessary. In the same way as we demand in suitable cases the administration of other remedies together with water-treatment in hydrotherapeutic establishments, so we must also express a wish, that out of such establishments, hydrotherapeutic elements should be more generally combined with the usual medical treatment. For this purpose it is to be desired that well-conducted establishments should be in or near large towns, in order that persons following their usual occupations might undergo certain kinds of treatment at such establishments, or that attendants from such establishments might be sent to the house of invalids. Hermann Weber.

HYDROTHORAX (*ὕδωρ*, water, and *θώραξ*, the chest).—Dropsy of the pleura. *See* Pleura, Diseases of.

HYDRURIA (*ὕδωρ*, water, and *οὖρον*, urine). A profuse flow of watery urine. *See* Urine, Morbid Conditions of.

HYÈRES, in Var, France. Dry, warm climate. Town three miles from the sea. Much exposed to N.W. wind (*Mistral*) in spring. *See* Climate, Treatment of Disease by.

HYGIENE (*ὑγίεια*, health).—The science and art relating to the preservation of health. *See* Personal Health; and Public Health.

HYPÆMIA (*ὑπὸ*, under, and *αἷμα*, blood).—Deficiency of blood in a part; a synonym for local anæmia. *See* Circulation, Disorders of.

HYPÆSTHESIA (*ὑπὸ*, under, and *αἴσθησις*, sensation).—Diminished sensibility of a part. *See* Sensation, Disorders of.

HYPERÆMIA (*ὑπὲρ*, over or excessive, and *αἷμα*, blood),—Excess of blood in a part. *See* Circulation, Disorders of.

HYPERÆSTHESIA (*ὑπὲρ*, over, and *αἴσθησις*, sensation).—Increased sensibility of a part, *See* Sensation, Disorders of.

HYPERALGESIA (*ὑπὲρ*, over, and *ἄλγος*, pain).—Undue sensibility to painful impressions. *See* Sensation, Disorders of.

HYPERIDROSIS (*ὑπὲρ*, excessive, and *ἱδρῶς*, sweat). — Excessive perspiration; also termed *idrosis*, *ephidrosis*, and *sudatoria*. *See* Perspiration, Disorders of.

HYPERINOSIS (*ὑπὲρ*, over, and *ἴς*, *ἰνὸς*, flesh).—Excess of fibrin in the blood. *See* Blood, Morbid Conditions of.

HYPERMETROPIA (*ὑπέρμετρος*, beyond all measure, and *ὦψ*, the eye).—A congenital or acquired error of refraction of the eye, in which, owing to low refractive power of the dioptric media, or too little convexity of the refracting surfaces, or unnatural shortness of the anterio-posterior axis of the eyeball, parallel rays of light do not, while the accommodation is in repose, converge to a focus on the layer of rods and cones of the retina, as in the normal or emmetropic eye, but to an imaginary point somewhere behind. It is the opposite of Myopia, and is sometimes called Hyperopia or Hyperpresbyopia. *See* Vision, Disorders of.

HYPEROPIA (*ὑπὲρ*, above, and *ὦψ*, the eye). *See* Hypermetropia.

HYPERPLASIA (*ὑπὲρ*, over, and *πλάσσω*, I mould or form).—An excessive growth of normal tissue-elements, which may lead to hypertrophy, or to the formation of distinct tumours. *See* Hypertrophy; and Tumours.

HYPERPRESBYOPIA (*ὑπὲρ*, above, *πρέσβυς*, old, and *ὦψ*, the eye). *See* Hypermetropia.

HYPERPYREXIA (*ὑπὲρ*, excessive, and *πυρεξία*, fever).—Excessive pyrexia. *See* Fever; and Temperature.

HYPERTROPHY (*ὑπὲρ*, over; and *τροφὴ*, nourishment).

Definition.—The word 'hypertrophy' signifies excessive nourishment, but is in practice used to designate the result of excessive nourishment, that is, excessive growth. Hypertrophy may be *general* or *partial*.

I. **General Hypertrophy.**—General hypertrophy, though a remarkable condition, is of little practical importance. It is known only in those individuals of enormous size, who are called 'giants.' The production of giants depends on causes entirely unknown, since it is noticeable that this condition commonly affects only one in a family, and is in its most conspicuous forms not hereditary. Giants are usually of feeble constitution, and deficient in procreative power. The name *macrosomatia* has been given to a condition equally unexplained, in which the whole body becomes enlarged in a monstrous degree. This condition has been observed to be in some instances congenital, or, at least, to begin in very early life. True general hypertrophy does not appear to be capable of being produced by any artificial means, since excessive feeding either produces hypertrophy almost confined to one tissue, namely, fat, or else fails to produce any enlargement at all.

II. **Partial Hypertrophy.**—By this is meant (*a*) excessive increase of any part of the body during the period of natural growth, either in intra-uterine or extra-uterine life; or (*b*) increase of a part already completely formed. According to this distinction hypertrophy may be classified as *congenital* or *acquired*.

1. CONGENITAL HYPERTROPHY. — Congenital hypertrophy is that condition in which some part of the body begins from the first to grow so rapidly as to attain a size far beyond the normal. This condition has been seen to affect one side of the body, or one limb only, which thus becomes much larger than its fellow on the other side. Such a condition might be in theory difficult to distinguish from atrophy of the opposite side, or of the other limb, that is, from hemiatrophy (*see* ATROPHY); but in general the hypertrophic side is so far beyond the normal size as to prevent ambiguity. One remarkable case is on record in which one leg and arm assumed the proportions of those of a giant, whilst the other remained unaltered. Sometimes a congenital hypertrophy occurs without this unilateral character, as in the case reported by Mr. Curling of a girl aged fifteen, who had several fingers of both hands enlarged in an extraordinary degree without any assignable cause, the equality of the two sides being nevertheless preserved. Such instances, although unexplained, must, it would seem, be put into the same class as the gigantic growth of the whole of the body. Hypertrophy of special tissues is also sometimes congenital, as of the skin in ichthyosis. Hypertrophies similar to those here called congenital may occur, though rarely, in adult life. The enlarged part is found to be highly vascular, to have an increased temperature, and to preserve its normal proportions. The cause is in these cases equally unknown.

2. ACQUIRED HYPERTROPHY.—Acquired hypertrophies appear to result, roughly speaking, from the following causes:—(*a*) increased work; (*b*) pressure; (*c*) inflammation; (*d*) increased supplies of nourishment; or (*e*) physiological changes.

(*a*) *Increased work.*—Increased use of the part can produce hypertrophy only in those organs which have an active function, especially the muscles. It is a matter of familiar observation that voluntary muscles increase in size when much employed, as is seen in the often mentioned arm of the blacksmith or the leg of the ballet-dancer. In order to produce this increase, the exercise must be of a certain degree of intensity, but not excessive. It must be frequently repeated, with intervals of rest; and at the same time the nutrition of the whole body must be good. In the absence of these conditions, exercise is more likely to produce wasting. The explanation of this familiar process is still obscure.

Hypertrophy of the heart occurs in cases where that organ is made to work at a higher tension than the normal, and this higher tension can only result from increased resistance to the flow of blood, either at the orifice of the heart, or in the peripheral vessels. Hence the conditions most commonly giving rise to it are valvular disease, especially stenosis; and obstruction of the arteries, either by the thickening of their walls, or by contraction of their muscular coats. The right side of the heart will also become hypertrophied when any condition whatever hinders the passage of blood through the lungs. Disease of the kidneys is a frequent cause of enlargement of the left ventricle of the heart, though in what way is still a matter of discussion. It is only quite clear that the kidney-disease in some way increases the resistance in the smaller arteries and capillaries.

Hypertrophy of the smooth or involuntary muscular fibres also occurs whenever that tissue has to contract for a long period under a higher tension than the normal. Thus the walls of the bladder become thickened in cases where, from obstruction of the passages, the evacuation of urine is effected with more difficulty, and under a higher pressure, than usual. In the same way the walls of the stomach, the œsophagus, and intestines become hypertrophied in cases of obstruction to the passage of food through the alimentary canal.

The explanation commonly given of these cases of hypertrophy in the contractile organs is, that in consequence of obstruction the organ has to contract with greater force than usual, and thus becomes hypertrophied in the same manner as a voluntary muscle, which is frequently exercised. It is, however, clear that this so-called explanation does not account for the connection between obstruction and more powerful contraction. The only explanation that can be given is that in these cases pressure or tension on the organ itself is the stimulus to contraction, and that the force of contraction appears to depend roughly upon the strength of the tension which produces it.

There is less evidence that nervous or glandular structures undergo hypertrophy in consequence of their increased use; but if one kidney be destroyed the other is generally found enlarged; and some authorities believe in an increase in the size of the brain from mental activity.

(*b*) *Pressure.*—Pressure appears to produce hypertrophy only when it is moderate and intermittent. Excessive or continuous pressure rather produces atrophy. Thickening of the epidermis from external pressure is the most familiar instance. Pressure, perhaps, leads to hypertrophy by causing an increase of the flow of blood.

(*c*) *Inflammation.*—Inflammation when chronic is a cause of hypertrophy in some of the tissues, more especially in various forms of connective tissue. This is constantly the case in chronic interstitial inflammation of solid organs, in which indeed it is impossible to draw the line between inflammation and fibrous hypertrophy. But it should be remembered that this condition is usually accompanied by atrophy of the other tissues, so that the size of the organ itself is more likely to be diminished than increased. The serous membranes, as the pleura, peritoneum, and dura mater, become thickened from chronic or repeated inflammation. Thus periostitis is a frequent cause of hypertrophy of the bones. The skin also becomes thickened in chronic eczema, and this condition may extend to the subcutaneous tissue. Acute inflammation, on the other hand, is more likely to produce wasting of the organ it affects.

(*d*) *Increased nourishment.*—It must be regarded as doubtful whether increased nourishment alone is capable of producing enlargement of any part of the body. It certainly does not necessarily do so, as is shown by the case of experimental hyperæmia. When this condition is produced, for instance, by section of the cervical sympathetic nerve, in one side of the face and head of an animal, hypertrophy is only a rare and occasional consequence. When, however, the increased supply of nutrition in the form of blood is combined with some irritation or functional stimulus, we often find hypertrophy result. Thus, for instance, reflex hyperæmia of the skin of the face or blushing, which is produced by numerous internal causes, such as gastric or uterine derangement, may subsist for years and reach a very high degree without altering the nutrition of the part. But if there should be in addition some disturbance or inflammation of the glands of the skin, we have the conditions called *acne rosacea*, &c., in which hypertrophy is an important element. Almost the only instance that can be quoted of hypertrophy from increase of blood-supply alone is that of the corpus luteum during pregnancy, when the ovary participates in the functional hyperæmia of the uterus. The well-known experiment of Hunter should also not be forgotten, in which he transplanted the spur of a cock from its foot to its head, and found it to increase in size.

It is, however, important to remember that hypertrophy, however produced, is always accompanied by an increased supply of blood, and enlargement of the vessels.

(*e*) *Physiological changes.* — Physiological hypertrophies form an important class. One of the best instances is that of the enlargement of the uterus during pregnancy. This enlargement is clearly not the consequence of hyperæmia alone, nor of increase of the functional activity in the muscular walls, though both these conditions are present; but must proceed from some direct physiological stimulus like that which determines the growth of the embryo itself. The hypertrophy affects all parts of the organ—its mucous and serous coats, as well as the muscular walls. Enlargement of the mammæ appears to arise from similar causes; and it is even probable that swelling of the thyroid may, through some obscure connection with the sexual organs, be caused in the same way. Some instances of hypertrophy we cannot in any way explain, such as the apparently spontaneous enlargement of the tonsils, spleen, and thymus gland, which are sometimes observed. The same is true of the enlargement of the prostate which is so common in old age. These changes have been sometimes explained by a supposed derangement of the so-called *trophic nerves*, but this explanation only puts the difficulty a little further back.

Process of Hypertrophy.—It has been a question whether hypertrophy depends upon the increase in the size of the minute elements of an organ, or only on increase of their number. There can be no doubt that the former change often occurs. Thus, in the pregnant uterus the muscular fibres have been found from seven to eleven times as long as natural, and from twice to seven times as wide. In a remarkable case of enlargement of the nerves, described by Dr. Moxon, the nerve-fibres were found to be on an average three times and some of them even forty times as large as normal. When enlargement of one kidney takes place as a consequence of destruction of the other, the tubules and Malpighian tufts are found greatly increased in size. In hypertrophy of the heart, the muscular bundles are found to be thickened, though the fibrillæ are unchanged; but in most cases multiplication of the tissue-elements is the chief cause of the increase in size. To this latter process Virchow gives the name of *hyperplasia*, and it is important to remember that, though constantly occurring in hypertrophy of organs, it does not necessarily lead to the latter change.

'False' Hypertrophy.—We sometimes have to distinguish between *true* and *false* hypertrophy, meaning by the latter a process in which an organ becomes outwardly increased in size, owing to the deposition within it of some foreign material, or to mere distension. Thus in a fatty liver the real liver-tissue is wasted, but is replaced by fat. An emphysematous lung appears to be increased in size, but has actually suffered atrophy. The substance of the brain in hydrocephalus may be greatly reduced in volume, though the head appears of enormous size. The very remarkable disease called 'Duchenne's Paralysis' is an instance of apparent hypertrophy of the muscles, through deposition of fat between the fibres. Finally, it should be remembered that hypertrophy is not necessarily a progressive or permanent condition, but may be only a stage in some chronic morbid process of which the termination is atrophy. This is very clearly seen in the process called 'fibroid degeneration,' elsewhere described.

Treatment.—No general rules can be laid down for the treatment of hypertrophy. When it is connected with increased functional activity, it is usually a favourable rather than a hurtful condition, though in some cases it may appear that the hypertrophy more than compensates the deficiency or irregularity by which it is produced. But even if this be so, the cure of excessive hypertrophy is not within our powers. Those forms of hypertrophy which are most likely to be injurious or fatal are unfortunately those of which the origin and conditions are most obscure, such, for instance, as enlargement of the prostate, the thyroid, or the spleen. The only hypertrophic condition which appears to be, generally speaking, amenable to treatment is that of fibrous thickening. Whenever the thickened fibrous tissue is accessible to direct treatment, we may probably be able to produce a beneficial effect by the application of counter-irritants, or by special stimulants, such as iodine. The administration of iodine or iodide of potassium internally also has a remarkable, and as yet unexplained effect in many such cases. It is, however, well to point out that when functional hypertrophy has resulted from some obstacle or undue resistance, it may entirely subside when that resistance is removed. Thus if the uterus have enlarged around a fibrous tumour, it may regain its normal bulk when the tumour is removed; and we sometimes see a sensible diminution in the size of a hypertrophied heart when the derangements which produce it no longer act. Moreover, hypertrophy may be completely reduced by a general lowering of the nutrition of the body. Thus, in early stages of pulmonary phthisis, the heart may be hypertrophied, but when death occurs in a late period of the disease, the organ is rarely found enlarged, and is even wasted; though, according to Dr. Peacock's tables, less so than in other wasting diseases.

J. F. Payne.

HYPINOSIS (*ὑπὸ*, under, and *ἴς*, *ἰνὸς*, flesh). Deficiency of fibrin in the blood. *See* Blood, Morbid Conditions of.

HYPNOTICS (*ὕπνος*, sleep).—Measures that induce sleep. *See* Narcotics.

HYPNOTISM (*ὕπνος*, sleep).—A synonym for Braidism. *See* Braidism; and Mesmerism.

HYPOCHONDRIAC REGION (*ὑπὸ*, under, and *χόνδρος*, a cartilage).—This region is double, right and left, occupying the upper part of the abdomen on either side of the epigastrium, and partly corresponding to the lower regions of the chest, being almost entirely covered in by the ribs and their cartilages. Each hypochondrium is bounded below by a horizontal line at the level of the ninth costal cartilage; and internally by a vertical line from the eighth cartilage downwards. The organs situated in the right hypochondrium are the liver and gall-bladder mainly; with, more deeply, the pyloric end of the stomach, part of the duodenum, and the hepatic flexure of the colon. In the left region lie the spleen, a small portion of the left lobe of the liver, the fundus of the stomach, the tail of the pancreas, and the splenic flexure of the colon. The gastro-splenic fold of peritoneum, with its vessels, passes from the stomach to the spleen.

Clinical Investigation.—It must be borne in mind that morbid conditions within the chest not uncommonly originate clinical phenomena, both subjective and objective, in connection with one or other hypochondriac region, and these must always be taken into consideration when investigating any particular case. In making a diagnosis, no reliance whatever can be placed on mere sensations referred to these regions, but physical examination is in every instance required, in order to determine the conditions present, and especially palpation and percussion. Moreover, it must be remembered that disease of an important and serious nature may arise without the occurrence of any unusual feelings. Pain of various kinds is often complained of, and when referred to the right hypochondrium is usually supposed to be connected with the liver; but it may depend upon affections of the superficial structures; peritonitis; right pleurisy or pneumonia; or conditions associated with the pylorus, duodenum, or colon. A characteristic pain starting from this region is that of hepatic colic, usually due to the passage of a gall-stone. Persons who are hypochondriacal not uncommonly refer some abnormal sensation to their right hypochondrium, for which there is really no obvious cause. In the left hypochondrium pain may also be due to affections of the walls, or of structures within the thorax; of the cardiac end of the stomach; of the colon; or, in exceptional cases, of the spleen.

The morbid conditions which are capable of originating abnormal physical signs in the hypochondriac region may also be either thoracic or abdominal. Of the former, pleuritic effusion is the most frequent; and on the right side this condition may cause marked depression of the liver. In exceptional instances the heart is so enlarged as to reach the left hypochondrium; and the writer has met with a case in which a large thoracic aneurism presented in this region. As regards abdominal diseases in the right hypochondrium, abnormal physical signs are usually associated with the liver, which is altered in position, shape, size, or physical characters. Occasionally they are connected with the abdominal walls; the gall-bladder; or the stomach, duodenum, or colon. On the left side enlargement of the spleen is the main condition discovered by physical examination; but the stomach may also give signs of distension in this direction, or of organic disease of its walls. Exceptionally the colon may present abnormal physical signs. Growths may originate here in connection with the peritoneum, and the writer has recently had under observation a case in which a growth started from the left hypochondrium, probably of a malignant nature, and involving more than one structure, but it was impossible to say where it commenced. Of course the hypochondria are involved along with other regions in general enlargement of the abdomen; and organs from other regions may so increase in size in certain diseases as to extend into one or both of these regions.

Frederick T. Roberts.

HYPOCHONDRIASIS (*ὑπὸ*, under, and *χόνδρος*, a cartilage).—Synon.: Fr. *Hypochondrie*; Ger. *Hypochondrie*.

Description.—The term hypochondriasis is derived from an ancient hypothesis that the symptoms of this disorder were due to perturbations of natural force generated in the liver and pylorus, to which idea the frequent prevalence of flatulence in the disorder conduced. The condition thus called is really a disease of the nervous system. It is a form of mental unsoundness closely allied to melancholia, of which, indeed, it often forms the initiatory stage. It is characterised by a morbid anxiety, either without any, or having only very slight foundations, relative to the state of physical health. The patient thinks about his health unduly, observing himself with restless care, examining especially the characteristics of his secretions, translating into evidence of progressive organic mischief every trivial departure from perfect action of his organs, and becoming more and more absorbed in precautions against the malady with which he believes himself affected. Nothing that happens tends to the side of reassurance. If his sleep be disturbed, the symptom may be portentous, he thinks, of brain-softening; if it be sound, the patient, instead of being comforted, fears apoplexy. Constipation of the bowels signifies obstruction; a slight diarrhœa implies coming exhaustion. Everything which he reads or hears in reference to disease, the patient applies to his own case, examining himself on every point thus presented to his mind, and rarely failing to find something which dovetails with symptoms of his own. For he recognises only the points of resemblance; the features of difference are unconsciously ignored. In some cases the patient is constant in referring his troubles to one particular organ. Year after year his story is the same; it is his stomach, liver, brain, or some other organ which is in fault; but always the same. In other instances there is a vacillation quite as remarkable. Routed, perhaps, by the convincing arguments of his adviser, he is forced to yield the position which he had assumed, but only to take an equally strong one in reference to some other part of his frame. These diversities strongly recall the fixed and shifting delusions of insanity. He is prone to wander from one doctor to another, often carrying with him a bundle of prescriptions and a long written list of questions, which must receive categorical answers. Apparently satisfied at the time, he speedily recollects some point upon which he has not received assurance, and this he conceives vitiates the whole of the explanation and advice which have been given to him, and he is plunged again into his previous state of anxiety and doubt. Where circumstances do not involve forced labour for existence, the patient passes his time in chasing his health, which is always contriving to elude his grasp. If he holds an appointment, he will resign it in order to have full opportunity for studying himself, and his occupation once gone, he finds too late that it was his best friend, and he then ascribes to his forced idleness all the ills which had induced him to seek retirement.

In many cases the most careful examination can discover no signs of disease, and the patient wears the aspect of health; or there may be a worn, anxious look. In others there may be, especially in the digestive organs, slight deviations from perfect integrity, which explain some of the symptoms, but not the exaggerated apprehensions to which they give rise.

Hypochondriasis is a chronic disorder. It may continue, and this most frequently, as a harmless peculiarity attached to a life which is not perceptibly shortened in length, though often sadly diminished in utility and happiness, by its symptoms. Or there may be an improvement practically amounting to a cure, which will endure for a longer or shorter period. In the decline of life, however, there is very apt to be a return of symptoms. Or hypochondriasis may pass into true melancholia, and then the bodily health, previously the constant object of solicitude, improves wonderfully. Indeed, nothing more is heard about it.

Ætiology.—Hypochondriasis is very much more common in the male than the female sex. The period of life most prone to it is from 20 to 40 years of age. It is apt to occur in those who inherit a tendency to insanity, and the disease in its own peculiar form is often hereditary. Excesses of various kinds, especially on the side of the sexual system, will precipitate the appearance and intensify the symptoms of the affection, but it is doubtful whether they can altogether originate it. The same may be said of gout, which is apt to be associated with the condition and to complicate its symptoms. Depressing moral circumstances also are not without influence in determining an onset of hypochondriasis in those predisposed. This is especially true of mental strain. The frequent occurrence of some deviation from healthy condition in the liver, stomach, or bowels, which is noted in these cases, would suggest that, probably through an interruption to the perfect nutrition of the body, diseases of these viscera bear their part in the causation of hypochondriasis. The intercurrence of internal hæmorrhoids with bleeding is very common, and this would manifestly tend to keep up if it did not originate the disease. Stricture and chronic ulcer of the intestines are occasionally associations which probably also influence the appearance of hypochondriasis.

Anatomical Characters.—There are no anatomical characters peculiar to the disease.

Diagnosis.—When careful examination, which must never be omitted, has disproved the existence of organic disease tending to produce the symptoms described by the patient, it sometimes becomes a question whether the case be one of hypochondriasis or of melancholia.

In the former there is no tendency to suicide; on the contrary a strong desire to live pervades the sufferer's mind, and impels him to endless search for the cure of his ailments. He delights in consulting medical men and entering into the minutest details which he thinks can aid them in helping him. Up to a certain point his story is frequently characterised by a logical accuracy, which fails him, however, in some point of great importance, by which the conclusions are invalidated. The melancholic patient, on the other hand, is often suicidal and always despairs of any relief to his condition, the description of which as given by him is confused, frequently incoherent, and unintelligible.

Prognosis.—Early and marked hypochondriasis occurring in a person with a strong hereditary taint of insanity, without any definite cause of mental depression, is of ill omen. Such a case very often drifts into melancholia.

The prognosis is favourable, perhaps, the less strongly marked the hereditary predisposition and the more evident and adequate the immediate causes to which the patient has been exposed, the most potent of which are sexual or alcoholic excesses, mental strain or shock, or the sudden change from a life of activity to one of forced and, as the sequel shows, uncongenial leisure.

Treatment.—Moral treatment is alone of any influence in a large majority of cases. Where there is, however, manifest anæmia, a history of syphilis, evidences of gouty mal-assimilation, accumulation of fæces, catarrh of the intestinal canal, or hæmorrhoids, the therapeutics proper to these conditions should be employed. Alcoholic stimulants should be avoided. Travel, especially under judicious companionship, and the encouragement of regular, definite, and useful employment for the attention and the physical powers, are the most potent means of treatment, by which the disease may be often much amelorated, and sometimes cured. Ridicule of the patient's sufferings will rarely or never be of service, but at the same time a habit of prescribing for all the symptoms as they arise must be avoided. T. BUZZARD.

HYPODERMIC INJECTION (*ὑπὸ*, under, and *δέρμα*, the skin).—The effective introduction of remedial agents into the system by subcutaneous injection was rarely possible until the discovery of the alkaloids enabled us to administer an active dose in very small bulk. Dr. Alexander Wood, of Edinburgh, undoubtedly deserves the credit of bringing this principle practically before the profession; and, improved as it has been by Mr. Hunter and others, the hypodermic method is now justly regarded as one of the most active and reliable of our therapeutic resources. It may be used in two essentially different ways.

I. The remedy is thrown into the *subcutaneous cellular tissue* by means of a sharp-pointed hollow needle, attached to a carefully graduated glass syringe. The little prick must be made as rapidly as possible, either by direct puncture, or in a more valvular direction, through a pinched-up fold of skin; and care must of course be taken to avoid the neighbourhood of all important structures. The solution employed must be small in quantity and bland in quality, and must be slowly introduced, as pain usually follows the too sudden or forcible depression of the piston; and we must satisfy ourselves before we begin to inject, that the point of the instrument has passed fairly through the skin, without imbedding itself in the substance of the muscles. When carefully performed, the advantages of this plan are great, for not only is it economical, drugs administered in this way acting much more powerfully than when given by the mouth; but absorption is very rapid, and the desired effect is swiftly and surely produced. The drawbacks of the hypodermic method are—the pain of puncture (which may be alleviated by a slight preliminary freezing of the skin); an occasional tendency to irritation and the formation of abscess; and, where morphia is concerned, the risks of nausea and syncope, and the dangers attending the not very remote possibility of acquiring opium-eating habits.

The principal drugs used hypodermically in this way are the following:—

1. *Morphia.*—Morphia thus administered forms by far our most effectual remedy for the relief of suffering. In all varieties of neuralgia, in the wearing agony of cancer and other incurable disorders, as well as in a host of painful and irritative affections, we derive invaluable aid from the use of the hypodermic syringe: remembering that the dose must at first be small, not exceeding $\frac{1}{4}$ of a grain, and that we derive no special advantage from injecting directly over the spot where the uncomfortable sensations are felt. Recollecting also the occasional occurrence of sickness and faintness, we shall do well to enforce the recumbent posture; to keep our patient under observation for a few minutes after the operation is over; and perhaps to combine $\frac{1}{100}$ grain of atropia, which seems to have in some measure the power of preventing the depressing action which morphia occasionally displays when administered alone.

2. *Atropia.*—Anstie had great faith in atropia, as the best of all remedies for pain in the pelvic viscera; and its injection hypodermically has been attended with good results in the nocturnal sweating of phthisis in doses of $\frac{1}{100}$ to $\frac{1}{50}$ grain; and also as an antidote in opium-poisoning, even up to half-a-grain.

3. *Ergotine.*—Ergotine acts most effectively in cases of hæmorrhage, its chief disadvantage being the development of black painful lumps at the site of puncture. The average dose is 2 grains.

4. *Quinine.*—This useful drug has been extensively used in tropical climates by hypodermic injection for ague, sunstroke, &c.; but the great pain attending the operation, and the subsequent liability to the formation of abscess, have proved effectual barriers to the general introduction of the practice into this country.

5. *Other drugs.*—Chloral, where subcutaneously used, also causes severe suffering, with the production of unhealthy ulcerations of the skin. Many persevering attempts have been made, but have not yet been successful in overcoming the very irritating effects of mercury when employed in this way. Out of the large number of other drugs, the subcutaneous use of which has been tried from time to time, we are unable to report any substantial advantage thus gained over their administration by the mouth.

II. The second hypodermic method is that recommended by Bartholow and various American and Continental physicians, and usually called the *deep* or *parenchymatous* method. This essentially consists in plunging the point of the needle into the muscles, and forcing the fluid freely among their fibres, and into the immediate neighbourhood of painful nerves. We are told that in this way chloroform is a very certain remedy for neuralgia; that strychnia is indicated in infantile, reflex, hysterical, and lead palsy; and that carbolic acid is useful in erysipelas. As yet, however, there is not much British experience to quote in confirmation of this practice.

In conclusion, we may note that most hypodermic solutions are readily destroyed by mould; and that Dr. Sansom has suggested a very handy series of gelatine disks, which will keep well in all climates, and which may readily be melted down when required for use.

ROBERT FARQUHARSON.

HYPOGASTRIC REGION (*ὑπὸ*, under, and *γαστὴρ*, the belly).—The hypogastric region is conventionally described as lying between the right and left inguinal, below the umbilical, and above the pubic regions.

ANATOMICAL RELATIONS.—The *surface* of the hypogastric region in ordinary persons is flat, showing the muscular reliefs; it is rounded in children; and in some individuals, much emaciated from disease, it becomes concave.

The *median furrow* disappears below the umbilicus, owing to the approximation of the recti muscles.

The *integument* is very elastic and movable, especially at the sides.

The *superficial fascia* consists of two laminæ, between which lie the subcutaneous vessels; but in the middle line these laminæ are blended. It is strengthened at its lower part by the *triangular fascia.*

The *aponeuroses* of the external and internal oblique muscles are united in the linea alba, and form a portion of the *sheath of the rectus.*

The *recti muscles* themselves have their inferior attachments in this region, along the line extending between the spine and the symphysis of the pubes; their outer edges curve outwards, and become straight as they enter the sheaths.

The *pyramidales*, two small triangular muscles, arise from the pubes, lie in the same sheaths as the recti, and assist in closing in the abdominal parietes anteriorly and below.

Immediately beneath the recti is the *fascia transversalis*, with a little loose areolar tissue and fat, the fascia being tolerably adherent along the central line. Beneath the fascia transversalis there is a considerable amount of loose areolar tissue, between it and the *parietal peritoneum*, which in this region is very loosely attached, and reflected off the bladder on to the fascia transversalis. Enclosed in folds of the peritoneum lie, on either side, passing upwards to the umbilicus, the remains of the hypogastric arteries; and from the apex of the bladder in the middle line, passing to the umbilicus, is the obliterated urachus, which acts as the superior ligament of the bladder.

The *viscera* corresponding to the hypogastric region are:—the *bladder* when full; and the *small intestine*, covered by the *great omentum*. When the bladder is full, the intestines are pushed aside, and the former then lies against the pubes and recti. In children the bladder, being an abdominal rather than a pelvic viscus, always lies in this region. During pregnancy the *uterus* also corresponds with the hypogastric region.

The *vessels* are the deep epigastric, with the *veins* which pass obliquely inwards from the internal iliac. They lie between the peritoneum and the transversalis fascia.

The *nerves* are derived from the lower intercostals and lumbar. The *lymphatics* pass into the inguinal, superficial pubic, and lumbar glands.

Clinical Relations.—The hypogastric region is of clinical importance chiefly from an operative point of view. It is in the median furrow of this region that the operation of tapping in ascites is usually performed; and that the principal incision is made in ovariotomy, the Cæsarian section, and supra-pubic lithotomy. The bladder is occasionally tapped above the pubes. The presence of the distended bladder or of the pregnant uterus, forming a tumour in the hypogastrium, has been already referred to. Enlargements here from these causes have to be diagnosed from pelvic tumours of various kinds, which, in growing upwards into the abdomen, occasionally occupy the middle line instead of either groin. The only morbid condition of the abdominal parietes in the hypogastric region that requires special mention is abscess connected with disease of the lumbar spine, which occasionally points above the pubes, on either side of the middle line. The pus in such a case is situated between the peritoneum and the fascia transversalis.

Edward Bellamy.

HYPOGLOSSAL NERVE, Disorders of. The hypoglossal nerve is the motor nerve for the tongue, and for most of the other muscles which are attached to the hyoid bone, the exceptions being the stylo-hyoid, the mylo-hyoid, and the middle constrictor of the pharynx. It also supplies the sterno-thyroid muscle.

1. **Paralysis.**—Paralysis of this nerve is shown chiefly by the resulting interference with the movement of the tongue—'glossoplegia.'

Ætiology.—The nerve may be damaged in any part of its course by the growth of tumours; but is most commonly affected at its origin within the spinal canal, by pressure from tumours, meningitis, or syphilitic growths, or by caries of the upper cervical vertebræ. The tongue is also paralysed by disease of the nucleus of origin of the hypoglossal fibres, but its paralysis is then associated with that of the lips, and commonly also of the palate, pharynx, and glottis (*see* Labio-glosso-Laryngeal Paralysis). Disease of the motor tract above the nucleus also causes paralysis of the nerve, together with the face, arm, and leg of the same side. Bilateral glossoplegia commonly results from disease of the nucleus or its neighbourhood. Unilateral paralysis is due to disease of the motor tract above the nucleus, rarely of the nucleus itself, often of the fibres of the nerve within or outside the medulla.

Symptoms.—In unilateral paralysis, the tongue at rest is in its normal position in the mouth, but its root is higher up on the paralysed than on the normal side, in consequence of the loss of the tonic, or voluntary, contraction of the posterior fibres of the hyoglossus. Within the mouth the tongue is moved freely to the healthy side, but is not moved to the paralysed side. When protruded it deviates towards the paralysed side, because the protrusion is the result of the action of the fibres of the genio-glossus, and the tongue is pushed over towards the weaker side. In bilateral paralysis the tongue lies in the mouth behind the teeth, and cannot be protruded. If the loss of power is complete, the tongue cannot be projected over the lower teeth. It is broad and flabby, if there is no atrophy, and sometimes when atrophy is associated with fatty overgrowth. When there is much wasting, the part affected is shrunken and wrinkled. In unilateral paralysis, articulation and deglutition are little impaired. The pronunciation of labials, and the production of falsetto notes may, however, be difficult. In bilateral paralysis, articulation is impossible. Phonation is not impaired, unless the larynx is also paralysed. The mastication of food is impeded, because the food cannot be moved about the mouth. Deglutition is also interfered with, because the food cannot be rolled into the fauces; and soft foods, when they reach the pharynx, may be driven again into the mouth in consequence of the absence of the natural supporting movement of the tongue. Taste is not primarily affected, but may be somewhat dulled, because the patient is unable to move substances about the mouth.

Diagnosis.—The position of the lesion is indicated by the associations of the paralysis. If the disease is in the motor tract above the nucleus (pons, crus, or hemisphere), there is hemiplegic weakness on the side of the paralysis of the tongue. In disease of the nucleus the paralysis is commonly bilateral, is associated with paralysis of the lips and throat, and there is usually wasting. Disease of the fibres of origin within the medulla is associated with paralysis of the opposite limbs, so that the tongue deviates from the paralysed side. When the disease is at the surface of the medulla, the paralysis is commonly unilateral, and is associated with paralysis of the corresponding half of the palate and vocal cord (Hughlings Jackson.) In disease of the fibres of origin within or outside the medulla, there is commonly wasting. The diagnosis of the pathological cause of the paralysis rests on the course of the affection, and on the presence of any causal and associated condition.

PROGNOSIS.—This is usually unfavourable, on account of the gravity of the disease which damages the nerve or centre. Even in syphilitic cases, recovery is often incomplete.

TREATMENT.—The treatment of paralysis of the hypoglossal nerve is that of the causal disease. Tonics, counter-irritation, iodide of potassium and mercury, with occasionally the application of electricity to the tongue, are the most important remedies to be employed, according to the ætiological indication. The most convenient method of applying electricity is by means of a tongue depressor in a wooden handle, the blade being insulated by a coating of sealing wax where it comes in contact with the lips.

2. **Spasm.**—Spasm in the parts supplied by the hypoglossal nerve is rare. The tongue participates in the convulsive movements in epilepsy, is jerked between the champing jaws, and thus becomes bitten. Cases have been met with in which the tongue is affected with a 'functional spasm' in speaking, analogous to 'writer's cramp,' but these are so rare as scarcely to need detailed description.

W. R. GOWERS.

HYPOSPADIAS (*ὑπὸ*, under, and *σπάδιον*, a space).—A malformation of the penis in which the orifice of the urethra is underneath or behind the glans. *See* MALFORMATIONS.

HYPOSTASIS (*ὑπὸ*, under, and *στάω*, I stand).—DEFINITION.—This term is applied to that condition of the vessels of a part, which consists in an overfulness, caused mainly by a dependent position, with a varying degree of diminution in the rate of flow of the contained fluid.

PATHOLOGY.—The entire conditions of the venous circulation are such as to readily favour a stasis or stagnation of the blood-flow; and a trifling cause, such as would in no way affect the arterial flow, may easily impede the venous current. The veins also are, as a rule, less firmly supported by the surrounding tissues than the arteries; and this, with their thinner coats, slighter elasticity and resistance, render them easily liable to distension by the blood in congestion. If a dependent position be added to these conditions, thereby offering a resistance to the return flow of the blood, whilst it favours the circulation in the arteries, a combination of circumstances exists to which the term *hypostatic congestion* is applied. The liability of the veins of the leg to become congested, leading to a varicose condition and its results, is an example of this state. If, in addition to all these factors, the heart be enfeebled and the arterial tone be diminished, obviously another cause for stagnation is introduced, and of necessity will manifest itself most in those situations predisposed to stasis. Such a state is seen in the hypostatic congestion of the lungs, which usually attends in a greater or less degree all pyrexial conditions. The recumbent attitude, the enfeebled heart, and the lax vessels eminently favour an overfulness of the veins. It is obvious that although the excess of blood primarily occurs on the venous side of the capillary system, very soon the arterial area will share in the engorgement, and the whole vascular system of the part become overfilled.

RESULTS.—The pathological results of such a state are very much the same as those following any congestion. The distended vessels, with the increased blood-pressure that co-exists, readily permit of a transudation of the fluid part of the blood, hence œdema; if the conditions be extreme, capillary rupture may take place, and hæmorrhagic effusions result. Any continuance of this state will lead to malnutrition of the tissues affected; the proper supply of arterial blood is interfered with; and the part is loaded with an effete venous blood, and infiltrated with serum. Hence the structural repair of the tissues is improperly performed, and there is a tendency to the development of an imperfect form of connective tissue; or, on the other hand, the destructive rather than the productive aspect may predominate, and ulceration follow. When the hypostasis is associated with an acute general state, as of the lungs in any specific febrile disease, it is very apt to pass on into a form of inflammation characterised by a want of acuteness. There are the same inflammatory products, the same changes in the vessels and tissues of the lungs, and very much the same symptoms as occur in the course of an ordinary pneumonia, but they are less severe in character, and on the whole do not tend so readily to a favourable resolution.

TREATMENT.—Recognising the cause, alteration of position is obviously the rational treatment of hypostatic congestion; additional support by bandaging is often advisable. In acute febrile diseases stimulants are of much service in the prevention or relief of this condition in connection with the lungs, should the heart's action be enfeebled.

W. H. ALLCHIN.

HYSTERALGIA (*ὑστέρα*, the womb, and *ἄλγος*, pain).—Pain in the womb, frequently supposed to be of a neuralgic nature. *See* WOMB, Diseases of.

HYSTERIA (*ὑστέρα*, the womb).—SYNON.: Fr. *Hystérie*; Ger. *Hysterie*.

Hysteria is a term the etymology of which is misleading, and had best, therefore, be disregarded. It is often improperly applied to cases of simple malingering, and others which do not admit of ready explanation. Its use is best restricted to a condition of the nervous system fairly defined, but the intimate pathology of which is not known, characterised by the occurrence of convulsive seizures and by departures from normal function of various organs, leading to very numerous and often perplexing symptoms. These are apt to simulate those commonly arising from definite alterations of structure, but differ from the latter in the fact that they may often, even when at their worst, be removed instantaneously, usually under the influence of strong emotion. It would seem that there is a disturbed or congenitally defective condition of the cerebral substance, involving in all cases the highest nervous centres, and in various examples extending more or less also to some of those which preside over automatic phenomena. Partial or complete suspension of inhibitory influence would appear to be the most patent result of the condition, whatever it be, and this is recognised as well in regard to the mental as to the more evidently physical processes belonging to cerebral function. A laugh which cannot be checked, but continues until tears flow, or the limbs become convulsed, is a typical example of such a suspension of control, and, if studied, throws light upon the nature of a considerable portion of the phenomena of hysteria. The jerking expirations of laughter arise from excitation of the respiratory centre, and when this excitation, uncontrolled by higher centres, acquires an abnormal strength, it extends to other parts of the medulla oblongata and spinal cord, and produces general convulsions. It overflows, as it were, into other nervous centres which in health would receive none of the exciting impulse. Between the lowest (automatic) functions of the cerebro-spinal nervous system and the highest (psychical) there is an ever-increasingly complex system of excito-motor processes, which may be in part or wholly under the pathological influence, whatever it be. Hence the *bizarre* character of the hysterical phenomena, and the circumstance that the symptoms always include modifications of those processes which underlie the mental faculties. The suspension of the power of control possessed by the higher centres explains the irregular movements, spasms, and convulsions. Hyperæsthesia and pain are dependent, probably, in hysteria, upon such a molecular change being initiated in the sensory ganglionic centres as is ordinarily propagated from the periphery. Hysterical paralysis, on the other hand, signifies that the power of the higher centres in liberating movements is in abeyance. In hysterical anæsthesia it is probably feeling or sensory perception and not the function of the sensory apparatus which is in abeyance, whilst the reflex actions which result from excitation of sensory nerves are performed in an orderly manner. A patient may work a needle with fingers which can be touched or pricked without the act being felt. Tactile impressions are conveyed to the ganglionic centres by the afferent nerves, and excite the action of efferent nerves so that the muscles are contracted. What is wanting is the participation of those higher centres in which consciousness runs parallel to this physiological action.

Ætiology.—*Predisposing causes.*—A state of more or less imperfect development of the higher nervous centres of congenital origin very frequently underlies, it is probable, the various circumstances which apparently conduce to the hysterical conditions.

The female sex is much more prone than the male to the affection, which usually occurs between the ages of fifteen and thirty, and most frequently of all between fifteen and twenty. Luxury, ill-directed education, and unhappy surroundings, celibacy where not of choice but enforced by circumstances, unfortunate marriages, alcoholism, premature cessation of ovulation, and long-continued trouble—all predispose to hysteria. A somewhat frequent antecedent is a long and wearisome nursing of a sick relation, with much broken rest. The disorder is only exceptionally found in women suffering from diseases of the genital organs, and its relation to uterine and ovarian disturbance is probably neither more nor less than that which obtains in other neuroses. Exception must be made in the case of prostitutes affected with venereal disorders, who are very prone to hysteria. In this class, however, the condition is complicated by the physical and moral influences to which their life subjects them, and amongst these alcohol frequently occupies a very important place. Like epilepsy, migraine, and some forms of insanity, hysteria is prone to be intensified at the catamenial period.

The occurrence of hysteria (although comparatively rare) in males is sufficient of itself to disprove the uterine theory of causation.

Determining causes.—These include painful impressions; long fasting; strong emotions; imitation; and shock to the nervous system, physical or moral.

Symptoms and Diagnosis.—In the limited space in which it is necessary that the subject of hysteria should be treated, it will be best to describe together some of the most frequent forms which the neurosis takes, and the principles upon which a diagnosis can be made. Hysteria produces symptoms which may be referred to every function of the body. For consideration they may be roughly classed in the following groups, it being understood that all may occur either coincidently or in succession:—1. *Mental.* 2. *Sensory.* 3. *Motor.* 4. *Circulatory.* 5. *Visceral.*

1. *Mental.*—The intelligence may be apparently of good quality, the patient evincing sometimes remarkable quickness of apprehension; but, carefully tested, it is found to be wanting in the essentials of the highest class of mental power. The memory may be good, but judgment is weak, and the ability to concentrate the attention for any length of time upon a subject is absent. So also regard for accuracy, and the energy necessary to ensure it in any work that is undertaken, are deficient. The emotions are excited with undue readiness, and when aroused are incapable of control. Tears are occasioned not only by pathetic ideas but by ridiculous subjects, and peals of laughter may incongruously greet some tragic announcement. Or the converse may take place; the ordinary signs of emotion may be absent, and replaced by an attack of coma, convulsion, pain, or paralysis. Perhaps more constant than any other phenomena in hysteria is a pronounced desire for the sympathy and interest of others. This is evidently only one of the most characteristic qualities of femininity uncontrolled by the action of the higher nervous centres, which in a healthy state keep it in subjection. There is very frequently not only a deficient regard for

truthfulness, but a proneness to active deception and dishonesty. So common is this, that the various phases of hysteria are often assumed to be simple examples of voluntary simulation, and the title of disease refused to the condition. But it seems more reasonable to refer the symptom to impairment of the highly complex nervous processes which form the physiological side of the moral faculties.

2. *Sensory.*—Pain, hyperæsthesia, and anæsthesia occur with perhaps equal frequency. The diagnosis of the hysterical origin of such alterations of sensibility is effected partly by excluding the presence of other causes, and partly by consideration of any accompanying or antecedent peculiarities of manner and conduct. Hysterical *pain*, where it is associated with some evident local change, is found to be greatly in excess of that which would ordinarily accompany the observed cause. Where pain or hyperæsthesia is complained of in situations and of a character which would commonly point to some existing inflammation, it is necessary, by examination of the pulse and temperature, to exclude such a condition. Hysterical pain is apt to cease suddenly when the attention is diverted, and to be increased by inquiry and sympathy. Some of the most common seats of pain and tenderness are the following:—

(*a*) The lower part of the side of the chest (usually the left) simulating intercostal neuralgia, but distinguished from it by the tenderness being wide-spread, superficial, and not confined to certain points. Pressure here will sometimes occasion disturbances of respiration and circulation.

(*b*) Some of the vertebral spines, usually in the cervical and upper dorsal region. From the error of mistaking this for commencing disease of the vertebræ numbers of young women have been confined to a couch for months or years, and their health permanently damaged. The points of diagnosis are the patient's antecedents; there is often a history of aphonia, or paralysis, or hysterical fits. Or it may happen that, long after the pain has been first complained of, the patient has been seen to take a prodigious amount of exercise *on some one occasion* without complaint. A very much slighter pressure, too, causes pain than is at all usual in vertebral caries. It has to be remembered, however, that a patient affected with vertebral disease may also be hysterical.

(*c*) Acute pain in a joint, occurring usually some little time after a slight injury and giving rise to suspicion of inflammation, but distinguished from this by the fact that after a few days of great pain the joint does not feel hot to the touch, and is not swollen, and that the thermometer shows no rise of temperature. The pain is more easily excited, too, by touching the skin than by pressing the articulatory surfaces against each other.

It is necessary to remember that in locomotor ataxy there may be exquisite pains (of a shooting character) having their seat in a joint or its neighbourhood, and accompanied by some localised hyperæsthesia of the skin. The disease rarely affects young females, but it may do so, and the condition is then extremely liable to be mistaken for hysteria. The chief points of diagnosis are, that in locomotor ataxy there will be—1. absence of patellar tendon reflex; 2. a peculiar character of the pains—lightning-like; 3. probably some analgesia of the extremities; and 4. an ataxic gait. *See* LOCOMOTOR ATAXY.

(*d*) Tenderness of the mamma or darting pains through its substance, recalling those of scirrhus. The absence of any lump, and the effect of engaging attention, will serve to distinguish.

(*e*) Pain in the head of very severe character, 'like a nail being driven into the skull' (*clavus*). This is probably neuralgic, and is by no means confined to the hysterical. There is also a more diffused pain, described as of great violence and exceedingly obstinate. This pain is sometimes suggestive of cerebral tumour, from which, however, it may often be distinguished by the fact that the ophthalmoscope shows no optic neuritis, and that there is no vomiting. But great caution is necessary in coming to a conclusion that severe and long-continued pain in the head is hysterical. And here it may be well to say that in an accurate knowledge of the characteristics of the disease supposed to be simulated lies the only safety as regards diagnosis. Nor must it be forgotten that persons with serious organic disease are frequently affected also with hysterical symptoms.

(*f*) Epigastric tenderness. Careful pressure will often show that the tenderness is at the origin of the recto-abdominalis muscles, and not in the stomach. But there is sometimes pain in the stomach itself, and this may be associated with disgust for food or depraved appetite.

(*g*) Tenderness in one or other iliac region, deep pressure upon which will sometimes evolve hysterical symptoms, and also in some cases of hysterical convulsions will check the paroxysm.

Anæsthesia may involve (though rarely) the whole body. It is more commonly confined to one half, and this the left, and is then frequently associated with tenderness in the iliac region of the same side; or it may be limited to a small patch. The sense of touch often remains whilst painful impressions and those of temperature cannot be perceived. The anæsthesia may be confined to the surface, or involve as well the deeper structures, into which pins may be stuck without evoking signs of pain. The left conjunctiva is often the seat of anæsthesia, so that it may be touched or even rubbed without any reflex movements of the eyelids being excited. So also the pharynx may be tickled without exciting the ordinary spasmodic contraction, and the epiglottis touched by the finger without inconvenience. Such affections of cutaneous sensibility may have to be looked for, as they are often unsuspected by the patient herself. As regards diagnosis the existence of peripheral nerve-lesions may be excluded, by the absence of trophic disturbance. The condition is not likely to be confounded with hemiplegia, unless perhaps when it has immediately followed a convulsive attack, and is accompanied by apparent loss of power in the limbs. Examination of the patient and her history will suffice for the diagnosis. The other special senses also may be disordered in hysteria. There may be intolerance of light, subjective sense of taste or smell, roaring noises in the ears; or, conversely, loss of sight (either in half of both eyes, or in one eye), loss of smell, or taste, or hearing. Or there may be feelings as of a limb or other part being enormously enlarged, of the body being confined in a stiff case, of the feet being drawn up by strings under them, of 'pins and needles' around the waist, or of numbness and coldness in one half of the body (almost always the left). It may be said generally of the disorders of sensation that they are capricious in their appearance, coming and going, as they would not did they depend upon organic disease (this recurrence is especially significant); that they are very apt to ensue upon some moral shock or convulsive seizure; and that careful examination will prove them to be unaccompanied by such other symptoms as would be likely to be present did they depend upon the organic alteration which they simulate.

3. *Motor.*—The principal motor symptoms in hysteria are local spasm, more or less general convulsion, and paralysis. The most common of all symptoms of hysteria is the *globus hystericus.* A lump appears to the patient to arise from the epigastrium like an egg, and, travelling upwards to the throat, causes a sensation of choking, and is often accompanied by an outburst of tears.

Spasm affecting some out of the various muscles concerned in the respiratory acts gives rise to a great variety of symptoms highly characteristic of hysteria. There may be cough of a peculiarly sharp, ringing character, constant except during sleep, unaccompanied by expectoration, strongly influenced by moral causes. A little observation will show that the cough does not occur when the patient is quite alone and apparently no one within earshot, but, on the other hand, it is greatly intensified by enquiry and solicitude. It ceases during sleep. Sometimes, instead of cough, a loud expiratory sound is produced, of most discordant character, resembling, perhaps, a railway whistle, the quacking of a duck, or the barking of a dog; and this may take place irregularly, or may be marked by a curiously distinct periodicity. Or there may be rapid, deep whooping inspirations, with signs of suffocation. Occasionally with the hysterical cough there is a hypersecretion of mucus; and if, as often happens, there is also disturbance of digestive functions and consequent tendency to emaciation, and at the same time such constriction of the air-passages as gives rise to sibilant *râles*, a *primâ facie* resemblance to phthisis is presented, which can only be distinguished by prolonged observation, aided by the stethoscope and thermometer. Laughing and crying are very frequent forms of expiratory spasm. Yawning, hiccough, and sneezing are also met with. *Clonic spasm* of muscles, especially of those moving the head and shoulders, or back, is not uncommon. Or one of the muscles of the thigh may be so affected, and the apparent pulsation caused by the rhythmical contractions give rise to a suspicion of aneurism.

Tonic spasm of one or more muscles of a limb is still more frequent. It is often very obstinate, and after enduring for months or years may suddenly resolve without any permanent alteration being left behind.

Contraction of a limb thus produced may continue during sleep and even resist the influence of chloroform inhalation, unless this is pushed to its full extent. Should one of the abdominal muscles be thus affected, an abdominal tumour is produced, which may be mistaken for some growth in the cavity; and if the pulsations of the aorta should be communicated to it, a strong *primâ facie* resemblance to abdominal aneurism is caused. The best mode of diagnosis is by faradisation, which, if persevered in for several minutes, will exhaust the muscular contractility and cure the ailment if it be of this kind. If it is not a 'phantom tumour' of this description but a genuine growth, the muscle will be contracted by the current, and it may then be possible to feel the tumour as something evidently distinct from the muscle.

Convulsive seizures are of common occurrence, and are usually preceded by a sense of suffocation, difficulty of swallowing, pain in the belly or stomach, headache, vertigo, or some indescribable sensation in one of the extremities. There is often a cry as of one being choked, unlike the peculiar wailing shriek which ushers in the epileptic seizure. Usually there is not the extreme suddenness of attack which characterises epilepsy, but the patient may be manifestly struggling against the seizure for a small but appreciable interval. When at last she falls, she does not usually do so with violence enough to receive severe injury, and positions of danger are generally avoided. The epileptic often falls in the fire, the hysterical patient never. The spasms of muscles which succeed are often tetanic in character, and sometimes wear an aspect of design—the patient grips articles with her hands or teeth. The face may be more or less red. In epilepsy it is usually first pale and then livid.

There is often more or less complete opisthotonos, which is usually absent in epilepsy. It is doubtful how far consciousness is ever completely lost, but though for the most part it is retained during the attack, there are certainly cases in which it is to a great extent in abeyance. It is characteristic of hysteria that, however rapid and violent the contortions, the patient usually avoids inflicting any serious injury upon herself. During the attack gesticulations and language are apt to be used which may be reproachful, or marked by an amatory character as regards some bystander, such as is calculated to cause embarrassment. There may be a single convulsive seizure, terminated by a fit of weeping and the passage of a large quantity of almost colourless urine of low specific gravity. Or there may be a succession of attacks extending sometimes over several hours. The tongue is not bitten. As a rule the hysterical patient rapidly returns to her ordinary condition after the outburst is completed, and fails to show the heaviness and tendency to sleep which is characteristic of epilepsy. The variety seen in the character of hysterical convulsions suggests that the pathological influence involves the nervous centres, sometimes more and sometimes less extensively; showing every degree of muscular movements, from those of a highly co-ordinated or quasi-voluntary kind, down to those of a simply tetanic form, such as appear to indicate either that control of the reflex function of the spinal cord is temporarily suspended, or that the cerebellar influence, as Hughlings

Jackson thinks, is being allowed to have full play, owing to some peculiar condition of the cerebrum interfering for a time with its normal power of antagonism. But it must be borne in mind that the hysterical patient may, like others, become epileptic, and that there is nothing to prevent the chronic epileptic betraying occasionally symptoms of hysteria. Such mixed cases are often difficult of diagnosis, and it is usually only a prolonged observation which succeeds in distinguishing the nature of the condition. Movements which somewhat resemble those of chorea are occasionally met with, but their character and the surrounding circumstances usually make it easy to distinguish them.

Paralysis may affect any of the limbs in hysteria, but paraplegia is the more usual form. Hemiplegia is comparatively rare. The muscles retain their nutrition. There is often at first a slight loss of irritability to induced currents, but after a very few applications this becomes normal. At first, too, considerable electro-cutaneous and electro-muscular insensibility may be present. If the form of paralysis be hemiplegic, the mouth is not affected; if paraplegic, the sphincters are not paralysed, and there is never any bedsore. If the arm be the limb affected, and the examiner, after flexing it slightly leaves go, it will sometimes remain in the flexed position, which it would not do in hemiplegia. It is noteworthy that in half the cases of hysterical paralysis, there is no history of antecedent convulsions. Cutaneous anæsthesia of the extremities will give rise sometimes to a pseudo-paralysis, and muscular anæsthesia may cause symptoms of ataxy. These may be distinguished from the result of organic change by careful examination. Hysterical speechlessness may be distinguished from aphasia by the patient being able to write down with great facility the wishes she is unable to express in speech; and from localised paralysis of the tongue, by her being perfectly able to swallow.

4. *Circulatory.*—There may be syncope which will simulate dying. After an indescribable sensation at the heart—a fulness or stifling feeling —the pulse becomes almost imperceptible, the patient is speechless, and, for periods varying in length, is apparently in a most precarious condition, recovery taking place after prolonged sighing. Or there may be tumultuous action of the heart. The abdominal aorta (and sometimes also other arteries) is occasionally the seat of powerful pulsations, which are visible in their effects upon the abdominal wall and strongly suggest the existence of aneurism. The capillary circulation may be deranged in the two directions of hyperæmia and ischæmia. In the former there is a patch of redness of the skin accompanied by a feeling of burning and tenderness; in the latter, which is especially seen in conjunction with analgesia, the skin is pale and no bleeding follows the pricks of a pin. In a recorded case, pressure upon a tender spinous process checked the radial pulse for a time.

5. *Visceral.*—Vomiting is sometimes a very obstinate symptom, all food taken being speedily ejected, the condition lasting a surprisingly long time, often for many months, without usually so much prostration as might be expected, but nevertheless with great loss of weight. Or there may be such an active aversion from food as renders it very difficult to support nutrition; or a depraved appetite may cause substances to be swallowed which have no nutritious property. In the belly there is frequently a hyper-secretion of gas with spasm of the bowels, causing borborygmi and noisy eructations. Intestinal gas may be imprisoned between two points of spasmodic contraction of the intestine, giving origin to a tumour capable of being moved about in the abdominal cavity, and of sudden resolution. These balloons, it is probable, are sometimes mistaken for tumours of the spleen, kidney, or other organ. It is not uncommon to have retention of urine, the bladder becoming greatly distended, but contracting at once and expelling its contents if the patient be placed in a hip-bath, and a bucket of cold water be thrown over the pelvis. In other cases there is an unduly frequent desire to empty the bladder. The secretion of urine may be suppressed almost entirely (but this is very rare), the little urine that is passed containing an unusual proportion of urea, which is also found in the vomiting accompanying this condition.

There is sometimes very obstinate constipation giving rise to enormous impaction of fæces—occasionally also diarrhœa.

Cases occur in which the symptoms of cerebro-spinal sclerosis of the disseminated form, after persisting perhaps for many months in a young woman, rapidly or even suddenly disappear. The close resemblance to a disease which is not only incurable but tends to become progressively worse, is so strong that it is often impossible to form a diagnosis, and a very guarded prognosis becomes necessary. In the present state of our knowledge it is customary to class such cases with those of hysterical paralysis; but it is quite a question whether they are not really cases of incipient cerebro-spinal sclerosis, recovering ere the stage of irreparable change is arrived at. There is good reason to think that cases of disseminated cerebro-spinal sclerosis are not at all unfrequently supposed to be simple examples of hysteria. The disease is characterised in its early stage (the only period when mistake is possible) by some general weakness of limbs, accompanied by slight tremors on voluntary movement only, and an utterance which is slow and drawling, with occasional slurring of words. Careful examination, especially noting the circumstance that, for example, the arm only shakes when the patient is directed to take hold of an object, is usually sufficient to distinguish the disease from hysteria, but there is sometimes considerable difficulty, and caution should be observed in avoiding hasty conclusions.

SEQUELÆ.—Hysterical symptoms sometimes pass into those of mania, melancholia, and occasionally also of dementia.

PROGNOSIS.—This is favourable as regards life, death from hysteria being very rare. Recovery for a time is common enough, but too often there is a return of the disease, the symptoms being usually of a different kind. Some patients will run through almost every conceivable phase of the disorder in turn. As a rule there is a tendency to cessation of the disease after the climacteric period. It occasionally happens, however, that the disease is continued into an advanced period of life.

Treatment.—If Medicine were in a position to regulate the mode of life, food, education, and especially the selections for propagation of the species, it is probable that in succeeding generations hysteria would become more and more rare in the race. It can do, however, but little for the individual. Intercurrent maladies must of course receive the treatment proper to them. Where anæmia is present much good may often be done by iron. States of malnutrition tend to precipitate and intensify hysterical symptoms; and to remedy these is often to do much for the concomitant nervous disorder.

But probably the greatest amount of benefit which can be brought to bear upon the hysterical patient is through her surroundings. A girl who has not spoken above a whisper for months whilst at home, will often recover her natural tone of voice in a week if placed under the judicious discipline of strangers. This is a well-known circumstance, and the fact has tended very much to the belief that hysteria is simply vicious simulation. Such an inference is unjust.

That an altered relation of the ganglionic nerve-cells to the blood-supply forms at least a part of the pathology of hysteria appears probable from the effects of fasting in provoking hysterical outbursts, and the influence of food and stimulants in postponing them. Ammonia inhaled by the nostrils is a well-known and valuable agent for the purpose. Alcohol should be avoided altogether, as there is great danger of excess.

It is through the sensory nerves that the most rapid influence is brought to bear upon the hysterical condition. Thus cutaneous anæsthesia and hyperæsthesia may often be rapidly cured by the application of strong induced currents to the portion of skin; aphonia by acting in a similar way upon the skin covering the larynx. Paralysis of the limbs is in many cases quickly cured by the same means.

Hysterical convulsions may almost always be cut short by douching the patient very freely indeed with cold water. This should be poured from a height upon the face. For a few seconds there is no perceptible effect, then the breathing becomes gasping, and the patient seeks by moving away to avoid any further application. It often happens that the remembrance of this treatment serves to prevent a repetition of convulsions, but it would be wrong to conclude from this that the proceedings of the patient had been voluntary. The effect of the cold douche is to create, through the medium of the cutaneous nerves, a sudden change in the character of the blood-circulation, which may well influence the state of the ganglionic nerve-centres. The supposition seems fair that to remember the shock is to have a weak excitement of the nerve-centres which were strongly excited by the application.

Bromide of potassium, which is of such value in the *grand mal* of epilepsy, has no influence in preventing hysterical convulsions. In a doubtful case the exhibition of this drug is therefore useful for purposes of diagnosis. Valerian (the powder or tincture) has an unquestionable effect in the convulsive and spasmodic symptoms of hysteria, little or none probably upon the paralytic phases. Assafœtida by enema is useful in tympanites and colic of hysterical origin. Small doses of strychnia and opium are useful in relieving some of the distressing feelings complained of by hysterical patients.

It is often a question whether the hysterical should marry. Where the disorder is slight and the general health is good, marriage may be advised, supposing that the prospects of a happy union are favourable. But in very severe cases, and especially when there is also a strong neurotic history in the family, it should be discountenanced. Nothing but harm can be expected from the strain of domestic cares upon a congenitally defective nervous system. T. Buzzard.

HYSTERICAL INSANITY.—Almost every variety of insanity may present in certain patients features which are commonly known and termed 'hysterical.' Melancholic individuals will be afflicted with hysterical paraplegia or other paralyses. Some will become cataleptic or apparently unconscious, others will display all the phenomena of hystero-epilepsy. Not unfrequently do we see a violent outburst of acute mania culminating and subsiding in a brief period of time, resembling in this an ordinary attack of 'hysterics.' It may be doubtful, however, whether hysterical insanity should be looked upon as a special variety of the malady. It seems more correct to look upon it as insanity occurring in hysterical patients, and characterised by the phenomena peculiar to them. We may expect sudden changes of symptoms, sudden improvements, and sudden relapses.

Prognosis.—The prognosis is unfavourable, as this insanity is found in patients of an unstable nervous organization, prone to frequent derangement. Even if recovery takes place, subsequent attacks are not unlikely to occur.

Treatment.—Such persons require above all others moral treatment. Medical treatment should be directed towards the improvement of the general health rather than the removal of special symptoms. G. F. Blandford.

HYSTERITIS (ὑστέρα, the womb).—Inflammation of the womb. *See* Womb, Diseases of.

HYSTERO-EPILEPSY.—Synon.: Fr. *Hystéro-Épilepsie*; *Hystérie épileptiforme*; Ger. *Hysteroepilepsie.*

Definition.—A term applied to a form of hysteria of unusual gravity, the convulsions in their violence recalling those of epilepsy, and characterised by the occurrence of remarkable forms of anæsthesia, paralysis, and contraction of muscles.

Ætiology.—The condition is one which must be classed with hysteria, and not with epilepsy, and the circumstances which tend to the production of the former disease are here equally potent. *See* Hysteria.

Symptoms and Diagnosis.—It is to the French school, and especially to Professor Charcot of Paris, that we owe the most important descriptions of this disease, which would appear to be more common on the Continent than in England. The symptoms may be divided into:—1. *Motor*; and 2. *Sensory*.

1. *Motor.*—Convulsive seizures occur, preceded

by an hysterical aura (abdominal or epigastric), which usually gives the patient timely warning enough to enable her to place herself in a position of safety. Then there is a shriek, the face is pallid, and she falls (perhaps whilst endeavouring to quit the room), the features become distorted, and the limbs pass into a state of tonic rigidity. There is foaming at the mouth, sometimes the tongue is bitten, and there may be some clonic convulsions with lividity of features. Relaxation of the muscles and a more or less comatose condition succeed, to be followed shortly, however, by contortions and gesticulations of a violent character, coarsely suggestive of the influence of various passions—wrath, fear, disgust, lust. Or there may be meaningless writhings, presenting a hideous aspect. To this phase sometimes succeeds hallucination of vision, or of hearing. Rats and serpents and other objects of horror are seen. The attack ends with sobs or hysterical laughter. There may remain a temporary inability to empty the bladder or to swallow food.

Convulsive seizures of this co-ordinated or purposive character, although much more common in the female than the male sex, are by no means confined to the former. The condition is not unfrequently observed in boys, less often in men. In the latter there is usually the history of some great moral shock antecedent to the first outbreak.

In patients liable to attacks such as have been described, it is not uncommon to find a *contracture* of one or more limbs. This may assume the *hemiplegic* or *paraplegic* form; and it may be of a passing character, lasting a few days only, or enduring for many years. The attitude may be either that of rigid flexion or extension; and it is found to remain during sleep, only relaxing under the profound effect of chloroform narcosis. The limb so affected does not suffer in its nutrition, and the reaction of the muscles to electrical currents remains normal.

The contractures, as well as the sensory disturbances described below, may be said to be practically confined to patients of the female sex. It is very rare indeed to find them in males.

2. *Sensory.*—It has been noted that in female patients thus affected (as indeed is common in hysteria generally) there is apt to be a pain in one or other iliac region, most often the left, which is sometimes constant, and in other cases is only discovered by pressure. The seat of this pain is thought to be the ovary, and it is found that whilst a moderate pressure in this region may determine the production of the aura and sometimes of an hysterical attack, energetic compression at the spot will very often cut short the convulsive seizure.

Anæsthesia and *analgesia* are apt to be found sometimes in both sides, but much more frequently in one half of the patient's body, parted off from the other by the median line, and thus involving apparently half the head, face, and trunk, as well as the upper and lower extremities, though it may be in different degrees of intensity. It not seldom happens that the patient is herself unaware of the existence of this insensibility until examination has disclosed it. The loss of sensibility sometimes affects also the special senses; and smell, taste, hearing, sight, and the perception of colour, may each or all be lost on one side.

Accompanying the analgesia it is often seen that the pin-prick employed to test the condition fails to draw blood on the affected side, whilst readily doing so in the opposite limb.

Where there is loss of power of the limbs with contracture and anæsthesia following a convulsive seizure, it is not difficult for the condition to be ascribed to an attack of hemiplegia, resulting from organic disease, and there is sometimes a doubt on this matter which is not easily resolved. The points of most value in making a differential diagnosis are the following:—*a.* The absence *from the first* of any deviation of the tongue or facial paralysis. After a time, no doubt, in some cases of hemiplegia of organic origin these symptoms become scarcely visible, but it may be said that practically at the onset they are always present to a greater or less extent. *b.* The extent and completeness of the analgesia, especially the mode in which it affects the trunk, which ordinarily escapes in hemiplegia. Such complete anæsthesia as occurs in these cases is rarely observed in hemiplegia of cerebral origin. In spinal hemiplegia, again, it would occupy, as Brown-Séquard has pointed out, the side of the body *opposite* to that affected with motor paralysis. Besides these there is rarely much difficulty in finding in the symptoms, surroundings, or history of the patient, circumstances which, combined with those described, throw a strong light on the nature of the condition. The hysterical patient may present, for example, retention of urine, ovarian tenderness, and tympanites; and in her history there may be an account of aphonia, convulsive seizures occurring under emotion, hysterical cough, or some other feature which tends to stamp the case as one belonging to this great neurosis.

Occasionally these contractures remain permanent. Much more frequently they relax, after a longer or shorter period, and the relaxation almost always takes place suddenly, usually under the influence of some moral shock.

It will sometimes happen that paresis and contracture of a limb will occur without any previous history of hysterical symptoms, and the possibility of this must always be borne in mind. Where there is during many hours a long-continued succession of fits with brief intervals of immunity, considerable doubt may arise as to the nature of the attacks, because a very similar, numerous, and rapid recurrence of fits sometimes takes place in true epilepsy. We are indebted to Charcot for the observation that whilst in the case of the epileptic seizures of this kind the temperature is observed to rise greatly (attaining, for instance, a height of 105° F.), no such great increase is noted when the fits are of hysterical origin—a slight elevation only occurring.

In cases of hystero-epilepsy it has been noted that there is often colour-blindness, affecting the eye on the same side as the hemianæsthesia—the order of disappearance, in most cases, being the following:—violet, green, red, orange, yellow, blue. Violet is the colour most easily lost, red and blue, according to Charcot, being those which persist most, except in those cases where achromatopsia is absolute, that is, where the patient looking at a painting sees nothing but black and white.

Remarkable results have been known to follow the application of metallic plates and the approach of a powerful magnet to the anæsthetic side of the body. It is found that if a small plate of some metal be applied for a few minutes to the skin, a return of sensibility occurs, touches and pricks previously unperceived are felt, and colour-vision is restored in the affected eye. The particular metal which will effect this change has to be sought by experiment; in one person gold, in another silver, in others again iron, tin, or copper, alone producing the effect. So again it is stated that the approach (without actual contact) of a powerful horse-shoe magnet will produce a similar effect to the contact of a metal. In either case, *pari passu* with the return of sensibility on the affected side, it is noted that the other half of the body acquires the anæsthetic state. There is a transference apparently of the phenomena. The approach of a magnet, it is also found, will cause a contracture to relax, the relaxation lasting for many hours. But in this case, again, the corresponding limb of the previously normal side is found to present evidence of paresis. In two instances Rosenthal and the writer have found defective electrical excitability, as tested by sudden interruption of a strong voltaic current, in the cerebral hemisphere opposite to the side which is marked by anæsthetic symptoms. In the writer's own case the experiment was followed by considerable improvement in the cutaneous sensibility.

Treatment.—Cases of hystero-epilepsy are not amenable to any treatment by drugs. Powerful moral impressions, especially energy and commanding influence in the medical attendant, are more potent than anything else in bringing about recovery, but it is not always that these can be brought to bear. It is desirable, therefore, that in suitable cases the influence of the measures just described should be tested. In cases of convulsion strong pressure should be made upon that ovarian region in which tenderness is discovered. In examples of contracture and hemianæsthesia an application of metallic plates of various kinds may well be made to the skin of the affected side.

Very useful effects are often produced by the application of strong Faradic currents, which may require to be persisted in ere any influence is produced. Blisters also repeated every three or four days are occasionally very useful in causing the relaxation of a contractured limb and the return of sensibility to an anæsthetic skin.

Removal of the patient from the family circle and the society of frightened or sympathising friends, is in most cases a *sine quâ non* of successful treatment.

T. Buzzard

I

ICE, Therapeutics of. *See* Cold, Therapeutics of.

ICHORRHÆMIA (ἰχὼρ, puriform matter, and αἷμα, the blood).—A morbid condition of the blood, caused by the absorption of septic materials. *See* Pyæmia; and Septicæmia.

ICHTHYOSIS (ἰχθὺς, a fish).—Synon.: Fish-skin disease; Fr. *Ichthyose*; Ger. *Fischschuppenausschlag*.

Definition.—An affection of the skin which has received its name from the breaking up of the cuticle into polygonal areæ, which suggest the idea of the scales of the fish. The surface of the skin is dry, rigid, rough, and greyish in colour; and the cuticle exfoliates in fragments, which in one place resemble dust, and in others are composed of thin glistening laminæ, like those of mica or bran.

Ætiology.—As a defect of development and normal growth of the skin, ichthyosis is a congenital affection, and often hereditary; and the degree of its manifestation will depend on accidental circumstances of various kinds, and more particularly on such as appertain to food and cleanliness.

Anatomical Characters.—In ichthyosis the cuticle is more abundant than natural; the fibrous tissue of the derma is condensed and hard; the papillæ cutis are enlarged and elongated; the subcutaneous connective tissue is lax and fatless; and the whole organ is devoid of succulence and elasticity. In a word, it may be said to be starved. The remaining characteristics of the disease are such as might be predicted from this description. The cuticle formed in excess is hard and brittle, and breaks up into fragments corresponding with the areæ of the lines of motion and wrinkles of the skin; the fragments being simply pulverulent in one part, as upon the inner side of the limbs, the neck, and front of the trunk; angular and prominent in the neighbourhood of the joints; and smooth, flat, and polyhedral on the internodal parts of the limbs. The follicles of the skin are filled with dry exuviæ and dry sebaceous substance, which in some situations concretes on the surface, thereby increasing the thickness of the epidermic crust. The skin as a whole is marked with coarse wrinkles, resulting from the stiffness and hardness of its substance; and from the looseness of the subcutaneous tissue, it moves freely on the fascia beneath. While the general character of the integument is that of want of harmony as to growth with the rest of the body of the individual, there is a defect of the oily secretion of the skin, sometimes also of its aqueous secretion; a want of the clearness, transparency, and lustre which are met with in the healthy skin; and an exhalation of an unpleasant odour.

Varieties.—The most striking modifications of ichthyosis are to be looked for on the limbs, where the disease is most marked, and the scales of greatest magnitude; on the hands and feet, which are dry and horny and deeply wrinkled; on the neck and trunk, where the exfoliation is pulverulent; and upon the face, where the cuticle is shining, roughened by the edges of exfoliating laminæ, and seemingly distended, altering the complexion to a brick or apple-red. Another modification results from the presence of an excess of sebaceous substance, which, by its adhesion to the skin, produces prominent scales—*Ichthyosis sebacea*—varying in thickness in different parts of the body, and sometimes giving rise to spines of considerable length and thickness—*Ichthyosis spinosa.*

These modifications occasion a certain diversity of appearance in the affection, which has suggested a variety of synonyms. Thus, when its conspicuous symptom is dryness of the skin, we have termed it *Xeroderma*. When the network of lines which bounds its scales has attracted especial attention it has been named *Ichthyosis reticulata.* When the mother-of-pearl-like polish of the smooth area within the meshes of the lines of motion has been conspicuous it has been called *Ichthyosis nitida* and *Ichthyose nacrée.* When the concretion of the epidermic and sebaceous substance assumes the figure of the scales of reptiles, the term *sauriasis* is applicable, and *Ichthyosis serpentina*; whilst the elongated form of crust has given origin to the term *Ichthyosis hystrix*, the 'porcupine disease.'

Treatment.—These considerations lead us to the principles of treatment of ichthyosis, and suggest as primary indications:—*first*, to promote an improved nutrition of the body; *secondly*, to effect the removal of the excess of epidermic matter and sordes; and, *thirdly*, to stimulate the innervation and circulation of the skin by inunction and friction. The first of these indications is to be achieved by the use of nutritious food, cod-liver oil, arsenic, iron, and tonics in general; the second, by saponaceous ablutions and frictions, and especially by the Turkish bath and shampooing; and the third, by frictions of oily and gently stimulating liniments into the skin; one of the most suitable of these remedies for the purpose being the oleum theobromæ, or cocoa butter. Erasmus Wilson.

ICTERUS (*ἴκτις*, a weasel; with yellow eyes). A synonym for jaundice. *See* Jaundice.

ICTUS SOLIS (*ictus*, a stroke; *sol*, the sun). A synonym for sunstroke. *See* Sunstroke.

IDIOCY (*ἰδιώτης*, a person private or apart). Synon.: Feeble-mindedness; Fr. *Démence innée*; *Idiotisme*; Ger. *Die Spracheigenheit*; *Blödsinn.*

Definition.—Mental deficiency occurring during infancy or the early periods of life.

The term *idiocy* is not a scientific one, but it is convenient to employ it here to include a class of maladies which differ essentially from insanity both as to their nature and treatment. The strict meaning of an idiot is, 'a solitary one,' but it has become so much used as a term of opprobrium that it were well if the phrase, 'feeble-minded,' could take its place.

Description.—The term idiocy covers such a large area, and includes such a great variety of cases, that there is endless gradation in its manifestations, from slight departure from a normal condition, to that state of profound idiocy in which the unfortunate subject thereof sees nothing, feels nothing, does nothing, and knows nothing. The typical illustration, however, is best conveyed by reference to an average condition. For the most part, the lesion is not only a psychical one, but profoundly affects the physical, and frequently the moral life. The stature is less than normal, with great tendency to assume a stooping posture. The skin is often coarse, deficient in elasticity, and lax, with increased development of areolar tissue. The muscles are weak and flabby, and respond feebly and irregularly to the action of the will. The bones are often yielding and deformed. The circulatory system is usually weak, rendering the patient liable to destructive chilblains and frostbite, inducing perilous effects from exposure to a low temperature, and rendering slow any reparative process. The lungs are extremely liable to inflammatory attacks, both in their bronchial tubes and parenchyma, and prone to tubercular disease if the subject be resident on a clay soil. The digestive system is liable to be deranged by defective mastication of food, and alternately subject on the one hand to constipation from defective innervation, and on the other hand to diarrhœa from catarrh, resulting from rapid alternations of temperature. The sexual functions are often abnormal; there is a tendency to masturbation very early in life, while puberty itself is generally delayed, and often sterility exists. There is not unfrequently phimosis and undescended testis in the male, and non-development of the ovary in the female. The motor functions are abnormal; there is usually defective co-ordination, resulting in a deficiency in purposive acts, while there is a tendency to the production of purely rhythmical and automatic movements. There is diminished sensibility, so that what is painful to others is borne with complacency. Speech is defective, partly from want of co-ordination of the muscles of the tongue, partly owing to deformations of the mouth and palate, and partly to inability to convert ideas into words. The sight is often defective, due to hypermetropia, to imperfect retinal sensibility, to congenital cataract, or to diminished accommodation. These conditions are frequently associated with strabismus or nystagmus. The sense of smell is lessened, and the discrimination of odours almost *nil.* The sense of taste is defective, leading to the eating of things of an unpalatable, and even repugnant nature. The faculty of hearing is not much interfered with, except in cases where there has been destructive disease of the ear. The faculties of observation and attention are limited. There is generally great fondness for music, and simple airs are often readily learned. The memory is not usually very defective, and there are often instances of remarkable power in this respect. There is very little imagination or power of abstract thought, while judgment and reasoning power are almost entirely absent.

Classification.—The best classification of idiocy, the one which most assists in the prognosis and treatment, is that which is based on its ætiology. The whole of the cases may be divided into three important groups, which groups afterwards admit of subdivision. The primary groups are:—1. *Congenital*; 2. *Developmental*; and, 3. *Accidental*.

1. *Congenital idiocy.*—The congenital group includes all those cases which at the period of birth manifest signs of defective mental power, associated usually with conditions of the head, skin, and other organs, which are indicative of a congenital origin. They are cases which have never possessed ordinary mental power. The congenital group contains the following subdivisions:—*a.* Strumous; *b.* Microcephalic; *c.* Macrocephalic; *d.* Hydrocephalic; *e.* Eclampsic; *f.* Epileptic; *g.* Paralytic; and *h.* Choreic.

2. *Developmental idiocy.*—The developmental group includes a smaller number of cases, where the child is born manifesting an average intelligence through infancy, or even up to the commencement of puberty, but from causes which have influenced the nutrition of the embryo during its intra-uterine life, is born with a proclivity to mental break-down during one of the developmental crises; the crises being the periods of the first dentition, of the second dentition, and of puberty. The group includes those cases in which speech and mental faculties are lost in children in whom previously the intelligence was good—cases where the brain and nervous power was sufficient for its early years, but insufficient to carry it through evolutional stages. They usually present outward signs in their cranium or elsewhere that the tendency to catastrophe was born with them. The developmental group embraces the following subdivisions:—*a.* Eclampsic; *b.* Epileptic; and *c.* Choreic.

3. *Accidental idiocy.*—The accidental group includes all those cases of idiocy where the child has been born with a normal nervous system, free from any present or potential defect, when unfortunately a fall, a fright, epilepsy, the result of some peripheral irritation, disease of the bones of the ear sequential to measles or scarlet fever, meningitis, or other cause, may lead before puberty to mental break-down—a break-down not of a genetic, but of a purely accidental origin. (For the group of idiots produced by endemic influence *see* Cretinism.) The accidental group includes:—*a.* Traumatic; *b.* Inflammatory; and *c.* Epileptic idiocy.

Ætiology.—The production of idiocy is multiform in its causation; often more than one factor has been at work. The *congenital* kinds are produced by neuroses, struma, tuberculosis, alcoholism, over-intellectual work, over-sexual indulgence, and constitutional debility of the progenitors. Syphilis holds but a very unimportant place. Intermarriage of relations, *where there is a constitutional taint*, in consequence of its insuring the existence of two potent factors; fright and emotional disturbance, or anxiety of any kind on the part of the mother during her pregnancy; and prolonged parturition and suspended animation at birth, are also to be reckoned as causes of congenital idiocy. The *developmental* kinds have their proclivity given to them by causes affecting their nutritive life *in utero*; notably emotional disturbances, and sickness produced by the pregnancy or a prolonged sea-voyage. The exciting cause is a developmental crisis, such as occurs at the periods of dentition, and the evolution of puberty. Masturbation is a most important factor in determining this kind of idiocy. The *accidental* kinds are produced by injuries to the cranium of any kind, sunstroke, exanthematous disease, tubercular or other forms of meningitis, inanition, epilepsy referable to worms, masturbation, or other sources of peripheral irritation.

Prognosis.—In idiocy the future of the patient will be forecast by reference to the nature of the case. Other things being equal, patients paralysed or epileptic are less amenable to treatment than others, but the worst results are obtained among cases of accidental origin. It is important to recognise the fact that congenital cases, with marked traces of their infirmity in their faces and bodies, are, for the most part, more susceptible of improvement than the developmental, and these again than the accidental, who may have no appearance of idiocy in their faces or bodies; that, in fact, the prognosis is often inversely as the patient is winsome, fair to look upon, and comely.

Treatment.—The treatment of idiocy consists of a judicious combination of medical, physical, moral, and intellectual agencies. The patient should be rescued from his *solitary* life, and have the companionship of his peers. He should be surrounded by influences, both of Art and Nature, calculated to make his life joyous, to arouse his observation, and to quicken his power of thought. The basis of all treatment should be *medical* in an enlarged sense. Success can only be obtained by keeping the patient in the highest possible health. The dietary should be liberal, containing a fair proportion of nitrogenous elements, while rich also in phosphatic and oleaginous constituents. The food should be presented, too, in a form suited to the masticatory power of the patient. It is of importance that the rooms should be well-ventilated, whilst kept warm; and daily baths with shampooing should be employed. Of first importance is the soil: a clay soil is fatal to all proper progress, inducing tuberculosis, and lowering the vital power. *Physical* training forms an important part of treatment. The attenuated muscles have to be nourished by calling into exercise their functions, and the automatic and rhythmic movements have to be replaced by others which are the product of the will. The simplest movements should be first taught, then the more complex, thus causing to grow up together the mandate and the result. From purposeless acts the idiot thus builds up a series of co-ordinated and voluntary movements which are applicable to the wants of daily life. The training has to be carried out in minute detail, so that every voluntary muscle and every congeries of muscles may be called into action, and trained to fulfil with rapidity the end for which they are designed. The *moral* education is of paramount importance. The pupil has to be taught to subordinate his will to that of another. He has to learn obedience, that right doing is productive of pleasure, and that wrong-doing is followed by deprivation thereof. Corporal punishment should be forbidden; the affective faculties of the patient should be cultivated, that the deprival of the love of his teacher should be felt as the greatest punishment, and the manifestation of it his highest reward. In no case should the punishment interfere with hygienic treatment. The *intellectual* training must be based on a cultivation of the senses. The patient should be taught the qualities, form, and relation of objects by their sense of touch; to apprehend colour, size, number, shape, and relation by sight; to understand the varieties of sound when addressed to the ear; the qualities of objects by the taste and smell. These lessons should be of the simplest at first, and gradually cumulative. Nothing should be left to the imagination. The idiot must be taught the concrete, not the abstract. It is in this way we should give him the basis from which the reasoning and reflective faculties can be built up. Synchronously with this, use should be made of the physical powers which have been cultivated. He should be taught to dress and undress himself, to acquire habits of order and neatness, to use the spoon or knife and fork, to walk with precision, to handle with tact. The defective speech is best overcome by a well-arranged plan of tongue-gymnastics, followed by a cultivation of the purely imitative powers. J. Langdon Down.

IDIOPATHIC (ἴδιος, peculiar, and πάθος, a disease).—A term applied to a morbid condition when it arises primarily, and not in consequence of some other disease or injury. It is used in contradistinction to *symptomatic* and *traumatic*.

IDIOSYNCRASY (ἴδιος, peculiar; σύν, with; and κρᾶσις, constitution or temperament).

Definition.—This term, like many others used in science, has a more restricted application than its etymology would indicate. From meaning the personal constitution of an individual, it has come to mean any peculiar and not obviously correlated reactions against external influences exhibited by any individual. It is not to be confounded with 'constitution,' which is the foundation of the individual, his powers, capacities, and organisation; nor with 'temperament,' which denotes the correlation of powers and tendencies with the physical conformation of the individual, which has therefore a generic or race application, and which is defined by some writers as the 'general form' of the man. Commonly, any single peculiarity of a person is spoken of as 'an idiosyncrasy,' so that one individual may, in this sense of the word, manifest several idiosyncrasies or personal attributes.

Description.—Idiosyncrasies, so defined, may be mental or physical; may be innate or acquired; may be permanent or temporary.

The existence of idiosyncrasies being declared chiefly through the agency of nerves, and their operations being mostly capable of being brought under laws of innervation, Prochaska, Claude Bernard, and other authorities have regarded them as 'a peculiar affection of the nervous system.' But a review of the phenomena admitted to belong to the class will be found to compel us to recognise in many cases a more comprehensive relation, involving the whole organism, or parts of it other than the nervous system.

In the enumeration of the principal kinds of idiosyncrasies, to purely mental manifestations of likes and dislikes toward persons, things, and pursuits,—affections covered by such terms as 'sympathy,' 'antipathy,' 'predilection,' etc.,—must be added reactions in which the mind, the emotions, and the organic nervous system are affected simultaneously, but in varying proportions, by impressions received through organs of sense.

For example, vision may be the channel of affection. Syncope is produced in some persons by the sight of blood; or, as is related by Prochaska, swooning may invariably occur on the sight of beetroot. As regards olfaction, some people are distressfully affected, in both bodily and mental ways, by the exhalations from certain animals, the cat in particular; in others, horror and fainting are induced by the odour of roses or of apples. And so on through the rest of the senses.

In another group of idiosyncrasies the higher nervous centres play no part, the phenomena being of reflex production through the spinal centres, or being due to direct poisoning of the system or of organs. Among foods or drugs swallowed, among gases or dusts inhaled, among substances brought into contact with the skin, many, harmless to the majority of men, are for this or that individual irritants or poisons. For instance, eggs, honey, sugar, or fish may produce gastric pain, nausea, or vomiting; strawberries are to a few persons a most deadly poison, producing symptoms of intense nervous shock; convulsive spasms may be excited by the smell of musk or civet; asthma by the inhalation of the powder of ipecacuanha; urticaria by the eating of shell-fish, or even by the application of the yolk of egg to the skin.

> Some men there are love not a gaping pig;
> Some that are mad if they behold a cat;
> And others, when the bag-pipe sings i' th' nose,
> Cannot contain their urine.
>
> *Merchant of Venice.*

Idiosyncrasies confronting the use of drugs have a special interest for the medical man. They may be of a qualitative nature, as in the production of unusual symptoms with dangerous or fatal results by anæsthetics, or in iodism; or of a quantitative nature, as in the case of opium and belladonna, minute doses of which will poison some persons, while doses of them, large enough to destroy a dozen average individuals, may be taken by one here and there with impunity.

The consideration of this part of our subject introduces the question of the variations of idiosyncrasies. The transient oddities of susceptibility arising in pregnancy, hysteria, and madness, are excluded by some authors from the category, but as they only differ in their transitory character from other idiosyncrasies, we shall here associate them with those modifications of reactive sensibility to which the term is commonly extended. Seeing that the causes of innate idiosyncrasies are for the most part unexplained, we may search out in varying or acquired idiosyncrasies varying correlations which may help us to the ultimate better understanding of the former group. Thus we know that intolerance of opium may arise in some morbid states the nature of which is fairly known; that tolerance of, or comparative indifference to, the same drug may be attained by its constant use. As in pregnancy new idiosyncrasies appear, so age, habits, and state of body may each and all modify the reaction of any individual towards his surroundings; may change his behaviour under the influence of drugs; may at one time charm him against morbid poisons, at another time leave him their easy victim; may make him inflame sometimes in a suppurative, sometimes in a plastic way. From this point of view, we may with Claude Bernard summarise idiosyncrasies as being 'mere manifestations of the ordinary laws of physiology.'

Imaginary idiosyncrasies.—Persons are not unfrequently met with who, held by prejudice, or misled by fancies or unsound judgments, declare that particular foods and medicines disagree with them. It may often be found, on investigation, that the assertion is incorrect. The obstacles offered to effective treatment by such fancies are sometimes of grave importance, tasking severely the sagacity of the medical man in the way of analysis, and his skill in the way of counteraction. But when the idea of their existence shall have been proved in any case to be unfounded, it is generally possible to evade such obstacles by tact, or to undermine them by argument, and, most of all, to dissipate them by firmness.

William M. Ord.

IDROSIS (ἱδρώς, sweat). A synonym for hyperidrosis. *See* Perspiration, Disorders of.

ILEO-TYPHUS.—A synonym for typhoid fever. *See* Typhoid Fever.

ILEUM, Diseases of. *See* Intestines, Diseases of.

ILEUS (εἰλέω, I twist).—A synonym for an intestinal obstruction. *See* Intestinal Obstruction.

ILIAC REGION.—The iliac region, or region of the iliac fossa, is limited laterally and superiorly by the crest of the ilium, anteriorly by Poupart's ligament, and internally and below by the brim of the true pelvis or inner edge of the psoas magnus muscle.

Anatomical Relations.—That portion of the abdominal cavity which corresponds to these boundaries, contains the following viscera on the right side:—the cæcum, the vermiform appendix, some coils of the small intestines, and the ureter; and on the left side:—the sigmoid flexure of the colon and small intestines, and the ureter.

In front of the cavity is the ilio-inguinal region, which forms its anterior parietes, and from which surface all examinations of the region are instituted. Exploration is difficult in obese persons, and to facilitate it we must relax the abdominal parietes by flexing the thigh, and by pressing the fingers immediately above the crural arch.

The *peritoneum* is but very slightly united to the subjacent tissues, and is easily separated from them. It completely covers in the left iliac fossa; but on the right side, owing to the presence of the cæcum, this investment is incomplete (*see* Lumbar Region).

The *sub-peritoneal cellular tissue* may be regarded as being composed of two distinct layers. The first, immediately beneath the peritoneum, is a continuation of the lax cellulo-fatty envelope of the kidney and cæcum, passing with the femoral vessels into the crural canal, and with the spermatic cord into the scrotum. The deeper or sub-aponeurotic layer lies beneath the sheath of the iliaco-psoas muscle, being continuous above with the sub-pleural cellular tissue, and accompanying this muscle downwards as far as its insertion into the lesser trochanter.

The *arteries* of this region are the common and external iliac, and their branches.

The *nerves* of the iliac fossa are the lumbar plexus (the trunks of which lie in the iliaco-psoas muscle) and its branches; and the solar, renal, hypogastric, and lumbo-aortic branches of the sympathetic.

The *fascia iliaca* is attached above to the entire inner lip of the iliac crest. Internally it is blended with the sheath of the psoas at the level of the promontory of the sacrum; and below this point it becomes fixed to the brim of the true pelvis, passing behind the vessels and giving off a thin cellular lamella in front of them.

The *sheath of the psoas muscle* is attached above to the ligamentum arcuatum internum; it encloses the psoas anteriorly (the posterior portion of its envelope being formed by the lumbar vertebræ); it is blended externally with the sheath of the quadratus lumborum; whilst internally it is attached to the anterior common ligament. Inferiorly it is continuous with the fascia iliaca.

The *osseous layer* corresponds with the iliac bones.

Pathological and Clinical Relations.—The viscera which have been enumerated above, as being contained in the iliac region of the abdomen, present various diseased conditions, which cannot be satisfactorily diagnosed without a practical knowledge of its anatomical relations, and especially of the fasciæ, sub-aponeurotic, and aponeurotic structures of the iliac region. Thus in the right iliac region the physician meets with tumours and other diseases of the cæcum, vermiform appendix, and lower part of the ileum, including the local lesions of typhoid fever (*see* Cæcum, Diseases of). In the left iliac region, the diseases of the sigmoid flexure possess equally important relations. The tumours, extravasations, and abscesses, which may commence in the pelvis, frequently make their way into either iliac region; and this is also the seat of morbid conditions connected with the ureter in the middle portion of its course, as well as partly of the pain in renal calculus. In the sub-peritoneal tissue we meet with bloody or urinary infiltrations, fæcal abscesses, and perityphlitic or idiopathic abscesses independent of any intestinal lesion. Collections of pus beneath the fascia are generally dependent on caries of the vertebræ, and may either be confined to the iliac fossa, or lie within the sheath of the psoas muscle (psoas abscess).

Again, lumbar abscesses may point anteriorly, and be diagnosed by palpation of the abdominal walls.

This region is the seat of ligature of the common, external, or internal iliac arteries. The pulsation of the two former can generally be felt; and it must be borne in mind that the abdominal aorta pulsates in the left iliac region.

EDWARD BELLAMY.

ILLUSION.—A false or mistaken perception of one of the senses, as when a person sees or hears something, and takes it to be something else. The term has been used as synonymous with delusion and hallucination. Illusions may occur in the sane as well as the insane. *See* HALLUCINATION.

IMBECILITY. *See* DEMENTIA; and IDIOCY.

IMPETIGINODES.—Impetiginous; that is, having the character of impetigo; hence, eczema impetiginodes. *See* IMPETIGO.

IMPETIGO.—SYNON.: Fr. *Impétigo*; Ger. *Eiterflechte.*

DEFINITION.—A term used by Celsus and Pliny, apparently signifying *ab impetu agens,* that is, breaking out with violence or impetuosity. In modern dermatology the term is restricted to an eruption of small pustular vesicles, accompanied with but little redness or inflammation, and that of a superficial character; hence, the individual pustules have been termed *psydracia* or 'cold pustules,' in contradistinction to the pustules of ecthyma, which are termed *phlyzacia,* or 'hot' and inflammatory pustules.

ÆTIOLOGY.—Impetigo is an outbreak of a sensitive and weakly skin, associated with nutritive debility; and is more common in children and women than in men.

VARIETIES.—Impetigo presents itself in three forms. First, it occurs as an eruption of isolated pustules, distributed more or less generally, when it is called *Impetigo sparsa.* Secondly, it is found as a congregation of pustules forming blotches, rarely exceeding one or two inches in diameter, constituting *Impetigo conferta* and *Impetigo figurata.* And, thirdly, it is seen as a complication of eczema, representing a pyogenic tendency, as *Eczema impetiginodes.* In children it is apt to occur on the face, hands, and feet, and particularly in the region of the mouth, nostrils, and ears; and, from its frequent spreading through a whole family or neighbourhood, has awakened a suspicion of contagion, and as such, received from the late Dr. Tilbury Fox the name of *impetigo contagiosa* (*see* IMPETIGO CONTAGIOSA). Dr. Fox likewise detected epiphytes in this form of eruption. Nevertheless, impetigo will best be regarded as a simple pyogenic eczema, and not ordinarily contagious.

DESCRIPTION.—Pathologically, impetigo is a vesicle containing pus or a muco-purulent fluid, rather than a true pustule, and varies in size from a mere point, not larger than a pin's head, to a hemisphere of a quarter of an inch in diameter. With the smaller dimension, it often occupies the aperture of a follicle; whilst when more extensive, it spreads over the surface occupied by several of these apertures. The colour of its contents likewise varies in different specimens, being sometimes brightly yellow, at other times cream-coloured, and in the 'epidemic' variety almost colourless. After a few days the secretion dries up into a crust, of yellowish or brownish colour; and the crust varies in figure and thickness according to the activity of the secreting process, or the undisturbed condition of the pustules. On the face of children it will sometimes dry up into a crust of considerable dimensions; and in this state, when it retains its yellow colour, is an example of what the ancients denominated *melitagra.* More frequently, however, the crust is discoloured and blackened by admixture with blood; and when associated with eczema, is capable of forming a mask over the whole face—*Impetigo larvalis*—or, in the case of infants at the breast, an impetiginous *crusta lactea.*

PROGNOSIS.—The prognosis of impetigo turns upon the fact that it results from nutritive debility. It is perfectly curable, is by no means grave in its nature, and disappears completely when the health and strength of the patient are restored; in ordinary cases, in two or three weeks.

TREATMENT.—If any derangement of digestion and secretion be evident in a case of impetigo, this should be regulated before tonics are resorted to. The diet and regimen should be nutritive and wholesome; while the tonics most suitable to such cases are iron, quinine, arsenic, nitrohydrochloric acid, and cod-liver oil. Locally, the blotches should be kept covered with the oxide of zinc ointment, or with a lotion of lime-water and oxide of zinc. The former of these remedies preserves the softness and pliancy of the crusts; whilst the latter dries them up. Both processes promote their removal; and in the selection of the remedy the best guide will be the amount of discharge, the degree of irritability of the skin, and especially the sensations of the patient.

ERASMUS WILSON.

IMPETIGO CONTAGIOSA (*impetigo,* a scabbing disease of the skin; *contagiosa,* contagious).—DEFINITION.—A contagious vesico-pustular disease; sometimes epidemic; attacking children in the vast majority of cases; and often affecting several members of the same family.

SYMPTOMS.—This disease, which was first described by the writer, is sometimes attended at the outset with pyrexial disturbance. The eruption first makes its appearance about the face, and indeed is chiefly marked in this situation; but it may appear on the neck, head, and limbs, and more rarely on the trunk. The eruption is composed of one or more crops; and begins by the formation of vesicles, which develop into little bullæ. The contents of these become milky, and then sero-purulent; and speedily dry into light-yellow scabs which look as if stuck on, unless the spots are injured by scratching. Mothers describe these little vesico-pustules in their early stage as 'little watery heads' or 'watery pocks.' The significant features of these spots are their separateness; their superficiality; their replacement by the flattened scabs; and the contagious quality of the fluid contents of the vesico-pustules. Very often bullæ appear about the hands of the children affected.

TREATMENT. — The treatment of contagious impetigo consists in applying the unguentum hydrargyri ammoniati in a diluted form to the red surfaces beneath the scabs, by which the characters of this secreting surface are altered, so that the disease is not spread by auto-inoculation. As each spot tends to run a definite and short course, the whole disease is quickly cured by the prevention of its spread in this manner. The general health may require attention. TILBURY FOX.

IMPOTENCY (*in*, not, and *potens*, capable). SYNON.: Fr. *Impuissance*; Ger. *Impotenz*.

ÆTIOLOGY AND PATHOLOGY.—Impotency implies an incapacity for sexual intercourse, and it arises from various causes. The testicles are the organs which furnish spermatozoa, the element essential to impregnation. Their functions may become suspended, or be incapable of excitement; or they may be exerted to excess, improperly excited, and so abused as to fail prematurely; or these organs may become impaired or destroyed by disease.

The impulse for commerce with the other sex exists in different degrees of force in different men. A certain degree of vigour is necessary to bear the nervous excitement attending it; hence in advanced years, and in weak and susceptible individuals, the frame is unable to sustain frequent coition with impunity. Rules have been given for regulating the sexual functions, and restricting their exercise within due bounds. They are, however, of little value, for the powers vary greatly in different persons, and also at different periods of life, and what is moderation in one man, or at one period of life, is excess in another man, or at another time of life. Whenever the sexual act is followed by a prolonged sense of debility and lassitude, an uncomfortable feeling in the head, and disinclination for either physical or mental exertion, the limits consistent with health have been exceeded.

In adult persons of recluse and studious habits the testicles often continue dormant for years. Like the mammæ in the unmarried female, though inactive, they remain sound and competent for secretion when duly excited and called upon to exercise their functions. The case is different later in life. Thus widowers, after remaining chaste for some time, on marrying have been doomed to disappointment. Inaction has hastened the natural decline. After middle age, as life advances, the testicles diminish in size, and become soft and flaccid; the secretion of semen becomes languid; and the desire and power to indulge in coition gradually subside. The period of life at which these changes become marked varies in different men, but most persons are conscious of some decline in sexual vigour after the age of forty. There are some remarkable instances on record of men who are reported to have been capable of the reproductive act in very advanced life. Cato, the censor, is said to have had a son at eighty years of age. Zadislas, king of Poland, at the age of ninety, married his second wife, and had two sons. The writer has often detected spermatozoa in the fluid from the testicles of very old men, one a tailor aged eighty-seven. Duplay discovered them in nine octogenarians. Though the scantily secreted sperm may retain its fecundating properties, old men may still fail in the other conditions essential to the due performance of the sexual functions.

The testicles are under the influence of the brain, which animates and controls the desire for sexual intercourse. An emotion of the mind, as sudden disgust or anger, arrests the secretion of these glands as quickly and as effectually as a strong mental impression stops the secretion of gastric juice, and takes away the appetite for food. An attack of apoplexy, or severe injury to the head, may extinguish all desire as well as capacity for coition. A gentleman, aged thirty-four, had a concussion of the brain which rendered him insensible for twelve hours. For four months afterwards he lost all sexual power, and on its recovery it remained feeble. There are several cases on record in which severe injury of the head has been followed by complete wasting of the testicles, as well as by permanent impotency. Diseases and injuries of the spinal cord, producing paraplegia, have no direct effect on the testicles, but destroy the power to copulate.

Some men are but little susceptible to the influence of the female sex, and though of vigorous mould, they have not only passed a life of absolute chastity, but have never evinced the slightest disposition for sexual enjoyment. This arises probably from some cerebral imperfection. Owing to the same cause, the testicles may remain undeveloped in adult age, attended with an absence of sexual desires. Cases of wasting of the testicles after injuries of the head, and the non-development of these organs, with absence of the venereal appetite, in certain cretins and idiots, tend to strengthen this view.

The most common cause of impotency is want of self-confidence—excessive apprehension of inability to perform well the duty of the sex, a feeling which is often greatly aggravated by the perusal of the productions of quacks and other impostors. When persons entertain these groundless fears, it may be long before success attends their efforts, every failure adding to the evil by diminishing the reliance upon their powers. In the case of persons recently married, who may be affected with this form of impotency, a tonic may be prescribed, and the patient be directed to abstain from all attempts at intercourse whilst under treatment, and we may rest satisfied that not many days will pass over before nature asserts her empire. These cases must not be lightly treated. The patient is in great distress of mind. The true cause of failure may be explained to him, and he may be confidently assured of the groundless character of his fears, and of the influence of his doubts and apprehensions in preventing him from fulfilling his desires. Encouraging assurances will do more in effecting a cure than stimulating medicines or any sort of medical treatment. A single success banishes at once all his fears, and gives security for the future.

Excessive exercise of the sexual functions is a frequent cause of impotency, and its too early indulgence often entails a loss of power in middle age. This is often the case in the despotic countries of the East. Another result of inordinate excitement of the organs is frequent involuntary discharges of the spermatic fluid. Varicocele tends gradually to impair the nutrition, and diminish the secreting powers of the testicles. When limited to one side, as usual, a varicocele need not disturb the mind of the patient. Diseases which destroy the substance, or produce wasting of the testicle, necessarily prevent its secreting. The functions, however, of this gland are not very readily impaired by disease, and so long as a small part remains entire, the organ may be fitted to perform its office sufficiently for the end destined by nature. A person who has lost both testicles by operation after arriving at puberty, may experience desire, have erections, accomplish coitus, and even emit fluid for many months and even years afterwards, but he soon loses the capacity to impregnate, and all sexual power gradually subsides.

Virility is more or less affected by constitutional diseases. Few complaints have greater influence in impairing the generative functions than those of the kidney. Diuretics, as the nitrate of potash, carbonate of soda, &c., are well known to act as anaphrodisiacs. In irritative dyspepsia, with deposits in the urine of earthy phosphates or oxalate of lime, there is generally some inability. Impotency in these cases is only one of the manifestations of defective assimilation and depressed vital force. The treatment of such cases by mineral acids and other remedies calculated to improve the general health is very successful in restoring sexual vigour. In diabetes and albuminuria the reproductive organs are weak and often quite inactive, but may regain tone as the kidneys are restored to a healthy state.

Impotency sometimes occurs in middle life without any obvious cause. In such persons the writer has noticed a constitutional change similar to that which occurs in eunuchs, but less marked. They have been observed to grow sleek and corpulent, to have a scanty beard, and to be indisposed to active muscular exertion. In general they evince no unhappiness at their altered condition. In atonic impotency, the external organs afford indications of the want of power. Not only are the testicles soft and flaccid, from the absence of blood in the vessels and sperm in the tubes, but the penis is small and shrivelled, and the glans relaxed. The scrotum is also loose. These parts are pale, feel cold, and their sensibility to contact is diminished.

TREATMENT.—Certain medicines, reputed to possess the property of stimulating and invigorating the sexual organs, have been classed as *aphrodisiacs*, and some of them are said to be used, especially in the East, by the sensualist, to excite the organs when exhausted by satiety and excess. Several act on and stimulate the urinary organs, and thereby give temporary power to the function of erection; but they produce little or no effect on the special sexual organs. They determine blood to the penis, and cause morbid erections, without any voluptuous sensations and desires. Such appears to be the character of the influence produced by cantharides, the most common of this class of medicines, and the chief ingredient of quack medicines for impotency. There are, however, certain cases in which cantharides is useful. In an atonic state of the organs, in which the erections are feeble, unstable, and insufficient—ten to fifteen minims of the tincture may be given every three or four hours for a short time before the occasion arises for the exercise of the sexual functions. Dilute phosphoric acid, the phosphate of iron, the liquor strychniæ, and ergot of rye are remedies which may be given in impotency. The conditions to which these aphrodisiac remedies are chiefly applicable is when the intromittent organ is but feebly excited, and does not maintain the physical state necessary for penetration, during the period of congress. Such torpidity may exist in persons in whom desires are at times strongly felt, and the functions of the testicles properly performed. In these cases, also in timid persons, and in others whose organs are inexcitable from long disuse, stimulating treatment may conduce to success, and ensure confidence for the future. But these remedies exert no influence in a constitutional apathy of the sexual functions. They have rarely, also, more than a temporary effect; and in persons advanced in life, when the parts, having fulfilled their office, are experiencing their natural decline, they operate injuriously, and tend to produce congestion of the prostate and local disease. In those cases also in which the sexual organs are weakened or prematurely exhausted by excess, they are likewise hurtful, as well as fruitless. After such abuses a period of repose is required, and by the avoidance of all sources of excitement, and by diet and remedies adapted to invigorate the body, such as the preparations of steel, a gradual restoration of the procreative functions may be hoped for.

Electro-magnetism is a remedy of some efficacy in certain forms of impotency. Interrupted currents (Faradic) may be passed in two directions, from the perineum to the glans penis in cases of defective erectile power, and from the groin along the spermatic cord to the testicles, in cases where these organs are soft and flaccid, and where secretion is languid. The results are often disappointing. In cases in which the desires are strong, but the erections feeble, the sensibility of the glans penis is so lowered that the friction of coition is incapable of maintaining prolonged distension of the organ, and erection subsides shortly after penetration and before completion of the act. A few applications of the electric current, by rendering the glans penis more sensitive, may cause a more persistent distension of the organ under the natural excitement. Electro-magnetism succeeds more frequently in impotency of this character than where, in addition to defective erection, the desires are feeble, and the testicles soft and inelastic; and yet the repetition of the remedy has succeeded in some instances of this less hopeful kind in rousing a dormant power, causing secretion to be resumed and erections to return. The special treatment required in cases due to injury of the central nervous system, after recovery from head-symptoms, is the use of electro-magnetism, applied from the occiput along the spine.

T. B. CURLING.

IMPULSE (*impello*, I thrust forwards).—A sensation of a stroke communicated to the hand, for example, by the action of the heart or the pulsation of an aneurism; or by the sudden movement of a fluid when agitated in any way (*see* Physical Examination). The term is also employed in connection with a mental condition in insanity. *See* Insanity, Varieties of.

IMPULSIVE INSANITY. *See* Insanity, Varieties of.

INCARCERATION (*in*, in, and *carcer*, a prison).—A condition of hernia in which it cannot be reduced, on account of obstruction at the neck of the sac or from some other cause. *See* Hernia.

INCOHERENCE (*in*, not; *con*, together; and *hæreo*, I stick).—Inconsecutive or 'wandering' thought, as expressed in speech. *See* Consciousness, Disorders of.

INCOMPETENCE (*in*, not, and *competo*, I meet accurately).—In its general sense this term' signifies inability of a part to perform its functions. It is mainly applied to imperfection in the closing apparatus of an orifice, such as the valves of the heart or the pylorus. *See* Heart, Valves of, Diseases of.

INCOMPRESSIBLE.—Incapable of perceptibly yielding to pressure. Usually applied to the pulse. *See* Pulse.

INCONTINENCE (*in*, not, and *contineo*, I hold).—In medical language incontinence signifies inability to retain the urine or fæces, so that they are discharged involuntarily. *See* Defæcation, Disorders of; and Micturition, Disorders of.

INCUBATION (*incubo*, I hatch).—Definition.—The development of disease from infecting particles, and the time occupied in the process.

Period of Incubation.—The period of incubation is the interval between exposure to infection and the appearance of the resulting disease. It is divided into two stages, those of *latency*, and of *invasion*; the one has reference to supposed changes in the infecting particles, the other to noticeable changes in the health of the person infected; the first stage is of variable duration and without definite symptoms, while in the second the disease is progressing and the patient is said to be sickening for it, its duration being nearly constant for each special disease. The division is not well-marked; there are changes in the so-called latent period which do not always escape detection, while those of the invasion have often to be considered as part of the disease. Where the latent stage is much prolonged a *dormant* period is inferred, for it is possible that infection may remain in the body for a time dormant; this term is only applicable to certain conditions under which infection is transmitted, and instead of speaking of the long intervals of inactivity at which epidemics recur as periods of latency or of incubation, it is to these periods of quiescence that the term dormant should be restricted.

The results of septic infection are manifested in the body without any true incubation.

Incubation properly refers only to the latent periods of infection in the acute specific diseases; still it is usual and often convenient to reckon the period of incubation as extending to the full development of the more characteristic signs of each of these diseases.

The duration of this period differs for different classes of infectious diseases, and in a less degree for each disease; it varies within certain limits for the same disease, but is sufficiently constant to afford some distinctive characters useful in diagnosis and a knowledge of which is essential to preventive medicine. The germs of all the incubative diseases are reproduced in the bodies of the sick; to stop infection the susceptible who have been exposed to it should not mix with others till the incubation-period has passed without signs of illness. Hence it is important to ascertain the laws regulating the incubation of each specific infection, and to define the limits of variation. The invasion-stage of all these diseases is already infectious.

1. *Variola* and *Vaccinia.*—In small-pox, after infection, the eruption occurs in fourteen days, and marked illness begins two days sooner. This is so well established as to afford a guide to the source of infection, by which it may frequently be discovered. Dr. Gregory's experience only furnishes one case in which the interval was prolonged to fifteen days. As short an interval as twelve days may be met with, though rarely, in small-pox modified by vaccination or by a previous attack. Small-pox by inoculation is developed in nine days; a local vesicle appears on the fourth day, there is glandular sympathy on the sixth, and febrile disturbance on the seventh and eighth days. Exactly this course is observed in vaccinia resulting from vaccination.

2. *Varicella.*—Chicken-pox has an uncertain incubation-period, varying from ten or twelve to fifteen or even nineteen days. The eruption begins with the first symptoms of illness.

3. *Morbilli.*—Measles has twelve days of incubation, reckoning to the appearance of the rash, or eight days from infection to the sickening; the latent period may be only four or six days, that of invasion may extend to six instead of four days. The general experience of schools and hospitals gives ten days from rash to rash, which is twelve days for incubation. Measles results from inoculation in seven or eight days; the shortest instance from infection, one of fifty cases traced by the writer, was eight days, the two longest, sixteen and eighteen days; but it may possibly extend to twenty-one days.

4. *Rötheln.*—Rötheln has an incubation-period of not less than ten to fourteen days, frequently extending to seventeen or twenty-one days. Very little illness precedes the rash.

5. *Mumps.*—Mumps usually takes from fourteen to twenty-one days for incubation; the shortest period is ten days; the longest that has come under the writer's observation was twenty-two days. Symptoms referable to the invasion-stage may be noticeable for a week before the swelling of the parotids; the latent stage may continue from eight days to twenty.

6. *Pertussis.*—This generally has one week, or even two, of incubation before the first febrile and catarrhal symptoms appear; there is often a latent period of only four or five days, as some cough may precede the fever; the distinctive cough is seldom heard till after the second week; the shortest period in which it has been known to occur is eight days.

7. *Influenza.*—Influenza has a very short incubation-period, reckoned by hours.

8. *Scarlet Fever.*—Scarlet fever has a short incubation-period; from three to five or six days is the time in which the disease is usually declared; it may appear in less than two days; the longest interval is seven or eight days. There are instances where exposure to this infection has produced no effect until after some accident or surgical operation, the rash then appearing in from three to five days. Supposing infection to have been received a week previously, twelve days would not be too much to allow for such possible extension of the incubation-period. After removal from a source of scarlet fever, those who have no symptoms of the illness within one week will generally escape.

9. *Diphtheria.*—Diphtheria may be developed in three or four days; an interval of from six to eight days is not unfrequent. Sometimes two or three days' fever precedes the first local signs; or these may appear at the very commencement, and the incubation be reduced to a single day. On separating the healthy from the sick, more than a week must elapse before immunity can be predicated.

10. *Typhoid Fever.*—In enteric fever, the occurrence of the first symptoms in a large number of cases, traced by Buchanan, was eleven days after the operation of the cause, many other cases occurring two or three days later. Dr. Hunter of Linlithgow gives one case, with a single definite exposure, where the prodromata occurred in the early part of the third week with a rigor at the end of it, twenty-one days elapsing before the fever was marked; certain interruptions to the febrile process may still further prolong the interval. An incubation-period of only five days has been noted, once from contaminated milk, and once from infection; there are instances of an eight days' incubation when some of the poison has been inhaled.

11. *Typhus.*—Typhus has, in the great proportion of cases, twelve days of incubation. The late Dr. Murchison gives three cases that have exceeded this period by two or three days, and one of twenty-one days; ten of his cases fell short of it by two, six, or eight days; one of these did not exceed two days, and in two of them the latent period must have been a few hours only. The distinctive rash appears on the fourth or fifth day of illness.

12. *Relapsing Fever.*—This fever has five days of incubation; this exactly agrees with the life history of the *spirillum* observed in the blood during the fever; the incubation-period may, however, be prolonged to seven, nine, or twelve days, or shortened to two days; many cases have succeeded almost immediately on exposure to a concentrated infection.

13. *Plague.*—Plague is communicated in from two to five days; the fever may commence on the first day, the glandular swellings on the third, or sometimes glandular tenderness begins with the fever. A period of four days suffices to set up the constitutional symptoms when the plague is conveyed by inoculation.

14. *Yellow Fever.*—Yellow fever has a short incubation of from two to six days, rarely exceeding eight days. Dr. Cargill of Jamaica gives a case fatal the day after exposure to infection.

15. *Dengue.*—Dengue is quickly developed, usually in three days. The febrile ingress is sudden, and precedes the rash only by a few hours.

16. *Cholera.*—Incubation in cholera lasts from a few hours to four days. The reports of numerous commissions give from one to five days; within five days, before the third, and not later than the fourth day. Individual cases often fall on the second or third day; the premonitory diarrhœa should be considered as part of the disease.

17. *Malaria.*—The infection of true malaria is not given off by the bodies of the sick, but limited to certain localities. This kind of miasm, to which the term infection is sometimes improperly restricted, has a marked period of incubation, which is often a lengthened one. The non-contagious malarious fevers of the West Coast of Africa often show an incubation-period of ten to twelve days. In July, 1810, our troops in Sicily fell ill with remittent fever thirteen or fourteen days after exposure to malaria. Men continued to fall ill for twelve days after their removal from the infected site. Labourers going to our fen-districts for the harvest seldom had ague till the end of their month's work, and often not till two or three weeks after their return. Ague may not appear till months after residence in a marshy district.

18. *Syphilis.*—The induration of a syphilitic sore appears after ten days; six weeks later the rash or sore throat. The localised changes of the initiatory period may occupy from three days to three weeks or even longer; in the shortest instances with immediate adenopathy the eruption follows in six weeks. John Hunter gives the interval from the local to general infection as two months; this may extend to eighty days. Other constitutional symptoms occur at much longer intervals. The contagion of secondary syphilis requires five weeks or longer to become manifest.

19. *Rabies.*—Hydrophobia presents us with the longest, and also with the most variable period of incubation; this, however, has a limit of great practical value; the shortest interval known is a fortnight, so that ill effects felt in a less time than this, or following rapidly after the bite, are readily distinguished from rabies. The usual period of incubation is six weeks. Three weeks is an exceptionally short period, three months not exceptionally long. Dr. Mead gives cases occurring after eleven and fifteen months. An interval of thirteen years has recently been recorded. After the second month has elapsed the fear of any ulterior consequences becomes less and less. In the dog the usual interval is from three to six or eight weeks; it has occurred after three months, and in one instance recorded by Youatt after seven months. The shortest interval given by Regnault, from the bite to signs of rabies in the dog, is ten days; of his sixty-eight cases ten were from a fortnight to three weeks, and fifty-seven at longer intervals.

The incubation-periods of these widely-differing diseases, while retaining distinctive differences, merge into each other. The longest intervals observed for scarlet fever and diphtheria correspond with the shortest observed in measles and small-pox, while the longest in these diseases and in mumps come near the shortest period for hydrophobia or ague. Many important diseases are separated widely and distinctly by their length of incubation, as small-pox from cholera, yellow fever and plague from typhus, and still more widely from the recurrent paludal fevers.

WILLIAM SQUIRE.

INDIAN RINGWORM. *See* EPIPHYTIC SKIN-DISEASES.

INDICATION (*indico*, I point out).—That which suggests or clearly demonstrates the course to be pursued, and the remedies to be adopted by the practitioner, either for the prevention, or in the actual treatment of disease.

INDIGESTION.—Difficulty in digestion. *See* DIGESTION, Disorders of.

INDURATED CHANCRE.—A synonym for hard chancre. *See* SYPHILIS.

INDURATION (*induro*, I harden).—A term applied to the process or condition of hardening of the tissues from any cause.

INFANTILE CONVULSIONS. — *See* CONVULSIONS; and INFANTS, Diseases of.

INFANTILE PARALYSIS. — SYNON.: Fr. *Paralysie essentielle de l'enfance* (Laborde); *Paralysie atrophique graisseuse de l'enfance* (Duchenne); Ger. *Kinderlähmung*.

ÆTIOLOGY.—This is a disease which affects children at an age varying from a few months to a few years, and commonly during the first dentition. Antecedent events, such as falls, injuries, and dentition, have been assigned, but on no sufficient evidence, as causes of this lesion; and beyond the fact that infancy is a distinct predisposing cause, almost nothing is positively known in regard to the ætiology of this affection. Its onset is often quite sudden, in the midst of what appears to be perfect health.

ANATOMICAL CHARACTERS.—Recent microscopical investigation of the spinal cord and muscles has thrown much light on the morbid anatomy of infantile paralysis. In most cases the atrophied muscles are found to have undergone fatty degeneration, with disappearance, to a greater or less extent, of the transverse striæ. Oil-globules and numerous fat-cells are also found between the fibres.

It has been shown by the investigations of Cornil, Prévost and Vulpian, Charcot and Joffroy, and the writer, that in fatal cases of infantile paralysis the spinal cord and its nerves are affected by a variety of lesions. These morbid changes consist of atrophy of the anterior cornua and their nerve-cells; of granular disintegration and atrophy of the anterior nerve-roots; and of atrophy of the anterior columns, particularly in the cervical and lumbar enlargements, where the nerves that supply the atrophied limbs are given off. Corpora amylacea have also been found both in the white and grey substances.

SYMPTOMS.—Infantile paralysis is usually preceded by pyrexia, and more or less pain in the back. The attack is generally sudden, and sometimes is accompanied by convulsions, which are at once followed by paralysis, but without loss of sensibility. The lower extremities are generally the first invaded, and the paralysis rarely attacks the upper extremities alone. In the beginning it is more or less generalized, but after a time it becomes limited to groups of muscles, to particular muscles, or to one member. The muscles most prone to be affected are those at the anterior part of the leg—the extensors of the toes, and the flexors of the foot; the extensors and supinators of the hand; the extensors of the leg; and the muscles of the foot. In some instances the disease fixes on single muscles, particularly the extensor longus digitorum pedis, the tibialis anticus, the sterno-mastoid, or the deltoid. There is a loss of five or more degrees of temperature in the parts affected; and their reflex excitability, as well as their electric contractility, is more or less diminished, and sometimes completely abolished. After a period varying from one to two or more months, the paralysed muscles begin to waste. This wasting is much more rapid than in progressive muscular atrophy, and is in proportion to the loss of electro-muscular contractility. Bones and ligaments are also often involved in the atrophy.

After a period, varying from a few days to a few weeks, those muscles of which the structure has remained unaltered may recover their voluntary contractility, and then the paralysis disappears; but this period is sometimes more protracted. In those which regain their voluntary and electric contractility, nutrition improves, and their volume increases; whereas those muscles which remain paralysed undergo progressive atrophy, accompanied by granular or fatty degeneration. The tonic force of those muscles, therefore, which have preserved or have recovered their contractile power, not being opposed by their antagonists, which have undergone atrophy and degeneration, a variety of deformities and unnatural attitudes gradually ensue, and call for the skill of the surgeon. The most important of these club-foot deformities are *talipes equinus*, *equino-varus*, *equino-valgus*, *calcaneus* or *calcanes-valgus*, and *varus*.

PROGNOSIS.—This will depend on the nature and extent of the morbid changes that have taken place in the nervous centres and in the muscles. The extent of these changes can be surmised by the electro-muscular test. Just in proportion as a paralysed muscle loses its electro-muscular contractility and sensibility does it undergo atrophy, and subsequently pass rapidly into a state of granular or fatty degeneration. If, therefore, the electric contractility of the affected muscles be lost to the induced and continuous current, the prognosis will be of the gravest character.

TREATMENT.—In the treatment of this disease both general and local means must be adopted. In the acute stage, rest in the recumbent posture is of great importance. When the muscles have become affected by paralysis and atrophy, local as well as general means of treatment must be employed. Of the local means electricity is one of the most important. If the induced current should fail to produce contraction of the affected muscles, the continuous current should be employed. Shampooing, friction, and the application of hot water to the muscles are also useful. The subcutaneous injection of minute quantities of strychnia the writer has used with great advantage in several cases. At the onset of the paralysis he decidedly recommends a repetition of blisters to that portion of the spine from which the nerves supplying the affected muscles proceed.

In the later stages of the disease, when it is manifested chiefly by paralysis and atrophy of muscles, the most approved general remedies consist of strychnine, cod-liver oil, the preparations of cinchona and iron, arsenic and phosphorus, together with attention to the secretions and excretions, and to ordinary hygienic measures. J. Lockhart Clarke.

INFANTILE REMITTENT FEVER. By some authorities a disease thus named has been regarded as a special kind of fever; but the condition is probably either typhoid fever of a mild type, or febrile disturbance accompanying disorders of the alimentary canal.

INFANTS, Diseases of.—There are few disorders which can be said to be peculiar to infancy and childhood. The diseases to which children are liable are, as a rule, those which attack older persons, and present the same pathological characters. But disease as it occurs in children does yet require especial study, for the symptoms by which it is accompanied often differ widely from those with which ordinary hospital practice has rendered us familiar. Children are not merely adults in miniature. They have special peculiarities of constitution, which impress their own stamp upon all acute diseases, and often raise up a number of accessory phenomena which overshadow the main symptoms, and obscure a case which but for them would be simple and clear.

General Characters.—The most striking peculiarity of childhood is the marked excitability of the nervous system; for the promptness and intensity with which the whole system reacts against any source of irritation is a cause of continual embarrassment to the physician. A fragment of indigestible food, for example, may produce high fever, or alarming agitation, and even throw the child into convulsions: a slight irritation of the larynx may produce severe spasm, and simulate for the time all the symptoms of true diphtheritic croup. The beginning of acute disease is almost invariably accompanied by profound general disturbance; but disturbance as profound may be excited by the simplest functional disorder, so that the severity of the symptoms is no guide at all to the severity of the lesion with which we have to deal. In all cases, therefore, it is of importance, if possible, to pick out the local symptoms—those, namely, which point to mischief of any special organ—and separate them from others which are expressive merely of the general distress. Such local symptoms are the cough, rapid breathing, and active nares which point to acute lung-disease; the squinting and immobility of pupils which are so characteristic of cerebral affections; and the peculiar jerking movement of the legs which, combined with hardness of the abdominal muscles, betrays the existence of colicky pain. Such local symptoms are not, however, always to be discovered, and even if present may not furnish trustworthy indications; for so great is the sympathy in the young child of distant organs with one another—linked together as they are by the impressionable nervous system—that the organ from which the more definite symptoms appear to arise, may not be the organ which is actually the seat of disease. The two organs which are most frequently found to present these deceptive manifestations are the stomach and the brain. The sympathy of the stomach with an irritable condition of other parts of the body continues more or less through life: the vomiting of pregnancy and of disordered uterine function in the female, and of cerebral and renal diseases in both sexes, being matter of common observation. In the child, however, this sympathy is carried to its highest point. Vomiting is a common symptom at the beginning of every acute disease, and in many children any casual disturbance is apt to be attended by it. The brain, again, exhibits a close sympathy with irritation of the more important organs. In some cases of pneumonia, notably those where the inflammation is seated at the apex of the lung, headache, vertigo, delirium, and stupor may be so marked that the ordinary symptoms of the disease are completely obscured, and the case is mistaken for one of meningitis. Again, the violent nocturnal delirium so often excited by the irritation of worms in the alimentary canal, must be within the experience of all.

The nervous excitability of children, and its influence upon the system generally, is well illustrated by the high temperature noticed in many children on the first evening after admission into the wards of a hospital. The elevation varies in degree in different children; but if the patient be not a mere infant, it is usually over 100°, although the complaint be one not ordinarily attended by pyrexia.

Perhaps, however, the most familiar instance of the impressibility of the nervous system is seen in the case of convulsions. A 'fit' in the child has a very different meaning to a similar attack in the adult. In the latter it is usually evidence of a grave centric lesion, and its occurrence occasions the greatest anxiety. In the child, on the contrary, it is a common expression of the perturbation of the nervous system, set up in response to some excentric irritation, and often, as in the case of the onset of acute disease, is analogous to the rigor which ushers in an acute attack in older persons. Sometimes, it is true, convulsions are produced in the child, as in the adult, by severe cerebral disease; but in such cases the fits are frequently repeated, and are succeeded by rigidity, paralysis, and other signs of centric irritation. As a rule, single fits, or convulsions occurring without other signs of nerve-lesion in a healthy child, are purely reflex, and have no gravity whatever.

The impressibility of the nervous system is increased by causes which produce a sudden depression of strength, such as a bad attack of diarrhœa, or loss of blood, and in one chronic disease—rickets—the nervous irritability is very great. The effect of chronic wasting upon the child is, however, usually to produce an opposite result; and under the long-continued influence of enfeebling disease the excitability of the nervous system becomes gradually less and less manifest, until it finally disappears almost entirely. It is of importance to the practitioner to bear this fact in mind, for in a child much reduced by chronic illness, the presence of an intercurrent acute complication—such as inflammation of the lung—may be indicated by very few symptoms, the system having become almost insensible to nervous impressions.

Another peculiarity, which strikes the attention of anyone accustomed only to disease as it occurs in the adult, is the vast preponderance in infantile disorders of mere disturbance of function, and the disastrous consequences which may ensue from such derangements. Infants rapidly part with their heat, and are easily chilled. They are therefore excessively sensitive to changes of temperature. A catarrh is a common ailment in the young child, and is attended by various dangers according to the part of the mucous tract which is affected by it. Gastric catarrh with violent and repeated vomiting, and intestinal catarrh with uncontrollable diarrhœa, are answerable for a large proportion of the deaths amongst young children during the warmer months. Even in cases where the catarrh affecting the digestive organs is of a less acute and violent character, the issue is often very serious. The gradual failure in nutrition, which is the result of such an impediment to the digestion of food, is a common cause of wasting in young children; and unless measures be taken early to restore the proper working of the alimentary functions, the case may end fatally. In the autumn and winter the bronchial mucous membrane is more frequently attacked. In such cases, however apparently slight may be the catarrh, a weakly infant is always exposed to the danger of pulmonary collapse; and a rapid interference with the respiratory function, such as takes place when collapse of some extent of lung is quickly brought about, is often a cause of sudden death.

It is in consequence of this frequency of functional derangements, and their dangerous character, that *post-mortem* examinations in infants are so often unsatisfactory in finding any appearances explanatory of the cause of death.

Clinical Examination.—The clinical examination of young children requires tact and patience, but unless the child be very unruly it is not difficult. The patient cannot himself describe his symptoms, but all necessary information can be gained from the parents. Mothers are, as a rule, good observers, and allowing for their natural anxiety and a slight tendency to exaggeration, their statements can usually be relied upon. We can thus learn the previous state of the child, the exact date at which his symptoms began, and the order in which they appeared. Infants should be always stripped for examination, so that the whole body may be exposed to view. Before, however, ordering the removal of the clothes, we should be careful to satisfy ourselves upon certain points which can only be properly observed while the child is in repose. Thus, in order to count the pulse and respiration, perfect quiet is indispensable, for the least movement quickens the heart's action, and alters the rapidity of the breathing. At the same time the temperature can be taken by the thermometer in the rectum. The whole body should then be examined for spots or swellings; the condition of the skin can be noted—whether dry or moist; and we can ascertain the state of the belly, with regard to hardness or softness of the abdominal walls, and the size of the liver and spleen. If the child cry at the time, we mark the character of the voice, for hoarseness is an early sign of congenital syphilis.

In the physical examination of the chest in a child, it is important to attend to the following points:—To employ percussion of the two sides at the same period of the respiratory movement, that is, during expiration or during inspiration; to strike gently with *two* fingers, for by this means a larger volume of sound is brought out, and slight dulness is more easily detected; always to use a stethoscope instead of the unassisted ear, in order to limit the area listened to; and to manage so that the child's mouth be open during auscultation, so as to hinder the transmission of sounds from the throat. In an infant the back is best examined by placing the child on the nurse's left shoulder, with his left arm round her neck. If the chin be now depressed by the nurse's hand on the child's head, the muscles of both shoulders are relaxed. The front and sides of the chest can be examined as the infant lies on his back. We must remember that the breath-sounds, especially that of inspiration, are of a more blowing quality in the child than they are in the adult; and that there is naturally less resonance at the right base, on account of the proportionately greater size of the liver.

At the end of the examination the mouth should be looked at for signs of aphthæ or thrush; and the condition of the gums, as to heat and swelling, should be ascertained. Lastly, the throat is to be inspected—depressing the tongue with the handle of a spoon. If there be disorder of the digestive apparatus, such as sickness, constipation, or diarrhœa, it must not be forgotten to examine always and carefully the discharges. The urine should not be overlooked.

Diagnosis.—Diagnosis in the young child is sometimes very difficult, but it is often easy enough. Being aware of the nervous excitability in young subjects, we are prepared for evidences of general disturbance, and look for more special symptoms—such as will indicate local distress, and direct our attention to a particular organ. We are also guided by a history of the attack, as gathered from the mother, and can put our suspicions to the test by a careful exploration of the whole body. In the investigation our general knowledge of the course of disease will be of service. Thus, many disorders have known pathological consequences, and are apt to be followed by special sequelæ. Measles and hooping-cough leave behind them a tendency to catarrhal pneumonia, and a liability to tuberculosis. Scarlatina often leads to acute desquamative nephritis and dropsy. Other diseases again encourage particular susceptibilities—as rickets, which renders the body exceptionably sensitive to changes of temperature, and provokes catarrhal derangements. In doubtful cases we must not forget to take prevailing epidemics into account, as the beginning of zymotic diseases is often excessively puzzling. In all cases, especially if the patient be an infant, it is important to inquire into the hygienic and dietetic arrangements to which the child is subjected. When we are still undecided, after having exhausted all means of investigation, we must be contented to wait for further indications, and no positive opinion should be hazarded while any doubt remains.

TREATMENT.—Children, as a rule, respond well to treatment. This may be explained partly by the large proportion of mere functional derangements in the illnesses to which they are subject, and partly by the state of constant change through which the body is passing; growth and development are active in organs, and the tendency is to repair. The term treatment, however, includes far more than the mere giving of physic. A complete change in all the influences acting upon the patient—a reconstruction of the dietary, and a reformation in the hygienic arrangements, especially with regard to air, light, and clothing—will often prove of immense service, and be of far more value than actual drug-giving in furthering the recovery of the child.

In the treatment of acute illness we must remember that young children cannot bear lowering measures; but we must not therefore rush to the opposite extreme, for unless suffering from temporary exhaustion, they are far from being benefited by profuse stimulation. In the beginning of acute inflammatory diseases stimulants are injurious. Even in chronic ailments, such as rickets, where a certain amount of alcohol is often of service, wine should be given with caution, and its effects upon the digestion carefully watched; it can only be given with advantage so long as it improves the appetite, and increases the digestive power.

With regard to medicines little need be said in this place. It may be remarked that, on account of the tendency to acid dyspepsia in all children, alkalies are of especial service; and that they should be always combined with an aromatic, on account of the value of the latter in stimulating the alimentary mucous membrane, and relieving the flatulence and other painful consequences of indigestion. It is important also to remember that children are wonderfully tolerant of certain drugs, while they bear others very badly. Belladonna may be given to infants and children in very large doses. They are also more tolerant of arsenic than their elders. To the action of opium, however, they are excessively susceptible, and the drug should be given—to infants especially—with extreme caution.

EUSTACE SMITH.

INFARCT (*infarcio*, I cram in).—This term was formerly applied to any kind of infiltration of an organ; but its use is now almost confined to the expression *hæmorrhagic infarct.* A hæmorrhagic infarct is a firm, red, usually wedge-shaped patch, which is found in certain organs as the effect of arterial embolism, or, more immediately, of the congestion and extravasation of blood to which the embolism gives rise. *See* EMBOLISM.

INFECTION
INFECTIOUS
INFECTIVE } (*inficio*, I stain).—There is much ambiguity and want of precision in the application of these terms, and it is only intended here to attempt to define them according to their several uses, the reader being referred for fuller illustration to the appropriate articles. Usually, they are coupled with diseases which are known to be capable of transmission from one animal to another of a different class, or from one individual to another of the same species. In general language such diseases are said to be *infectious*, and to be conveyed by *infection.* These words are, however, often employed in a more definite and limited sense, as signifying the transmission of affections of this kind without the necessity of any direct contact between the individuals, or of any obvious application of the morbific agent to the body, or its immediate introduction into the system, this agent being conveyed through the atmosphere, and taken in mainly by respiration. This limited meaning is employed in contradistinction to *contagion* and *contagious*, which then imply direct contact, and to *inoculation*; in this sense some affections being regarded as infectious but not contagious, and *vice versâ.* The word *infection* is sometimes used as synonymous with the *contagium* or agent by which a communicable disease is conveyed. An important application of the term *infective* is that in relation to the effects resulting from certain morbid products, which have been made evident during recent years, mainly by the investigations carried on in experimental pathology. Thus it has been found that the introduction of tubercle subcutaneously will lead to the formation of a similar product in different organs of the body; and the same result may follow mere suppuration under certain conditions, as well as the accumulation in the body of caseous material. The morbid products are absorbed, and originate tuberculosis by an infective process. It is even maintained that tuberculosis may be produced in this way by merely introducing tuberculous material into the stomach, as in the form of diseased meat. Again, the inoculation of septic matter has been proved to cause septicæmia and pyæmia by a similar process. When certain morbid conditions have been established within the system, other parts, more or less distant from the primary seat of mischief, often become involved by infection within the body itself, in consequence of the products being conveyed by the bloodvessels or lymphatics to these remote parts, and there undergoing further multiplication and growth. Indeed the whole system may thus become tainted, including the blood and other fluids. Illustrations of this signification of infection are afforded by cancer, syphilis, tuberculosis, and suppuration, the last-mentioned not only being liable to originate secondary collections of pus, but also being the usual cause of pyæmia. *See* CONTAGION.

FREDERICK T. ROBERTS.

INFILTRATION (*in*, into, and *filtro*, I filter).—This term was formerly applied to the effusion of a fluid into the interstices of a tissue, especially connective tissue. Now, however, its meaning has been extended to imply the diffusion of any solid or fluid morbid product in the midst of tissue-elements, such as is seen in calcareous, albuminoid, fatty, and tubercular infiltration. *See* Degeneration.

INFLAMMATION (*inflammo*, I set on fire). Synon.: Fr. *Inflammation*; Ger. *Entzündung*.

Definition.—Very numerous definitions have been given of inflammation. The most generally received has been that attributed to Celsus, which gives the four marks of inflammation as *rubor, tumor, calor, dolor*; but this appears to have been really due to Erasistratus, who, according to Galen, first gave precision to the conception of simple burning, as understood by the older Greek physicians, and applied the name φλεγμονή (previously synonymous with φλόγωσις) to a swelling, which had also the characters of heat, pain, throbbing, and resistance. The definition was thus based upon the notion of *swelling*, and would hardly have taken this particular form had it been derived from superficial inflammations. Although the four 'cardinal' signs may still be recognised in what we call inflammation, the definition is best derived from a cause known to be capable of producing it, and we say that *inflammation is a series of changes in a part identical with those which are produced in the same part by injury*; and, for the sake of precision, *injury by a chemical or physical irritant*. The most evident result of a slight and temporary irritation is, in vascular parts, hyperæmia, and inflammation may be regarded as produced by a more intense action of the same cause as produces simple hyperæmia; but it is not, as formerly said, a kind of, or a further degree of, hyperæmia. The minute study of inflammation is best conducted by continuous observation on transparent parts of animals seen under the microscope, especially the mesentery and tongue of the frog. No non-vascular part is equally available for continuous observation in a living state, but by special methods the process may be followed in the frog's cornea.

Description of the process in vascular parts.—When the mesentery or tongue of a frog is drawn out and placed under the microscope, the contact of the air soon determines inflammation; and by means which need not here be described, both the vessels and the tissue-elements may be observed for hours together. The earliest change seen in the vessels of a part thus exposed is dilatation, first of the arteries, then of the veins, the capillaries being little affected. The dilatation of the vessels is accompanied at first by acceleration of the blood-stream, most noticeable in the arteries; but the acceleration does not last more than half an hour or an hour, and it then gives place to retardation, which continues as long as the inflammation lasts. The 'primary acceleration' is, however, sometimes absent or too short in its duration to be noticeable. So far, the process is doubtless the same as in active hyperæmia produced by local irritation. Whether the first dilatation is due to direct paralysis of the muscular walls of the arteries, or to a reflex action passing through the spinal cord, or to an inhibitory action passing through nerve-ganglia in the arterial walls, is uncertain. There need not, however, be any reflex action through the spinal cord, as dilatation may take place when the part is disconnected from the great nerve-centres.

From this point begin the phenomena peculiar to inflammation. The dilatation of arteries may go on increasing for ten or twelve hours, till these have double their original diameter, and pulsation becomes very prominent in them. The capillaries look as if gorged with corpuscles, forming a quasi-solid mass. The blood-current in all the vessels becomes slower and slower, till it is almost stagnant. This condition is known as *stasis*. At the same time certain peculiarities are observed in the behaviour of the red corpuscles and leucocytes in the veins. In ordinary conditions of the circulation, the central part only of the vein (as of the artery) is occupied by the corpuscles, which move on mingled together. But during *stasis* the corpuscles, especially the leucocytes, spread over the marginal portion of the vein usually free from them, and the leucocytes begin to drag along the walls of the vein, as if adherent, till at length they form a layer lining the wall of the vessel, while the red corpuscles are carried on by the current. In the capillaries, this marginal layer is never perfectly established, though leucocytes may be seen momentarily adhering to, or moving slowly along the walls. In the arteries, no such process is observed, except (according to Cohnheim) it may be for a moment during the diastole of the pulse. When this *marginal position* of leucocytes is established, and the *stasis* is at its height, begins the process which, observed long ago by Waller, and less clearly though earlier by William Addison, was re-observed and brought into notice by Cohnheim. In the words of the last-named observer: 'On the outer contour of the wall of a vessel, usually a vein, in which the marginal layer of leucocytes is well developed, sometimes first in a capillary, is seen a small projection which enlarges in length and breadth, and becomes a roundish colourless lump. This again enlarges, puts out new pointed projections, and gradually withdraws itself from the wall of the vessel, till it is attached to it only by a long narrow stem. Finally this attachment also is broken, and we see a colourless contractile body with one long process and several shorter, with one or several nuclei, in fact, a *leucocyte*.' The same process is going on meanwhile at other points of the veins and capillaries, till at length, either quickly or slowly, the outer surface of all the visible veins becomes covered with several rows of leucocytes, while their interior shows the same appearance as before. That the leucocytes seen outside were formerly inside the veins, having simply passed through the walls, admits of no reasonable doubt, though it is often difficult for the eye to seize the precise moment of passage. In the arteries nothing of the kind is seen. In the capillaries the emigration of leucocytes is very evident, and accompanied by the passage of red corpuscles also through the walls, which does not take place in the veins proper. The latter process was observed by Stricker before the revival of the observation of emigration of leucocytes.

Accompanying the extravasation of the blood-corpuscles, there is always a copious exudation of serum, which goes far beyond physiological limits. Aided by this and by their own spontaneous movements, the leucocytes are carried far and wide into the tissue, till the whole field, that is, the whole mesentery, is so crowded with them, that nothing else can be seen. The red corpuscles, on the other hand, remain more closely in the neighbourhood of the vessels. When the exudation, carrying with it the corpuscles, and containing, as it does, coagulable material, reaches the surface, it forms the layer or false membrane of inflammatory lymph, seen in inflammations of serous surfaces.

Cause of stasis and cell-emigration.—The processes just described mark inflammation off sharply from simple hyperæmia. The production of stasis was at one time ascribed to thickening of the blood from transudation of serum; also to coagulation in the vessels; to the adhesiveness of leucocytes; and to a change in the tissues external to the vessels. But there is little doubt that the essential factor is a change in the constitution of the vascular wall, though it is still possible that this may be connected with a change in the tissues outside. The same change, while it retards the passage of blood, makes the vascular wall permeable to the corpuscles, and favours exudation. What the change is we cannot say, but it seems probable that it is the same as the walls of vessels undergo when inadequately nourished. Two classes of experiments throw light on this point.

It has been found by Ryneck that other fluids than blood, such as milk, pass with greater difficulty than usual through the vessels of an irritated part; and that stasis can be produced in the vessels of a frog, which is kept alive by the circulation of salt-solution instead of blood in its vessels. Cohnheim has also shown that a state of the vascular walls similar to that which may be presumed to exist in inflammation, may be produced by shutting off the blood from the vessels for a certain time. He put a ligature round the tongue of a frog, and observed the vessels after the ligature was cut. If the blood had been excluded for twelve to twenty-four hours only, the vessels on the return of the blood passed into a condition of simple hyperæmia; but if longer, stagnation, marginal position of leucocytes, and extravasation of corpuscles were observed, and these phenomena were more marked the longer the ligature had remained, provided it was not long enough entirely to destroy the vitality of the part. From these experiments we must conclude that the cause of stasis and its attendant phenomena is not in the blood or the cells, but in the walls of the vessels, and that the change in these is of the nature of degeneration.

Changes of the tissue-elements.—These changes are most simply seen in non-vascular parts, which will be first considered. Alterations in cartilage-cells during ulceration were observed long ago by Goodsir and Redfern, but were not then thought to belong to inflammation, non-vascular parts being not thought liable to this process. Lately the cornea has been taken as the type of non-vascular tissues. If the cornea of a frog be irritated by touching a small spot with nitrate of silver, and cut out within from twelve to twenty-four hours afterwards, many of the fixed corpuscles are found to be already altered. Their processes are become shorter and thicker; their bodies of irregular shape; and they often show amœboid movements, and become converted into many-nucleated protoplasmic masses, resembling what are in some other parts called giant-cells. Finally, in their place may be seen groups of new cells, or pus-corpuscles. But there are always some corneal corpuscles which remain quite unchanged. These changes cannot be traced farther, as the cornea soon becomes turbid, and the whole field of observation crowded with leucocytes.

It is still a matter of dispute whether these changes are truly reproductive or only degenerative; and whether any new cells are really formed from the fixed pus-corpuscles of the cornea, or whether the origin of these leucocytes is the same as of those which are seen surrounding the veins and capillaries of the inflamed frog's mesentery. On the one hand, it is said that the cornea can be excised so early as to preclude the possibility of migratory corpuscles finding their way from the vessels surrounding the cornea, and that even then groups of leucocytes are found in the place of corneal corpuscles, which must have been produced by germination from them. On the other hand it is urged that, even supposing it impossible that these cells could come from the surrounding blood-vessels, the conjunctival lymph-sac contains lymph-corpuscles which might travel into the cornea. Further, the leucocytes of the blood have been coloured by injecting colouring matter into the veins, which the leucocytes take up, and cells thus marked are found among those supposed to be derived from the corneal corpuscles. Without discussing these conflicting arguments, we may say that we believe the truth to be this: that young cells, undistinguishable from leucocytes or pus-corpuscles, are formed by a process of growth, cell-division, and germination, affecting the fixed corneal corpuscles, but that the number of these is inconsiderable compared with those which, even in a non-vascular tissue like the cornea, are derived from the vessels.

The process of inflammation in other non-vascular parts, such as cartilage, has been studied in the same way as in the cornea, in all cases with the disadvantage that continuous observation is impossible. The general result is the same, namely, that changes are seen, apparently without any participation of the vessels, which are regarded by some as showing degeneration and breaking up of the fixed tissue-elements; by others as showing germination and formation of new cells, but which in any case do not play an important part in the whole inflammatory process.

Tissue-changes in vascular parts.—These, though apparently more ambiguous than in non-vascular parts, are yet sometimes susceptible of more minute study. In the omentum of mammalia, changes occur during inflammation in which unbiassed observation can hardly see anything else than cell-division, growth, and germination. There is indeed reason to believe that such appearances are found normally, as evidence merely of growth, but the inflammatory changes are distinguished from the normal by their greater frequency and luxuriance. In fibrous connective-tissue similar processes have long been observed, and since attention was drawn to them by Virchow, have been regarded till lately as showing, in the clearest manner, that the fixed cells of the tissue germinate and produce new elements. This 'proliferation of connective tissue' was regarded, especially by German pathologists, as an obvious fact, and as the explanation of many morbid processes. But it is now known that what were regarded as connective-tissue corpuscles are really spaces, which may become filled with leucocytes migrated from neighbouring blood-vessels, and when the cells proper can be seen, the latter are often unaltered. Around inflamed parts the connective-tissue is often found infiltrated with young cells, the origin of which was formerly set down to proliferation. But it seems more simple to regard this 'small-celled infiltration,' which is a very frequent accompaniment of inflammation, as resulting from migration of leucocytes from the veins and capillaries of the inflamed part. The possibility, however, of 'connective-tissue proliferation' cannot be doubted; and, if it occurs, the number of elements thus produced will not, as in the case of non-vascular parts, be necessarily limited. With respect to other tissues, such as muscle, nerve, &c., very conflicting statements have been published. Some years ago numerous observations were made, supposed to show the formation of new cells from the connective-tissue stroma of inflamed parts; it was then supposed that more specialised elements, such as muscle-fibre, epithelium, &c., could not produce the same; afterwards the same appearances were seen in these tissues, and interpreted in the sense which has been explained above. The recent observations of Stricker and his pupils tend to show that the tissues take part in the formation of pus-corpuscles, in true suppuration if not in lower degrees of inflammation, but do not, we think, materially alter the views to be derived from a direct study of the inflammatory process.

Besides the twofold origin of new cells above indicated, there is reason to believe that the leucocytes emigrated from the vessels, and perhaps those produced from the tissues, further divide and 'proliferate.' Stricker and Klein have both observed actual cell-division take place under the microscope; so that some of the new cells are regarded as the descendants of emigrated corpuscles. We may compare the new cells of inflamed parts to the population of a colony, where most are emigrants, or the descendants of emigrants, but some few trace their descent from the aboriginal inhabitants.

Beyond the production of new cells, the tissues outside the vessels cannot be said to play an active part in inflammation. Their passive changes are, however, important. These are chiefly degenerative, that is, necrosis of the elements takes place, preceded by various kinds of degeneration. Connective-tissue fibres soften; muscular fibres undergo fatty degeneration; and epithelium also wastes by means of fatty degeneration, and on surfaces is shed off. Nerve-tissue and all special tissues soften, liquefy, and disappear. In places where there is a large collection of pus-corpuscles, all tissue-elements become absorbed, and the *débris* is either carried away by the lymphatics and veins, or becomes mingled with pus. In fact, along with nutritive and germinative processes, there are destructive and atrophic processes equally active.

We must now consider the products and results of inflammation, without further distinguishing between the share of the vessels and of the tissues.

Products and Results.—All inflammatory products result either from exudation (with or without participation of the tissues), or from new growth. The exudative products are serum, mucus, and fibrin; which by combination with leucocytes, form inflammatory lymph and pus. New growth takes place from the vessels in the form of vascular connective tissue, of which a special form are granulations. With regard to exudations, no clear line can be drawn, at any stage of the process, between serous and fibrinous exudations, inflammatory lymph, and pus; the differences being only of degree.

Exudations.—Serous and mucous exudations can only when excessive be regarded as products of inflammation. The fluids formed in inflammations of serous cavities differ from those produced in passive exudations (or dropsies), in containing more fibrin and more albumen. But inflammatory exudations vary in this respect, and are sometimes scarcely to be distinguished from simple serous effusions. The fluids poured out on serous surfaces in acute inflammation always coagulate, and even in chronic cases can often be shown to be capable of coagulation. On mucous surfaces, on the contrary, the exudation does not as a rule coagulate. That this is owing in some way to the action of the epithelium seems most probable, whether it is that filtration through epithelium alters the composition of the fluid, or whether the living epithelium prevents coagulation in the same way as the endothelium of the vessels prevents coagulation of the circulating blood. When, however, the epithelium is removed, a fibrinous layer may be produced on the mucous surface; and the same result seems to follow the application of very powerful irritants, as in croupous inflammations. Mucous exudations contain mucin, as well as serum-albumen, in variable proportions.

Fibrinous exudations, in coagulating, entangle whatever leucocytes may be either extruded with the exudation, or present in the tissues. The properties of the coagulated mass differ according to the proportion of corpuscles. Hence it was at one time usual to distinguish *fibrinous* from *corpuscular* lymph, or even to regard fibrin as a mixed substance, partly made up of corpuscles. It is now known that these differences do not show any corresponding differences in the composition of the blood, but depend upon the facility with which the corpuscles leave the vessels. The product called *inflammatory lymph* consists of coagulated fibrin entangling leucocytes, the two constituents being in varying proportions. The fibrin does not differ from that of blood-clot; and may therefore be formed in the same way by a reaction between the exuded constituents of blood. But it is not a constant product of inflammation, and hence has been thought to owe its production to local causes—that is, to reaction between the tissues and the exudation. Thus fibrin is formed on serous surfaces where normally one of the fibrin constituents is found, and for the same reason, in connective tissue; but, as stated above, not generally, on inflamed mucous surfaces, or in epithelial structures. But since it is possible that in these cases the exudation becomes altered by filtration through the tissues, there is no reason to doubt that fibrin, or both its chemical constituents, may be exuded from the vessels. Formerly great importance was attached to this product of inflammation. It was regarded as capable of forming, by organisation, new tissues; and by degeneration, pus and other things. But it is quite uncertain whether lymph is ever, strictly speaking, organised into tissue, and the formation of pus must be considered as differing from that of ordinary lymph only in degree.

Pus.—Pus is inflammatory exudation in which the corpuscles greatly predominate, and the intermediate substance is liquid. It is thus difficult to draw a line between pus and softer forms of inflammatory lymph, but the former does not contain fibrin, nor does it coagulate spontaneously. The following analysis of pus may be taken as representing an average specimen:—

Water	887·6
Pus-cells and mucus . .	46·5
Albumen	43·8
Fat and cholesterin . .	10·9
Sodium-chloride . . .	5·9
Other alkaline salts . .	3·2
Earthy phosphates and iron .	2·1
	1000·0

It is noticeable that pus contains a much larger proportion of fat than any other inflammatory products, or than blood. Its specific gravity is 1·030 or 1·033. The appearance of pus is well known; it is a creamy fluid, which, when normal or 'laudable' and fresh, has a very faint, not offensive odour, and no sign of putrefaction. Under certain circumstances, it has a strong ammoniacal or putrefactive odour, and is described as 'unhealthy,' or sanious. When allowed to stand, all pus separates into a liquid portion or 'serum;' and a sediment consisting chiefly of the corpuscles. The serum resembles blood-serum, containing paraglobulin or fibrino-plastic substance, potash-albuminate (or casein), ordinary serum-albumen, and myosin. Other constituents of pus are protagon, chondrin, gelatin, leucin, tyrosin, and xanthin.

Pus-corpuscles.—The corpuscles of fresh newly-formed pus, as seen, for instance, on an inflamed mucous surface, are not distinguishable from leucocytes of the blood, showing active amœboid movements, and continual change of form. Most corpuscles from large collections of pus, such as abscesses, are already dead, being nearly spherical in form, with the appearance of a cell-wall, and showing when acted upon by acetic acid three or more small nuclei.

Suppuration.—While the production of individual pus-corpuscles is to be explained in the same way as that of inflammatory cells in general, there are some reasons for thinking that the formation of pus requires, in addition, more special causes. Where a collection of pus, or an abscess, is formed, it is probable that the tissue-cells take an especially active part in the formation of new elements. Suppuration is preceded by hardening and swelling of the connective tissue, a change which Stricker refers entirely to enlargement of the connective-tissue bundles. He asserts that even in the cornea this hardening is seen in those parts where pus is afterwards formed. While, therefore, we cannot say that pus is formed solely from connective tissue, we admit that the proliferation of the tissues has a more important share in suppuration than in other forms of inflammation.

Another most important view as to the *cause* of suppuration is suggested, though not proved, by modern processes in surgery, which show that the entire exclusion of air containing solid particles, and any air but that which has been subjected to the action of antiseptics, prevents the occurrence of suppuration, even after severe injuries or operations. It is probable, therefore, that these septic particles or bacteria are largely concerned in the production or keeping up of the suppuration, as distinguished from milder forms of inflammation.

Vascular connective tissue.—When a part has been destroyed by inflammation, the lost tissue is replaced by the preliminary formation of a peculiar structure, consisting of a highly vascular connective-tissue framework, containing an excessive number of leucocytes. The vessels are of delicate structure, and easily lacerated. This tissue also contains nerves. It has been compared to the cellular structure which composes the embryo, or to *embryonic* tissue, but the great predominance of vessels constitutes an important difference. Such tissue always originates as an outgrowth of the vessels of the inflamed part; it grows into regular connective tissue, and is thus the most important means of replacing the tissue destroyed. When produced on a surface, and growing out in the form of tufts, it receives the name of *granulations*; and, as is well known, ulcers and cavities become filled up by it. There is no doubt that granulation-tissue may form fibrous tissue, and probably other forms of connective tissue; but it is still uncertain whether epithelial structures ever pass through this stage, and whether nervous or muscular tissue is ever thus regenerated.

VARIETIES.—The most striking differences between different kinds of inflammation are those depending upon the differences of tissues, and of the situations in which it occurs.

1. *Catarrhal.*—On mucous membranes, the exudation is mucous, does not coagulate, and contains only detached epithelial cells, with scattered leucocytes; the process readily becomes chronic; but the effect on the body as a whole is less marked than in other forms. This is *catarrhal* inflammation, a term which is with less propriety transferred to inflammations of the skin, the lung, and some glandular organs.

If catarrhal inflammation is very severe it becomes purulent, and the exudation consists chiefly of pus, little or no mucus being produced. This purulent catarrh is especially characteristic of specific inflammations of the mucous surfaces, such as virulent conjunctivitis or gonorrhœa.

2. *Croupous or fibrinous.*—Croupous inflammation is that form in which a coagulable exudation is formed upon a mucous surface. In diphtheritic inflammation there is, besides a membranous exudation, some necrosis of the mucous membrane. In these forms the tendency is to acute, not chronic, disease; and the general symptoms are strongly marked. The name croup has also been transferred to certain inflammations of the lung ('croupous pneumonia') and of the kidney, but, in the latter case especially, with doubtful propriety.

The *fibrinous* form may be regarded as the normal or usual form of inflammation of serous membranes and connective tissue.

On serous surfaces the lowest degree of inflammation is seen in a serous exudation, containing little or no plasma, hardly to be distinguished from simple dropsy; but there is no clear line between this and a coagulable exudation, or fibrinous inflammation. This too, if still more severe, may become purulent; and, as we see in the pericardium or pleura, a purulent may succeed to a fibrinous inflammation. Finally, vascular connective tissue, forming adhesions, is generally produced. In areolar connective tissue, and in the interstitial tissue of various organs, the same stages may be distinguished, known as *inflammatory œdema*, which occurs near a focus of acute inflammation; *inflammatory hardening*, such as precedes the formation of an abscess; and, finally, either abscess itself or purulent infiltration—the two forms of suppuration in connective tissue.

3. *Parenchymatous.*—It is not so easy to define the kinds of inflammation as affecting the special elements or parenchyma of organs. The lung appears to be an exception to the general rule that epithelial surfaces show the catarrhal form of inflammation, since lobar pneumonia is a type of the fibrinous form; but it should be remembered that the anatomical structure of the air-vesicles more resembles a serous than a mucous surface, having only a single layer of epithelium; and that a catarrhal form of inflammation is always the result of mechanical injury to the lung.

The name parenchymatous inflammation has been given to those changes occurring in the special tissues of organs, independent of their connective-tissue framework. The only factor common to all such appears to be a granular degeneration of the protoplasma of their cells, identical with what is elsewhere called albuminous degeneration, though it may end in fatty or other degeneration. In contradistinction to this, inflammation of the connective-tissue framework is termed *interstitial inflammation.*

4. *Phlegmonous.*—Phlegmonous inflammation is the same as *acute interstitial inflammation*, that is, the formation of abscess.

5. *Indurative.* — Indurative inflammation is that in which new connective-tissue is produced in the interior of organs. This is *chronic interstitial inflammation.*

6. *Degenerative.*—This variety of inflammation hardly needs explanation.

7. *Scrofulous.*— Scrofulous inflammation is that type which occurs in cachectic persons, whose tissues are easily injured and heal slowly. Such persons are subject to chronic inflammations, which, further, involve destruction of tissue, and in which the inflammatory products readily undergo degeneration; unless these characters of destruction and degeneration are present, the name scrofulous has no precise meaning. *Strumous* is a word better forgotten, being synonymous with scrofulous, and liable to be misunderstood.

8. *Infective.*—Infective inflammations are those produced by the passage into the blood of infective matter derived from some previously existing inflammation. Pyæmia is a type; perhaps also tuberculosis.

9. *Chronic.* —Most inflammations have at first a typical course, reaching their acme and then declining. If the decline is not followed by resolution they become chronic. Others, again, show from the first the character they all along maintain. Chronic inflammations are usually distinguished by the persistence of that condition of the vessels which permits exudation and cell-emigration, with less hyperæmia and general fever than in the acute form. On mucous surfaces the chronic form differs little from the acute, except in these two respects. In serous membranes chronic inflammation produces fibrous adhesions, with little or no liquid exudation. In the interstitial tissue of solid organs a large amount of new connective-tissue is produced by chronic inflammation, which first compresses the special elements, causing them to waste, and then contracts in bulk, so that the organ becomes atrophied, and usually harder and more fibrous. This is the process called 'fibroid degeneration,' as in cirrhosis of the liver. 'Chronic parenchymatous inflammations' are simple degenerations, as seen in the kidney.

TERMINATIONS.—The most favourable termination of inflammation is what is called *resolution*, in which the vascular phenomena and tissue-changes decline together, and pass away without leaving any tangible material result. Even in the apparently most perfect cases of resolution, there is little doubt that products of exudation remain when the vascular changes have subsided, and are slowly removed by the lymphatics. Other so-called terminations are *necrosis*, or total death of the part; and partial destruction by suppuration or *ulceration*. But if any loss of substance occurs, the inflammatory process cannot be regarded as at an end till the loss is wholly or partially restored by newly-formed connective-tissue. Where there is no destruction of tissue, but only masses of liquid or solid exudation, the inflammation is not, strictly speaking, resolved till these are removed. Very frequently an acute passes into a chronic inflammation.

CONSEQUENCES.—(1) *Local consequences.*— If an inflamed part does not simply return to its original state, *atrophy* is the most common consequence. *Hypertrophy* can hardly be said to occur in the part actually inflamed, though it may in adjoining parts, as we see in enlargement of bone from periostitis. False hypertrophy, from new formation of connective-tissue, is common, but as such tissue contracts, the final result is atrophy. The hardness of this tissue causes *induration* to be put down among the consequences of inflammation.

(2) *General consequences.*—The effect of inflammation on the whole body is to produce the condition of *fever*, which is discussed in another part of this work. It will suffice here to say that fever involves raising of the body-temperature, weakening and acceleration of the heart, and disturbance of the nervous system, as well as of all the nutritive processes. It was formerly supposed that local inflammation produced fever simply through the increased production of heat by more rapid tissue-change in the inflamed part; this process raising the temperature of the blood passing through the part, and thus of the whole body by means of the blood. But this simple explanation is not adequate. It has even been much disputed whether the heat of inflamed parts ever surpasses that of the blood. The temperature of inflamed external parts is higher than the normal in that situation, or than that of a corresponding part, not inflamed, on the other side of the body. But this is also the case in hyperæmia, in which condition the external temperature never surpasses that of internal organs. Experiments on inflammation have led to very conflicting results: those of Simon and Weber being directly opposite to those of Jacobson and others. But even if we assume an actual production of heat in inflamed parts, this will not be enough, as is shown by calculation, to account for the rise of temperature in the whole body. It has also been supposed that some fever-producing or *pyrogenic* substance passes into the blood from every inflamed part, and causes increased tissue-change, with consequent increased production of heat through the whole body. But till the pyrogenic substance is known, this view does not go beyond hypothesis. Finally, it is held that the nervous system has a large, or even the chief share in the production of fever; the inflamed part acting through the nerves on the centre controlling the temperature of the body, which physiologists place in the medulla oblongata. But none of these theories is definitely established, and the manner, therefore, in which local inflammation produces fever is not yet perfectly understood. The degree in which local inflammations cause fever varies, and does not appear to depend wholly on the mass or the intensity of the inflammation, though both these conditions are partly concerned. Acute inflammations produce more fever than chronic; those of connective-tissue more than those of mucous surfaces; and, most of all, those which end in suppuration. In infective inflammations the fever is generally high, but not to be attributed to the local inflammation, being a concurrent effect of the same cause—the infective poison. Besides general fever, the special condition called *pyæmia*, in which other local inflammations result, may be a consequence of primary inflammation; but here, probably, some other factor is at work. *See* FEVER; and PYÆMIA.

ÆTIOLOGY.—Most inflammations are caused by some injury—either mechanical, as by actual violence; or physical, as changes of temperature; or chemical, by powerfully acting substances, as acids, alkalies, and many more. A most important secondary factor is the condition of the body, whether under- or over-nourished, or in some other way wrong; and this may probably be still more closely defined as the condition of the blood-vessels. Many parts of the body, as the skin and the stomach, are constantly exposed to injury, but do not become inflamed unless from some internal cause; and, therefore, a change of nutrition may be the apparent or immediate cause. It is also clear that certain inflammations, as herpes zoster, are determined by disturbance of the nerves; and it is very probable that similar nervous disturbances cause other local inflammations. Besides these there are certain specific causes, namely, infective or specific poisons, which, when introduced into the blood, produce local inflammations. Many local inflammations, external and internal, appear to arise spontaneously, neither irritation nor fault of nutrition being easily traced. Such are, for example, carbuncle and pneumonia. But in these, as in others, it is already probable that some infective cause is at work. It is also probable, and in some cases proved, that other inflammations which were at one time thought spontaneous, are really secondary, depending upon some previous local inflammation, even without what is called actual pyæmia. Thus the number of such apparently spontaneous inflammations is gradually lessening.

TREATMENT.—We shall divide this subject into the treatment of *directly accessible* (chiefly external) inflammations; and that of *indirectly accessible* (internal). Treatment will also differ according as the inflammation is acute or chronic; according to the stage, if acute; and also according to the constitution of the patient.

a. Directly accessible.—Directly accessible inflammation in an early stage may be treated by local blood-letting, and by astringents. The benefit of local blood-letting in an early stage is undoubted, and is probably due to its relieving the condition of stagnation, and permitting freer circulation of blood in the part. The type of astringents is *cold.* When the vascular disturbance, that is, hyperæmia, is great, and the general fever high, cold, produced either by ice or evaporation, is generally the best treatment. In the case of mechanical injuries, for instance, it may be regarded as an ascertained fact that if any injured part be kept cold during the period of reaction, the inflammation is less severe. When the condition of stasis, with exudation, is set up, the effect of cold is less marked; and if a temporary benefit is produced, the condition after the application of cold is stopped may be as bad as ever, or perhaps worse. The defect of cold as an antiphlogistic seems to be that, though it reduces hyperæmia, and if sufficiently intense actually checks inflammation, it does not remove the condition of the vascular wall on which stasis and the associated changes depend. Cold is also a powerful nervous sedative, and reduces the nervous irritability of inflamed parts. It is remarkable that an effect like that of cold is produced by solutions of certain *metallic salts*, especially those of lead, zinc, silver, and bismuth. These salts furnish the most certain and direct means of treating an inflammation in parts actually accessible to their action. Hence they are used in superficial inflammations of the mucous membranes, such as the digestive mucous membrane and the conjunctiva, and of the skin. Their use is limited by the difficulty of bringing them in actual contact with deeper inflamed parts. But Mr. Hutchinson has shown that even in severe injuries the antiphlogistic effect of lead is quite equal to that of cold, if it can be made to pass deeply enough into the injured parts. These mineral (and vegetable astringents also) act more potently on the exudative processes of inflammation, than on the vascular disturbance. Hence their activity is most valuable when that of cold ends; and they have a striking effect on chronic inflammations which are unaffected by cold. Even *pressure* may be useful as an astringent, as we see in strapping a testicle or an inflamed joint. In applying all astringents, it is of the first importance to be sure that they actually arrive at the inflamed part. In applying ice to the chest for pneumonia or pericarditis, for instance, this result is very doubtful.

In the treatment of even acute inflammations, the precisely opposite application, that of *heat*, is sometimes valuable. Hot and cold have respectively always had their partisans, and have been, we think, needlessly opposed. If it were possible to apply a temperature high enough to kill leucocytes, it is probable that most inflammations might be suddenly brought to an end. Almost the only instance of this is the cure of a whitlow on the finger by plunging it into hot water; a treatment which would be more satisfactory if the necessary temperature were precisely fixed. Short of this, heat doubtless increases the activity of most inflammatory processes. But heat combined with *moisture* is the type of an *emollient*, by which the substance of inflamed tissues is relaxed, the blood-vessels dilated, the sense of tension and nervous irritation removed, and though exudation-processes are probably encouraged, the *mechanical* condition of stasis is relieved, and resolution is thus hastened. When pus is forming, there is little doubt that heat and moisture (in the form of poultices and fomentations), hasten the process, and increase the amount of pus formed; but the amount of pus is often of no great consequence, and it is more important to hasten the process. Thus it may be the right treatment for suppuration. When pus is once formed, the same treatment is useful in guiding it in the direction in which it is least hurtful. Finally, it may be beneficial to apply heat and moisture superficially, to relieve deep-seated organs, by stimulating the vascular and lymphatic circulation through the skin. Thus, in applying poultices for pneumonia we do not make the lung or even the pleura hotter, but relieve the overloaded blood-vessels and lymphatics.

Further, in treating all superficial inflammations we must guard against anything which increases the injury, such as movement, further irritation by the air or anything contained in the air. Thus, in some skin-diseases, as herpes zoster, secondary inflammation is prevented by an artificial covering of collodion. Antiseptic surgery shows that not the air, but something in the air, is to be feared, and if this is excluded much inflammation is prevented. The benefits of mechanical rest in treating injuries of the limbs need not be more than mentioned; nor that of physiological rest, wherever it can be obtained, in threatened or existing inflammation of any active organ whatever—for example, the brain, the stomach, or the kidney.

In many acute inflammations, however, where the course of the inflammation is known, and we know we cannot absolutely stop the process, our best method may be merely to apply palliatives, that is, to adopt an *expectant method*.

Diet is also of great importance. There is little doubt that the intensity of all inflammations is lessened by greatly diminishing the food taken. In some acute inflammations, especially fevers, we may pursue a different system, with the view of saving the patient's strength; but it is possible that in the reaction against the starving process, feeding may be sometimes carried too far.

In the treatment of *chronic inflammation* in accessible parts, the first aim will be to check the exudation and cell-migration, that is, to bring the vascular wall into a healthy state. Here we find that metallic and vegetable astringents are most useful. But it may, with the same object, be well to draw more blood into the part, in order that the vascular wall may be better nourished. This is effected by *stimulants*, which are of well-known efficacy in chronic inflammation. These agents are for the most part the same as astringents, but in a more concentrated form—nitrate of silver, sulphate of copper, &c.; but also some aromatic substances, as tar, which is used in chronic inflammations of the skin, copaiba for the urethra, &c. Again, it may happen that it is best to sweep the old tissue away, and allow new vessels to be formed, which will probably have healthier walls. This is effected by destructive *caustics*, as nitrate of silver, potassa fusa, chloride of zinc, or even the actual cautery.

In chronic inflammations, internal treatment is often of great service, as we shall presently show.

b. Indirectly accessible.—The treatment of indirectly accessible inflammations, or, what amounts to the same thing, the treatment by internal (general) methods even of directly accessible inflammations, is much less satisfactory than the local.

The first indication is to give the part actual rest, mechanical or physiological; the next, to consider if there is any way of reducing the intensity, either of the local reaction, or of the fever. Of such means the chief are general blood-letting; the general application of cold; and certain drugs called vascular depressants, such as mercurials, antimonials, purgatives, digitalis, aconite, quinine, and a number more.

Of *general blood-letting* we cannot say much here. There can be little doubt that it often lowers the energy of inflammatory processes in an early stage. If it has gone out of use, it is probably because the course of many diseases is now better known, and we do not expect to cut them short; because the list of infective diseases is enlarged; and because the benefits are supposed to be outweighed by the supposed drawbacks in diminishing the strength of the patient. Of *cold baths* we need only here say that they are far more potent in checking the condition of fever, than in stopping local inflammation. Of *drugs*, digitalis is supposed to act by depressing the heart's action; but in theory this is doubtful, and in practice we see little effect on organic inflammations. Aconite also has little local effect, but does modify the febrile state. Quinine is thought, on theoretical and experimental grounds, to check the emigration of leucocytes, and to kill organised bodies or germs resembling bacteria. The first belief is experimentally true if the drug is in a certain degree of concentration; but we have no safe means of introducing it, in this degree of concentration, into the blood. Alcohol even has been recommended as an antiphlogistic, on the ground that it lowers the temperature in health. But even this is not constant, and there is no good reason for thinking that it has this effect in fevers, still less that it checks the inflammatory process. If alcohol be given, it must be on other grounds. Salicylic acid, carbolic acid, and thymol are lauded as destroying fever-germs; but, as with quinine, we cannot get them into the blood in sufficient concentration, and if we could, it is probable that other more serious disturbances would be produced.

The conclusion must be that there is no one drug which is capable of controlling local processes of inflammation, though the resulting condition of fever may be modified.

The use of mercurials and antimonials seems to have been affected by the same considerations as blood-letting. The action formerly attributed to them is now doubted, and it is further thought they do harm in other ways. But no adequate explanation has been given of the difference in this respect between the practice of this and the last generation. Purgatives remain as a harmless, unquestionable, but not very potent antiphlogistic method.

In the general treatment of *chronic* inflammations we have more satisfactory principles. It is in cachectic persons, or persons with an inherited proclivity (perhaps not yet manifest) to cachectic diseases, that inflammations most tend to become chronic. Hence, the first rule is to improve the nutrition. Many patients with chronic inflammations get well at once when placed in good quarters, and on good food. Next in importance come nutrient tonics, of which cod-liver oil is the chief. There are few chronic inflammations in which it does not do good. Iron is very often valuable; and, if it fail or is contra-indicated, arsenic may be employed. In chronic inflammations of fibrous tissues, iodide of potassium has a real value, not easily explained. In treating other inflammations, either acute or chronic, there are many specific remedies, but these are remedies for the disease, not for its inflammatory features only. For this reason, we do not here speak of mercury, colchicum, salicylate of soda, and other agents.

Finally a most important means of treating indirectly accessible inflammations must be mentioned, namely that by *counter-irritants*, or setting up a rival inflammation. In order to relieve an inflammation, for instance, of the knee-joint, we produce a superficial inflammation of the skin. This is most used in chronic, but applies to some acute inflammations also. Various explanations have been given of the undoubted efficacy of this treatment. Some believe the action is transmitted through the nerves; others that blood is drawn away; others that the lymphatics are stimulated. The writer's belief is that in the most marked cases of benefit from counter-irritation, there is a continuity of tissue between the inflamed organ and the part where the counter-irritant is applied, and that the action may sometimes consist in drawing away blood; but generally this is not possible, and the benefit results from setting up currents of plasma through the lymphatics and the connective-tissue spaces. It should be noted that in some inflammations, where œdema is a marked feature, simple puncture has an unquestionable efficacy which may perhaps be explained in the same way. The substances used for counter-irritation are either vesicants, such as cantharides or ammonia; or rubefacients, as mustard and iodine. Dry heat at different temperatures may produce the effect of either of these classes. When redness is produced on the skin, it does not follow that hyperæmia alone results. In fact the desquamation often shows that a low form of inflammation has been established. We have here endeavoured to give the principles only of the treatment of inflammation. For the treatment of inflammations of special parts, the articles on these subjects, as well as the articles on BLOOD, Abstraction of; COUNTER-IRRITATION; and HEAT, Therapeutics of, must be consulted.

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INFLATION (*inflo*, I blow into).—A term applied, therapeutically, to the method of blowing air or gas into any hollow space. It is employed particularly in connection with the lungs in the process of artificial respiration (*see* ARTIFICIAL RESPIRATION). It is also used for the purpose of dilating the bowel in cases of obstruction (*see* INTESTINAL OBSTRUCTION). The term inflation was formerly used, pathologically, as a synonym for emphysema of the lungs, but is now more strictly limited to the condition in which the alveoli are temporarily distended with air, from any obstruction in the air-passages. *See* LUNGS, Emphysema of.

INFLUENZA.—SYNON.: Epidemic Catarrh; Fr. *Grippe*; Ger. *Influenza*; *Epidemischer Schnupfenfieber.*

The term Influenza is said to have been first introduced in 1741, when the disease was prevailing in the North of Italy, and it has been generally adopted in this country; though the more scientific term—Epidemic Catarrhal Fever—is often used in systematic works.

DEFINITION.—This disease is not to be regarded as simply an unusually prevalent common catarrh, but must be considered as a specific affection, which appears occasionally over wide districts, and at or about the same time; is characterised by marked febrile symptoms; is often attended by serious complications; and causes great and prolonged prostration of strength.

OCCURRENCE.—Various epidemics of influenza are on record from the middle ages down to more recent times, and those which have occurred in the last and present centuries have been fully described. The disease is reported to have prevailed in 1729, 1732–33, 1737, 1742 1758, 1762, 1767, 1775, and 1782, and in 1803, 1833, 1837, and 1847. The following account is chiefly founded upon the disease as it prevailed in 1847, but the description given of its peculiarities corresponds with the accounts of previous epidemics.

The disease may be described as assuming three distinct forms:—

1st. That in which it is *simple*, or unattended with any serious complication.

2nd. When it is *complicated* by serious affection of the aërial mucous membrane, and especially with bronchitis and pneumonia; and

3rd. When the *disorder of the digestive organs*, which generally exists to some degree in the disease, becomes a more prominent character; while there are marked rheumatic symptoms, and a tendency to assume a remittent form.

The description would also be imperfect without reference being made to the *modifying influence* which the epidemic exerts *over other diseases* prevailing at the same time, and especially over the specific fevers.

1. Simple Catarrhal Fever.—SYMPTOMS.—In this form of the disease the attack is most commonly sudden. The patient experiences a sense of cold down the back and between the shoulders, lapsing into general chilliness or complete rigors, and succeeded by flushes of heat and dryness of the skin, pain in the head, chest, and extremities, and prostration of strength. Generally these symptoms follow some exposure to cold and damp, but occasionally they appear without being traceable to any immediately exciting cause, and more rarely the attack comes on gradually, with a general feeling of indisposition of two or three days' duration.

At first there is dryness of the nostrils and soreness of the throat, with a sense of tightness or constriction of the chest, and a dry, hard cough. As the disease advances, copious defluxion from the nostrils takes place; the throat is often seriously affected; and the cough is more frequent. The expectoration is at first scanty, and consists of a pale glairy fluid; but at a later period there is more copious discharge of opaque mucus. At the same time some degree of difficulty of breathing and soreness at the chest are experienced. The respiration is in most instances accelerated; and, on auscultation, the inspiratory sounds are dry and harsh, especially in the posterior and inferior parts of the chest, and sibilant and sonorous rhonchi may be audible on forced inspiration. In some cases no marked sounds are heard, but the vesicular murmur is very indistinct. A sense of chilliness, alternating with flushes of heat, is a general symptom throughout the progress of the attack; and there is distressing headache, particularly in the forehead, across one or both eyebrows, as well as pain in the balls of the eyes. These symptoms often undergo considerable remission during the day, and become much increased in severity towards night. There is also commonly much mental depression, listlessness, inability for intellectual exertion, and nocturnal restlessness. The tongue is usually moist, and covered with a white creamy fur; but occasionally it is morbidly red at the tip and edges, and thickly coated with a whity-brown fur towards the centre and root; more rarely, and especially in the morning, it is dry. In the greater number of cases, entire loss of appetite, with some nausea, and a confined state of the bowels, are present from the commencement; but occasionally diarrhœa is observed at an early period, and not unfrequently it comes on during the progress of the disease. Sense of weight, tenderness, and pain in the right hypochondrium are frequently experienced; and there is often some icteroid tinging of the conjunctivæ, or of the general complexion. The urine is scanty and high-coloured at first, but subsequently becomes more free, and deposits some sediment.

Prostration of strength is throughout one of the most marked and distressing features of the complaint, and there is a general feeling of soreness, with dull aching pains in the chest, back, and limbs. The pulse is but little varied in frequency, generally ranging from eighty to ninety, and rarely exceeding a hundred beats in the minute. Though occasionally full, it is uniformly very compressible, and, after the first day or two, feeble. The skin is seldom hot or very dry, or, if so, it is only at the commencement of the attack, and it soon becomes cool and moist; the complaint usually subsides with free perspiration.

The ordinary duration of the indisposition in this form of the epidemic may be stated at from three to five days in the milder cases, and from seven to ten in those of a more severe description. The disease, however, on its subsidence usually leaves the patient for some time much prostrated, and suffering from loss of appetite, inaptitude for bodily or mental exertion, and a troublesome cough. There is a great tendency to relapse.

Not unfrequently towards the termination of the attack the transient pains, which are troublesome during its course, increase in severity, and rheumatic affections of an obstinate and painful character supervene. These often assume a remittent or intermittent form, returning regularly at the same hour for several days in succession, and not unfrequently affecting one side of the head, or one eyebrow or eyeball, and occasionally the intercostal muscles of one side of the chest.

2. Epidemic Catarrhal Fever with predominant Pulmonary Affection.—SYMPTOMS. It has already been noticed that some amount of soreness of the throat, and uneasiness or pain in the chest, with cough and expectoration and slight bronchitic signs, are observed in the cases of the epidemic which might be considered as assuming the simple form. Not unfrequently, however, the symptoms of affection of the aërial mucous membrane are more marked, there being decided quinsy, laryngeal symptoms, croup, bronchitis, or pneumonia. Of these, however, the most frequent and important are the bronchitic and pneumonic complications.

The bronchitis has especially the tendency to assume the acute capillary form. In cases of *acute capillary bronchitis* occurring as a complication of influenza, there is usually in the *early* stage increased frequency and some difficulty of breathing, constriction of the chest, and soreness or stiffness of the throat. The cough, though slight, is troublesome from its frequency. The expectoration, if there be any, is scanty and of a glairy character. The tongue is usually red at the tip and edges, and covered at the dorsum with a creamy mucus or with a whity-brown fur; occasionally it is morbidly red throughout. The pulse is accelerated, beating generally 110 to 112 or 116 in the minute, and occasionally more. The skin is not usually hot, except it be at the commencement of the attack, and if so it usually becomes cooler in two or three days. With these symptoms there are the marked prostration of strength, the severe frontal headache, the general soreness of the body, and the pain in the back and limbs, which characterise the ordinary cases of influenza.

When the chest is examined in this stage of the disease, the only morbid signs detected are a roughness of the inspiratory sound, particularly when a forced inspiration is drawn; some slight crepitation, audible more especially towards the lower part of each dorsal region; feebleness of the vesicular murmur; and perhaps slight sibilant rhonchus in front. The respiration is, however, quicker and shorter than natural, averaging 28, 32, or 40 in the minute; the dyspnœa is greater than is explained by the obvious physical signs; and most generally there is some lividity of the face.

In the *second* stage all these symptoms are much aggravated. The respiratory acts are performed quickly and imperfectly, the respirations in the minute varying from 30 to 40 or 50. The cheeks are much flushed, and the lips of a somewhat purple colour. Generally there is not acute pain in the chest, but rather a sense of constriction and soreness; the cough, though frequent and occurring in paroxysms, is not usually severe. The expectoration still continues scanty, and consists of small yellowish-white pellets, forming tenacious masses of a peculiar nodulated or botryoidal form, very much resembling, when floating in water, fragments of some of the large oolitic limestones. The tongue is mostly covered with a thick whity-brown fur, and somewhat dry and often red at the tip and edges; or morbidly red and glazed. The pulse is much accelerated, beating 120, 130, or 140 times in the minute, but it is generally small and very compressible. In some instances, after being low and feeble at the outset of the disease, it acquires a more sthenic character in the second stage. The skin is rarely dry, or much above the natural temperature; and the hands and feet are generally cool. The skin of the extremities is also much congested, so that when blanched by pressure, the colour does not readily return. The prostration of strength also becomes greater; and there is much headache, and often transient delirium, especially during the night. On percussion, the chest does not present any marked alteration of resonance, unless there exists some other disease of the lung; and on auscultation, crepitation of a more or less fine character is audible with the inspiration, first in the inferior part of one or both dorsal regions, then spreading rapidly higher up in the back and toward the bases of the lungs in front, whilst sibilant rhonchus is heard in other parts of the chest.

The *third* stage of the disease is marked by the dyspnœa becoming so severe that the patients are compelled to sit constantly upright in bed, or to lean forwards, resting on their arms and elbows; whilst at intervals the respiration becomes very laborious. The lividity of the cheeks, lips, and hands is increased; the eyes become prominent; and the expression of countenance is extremely anxious. The cough is frequent, and of a short abortive character, giving the impression of viscid secretion in the lung, which the patient has not power to expectorate; whilst it is aggravated by paroxysms, which cause pain in the head, and increased lividity. The sputum now becomes large in quantity; it is of a greenish-yellow colour, very viscid, contains little air, and is occasionally streaked with blood. The respirations are very frequent, 50 to 60, or even more; and expiration is very laboured and prolonged. The pulse is very feeble, and either extremely quick—140, 150, or 160 in the minute—or intermittent, so as to number only 100 or 120 beats. The tongue is covered with a thick yellowish-white or brown fur, and is generally dry; sordes also form upon the teeth. The general surface of the body becomes cool and bathed in perspiration; and the hands and feet decidedly cold. The delirium is more constant; with the decaying strength the cough declines; the expectoration ceases or becomes slight; and the patient sinks.

With the progress of the disease the physical signs change. The chest in front yields a uniformly clear sound on percussion, while behind there is a general impairment of the resonance. The crepitation gradually extends over larger portions of the lungs, being of a finer character in the parts more recently involved; giving place to subcrepitant and mucous rhonchi in the situation in which it was first heard; and finally becoming of a gurgling character in the neighbourhood of the larger bronchial tubes. The subcrepitant rhonchus also towards the end of the attack is heard with the expiration as well as with the inspiration; and if there is some local condensation, bronchial respiration may be developed.

In the cases which terminate favourably, the amendment is marked by the respiration becoming less hurried and laborious; by the expression of countenance being less anxious, and the face less livid; and by the prostration of strength decreasing. The pulse becomes less frequent, the cough less severe, and the sputum less viscid—more of a muco-purulent character with a tendency to form a homogeneous mass, containing large air-bells. At a later period it becomes thinner, and declines in amount. The mucous and subcrepitant rhonchi are replaced by finer sounds, and the space over which the morbid signs are heard diminishes—these disappearing first in the upper part of the chest, then at the front and sides, and lastly in the dorsal regions. The clearness of the sound on percussion on the front of the chest also passes away, and is often succeeded by a somewhat dull sound; and the respiratory sounds become indistinct. The convalescence is, however, generally protracted; the patient is liable to returns of dyspnœa at intervals; and the cough continues troublesome. After the subsidence of the pulmonary symptoms, the rheumatic pains, if previously present, may become aggravated, or may then first appear and become troublesome, affecting the head, face, or intercostal muscles, and being aggravated towards night.

Anatomical Characters.—On examination after death, one of the peculiar features of this form of disease is the extremely inflated condition of the lungs, which in lieu of collapsing when the chest is laid open, in some cases protrude from the cavity. This condition is not limited to certain parts in which there are larger or smaller bullæ, but consists in a general inflation of large portions of the lung. The mucous membrane of the bronchi is reddened, and the injection increases towards the smaller tubes, where the membrane may be intensely red and have a villous appearance. The lung-tissue in the cases proving fatal at an early period has a peculiar dry appearance, but in the later stages it is œdematous. There is also more or less lobular condensation, the condensed parts being depressed below the adjacent inflated tissue, and having a deep purple colour. At a later period the condensed tissue may soften from the presence of pus, and small cavities may be formed in this manner. The bronchial glands are enlarged and softened. The cavities of the heart, especially on the right side, are distended with firm and more or less decolorised coagula.

Prognosis and Duration.—The cases of influenza complicated by acute capillary bronchitis are always very serious in their character; and when the disease occurs in persons who have before been out of health, and especially if there be any previous disease of the lungs or heart, or if the subjects be very young or elderly, they prove fatal in a large proportion of cases. The duration of the disease in the cases which prove fatal is from about ten to fourteen days; and when recovery occurs, the patient is ill from a fortnight to three weeks, or longer.

Pneumonia.—In the cases of pneumonia which were seen during the prevalence of the last epidemic of influenza, the disease was very generally combined with bronchitis, either affecting the larger or smaller tubes, yet the cases were less serious than those in which the disease assumed the form of acute capillary bronchitis alone. This is the more remarkable as they were more frequently combined with serious disorder of the abdominal organs, and with rheumatic symptoms, and were attended with great prostration of strength. Of the symptoms in these cases, cough is one of the most troublesome; the expectoration is peculiar, partaking both of the glassy, transparent, or opaque character of the sputum of bronchitis, and of the brownish viscid expectoration of pneumonia, with the usual small air-bells. In some cases, however, when there is great prostration, there may be no expectoration. Pain in the chest is generally experienced at the invasion of the disease, of a more or less severe character, but afterwards it is not present to any marked extent, or is only experienced when the patient has a severe paroxysm of coughing. The dyspnœa also is not severe, and there is not much lividity of the face, unless in cases in which there is also considerable bronchitis. The breathing is not usually very rapid, the respirations not exceeding 28 or 32 in the minute. The pulse also is comparatively quiet, beating 80, 90, or 100, and it is usually soft and compressible, or decidedly small and weak. The skin, as in the other forms of influenza, is not generally hot or dry; or, if so at the commencement of the attack, it soon becomes cool and moist. The tongue has usually the whity-brown covering which has before been described, and is not dry; but sometimes it does become dry and brown. There is often very marked disorder of the digestive organs—sickness and vomiting and diarrhœa; and usually some slight jaundiced tinge of the skin is observed. There is also not unfrequently some delirium and stupor of mind; and the prostration of strength is often extreme. On examining the chest, in addition to the signs of bronchitis, which are always present to a greater or less degree, there are the usual indications of pneumonia. At first fine crepitation is perceived in the seat of the disease; to this more or less marked dulness on percussion, bronchial respiration, and increased resonance of the voice and cough succeed; and these signs, though generally found in one or both dorsal regions, may be more widely diffused. Notwithstanding, however, the threatening character of the symptoms, it was observed in the epidemic of 1847 that the disease was not very fatal, and the signs of consolidation disappeared more readily than in most ordinary cases of pneumonia. The resolution was shown by the return of crepitation, though of a coarser character, in the seat of consolidation; and by the gradual diminution of the bronchial respiration, and of the dulness on percussion. After a time the natural vesicular breathing again became audible. The duration of the disease was very similar to that in the cases of acute capillary bronchitis. In this, as in the other forms of influenza, the convalescence was often very protracted; there was the same tendency to recurrence of the symptoms on any slight exciting cause; and the rheumatic pains often long continued to distress the patient.

3. Catarrhal Fever, complicated with gastro-intestinal affections and rheumatism, and of a remittent character.

It has already been stated that in the last epidemic of influenza, there were very generally present more or less marked symptoms of gastro-intestinal and hepatic disorder; and that rheumatic pains, having a more or less decidedly remittent character, were very usually observed. It has further been said that in the cases in which the pulmonary complication assumed the pneumonic form, these symptoms were generally more marked than in the cases of acute capillary bronchitis.

In some cases, however, the latter symptoms were, throughout, the predominant feature; and as similar observations have been made as to former epidemics, cases of this kind may fairly be regarded as constituting a special form of the disease.

In this form of the epidemic, nausea and sickness generally occurred at an early period of the attack, and often became very urgent symptoms. The matters vomited often had a bilious tinge; and there was generally a marked bilious tinge of the conjunctivæ and general surface of the body, amounting in some cases to decided jaundice. There was often diarrhœa; and sometimes blood was passed in the stools. The pains in the head, back, loins, and extremities, which are present with more or less severity in all forms of influenza, were from the first of a severe character, or increased with the progress of the disease till they constituted a predominant feature. The pain was usually most distressing in the head, especially in the forehead, and in some cases was limited to one temple, one eyebrow, or one eyeball. This was generally of an intermittent or remittent character, coming on at night after more or less distinct remission during the day; and was attended with singing in the ears, distressing restlessness, agitation, and inability to sleep, whilst delirium generally increased during the exacerbation. In some cases it only amounted to a little excitement and incoherence, but in others it was so urgent as to require the employment of restraint to retain the patient in bed, and sometimes it continued without intermission for some hours. It was, however, remarkable how completely it subsided, as a rule, in the morning. With these symptoms there was usually much tremor of the extremities; and the eye was pale and glassy, though the pupil was frequently contracted.

Early in the attack the pulse was quick and feeble, and of a peculiarly vibratory character, though sometimes it was but little accelerated. At a later period it often became very rapid and feeble, or fell below the natural standard of frequency, being very soft and compressible, and occasionally intermittent. The tongue was at first moist, covered with the usual whity-brown fur, and red at the tip; subsequently it had a tendency to become dry. The breath had a peculiar, offensive, acid odour. Epistaxis occasionally occurred, and sometimes to an alarming amount. The skin was generally moist; and the perspiration had the usual sour rheumatic smell. The urine was at first scanty, but afterwards increased in quantity, and deposited much sediment of urates. Occasionally it was slightly albuminous.

With these symptoms there were evidences of some pulmonary disorder—bronchitis or pneumonia; and very frequently murmurs were heard at the heart, which were not, however, generally persistent.

After the exacerbations the sweating was often very profuse, so that in the morning the patient was found completely bathed in it, and the bedclothes were quite wet. The prostration of strength also was often extreme, so that the hands and feet became livid and cold, and the patient resembled a person in the algide stage of cholera.

Notwithstanding their severity, the cases of this third form of influenza generally did well, though the patients long suffered from the rheumatic symptoms, and only very slowly recovered their strength. As seen from the Registrar-General's reports, there was a great increase in the deaths from 'rheumatism' during the prevalence of the epidemic, which probably referred to cases of this kind.

4. **Modifying Influence of the Presence of Influenza on other Diseases.**—In all visitations of influenza of which we have detailed accounts, the epidemic has been attended by an unusual prevalence of other forms of disease, and especially of the specific fevers—and the features of such diseases have been much modified by the epidemic influenza. To this rule the influenza of 1847 affords no exception. As shown by the reports of the deaths in London and the country generally, there was a great increase in the total mortality; this especially showed itself in the zymotic class of diseases, but obtained also as to diseases of the heart, brain, and digestive organs. An unusual number of deaths were recorded from 'typhus,' under which head were then included the fevers which we now discriminate into typhus, typhoid, and relapsing fever. Of all these forms of disease, cases occurred during the time, though the chief prevalence was apparently of typhoid and relapsing fever. The features of these diseases were generally so much modified by the epidemic influence, and they were so constantly attended by pulmonary complications, that it was often difficult to decide whether any given case was to be regarded as a case of specific fever or of influenza. Various forms of local disease were also prevalent at the time, both as distinct affections, and as complications of specific fever, such as diphtheria, parotitis, otitis, stomatitis, and quinsy, with erysipelas, abscesses, &c.; and these were often attended by great prostration of strength, and added greatly to the danger of the various other forms of disease with which they were combined.

Pathology.—Every phenomenon of influenza points conclusively to the influence of some powerful depressing agent, operating on the nervous system, or entering the blood. The sudden seizure of a large proportion of cases; the extreme prostration of strength from the commencement, and to a degree disproportioned to the amount of local disturbance; the symptoms of disorder of all organs, and especially of the cerebro-spinal system; and the debility which so often succeeds even simple cases of the disease, can on no other supposition be explained. It seems probable also that the affection of the respiratory mucous membrane may be due to the morbific influence, whatever it may be, operating more specifically upon it; but it is extremely difficult to offer even a probable suggestion as to the nature of that influence. The almost simultaneous outbreak of the epidemic in places widely apart; the seizure of a large proportion of the population of a town or district within the course of a few hours; and the sudden illness of individuals or bodies of men visiting a locality where influenza is, or has very recently been, prevailing, and previous to direct intercourse with any persons actually suffering—are all circumstances opposed to the notion of the disease being dependent on infection in the ordinarily understood sense; and might seem to point to the operation of atmospheric influence as the cause. The conditions, however, under which the disease has presented itself in different epidemics, render such an explanation impossible. It has travelled over districts without reference to season or climate, and has prevailed in the same locality in all seasons and in almost every variety of weather. It is true that it has often broken out after great meteorological changes, as in the last two epidemics after sudden and remarkable falls from a comparatively high to a very low temperature; but, on the other hand, epidemics have arisen under other circumstances, and such alternations of temperature frequently occur without the occurrence of an epidemic of influenza. The disease has also broken out at the same time at different places in which the same atmospheric conditions did not exist, so that the operation of the sudden change can scarcely be regarded as acting even as an exciting cause. There can, however, be no doubt that the more common predisponants to disease, such as defective drainage, overcrowding, impure air, deficient clothing, and insufficient or unsuitable food, powerfully conduce to the prevalence and fatality of the epidemic.

Treatment.—Of the treatment of the simpler forms of influenza it is not necessary to say much. The patient should be confined to bed; have a footbath; take some form of diaphoretic medicine; and be allowed a mild, unstimulating diet. If the cough becomes troublesome, or if there be pains in the chest, sinapisms may be applied, and some anodyne may be added to the medicine; and for the relief of the subsequent debility, stimulants, tonics, and a nutritious diet may be enjoined. In the cases complicated with pulmonary affections, the same measures may be used, in combination with expectorants and anodynes; and more decided counter-irritation may be applied to the chest. When there is very copious secretion, and the patient cannot expectorate freely, the greatest benefit is often derived from the use of emetics, and they may be employed with advantage in cases in which the patient's strength is too much depressed to allow of nauseating doses of medicine being given. To the use of emetics, the stimulating expectorants — squills, ammonia, &c.—should succeed. For the relief of the cases in which there is nausea and sickness or vomiting, effervescents with morphia, or hydrocyanic acid, may be given. When there is more or less jaundice, small doses of calomel or grey powder, in combination with Dover's powder, are very beneficial; and when there is diarrhœa the Dover's powder or decided astringents—such as acetate of lead, or tannic acid—may be employed. When the rheumatic symptoms are severe, the greatest relief is obtained by the administration of small doses of colchicum with carbonate of potash and opiates; and when the prostration of strength is great, ammonia, in combination with bark, should be given. In the cases in which there is a decided tendency to remissions and exacerbations, bark also may be prescribed, or, in the more severe cases, quinine; and quinine and other tonics should be freely given during convalescence.

In all cases of influenza all depressing treatment should be avoided. The cases do not require it, and the patients are too much prostrated to admit of its employment. In all the different forms of influenza it is necessary to administer support very freely, and sooner or later to exhibit stimulants. In the cases in which there is pulmonary or other local complication, the strength becomes more rapidly and more seriously depressed, and stimulants and support are still more urgently needed; and indeed it is necessary to have recourse to them at an earlier period, to exhibit them more freely, and to persevere in their use for a longer period in such affections, when occurring during an attack of influenza than when arising as idiopathic diseases. In the management also of the other forms of febrile affections which are seen during an epidemic of influenza, a more restorative and stimulating treatment is required than under ordinary circumstances, for all such diseases partake of the peculiarly asthenic type of the epidemic.

Thomas B. Peacock.

INHALATION, Ætiology of.—*See* Disease, Causes of.

INHALATIONS, Therapeutic Uses of (*inhalo*, I breathe in).—Inhalation is a method of applying remedial agents to the respiratory tract, whereby these substances in a gaseous or atomized form are brought into contact with the mucous membrane of the nose, mouth, pharynx, larynx, and bronchi, and may even penetrate to the epithelium of the air-cells. Inhalation dates from the days of Hippocrates and Galen, and has been more or less in vogue in all ages; but only lately has it been proved that the inhaled material passed through the finest ramifications of the bronchi into the pulmonary alveoli, and in some instances became absorbed by the capillaries, thus entering the general circulation. The examination of the lungs of colliers, grinders, and others engaged in dusty occupations has shown that the inhaled dust can be detected in the lung-tissue, where it induces chronic pneumonia. The experiments at the Academie de Médecine proved that medical sprays are equally penetrating.

Methods.—The modes of inhalation vary with the drug used, depending mainly on the temperature at which it volatilizes, and also on the medicinal effects aimed at.

Chloroform, ether, bichloride of methylene, and nitrite of amyl evaporate at ordinary temperatures, and only need to be diluted with air to be safely inhaled. Calomel and sulphur are sublimed at high temperatures in special apparatuses; but the majority of drugs are best vaporized through the medium of hot water or steam, or reduced to fine spray by passing compressed air through their solutions.

Many forms of inhaler are in use, but in selecting one for warm inhalations the requisites are:—(1) that it can be used without difficulty by the patient; (2) that a temperature of 130° to 150° F. can be steadily maintained; (3) that the steam be thoroughly impregnated with the medicament; and (4) that the inhaling tube be fitted to the nostrils as well as to the mouth, so as to ensure a sufficient supply of the inhaled vapour. When no inhaler is at hand, a jug with a wide mouth and half filled with hot water may be used, a towel being placed round between the mouth and nose of the patient and the opening of the jug, to prevent the escape of the vapour into the air.

Varieties and Uses.—Inhalations are employed chiefly in diseases of the pharynx, larynx, and air-passages, and may be classed as *sedative*, *stimulant*, and *antiseptic*.

Sedative.—Steam is soothing to the throat, when this part is dry, inflamed, or irritable. In incipient laryngitis and croup, as well as in irritable bronchitis, the inspiration of steam from specially arranged kettles is very grateful, the moist vapour promoting secretion and expectoration.

Jets of steam are used in hospitals and bath establishments as vehicles for the inhaled drugs, and are directed into the patient's mouth.

As sedatives the vapor conii and the vapor acidi hydrocyanici are recommended in cases of laryngeal or pulmonary irritation. A sedative inhalation made of equal parts of chloroform and rectified spirit—of which one teaspoonful may be added to a pint of water, at 60° to 100° F.—is much commended in hay-fever and laryngeal spasm. A combination of chloroform and conium, in the proportion of 15 minims of the former to 1 drachm of the succus conii, in half a pint of boiling water, is useful in phthisis and some forms of asthma.

Stimulant.—Stimulating moist inhalations can be prepared with various volatile oils. Oils of pine and of cubebs are useful stimulants in cases where there is much secretion from the throat and air-tubes. Thus 2 drachms of oil of pine or oil of cubebs may be mixed with 60 grains of light carbonate of magnesia in 3 ounces of water; and of this mixture 1 drachm may be used in a pint of water at each inhalation. One drachm of the compound tincture of benzoin, in half a pint of hot water, is often useful in chronic bronchitis and laryngitis. Oil of turpentine or of pinus silvestris (1 drachm to the half-pint of hot water) makes excellent stimulant inhalations in cases of dilated bronchi.

Antiseptic.—Antiseptic inhalations are used where the object is to correct a fœtid secretion, as well as to stimulate the secreting membrane to fresh action. In fœtid bronchorrhœa, in gangrene of the lung, in fœtid abscess, and in pyopneumothorax, benefit is derived from the vapor creasoti, the vapor iodi, or from glycerine of carbolic acid (from 2 to 3 drachms to the pint of boiling water), or again from oil of thymol, prepared like the other essential oil vapours, with light magnesia and hot water (10 grains to the 3 ounces). The fumes of nitre paper are employed as inhalations in cases of pure spasmodic asthma uncomplicated with bronchitis. The paper—prepared by soaking white blotting-paper in solution of nitrate of potash—is sometimes washed over with tincture of benzoin, and this, in certain cases, may be an improvement; but in ordinary forms of asthma the nitre paper (30 or 40 grains of nitrate of potash to 1 ounce of water to form the solution for soaking the paper) burnt till the patient is enveloped in smoke, will usually relieve the asthmatic paroxysm. The fume of a grain of powdered opium volatilised on hot metal has been praised as a remedy to cut short nasal catarrh; as well as smoking solid opium in the Chinese fashion through a pipe, in spasmodic asthma. Cigarettes and pastilles containing stramonium and other antispasmodics, are sometimes used with benefit.

Atomised inhalations of spray have of late years come into deserved repute as valuable aids to the treatment of chronic diseases of the throat and lungs. The principle of the hand-ball and steam-spray atomisers is, that if two capillary tubes are placed at a certain angle to each other, one dipping into a fluid, while through the other a stream of air is driven by heat or compression, a vacuum is formed in the first, causing the liquid to pass out in the form of fine spray. In using these instruments, the operator should seek to blow the spray into the patient's throat at the time when an inspiration is being taken, as thus the spray will obtain a free entrance through the larynx into the trachea. It is doubtful if much spray enters the air-tubes; some certainly does, as has been stated above, but the cold sprays do not appear to afford so much relief to affections of the lungs as the warm inhalations. In cases of tumidity of the larynx, a spray containing 10 grains of alum to 1 ounce of distilled water may be used. In place of alum, 2 grains of sulphate of iron, 5 grains of sulphate of zinc, or 5 grains of dry chloride of iron, in 1 ounce of water, may be employed. For antiseptic purposes, 5 minims of sulphurous acid, or 1 minim of carbolic acid, to 1 ounce of water, or a like quantity of liquor iodi may be used. In putrid sore-throat and diphtheria the writer has seen excellent results from iodine, either inhaled in vapour or applied in solution. Three and a half drachms of lactic acid in 10 ounces of water form a solution which, thrown as spray into the throat, is of use in diphtheria; it seems to dissolve the exudation. As a styptic and hæmostatic spray 50 to 200 grains of tannic acid are employed, dissolved in 10 ounces of water, but for relaxed throat a weaker solution is useful. For sedative purposes a solution of bromide of ammonium, or one containing half a grain of acetate of morphia to 1 ounce of water, may be employed. Diluted ipecacuanha wine spray is said to be very efficacious in relieving the dyspnœa of chronic bronchitis and emphysema. This spray in a few instances may induce vomiting, but this accident may be obviated by diluting the wine with a considerable proportion of water. At the Continental spas it is usual to medicate large chambers by means of sprays and vapours, in which patients can sit for hours breathing the artificial atmospheres; and in this way various mineral waters, such as those of La Bourboule, Aix-les-Bains, and Cauterets are locally applied.

John C. Thorowgood.

INJECTION (*injicio*, I throw in).—Synon.: Fr. *Injection*; Ger. *Einspritzung*.

Definition.—Injection is the act of introducing a fluid into any part of the body, by means of a syringe or similar apparatus. The word is also employed to designate the fluid so introduced.

Varieties.—Injections are chiefly used in the treatment of disease; but reference must also be made to the method as it is practised by anatomists for the preservation of 'subjects' for dissection; and for the purpose of filling the blood-vessels, lymphatics, ducts, cavities, spaces, &c., preparatory to microscopical examination.

The therapeutical application of injections comprehends the following measures:—

1. *Hypodermic* or *subcutaneous* injection, in which the fluid is injected under the skin. *See* Hypodermic Injection.

2. Injections into the natural *canals* or *open*

cavities of the body; for example, the external ear, the Eustachian tube, the nose, the nasal duct, the stomach, the rectum (*see* ENEMA), the urethra, the bladder, and the vagina and uterus. The various forms of injections just indicated will be found fully discussed under the diseases of the several organs.

3. Injections into *shut sacs*, normal or morbid; such as the tunica vaginalis, the serous cavities, the synovial cavities, the sheaths of tendons, and cysts and chronic abscesses. The fluids used in this class of injections are generally stimulant, such as a solution of iodine. *See* HYDROCELE.

4. *Intravenous* injections, the fluid introduced into the circulation being either blood (transfusion), milk, or some kind of nutritive solution. *See* TRANSFUSION. J. MITCHELL BRUCE.

INOCULATION (*in*, into, and *oculus*, a bud, a graft).—As usually understood, inoculation is either an operative procedure or an accidental occurrence, by means of which morbid materials are brought into direct contact with the minute vessels of the skin or of a mucous membrane, or with those of the subcutaneous or submucous tissue, so that they are readily and speedily absorbed, the result being that they originate certain definite and specific diseases, varying with the nature of the material employed. In short, inoculation, as commonly practised or observed, is a mode by which the contagia of certain specific diseases are conveyed from one animal or individual to another; and some of these affections can only be thus transmitted, while others are capable of being communicated in other ways, but in this way most effectually and with the greatest degree of certainty. The most familiar examples of diseases thus transmitted are vaccinia, small-pox, syphilis, and hydrophobia. It need hardly be mentioned that vaccinia can only be conveyed by inoculation, and it is for the purpose of inducing this disease that the method is ordinarily intentionally practised, so that the terms *vaccination* and *inoculation* have come to be popularly regarded as synonymous (*see* VACCINATION). Under certain exceptional circumstances inoculation of the contagious matter of syphilis, small-pox, or anthrax is employed, with the deliberate purpose of originating these affections (*see* SMALL-POX; SYPHILIS; and PUSTULE, MALIGNANT). This plan has also been practised of late years in experimental pathology, by which the effects of the inoculation of septic liquids upon the system have been demonstrated; while it has also been shown that the introduction of certain solid morbid products in this way may originate an infective process, leading to definite pathological results. *See* CONTAGION.

With regard to the modes by which inoculation is effected, it need only be said here that when it is practised as an operation, the material is usually introduced into the subcutaneous or submucous tissue, by means of a lancet or other pointed instrument. Sometimes the surface of the skin is merely scarified, so that the epidermis is more or less destroyed; or this is removed by some blistering agent, and the contagious substance then applied to the exposed cutis. Accidental inoculation may take place in connection with any abrasion, wound, or ulcer on the skin or on a mucous surface; or by the bites of animals, as in the case of hydrophobia.

FREDERICK T. ROBERTS.

INSANITY.—SYNON.: Fr. *Folie*; Ger. *Geisteskrankheit*; *Geistesstörung*.

Insanity is popularly known as disorder of mind: as physicians, we know it to be disorder of the highest organs of the nervous system which unite in the performance of that function recognised and spoken of as mind. There can be no disorder of mind without disorder of brain: as physiologists and pathologists we have to study and treat the latter, and for this reason the legislature enacts that certificates of insanity shall be given by medical men, and by them alone, and that to their care shall be committed those who are insane.

As a preparation, then, for the study of insane mind, the learner ought to acquire a knowledge of healthy mind—the healthy function of a healthy brain. He must know what are the structures which combine to make up that which we call the cerebrum, and contribute to its healthy working, and must trace the growth and development of this working from the earliest days of infancy to the time of adult life. He will perceive that the growth of mental function is as gradual as that of bodily power; that in some it may be more rapid than in others, like that of the body; that it may be arrested in its development, or stunted and deformed; and that it may by imperfection of the organs, as blindness or deafness, be impeded or stopped. In all particulars it will be found subject to the laws which regulate the growth of the body generally.

Before examining brain-function, it will be necessary to become acquainted with the various structures which form the cerebrum. The brain of man, and indeed of all vertebrates, is made up of nerve-cells and nerve-fibres; of a substance or *stroma* in which the cells are imbedded, called neuroglia; and of blood-vessels and lymphatics. The nerve-cells are gathered into convolutions or *centres*; and by means of the nerve-fibres communicate with the organs of special sense, with the sensory ganglia and spinal cord, with each other, and with the convolutions of the other hemisphere. Modern science is endeavouring to throw light upon the nature and uses of these convolutions. The seats of the highest intelligence, they at the same time appear to be centres of voluntary motion, and of the outward manifestation of intellectual action.

Concerning the physiology of the blood-supply of the brain there is still great doubt and controversy. Anatomically we know that from the internal carotid and vertebral arteries, combining in the circle of Willis, there pass to the brain-substance the anterior, middle, and posterior cerebral arteries. The terminations of these ramify in the pia mater, and thence send many small vessels to the grey matter, and fewer, but larger ones to the white, the supply of blood to the former being much the more plentiful. That, however, which chiefly concerns the student of insanity is the vaso-motor system of nerves which controls and regulates the blood-supply. Modern research appears to render it more and more certain that the condition of insanity, at any rate in its early and acute stage, is mainly one of increased blood-supply. On what does this depend? To this question no precise answer can as yet be given. Investigations are still being made as to the nerves which dilate and contract the vessels; but with regard to this subject, and the so-called inhibition of nervous influence, much more must be ascertained before the pathology of insanity can be definitely fixed. The lymphatics of the brain are also, according to some observers, largely concerned with the disturbance of mental function, if it should happen that by being blocked up or impeded they fail to carry off the waste products of the organ. They are contained in perivascular lymph-spaces, lying between the outer fibrous coat of the blood-vessels and a hyaline membrane or sheath of pia mater which separates them from the brain-substance.[1]

Even concerning the neuroglia, controversy exists. Is it merely connective-tissue, or is it nerve-structure? Authorities lean to the former view, and the increase of it in diseased brains seems to point to a growth of lower structure at the expense of higher.

Passing to the functions of the brain, the phenomena comprised under this name are of two kinds. There are the various movements excited by the stimulation of the different brain-centres, on which the experiments of Dr. Ferrier have thrown new and interesting light. But these are not the phenomena of mind. The latter can only be studied by observation of a totally different character. For mind implies sensation, feeling, consciousness; and as we have no consciousness of any feelings but our own, it is evident that here objective observation is insufficient, however unwilling physiologists may be to admit it. Yet the subjective examination of ourselves is as inadequate by itself to explain the phenomena of diseased mind, as objective observation is to make known the nature of mind in general. We must use the subjective method as our key, and by means of it open up and interpret the phenomena of mind: we may then objectively examine the mental characteristics, the growth and development, the diseases and decay of mind in all human beings, children or adults, idiots or insane, and by tracing thus the effects of injuries and disease, we arrive at a knowledge of the differences between sound and unsound mind.

By observation of the movements brought about by nerve-function, we perceive that they follow the application of a stimulus, and that many actions take place in response to stimuli which we call reflex, instinctive, or automatic, before those begin that are the product of mind in its highest sense. For mind grows slowly and gradually. The first movements of the child, reflex or instinctive, are the result of stimulation of nerve-centres, but are only slightly, if at all, attended by consciousness. This becomes appreciable later, and with it the commencement of *memory* and *ideas*, as the feelings roused by stimulation are stored away in the mind, to be reproduced as some new stimulus is presented to them. The various brain-centres are in this manner stored with ideas, the result of experiences derived from without, and by means of the nerve-fibres they are united in groups till a most complex system is evolved. The sensations are developed into more and more complex feelings, till the highest emotions of civilised man are reached; and in a similar manner the intellectual processes grow from mere perceptions and cognitions to the highest trains of thought. Mind may be said to be made up of feelings and the relations between feelings, for the intellectual element of mind is the relational element, and it will be found that we cannot locate in two parts of the brain the emotions and the intellect, as some physiologists have proposed; for no kind of feeling, sensational or emotional, can be wholly free from the intellectual element; and on the other hand it very rarely happens that any act of cognition can be absolutely free from emotion.[2]

For the growth of healthy brain and mind all the conditions of physical health are necessary. If at birth there is inherited defect or accidental injury, or if at any subsequent period development is arrested or perverted, idiocy or imbecility is the result. There will be an imperfect recording of the experiences of life, an inability to learn, and a deficient power of bringing into relation one with another the various groups of nerve-centres which make up the brain, and are the seat of mind.

If, however, growth and development have proceeded normally, and normal mind is the result, what are the conditions of insanity, or disorder of mind? What are the conditions of healthy and unhealthy brain-function?

I. We know by experiment on nerves and nerve-centres, and by observation of the objective phenomena of motion, that a discharge of nerve-force or nervous fluid—call it what we will—is liberated when a centre is stimulated, and that this ramifies according to its quantity in various directions throughout the system. When there is health and vigour the supply will be large, and every channel both in the brain and body will be duly supplied. But in the healthiest nervous system there must in time be a cessation of this discharge, for in time the supply will be exhausted, and repair and replenishing must take place. And unless this is done, nerve-function will be impaired or cease. For the repair of the higher nerve-centres sleep is necessary, for only during sleep is the repair of the waste effected, and we commonly, nay, constantly find, that mental disturbance is preceded by loss of sleep.

In some cases want of sleep may depend on the actual time allowed for it being insufficient. Though not a very common cause of insanity, yet it sometimes is found in persons who are very hard-worked, or who, by religious exercises and services, deprive themselves of sleep. In the great majority, however, want of sleep is the result of a pathological condition of the brain, a condition which by appropriate treatment the physician seeks to remedy as the first step towards the cure of the insanity.

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[1] Dr. Batty Tuke. Morisonian Lectures. *Edinb. Med. Journ.*, Dec. 1874.

[2] Herbert Spencer, *Principles of Psychology*, vol. i. p. 473.

Not only may there be a want of repair and replenishing of the nerve-force expended, but there may be also a defective generation and supply of it. Through anæmia or exhaustion from acute diseases or long-continued illness, the nerve-centres fail to generate from the blood the power necessary for their due operation. The discharge liberated does not ramify throughout the nervous system, calling into action every part of the brain, and penetrating to every portion of the muscular structures; thus the failing supply is manifested in the gloom of *melancholia* and the slow and torpid movements which accompany it; and when it is reduced to a still lower ebb, there may be not enough to carry on even the semblance of mind: the patient presents the appearance of utter fatuity seen in *dementia*, whether primary or secondary, and either sits motionless and lost in the condition termed *melancholia cum stupore* [Fr. *mélancolie avec stupeur*; Ger. *Schwermuth mit Stumpfsinn*] or executes the purposeless and automatic movements of acute dementia [Fr. *Démence aiguë*].

The defect of nerve-force may bring about insanity in more than one way. A sudden strain or shock may make an unwonted demand upon the nervous supply. Incessant thought, especially of a painful kind, may use up the reserve of force: this is not renewed, and insanity is the result, the increased molecular discharge not being duly compensated by an increased supply from the nutritive sources. Secondly, the supply may fall so far below the standard that it is not sufficient for the ordinary demands of everyday life, and so, without any mental cause, but simply from nerve-inanition, the stage of depression appears. In both of these cases, however, as in all recent insanity, the brain is in a state of hyperæmia, as evidenced by heat of head, want of sleep, and often pain and congested appearance of face. The hyperæmia impedes healthy nutrition and causes sleep to be absent, but it is erroneous to say that the brain in such patients is in a state of anæmia, even if the general bodily condition deserves that name.

II. It may be, however, that there is not so much a defect of nerve-force, as an unstable condition of the cerebral centres, which is manifested by a rapid and continuous discharge. Such a discharge in a more sudden and violent form we are familiar with in the phenomena of epilepsy. In insanity it may vary from undue hilarity and excitement up to the incessant movements and vociferation of acute delirium; and like epilepsy it may terminate in exhaustion, coma, and death. The supply of nerve-force in such cases is often abundant. The patient goes without sleep for days and nights, and yet recovers. The higher brain-centres lose the power of control, owing to the violence of the discharge, and the lower and more automatic centres thus liberated are stimulated to overaction, which is manifested in noisy and violent delusions, and so on to mere delirious incoherence. And after the discharge has ceased, there may be a period of dementia and complete obliteration of mind, before the exhausted brain begins to recover. Persons who are in this condition of unstable nerve-equilibrium may be thrown off their balance by mental causes—by shock, or grief, or losses. Their brain may also be affected by disorder of the other organs of the body *sympathetically*. In all such patients there is a predisposition, often inherited, to nervous instability and rapid discharge, and such 'causes' as puberty, pregnancy, or child-birth bring about an explosion. Here, too, there is marked cerebral hyperæmia, producing an abnormal nutrition and corresponding abnormal function.

III. Disturbance or defect of mind may be caused by incomplete development of any part concerned in mental action, or by the presence of anything within the cranium which interferes with the healthy life of the various organs. There may be tumours of different kinds, or abscess. Insanity also follows blows on the head; and deterioration of brain is frequently caused by the action of alcohol and other poisons. In all these cases we have not a functional disturbance which may suddenly arise and as suddenly pass away, but a gradually organized lesion which usually advances, producing serious and permanent results. The degeneration of the organ and tissues through age will also produce corresponding results.

Symptoms.—What are the symptoms of insanity, and how far do they correspond to the pathology of brain-disturbance as set forth in the above remarks?

The first symptom usually noticed in a person becoming insane is an alteration in his *emotional* condition. Either he is more quiet and dull than usual, or, on the contrary, more restless, irritable, excitable, or hilarious. The dulness may vary from a mere disposition to sit still, and neglect his work or amusements, to actual gloom and despondency. The restlessness and excitement may also vary in degree, and be accompanied by gaiety or outbursts of anger and violence. The change may be more or less concealed, according as the patient can or cannot control himself. Those of his own family or people about him may notice it long before others, and this stage will vary in duration, often lasting some time before delusions or other marked symptoms are discoverable.

The *acts* of the patient will correspond to his altered feelings. His relations towards the outer world will be altered. In his torpor or gloom he will look on everything despondingly; will be unable to perform his duties, will not care for amusements, will sit at home inactive, or take up morbid fancies about his health. Conversely, he will act rashly in matters of business, embark in foolish speculations, take no heed of time or appointments, spend money recklessly, indulge in debauchery or frivolous pursuits, show causeless anger to those about him, or exhibit silly and childish hilarity when matters of grave moment are pending.

Here we have a *slight insanity*. The higher brain-centres are but slightly disturbed, and still exercise a considerable amount of control over the lower and less specialised centres. It may be difficult to say that any one act or feeling is of itself indicative of insanity, but the patient is a changed man, and the term *moral insanity* is specially applicable to this condition.

Such an insanity may remain and be permanent: more frequently, however, it either passes off, the patient recovering, or advances in one or other of the directions already indicated. The gloom will increase; corresponding delusions will present themselves with appropriate acts and conduct; and the patient will drift into *melancholia*. Or he will become more and more hilarious, angry, excited, or suspicious, and a state will arise to which for want of a better we give the name of *mania*. Though delusions are not usually found in the stage of alteration, they are seldom absent in the second and more advanced period, and generally correspond to the feeling of the sufferer, so much so that the appearance and humour frequently enable us, without previous information, to arrive at the delusions under which he is labouring. This stage is often called *intellectual insanity*, or insanity with delusions. Patients labouring under one or other of these forms vary in the degree of insanity, from a condition in which they are able to talk coherently on many topics to one of complete incoherence or delirium. To the former the name of *partial insanity* is often applied.

Another condition is that of fatuity or childishness in various degrees. It may come on rapidly, the patient passing at once into this state, which is then called *acute* or *primary dementia*; or it may be the result of years of insanity or brain-disease, and is termed *chronic* or *secondary dementia*. In such people we find loss of memory, inability to revive the relations of feelings and ideas—not emotional disturbance, but rather an absence of all emotion.

As regards the bodily symptoms, almost every variety of insanity is ushered in by sleeplessness, sleep being deficient or altogether absent, perhaps for days, according to the acuteness of the attack. This indicates a disturbance of the brain-circulation, which is also shown by heat and pain of head, injection of the conjunctivæ, and throbbing of the carotids. There may be excessive vascular action even when the insanity is the reverse of what is sometimes termed 'sthenic,' and the general condition of the patient is one of anæmia rather than hyperæmia.

It has been said that the mental symptoms of insanity are accidental, that they do not indicate the pathological conditions, but depend on the state of the body, and that no classification of the forms of the disorder ought to be based on them. But it is perfectly certain that the brain of a man suffering from melancholia differs altogether from that of one in acute mania. In the former there is a scanty generation of nerve-force, which is insufficient to reach the remote channels and plexuses of the brain. There is not a general incoherence and confusion of ideas, and the patient can converse rationally on many topics. His feelings are those of pain and not of pleasure, because pains in general are more intense than pleasures in general,[1] and the former are evoked into consciousness by the feeble nerve-currents, while the latter are not. In what is termed mania we may have every shade of feeling displayed, from gloomy and suspicious irascibility to great hilarity. Feelings of anger and resentment are called up without the controlling power of reflection and judgment, such as would prevail were the whole brain at work, and the higher faculties and feelings co-operating and in relation with the lower. This, again, may be due to a want of nerve-force, or more frequently to an undue expenditure of it, as may be seen in the irritability of an over-tired child. What we may call the more automatic and less complex feelings of fear and self-love are evoked, while there is not force and pressure enough to supply the rarer and more remote qualities of comparison and reasoning which require the combination and union of the highest portions of the brain. If there is an increased and accelerated blood-flow, great hilarity and self-satisfaction may be the result, yet with perfect incoherence of ideas, owing to all the relations of the brain-plexuses being interrupted by the tumultuous or impeded circulation, and the excessive nervous discharge. And in dementia the very opposite may be witnessed. The supply of force is reduced so low that there is an absence of all ideas; memory, at any rate of recent events, is lost, and only the well-marked occurrences of earlier life are recalled.

That the mental symptoms are to be by the pathologist altogether disregarded, and that they are of no assistance in the appreciation of the pathological condition, seems a most extraordinary assertion. These symptoms do not depend on the state of the body generally, but on that of the brain, and as accurately indicate the condition of the latter as the breathing indicates that of a lung. The brain in insanity is the *pars affecta*, the insanity is the symptom, and when we see in the same individual at one time mania and at another melancholia, we may be sure that the condition of brain at the one period is not the same as at the other, though originally one cause may have lighted up the malady.

Diagnosis.—Accuracy of diagnosis is specially important in insanity, owing to the legal and social results which flow from it, and because the restrictions on liberty which may be necessary for proper treatment cannot be resorted to until a diagnosis has been conclusively established. The direction of the investigation will be different, according as the condition may be the result either of incomplete development, or of disablement or perversion by disease. Where *imbecility* is in question, it may often be necessary to take several opportunities of examining the patient. This condition always implies intellectual defect, though great moral depravity is often the predominant symptom. It is therefore necessary to ascertain whether any or what kind of occupation has been attempted, and what amount of incapacity has been shown, and whether the individual has proved capable of profiting by such education as he has received. Adults in ordinary circumstances ought at least to be able to read, write, and count. The decision rests on whether such capacity has been shown as is required in the ordinary conduct of life. To form a correct opinion in cases of *acquired insanity* is often a very difficult matter. The relatives of the patient often obstruct rather than aid the enquiry. They are generally divided in opinion, and this may be partly an aid and partly an obstruction; but great care is required to avoid taking part at first with either side. Before seeing the patient it is proper to make what inquiry is possible into the hereditary history of the family, the nature of the diseases or injuries from which the patient may have suffered, including any previous attacks of insanity. The ordinary habits, disposition, tastes, and occupations must be ascertained, and also the present habits, disposition, tastes, occupations, amount of sleep, and general bodily health. The mental symptoms, such as suspicions, delusions, or loss of memory, which have suggested the allegation of insanity, must also be inquired into; and special attention must be paid to any indication of the change of conduct or disposition which is so characteristic of the advent of mental disease. A reference to the articles descriptive of the forms of insanity will show the importance of all these points. In the whole investigation care must be taken to avoid accepting mere *ex parte* statements, and as much information as possible should be obtained by the inspection of letters or other documents written by the patient. Sometimes the conduct of the patient renders it difficult to obtain an interview, and care must be taken not to overstep legal limits in the attempt. If the physician has to see the patient in the presence of other persons, it is a necessary precaution to make certain that he clearly understands whom he is to examine. In obtaining the interview a certain amount of stratagem may sometimes be resorted to; but it is best that the physician should be introduced by a friend in his true character as a doctor, and on no account should any false statement be made. As a mere matter of expediency it will be found that any deviation from this produces more evil than good. If the interview takes place in the patient's home, valuable information may frequently be obtained by observation of the order or disorder which prevails. The condition of the furniture, the state of the patient's clothing, the manner of the patient towards the rest of the household and their bearing towards the patient, ought to be noted. The patient's physiognomy, the condition of the pupils, and any gesticulations or convulsive or tremulous movements, must be observed. In conversation it is well to get as soon as possible to the subject of the patient's health, as it relieves many necessary questions of their offensive character. Eccentric ideas ought not to be combated more than may aid in making the patient disclose them fully; and everything tending to show the presence or absence of delusions, irrational suspicions, or loss of memory, ought to be elicited. Many other points will probably be suggested by the course of each inquiry; and the importance to be attached to them, as well as to those just mentioned, must be decided by a careful study of how far they are included or excluded by the known symptoms of any of the various forms of insanity.

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[1] *See* Herbert Spencer, *Principles of Psychology*, vol. i. p. 602.

Ætiology.—We now pass to the causes of insanity, which are usually spoken of as *predisposing* or *exciting*: in many cases both combine in the causation of the disorder.

The great *predisposing* cause is an inherited disposition to neurotic disorder—one difficult to estimate and, indeed, to discover, owing to the care with which it is concealed, but the importance of which cannot be questioned. It has been adverted to in the second section of the pathological conditions, and will again be noticed. *See* Insanity, Varieties of.

When we speak of such predisposing causes as *sex*, *age*, and *condition of life*, it is evident that they can only be called causes in the sense of being concurrent conditions, in some of which a man or woman is more likely to become insane than in others.

Has *sex* anything to do with insanity? Referring to statistical tables we find that in the Report of the English Commissioners in Lunacy for the year 1874 there were under treatment in asylums at the end of the year 1873, 18,872 males and 20,741 females. There were admitted during the year (not reckoning re-admissions or transfers) 6,264 males and 6,347 females, while in the same period there died 2,288 males and 1,705 females. The preponderating number of females under treatment is probably due to the fact that the mortality among them is far less than among males, and consequently they accumulate in asylums. The difference in the number of the two sexes who become insane is probably not material, but it seems that the males are the larger number, or, looking at the difference in the mortality, they would fall below the number of the females further than they do.

With regard to *age*, we find that the tendency to insanity increases with the development of brain and mind. In the first decade of life it is rare. In the second, which includes the period of puberty, it is more common, but not so much so as in the next. The period between 25 and 40 years is that in which the greatest number of cases arises, and is that of the highest development and working power. After this the number declines in each decade, as before it rose. With the age the character of the insanity varies. In youth it is displayed in violent and paroxysmal mania, sometimes in acute dementia, and cataleptoid states. There is great motor disturbance and emotional rather than intellectual aberration. Rarely are the young melancholic. In the prime of life there is active mania with delusions and intellectual insanity, and at this period we meet with the most acute forms. Later, melancholia prevails; while in old age weakness of mind, passing into fatuity and second childhood, indicates the general decay of the brain and nervous system.

As to the *condition of life* in which insanity is most frequently found, there is not much to be said. That it occurs more frequently in civilised than in barbarous countries may be assumed without recourse to figures, because in the former mind and brain are more complex, and therefore more prone to disorder. It is, however, the failures and vices of civilisation that bring about the great mass of insanity. And of these the chief is *poverty*, with all its attendant physical evils of insufficient food and wretched dwellings, and moral evils of anxiety and degradation. Next to poverty, and closely bound up with it, is *drinking*, which among the working classes plays a fearful part in the causation of the disease. Among the predisposing causes of insanity included by the International Congress of alienist physicians in 1867 are, besides those already enumerated, consanguinity; great difference in the age of the parents; influence of the soil and surroundings; convulsions or emotions of the mother during gestation; epilepsy and other nervous affections; pregnancy, lactation, menstrual periods, critical age, puberty, venereal excess, or onanism. We may add to these, damage received at birth owing to difficult parturition.

The *exciting* causes of insanity are usually divided into *moral* and *physical*. Among the former we may reckon domestic trouble and anxiety, mental shock, overwork, religious excitement, political excitement and war, and disappointment. Concerning such little need be said. They may vary in duration, some quickly bringing about insanity, others persisting for years before that result is reached. For the most part those who are affected by such causes are already predisposed by hereditary taint, by a neurotic temperament, or by being at one or other of the critical periods of life.

Among the *physical* exciting causes are some which are both exciting and predisposing—for example, intemperance and epilepsy. These may be the immediate precursors of an attack; as well as agents causing a predisposition to the disorder, by being repeated through a series of years. Other physical causes are parturition, menorrhagia, amenorrhœa, and various other ovarian and uterine ailments; diseases and injuries of the head; acute febrile diseases and chronic illness, producing exhaustion; constitutional diseases, as gout, ague, or syphilis; disease of heart and vessels; exposure to great heat or cold; lead and other poisons; anæmia; blows on the head, and organic affections of the bones of the cranium, or the various parts contained therein.

CLASSIFICATION.—Almost every writer on insanity has suggested a special classification of its forms, and the majority have founded their suggestions either on the ætiology or symptomatology of the disease. Of those based on symptoms none is simpler than Griesinger's:—(1) states of mental *depression*; (2) states of mental *exaltation*; (3) states of mental *weakness*. He placed general paralysis and epilepsy apart as mere complications of insanity. His groups, therefore, correspond broadly with the old divisions of *Melancholia*, *Mania*, and *Dementia*. The ætiological classification most widely known is that of Morel. He divides the forms into six:—(1) *Hereditary* insanity, including congenital nervous temperament, moral and impulsive insanity, imbecility, and idiocy; (2) *Toxic* insanity, including conditions caused by insufficient or injurious food, poisons, or noxious air or water; (3) *Hysterical*, *epileptic*, and *hypochondriacal* insanity; (4) *Idiopathic* insanity, dependent on disease of the brain or its membranes; (5) *Sympathetic* insanity; and (6) *Dementia*, or the condition of terminative enfeeblement. For any systematic study of the subject, it is obvious that some symptomatological grouping, based on the characters of the mental manifestations, must be necessary. It has, however, been maintained that it is impossible, either on this or on a purely ætiological basis, to found groups which have more than an artificial relationship to one another. And there is some truth in this criticism. But, though the ties which bind the psychological groups together may be in a sense regarded as artificial, it is found in practice that the associated conditions exhibit a considerable amount of intimate natural connection.

At the International Congress of Alienists in 1867 the following classification was laid down, intended to combine the ætiological and symptomatological methods:—1. *Simple Insanity*, comprehending mania, melancholia, monomania, circular insanity, moral insanity, and the dementia following these forms. 2. *Epileptic Insanity*. 3. *Paralytic Insanity*. 4. *Senile Dementia*. 5. *Organic Dementia*. 6. *Idiocy*. 7. *Cretinism*.

The first class, it will be observed, comprises all the varieties which may be regarded as merely functional; the others are mostly associated with permanent structural lesions.

No classification which has been proposed can be regarded as altogether satisfactory. This is partly owing to the fact that the true nature and limits of insanity itself have been very imperfectly recognised. The essence of the condition is, of course, the manifestation of disease through some deviation from the healthy standard of mental action. It is a condition of mental unhealth analogous to bodily unhealth. But we must not allow ourselves to imagine that there is a class of morbid mental manifestations which are independent of the condition of the physical frame. The truth is that there is no pathological condition of the individual in which both mind and body are not affected; but in some diseases the mental symptoms come into prominence, in others the physical. The notion, not yet altogether exploded, that there is something in insanity altogether distinct from bodily disease, arose from the belief so long prevalent that mental action is independent of physical conditions, and from the fact that the study of insanity has been and still is too much dissociated from the study of the rest of cerebral pathology. Acting upon the broader and truer views, attempts have been made by Schroeder van der Kolk, and others, to introduce a more natural system of classification. Such attempts have proceeded on the recognition of all mental symptoms as phenomena whose nature cannot be ascertained without a full consideration of the physical symptoms of disease by which they may be accompanied. Dr. Skae proposed a classification based on the belief that every mental disorder bears a relation to some bodily disease—acute or chronic—analogous to what the delirium of fever does to the fever in whose course it is manifested. The detailed list which he offered was, however, admittedly imperfect; and it is likely that any satisfactory classification on this principle will only be arrived at after a much closer study of the mental symptoms of disease than has yet been given to them. But Skae deserves the credit of having given the most powerful impulse to the purely medical, as opposed to the metaphysical, mode of studying insanity. In furtherance of this, some progress has been made by Clouston, Batty Tuke, and others, who have published careful monographs of some of the more prominent forms. If by such means we can group together conditions which are similar, not only in their mental but also in their physical characters, we obtain units which may ultimately contribute to the building up of a more perfect system, and which can never be altogether disregarded by classifiers in future. Most of the attempts which have been made to describe such groups must at present be regarded rather as valuable suggestions than as well-established clinical and pathological species. For the purposes of this work it has been considered best to describe in the present article, the various phases of insanity which have been regarded as of special importance, without regard to the principles which underlie their conception; and afterwards to discuss the various well-marked forms of the disease under their several heads, alphabetically arranged.

Prognosis.—The general prognosis of insanity will depend (1) on the duration of the existing disorder. Perhaps the best established fact of all is, that the chances of recovery diminish in direct proportion to the duration of the malady, and that it is consequently of the utmost importance to place a patient early under adequate and appropriate treatment. If a twelvemonth elapses without appreciable improvement, the chances are decidedly unfavourable. If delusions or hallucinations remain fixed and unchanged at the end of a year, especially if there be hallucinations of hearing, the prognosis is bad. The chief exception is where there is marked melancholia. Patients will recover from this after long periods; whereas such recoveries are seldom found in insanity when depression is absent. (2) When the cause of the insanity has been of long duration, the prognosis is less favourable than when it is a passing or accidental cause. (3) Is the prognosis unfavourable in hereditary insanity? So much of the so-called simple insanity is hereditary, that we must admit that recoveries from it are not infrequent, for it is from this simple insanity that recoveries chiefly take place. Hereditary insanity is brought about by very slight exciting causes, and thus the prognosis is often favourable, and recovery takes place; but relapse is to be feared, and the prognosis in a second or third attack is not nearly so good. In this hereditary insanity, too, we frequently meet with the cases of recurring and 'circular' insanity, the progress of which is most unfavourable. Both Ray and Griesinger have remarked that the prognosis in hereditary insanity is favourable only where the individual has previously been of normal mind. When he has always been eccentric or semi-insane, and undoubted insanity at last manifests itself, the prognosis is very bad. (4) The more acute the symptoms, the greater the cerebral disturbance and insomnia, the more favourable is the prognosis, if the case is recent. Conversely, the prognosis is bad when there is little bodily disturbance, where sleep is present, the appetite normal, and the secretions unaffected, especially if persistent delusions or an entire moral change are found. (5) As all deviation from the ordinary mental state and disposition is indicative of insanity, so any return to it is a favourable sign, however trifling the circumstances may be. (6) Improvement, however slow, is a good sign if it be progressive. So long as this goes on, recovery may take place; but many patients improve up to a certain point, and then go no farther. (7) The age of the patient must be considered. Young people recover in greater numbers than those advanced in life. The latter recover if their insanity be melancholia; but, if it be mania, with hallucinations and delusions, and obscene conduct and ideas, recovery is rare, especially if the memory is impaired, and signs of approaching dementia are present. (8) All periodicity in the disease, such as exacerbations and remissions on alternate days, is unfavourable.

Treatment.—Only a few general remarks on treatment will be offered here. Our objects should be to restore to health the disordered brain, to cause the incessant waste to cease, to promote a storing and not an expenditure of nerve-force. The brain must be nourished by healthy blood. The quantity of the latter when in defect must be increased; when its quality is in fault it must be improved; and when the blood-flow is in excess it must be checked; while all causes of disturbance reacting upon the brain from other organs of the body must be removed.

It is not to be forgotten that powerful effects are produced throughout the nervous system, both in the lower and higher centres, by what has been termed 'inhibition.' By the diversion of nervous action from one channel to another, considerable influence may be exercised.[1] Emotional excitement may be diverted into motor or intellectual channels; or, by other emotional stimuli, may be counteracted or arrested. Intellectual or ideational troubles may be diverted by emotional longings, or by counteracting intellectual pursuits. And for all this certain adjuncts are necessary. Painful emotional distress, with the idea of impending ruin, is perpetually fostered by the sight of the loved faces of wife and children: the patient must therefore be removed from them. Outbursts of anger are constantly directed against those most familiar, and delusions correspond. These must be abolished by his being placed among strangers. Great as is the need in many cases of medicinal treatment, it is not so universally demanded as is the removal of the sufferer to fresh surroundings. We try again and again, in apparently the most promising cases, to effect a cure at home, and we fail. The necessity for early treatment in insanity is dwelt upon by every writer; and the treatment, when insanity is once fairly established, only begins after the patient is removed.

The first questions to be solved are how the removal is to be effected; and to what place the patient is to be removed. In the majority of cases, especially in the case of the urban poor, no doubt can arise—an asylum is the only place open to them, because either the friends are poor and cannot afford any other plan of treatment, or are compelled to have recourse to the public asylums of the land. For many an asylum is necessary because the patient is dangerous to himself or others, or would incessantly struggle to escape from a less guarded dwelling. But there are some patients who may be cured out of an asylum. Some recover from acute but transitory attacks of delirious mania very rapidly, much as do the sufferers from delirium tremens, and, if measures of safety can be taken, we may watch such for a few days and perchance they may recover without removal. Many persons at the very outset of insanity may by removal and judicious treatment be cured, if their friends will only open their eyes and acknowledge the threatening evil, and not wait, as they so often do, till compelled by circumstances to interfere. Such patients must not be sent abroad or out of reach, must not go alone, or without able or skilled companions. They may go from place to place, or to a friend's or medical man's house. Fresh scenes and faces, and the cessation of work or worry, will often effect a cure. But they must be people able to walk out in public thoroughfares, and to live in houses under ordinary precautions. Where they cannot walk in public, and cannot live in a house without its being converted into a prison, they ought to go to an asylum, where there are grounds for exercise, and where facilities for escape are not always suggesting attempts. Patients' friends constantly make a mistake: they keep the patient out of an asylum at the time asylum treatment would cure him, and send him there when all hope of cure is over, and when, as a chronic lunatic, he would be just as well off out of one.

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[1] Dr. Lauder Brunton, on Inhibition. *West Riding Reports*, iv. 179.

With regard to medicinal treatment little need here be said. The drugs chiefly used in insanity are sedatives and narcotics. The writer has little faith in these, except for the purpose of obtaining sleep, and gives them only at night, except in the happily rare cases where life is in danger from want of sleep. To procure sleep no drug in his experience approaches chloral in value; and few are the cases where it is totally inefficacious. He has failed to observe the pernicious effects attributed to it by some writers, and the results both in severe and slight cases have been most satisfactory. In the melancholic and non-excited cases the preparations of opium are of great service, alone, or in combination with chloral. In excitement, bromide of potassium is valuable, alone, or in combination with chloral, Indian hemp, or henbane. Digitalis, alone, or with morphia, is highly spoken of by Drs. Robertson and Williams. Ergot of rye is efficacious, according to Dr. Crichton Browne, in recurrent and chronic mania; and the same physician extols the virtues of calabar bean in general paralysis.

Good and abundant food is an essential in the treatment of the insane: stimulants are required in many cases, particularly the depressed and anæmic forms, but in the opposite, though often useful, they in some cases produce or increase excitement, especially in the early stage. With the food tonics should be given, and those best suited are, in the writer's experience, the mineral rather than the vegetable, and chief of all the preparations of iron.

G. F. Blandford.

INSANITY, Morbid Histology of.—Up to the present time no definite and distinct lesion has been shown to accompany invariably any definite and distinct form of insanity, with the exception of general paralysis; it may, however, be considered an established fact that in every case, whether recent or chronic, a marked departure, or departures, from healthy conditions may be observed if properly sought for; but in what manner these lesions have influenced the character of the case in respect of its leading symptoms, mania, melancholia, or dementia, little as yet has been elucidated. Nevertheless, the nature of the morbid appearances is sufficient to account for perversion of functional activity, although we are unable to account for the peculiar nature of the perversion.

One great difficulty which presents itself to the mind of the cerebral pathologist is to determine whether the morbidities which are apparent on microscopic examination are of a primary or secondary nature, whether they have been efficient causes of insanity, or whether they are merely the results of mal-nutrition of the brain, and as such efficient causes of chronic lunacy. There exists an undetermined point in anatomy which, until settled, must leave the question to a certain extent open—that point is the presence or absence of cerebral lymphatics. When it is considered that the brain is an exceedingly active organ, performing many and various functions, and when it is further considered that it can obtain no vicarious aid in the performance of those functions—that it cannot, like the lungs, seek assistance from other systems—it must be at once apparent that the question of its possession of an overflow for getting rid of superfluous plasm and waste products is of paramount importance. Fohmann and Arnold demonstrated to their own satisfaction the existence of a system of lymphatics in the pia mater; and His, Obersteiner, and Boll believe that the pia-matral envelope of the cerebral arteries (hyaline membrane) exercises the function of a lymphatic duct. The very existence of such a sheath or envelope has been called in question, but comparatively slight study is needed to make its demonstration certain. Although differences of opinion exist as to its relations and manner of debouchement, we believe that it terminates by funnel-shaped openings into the spaces which exist over the sulci between the pia mater and the so-called arachnoid membrane. Kölliker[1] has pointed out that the connection between the pia mater and the arachnoid over the convolutions is so complete and perfect that only at parts, namely over the sulci, a distinct space can be shown to exist. It is questionable whether the arachnoid should not be considered to be merely the outer layer of the pia mater. The bearings of this point on pathological histology will be considered under the head of cerebral congestion; it would not have been alluded to were it not that it assists somewhat in the differentiation between primary and secondary lesions of the cerebral tissues.

In prosecuting the study of the morbid histology of the brain and spinal cord, two methods of investigation should be adopted:—1. The examination of the tissues in the fresh state; 2. The examination of the parts *in situ* by means of sections made after submission of portions of nervous tissue to hardening agents. The condition of the constituents of the recent brain can best be observed by colouring small specimens with rosaniline. The modern method of freezing, and section by means of the microtome designed by Mr. Bevan Lewis, has rendered the investigation of histological brain-changes a comparatively easy task.

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[1] Kölliker's *Histology*, Old Syd. Soc. vol. i. p. 450.

The Membranes.—The dura mater is, comparatively rarely, thickened by proliferation of its elements; the vessels are found to be irregularly dilated and tortuous, with thickening of their walls.

The arachnoid and pia mater are in such close anatomical relation on the convexity of the hemispheres, that they can be best described together. Between them, supported by a delicate connective tissue, lie the blood-vessels which dip into the sulci, carrying with them an investment of pia mater, which gives prolongations to accompany them when they pierce the cerebral substance, and forms the so-called hyaline membrane. Over the sulci are the spaces usually termed sub-arachnoid, which communicate with one another by conduits accompanying the vessels. The microscopic appearances of 'milky arachnoid' have not been thoroughly described; both membranes are often thickened, presenting a laminated appearance, and the connective tissue supporting the blood-vessels is considerably increased, as well as the pia-matral prolongations accompanying the blood-vessels into the cerebral substance, which loses its hyaline character, and becomes distinctly fibrous. Extensive but thin blood-clots are occasionally found between the arachnoid and pia mater, while more rarely extravasations of blood are found between the pia mater and the cerebral substance. Deposits of hæmatoidin often surround the vessels, and their coats are frequently hypertrophied. Crystals of triple phosphate have been seen on the visceral surface of the pia mater. Lymph has been found between the pia mater and the spinal cord; the membrane was thickened, and internal to it were numerous distinct laminæ of a finely fibrillated material, in some places $\frac{1}{200}$ of an inch in breadth. In one case there was long-standing epilepsy, in the other chorea, both being complicated by insanity.

The Epithelium. — The ground-glass appearance frequently seen in the ependyma of the ventricles is due to three different morbid conditions, which are, in the order of their frequency, proliferated epithelium, lymph-exudations, and crystalline deposits.

When change in the epithelium is the cause of the granulations, a vertical section shows simply a proliferation of cells projecting into the ventricle, like villi.

When lymph-exudations have pushed the ependyma upwards, it presents the appearance of rough, irregular, bullæ-like nodules, consisting of the layer of proliferated epithelial cells, and a greenish homogeneous stroma, which together overlie the pia mater; the same material can be frequently seen infiltrating the subjacent cerebral tissues. Deposits of phosphate of lime have been recorded as occurring beneath the ependyma of the lateral ventricles in general paralysis, and Bergmann discovered a formation of pretty large crystals of 'double phosphate' in both plexus choroidei in a case of 'mania with mental weakness' (Griesinger, *New Syd. Soc. Trans.*, p. 429).

A proliferation of the columnar epithelium of the central canal of the medulla oblongata is not unfrequent, causing its occlusion.

The Nerve-cells.—The changes in the nerve-cells are most marked in the anterior two-thirds and superior parts of the hemispheres, as in this situation they are usually most numerous and large in size. In the depending portions of the hemispheres and the occipital lobe few, if any, changes have been noticed.

The special morbid conditions of the nerve-cells are:—α. Atrophy; or pigmentary, granular, or fuscous degeneration. β. Hypertrophy. γ. Calcification.

Pigmentary, fuscous, or granular degeneration is a very common condition in many forms of insanity, particularly senile insanity and general paralysis, and is probably to some extent a normal senile change. Dr. Major distinguishes three stages:—1st. The cells lose their sharply defined triangular contour, and become swollen or inflated in appearance; the process running towards the periphery of the convolution usually remains distinct, but the other processes disappear, and the cell becomes rounded off; the nucleus becomes swollen and more or less round or oval, and the nucleoli are seen with great distinctness. 2nd. A deposit of granules takes place, either external to the cell and pressing upon it, or in its interior, until it becomes more and more yellow and opaque; or both these conditions may occur together. 3rd. The cell goes on to destruction, breaking down and shrinking, leaving the nucleus surrounded only by a mass of granules, and forming a gap in the cerebral tissue formerly occupied by the swollen cell; still later the granules entirely disappear, leaving the nucleus free. He has not observed the nucleus actually undergoing disintegration, but often no trace of it is to be found in the mass of granules left by the degenerated cell.

Hypertrophy of the large pyramidal cells of the inner layers has been observed in senile atrophy and general paralysis; as the name implies, they are large, abnormally distinct and swollen in apperance, often presenting granular masses in their interior; the processes are increased both in size and number; and the angles of the cells may be greatly prolonged or swollen and stunted.

Calcification of the cells by the deposit of phosphate of lime within their walls has been observed, according to Blandford.

The Nerve-fibres.—The chief changes in nerve-fibres, apart from their disintegration by apoplexies, softenings, &c., are coarseness, irregularity and twisting of outline, and their power in the fresh state of resisting pressure under a covering glass, some becoming readily ampullated. They may be affected by a pigmentary degeneration similar to that occurring in the cells; and finally they may present fusiform or oval swellings, which tint strongly with carmine, and give rise to the appearances known as amyloid bodies.

Special Morbid Conditions of the Grey Matter.—In many subjects when the pia mater is thickened and hyperæmic, a condition of the grey matter closely resembling grey degeneration in the white matter is often found; it differs from the latter by the absence of proliferated nuclei, and is strongly suggestive of lymph-infiltration, which has gradually caused atrophy and absorption of the normal structures. Circumscribed spots of yellow softening show under the microscope ragged fibres, colloid bodies, and granular corpuscles at the base of the diseased tract.

Local atrophies of the convolutions are pretty common; under the microscope a thin layer of indurated grey matter, presenting no trace of normal structure, may be found; in other cases there is simple absence of the grey matter, the white matter in both being unaffected.

The Neuroglia.—This substance undergoes inflammatory changes of a sub-acute or chronic nature, with the results of which we are familiar as more or less diffused *sclerosis*. Together with the other elements of the cerebral tissues, it undergoes atrophy in the brain-wasting of senility, and especially of senile dementia; it is also liable to special forms of degeneration, which have been called miliary sclerosis and colloid degeneration, though those terms are somewhat misleading, as the changes in question differ entirely from those generally described by these names.

General sclerosis has only been observed in one case, which is fully detailed in the *Journal of Anatomy and Physiology*, May, 1873. In a hydrocephalic epileptic idiot (whose brain weighed sixty ounces) the hemispheres varied in weight; the left being 23¾ ounces, the right 30¼ ounces. In the heavier or hypertrophied side, the nerve-fibres were found lying in fasciculi consisting of from four to six strands; these fasciculi were separated from one another by a clear, finely-fibrillar plasm, in which nuclei existed, somewhat larger than normal.

Disseminated or *partial sclerosis*, or *grey degeneration*, is a lesion frequently met with in the brains of old-standing cases of insanity, especially in general paralysis. Its most frequent seat is the white matter of the motor tract; less frequently it is met with in the hemispheres. In the pons varolii, medulla oblongata, and spinal cord of epileptics, patches of this disease are of common occurrence and in an extreme degree. When a fine section of nerve-tissue affected by this disease is examined by the naked eye, circumscribed opaque patches can be seen; in coloured sections these tracts are strongly tinted; as a rule, they are found contiguous to a vessel whose nuclei are much proliferated, and around which considerable proliferation of the nuclei of the neuroglia exists. Under the microscope, the nerve-fibres are seen to be partially or completely atrophied; the axis-cylinders and sheaths are destroyed; and the field is occupied by a finely molecular and fibrillated material, imbedded in a cloudy homogeneous plasm. In this matrix the proliferated nuclei exist, somewhat enlarged, sometimes slightly granular in appearance; but around the implicated spot they are to be seen in much greater quantity, and not actively diseased. The atrophied nerve-fibres occasionally project raggedly into the grey matter, where they are lost. Rokitansky believes this to be essentially a primary increase of the neuroglia. Leyden thinks it occurs secondarily to the atrophy of nerve-fibres; while Rindfleisch and others are of opinion that the first stage is marked by proliferation of the nuclei of the vessels, which is followed by an increase of the neuroglia, and the development of a morbid plasm, which is, in all probability, modified neuroglia.

Miliary sclerosis.—For the full details of this remarkable lesion the reader is referred to the *Edinburgh Medical Journal* for September, 1868, and to the *British and Foreign Medico-Chirurgical Review*, July, 1873. The following is a short account of its principal features. It is not confined to any one class of mental disease, but has been found best marked in cases accompanied by paralysis or epilepsy. It differs from all other lesions termed sclerosis in not being preceded, attended, or followed by proliferation of the nuclei; it is a circumscribed lesion, occurring in patches from $\frac{1}{40}$ to $\frac{1}{1500}$ of an inch in length, not involving surrounding tissues, except by displacement, diffusing no morbid plasm beyond its own area, and not connected with the blood-vessels. It is essentially a disease of the nuclei of the neuroglia, and its progress is marked by three stages:—1st. A nucleus becomes enlarged, and throws out a homogeneous plasm, of a milky colour and apparently of a highly viscid consistence, forming a semi-opaque oval spot, usually unilocular; but by aggregation the spots may be bilocular, or, more rarely, multilocular. In the centre of these spots a cell-like body containing a nucleus is discernible—the original dilated nucleus of the neuroglia. 2nd. The morbid plasm becomes distinctly molecular, and permeated by fine fibrils; as it advances, the plasm round the periphery of the spot becomes more dense, and a degree of absorption of the nerve-fibres around it takes place. 3rd. The molecular matter contracts on itself, becomes more opaque, and often falls out of the section, leaving ragged holes.

Colloid degeneration may be either a primary or a secondary product, that is to say, there is reason for believing that in certain forms of insanity it is the primary pathological change, and that it is also to be met with in the brains of chronic cases as a result of long-continued perverted vascular action. It has been produced artificially in the brains of pigeons by incising them and allowing the wound to heal. This degeneration should be searched for in recent specimens. It consists of round or oval bodies, from $\frac{1}{4000}$ to $\frac{1}{3000}$ of an inch in diameter, bounded by a distinct wall containing a homogeneous, transparent, and colourless plasm; sometimes it is somewhat granular. The general appearance of a section may be compared to a slice of cold sago-pudding; it cannot be coloured by carmine. The condition may be regarded as a degeneration of the nuclei of the neuroglia, and is found in both grey and white matter.

The Blood-vessels.—When we examine an injected preparation of the substance of a cerebral convolution, and witness the perfection and delicacy of its circulatory apparatus; and when we reflect on the results of the phenomena of congestion, stasis, and anæmia on the functions of other organs; we have little difficulty in comprehending the influence such conditions must have upon the highly complex elements which make up the organ of the mind. It is certain that in most cases of recent insanity, disturbance of the cerebral circulation is one, if not the essential, pathological factor; and if such disturbance is of long continuance, permanent lesions of cells, fibres, and nuclei, and, as a consequence, chronic insanity in some form, must result. The examination therefore of the cerebral vessels is of primary importance.

The following is the method of examination adopted by the writers:—After noting the degree of engorgement or anæmia in the centrum ovale, and whether on section the vessels are dragged out by the knife, vessels of moderate size should be dissected out and carefully washed with camel's-hair brushes, and then submitted to the microscope. By this mode of procedure the following changes may be discovered:—(*a*) Thickening or degeneration of one or other of the coats. (*b*) Thickening of the sheath or hyaline membrane. (*c*) Deposits between the adventitia and the sheath. (*d*) Proliferation of the nuclei.

(*a*) *Thickening or degeneration of the coats.*—The *inner fibrous* coat has been found thickened and more fibrous than in health. The *muscular coat* is often hypertrophied, especially the circular fibres; it is best marked in general paralysis and epilepsy. The *adventitia* is occasionally thickened. The whole of the coats sometimes undergo a hyaloid or vitreous change, which is probably allied to lardaceous disease.

(*b*) The *hyaline membrane* or *sheath* is often thickened and fibroid, enveloping the artery in a loosely sacculated manner.

(*c*) *Deposits* between the adventitia and the sheath are of two kinds; but neither is peculiar to insanity, being found in the brains of persons who have died of fever or Bright's disease with cerebral symptoms. The first is a finely molecular material of a pale yellow tint, or more often colourless, closely resembling in appearance the spores of the Favus fungus, and refracting light highly; it undergoes no change when treated with the ordinary oil-tests, and is found on the smallest capillaries. The particles vary in size from $\frac{1}{4000}$ to $\frac{1}{7000}$ of an inch. The second form of deposit consists of irregular crystals of hæmatoidin distributed pretty equally over the vessels, except at the bifurcations, where they are aggregated.

(*d*) *Proliferation* of the *nuclei* usually accompanies proliferation of the nuclei of the neuroglia; they do not seem to increase to the same size as those of the neuroglia, but become oval or irregular in shape.

Fine sections of hardened tissues are necessary for the demonstration of the following vascular changes:—(*e*) Abnormalities in direction. (*f*) Dilatation, microscopic aneurisms, and apoplexies. (*g*) Perivascular spaces. (*h*) Syphiloma.

(*e*) *Abnormalities in direction* may take the form of extreme tortuosity or actual thickening; these are usually evidences of congestion, but may under certain circumstances be produced artificially.

(*f*) *Dilatation, microscopic aneurisms, and apoplexies.*—Ecker, Romaer, and Major have found a general dilatation of the small vessels in mania and 'brain-wasting.' MM. Bouchard and Charcot have carefully described the appearances of microscopic aneurisms; they are usually fusiform, more rarely sacculated, measuring $\frac{1}{30}$ to $\frac{1}{40}$ of an inch in length, their breadth being one-fourth of their length. These authors describe a thickening of the fibrous coats, with proliferation of the nuclei, and atrophy of the transverse muscular striæ. Drs. Bastian and Blandford have described a thrombosis of the minute vessels by masses of white corpuscles occurring in mania and delirium.

(*g*) *Perivascular spaces.*—In subjects who have been liable to cerebral congestion the vascular canals are often distinctly dilated, to an extent several times the calibre of the vessels; the brain-substance bounding them is condensed.

(*h*) *Syphiloma* of the cerebral arterioles is characterised by the formation of a plastic deposit around their walls, which becomes converted into fibrous tissue, and gives to their transverse sections an enormously hypertrophied and concentric appearance, going on to almost complete occlusion of the canals.

Tumours.—Tumours have been met with in some cases of insanity, but as no growth peculiar to insanity has been described, it is unnecessary to enter into their description.

The Spinal Cord.—Microscopic examination of the spinal cord has not revealed any lesion peculiar to the various forms of insanity, excepting general paralysis. Drs. Westphal, Meredith Clymer, Boyd, and others are of opinion that in this disease well-marked departures from health are to be found. The first-named pathologist describes an atrophied condition of the cells of the posterior columns, with increase of their connective tissue, commencing externally and extending inwards; he also believes in a chronic myelitis affecting the posterior columns and the posterior sections of the lateral columns. As far as the writers have been able to observe, this is by no means an invariable accompaniment of this disease, although in one case it was undoubtedly present. The cells of the cord were in most instances undergoing fuscous granular degeneration, like those of the hemispheres.

The Sympathetic System.—The sympathetic ganglia undergo a pigmentary degeneration in various forms of cerebral disease.

J. Batty Tuke.
Robert Saundby.

INSANITY, Varieties of.

—In this article various forms of insanity will be described under separate heads. Dementia, General Paralysis of the Insane, Mania, and Melancholia will be found in other parts of the work.

1. **Alcoholic Insanity.**—The conditions included under this head must not be confounded with what is called dipsomania. In the latter affection the indulgence in alcohol is a symptom, and not necessarily a cause; while here the insanity is always a direct result of some form of alcoholic poisoning. It is met with in three forms, namely, *acute alcoholic insanity*, *chronic alcoholic insanity*, and *delirium tremens*.

Acute alcoholic insanity seldom occurs except when there is a strong hereditary tendency to mental disturbance, or when the cerebral energies have been notably impaired by excesses or overwork. Where all these predisposing causes exist, it may not require a large dose of alcohol to bring on an attack. The most frequent form of the affection is violent maniacal delirium, known as *mania a potu*, with a tendency to homicidal acts. In some cases the mental disorder takes the melancholic form, and it becomes necessary to guard specially against the strong suicidal tendency which generally characterises it. Unless the brain has been weakened by repeated attacks, both forms are curable and generally of short duration. The treatment is the nourishing, non-stimulating regimen detailed in the articles on Mania and Melancholia.

Chronic alcoholic insanity is one of the results of chronic alcoholism, and there is no condition which better illustrates the 'solidarity of the psychical and somatic functions of the nervous system' and the interdependence of their morbid manifestations. The physical symptoms are fully described in the article on ALCOHOLISM; the mental symptoms are generally present from the beginning, though not always prominent enough to attract special attention. The sleeplessness, so characteristic of commencing mental disorder, is an early symptom; then restlessness and depression, with suicidal tendency, sometimes passing rapidly into complete dementia, but generally passing gradually through a course of moral and mental degradation, which progresses step by step with the symptoms of failure of physical nervous power. The affection presents many points of resemblance to general paralysis of the insane, and is in some cases only to be distinguished from it by obtaining evidence of alcoholic poisoning, and by the persistence of the mental depression, which is seldom more than a transitory symptom in the general paralytic.

Delirium tremens is described fully under the heading of ALCOHOLISM; but it is proper to note here that after the acute symptoms of that disease have passed away, there is sometimes left behind a state of subacute insanity of a characteristic nature. At first suicidal symptoms are apt to appear. Suspicions of poisoning, fear of impending evil, and hallucinations of hearing are also frequent. The treatment required is constant companionship of a trustworthy attendant, exercise, fresh air, and change of scene, with attention to every ordinary means of restoring the functions to a healthy state. Under proper treatment the prognosis is favourable.

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2. **Amenorrhœal Insanity.** — Mental derangement is often accompanied in females by suppression of the menses. But in many such cases the insanity cannot be called amenorrhœal, as the cerebral and uterine disorders may only be associated as both symptomatic of some debilitating cause affecting the whole system. Then the mental condition is usually the depression produced by anæmia. But there is a mental derangement directly resulting from sudden suppression of the catamenia, to which this distinctive name is not inaptly applied. Here the insanity takes the maniacal form. It is sometimes ushered in with urgent febrile symptoms, in which case the mania assumes the acutely delirious character. Where general febrile disturbance is not prominent, the mental condition is more simply maniacal, and sometimes does not get beyond mere irritability with delusions. The pathological condition must in either case be regarded as mainly a hyperæmia of the brain.

TREATMENT.—This must be directed towards the restoration of the arrested discharge. If the patient be seen at the commencement of the attack, the hip-bath and a gentle purgative may recall it. If the menstrual period has passed, the attention of the practitioner must be devoted to the relief of the more urgent symptoms. If the symptoms of cerebral congestion are distinct, leeches will probably be found useful. Regular action of the bowels should be secured, but active purgation should be avoided. The food ought to be easy of digestion, and care should be taken not to let it be deficient in quantity. If the mental excitement is great and long-continued, it will necessarily produce considerable exhaustion, and the condition of the patient after recovery from the mental excitement will depend very much on the extent to which the strength has been supported during the continuance of this strain. The re-appearance of the catamenia generally implies recovery of mental health; but cases occur where prolonged amenorrhœa leads to a chronic maniacal condition, ultimately passing into hopeless dementia.

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3. **Choreic Insanity.**—There appears to be an intimate connection between the pathological basis of chorea and a certain disturbance of the mental functions. The physical and the mental symptoms however do not necessarily correspond in intensity. Sometimes where the convulsive symptoms are very severe, the mental condition is merely one of dulness, apathy, or irritability. In children it shows itself generally in a maniacal restlessness, accompanied by delirium of a peculiarly automatic character. It is frequently associated at all periods of life with the rheumatic condition, and hence it has by some authors been called rheumatic insanity. It generally commences with sleeplessness and delirious excitement of a remittent character, which is sometimes accompanied by violent convulsive effort. As the excitement passes off, delusions of suspicion are apt to arise, and these are strangely associated with an apathetic mental condition. In the acute form the prognosis is favourable, recovery generally taking place in from four to eight weeks. The chronic form is apt to pass into dementia.

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4. **Epileptic Insanity.** *See* EPILEPTIC INSANITY.

5. **Feigned Insanity.**—Insanity may be feigned in order to escape the obligation of duty, or the consequences of crime. If manifested at a time when its recognition might be a benefit to the individual, it becomes necessary to test its reality. It must not be rashly inferred in any case that insanity is feigned; for it sometimes results from the excitement consequent on a sense of guilt or

the shock of a false accusation; or it may arise coincidently but independently of such conditions. The best preparation for making a satisfactory examination in such a case is a familiar acquaintance with the appearance and conduct of persons undoubtedly insane. A person feigning insanity must, to be successful, simulate some known form of the disease; and as each form presents a more or less definite group of symptoms, an impostor is apt to reveal the truth by omissions or by additions inconsistent with the part that he attempts to play; but the mistake generally made by the impostor is to over-act the part. The inquiry may, of course, assume various aspects. A person may pretend to have been insane *at the time* a certain act was committed. Here it is to be remembered that the insanity, if real, would not probably have been confined to the time of the commission of the crime; and some evidence of premonitory symptoms previous to the act would probably be found. In such cases it is proper to regard want of motive as so far an indication of insanity; but when the supposition of a sudden mental perturbation is put forward, some reason would have to be shown for its occurrence; and some history of the occurrence of cerebral injury, or of previous attacks of insanity, epilepsy, or other cerebral affection ought to be forthcoming. A person feigning to be insane *at the time he is examined* must endeavour to present symptoms of either mania, melancholia, monomania, dementia, or imbecility. When the symptoms arise suddenly, simulation of the maniacal condition is generally attempted. The exertion which this entails will, however, generally compel an impostor to exhibit symptoms of fatigue, and even to sleep, when the true maniac would exhibit persistent excitement. The raving also when feigned may be recognised as hesitating and premeditated. Forgetfulness, which is generally assumed by the impostor, is an unfrequent symptom of mania, except when it occurs in the course of general paralysis, and this is a disease whose other symptoms could scarcely be simulated. If melancholia or monomania be feigned, the chief facts to be borne in mind are that such conditions, when real, are very unlikely to arise suddenly where there are no symptoms of bodily disease to account for them; and that they are usually characterised by a tendency to conceal peculiarities, or at least not to push them ostentatiously forward. Dementia never occurs suddenly without evident cause. A class of cases occur in which insanity is only partially feigned. Young criminals frequently try to exaggerate the signs of the intellectual weakness which is so generally mingled with their moral depravity, in hopes of obtaining a relaxation of discipline, or a transference from a prison to an asylum. Such cases are often full of difficulty. The principle which ought to regulate our action is to avoid the continuance of punishment when disease or deficiency renders it useless. Before deciding upon the reality of any doubtful case of insanity, all the physical conditions of the individual, such as the amount of sleep, the state of the pulse, skin, tongue, and digestive system generally, the conduct and the state of health immediately preceding the signs of insanity, should be ascertained. The effect of remarks made within hearing of the suspected person should be observed; one who proclaims his own insanity should be distrusted. And the medical history of the family and of the individual should be inquired into, with a view to disclose anything which might have caused insanity or predisposed to it.

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6. Gastro-Enteric Insanity. — The emotional condition is well known to be to an appreciable extent dependent on the state of the *primæ viæ*; and where the nervous system is predisposed to derangement, certain affections of the stomach and bowels seem sufficient to produce insanity, and to stamp it with a special melancholic character. In addition to the mere depression caused by anæmia, there is associated with such affections a peculiar anguish of mind, and tendency to self-accusation, which is often of the most distressing nature. Refusal of food is frequently a prominent symptom. The intellectual perversion is often slight, and seldom so prominent as in other acute insanities. Relief of the bodily symptoms is generally accompanied by a return to sanity. The affections which have been most frequently observed to produce this form of melancholia, are irritation and catarrh of the mucous membrane, constipation, stricture or other causes of distension of the viscera, and pressure upon the stomach or intestines by tumours in the epigastric region. Schroeder van der Kolk described the mental symptoms as being always due to affections of the colon; but disease of other portions of the canal—as the rectum and anus—seems also to produce them. John Sibbald.

7. Hereditary Insanity.—Synon.: Fr. *Folie héréditaire*; Ger. *Erbliche Geisteskrankheit.*—This implies insanity symptomatic of hereditary weakness of the nervous system, generally coming on without the intervention of appreciable exciting cause.

The nervous system seems to be peculiarly liable to be involved in the effects of hereditary degeneracy, and this is frequently evinced by the occurrence of mental symptoms. The ages at which these are developed, and the character which they exhibit, depend both on the nature and on the strength of the hereditary disposition. The forms of insanity, however, which seem to be most directly the result of hereditary influence, generally make their appearance at those periods of life when either rapid structural development takes place, special functional activity is first exhibited or is ultimately arrested, or upon the advent of senile decay. The ordinary exciting causes of insanity may also affect persons at these periods, and in such cases the resulting disorder will be stamped more or less distinctly with the impress of its origin. But where these forces do not come powerfully into play, it is found that hereditary insanity exhibits a special character according to the period at which it is developed. We have thus an *insanity of pubescence*, a *climacteric insanity*, and a *senile insanity*. Idiocy and imbecility (which will be found discussed under their respective heads) are also frequent results of hereditary weakness, showing itself during fœtal life, or during the period of dentition; and the mental derangements which often affect women at parturition, and during the processes which precede or follow it, seem to occupy a position in the pathological scale intermediate between the hereditary and the accidental form of insanity.

Insanity of pubescence is a condition not unfrequently met with, and one which it is very important to recognise early in its true character. Much unintentional injury is frequently done by the patient being at first regarded as a delinquent and treated accordingly, instead of receiving the careful management suitable to the disease. The affection is characterised by great disorder of the emotional and moral nature, which is evinced by restless though seldom violent excitement, eroticism, acts of purposeless mischief, and exhibitions of inordinate vanity. Any marked change of disposition during the passage from youth to adult life ought to be regarded as probably pathological in its nature, and must be carefully watched. Persistent sleeplessness at such a time must also be regarded as significant of danger to the mental functions. The physical condition is indicated by capricious appetite, and symptoms of anæmia. The treatment required is rest to the mind, both in its intellectual and emotional energies, with cultivation of everything likely to develop physical vigour. If the hereditary tendency is not exceptionally strong, or aggravated by accidental causes, the prognosis is not unfavourable.

Climacteric insanity occurs in males between the ages of fifty and sixty, and in females between forty and fifty. Its general character is a form of melancholia, gradual in its development, manifesting itself in loss of sleep, fear of undefined evil, religious despondency, hallucinations of the senses, refusal of food, and frequently in a suicidal tendency. Excitement and exaltation occur rarely, and are generally of short duration. The mental disorder is frequently accompanied by very marked emaciation, and the tendency is always to anæmia. The treatment required at the commencement is cessation of mental labour and change of scene. During the whole progress of the disease the diet should be full and nourishing, and the digestive functions often require to be stimulated to healthy action. In the majority of cases the prognosis is unfavourable, and where recovery does not take place within one or at most two years the course is generally towards dementia.

Senile insanity is essentially a form of dementia, which comes on gradually in persons who have passed through the earlier periods of life without disturbance of their mental health, but who break down in old age. Its principal features are loss of memory, slight excitements, whimsical likings and dislikings, querulousness, and a gradual decadence into fatuity. It is subject to occasional remissions, which are sometimes very short, as when caused by the stimulus of acute febrile conditions. But they are sometimes so prolonged as to amount practically to recovery. Not infrequently the breakdown of the nervous system pursues a rapid course, and in such cases there is often a marked similarity in the symptoms to those of general paralysis. Both mental and physical conditions in the advanced stages of each are sometimes practically indistinguishable. The diagnosis will depend on whether the characteristic first stage of general paralysis has been observed at the commencement, or only a gradual loss of physical and mental power. Paralytics, moreover, are seldom of advanced age.

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8. **Impulsive Insanity.**—Violent acts are committed under an insane impulse by numerous patients whose insanity is plain and acknowledged. They may be done under the influence of delusions or hallucinations, but the term *impulsive insanity* is commonly applied to a disorder manifested, not by delusions and similar symptoms, but by acts of violence to which a patient is driven by blind, uncontrollable, and morbid impulse, whereby the will and the reason are overpowered for a longer or shorter time. These are for the most part acts of *suicide* or *homicide*; and in connection with the latter, great controversy has arisen as to the responsibility of persons committing them. Here, as in moral insanity, there are no delusions; frequently no change will have been detected in the individual prior to the act, nor will there be observers of it. And it is a fact that the impulse may be satisfied and exploded in the act, and having thus found a vent may be felt no longer, at any rate for a time. It may be as sudden as an epileptic fit, and may, like the latter, bring relief to the brain. Indeed, there is a strong connection as well as analogy between the two disorders, and, as Dr. Maudsley says, instead of a convulsive movement there is a convulsive idea.

In estimating such acts as these we must not only consider the act itself and the manner of its performance, but must also closely inquire into the past history of the perpetrator and his progenitors. For all this we may or may not have opportunity. If the act is one of attempted suicide, and the individual is kept under observation, we may have no difficulty in diagnosing insanity. If it is one of homicide, and the criminal is in prison for, perhaps, only a week or two, opportunity of ascertaining the history of his family may fail, nor will he himself be under skilled observation. Moreover the period just after the committal of an impulsive homicide will very probably be the one in which fewest symptoms of insanity will be noticeable. The period immediately preceding it will be that which most closely demands a scrutiny, but we may be able to get no information if the accused has been moving from place to place, has been among strangers, or has had those about him who were obtuse and unobservant. Many an act of suicide and homicide would be prevented if the friends would not shut their eyes with such pertinacity to the strange and altered looks and conduct of the patient. But in this impulsive form, although there may not have been enough to warn those about a man to restrain him, there may have been symptoms which are sufficient subsequently to indicate to a physician the presence of mental disorder. There may have been attacks of *grand mal* or *petit mal*: there may have been former attacks of insanity, periods of, it may be, slight depression, which, though they may have attracted little notice at the time, may indicate an insane diathesis. The sufferer may have been sleeping badly or have taken less nourishment than usual.

The medical witness will, in the case of homicide, carefully examine and pay special attention to the following points:—

(*a*) The nature and character of the act must be noted. The presence or absence of motive may often assist us. When the victim is near of kin and dearly loved, suspicion of insanity will at once arise. When, on the other hand, it is a perfect stranger, never before seen, where there has been no previous meeting or quarrel, the same suspicion will arise. The method of the act may guide us somewhat, but not so much. There may be premeditation, though generally there is not.

(*b*) The demeanour of the prisoner after the act may assist us. Were there, or were there not, attempts to conceal it, or to escape detection and arrest? What was said in explanation? It sometimes happens that there is complete unconsciousness or forgetfulness of what has occurred, and we may then strongly suspect the presence of epilepsy.

(*c*) We must closely inquire into the family history, and shall often find that in cases of impulsive homicide, the family of the accused is saturated with insanity. And where this is so, we may also find that from youth the accused has been deficient and weak in intellect, or odd and eccentric. The weak-minded, in fact, may be grouped in a special class of homicides. As there is a weak-minded moral insanity, so there is a weak-minded impulsive homicidal insanity the sufferers from which have not unfrequently been hanged, their insanity not having been sufficiently marked to absolve them from legal responsibility. Fits in childhood may contribute to this state. And throughout, at the age of puberty, or in adult life, there may be slight but sure indications of the insane blood that has been inherited, which are displayed in an impulse to homicide or suicide, even as in others the tendency is shown in ordinary attacks of insanity.

(*d*) We must look very closely for symptoms or a history of epilepsy. Such indications as nocturnal micturition or a bitten tongue may guide us to the truth, while in acknowledged epileptics it may happen that the homicidal attack takes the place of the ordinary convulsion, and without the occurrence of the latter there may be a period of unconsciousness and unconscious action lasting, perhaps, for days. *See* Epileptic Insanity.

The occurrence of one homicidal attack of a strange or anomalous character may make us fear its recurrence, and when we have to examine a criminal who has committed one act of this kind, it is important to inquire whether he has ever at any former time done any sudden act of violence of a similar description. For this reason such patients should not be released from an asylum, except under great and special precautions.

G. F. Blandford.

9. Legal Insanity.—Lawyers regard insanity from a different point of view from medical men. A medical man applies his mind to its study so as to ascertain how far he may infer from the evidences of mental action the existence of morbid conditions which he may hope to alleviate or remove. It is therefore his duty to be acquainted with such symptoms as give the earliest indication of the approach or development of these morbid processes. For it is during their initiatory stages that he may most successfully intervene with the resources of his art, to check their progress or to ward them off. He therefore identifies with the existence of disease, every deviation from the healthy mental standard which indicates the necessity for medical treatment or advice. A lawyer, on the other hand, takes note of insanity only in so far as it affects the safety of person or the preservation of property. The question which he seeks to determine is whether a person is justly responsible for certain acts which he has committed, or is competent to perform certain acts which he may be called on to perform. It is evident, therefore, that the legal view of insanity must naturally be much more limited than the medical. 'A lawyer, when speaking of insanity,' says Mr. Justice Stephen, 'means conduct of a certain character; a physician means a certain disease one of the effects of which is to produce such conduct;' and though this has been adversely criticised it seems to show correctly the directions in which the two views diverge. They might perhaps be as fairly indicated in other words if we say that the lawyer has to deal with the nature or quality of certain acts, while the physician has to deal with the condition of certain persons. No satisfactory general definition of legal insanity has been given. In the earlier ages of our legal system none but the most outrageous cases of insanity were recognised. Bracton in the thirteenth century defined a madman as 'one who does not understand what he is doing, and, wanting mind and reason, differs little from brutes.' Sir Edward Coke, though he recognises different classes, according as the insanity is congenital, permanent, or temporary, only admits that a person is insane when he is *non compos mentis*, or has wholly lost his memory and understanding. Sir Matthew Hale, in the seventeenth century, was the first to recognise the existence of less extreme forms of insanity. 'Some persons,' he said, 'that have a competent use of reason in respect of some subjects, are yet under a *particular dementia* in respect of some particular discourses, subjects, or applications; or else it is partial in respect of degrees, and does not excuse persons who commit capital acts in this state.' He also said that it is 'very difficult to define the invisible line that divides perfect and partial insanity,' and 'that most persons that are felons, of themselves or others, are under a degree of partial insanity when they commit these offences.' The recognition of these gradations, reaching even to the mutual overlapping of crime and insanity, indicates as much breadth of view as could be expected at a time when the very judge who recognises them passed sentence of death on persons convicted of witchcraft. We cannot doubt, indeed, that at that period the ignorance of the nature of insanity was such that many lunatics were executed for this offence. The recognition of the necessity of taking legal account of minor degrees of insanity than 'furious madness' or idiocy may be said to commence at the beginning of the present century. The mode in which unsoundness of mind comes into relation with law at present, may be looked at most conveniently from three points of view:—1. Where a person suffers from such unsoundness of mind that it is necessary for his welfare, or the safety of the public, that his liberty should be restricted by his being placed in an asylum or subjected to similar restraint. 2. Where a person suffers from such unsoundness of mind that he is incapable of managing himself or his affairs. 3. Where irresponsibility for crime, on account of insanity, is pleaded in a court of law. It will be found more convenient to consider these three relations of insanity and jurisprudence separately. The reader is consequently referred to the articles specially devoted to them, which will be found under the heads of LUNACY, LAW OF; CIVIL INCAPACITY; and CRIMINAL IRRESPONSIBILITY.

JOHN SIBBALD.

10. **Moral Insanity.**—SYNON.: Fr. *Manie sans délire*; *Folie raisonnante*; *Monomanie affective*; Ger. *Gemüthswahnsinn*.

Under the names of *moral insanity*, *emotional insanity*, *impulsive insanity*, *affective insanity*, has been described the disorder of certain patients, which is manifested by insane actions and conduct rather than by insane ideas, delusions, or hallucinations. Such persons are sometimes said to be of whole and perfect intellect, though unsound in the moral and emotional part of their brain. They come under the notice of medical men, not so much for purposes of treatment as for diagnosis. Their conduct being chiefly displayed in foolish or violent acts, they require to be restrained, and the question arises: Is this conduct badness or madness? are they responsible for it or not?

Dr. Maudsley gives *moral insanity* and *impulsive insanity* as two subdivisions of *emotional* or *affective insanity*; and, as the symptoms are certainly different, we cannot do better than consider them under separate heads. But certain observations are applicable to both. In neither will there be found delusions, and as delusions are, in the opinion of some, especially lawyers, necessary to the establishment of legal insanity and irresponsibility, these patients are not legally insane. Another remark is that this moral or impulsive insanity does not constitute a definite and well-marked disease, like acute delirium or general paralysis. Every patient may at one time or other be 'morally insane,' that is, may not have reached the stage of delusions, or may have recovered from it, and every patient may commit 'impulsive' acts of violence, whether his insanity is displayed in other ways or not.

By *moral insanity* is to be understood a disorder of mind shown by an entire change of character and habits, by extraordinary acts and conduct, extravagance or parsimony, false assertions and false views concerning those nearest and dearest, but without absolute delusion. Such a change may be noticed after any of the ordinary causes of insanity. It may follow epileptic or apoplectic seizures, or may be seen after a period of drinking. Its approach is gradual, as a rule, rather than sudden, and the extraordinary character of the acts may not at first be so marked as subsequently. Friends wonder that a man should say this or that, or should do things so foreign to his nature and habits, but some time may elapse before they can convince themselves that such conduct is the result of disease, and the acts may be such that many will look upon them even to the last as signs merely of depravity. Such insanity of course varies in degree. When it is well marked, and the conduct is outrageous, there will be no difficulty in the diagnosis. But it may be less marked; it may consist of false and malevolent assertions concerning people, even the nearest, of little plots and traps to annoy others, in which great ingenuity and cunning may be displayed. And there will be the greatest plausibility in the story by which all such acts and all other acts will be explained away and excused. It would seem sometimes as if a universal badness had taken possession of the individual, yet a badness so inexplicable that it can only be looked upon as madness. Where we can ascertain that this condition of things is something which has come over the patient, being formerly absent, and that he is altogether changed, we may suspect insanity. But much examination and opportunity for examination may be needful before we can sign a certificate, for such people are often very acute, and quite on the alert. They have no scruples about falsehood, and will deny or justify everything with which they are taxed; and where the insanity is manifested in conduct, the medical man may never be a witness of it, and is obliged to receive on hearsay that which the patient strenuously denies. Careful inquiry, however, will probably reveal the origin and cause of the change; there may have been a period, though short, of acute insanity—as acute mania or melancholia—which passed away and left this as a permanent condition; or it may be the precursor of a more advanced stage of the disorder, one marked by the ordinary symptoms, as delusions and hallucinations. If the change has been rapid and progressive, if the sufferer has become more and more outrageous and eccentric, it is likely that in a short time unmistakable insanity will be displayed; but some cases progress slowly, and steps for restraint have to be taken before anything like delusion is to be found. It may be necessary to prevent a man from squandering all his property—a common symptom in this variety—or from wandering from home and absenting himself no one knows where, or keeping low company. And when a man previously quite sober suddenly takes to drinking, the question may arise whether this is not the effect of insanity. Great difficulty may be found in proving the latter, but unquestionably it is often the case. Here, however, if the habit is indulged in, the patient will most likely get rapidly worse, and then restraint will be more easily enforced.

Moral insanity may be the precursor of general paralysis; it may also be the sequel and result of a more severe insanity; it may be the outcome of apoplexy, or of a blow or other damage to the brain. It may be one of the alternating states of the so-called *Folie circulaire*. Here a period of depression alternates with one of excitement, gaiety, self-glorification, or irascibility, and the latter may be one closely resembling that usually called moral insanity, and evidenced by exaggerated conduct and absurd acts. It may follow a simple attack of epilepsy, or may be the precursor of such attacks, being a part of that epileptic condition known as masked epilepsy. *See* EPILEPTIC INSANITY.

The one constant and marked feature of this insanity is the absence of delusion; but we are not on this account to argue that the intellect is sound. There is often great acuteness and cunning displayed by such patients, yet along with the cunning there may be the most silly and foolish conduct. Often there is great acuteness shown by those who have delusions, but because of the latter we say their intellect is disordered. Yet it is proof of disorder of the intellect if a patient spends his capital as though it were income, defends and justifies the most outrageous acts, and cannot be made to see that they are outrageous. Close examination will probably reveal the fact that there is very considerable intellectual lesion in these cases. There is a want of the power of attention and concentration of ideas on a subject. A patient commences a story of his grievances, and in two minutes is far away from his theme, and is boasting of his virtues or conduct, and no amount of bringing back will enable him to give a definite and succinct account of what he has to complain of. Such rambling is a marked symptom of this insanity, and a strong indication of a weakened intellect.

There is one more form of moral insanity which is, perhaps, the hardest of all to diagnose and estimate. It is the congenital moral defect occasionally met with in persons who have been from birth odd and peculiar, and incapable of acting and behaving like other people. They can hardly be called idiots or imbeciles, for they may exhibit a considerable amount of intellect and even genius in certain special directions. We shall generally find that they are the offspring of parents strongly tainted with insanity, epilepsy, or alcoholism, and many in childhood are the subject of fits, chorea, or other neuroses. They are incapable of being instructed like other boys and girls, are often frightfully cruel towards animals or their brothers and sisters, and seem utterly incapable of telling the truth or understanding why they should do so. Here there is no change; we cannot compare the individual's condition with a former one, but we can only estimate him by the average of mankind. These are the persons who commit crimes and become the chronic inmates of prisons, and it is most difficult both for medical and other prison-officials to say how far they are responsible, and how far not. Careful and special education is needful for them, and this they may obtain if they are born of well-to-do parents, but a vast number are to be found amongst the ranks of the lower classes; the offspring of intemperance and poverty, they swell the numbers of the criminal classes in no inconsiderable degree.

G. F. BLANDFORD.

11. **Pellagrous Insanity.**—This is a form of insanity associated with pellagra, and not met with in Britain. It is characterised by mental symptoms usually indicative of anæmia—great depression, frequently with tendency to suicide, passing on to chronic dementia. It is most frequently met with in Italy.

12. **Phthisical Insanity.**—It has been generally observed that there is a special mental character associated with pulmonary tuberculosis. This consists frequently in a peculiar cheerful hopefulness, which has received the name of *spes phthisica*, and which seems strangely out of harmony with the unmistakable signs of an inevitable doom by which it is accompanied. But there is also a state of mental depression which has been observed in intimate association with the disease. The peculiar hopefulness is most frequently met with in the acute and active forms of phthisis, and it is often so irrational and persistent as to amount to an insane delusion, growing as it does in strength while the evidences of its baselessness accumulate. In the last stages of the malady the religious and general emotional exaltation is often extreme, and actual delirium is not infrequent. An opposite mental condition is met with in chronic phthisis, more especially in that form of it which has been called latent. All through the course of the disease there is a prevailing depression and distrustfulness, though the physical symptoms are neither so distressing nor so obvious as in the acuter forms. The mental symptoms sometimes precede the physical. Languor and depression, mingled with waywardness, are characteristic of the initial stage. This is usually accompanied by general functional debility, which is often attributed to mere disturbance of digestion and nutrition. The skin is habitually pale, and the circulation feeble. In many cases the physical signs of pulmonary disease when present are apt to be overlooked, and occasionally they escape observation for years. Where the mind is much affected the ordinary symptomatic cough, expectoration, and dyspnœa are often absent; and this is the case sometimes where physical exploration reveals the existence of extensive vomicæ and other characteristics of advanced disease. The mental condition as the further stages are reached becomes less one of depression and more one of distinct enfeeblement. Occasional fits of considerable irritability and excitement occur. Dr. Clouston, who first drew special attention to this condition, says of the patients that 'there is a want of fixity in their mental condition. There is a disinclination to enter into any kind of amusement or continuous work; and if this is overcome there is no interest manifested in the employment. It might be called a mixture of subacute mania and dementia, being sometimes the one and sometimes the other. As the case advances, the symptoms of dementia come to predominate; but it is seldom of that kind in which the mental faculties are entirely obscured, with no gleam of intelligence or any tendency to excitement. If there is any tendency to periodicity in the symptoms at all, the remissions are not so regular, nor so complete, nor so long as in ordinary periodical insanity. If there is depression it is accompanied with irritability and the want of

any fixed depressing idea or delusion. If there is any single tendency that characterises these cases, it is to be suspicious.' Where any chronic form of insanity is associated with phthisis the chance of complete restoration to sanity is very small. In the affection distinguished by emotional exaltation no special treatment is called for. The only indication of treatment in the other type of disease is the necessity of keeping up a full supply of nourishment to the brain; and this sometimes requires that forcible feeding should be resorted to. Where the mental condition is much disturbed, a trustworthy attendant ought to be employed, and the general treatment should always be tonic and stimulating. Removal to an asylum ought in most cases to be avoided. JOHN SIBBALD.

13. Puerperal Insanity.—SYNON.: *Insania gravidarum*; *Insania puerperarum*; *Insania lactantium*; Fr. *Folie puerpérale*; Ger. *Puerperalmanie.*

DEFINITION.—Insanity developed during pregnancy, parturition, or lactation.

It has been the custom of authors, till a recent period, to include under this heading the forms of insanity which occur in females during the periods of utero-gestation, the puerperal state, and lactation. It is now frequent to find the term 'puerperal' restricted to the derangements which come on at the time of delivery, or within a short period thereafter. Whatever names we adopt, it is impossible to consider the insanity occurring at these different periods quite independently. The condition of the woman during the whole process, from the time of conception till the child is weaned, represents one of those physiological crises during which congenital or acquired weakness of constitution tends to show itself.

The *insanity of pregnancy* generally takes the melancholic form, and seems to be due in some cases chiefly to a gradually developed anæmia, and in others to disturbance of the abdominal viscera, both of which conditions are frequently associated with mental depression. The delusions which characterise the disorder are generally exaggerations of the anxieties and whims so frequent in pregnancy. In the severer forms the suicidal impulse is frequently developed. The prognosis is generally favourable; but recovery seldom occurs till the termination of the gestation. It may sometimes be expedient to resort to the induction of premature labour. In all cases a torpid condition of the digestive functions should be carefully corrected.

Puerperal insanity in its more restricted meaning is frequently understood to include all derangements occurring at parturition, or within six or eight weeks after it. But it is better to limit the term to what occurs during the first three weeks, as the form of disorder which commences after that period is generally different in character.

ÆTIOLOGY.—Prominent among the causes of puerperal mania are all states of debility, either induced before parturition by want, intemperance, disorders of nutrition, or rapid succession of pregnancies, especially if lactations and pregnancies are carried on simultaneously; or it may be the result of weakness induced during parturition by hæmorrhage or exhaustion. It is liable to occur in primiparæ, when the subjects are either exceptionally young or exceptionally advanced in life. Irritation arising in the pelvic organs, intestines, or mammæ also tends to produce it. Any inordinate mental excitement or depression is apt to bring it on. Where any of these causes are superimposed on hereditary tendency, the danger is of course greatly augmented.

SYMPTOMS.—Attacks of maniacal excitement sometimes occur during actual parturition. They are usually of very short duration, and seem to be directly dependent on the intense suffering which may accompany the pains. The most frequent period of their occurrence is when the head of the child is passing either the *os internum* or *externum*. The more serious phase of the disorder is in its acute stage a variety of acute maniacal delirium. It usually commences within a week or ten days after delivery. Generally it is preceded by sleeplessness, and the patient manifests more or less apprehension of coming evil. Sometimes, however, she awakes delirious from what had been regarded as a healthy slumber. When the attack has commenced, sleep is always either very imperfectly obtained, or is altogether absent. The pulse is quick; the skin often, but not always, dry and hot; and the head throbbing. The eyes are bright, and the face generally pale, with occasional flushing. The expression is generally indicative of alarm or suspicion on the part of the patient. The tongue is dry and furred, and the secretions of milk and lochia are either suppressed or diminished. The bowels are sometimes loose, but constipation is the usual condition. The appetite is uncertain; sometimes it is impaired, but more frequently it is abnormally large. Not infrequently the sense of taste is perverted, and the patient suspects the presence of poison in her food, and persistently refuses it. The breath is often offensive in odour. Sometimes the mental excitement does not reveal itself in language, and the patient may be obstinately taciturn from the commencement. But there is usually a great increase of loquacity, gradually increasing from the beginning, and passing into incoherent raving. Sudden impulsive acts of violence frequently manifest themselves in this disorder, and in these the patient often attempts to destroy herself, her child, or persons for whom she has usually the most affectionate regard. She generally appears to be dissatisfied with those in attendance on her, and often entertains delusions as to their identity. In many cases the mental condition bears a strong resemblance to that of delirium tremens, especially when the patient has undergone privations, or has been intemperate during pregnancy.

DIAGNOSIS.—The only conditions for which puerperal insanity may be mistaken are the typhoid delirium of puerperal fever or pyæmia; and the violent excitement frequently symptomatic of meningitis. In these cases the febrile condition precedes the development of the delirium, while in puerperal mania the mental symptoms show themselves from the first. In meningitis the pupils are generally contracted, and the headache is peculiarly intense; while in puerperal mania the pupils are usually dilated, and the headache is not a very prominent symptom.

PROGNOSIS.—According to the published statistics of this disease, recovery may be expected in about 70 per cent. cf the cases, and a fatal termination need not be anticipated in more than 5 per cent. But as these figures are in a great measure obtained from asylum statistics, and other sources in which only the severer and more persistent forms have been taken into account, it may be fairly assumed that the true estimate would be much more favourable. The duration of the insanity may vary from a few days to a year, after which time the proportion of recoveries becomes extremely small. The great proportion of recoveries takes place during the first six months. The most favourable symptoms, in addition to amelioration of the mental symptoms, are increase of bodily weight, and restoration of the catamenia.

TREATMENT.—The transitory mania which sometimes accompanies the severer pains of labour does not require special treatment; but anæsthetics may be given as a preventive measure in cases where there is a known liability to such excitement. Special care ought also to be taken after such attacks, until the strength is fully restored, to avoid injury by premature bodily exertion, unnecessary social intercourse, disquieting news, or any kind of mental or moral strain. In the treatment of the graver form of puerperal mania, the chief objects are to remove all sources of irritation, to restore the patient's strength, and to obtain repose. If there is any accumulation of fæces, a smart purgative should be at once administered. If the lochial discharge is scanty, an injection of warm water, containing carbolic acid or some other antiseptic remedy, should be given *per vaginam*. The condition of the bladder should be ascertained, and this organ should be relieved, if necessary; care should also be taken not to allow the breasts to be over-distended. In those cases in which violent excitement does not come on suddenly, an attack may sometimes be warded off or cut short by relieving the sleeplessness which is one of the early symptoms. As a hypnotic about thirty grains of chloral is the best. Opium ought to be avoided, and hyoscyamus and belladonna cannot be relied on. In every case the patient should receive from the first as much light and nourishing food as her digestive powers can properly bear; for it must always be remembered that we have to deal with a condition of anæmia. Both in the first stage, and when the disease is more advanced, everything must be done to promote tranquillity. The room should be darkened, and stillness maintained as far as possible, for the attention of the patient is very easily excited, and both vision and hearing are preternaturally acute. Constant supervision is necessary, however, on account of the tendency to sudden impulsive violence; and the patient should see her infant as seldom as possible. After the maniacal condition has fairly declared itself, the child should be removed altogether, as its presence is sometimes productive of great excitement in the patient, and must always be regarded as attended with risk to itself. In cases where the excitement is somewhat of a hysterical character, bromide of potassium, given in twenty-grain doses at intervals of four hours, may produce good results. Cooling applications to the head sometimes soothe irritation, and induce sleep. Digitalis in small doses, and warm baths, have proved useful. Alcoholic stimulants should generally be given with the food; their effects being carefully watched, and the quantity varied accordingly. Bleeding and every kind of depletion should be avoided. The nursing and attendance should, if possible, be entirely entrusted to strangers, and the patient should not be permitted to see any members of her family. It will sometimes be necessary, especially in the case of poor persons, to resort to asylum treatment; but this ought not to be done if it can be avoided; and with patients in good circumstances it ought never to be necessary in the acute stage of the disease. When the disease becomes chronic, tonics, such as quinine and iron, ought to be given, and a plentiful supply of nourishment should then, as all through the illness, be carefully administered. Patients liable to this disorder should not be allowed without consideration to nurse their children.

The *insanity of lactation* is symptomatic of causes which come into play after the puerperal period, and it ought perhaps to be looked on as symptomatic merely of prolonged anæmia. Acute maniacal symptoms of short duration may occur; but the characteristic condition is melancholia, ushered in by headache, tinnitus aurium, flashes of light before the eyes, and other signs of debility. A suicidal tendency sometimes appears. The treatment required is to wean the child, and generally to save and increase the strength of the patient. The prognosis is favourable in the majority of cases. JOHN SIBBALD.

14. **Syphilitic Insanity.**—Among the results of constitutional syphilis, affections of the nervous system are not uncommon; and when the disease affects the brain, the mental symptoms that arise are found in the majority of cases to present a marked similarity in their character. In such cases the mental disorder is generally preceded, as in so many forms of insanity, by distressing sleeplessness. This is followed gradually by increasing depression of mind. Religious anxiety of a peculiarly hopeless character frequently shows itself. Exaggerated self-accusings are earnestly uttered by those who have previously been unusually callous as to the results of their actions. Hypochondriacal delusions are not uncommon, and are frequently associated, in the mind of the patient, with the fact of the syphilitic infection. The feeling of alarm which accompanies these symptoms sometimes developes into a violent excitement, which may be called maniacal. If the symptoms be associated with any of the ordinary signs of syphilitic poisoning —the dry, scaly skin, and the sallow lean face; and especially if any of the characteristic eruptions are present, the mental disease may be expected to yield to treatment by mercurials and iodide of potassium. The mental symptoms which have been here described seem to occur without the existence of any important structural lesions in the encephalon. The development of gummy products within the cranium is frequently

evinced by symptoms similar to those of general paralysis. Headache of very persistent character, giddiness, vertigo, and epileptoid fits occur, accompanied at first with mental depression. During the progress of the disease attacks of acute delirium are not unusual. Sometimes extravagant delusions, such as are frequent in general paralysis, are exhibited; but generally the progress of the disease is characterised by a gradual falling into dementia. The prognosis in such cases must be regarded as unfavourable, but considerable improvement frequently follows the administration of antisyphilitic remedies.

John Sibbald.

INSECT PARASITES.—Insect parasites are of two kinds, external and internal. The former are described under several affections of the skin (*see* Pediculi; Scabies; &c.); the latter are classed with the entozoa. *See* Œstrus; Chigoe; and Demodex.

INSENSIBILITY (*in*, not, and *sentio*, I perceive).—This word signifies either loss of consciousness; or merely loss of sensation in a part. *See* Consciousness, Disorders of; and Sensation, Disorders of.

INSOLATIO (*in*, in, and *sol*, the sun).—A synonym for sunstroke (*see* Sunstroke). Insolation is also used to designate a method of treatment, which consists in exposing the patient to the rays of the sun.

INSOMNIA (*in*, not, and *somnus*, sleep). Want of sleep, or sleeplessness. *See* Sleep, Disorders of.

INSPECTION (*inspicio*, I look upon).—The technical name for the examination of a patient by the sense of sight. *See* Physical Examination.

INSTILLATION (*in*, into, and *stilla*, a drop).—The method of applying remedies to a part in the form of drops. Instillation is chiefly employed in connection with the eye.

INSUFFICIENCY (*in*, not, and *sufficio*, I am sufficient).—A synonym for incompetence. *See* Incompetence.

INSUFFLATION (*in*, into, and *sufflo*, I blow).—This term is used in the same sense as inflation (*see* Inflation). It is also a name given to a method of applying remedies in the form of powder to the throat and respiratory passages, by blowing them through a tube into these parts. *See* Inhalations, Therapeutic Uses of.

INTEGUMENTS, Diseases of. *See* Skin, Diseases of.

INTELLECTUAL INSANITY. *See* Insanity.

INTEMPERANCE, Effects of. *See* Alcoholism; and Disease, Causes of.

INTERCOSTAL NEURALGIA.—Any of the dorsal nerves may be the seat of neuralgia, not differing materially in its symptoms from neuralgia affecting other mixed nerves, but especially important from a diagnostic point of view. The pains are paroxysmal; usually affect the region of distribution of the anterior division of one or two of the dorsal nerves; and are confined to one side, most frequently the left.

Ætiology.—The female sex, neurotic heritage, and weak general health predispose to intercostal neuralgia. As determining causes may be mentioned blows; the action of cold; local injury to the nerves from the growth of thoracic aneurism; and disease of the vertebræ. Exhaustion from oversuckling, menorrhagia, or leucorrhœa; irritation from cracked nipples; and pregnancy are all occasional but important causes of this form of neuralgia. The pain met with in the chest in early cases of phthisis is not unfrequently due to intercostal neuralgia.

Symptoms.—Pain is complained of at some part of one side of the thorax or abdomen, most often in the region innervated by the sixth, seventh, eighth, or ninth intercostal nerves, and much more frequently in the front or side than behind. It is occasionally found in the axilla and inner side of the arm. The pain may be intermittent, occurring in paroxysms, varying in number from a recurrence every few minutes to only two or three such during the twenty-four hours; or there may be persistent pain of a dull character, interrupted at varying intervals by darts of a very sharp kind, which may sometimes be referred with precision to the course of the neighbouring nerve. The pain is described as 'tearing,' or resembling such injuries as a 'stab of a knife,' or 'boring with a red-hot iron.' The acts of coughing or sneezing, as well as any rapid movements of the body, are apt to increase the distress, but the pain is also independent of these disturbances, and will attack without any such provocation. The pain is sometimes more of a wearing than acute character, and the rest will often be destroyed by it. Painful points are sometimes to be discovered in the following situations:—1. Over a spinous process corresponding to the emergence of the affected dorsal nerve from the intervertebral foramen. 2. At the side of the chest or abdomen, where the lateral branch becomes subcutaneous. 3. Near the sternum or at the margin of the rectus abdominalis muscle, at any part down to the pubes, where the termination of the nerve supplies the skin. The skin in the neighbourhood of the tender points is sometimes so hyperæsthesic that the pressure of the clothes is painful. In epileptics and other highly neurotic patients, intercostal neuralgia is often associated with palpitation of the heart, and the pain is usually referred in a vague manner to that organ. Close examination will show that it is in the chest-wall, and tender points may generally be discovered. The affection is not accompanied by fever. The paroxysms of pain may produce fainting and vomiting. They often cause dyspnœa, with an anxious expression of face, from the inability to draw a full breath without starting the pain.

Complications.—Intercostal neuralgia is sometimes accompanied by herpes zoster. The pain usually precedes the appearance of the eruption, but it is occasionally coincident only, and sometimes comes after it; more often than not it outlasts the eruption, it may be for a long period. In certain cases actual pain lasts but a few days, but is succeeded by an intolerable itching, which is described as being under, not in the skin. This sensation is said to be felt less in walking than when at rest.

Not unfrequently neuralgia of some other nerves, either at a distance, as the fifth, or anatomically near, as the brachial plexus, occurs as a complication of intercostal neuralgia. This is especially likely in cases happening in the period of bodily decay. It is then too, that the affection may occasionally be accompanied by attacks of angina pectoris.

Diagnosis.—Absence of pyrexia, as shown by the use of the thermometer; the intermittence of pain, and its occurrence irrespective of respiratory movements, although liable to be precipitated by them; and the results of physical examination, serve to distinguish intercostal neuralgia from pleurisy, a condition with which, on account of resemblance in the stabbing character of the pain, it is very apt to be confounded.

From muscular rheumatism it may be discriminated by the presence of the small and characteristic tender points; tenderness of the spinous processes on pressure; and by the pain being found to be not dependent upon movements. The same features serve to distinguish it from myalgia, especially that form which often comes from long-continued use in an unaccustomed manner of some muscle attached to the ribs, as when a person unused to carpentering handles the saw energetically for a long time.

Physical examination and the presence of pyrexia, will preserve from the error of confounding the dull pain often noted in pneumonia with that of intercostal neuralgia.

Pains of a stabbing, plunging, or electric-shock-like character are often experienced in the intercostal spaces in the course of locomotor ataxia, and it is important not to confound this disease with a simple attack of intercostal neuralgia. The distinguishing points are the occurrence of similar pains coincidently or alternately in other parts of the body, especially in the lower extremities; the absence of patellar tendon reflex; and the characteristic gait (if present)—all which mark locomotor ataxia.

Prognosis.—As in the case of other forms of neuralgia, that of the intercostal nerve can hardly be said to be attended with danger, though it must be allowed that in some very rare instances the severity of the pain appears to have actually destroyed life. It is apt, however, to be of troublesome duration, lasting for periods of weeks or months, and liable to recurrence.

Treatment.—Search should be made in other branches of the same nerve, and in the distribution of neighbouring nerves, for any source of irritation which it is possible to remove. Constipation of the bowels should be treated by 3 grains of pilula hydrargyri, followed by some Friedrichshall or Hunyadi Jànos water, repeated for two or three days. Quinine should be given in doses of from five to ten grains twice a day; and if there should be a state of anæmia, steel should be added. Exposure to cold and damp must be avoided; whilst the surroundings generally should be favourable to improving the nutrition and tone. If the pain be very acute, and sleep prevented, morphia may be injected hypodermically in the neighbourhood of the affected nerve, commencing with a dose of an eighth of a grain, and increasing this, if necessary, to a quarter of a grain in the twenty-four hours. This dose should not be repeated, however; and it is better to be satisfied with a repetition of the smaller dose, if required. Small blisters (size of half-a-crown) may be applied to the neighbourhood of the spinal column, near the point of emergence of the affected nerve, one succeeding another as it heals. The continuous voltaic current, from about 10 to 20 cells, Leclanché or Stöhrer, may be applied, one sponge on the spine and the other upon the painful points, in turn. There is no better application than collodion flexile for the herpes zoster which sometimes complicates intercostal neuralgia. *See* Neuralgia.

T. Buzzard.

INTERLOBULAR (*inter*, between, and *lobulus*, a little lobe).—Situated in the tissue between the lobules of any organ. A good illustration is *interlobular emphysema*, in which air occupies the parts between the lobules of the lungs.

INTERMITTENT (*intermitto*, I leave off for a time).—A temporary cessation or suspension, either of a function, for example, of the action of the heart, when the pulse is said to intermit; or of a disease, such as neuralgia or ague, when the symptoms cease for a certain time. *See* Pulse; and Intermittent Fever.

INTERMITTENT FEVER. — Synon.: Ague; Fr. *Fièvre Intermittente*; Ger. *Kaltes Fieber.*

Definition.—A fever of malarial origin, characterised by the sudden rise of temperature during the paroxysm; by the equally sudden fall at its termination; and by the regularity of the times of accession and apyrexia.

Ætiology.—Intermittent fever belongs to the class of malarial or paroxysmal fevers. It is the most typical, and the most common of the class. The human system once subjected to the phenomena of a regular attack of ague in any of its forms, is for the remainder of the life of the person so affected liable to a repetition of the attack, without his necessarily having been exposed afresh to the action of its cause. This tendency is very commonly shown in those who, after long residence in hot and malarial climates, are exposed to the influence of cold, and especially easterly winds, on their return to temperate climates in the spring time of the year. The more the person has suffered from the blood-changes and visceral degenerations described in the article Malaria, the more prone is he to such recurring attacks.

Anatomical Characters. — In the article Malaria the pathology of intermittent fever is fully discussed, including its probable dependence on the presence of the *Bacillus malariæ* in the body. The spleen is enlarged, and in pernicious agues proving rapidly fatal, it is found in a state of softening, often reduced to a state of deeply pigmented pulp. Death is common in malarious countries from rupture of the spleen, the result of blows or kicks, often of no great severity. The liver is usually found somewhat congested and pigmented, and in cases of long standing it enlarges like the spleen, with the same increase in the connective tissue. In the algide cases hereafter described, when blood is driven in large quantity into the abdominal viscera, the digestive mucous membrane of the stomach and duodenum is congested and softened. The heart is invariably soft and flaccid, pale, sometimes of a dirty yellowish colour—degenerative changes induced by the combined action of diseased blood and high temperature.

Blood-changes.—Blood-changes sometimes take place both in intermittent and remittent fevers with astonishing rapidity. Army medical officers serving in the Mauritius during the epidemics of malarial fever which prevailed there some years ago, noted that the sufferers were often reduced to a state of complete anæmia in a few hours; the same is the case in Algeria (*see* MALARIA). In such cases dropsical affections supervene, often rapidly, and military medical officers there record cases 'proving suddenly fatal from œdema of the glottis.' The blood is changed before any of the usual symptoms of an attack are present—it becomes dark in colour; the serum which separates has a dark brown colour; and when exposed to the air, the coagulum, which is large and loose, does not assume its usual bright-red colour. The white corpuscles are immensely increased in number; and the red corpuscles do not evince their usual tendency to run together in rouleaux.

State of the urine.—The urine contains a large amount of free acid, and retains a highly acid reaction for many days in the hottest weather. In the intervals it is often alkaline. When the paroxysms cease, the watery part of the urine diminishes; and it assumes a deep orange colour, depositing also an abundant sediment of urate of ammonia. This change is often observed by intelligent patients, who learn to appreciate its favourable significance. The late Dr. Parkes has shown that at the first elevation of temperature the urea increases; this lasts during the cold and hot stages; then it decreases, falling below the healthy average. Colin and other French authors note the enormous excretion of urea in malarial fevers both in Italy and Algeria.

SYMPTOMS.—Three forms of ague have long been recognised, namely, the *quotidian*, which recurs in twenty-four hours; the *tertian* in forty-eight hours; and the *quartan* in seventy hours. The term *double tertian* is used when the paroxysm recurs regularly on alternate days, the attacks being alike in severity and duration. Other more rare forms of the irregular type have been described, as the *triple tertian*, with two paroxysms in one day, and one the next; the *double quartan*, with a regular fit one day, a slight one the next, and a complete intermission on the third day. The quotidian is the most common; the quartan the rarest of all—a rule which seems to hold good wherever malarial fevers prevail. The quartan type has been noted from early times for the tenacity with which it clings to its victims.

Premonitory symptoms.—These are much the same as in all febrile disorders, namely pain in the back and lower extremities, languor, lassitude, gastric irritation, loss of appetite, nausea, and sometimes vomiting; with occasionally frequent calls to micturate, the urine being pale and highly acid. Then follow in succession the three stages, the *cold*, the *hot*, and the *sweating*; succeeded by what is technically known as the *interval* or apyrexial period, which lasts for a number of hours, varying according to the type of the disease.

Cold stage.—The patient experiences a sense of coldness in the back; then rigors set in, at first faintly, becoming quickly more distinct, until the teeth chatter, and the patient feels cold all over, and demands to have clothes heaped on him; the skin shrivels, the nails become blue, and he experiences a sensation of intense discomfort. This feeling of cold is, however, only a 'subjective symptom,' for if a clinical thermometer be placed in the mouth or rectum, even before distinct rigors set in, it will indicate a rise in the temperature of from two to three degrees. The skin, from contraction of the superficial vessels, is indeed colder than natural, but from the first the temperature of the blood is above the normal. The phenomena of the cold stage are gastric irritation, a foul tongue, a rapid pulse, and quickened respiration, with a feeling of coldness not confirmed by the thermometer.

Hot stage.—As this sets in, the patient grows warm all over, the face flushes, the pulse rises in frequency and volume, the skin grows hot, and the patient becomes restless, seeking ease to his aching head, back, and limbs in frequent change of posture. The tongue in this stage is usually dry, often bile-tinted; and the bowels are constipated.

Sweating stage.—At first beads of perspiration appear on the brow and face, and the hands become moist; and soon, to the immense relief of the patient, his whole body sweats freely, the temperature begins to decline, and the paroxysm is at an end. The average duration of the paroxysm is from five to six hours, but in severe cases it may last for twelve hours. When sufferers have been exposed to malaria in such places as the mangrove swamps of Africa, 'they will be reminded of what their systems have imbibed in the way of surroundings by the sickly scent of the swamps thrown off in the secretion through the skin.' (Waller.) Both officers and soldiers who came under the care of the writer on their return from the late expedition to the Gold Coast, observed the same fact in their own persons; some were severely nauseated by the unpleasant smell, recalling the stench of the places where the poison was probably taken into their systems.

Temperature.—The rapidity with which the temperature in ague rises to 105°, 106°, and sometimes 107° Fahr., and the equally sudden manner in which it falls when the sweating stage begins, is a very notable and characteristic fact of great diagnostic value. According to Wunderlich, nothing like this is to be seen in any other disease, with the exception of cases of relapse in typhoid, the febrile paroxysms in acute tuberculosis, and pyæmia. As soon as the sweating stage begins, the temperature declines, at first slowly, then as rapidly as it rose; when the defervescence is complete, it will be found one or two points of a degree below the normal, where it remains during the period of apyrexia. If the paroxysms be cut short by quinine, we may still detect at the hour of expected attack a distinct rise in the temperature, although none of the other symptoms of a paroxysm may occur, and the patient may be hardly sensible of it.

Pernicious agues.— This term is much used both by French and Italian authors, who apply it to cases both of intermittent and remittent fevers, in which certain symptoms are developed, such as delirium, coma, an algide condition; in a word, any serious complication placing the life of the patient in peril. So far at least as intermittent fever is concerned, this pernicious form appears to be more common in the intensely malarious regions of Italy than in India. Such was the experience of the writer, in whose large sphere of observation such grave complications were almost entirely confined to the worst forms of remittent fever, contracted in places notoriously dangerous. The writer is strongly impressed with the belief that the 'pernicious' symptoms, the mental incoherence and delirium, the coma, and the 'algide condition' so much dwelt on by some Italian physicians of the old school, were often the result, not so much of the disease, as of the lowering treatment to which they subjected their patients.

The algide form of 'pernicious' intermittent is sometimes described by writers on the diseases of India as 'ague of adynamic type,' and it was frequently seen and well described by the French military surgeons both in Algeria and in Rome, during the long occupation of that city by the French army. The surface is cold, but, unlike the cold stage of an ordinary ague, the patient is unconscious of the low temperature of the surface. The internal temperature is high, and of this he is aware. There is an immense accumulation of blood in the abdominal viscera, with great thirst. The expression of the patient is tranquil, and his intelligence is intact. 'Il se sent mourir,' says Maillot, 'et l'abattement est tel qu'il se complait dans cet état de repos; son physionomie est sans mobilité; l'impassibilité la plus grande est peinte sur la visage.' (Maillot, Colin.)

COMPLICATIONS.—Intermittents may be complicated by attacks of various diseases of greater or less severity—attacks often governed by climatic causes, by the habits of the individual patient, or by the fact that he has suffered from one or other of such diseases on previous occasions, such as pneumonia, bronchitis, asthma, dysentery, diarrhœa, or epilepsy. It is an old observation that the last-named disease, even in so-called 'confirmed epileptics,' sometimes disappears when the victim becomes the subject of an attack of ague. One very striking example of this kind the writer has seen.

Pneumonia is certainly the most formidable complication met with in intermittent fever. Invalids returning from India or from other hot and malarial climates to high latitudes, unless they are carefully protected by suitable clothing, are prone to suffer from this disease. The rapidity with which consolidation of the lungs takes place in such cases is very remarkable. It is not an uncommon thing to see five or six cases of this kind out of one party of invalids landed at Netley from India, if, on entering the Channel, they have been exposed to cold weather. The pneumonia is generally double, and recovery is rare, the patients either sinking at once, or dying after a longer or shorter illness from pneumonic phthisis. Pneumonia of this type is a common and fatal disease among the malaria-poisoned civil population of Rome during the winter months; and the French military surgeons record its prevalence in the French garrison there at the same season, and also among malarial invalids sent back to France both from Algeria and Rome (*Recueil des Mémoires Méd. Mil.* t. ii. 2ᵉ *Série*, p. 268). When pneumonia occurs as a complication of any form of malarial fever, it is one of the gravest import. There is no difficulty in making the diagnosis by the ordinary means.

DIAGNOSIS.—An ordinary intermittent presents no difficulties. The well-marked nature of the paroxysms; the sudden rise of temperature and its equally sudden decline; the splenic enlargement; the discolouration of the skin; the urinary changes described above; together with considerations relating to the place where the disease was contracted; and, above all, the therapeutic test, that is, the power of quinine in preventing the recurrence of the attacks, ought to clear up all doubts.

PROGNOSIS.—This, in ordinary agues, so far as immediate danger is concerned, is highly favourable; death from uncomplicated ague is very rare. The direct mortality from ague, at all events among the European races affected by it, is small; the indirect mortality from the malarial cachexia, occurring either *per se* or as a complication of other diseases, is very great. In complicated or so-called pernicious agues, the prognosis will depend on the extent to which important organs are involved—cerebral, pulmonary, or gastric; much on the stage the disease has reached before the patient comes under treatment; and much, very much, on the nature of that treatment.

TREATMENT.—Keeping in view the fact that every paroxysm of intermittent fever, particularly in a hot climate, is a step, however short, on the road to the cachectic condition described above and in the article on MALARIA, the importance of breaking the recurrence of the paroxysms will be apparent. This, then, is the first indication of treatment; the second is hardly less important, namely, to improve the condition of the blood, and by judicious treatment—therapeutic, dietetic, and climatic—to prevent further degeneration of organs, and, so far as may be, to restore affected tissues to their normal condition.

If, as the writer firmly believes, there be such a thing as a specific disease, intermittent fever is specific. Like all such, it has a certain definite series of phenomena to pass through, which we may assume to be needful for the purpose of destroying, altering, or in some way expelling the poison, or at least such portion of it as may at the time be acting on the system. There is no drug known to science capable of arresting the stages of a true malarial fever once it has entered on the first or cold stage. This doctrine, as Sir William Jenner has admirably stated it in his *Address on the Ætiology of Acute Specific Diseases*, has been taught by the writer, as regards malarial fevers and cholera, in his lectures at Netley for the last twenty years. There is little, therefore, to be said as to the treatment of the stages of ague; they must take their course, the only interference being to supply the patient with the warm covering so much desired during the cold stage; if this be protracted unduly, to give him draughts of warm tea; and should symptoms of collapse appear in any of the more 'pernicious' forms at the end of the hot stage, to administer such restoratives and stimulants as the case may demand. Excepting in cases where the stomach is oppressed by a recently taken meal, the time-honoured practice of administering an emetic may be safely omitted. The lamented traveller Livingstone, whose experience of malarial fevers was immense, began the treatment of nearly all cases with the following combination: Resin of jalap and of rhubarb, from 6 to 8 grains, with 4 grains of calomel and a like quantity of quinine. According to the great traveller and his hardly less experienced companion, the Rev. Horace Waller, this combination was found very efficacious as the commencement of treatment both in intermittent and remittent fever. In Livingstone's camp his pills were known as 'rousers,' and as such were at once administered to men who, 'from premonitory symptoms, became idle and lethargic.' In about five hours copious dark-coloured motions followed; if these were delayed, recourse was had to a brisk purgative enema. Quinine was then given in 4-grain doses every four hours, until twelve grains were administered in the twelve hours succeeding the purgative medicine. Livingstone and his followers deemed any other mode of dealing with the fevers of Africa to be 'mere trifling.' Common sense points to the necessity of caution in the use of such active purging in men much debilitated by disease or climate, or both, or when the patients are delicate women, or Asiatics, often calling for as delicate handling. It is hardly necessary to add that this sharp treatment is not applicable to those who are labouring, or have previously laboured under dysentery, or any other form of bowel-complaint.

In the 'interval,' energetic efforts must be made to bring the patient under the influence of quinine. At once the most effective and the most economical plan is to administer quinine, in solution, in a ten-grain dose at the end of the sweating stage, and to repeat it in from four to six hours. At least a scruple of the remedy should be given during the interval. If obstinate vomiting interferes with the retention of the quinine, which will rarely happen if the bowels have been well relieved, the quinine must be administered either by enema or by the hypodermic method. The first plan is very efficacious, and is safe; the latter is the most effective, but is not without risk of inconvenience from troublesome ulceration round the site of injection, if a mineral acid has been used to dissolve the quinine: this in urgent circumstances, such as in pernicious agues dangerous to life, or in remittents (as will be explained under the head of that type of fever), might be disregarded were it not that tetanus followed the operation in five cases in one year in the Bengal Presidency, all of them proving fatal. In the face of such a fact, this operation, trivial as it seems, should not be performed on light grounds. The neutral sulphate of quinine, which dissolves freely in water at a temperature of 90° F., does not, so far as the writer's experience goes, cause ulceration. The syringe used for this purpose should be a little larger than that for operations with morphia, and should have a platinum hollow needle.

Quinine, in one or other of the methods advised, should be used until the paroxysms are broken. The remedy should be continued daily, so long as the clinical thermometer indicates a rise in temperature at the time of expected attack, even if there be no sign of a regular cold stage; and within a lunar month from the time of first attack, the patient should be again brought under the influence of quinine for some days. In pernicious agues, or in cases where complications arise, it is in a high degree dangerous to pause in the administration of quinine to use remedies of a depressing kind for this or that set of symptoms. Those who so act will have little success in practice until taught by bitter experience the danger of departing from the golden rule of trusting to quinine. In this way, epilepsy, pneumonia, asthma, bronchitis may have to be met, aided by stimulation of the skin, support from proper food, and stimulants when called for. For many years the writer has urged this doctrine on the attention of young practitioners, and he is glad to see that it is even more strongly insisted on by Trousseau in his well-known lectures.

It is in such cases, and in grave remittents, that the *Tinctura Warburgi* has been found so useful as to warrant a strong recommendation. The active ingredient in this febrifuge is quinine, in combination with a variety of aromatic drugs, which either are now, or were formerly officinal. It is the most powerful sudorific known, and has been found in the writer's hands, and in the practice of many medical officers in Southern India, a remedy of great power in all malarial fevers. After opening the bowels, half an ounce of tincture is administered, undiluted, all drink being withheld: a second dose is given in three hours. It soon produces free action of the skin, the perspiration often having an aromatic odour. It is rare to see another paroxysm follow the use of the tincture. In adynamic cases it should be used in smaller doses, and with some caution, lest its excessive sudorific action should be too depressing.[1]

Substitutes for quinine.—The officers in charge of the Government cinchona plantations in India now prepare from the red cinchona bark, by a very simple and economical process, a preparation known as 'cinchona alkaloid,' which, in somewhat larger doses than quinine, is found to be effectual in checking malarial fever, but this preparation, although very cheap, has fallen into disrepute from the distressing nausea, and even vomiting, it often causes.

Salicylic acid is now largely used as an antipyretic.

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[1] Dr. Warburg has communicated to the writer the formula for the preparation of this tincture, which at Dr. Warburg's desire was published in the *Lancet*, and *Medical Times and Gazette*. (See *Medical Times and Gazette*, 1875, vol. ii. page 540.) As stated in the text, quinine proved to be the active ingredient, in combination with a number of aromatic drugs common to ancient and modern pharmacy. It is consistent with the writer's knowledge that this tincture has maintained its high reputation in the treatment of malarial fevers of the most dangerous type, in the hands of Colonel Gordon, in the pestilential regions traversed by him and his officers while carrying out the policy of the Khedive of Egypt along the head-waters of the Nile.

Arsenic has been used for ages, particularly in the East, in the treatment of agues. There is no doubt that it possesses considerable power as a so-called antiperiodic. The French military surgeons, who are obliged to study economy, use it largely, and in doses much larger than are commonly given by British practitioners. They seek, as Boudin expresses it, to oppose an arsenical to a malarial diathesis. In the brow-aches and other neuralgic sequels of malarial fever it is an effective remedy, either alone or in combination with quinine. The alkaline sulphites, so much lauded by Professor Polli, have hitherto disappointed the expectations of British medical officers who have tried them. In the late epidemic outbreak of malarial fever in the Mauritius they were found useless. The sulphate of cinchonine in scruple doses is much praised by Dr. Paul Turner. Biberine was largely tried by the writer in India, and found to be inert. Of late, various preparations of *Eucalyptus globulus*, the blue gum tree of Australia, have been much praised in the cure of ague, and more particularly in the treatment of its sequels. The writer is inclined to fear that this remedy, like many others, has been unduly vaunted. It certainly is often useful in the malarial cachexia, with occasional attacks of ague, but in the acute forms of the disease it is, in the experience of the writer, far below quinine. The best form is that of tincture. Both in France and Germany it is much used for the reduction of enlarged spleens.

Diet.—This should be nutritious and easy of digestion. Dr. Cornish has pointed out how much the mortality from malarial fevers is increased amongst the natives of India by 'starvation treatment.'

Treatment of malarial cachexia.—On the first signs of this condition appearing, the sufferer should be sent to a non-malarial climate. If by sea-voyage, care must be taken so to regulate the diet as to avoid the risk of ingrafting the scorbutic on the malarial cachexia. Remembering also the danger of exposure to cold insisted on already, scrupulous attention to clothing is a point of cardinal importance. According to the writer's experience, one of the most effective means of reviving the action of the skin, improving the condition of the blood, and restoring the spleen and liver to a more healthy condition, is to send those whose circumstances admit of it to Carlsbad or Homburg, where, under proper local medical advice, they may drink the waters and use the baths. The good effects of this treatment are often very marked and lasting. It should be supplemented by a course of the syrup of the triple phosphates of iron, quinine, and strychnia, in half-drachm doses three times a day; which after a time should give way to iron in some more direct form. The Carlsbad water, in combination with that of Friedrichshall, if continued for a sufficient length of time, is often most useful in improving the condition of the abdominal organs, even when the patient can only use them in this country; and the action of the skin may be stimulated with profit by the occasional use of a Turkish bath, or by a wet sheet packing. The writer has long used the ointment of the biniodide of mercury in reducing enlarged spleens, and often with great success. The strength of the ointment is 13 grains to an ounce of lard. Of this a piece as large as a walnut is to be well rubbed in before a good fire. The process is repeated on the afternoon of the same day, and again, if need be, in a fortnight. If ordinary care be taken to watch the effects, and not to use the remedy too often, no ill consequences need be feared. The writer has in this way again and again reduced spleens, extending even into the pelvis, to almost normal dimensions, without producing any of the inconveniences either of the mercurial or iodine ingredients of the ointment.

It is a point of great importance that patients should be placed under the most favourable hygienic conditions, and breathe the purest air available.

W. C. Maclean.

INTERNAL EAR, Diseases of. *See* Ear, Diseases of.

INTERSTITIAL (*inter*, between, and *sto*, I stand).—Relating to the interstices of an organ. The term is applied in physiology to the tissue which exists between the proper elements of any structure, namely, some form of connective tissue. In pathology the word is used in connection with *absorption*, when a part is gradually removed without any obvious breaking off; and also to indicate the implication of the interstitial tissues in morbid processes, or their infiltration with morbid products, as *interstitial pneumonia*, *interstitial hepatitis*, &c.

INTERTRIGO (*inter*, between, and *tero*, I rub).—Definition.—A slight inflammation of the skin occurring in the hollows of folds of the integument or joints, where two surfaces lie in contact with each other.

Ætiology.—The cause of intertrigo is not, as might be implied by its name, friction alone; but rather moisture and heat associated with contact and pressure, acting on a sensitive skin. In certain situations the amount of inflammation is liable to be aggravated by the addition of irritant discharges, such as excessive perspiration, urine, and fæcal matter.

Intertrigo is common in infants, in whom it is favoured by abundance of integument, and sensitiveness of skin. For a similar reason it is met with in corpulent persons; but it is not wanting in the emaciated, when there exists a tendency to eczema, or an eczematous diathesis. In infants it is seen in the perineum, extending from the anal fossa behind to the groins in front, and likewise in any other of the deep folds of the integument. Among adults, in addition to these situations it occurs in the axillæ, in the groove beneath the mammæ, and in the flexures of joints.

Description.—The term intertrigo points to a rubbing together or chafing, fretting, or galling of the skin by friction, and no doubt friction may have some share in producing the inflammation; but it is also certain that intertrigo results most frequently from irritation caused by the heat and moisture of the part. Intertrigo has been adopted as an erythema under the name of *erythema intertrigo*, but it very rarely remains at the erythematous stage, having a natural tendency to run on to exudation with the discharge of a muco-purulent fluid, and to be further complicated with excoriations and chaps. In this condition it becomes an eczema and is very properly treated as such. Indeed, it is more consistent with the genius of modern dermatology to consider it, even from the beginning, as an eczema, under the name of *eczema erythematosum*.

Prognosis.—The prognosis of this affection is favourable as to cure, but uncertain as to time, and in adults it is very apt to degenerate into chronic eczema.

Treatment.—The removal of the cause is the first indication to be attended to in the treatment of intertrigo. This may be effected by careful ablution with soap. The part should then be kept as dry and cool as possible, and dusted with fuller's earth, or any unirritating desiccative powder. Where powder is unsuitable, a lotion of lime-water inspissated with oxide of zinc will be found useful; and if this should prove irritating, zinc ointment, with the addition of a drachm of spirits of wine to the ounce, should be kept constantly applied. Where there is much exudation, it is desirable, as in eczema, to avoid ablution, and confine the treatment to wiping with a soft cloth previously to each repetition of the zinc ointment. Constitutional symptoms are rarely present in intertrigo, but should such arise, the indications to be considered are regulation of the digestive organs and associated functions; a suitable diet; and tonic regimen.

Erasmus Wilson.

INTESTINAL OBSTRUCTION. — Synon.: Ileus; Fr. *Occlusion intestinale*; Ger. *Darmverschliessung*.

Definition.—Under this term are included all those cases in which the contents of the intestinal canal are obstructed in their onward passage, by causes or conditions occurring within the abdomen or pelvis. Cases in which obstruction is due to causes or conditions affecting protruding or protruded bowel are included under the head of Hernia.

General Remarks.—The subject of intestinal obstruction will be best treated by first discussing the condition in general, and afterwards referring to its various pathological causes under separate and distinct heads.

Frequency.—The comparative frequency with which intestinal obstruction occurs is difficult to estimate. It is by no means a common affection, though less rare, perhaps, than is sometimes supposed or asserted. It is always fraught with danger, and in a very large proportion of cases more or less speedily proves fatal. Brinton estimates 1 out of every 280 deaths from all causes to be due to some form or other of intestinal obstruction. Leichtenstern gives 1 out of every 300 to 500. Brinton's estimate, founded on the results of 12,000 post-mortem examinations, is probably somewhat too high, inasmuch as a larger proportion of cases of intestinal obstruction are likely to have been inspected than of cases of more common and less obscure affections.

Ætiology and Pathology.—Most forms of intestinal obstruction are more often met with in the male than in the female subject. Out of a total of 1,806 sufferers, 1,018 were males and 788 females. But women are more liable than men to suffer from certain forms, as, for example, those which depend upon impaction of gall-stones or fæcal matter; upon compression of the intestine by tumours or displaced viscera; or upon constrictions by peritoneal or other adhesions. Some forms, especially intussusception and volvulus, most frequently occur during infancy or childhood; others, as strictures, at comparatively advanced periods of life.

The causes, or anatomico-pathological conditions which may give rise to intestinal obstruction, vary in nature, in mode of action, and in acuteness and severity of effect. Some are *Congenital*, depending upon developmental abnormalities; others are *Acquired*, resulting from accident, disease, or physiological incapacity. Some act by compression of the bowel from without; some by constriction of the bowel within; and others by blocking its canal. Some come into play suddenly or almost suddenly, and without warning, and at once lead to complete occlusion; the symptoms are most acute, and in the absence of relief, fatal results speedily follow. Some coming into play with almost equal suddenness, and accompanied by almost equally severe symptoms, do not, however, so immediately lead to complete occlusion; some degree of permeability remains for a time; and the chances of relief are somewhat better. Other causes, again, seem to develop slowly; the symptoms in the earlier stages, at any rate, are not acute; the malady takes a chronic course; better opportunities for consideration and treatment are afforded; and fatal results, though they may ultimately ensue, can be longer averted.

The causes of intestinal obstruction may be enumerated as follows, in order as nearly as possible corresponding to the acuteness and urgency of the symptoms, and the imminence of danger to life to which they give rise; and the relative frequency with which they occur may be approximatively estimated by the numbers appended, representing the results of an analysis of 1,839 fatal cases recorded or observed:—

1. **Congenital malformations.**
2. **Internal strangulation** (546).

(*a*) By peritoneal false ligaments or bands, the result of previous inflammatory mischief, either under such bands, or by loops or knots, or in button-hole slits, or by kinking caused by traction, or by the margins of slits or rings produced by adhesions of parts or organs to one another, or to some part of the parietes (219).

(*b*) By the omentum or mesentery (in association with some abnormal peculiarity) by bands or in slits (65).

(*c*) By diverticula or diverticular appendages, as the obliterated omphalo-mesenteric vessels, or by diverticular knots (75).

(*d*) By the appendix vermiformis (42).

(*e*) By twisting or knotting (volvulus) and consequent compression of the bowel by itself, or by its mesentery (106).

(*f*) By the margins of peritoneal pouches (retro-peritoneal hernia, hernia through foramen of Winslow, and other forms of internal hernia) (39).

3. **Impaction of gall-stones** (51).
4. **Intussusception or invagination** (537).
5. **Constriction** (511).

(*a*) By cicatricial contractions of the bowel itself, resulting from injury or ulcerative disease.

(*b*) By peritoneal thickening and contraction, with sometimes matting together of the bowel, from strumous or other form of peritonitis (138).

(*c*) By new growths, innocent or malignant, in the bowel itself (373).

6. **Compression.**

(*a*) By displaced (and often diseased) viscera.

(*b*) By new growths, innocent or malignant, hydatids, &c., outside the bowel (66).

7. **Impaction of foreign bodies or intestinal concretions** (78).

8. **Impaction of fæcal masses***:* 'Physiological Incapacity'; *Ileus Paralyticus; Confirmed Constipation, habitual* or *accidental* (78).

SEATS.—Every part of the intestinal tract is liable to be primarily affected by one or other cause of obstruction. But some parts are much more frequently than others, if not almost exclusively, affected by certain particular causes; and in regard to treatment, especially so far as operative measures for relief are concerned, it is often of very great importance to determine not only the cause, but also as nearly as possible the seat of the obstruction. Acute internal strangulation *by bands* most frequently affects the small intestine, *by twisting* the sigmoid flexure. Impaction of gall-stones, with very few exceptions, occurs in the jejunum or some part of the ileum. Compression and traction especially affect the small intestine. Intussusception most frequently involves the cæcum and colon, and next, the ileum. Constrictions due to morbid growths are most common in the large intestine, especially in the lower portion.

SYMPTOMS.—The symptoms and physical signs of intestinal obstruction are as a rule sufficiently constant and characteristic to establish the general diagnosis. But though they vary in acuteness, and in certain other respects, with the cause and seat of the obstruction, it is often very difficult, and sometimes impossible, to determine without exploration the differential diagnosis, however important it may be to do so.

The symptoms and signs commonly presented, the variations met with in different cases, and the special indications afforded by such variations may be stated as follows—the symptoms and signs especially characteristic of each form of obstruction being summarily repeated, or further discussed in subsequent sections.

1. *Pain.*—In a very large proportion of cases of obstruction depending upon most causes pain is the earliest, or one of the earliest symptoms; and in a greater or lesser degree, though it may change in character, and from time to time remit in severity, it usually persists more or less continuously and constantly very nearly to the end. The impaction of a gall-stone or foreign body, the commencement of an intussusception, or the strangulation of a portion of bowel occurring suddenly, is usually signalised by an access of acute, indescribable pain, often 'doubling the patient up,' and sometimes producing faintness, and even collapse. Strangulation by bands or in slits, after a period of incarceration, or as the result of twists, when the bowel is not suddenly gripped as it were, gives rise to pain, which, though supervening somewhat gradually, rapidly becomes almost equally severe. Strictures of the bowel, and obstructions due to the pressure of tumours, displaced viscera, &c., cause—at any rate in the earlier stages—comparatively little pain. Obstruction of the large intestine by impaction of fæces is attended by scarcely any actual pain; the patient as a rule complaining simply of fulness, weight, and discomfort.

The pain experienced varies in its cause and character in different stages. At the onset it is, doubtless, due to the injury immediately inflicted on the serous or mucous coat of the bowel; but it is very speedily increased and maintained, and sometimes probably is started, by the effects of the congestion and distension of the compressed blood vessels on their accompanying nerves. Somewhat later comes the pain associated with distension of the bowel itself; and this is increased, at more or less frequent intervals, by paroxysmal exacerbations of acute suffering, which accompany the futile peristaltic efforts of the intestine to move on the solid, liquid, or gaseous matters accumulated above the obstruction. Such exacerbations of suffering are probably due, not only to tension of the intestinal walls generally, but in some measure also to traction upon the injured parts. At a still later stage, when inflammation is established, the pain and tenderness, localised or diffused, of enteritis and peritonitis supervene.

The pain in the early stages of acute strangulation, or of impaction of gall-stones or foreign bodies, is increased, or if it have temporarily subsided, is rekindled, by pressure on or about the spot corresponding to the seat of the lesion; and often there is little or no general tenderness. In intussusception the pain is often relieved to some extent by moderate pressure. In chronic obstruction there is but little pain and tenderness on pressure; and some degree of relief even may sometimes be afforded by gentle, supporting pressure, diffused over one portion or other of the distended abdomen.

Associated with the actual definite pain, are the general physical anxiety and distress always present to a greater or less extent, and in expression almost characteristic of intestinal obstruction or severe intestinal trouble.

2. *Vomiting.*—Vomiting is a very constant symptom of intestinal obstruction, from whatever cause. It may commence almost simultaneously with the occurrence of the obstruction; in which case it may be regarded as sympathetic, and due to shock associated with the injury inflicted. Or it may come on somewhat later; in which case it depends, in part, upon the forcing backwards into the stomach of the accumulated intestinal contents, their onward progress being arrested by the obstruction, and in part upon reflex irritation associated with injury or inflammation of the peritoneum. At whatever period it may have commenced, the vomiting recurs with greater or less severity at more or less frequent intervals until the termination of the malady, although sometimes comparatively long intermissions occur. As a general rule, the nearer the seat of obstruction is to the stomach, and the more acute the cause, the earlier does vomiting come on, the more severe is it, and the more frequently does it recur. Early, severe, and frequently repeated vomiting indicates obstruc

tion of the small, rather than of the large intestine. When the obstruction is high up in the small intestine, but below the opening of the ductus communis choledochus, the vomit usually contains an admixture of bile, more or less altered it may be, and is but little offensive. When the obstruction is below the middle of the small intestine, the vomit is commonly 'fæcaloid' in appearance and odour. When the obstruction is in the colon, or even the lowest part of the ileum, the vomit is more or less decidedly fæculent in character, and sometimes contains distinct fæcal masses. It appears to be clearly established that great distension of the intestine may render the ileo-cæcal valve inefficient, to such an extent as to permit regurgitation from the large into the small intestine.

The occurrence of fæculent or stercoraceous vomit was formerly ascribed to reversed or anti-peristaltic action of the bowel. The possibility of such reversed peristalsis has, however, been disputed, and the matter may be regarded as at present undecided. Practically, it is obvious that contraction of the bowel on its contents must press them in the direction in which they can most easily go; and if they cannot pass onwards, in consequence of obstruction in front, they must pass backwards in the direction in which the way is open.

3. *Constipation.*—Constipation is of necessity a constant symptom of intestinal obstruction. It may be absolute from the first, or may become absolute after a variable period during which more or less scanty fæcal evacuations may be passed. It must be borne in mind that even after complete occlusion has occurred, there may remain in the bowel below the seat of obstruction some portion of its contents; and the secretions and excretions of the mucous membrane being added, the evacuation of these by natural effort, or by aid of enemata, may give rise to the false idea that the occlusion is not complete, or that relief has been obtained. Often, however, the bowel below the obstruction at once ceases to act, and after death may be found to contain fæces, although the constipation has been absolute. This is more likely to occur when the seat of the obstruction is high up. In intussusceptions, especially in the more chronic cases, the bowel is rarely altogether impermeable from the first, though later it becomes so, from the effects of inflammatory swelling. In such cases, sudden constipation is often followed by a period during which small quantities of fæcal matter, mixed with blood and mucus, are passed, and this is succeeded by absolute constipation so far as fæcal matters are concerned, blood and mucus only being passed. In strictures of the bowel, either simple or from morbid growths, or in compression by tumours, &c., constipation comes about comparatively slowly, and is often only rendered absolute by a twist or kink of the bowel, or by impaction of some portion of its contents. A very constricted condition of the canal, especially of the small intestine, in the absence of accidental plugging, suffices to permit the onward passage of its normal contents.

4. *Abdominal distension and swelling: Meteorism.*—The occurrence of obstruction, from whatever cause, is followed by distension of the intestine above the seat of obstruction, from accumulation of its contents. But the degree of distension, and the rapidity with which it comes on, vary with the cause and seat of the obstruction. In acute internal strangulation distension comes on rapidly and severely; in chronic obstruction it comes on gradually; in intussusception it rarely occurs, at any rate during the early stages. The portion of bowel immediately above the seat of occlusion is first affected, and sometimes its position can be recognised by the 'slight fulness to palpation,' and the 'much more definite dulness to percussion,' presented 'where many of the other indications of obstruction are scarcely perceptible, or even absent' (Brinton.) More or less speedily the distension increases, and the whole extent of bowel above the obstruction becomes affected. The more rapidly distension takes place, and the greater its degree, the more serious as a general rule is the aspect of the case, and the sooner is a fatal result likely to ensue. In the earlier stages, when the seat of obstruction is in the duodenum or high up in the jejunum, the distension is limited to the epigastrium or upper part of the abdomen, the lower parts appearing sometimes sunken. When the obstruction is below the middle of the small intestine or in the cæcum, the distension occupies principally the middle region of the abdomen at first, but gradually extends over into the flanks, the small intestines passing into the regions of the colon. When the hepatic flexure or the first part of the transverse colon is affected, distension appears at first in the right flank. When the obstruction is in the sigmoid flexure or the rectum, more or less speedily after distinct fulness of the left flank the whole region of the colon becomes distended, and the transverse colon often becomes especially prominent, leaving the mid-region of the abdomen below comparatively sunken. But very soon, either by implication of the small intestine from accumulation of contents, or from insufficiency of the ileo-cæcal valve—or more usually, perhaps, from extension of the sigmoid flexure over the front of the abdomen, and doubling down of the transverse colon—the distension becomes general. It must be borne in mind that the colon may be so distended and displaced, as to completely cover in, and conceal from examination, the small intestines. The abdominal distension occurring during the earlier stages of obstruction is characterised by tympanites, and more or less tension of the abdominal walls, with but little tenderness on pressure—sometimes, indeed, moderate pressure affords a sense of relief. Fluctuation is rarely obvious. The distended portions of bowel, as already indicated, can often be made out, and in many cases the peristaltic efforts and movements of the small intestines can be clearly recognised from time to time, through the abdominal wall, by sight and touch. One coil of intestine can be perceived rising up and becoming prominent, and then sinking down and giving place to another; and sometimes waves of action, as it were, seem to pass along a considerable length of bowel. Such movements recur at irregular intervals, and are

accompanied by gurgling noises and sensations (borborygmi), and by exacerbation of suffering. They are most frequently met with in cases in which the obstruction is of a chronic character, and is seated in the cæcum or first part of the colon. They are less commonly recognised when the obstruction is low down in the colon, the sigmoid flexure, or the rectum; and they do not as a rule occur in cases of acute internal strangulation, or in intussusception. They cease when the bowel has become paralysed by continued distension; or when peritonitis has supervened, or rupture has occurred.

Apart from such distension from accumulation of intestinal contents as has been discussed, certain localised swellings in the abdomen, which can often be recognised on examination, are liable to occur in connection with some forms of obstruction. Thus, intussusception commonly gives rise to an elongated, sausage-like swelling. Tumours of various kinds; misplaced viscera compressing the bowel; growths occupying the bowel itself, especially the rectum; and foreign bodies, intestinal concretions, and, though very rarely, gall-stones—all of these may cause swellings perceptible to the eye, or appreciable on digital examination, either of the external surface, or by the rectum or vagina.

5. *Derangement of the urinary excretion.*—In occlusion of the intestine occurring high up, especially in cases of acute strangulation, the excretion of urine is usually diminished to a great extent, and sometimes is almost or entirely suppressed. This may be due in part to the persistent vomiting, and consequent diminution of fluid for absorption (Barlow); in part to some vicarious secretion into the bowel (Brinton); and in part to some reflex inhibitory influence, exerted through the sympathetic nervous system upon the excreting function of the kidneys (Sedgwick, Fagge). When the obstruction is low down, affecting the lower part of the colon or the rectum, there is no marked diminution in quantity; there may even be an excess of limpid urine excreted, with sometimes, however, a difficulty in voiding it.

6. *General aspect, signs, and symptoms.*—In cases of acute obstruction from the first, and in the later stages of chronic obstruction, the general aspect of the patient is more or less characteristic. The countenance is expressive of physical anxiety and distress: the eyes are sunken, the nose pinched, the cheeks hollow, the lips pale or purplish, and the complexion faintly livid; the general surface is pale, cool or cold, and either dry or covered by profuse clammy perspiration; and although the mental faculties are as a rule undisturbed, there is a disposition to torpor, from which the sufferer is from time to time aroused by exacerbations of pain, or recurrence of vomiting. The pulse is small and thin, and towards the end becomes thready. Usually it is increased, but sometimes (for a time at any rate) it may be diminished in rapidity. The temperature is often lowered to a very marked extent, but rises if peritonitis sets in. Sometimes there is more or less dyspnœa, due either to reflex nervous influence, or to pressure upwards of the diaphragm by the distended bowel below, and the latter cause also often gives rise to distressing hiccough. The voice is altered in character, and towards the end is almost or entirely lost. The tongue is red; dry and pointed; or dirty brown and covered by thick tenacious mucus, coloured by vomited material. The patient suffers from severe and constant thirst, which often he fears to assuage, lest vomiting should be provoked. In some exceptional cases death has been preceded by subdelirium and coma; and in others, still more exceptional, by violent delirium and convulsions. In children convulsions occasionally occur at the commencement or during the early stages of intussusception, as well as towards the end, and probably arise from reflex nervous disturbance. The torpor commonly noticed may depend not only on general depression, but also in great measure upon imperfect aëration of the blood, from interference with respiration; and the coma, convulsions, and other nervous symptoms which occur in rare cases, have been attributed to uræmic poisoning from suppression of urine.

7. *Collapse.*—Collapse may occur at the commencement of an acute, or may immediately precede the fatal termination of a more chronic case of intestinal obstruction. When it occurs at the commencement, as in acute strangulation, acute intussusception, or sudden impaction of a gall-stone or foreign body, it is due to the shock of the injury at the moment inflicted; when it occurs after a more or less considerable interval, whether in an acute or in a chronic case, it is usually associated with rupture of the intestine, and extravasation of its contents into the peritoneum.

Diagnosis.—The general diagnosis of intestinal obstruction rests on the history of the case; and on the recognition and due appreciation of the symptoms and signs above discussed. In order to arrive at a right conclusion, not only must all the symptoms be fully considered, but careful and thorough examination of the abdomen must be made, by palpation and percussion of the external surface, and by exploration of the rectum and vagina. Such thorough examination should be instituted, and the differential as well as the general diagnosis made out as clearly as possible at the earliest practicable period, before general abdominal distension or the supervention of complications can have obscured the indications first presented. In some cases it may be desirable to administer ether or chloroform, in order to facilitate the examination by relaxing the abdominal muscles, and to save the patient from needless increase of pain. In all cases in which the symptoms indicate acute strangulation, the rings and openings of the abdominal walls must be carefully examined, and the previous or actual existence of an external hernia inquired into. In cases of chronic obstruction in which occlusion has come about gradually, or is even yet incomplete, it is especially necessary to explore the rectum as thoroughly as possible, by the introduction of the finger, or even of the whole hand. In the female, exploration *per vaginam* is often no less needful.

Various morbid conditions may give rise to symptoms—pain, vomiting, constipation—more or less closely resembling or simulating those of intestinal obstruction. Among such may be mentioned certain forms of colic, such as hepatic colic or renal colic; ulcerative enteritis, especially of the cæcum and appendix cæci; perityphlitis; and intense peritonitis, such as follows perforation. In these conditions there is arrest of action, but not mechanical obstruction of the intestine; a distinction which it is important to bear in mind. The history and progress of the case, together with due recognition of the more distinctive concomitant signs and symptoms usually presented by each of such conditions, serve as a rule to establish the diagnosis, though it may be often difficult, and sometimes may even remain doubtful.

Course, Complications, and Terminations.—The tendency of intestinal obstruction, from whatever cause, is towards a fatal termination, at an earlier or later period according to circumstances, and with or without the supervention of more or less obvious and extensive complications. But in respect to the more acute forms, there are scarcely any in which relief may not be afforded, sometimes coming about spontaneously as it were, almost as suddenly and unexpectedly as the lesion has occurred, sometimes resulting after an extended period of suffering, and sometimes consequent on the treatment adopted. In the more chronic forms, with the exception of those depending upon impaction of fæces, and some others perhaps (as chronic intussusception), complete and permanent relief is less likely to be obtained; and death, though considerably longer delayed, is almost more certain to ensue sooner or later, in spite of temporary relief afforded by operative measures or in other ways.

The *complications* and *accidents* that are liable to occur and to conduce to the fatal result are:—peritonitis starting from the seat of the lesion, and more or less rapidly spreading and becoming general; enteritis; ulceration and perforation of the bowel; sloughing of the strangulated or intussuscepted portions; hæmorrhage into the peritoneum or into the bowel; pneumonia, due to the entrance of vomit into the air-passages, or to pyæmia from absorption of decomposing and poisonous material; gradual asphyxia from interference with respiration by abdominal distension; uræmia; coma; and syncope from cardiac depression and cerebral anæmia.

In cases of acute strangulation, and others in which the occlusion has been sudden and complete from the first, and in which timely relief has not been obtained, the average *duration* has been found to be from five to six days. But death may occur within a few hours, or not until after the lapse of ten days or a fortnight. In cases of constriction or compression, in which complete occlusion has come about gradually, or even has not been finally established, the duration of life varies greatly according to circumstances and the complications which arise, and it may be prolonged for weeks, months, or even years.

Treatment.—The treatment of intestinal obstruction must necessarily be determined by the cause and the circumstances and conditions of the particular case with which we may have to do—and therefore can be more specially indicated and discussed in the subsequent consideration of the several forms of obstruction. But some general statement of methods of treatment may be not inappropriately given at once, inasmuch as tentative measures for relief are often called for before any definite conclusion as to the precise cause of the trouble can be arrived at.

1. *Purgatives.*—As a rule, when the existence of obstruction is established, and emphatically in all acute cases, violent purgatives are to be avoided. They tend to increase rather than to relieve the mischief. The object should be in the first place to soothe, and not to irritate and excite the suffering part. In cases in which it may have been deemed right to administer a strong purgative in the first instance, (and this is often done before the physician or surgeon is called in) failure of effect decidedly contraindicates the repetition of any similar dose. When all urgent symptoms have subsided, however, and in the more chronic cases, mild laxatives (especially some salines) often prove of great value—but caution in their administration is necessary.

2. *Sedatives.*—In almost all cases of intestinal obstruction sedatives and antispasmodics are demanded; and opium and belladonna, conjoined or separately, are the most useful and reliable medicines we possess. They should be given freely, but with judgment, according to the effect produced. They may be administered by the mouth; or, if the vomiting is severe and frequent, by the rectum, or by subcutaneous injection, in the form of morphia and atropine. In very acute cases the inhalation of chloroform or ether may sometimes be desirable, and may prove at any rate temporarily efficacious in relieving urgent suffering.

3. *Enemata.*—Injections more or less copious of simple gruel, soap and water, with or without the addition of oil, castor oil, turpentine, or ether, or of pure olive oil in quantity, are constantly of great service in cases of intestinal obstruction, not only in establishing the diagnosis, but also in affording relief to a more or less complete extent. In many cases it is advantageous to administer the enemata with the body inverted, or at any rate with the lower part well raised, and at the same time to manipulate the abdomen (*massage—abdominal taxis*), but this must be done with caution. When very copious enemata are deemed desirable, they may be administered more gradually, and probably more safely, by the syphon and hydraulic pressure than by means of the syringe. It has been sought to estimate the seat of the obstruction by the quantity of fluid that can be thrown into the rectum; but as a general rule no satisfactory conclusion can be thus arrived at.

4. *Insufflation.*—In cases of intussusception, insufflation of air by means of bellows has sometimes proved efficacious in affording relief; but in almost all other forms of obstruction this method of treatment has rather added to the distress of the sufferer.

5. *Local applications.*—Hot fomentations and poultices, especially with the free application of local anodynes (solutions of opium, belladonna, hemlock, or aconite), often materially relieve suffering, and thus, as well perhaps as by causing determination to the surface, and lessening in-

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ternal congestion, favour recovery. On the other hand, the application of ice-bags to the surface of the abdomen has been strongly advocated, and in some cases has certainly seemed to be productive of benefit. Galvanism to the surface—or with one pole introduced into the rectum—with the view of stimulating the peristaltic action of the bowel, has also been advocated.

6. *Abdominal taxis* (Hutchinson); *massage.*—Careful manipulation of the abdomen, with movement of the body from one position to another, has in some cases proved successful in bringing about relief of intestinal obstruction.

7. *Surgical operations.*—In many cases operative measures of one kind or other are urgently demanded, and seem to afford the only chance of rescue from impending death, or from more or less prolonged suffering. And although the statistical results hitherto may not seem very encouraging, yet careful consideration of the causes of failure in the past, and due regard to recent advances in surgical treatment and appliances generally, warrant the belief that such measures will be adopted more frequently, under more favourable circumstances, and more successfully in the future. The surgical operations demanded in intestinal obstruction may be divided into those which have for their object the removal of the cause of the obstruction, and those which aim solely at affording relief by establishing an opening above the seat of obstruction. The various methods will be best discussed in connection with those forms of obstruction in which they are respectively indicated.

Varieties.—The several varieties of intestinal obstruction, according to the pathological cause of the condition, will now be discussed.

I. Obstruction from Congenital Malformation.—Arrest or modification of the normal process of development, or the occurrence of peritonitis during intra-uterine life, may give rise to congenital constriction, or to defective continuity of the intestinal canal, resulting in more or less absolute occlusion.

Constriction or occlusion of such kind is occasionally, but very rarely, met with in the duodenum at or about the entrance of the common duct, or about the junction of the duodenum with the jejunum; and in some cases has appeared to depend upon valve-like folds of mucous membrane, somewhat resembling enlarged or confluent valvulæ conniventes. The lower portion of the ileum, near the ileo-cæcal valve, or about the point of junction with the omphalomesenteric duct, where a bend or twist takes place, appears more liable to be so affected, and instances have been from time to time recorded. The colon, and almost exclusively the sigmoid flexure, is the part of the bowel most frequently constricted by the effects of intra-uterine peritonitis and consecutive twisting; but instances are comparatively rare.

All such classes of cases are of pathological interest, rather than of practical importance. Vomiting of meconium, absence of proper evacuation, straining, convulsions, and evidences of more or less severe suffering, are followed by speedy death, though in some rare instances life has been prolonged for weeks or even months. No treatment can be of avail; and surgical operation can only hasten death, or at best succeed in prolonging misery.

Very much more common, and somewhat more hopeful, are those cases in which there is congenital defect of the lower part of the rectum, or of the anus. They may be divided into—(1) Those in which there is simply imperforate anus, the bowel being closed by a membranous or more or less thick layer of tissue, and forming a distended *cul de sac* above the floor of the perineum: (2) Those in which the anus is formed and leads into a *cul de sac*, which approaches more or less closely to the *cul de sac* of the portion of rectum above: (3) Those in which the lower end of the rectum opens into the bladder, urethra, or vagina.

Symptoms. — Retention of meconium, with persistent straining and sometimes vomiting, or the scanty escape of meconium by the vagina, serve to suggest the probable existence of some such defect, the more precise nature of which can generally be readily ascertained on examination or exploration.

Treatment.—Immediate relief may often be afforded by surgical operation, and in some instances more or less permanent good results have been obtained, and by persevering management maintained; but survival to adolescence or adult age has seldom ensued. *See* Rectum, Diseases of.

II. Obstruction from Internal Strangulation. — The various anatomico-pathological conditions which may conduce to internal strangulation have been already enumerated or indicated. Of these, some depend upon abnormalities or peculiarities for the most part developmental in origin, the existence of which—previous to exploration or post-mortem examination—cannot be predicated or ascertained; others, however, depend upon the results of previous inflammatory mischief or accidents. In every case, therefore, it is important to inquire minutely into the early history of the patient; as well as into the circumstances immediately preceding the strangulation. No better illustration of this can be quoted than that afforded by cases in which strangulation has been caused by omentum adherent to the sac of an old reducible hernia.

The *small intestines* are especially liable to become strangulated by bands or adhesions (peritoneal false ligaments), they having been found to be so affected in upwards of 90 per cent. of such cases. Bands, sometimes rounded and thread- or cord-like, sometimes broader and flattened, are met with from time to time, stretching from one part of the mesentery or omentum to another; but oftener attached by one extremity to mesentery or omentum, and by the other to some portion of bowel (comparatively rarely to the large intestine), or to the abdominal wall. Very rarely indeed are they found passing from one portion of bowel to another. The bowel may become incarcerated under or behind such bands (not in front between them and the yielding anterior abdominal wall), or it may be encircled by them, and they may be looped or even knotted or twisted round it; or, again, the bowel may become so kinked by the traction of a band adherent to one point, as to lead to its practical occlusion. The broader adhesions sometimes present slits, in which portions of bowel may be caught. Similarly, ruptures or slits may occur in the omentum or mesentery, or even in very rare instances in the suspensory ligament of the liver or broad ligament of the uterus; and these structures, especially the omentum, by adhesions may constitute broad or narrow bands, under which incarceration may take place, or by which portions of bowel may be surrounded and strangulated. Diverticula, and diverticular appendages (the obliterated omphalo-mesenteric vesels, &c.), by adhesion or by looping, and the appendix cæci, either adherent, usually by its extremity, or spirally elongated and twisted, may lead to a like result. It is worthy of note that by these, as by the foregoing conditions, the small intestine is most frequently affected. So also in the various forms of internal hernia (hernia into the foramen of Winslow, into peritoneal pouches, mesocolic, duodeno-jejunal, retro-peritoneal hernia, &c., all of which are very rare), it is still the small intestine that is most frequently involved.

Internal strangulation of the small intestine, depending on the several causes thus indicated, is most commonly met with during early adult life, the average age being about twenty-two years; and one sex does not appear to be much more liable to suffer than the other, except in the case of strangulation by diverticula, which has been observed about twice as frequently in the male as in the female subject.

The *large intestine*, as might be expected, is much more liable to become strangulated by torsion or twists than the small, and the sigmoid flexure is the part most frequently affected. Out of 106 cases, in 65 the large intestine (in 60 of these the sigmoid flexure) and in 41 the small intestine was found involved. The intestine may be twisted about its mesocolic or mesenterial axis, or one loop of intestine may be intertwined with another. In conjunction with the twisting there may be falling over, as it were, and dragging down, due to the weight of the intestinal contents. Twists of the intestine occur most frequently during the later periods of middle, or during advanced life. Their occurrence is favoured by original peculiarities in the length and disposition of the peritoneal folds, or by corresponding peculiarities acquired as the result of the stretching and relaxation which accompany the changing condition of parts at different periods of life.

The occurrence of internal strangulation is determined by the entrance of a portion of bowel into some such dangerous position as has been indicated, and its retention there. This may be due to a relaxed condition of the bowel—it may be after diarrhœa—and pressure upon it by the action of the abdominal muscles during some strain or twist of the body; to undue and irregular movement of the bowel itself; to the weight and dragging of fæcal matter accumulated at one part, and the futile effort of the bowel above to move it onward; or to some accidental circumstance that can neither be ascertained nor defined. Absolute strangulation may occur suddenly and at once; or may be brought about only after an appreciable period, by the consecutive swelling of the incarcerated or twisted bowel.

Symptoms.—The symptoms of internal strangulation closely resemble those of strangulation of external hernia; but often they are more acute, and unless relief is obtained, lead more speedily to a fatal result.

Intense abdominal pain, generally in the mid-region; not infrequently accompanied by collapse, either at the very commencement or very early supervening; severe and frequent vomiting, soon becoming more or less distinctly fæculent; abdominal distension, at first localised, rapidly becoming more or less general; constipation, with urgent desire and vain effort to evacuate the bowel—all coming on without warning in an apparently healthy subject, constitute a group of symptoms sufficiently characteristic. As the case progresses, these symptoms persist, increasing, or, in some respects, intermitting or decreasing in severity according to circumstances, and becoming more or less masked, modified, or added to by the symptoms of the complications already indicated as likely to arise, until either relief is obtained, or death ensues.

Cases have occurred from time to time in which all, even the most severe, symptoms of internal strangulation have been present, but in which relief has come about almost as suddenly as the distress has arisen; and it would seem that in such cases, after a period of rest, either by the aid of treatment or otherwise, the strangulated bowel has, as it were, recovered itself, and released itself from its entanglement, or reversed its twist. But such cases are rare, and very much more frequently it happens that death results, either very quickly from shock, or within four or five days from intense peritonitis, following, or without rupture of the bowel.

Treatment.—The treatment of a case presenting the above symptoms resolves itself into the question as to whether mere palliative measures should be perseveringly adopted, and the patient allowed to take his chance; or whether an attempt should be made by surgical operation to release the bowel, and thus afford opportunity for recovery (laparotomy), or to give relief by opening the bowel above the seat of obstruction (enterotomy).

During the earliest periods, and before the nature of the case is fully pronounced, there can be no doubt but that palliative measures alone should be adopted. Such measures consist in perfect rest; relaxation of the abdominal parietes by position; the application of either ice or a hot anodyne fomentation (each having its respective merits) over the especially suffering part; and the administration (after collapse has passed) of opiates and belladonna—by the mouth, subcutaneously, or by suppository, or of chloroform or ether by inhalation, as circumstances may indicate. If the physician do not venture to advise, or the surgeon be not bold enough to adopt operative interference, similar measures may be pursued still further, inasmuch as they tend to relieve suffering, and to lengthen the time during which relief may possibly come about. Enemata may be used, but strong purgatives can only add to the distress, and increase the danger of the patient. A little ice may be sucked with advantage from time to time; but it is worse than useless to attempt to introduce food or medicine in bulk into the stomach, only to be again speedily vomited.

Abdominal taxis.—After one, two, or at most perhaps three days (according to the circumstances and conditions of the particular case) have elapsed, without abatement, or with probable increase in the severity of the symptoms, when the nature of the case is clearly pronounced, and especially if the seat and cause of the obstruction are indicated, surgical operation appears to the writer imperative; and the earlier this is done, the better is the chance of success. The writer cannot forbear expressing in this place the strong feeling and conviction, after long consideration and some experience, that he entertains on this matter. Before proceeding, however, to the use of the knife, it may be well under chloroform to try the effect of changes in the position of the body, and of 'abdominal taxis' by gentle, firm, sustained manual compression of the part of bowel presumably strangulated and distended, and by attempts at movement in one direction or another. The good effects of sustained compression, with the view of emptying the distended bowel of its contents, rather than of pushing it back, in the reduction of external hernia, are not sufficiently generally appreciated and systematically attempted. And further, every surgeon of experience has met with cases of external hernia in which the movements or joltings of a journey to the hospital have resulted in reduction. So it may be with some cases of internal strangulation.

Abdominal section.—If such attempts fail, an incision should be made in the middle line downwards or upwards (as the indication may be) from the umbilicus into the abdomen, of sufficient extent to permit the introduction of the fingers, and the seat and cause of the obstruction sought for. As a rule, it may be better to extend the incision so far as to afford a clear view of the strangulated bowel; but it must be borne in mind that the longer the incision the more, probably, will the distended bowels protrude, and the greater will be the difficulty in replacing and retaining them. Any constricting band that may be discovered may then be divided, and the bowel released, or a twisted portion may be restored to position. The chief difficulties likely to occur arise from the protrusion of distended bowel, which is apt to hinder proceedings. Punctures may be made by a fine trocar and canula; but all such punctures should be carefully closed by ligature or suture. The chief immediate danger is that of giving way of the bowel at the seat of strangulation at the moment of release, and extravasation of its contents; but in cases in which this happens, it is almost certain that similar rupture would have speedily occurred if matters had been allowed to take their course. Any such opening in the bowel should be at once closed by suture, and every effort made to prevent extravasation into the peritoneal cavity. It has sometimes been found desirable to attach the edges of the ruptured portion to the abdominal parietes, with the view of establishing an artificial opening.

In cases in which there has been an external hernia, it may be preferable to make the incision in the groin, and to extend it upwards as far as may be needful. In several such cases (four in the writer's own experience) the cause of strangulation has been found to be omentum adherent to the sac of the old hernia, division of which up in the abdomen has resulted in release of the strangulated bowel. After the operation the abdominal incision should be carefully closed, and the patient kept for some time thoroughly under the influence of opium.

It must be admitted that the statistics of operations for internal strangulation do not seem encouraging. In 61 out of 95 recorded or observed cases death followed more or less speedily, and in 34 only did recovery take place. But the causes of failure are obvious. In most cases there has been either some error in diagnosis, or the operation has been performed too late, and at a period when recovery under any circumstances would have been hopeless. Increased accuracy in diagnosis; earlier resort to operation; and the adoption of improved surgical methods, among which must be especially urged the use of antiseptic precautions, may be confidently expected to yield better results in the future.

Colotomy.—In cases in which it appears that the lower part of the colon or sigmoid flexure is strangulated by twisting or doubling over, and in which it is deemed inexpedient to perform abdominal section, temporary relief at any rate may be afforded by lumbar colotomy—right or left. Or simple puncture of the colon by a fine trocar and canula may give relief, temporary or permanent, by affording escape for the flatus.

Enterotomy.—The operation of enterotomy is applicable to cases of chronic, rather than of acute strangulation, and will be subsequently referred to.

III. Obstruction from Impaction of Gall-stones.—Gall-stones may enter the intestine, either after passing down the gradually dilated duct, or after a process of inflammatory adhesion and ulceration between the gall-bladder and the duodenum or colon. It is in this latter way probably that gall-stones large enough to block its canal get into the bowel; and hence in such cases, though there is usually a previous history of more or less suffering in the hypochondriac region (which may assist the diagnosis), yet those paroxysms of pain and the jaundice which accompany the passage of gall-stones down the duct have not been experienced. Having entered the intestine, gall-stones may either pass along until they escape by the anus—sometimes giving but little trouble during their passage, sometimes being temporarily arrested, or damaging the bowel at one point or other, and giving rise to pain, vomiting, deranged action of the bowels, &c.; or they may become firmly impacted, and completely obstruct the intestinal canal. Obstruction from such cause, however, is comparatively rare, occurring in only about 8 per cent. of the cases of acute obstruction. It is met with about four times as often in the female as in the male subject; and almost without exception, or with very few exceptions, after late middle life—most frequently after the age of sixty.

The gall-stones which have been found to cause obstruction have been from one to two inches or more in longest diameter. As a rule they have been single, in some instances conglomerate. In a large proportion of cases they have been impacted in the duodenum or upper part of the jejunum; in some few instances about the middle of the ileum; and, again, in somewhat more cases, in the ileum near the ileo-cæcal valve. Impaction in the large intestine very rarely occurs, and has scarcely ever led to a fatal result, but in some instances it has been attended by very severe symptoms.

Impaction is favoured by natural or accidental narrowing of the bowel, and doubtless is aided or maintained by swelling of the mucous membrane and spasmodic contraction round the stone, as well as by a more or less persistently contracted condition of the bowel beyond it.

Symptoms.—The symptoms following impaction often come on suddenly, and are usually very acute; and death, preceded by all the indications of intense enteritis conjoined with those of acute obstruction, as a rule occurs in five or six days, if it have not occurred earlier as the result of shock. Recovery rarely takes place. In some few exceptional cases, however, relief has come about even after periods of severest suffering, by the release and onward passage of the stone; in some, the bowel has become stretched into a kind of diverticulum, in which the stone has remained lodged, a way by it being left; in some, after adhesion and ulceration, an opening has been formed between the small intestine and the neighbouring part of the colon through which the stone has escaped; and in some, again, after similar processes between the bowel and abdominal wall, the stone has escaped externally, or has been removed by operation.

Diagnosis.—The diagnosis of obstruction by gall-stone is aided by consideration of the age, sex, and previous history of the patient; the character and acuteness of the symptoms; the localisation of the earliest pain; and sometimes by the recognition on examination of a more or less distinct hard lump, corresponding to the obstructing gall-stone.

Treatment.—None other than palliative measures can as a rule be recommended; but having regard to the extreme danger of the condition, and the severe suffering of the patient, the operation of enterotomy would seem to the writer to be justifiable.

IV. Intussusception or Invagination.—By intussusception or invagination is understood the passage of one portion of intestine into the immediately adjoining portion.

Intussusceptions that have given rise to no symptoms during life are not infrequently found on *post mortem* examination, especially of the bodies of children, and those who have died of brain-disease. Such intussusceptions occur *in articulo mortis*, or immediately after death; they are easily reduced, are almost equally easily reproduced or imitated, and are accompanied by no sign of inflammation. They are of no practical import. But their possible occurrence should be borne in mind, lest, when met with, they should lead to false conclusions as to the cause of death or previous suffering.

Ætiology.—Intussusceptions occurring during life, and causing intestinal obstruction, are most frequently met with during infancy or early childhood. About one fourth of the cases on record have occurred during the first year, and more than one half during the first seven years of life. The male subject appears to be more liable than the female, in the proportion of about two to one.

The occurrence of intussusception would appear to be brought about, in the first place, by some irregular or disorderly peristaltic action of one portion of bowel, conjoined with inaction or paresis of another, dependent upon some ill-defined or unascertainable cause or other of derangement. Sometimes it follows diarrhœa or violent straining; sometimes it is associated with the presence of worms, or of masses of imperfectly digested food; and sometimes with the pressure or dragging of some new growth. Having once commenced, the intussusception goes on increasing, more or less continuously, as the result of peristaltic action. The portion of bowel first invaginated, as a rule, advances at the expense of the receiving portion, which turns in to form the middle layer. The length of bowel involved varies greatly in different cases, as a matter of course. But the process may go on until the portions first involved, having traversed the whole length of the colon, may reach, or even protrude or be expelled from the anus.

Anatomical Characters.—As a rule, with but very few exceptions, it is the upper portion of the bowel that passes into the lower. In ordinary cases the intussusception is *complete* and *single*, and thus a transverse section shows three rings of bowel; a longitudinal section, three layers of bowel on each side; the outer and middle layers having mucous surfaces in mutual contact, and the middle and inner having serous surfaces in mutual contact. In some rare cases, however, the intussusception is said to be *incomplete*; in such a funnel-shaped process is drawn down, usually by the dragging of a pedunculated tumour, from some part of the intestinal wall into the canal. In some cases, again also rare, the intussusception is *double*, the whole intussusception-mass being received into another portion of bowel; under such circumstances four rings or layers are shown on section.

Between the middle and inner layers the mesentery, or mesocolon, or both, as the case may be, are also received, and these determine, from the first, peculiarities in the conformation of the intussusception; and the consequent compression of their vessels, and arrest of the circulation through them, bring about complications and more or less characteristic effects, such as congestion and swelling, ecchymosis, and even considerable hæmorrhage.

Almost any part of the intestinal tract may be involved, but some parts are involved much more frequently than others. Thus in upwards of 50 per cent. of the cases, the ileum and cæcum have been found passing into the colon (*Intussusceptio ileo-cæcalis*); in about 30 per cent. the small intestine has alone been involved—the ileum in most of these (*I. ilealis*), the jejunum

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in a few (*I. jejunalis*), the duodenum in still fewer (*I. duodenalis*). In some a portion of ileum invaginated in another portion has passed on through the ileo-cæcal valve into the colon (*I. ileo-colica*). In about 12 per cent. of the cases the colon only has been involved (*I. colica*). The rectum, though it constantly forms the receiving layer of an extended intussusception, is very seldom primarily affected, except as the result of the dragging of, or pressure upon some new growth.

Symptoms.—The symptoms of intussusception usually appear suddenly and are very severe. First, there is pain, often most intense and agonising, sometimes like that of colic, sometimes 'straining and tearing' in character, felt most distinctly at a spot corresponding to the commencing lesion. In children convulsions sometimes occur. Vomiting speedily supervenes, and the vomited material is often streaked or mixed with blood, and, sooner or later, usually becomes fæculent. Diarrhœa soon sets in, and, accompanied by severe straining and tenesmus, recurs at frequent intervals. The evacuations, at first fæcal, very early are stained with blood, and soon consist of little more than blood and mucus, with only a slight admixture of fæcal matter, or none at all. The occlusion of the bowel is often not complete at first, but it speedily becomes so from congestion and swelling. After a variable period, some remission in the severity of the symptoms takes place, to be again followed by paroxysmal exacerbation.

On examination of the abdomen, a firm, cylindrical, 'sausage-like' swelling, of greater or less length, can be distinctly felt, and recognised as the intussusception-mass, in almost all cases of ileo-cæcal or colic invagination. In cases in which the small intestine alone is involved, such swelling is much less distinct and smaller, and often cannot be made out at all. When the intussusception has reached the lower part of the rectum, which it may do even by the second day, it can be readily felt, and its character can often be determined on examination *per anum*.

Diagnosis.—The diagnosis of intussusception of the intestine is generally established without difficulty, by the recognition of the signs and symptoms thus indicated, at any rate during childhood, and in the more acute cases. In some of the more chronic cases occurring in adult life, however, it is not always easy.

Course and Progress.—The course and progress of a case of intussusception may be (1) *acute*. Unless relief is obtained, the case will then terminate fatally, either speedily from shock, or within four or five days in children, or within a week or ten days in the adult from peritonitis or exhaustion. Or (2) the case may be *sub-acute*; death occurring within three or four weeks. Or (3) the case may become, or may be from the first, more or less *chronic*, and terminate in death only after a period of weeks or months, from peritonitis, or enteritis, followed or not by perforation; or from wasting and exhaustion. Lastly, recovery may take place after sloughing, separation, and evacuation of the invaginated bowel. The last event, which is of great interest, and, in regard to prognosis, of great importance, very rarely takes place during childhood. It follows peritonitic adhesion between the invaginated and receiving portions of bowel, and death of more or less of the former from deprivation of blood-supply. Numerous cases of this nature are on record, varying in detail. In most of them it has been some portion or other of small intestine that has come away. In some, however, the cæcum with its appendix and portions of the colon have been found. Sometimes the sloughed intestine is evacuated in shreds or fragments, sometimes in its entirety. Such separation and evacuation take place, as a rule, in from eleven or twelve days to three or four weeks, and much earlier in the case of the small than of the large intestine. In some instances the adhesions have given way at or immediately after the separation of the slough, and fatal extravasation of fæces has occurred; and in some a permanent stricture has resulted after fair prospect of recovery had been afforded.

Treatment.—*Acute* intussusception, especially in the child or infant, demands prompt and active measures for its relief. Purgatives can only increase the mischief; palliatives are, as a rule, of little or no permanent avail, though opium and belladonna may sometimes do good by relieving pain, checking undue peristaltic action, and thus hindering the progress of the lesion, and affording a possible chance of recovery, or, at least, by rendering the remaining hours of life comparatively free from suffering.

When once the diagnosis is established, resort should be had without delay to mechanical or operative treatment, for in such measures, according to the results of experience, lie the best prospects of complete and permanent relief. First, a copious enema of oil, or oil and thin gruel, should be gently and slowly injected, the body being inverted, and moved from one position to another, abdominal taxis and manipulation being, meanwhile, carefully and systematically carried out; or, in place of liquid injection, insufflation of air by means of bellows may be employed. If the intussusception have protruded from the anus, it should, of course, be first replaced, and if felt in the rectum pushed up as high as may be practicable. Numerous cases are on record in which such means have been attended by success. But should they fail after full and fair trial—and more than three or four attempts should not be made unless signs of improvement in the condition are manifest; then surgical operation—laparotomy—becomes justifiable, and increasing experience encourages its adoption. Laparotomy should be undertaken before there has been time for the formation of adhesions, or the supervention of general peritonitis. The abdomen having been opened, with all due precaution, by median incision of requisite extent, the intussusception is usually found without difficulty, and may be traced upward and downward. Reduction may generally be effected with comparative ease by gentle traction upon the upper part of the invaginated portion, combined with gradual working up of the lower part by manipulative pressure from below upwards upon the receiving portion (Hutchinson). After the operation, the wound must be carefully closed, an abdominal bandage applied, perfect rest secured, and after-treatment on general principles carried out.

In 15 out of 58 recorded cases this operation has resulted in recovery; in 43 it has been followed by death, although in most of these reduction was effected. It is probable, however, that a much larger proportion of successful than of unsuccessful cases have been published, and the figures must therefore be taken for what they may be worth; they suffice, however, to justify the more frequent and earlier adoption of such means of relief, especially under the protection of antiseptic precautions.

In the more *chronic* forms of intussusception, and especially in the adult, resort to operation is not so urgently called for. Palliative measures, and particularly the administration of opium and belladonna, with enemata from time to time, are often of the greatest service; and, as already indicated, recovery after sloughing of the intussuscepted bowel, or portions of it, not infrequently takes place, although consecutive and dangerous complications may sooner or later arise.

V. Obstruction from Constrictions.—The anatomico-pathological conditions involving some portion or other of the intestinal wall, which may give rise to obstruction, have been already enumerated or indicated. Regarding them the following further statements may be made.

1. *Simple cicatricial stenoses* may result from the effects of injuries inflicted by caustic poisons or foreign bodies; such are most likely to be found in the upper part of the small intestine; they are, however, very rare. Similar stenoses may follow the sloughing of intussusceptions; or the ulceration produced by temporarily impacted gall-stones, fæcal masses, or foreign bodies; or dysenteric, tubercular, or syphilitic ulceration of considerable extent and long standing. The dysenteric stenoses are most frequently found about the flexures of the colon; the tubercular in the lower part of the ileum or cæcum; and the syphilitic in the rectum or lower part of the colon. Typhoid ulceration is very rarely followed by stenosis.

2. *Peritonitic thickening and contraction*, with more or less matting together and constriction of the bowel, most frequently involves the small intestine or the flexures of the colon.

3. *New growths of innocent character*—fibromata, myomata, lipomata, and papillomata (benign villous growths)—are from time to time met with, connected with some part or other of the intestinal wall, and causing more or less obstruction, either by themselves blocking the canal, or by leading to dragging down of the part to which they are attached. Such growths often become polypoid. They are (with the exception of myomata and lipomata) most frequently met with in the rectum, sometimes in other parts of the large intestine, very rarely in the small intestine.

4. *New growths of malignant character*—fibrous cancer, forming hard, narrow constrictions, slow to ulcerate, scirrhus, encephaloma, colloid cancer, epithelioma, cylindroma, and sarcoma—are much more common; and from the readiness with which they involve the whole circumference of the bowel, much more rapidly lead to serious obstruction than do those of an innocent character In about 80 per cent. of the cases such growths have been found affecting the rectum; in about 15 per cent. the colon and cæcum; and in only about 5 per cent. some part or other of the small intestine.

SYMPTOMS.—The various conditions thus described, develop more or less gradually; and the symptoms to which they give rise are chronic in character, and in their earlier stages by no means well marked. Disordered, irregular, and imperfect action of the bowels, and general discomfort occurring from time to time, with intervals of comparative ease, constitute the earliest indications. Later, and after a very variable period, as the constriction increases, the trouble becomes greater and more constant, and the symptoms of obstruction become more pronounced. In most cases abdominal distension (meteorism)—localised or general, and accompanied by sensations of fulness, fœtid eructations, shortness of breath, and pains in the back, varying in degree from time to time—comes on sooner or later; and except when the seat of obstruction is in the rectum, the peristaltic movements of the intestines at intervals become very manifest through the abdominal wall. The pain experienced is very variable in character and severity, and is often paroxysmal, with periods of complete intermission. As the case progresses towards a fatal termination, the distress becomes extreme. Absolute occlusion, as a rule, comes about slowly. In some cases it is never completely established; but in other cases it occurs suddenly, from impaction of hardened fæces or undigested food, or from other cause; and in such the symptoms at once correspondingly increase in severity. It is worthy of note that even in cases in which the seat of constriction is in the sigmoid flexure or rectum, the greatest fæcal accumulation and corresponding discomfort are observed in the cæcum.

DIAGNOSIS.—The general diagnosis of obstruction from constriction, as a rule, is not difficult; but the differential diagnosis as to the precise nature of the constriction is often very obscure, except in those cases (the large majority) in which a stricture, or the presence of some new-growth, can be discovered on examination *per anum*. The previous history often supplies important indications, and should therefore be thoroughly investigated.

COURSE AND TERMINATIONS.—The course of all such cases, though very variable in duration, is progressively unfavourable, and sooner or later death supervenes, usually from peritonitis with or without perforation, or from exhaustion from prolonged suffering.

TREATMENT.—The treatment must be determined and varied in accordance with the symptoms and indications presented from time to time. In the earlier stages, soothing and palliative measures should be adopted during periods of exacerbation of suffering; and during periods of comparative relief laxatives may often be given with great advantage. In all cases in which there is reason to suspect the existence of some cause of constriction, the most careful attention to diet, and the administration from time to time of such medicines as favour a soft, semi-solid condition of the fæces, should be insisted upon.

Operation.—In the later stages resort must be had to surgical operation, and the greatest relief may often be afforded, and life prolonged, by the establishment of an artificial anus by opening the bowel above the seat of constriction, either by incision through the peritoneum—enterotomy; or by post-peritoneal incision—lumbar colotomy, right or left. Laparotomy is altogether out of the question.

In cases in which there is reason to believe that the constriction affects the *small intestines*, enterotomy should be adopted. An oblique incision in the right iliac region, more or less parallel with and above Poupart's ligament, having been made and cautiously carried down through the various structures, the peritoneum is to be opened to a limited extent, and the first protruding portion of distended small intestine is to be seized, and being well pulled out, opened by very limited incision. In the case of the small intestine, it is needless, on account of the semi-fluid nature of the contents, to make a large opening, and it is obviously disadvantageous to do so. The margins of the opening in the intestine are then to be sutured to the margins of the external wound. This operation, especially advocated by Nélaton, has proved successful in affording relief and prolonging life in a considerable number of cases (10 out of 16). One great drawback to it, in the event of prolongation of life, lies in the extreme inconvenience and annoyance the patient suffers from the continual escape of liquid fæces in the part of the body operated upon—an escape which there is the greatest practical difficulty in restraining.

In cases in which the seat of constriction is in the colon or rectum, lumbar colotomy (post-peritoneal enterotomy) is to be performed, on the right or left side according to the indications afforded. The merits of this operation in relieving suffering and prolonging life in such cases, can scarcely be esteemed too highly.

After the establishment of an artificial anus, and the rest from constant irritation thereby afforded, the constricted bowel may recover to a certain extent its permeability.

VI. Obstruction from Compression from without.—Various viscera, enlarged and displaced as the result of disease—especially the uterus and ovaries, and in rare instances the spleen, the pancreas, and even the kidney; tubercular or cancerous glands; tumours of the omentum or other parts of the peritoneum; tumours growing from one part or other of the abdominal or pelvic parietes, or from the contained viscera; hydatid cysts, &c., may so compress a neighbouring portion of bowel as to lead to obstruction, which either may be brought about gradually, or from some accidental cause may be suddenly determined.

Symptoms.—The symptoms more or less closely resemble those of obstruction, chronic or acute, arising from other causes.

Diagnosis.—Careful examination of the abdomen, including thorough examination *per vaginam* and *per anum* (sometimes the introduction of the whole hand into the rectum is especially likely to be useful), together with the history of the case, and the consideration of the collateral signs and symptoms, will generally suffice to establish, approximatively at any rate, the diagnosis of obstruction of the bowel from external compression.

Treatment.—The treatment of this condition consists, first, in the removal of the cause, if practicable; secondly, if this should be impracticable, in relieving the obstruction. By altering the position of the body, the displaced viscera may sometimes be so moved as to cease to compress the bowel; tumours, uterine and ovarian especially, may be taken away by operation; hydatid cysts may be tapped; and thus relief may be afforded. Or again, by manipulation or by the effects of copious enemata, the bowel itself may be so moved as to be no longer compressed; or after a period of rest, under the influence of sedatives, it may release itself. But if none of these measures should be applicable or successful, and if the symptoms of obstruction be severe, resort to one or other of the operations (laparotomy, enterotomy, or colotomy) already discussed, may become needful. In some cases, of this class especially, relief has been afforded, and the bowel has recovered itself, after puncture by fine trocar and canula and aspiration. The ultimate prospects must depend upon how far the compressing cause can be removed.

VII. Obstruction from Impaction of Foreign Bodies, Intestinal Concretions (Enteroliths) &c.

a. Foreign bodies in bulk, such as bones, coins, buttons, knives, forks, pins, needles, &c., accidentally or intentionally swallowed, occasionally find their way on from the stomach into the intestines. In a considerable proportion of cases they pass on, and are evacuated *per anum* without very much inconvenience; in some cases they give rise to enteritis and various other intestinal troubles; in some rare cases they lead to more or less complete occlusion, with acute or subacute symptoms.

Symptoms.—The symptoms of impaction of foreign bodies in the bowels vary with the extent of injury inflicted, and the degree of obstruction occasioned.

Diagnosis.—The diagnosis of such cases rests on the history, and on the recognition of the presence of the foreign body on palpation of the abdomen, or examination *per rectum*.

Treatment.—The treatment of this condition must be determined by the general circumstances and urgency of the case. As a rule, purgatives can only do mischief. Soothing remedies give temporary relief, and favour the gradual onward passage and ultimate expulsion of the foreign body. If absolute impaction has clearly taken place, and the symptoms are urgent, enterotomy and extraction may be justifiable, or even imperative. The wound in the intestine may either be carefully closed by suture, and the bowel returned; or its edges may be attached to those of the external wound, and an artificial anus temporarily established. In some instances, such procedures have been encouraged and favoured by the previous formation of inflammatory adhesions between the bowel and the parietes.

b. Foreign bodies—as hair, &c.; indigestible constituents of the food—as the skins, seeds, and stones of fruit (the husks of cereals, and oats especially), orange-pulp, and the curd of milk in young children; and some medicinal substances—as magnesia, chalk, oxide of iron, &c., swallowed bit by bit from time to time, may accumulate in some part or other of the bowel. Becoming matted or felted together, and agglutinated by the intestinal mucus and other secretions, these bodies may form rounded masses, which sooner or later may give rise to more or less complete obstruction. Such masses constitute the large proportion of the so-called 'intestinal concretions' in the human subject.

c. In some rare instances, however, hard stony concretions (*enteroliths*), consisting for the most part of phosphates of lime and magnesia with organic material, and resembling those not infrequently found in some of the lower animals, have been met with. These usually have as a nucleus some foreign body, or portion of hardened altered fæces.

Intestinal concretions are almost invariably found either in the cæcum or in the rectum. Their presence may commonly be recognised on examination. They are, as a rule, slowly formed, and only give rise to complete occlusion after a considerable period, during which repeated attacks of more or less persistent abdominal discomfort and distress have occurred. Death may be brought about by gradual exhaustion, or by the effects of inflammation with or without perforation; or recovery may follow the evacuation of the concretion, either *per vias naturales*, or through an ulcerated or artificial opening.

Foreign bodies introduced into the rectum, or which have passed down and there become impacted, and concretions similarly situated, may be removed *per anum*.

VIII. **Obstruction from Impaction of Fæces.**—Habitual or accidentally prolonged constipation may lead to definitive obstruction by impaction of fæcal masses, conjoined with paralysis and inaction of the bowel from distension, and contraction of the empty portion below. Sometimes the occlusion is rendered more absolute and irremediable by the doubling or dragging down of the bowel by the weight of its contents. The seat of the obstructing fæcal mass is usually the sigmoid flexure or the rectum, but corresponding accumulation is at the same time often found in the cæcum. This cause of obstruction is most frequently met with in advanced life, and especially among lunatics or idiots.

Symptoms.—The symptoms of fæcal impaction are characterised by their chronicity; and complete occlusion as a rule comes about slowly. There is little or no actual pain during the early stages, and even during the later stages, in the absence of complications, it rarely becomes acute. Vomiting is altogether absent at first, or slight and rare; towards the end, however, there may be fæcal vomiting. Abdominal distension only comes about gradually. Absolute constipation is only slowly established, and sometimes is preceded by more or less frequent scanty diarrhœa-like evacuations. The fæcal mass can sometimes be felt on abdominal examination, and much more often on rectal exploration, which in such cases should always be thoroughly carried out.

Diagnosis.—The diagnosis of such cases is determined generally without difficulty by the history; by the absence of acute symptoms; by the process of exclusion of other causes of obstruction; and by the aid afforded by physical examination.

Course.—In a considerable proportion of cases of this kind relief may be afforded by appropriate treatment. In some cases, however, death ensues from gradual exhaustion; in others from chronic peritonitis; and in others from ulceration of the bowel, followed or not by perforation and acute peritonitis.

Treatment.—In this form of obstruction of the bowels, very copious enemata, administered through a long, soft tube, carefully introduced and insinuated onwards as far as practicable, are especially useful. Such enemata—consisting of thin gruel, soap and water, oil, with or without turpentine, to the extent of two or three pints or more, should be given and repeated at intervals as indicated. Or a stream of warm water from a vessel raised to a height, through a long tube, may be advantageously made to play upon and wash away, portion by portion, the fæcal mass (Gay). Sometimes the mass may be cleared out of the rectum by the finger or a spoon. In some cases galvanism to the abdominal wall, in some the application of an ice-bag, in others hot fomentations or immersion in the hot bath, may be useful.

In the earlier stages, laxatives or even purgatives, as calomel in a full dose, or castor oil, may often be given with safety and advantage. A teaspoonful of Rochelle salts in a cupful of mutton broth, is an old but often efficacious remedy. In the later stages, and when purgatives have been found to fail or to increase distress, opiates are indicated; and belladonna in large doses seems often to exert a peculiar and beneficial influence.

When relief has been obtained, the greatest care as to diet and after-management is necessary, in order to prevent that recurrence of trouble to which the patient remains liable. *See* Constipation.

Arthur E. Durham.

INTESTINAL WORMS.—This combined term was formerly much employed in medical literature, as an equivalent for the simpler expression *entozoa*, which latter title is far better, more comprehensive, and now in general use. To be sure, nearly all the internal parasites of man, at some time or other during the course of their development, play the part of *intestinal* worms, within either the human or animal host; but since this particular residence frequently constitutes neither the only locality they occupy, nor the principal feature of their life-record, it is well that the use of these possibly misleading words should be discontinued. *See* Entozoa; Parasites; Worms; and Vermes.

T. S. Cobbold.

INTESTINES, Diseases of.—General Remarks.—Morbid affections of the intestinal tract are of very frequent occurrence at all ages; some being limited to certain periods of life, others presenting no such restriction.

The direct exposure that the canal offers to external influences, in the form of ingesta, will account for the causes of a large proportion of cases. So many irritants to disease have thus the opportunity to exert their immediate influence, and produce what may be termed *primary* affections of the canal. On the other hand, since much of the normal physiological work of the tract depends for its performance on a healthy condition of other functions, especially of the blood-circulation and nervous system, any disturbances of these processes will tend to influence injuriously intestinal digestion, and thus give rise to *secondary* diseases of the bowel. And it is evident that an improper preparation of the food in the intestine must in its turn affect the nutrition of the tissues generally, and among others those of the canal itself. In no case is the interdependence of the functions on one another seen more completely than in affections of the digestive apparatus.

For this same reason it is that the symptoms essentially due to any disease of the intestines may be considerably masked by more prominent signs of mischief elsewhere, though secondary to the intestinal affection; whilst in other cases the disease we may be called upon to treat is but an expression on the part of the bowels of a morbid state, primarily connected with some other organ.

Besides the direct nutritive disturbance of all organs and tissues of the body that must obviously follow any morbid condition of the intestinal function, there is a most close sympathy between the processes of digestion and the nervous system; or, in other words, a dyspepsia which may be so slight as practically to produce no apparent alteration in the general state of the body, may yet distinctly affect the mental condition, and all degrees of disturbance, from a mere irritability of temper to a complete hypochondriasis, may result. The frequent association of headache with dyspeptic symptoms is a further illustration of the connection; in reference to which we cannot avoid noticing the very extensive nervous supply that is provided by the sympathetic system to the chylopoietic viscera.

Although structurally continuous with the stomach, and closely associated with it in its working, the intestine nevertheless is exceedingly prone to be diseased independently of that organ, while at other times both suffer together. Certain spots in the course of the tract favour the development of certain diseased states, and it is rare to find the entire length of the canal involved; whilst one portion of the tube, the jejunum, is probably less liable to disease than any other organ of the body.

The indications of intestinal disease are frequently extremely vague and uncertain. The subjective symptoms, such as pain, may be completely wanting in some of the most serious conditions, or out of all proportion to the severity of the case. An ulcer may proceed to perforation, and a fatal result happen, with but a minimum of discomfort, whilst an attack of simple colic may be agonising. Nor is physical examination so fruitful in its results in the case of intestinal disease as it is in the affections of many other organs, though perhaps in no other region is the *tactus eruditus* so valuable. Many of the states to be considered below undoubtedly pass through their whole course without giving the slightest indication of their existence that can be recognised by physical examination. An investigation of the evacuations at present furnishes information within the narrowest limits. From all these circumstances, a diagnosis of many diseases of the intestines is almost a matter of pure inference and conjecture, based upon a careful consideration of all circumstances, with due regard to the value of experience.

In respect to treatment, very much may be done with the means at our command. The removal of causes is in a large proportion of cases easy, and a complete cure may be effected. And whilst some of the remaining cases admit of little or nothing being done for them, a greater number can be partially relieved by palliative remedies.

The several diseased conditions of the intestines may now be discussed, for the sake of convenience, in alphabetical order.

1. Intestines, Abscess in Walls of.—In the course of severe cases of enteritis—phlegmonous—where the inflammatory process affects all the coats of the bowel, and the products infiltrate the different tissues, collections of pyoid cells may be met with, but with no well-defined limit, which may be regarded as abscesses. Such bodies may burst into the intestine, leaving small ulcers; or through the peritoneal coat, and so conceivably cause perforation.

In the chronic enteritis so often met with in scrofulous subjects, the solitary and agminated glands may undergo slow suppuration, and form abscesses which end by bursting into the lumen of the gut.

Such morbid products are rather of *post-mortem* interest, since they give rise to no symptoms during life which will permit of their formation being diagnosed, apart from the general existing enteritis, and are practically incapable of treatment.

2. Intestines, Albuminoid disease of.—The intestines appear to be affected with albuminoid disease next in frequency to the spleen, liver, kidneys, and lymphatic glands, and it is rare for the alimentary canal to show signs of this degeneration until it has become far advanced in the above-named organs. It is stated that the intestines are affected in 42 per cent. of all cases (Habershon).

Anatomical Characters.—As in other organs, the inner coat of the arteries, particularly of those surrounding the solitary and agminated glands, appears to be the starting point of the albuminoid change, from which it gradually extends to adjacent tissues, until the whole thickness of the bowel may be replaced by this material. In milder cases it is limited to the mucous and submucous coats, which in all cases are the first to suffer. Considering the exceeding proneness of the Malpighian corpuscles of the spleen to undergo this change, it is noticeable that the solitary and agminated glands of the intestine, which are of similar structure, should long resist the degeneration, and in many cases may be quite unaffected. Sooner or later, however, the albuminoid granules appear in these structures, until the whole gland is involved. The mesenteric lymphatic glands are usually implicated; and in severe cases the mesenteric and peritoneal vessels, and even the appendices epiploicæ (Hayem).

The naked-eye appearance of the mucous membrane is that of a pale, thickened, leathery layer, often of a 'peculiar glistening aspect' (Friedreich). The pallor is very striking. When the degenerative process has become extreme, the surface is ulcerated, especially over the follicles, from fatty degeneration and breaking down of the new material, the diminished blood-supply by the constricted vessels leading to this result.

The small intestine, and particularly the lower part of the ileum, is the favourite seat of the disease, which sometimes extends upwards to the duodenum and stomach; the colon is sometimes affected.

SYMPTOMS.—The most prominent symptoms which this condition gives rise to, so far as the alimentary canal is concerned, are diarrhœa and hæmorrhage. Since the other important viscera are always simultaneously affected, other symptoms coexist.

The diarrhœa is rather characterised by fluidity than undue frequency of the stools, though the latter does occur; the evacuations are often greenish from altered blood. It is rare to find either pain or tenderness; and the diarrhœa when once established rarely ceases.

Dr. Grainger Stewart has shown that hæmorrhage from the surface of the mucous membrane, independently of any ulceration, is of frequent occurrence, and he considers it as due to rupture of the diseased vessels.

TREATMENT.—Enemata of starch and opium are the most efficacious, though their effect is at best but temporary. The writer, however, has seen a case, where extreme degeneration of all the abdominal viscera was present, almost completely recover on removal of the cause, namely, a suppurating joint.

3. Intestines, Atrophy of.—A general atrophy of the intestines accompanies a wasting of the entire body from any serious cause of malnutrition, such as starvation, where the organs are estimated in fatal cases to lose 42 per cent. of their weight, becoming extremely thin and transparent.

Intestinal catarrh, particularly in children, may lead to atrophy of the bowels, even to an extreme degree.

Wasting of parts of the canal are of more frequent occurrence from disease. This is well seen in cases where an artificial anus has been made, the gut below the opening becoming thin and shrivelled. In all cases where any considerable stricture of the intestine exists, the portion beyond the obstruction atrophies more or less. This subject will be found fully discussed by Nothnagel, in the *Zeitschrift f. Klin. Medicin*, IV., 1882, p. 422.

4. Intestines, Catarrh of.—This is a mild form of intestinal inflammation in which, however, the essentials of that morbid process are present, though in a slight degree (*see* INTESTINES, Inflammation of).

5. Intestines, Contraction of.—The calibre of the intestinal canal may be diminished by the pressure of tumours; by structural changes in the walls; or by displacements of portions of the bowels in invagination, &c. Such causes of stricture are more properly described under intestinal obstructions. *See* INTESTINAL OBSTRUCTION.

The term contraction may be applied to that state of shrinking which the gut is liable to present below the seat of any permanent stricture, whatever its nature, just as the portion of the canal above the obstruction tends to dilate. It is a condition that calls for no interference, being of no practical importance.

A spurious contraction of part of the intestines may be occasionally seen *post mortem*, due to extreme spasm of the muscular coat. Congenital malformations, producing contraction of the canal, may be met with.

6. Intestines, Dilatation of.—The normal diameter of the small intestine may be taken as 1½ inch throughout; and that of the large intestine as gradually diminishing from 2½ inches at the cæcum, to 1½ inches at the upper part of the rectum. But the canal is evidently capable of distension much beyond these limits, as may be recognised when large accumulations of flatus exist. Such conditions, however, may disappear after death, the bowel returning to its proper capacity. These dilatations, therefore, may be regarded as temporary, and it is impossible to say what may be the extreme limit reached and recovered from.

Other forms of distension of a more permanent nature are frequently observed.

Cases have been placed on record by Peacock, Crisp, and others (see *Path. Soc. Trans.*) where extreme distension occurred without any obvious cause, but associated with marked constipation. In one case the colon was uniformly distended to a diameter of six to eight inches; and in another the average diameter of the small intestine was twice the normal. In this case the stomach shared in the distension; and the person had been a large eater, and extremely fat.

In the greater number of cases the dilatation is attributable to the existence of some stricture in the course of the canal. It is rare for any distension to follow an acute obstruction, though it is not absolutely unknown; but a chronic stricture is almost invariably associated with more or less dilatation of the tube immediately above. The length to which this may extend is largely dependent on the duration of the case; and inasmuch as a persistent obstruction is usually located somewhere in the large intestine, it is the colon that is most frequently distended, and this may be so excessive as practically to obliterate the ileo-cæcal valve. The mere accumulation of the contents above the obstruction is doubtless one factor in causing the distension; but a diminished resisting power on the part of the gut probably co-exists, brought about by malnutrition of its textures. The muscular coat of the dilated portions is usually hypertrophied, while the mucous membrane is thinned and peculiarly liable to ulceration, the decomposing contents furnishing an exciting cause for this result.

The existence of any extreme dilatation may be recognised by inspection or manipulation of the abdomen, especially if the parietes be thin and wasted, as they frequently are in such cases. Fæcal vomiting may of course occur in connection with the existence of a dilated intestine, but this is rather to be attributed to the primary obstructing cause, in the symptoms of which the few indications peculiar to this condition are merged.

Paralysis of the muscular coats, by diminishing the resistance of the bowel, allows of its distension. This is well exemplified in the extreme dilatation from flatus which so frequently accompanies acute peritonitis.

7. Intestines, Gangrene of.

Ætiology.—The immediate cause of the complete death of a portion of the intestine is the complete arrest of the flow of blood through the part affected. This obstruction may be produced by:—

(i.) Embolus of the superior mesenteric artery. Several cases of this condition have been recorded, the emboli originating from the heart.

(ii.) Thrombus of the mesenteric veins. The perfect stasis induced by this cause is of very rare occurrence, but it has been seen to follow invasion of the portal vein by malignant disease.

(iii.) Local constrictions of the bowel. This is by far the commonest cause of gangrene, and is the probable sequence of an invagination or ileus. In these states the vessels are pressed upon by the altered position of the gut, which, with the continuously increasing pressure of the œdema that follows the venous obstruction, leads to complete stasis.

(iv.) The more gradual obstruction to the blood-flow, from constriction of the vessels by diseases of their walls, leads to sloughing, which frequently tends to occur in albuminoid disease of the intestines.

(v.) Sloughing also occurs as a sequence of the inflammatory state, when the process is of such intensity that complete cessation of the circulation takes place in localised spots, usually affecting the mucous membrane only, though occasionally penetrating deeper, ulcers remaining after separation of the sloughs.

Anatomical Characters.—From the nature of the constructive tissues of the intestine, the gangrene which is met with is of the moist variety. The portion of bowel which is affected is at first of an intense red colour, gradually increasing, and becoming purple, even to black. The extreme congestion of the vessels leads to effusion of blood into the tissues, which, however, are uniformly coloured; decomposition rapidly takes place in the stagnant blood, and the products acted on by the sulphuretted hydrogen of the intestines become black, all traces of red colour being soon lost. Meanwhile the mucous membrane and muscular coats are swollen and soddened by the serum and blood with which they are infiltrated, and a dark-black to ash-grey, soft, pulpy mass is finally thrown off from the healthy tissue.

The extent of substance which may undergo this necrosis and be separated is extremely variable, from a mere slough of half an inch in diameter or smaller, to portions of bowel several feet in length. Dr. Peacock records a case where 12 feet were passed in eight portions during a period of three years.

Symptoms. — The occurrence of symptoms whereby mortification of the bowels can be diagnosed is not to be expected. The signs resolve themselves into those of the existing inflammatory state. It is not until the sphacelus has been passed, or that signs of ulceration are manifest, that the existence of gangrene can be ascertained. A very few hours suffice to produce this condition when once the cause is established, and it cannot be either arrested or cured; the separation of the slough is to be desired, though fatal hæmorrhage may be associated with this process. The circumstances of this state preclude any treatment being specially directed towards it.

8. Intestines, Hæmorrhage from.—An escape of blood from the intestines is a sign of certain morbid conditions rather than an actual disease itself, hence the cause of the hæmorrhage must be sought for.

Ætiology.—The causes of intestinal hæmorrhage may be thus indicated:—

α. *Increased blood-pressure.*
  Intense hyperæmia or extreme congestion.
β. *Affections of the intestinal walls.*
  1. Injuries of the bowels.
  2. Ulceration.
  3. Vascular growths, hæmorrhoids.
  4. Amyloid disease of the walls.
γ. *Primarily altered blood-states*—
  1. Purpura hæmorrhagica.
  2. Leucocythæmia.
  3. Yellow fever and severe intermittent fever.
δ. *Occasional causes*—
  Rupture of aneurism into intestine.
  Vicarious menstruation.

The mere enumeration of the causes must here suffice. It is obvious that the relative frequency of these conditions differs considerably, and in many cases the cause is at once apparent, whilst occasionally the source of the blood may be more obscure. It would seem from statistics that intestinal hæmorrhage is of more frequent occurrence in males, as gastric hæmorrhage is more common in women; the latter fact being explained by the greater liability of females to ulcer of the stomach, as the former appears to be by the preponderance of males suffering from the determining causes of hæmorrhage, and not that the sex *per se* predisposes to such a result.

Symptoms.— Associated with the symptoms special to the loss of blood, and which are in the main similar to bleeding from any other organ, there are the signs and symptoms of the causal disease. The extent of the hæmorrhage will necessarily largely determine the symptoms, many bleedings being so trivial as to give rise to no appreciable effects, and in extreme cases the loss being so great and sudden as to lead to rapid collapse and death. Between these extremes all degrees of anæmia, faintness, pallor, giddiness, and failing pulse may be observed. A sensation as of a warm fluid flowing into the abdomen is occasionally complained of, but otherwise hæmorrhage in this situation is possessed of no characteristic feature. The occurrence of the above-mentioned indications in the course of a disease liable to lead to this condition, would point to hæmorrhage, especially if there be a fall in temperature from a previous pyrexial state.

Occasionally the escape of blood is beneficial. This is particularly the case where the cause is a congestion of the intestinal tract, with or without hæmorrhoids. Thereby the fulness of the bowels is relieved, and a more equable circulation is established. In some cases of typhoid fever, contrary to what might be supposed, improvement has been noticed to follow a moderate loss of blood. (Trousseau.)

Except in such cases as when the effusion of blood is so excessive that death takes place before any escapes from the bowel, intestinal hæmorrhage reveals itself sooner or later in the character of the evacuations. Unless the cause be such as an ulceration immediately within the anus, or that the blood be sufficient in amount to escape alteration, when the bright red colour is retained, the fluid is always altered in appearance. The hæmatin is readily affected by the sulphuretted hydrogen in the canal, and converted into a blackened material, sulphide of iron being formed, which stains the fæces; or a black tarry substance is evacuated, being the altered clotted blood (*see* MELÆNA). As a rule, when the blood has undergone this change, the source of it is in the small intestine; blood from the colon—where it is usually due to ulceration—being passed adherent to the fæces. The height of the source, and the duration of its stay in the canal, largely determine the extent of alteration in the effusion.

DIAGNOSIS.—The history of the case; the condition of the patient; and the character of the voided blood, are the points upon which a diagnosis of the cause of intestinal hæmorrhage is to be based.

PROGNOSIS.—The amount of blood evacuated is not a sure guide to forming an opinion of the result. It is difficult to estimate the actual quantity lost, since much may be retained in the bowel. The general condition of the patient, especially the state of the pulse, is of far more importance; whilst allowance must be made for the nature of the cause, not forgetting the occasional favourable import of a flux.

TREATMENT.—In a certain number of cases bleeding from the bowel is quite uncontrollable; in others it is capable of cure; whilst in a third group it is rather to be encouraged. When arrest of the hæmorrhage is desired, rest, both general and local, is essential; the patient should be kept in the recumbent position, as thereby the liability to syncope is averted; and the canal is to be kept quiet by abstinence from food, and the use of opium, to prevent peristalsis.

The active treatment is to be directed to withdrawing the blood as much as possible from the affected region, by means of heat, sinapisms, dry-cupping, &c., to other parts of the body; and to the application of styptics to the bleeding surfaces, or the administration of such remedies as arrest bleeding after their absorption into the blood. Among the agents which, administered by the mouth or rectum, act locally, may be mentioned turpentine in 30 to 60 minim doses, with two or three ounces of starch as an enema. Injections of equal parts of tincture of perchloride of iron and water may be given; or acetate of lead in combination with opium. Tannic acid and the vegetable astringents are usually too slow in their effects to be of much avail. Probably the most effective remedy is ergotin, administered subcutaneously in 2-grain doses dissolved in glycerine, and repeated if necessary. This acts not only by constricting the vessels, but by diminishing the blood-pressure. Bitartrate of potash in doses of two drachms, and the local application of a saturated solution of perchloride of iron in glycerine, are of great benefit in arresting the bleeding of piles; for which purpose also, as well as for vicarious hemorrhage from the lower bowel, the writer has found frequently repeated doses (♏v. to viii.) of tincture of hamamelis of much advantage.

When the hæmorrhage is distinctly the result of engorged vessels, its occurrence should not be checked, provided it be not excessive. Sulphate of magnesia in full doses, with a few minims of dilute sulphuric acid, is then of great service; by determining an effusion of the watery part of the blood, the congestion is relieved and the hæmorrhage is arrested, the patient meanwhile refraining as far as possible from taking fluids.

The giving of stimulants is a procedure that involves careful judgment. Whilst undoubtedly the tendency of loss of blood is to produce death by syncope, it is also true that faintness itself favours the cessation of the bleeding, and, so far as a general direction can be given, stimulants should be avoided, unless there be reason to fear, from the condition of the patient, character of the pulse, &c., that the syncope is excessive. Short of that, alcohol, by temporarily increasing the heart's power, increases the bleeding.

Transfusion of blood, when practicable, should be resorted to in extreme cases.

9. Intestines, Hyperæmia and Congestion of.—The former term is here applied to those conditions of vascular engorgement where the excess of blood is, primarily at least, on the arterial side of the capillaries (active congestion, fluxion, determination of blood); whilst the latter term is restricted to cases where the fulness is caused by some obstruction to the venous flow (passive congestion). Doubtless either of these conditions may lead to the establishment of the other, but it is desirable to consider them separately, not so much for the difference in the causes producing them, as for the great difference in their results.

It should be remembered that even within the limits of health a considerable variation is met with in the degree of vascularity of the alimentary canal. The fluctuating periods of rest and activity undergone by the tube are associated of necessity with alternations of comparative hyperæmia and anæmia, as during the digestion of a meal or during fasting. It is impossible, therefore, to draw any line beyond which the vascular fulness can be said to be abnormal; as it is equally impossible to say exactly where hyperæmia and normal gland-change end, and catarrh begins.

Anatomical Characters.—The appearances seen *post mortem* are far from being always indicative of what existed during life. For an extreme arterial fulness may completely disappear after death, from contraction of the vessels; whilst venous engorgement more or less completely remains.

Ætiology.—The causes of intestinal hyperæmia are as follows:—(α) Mechanical and chemical irritants, foreign bodies, and poisonous drugs. Spices and highly seasoned food, and alcohol; any substance, in fact, which may be swallowed, and at all exceeds the blandest nature, may bring about an abnormal degree of hyperæmia of the whole or part of the canal. These causes act locally and directly upon the vessels.

(β) Vaso-motor paralysis of the splanchnic area. If from any cause the normal tone of the mesenteric vessels is diminished, by inhibition or removal of the tonic influence excited by the sympathetic, the vessels dilate and hyperæmia ensues. It is in this way that diarrhœa following certain emotional states is to be explained. The intimate relation which has been shown experimentally to exist between the splanchnic nerves and the vaso-motor system generally, but especially with the cardiac innervation by means of the 'depressor nerve,' whereby any considerable peripheral resistance in the systemic capillary area which impedes the action of the heart is compensated for by a dilatation of the mesenteric vessels, renders it probable that an undue hyperæmia of the intestines is of very frequent occurrence.

(γ) Collateral hyperæmia, or the fulness of the vessels of one region caused by contraction of the vessels of another, as in the shrinking of the cutaneous vessels from cold, extensive burns, &c. In such cases the blood, remaining constant in amount, must distend other vessels; and those of the abdominal viscera, including the intestines, are peculiarly liable to become engorged, as explained by what may be called their compensating paralysis.

The causes of passive congestion are the following:—(*a*) A general congestion of the entire intestinal tract will be produced by any of those causes which lead to universal congestion of the tissues, as dilatation of the right heart from lung-disease. Pressure by tumours or other conditions on the inferior vena cava above the liver, or on the portal vein, will bring about the same result. So also will any obstruction to the portal circulation in the liver. This is by far the commonest cause of intestinal congestion, since cirrhosis of the liver, however produced, directly tends to it.

(*b*) A congestion of a portion of the tube occurs when any obstruction exists to the venous flow of that part, as is marked in cases of invagination and strangulation of the bowel. The rarer conditions of embolism of branches of the mesenteric arteries, or thrombosis of the veins, will induce intense congestion. This state also forms a part of the vascular changes undergone by any inflamed part.

Symptoms and Effects.—These conditions may of themselves give no evidence of their existence. But the following results may ensue:—

From hyperæmia, an increased secretion of mucus and other intestinal fluids, often more watery than normal, which with an increased peristalsis, induced by the same irritant that led to hyperæmia, produces a diarrhœa. Provided this over-functional activity be limited to the production of the normal secretions of the part, and increased healthy action only, the condition of hyperæmia is not exceeded; but the passage into catarrh is easy, and persistently sustained arterial fulness will sooner or later pass into that state.

The increased blood-pressure may be sufficient to induce diapedesis of the red corpuscles, or rupture of the capillaries, leading to capillary hæmorrhage, submucous petechiæ, &c.

As regards congestion, the more complete the obstruction to the flow, the greater will be the pressure in the veins, whose thin walls favour the transudation of the serous part of the blood, and so produce an œdema of the mucous membrane and entire thickness of the bowel, with a transudation on both surfaces, into the canal itself and into the peritoneal cavity, the latter being more marked. The fluid effusion in this case is dependent entirely on mechanical conditions, whilst the flow in hyperæmia is mainly the result of increased secreting activity. Hæmorrhage from rupture of the smaller vessels is of frequent occurrence, and may be very considerable.

A prolonged state of congestion—and as a rule the cause is such as to determine a permanent state—leads to certain structural alterations in the tissues of the bowel, from the imperfect nutrition that a chronic venous fulness permits of. The nature of the change is chiefly the infiltration of the mucous and submucous coats with an imperfectly formed connective tissue, which causes a thickening and toughness of the bowels, almost identical with the results of chronic inflammation.

Treatment.—It is seldom that these conditions are such as call for treatment. The hyperæmia is usually of a transient nature; and the cause of congestion is generally irremovable. Aperients, such as jalap, gamboge, &c., are sometimes beneficial, by inducing watery evacuations and so relieving the vessels, but they demand constant repetition.

The treatment of hæmorrhage has been considered; but this and diarrhœa, when due to congestion, are, unless excessive, often beneficial, and are not to be checked.

10. Intestines, Hypertrophy of.—This is always of local occurrence, a general hypertrophy, involving the entire length of the bowel, being practically unknown.

In chronic enteritis the mucous, submucous, and even muscular coats are apt to become much thickened, and though this is partly due to an excessive formation of connective tissue, there is also some actual hyperplasia of the normal textures.

In portions of the intestines above an obstruction, a true hypertrophy of the gut, particularly of the muscular layers, is to be found; and, as already said, this is usually associated with dilatation of the tube.

It is rare for this condition to be other than inferred during life; it gives rise to no symptoms and calls for no treatment; and when established is rather of the nature of a compensatory lesion.

11. Intestines, Inflammation of.—Synon.: Enteritis; Fr. *Entérite*; Ger. *Darmentzundung*.

Under this term are included all those structural changes in the mucous membrane of the intestinal tract which primarily follow the application of an abnormal irritant, provided that the irritant be not of sufficient intensity to produce absolute destruction of tissue. Such changes will involve more or less all the tissue-elements of the mucous membrane, and may extend to the muscular, or even the peritoneal coat. They are essentially characterised by productive, coincident with destructive features, the former leading to the formation of new material, as pus or connective tissue, the latter to ulceration or gangrene. The inflammatory process may present considerable variety in type. The simplest form, to which the term 'catarrh' may be applied, passes, by almost insensible gradations, from the tissue-changes met with in the course of normal digestion, to a distinct condition of disease. Or it may be that, superadded to the above-named characters of inflammation, are certain specific characters due either to the nature of the cause, or to the predisposition of the tissue affected, or to both, which determine the conditions known as diphtheritic, phlegmonous, dysenteric, &c.

There are thus differences in the severity with which enteritis may occur, both as regards the extent of departure from normal structure, and in respect to the symptoms which arise. But in all cases the essential characters of inflammation are present, which may be regarded as the results of the irritant, *plus* the efforts at repair on the part of the affected tissue.

The morbid process may affect the intestine throughout its entire length, either in common with or independently of the stomach—*general enteritis*; or it may be distinctly limited to certain parts of the canal—*local enteritis*, including duodenitis, ileitis, typhlitis, colitis, proctitis. As a rule the term enteritis is restricted to inflammation of the small intestines.

In respect to duration and intensity, enteritis may be *acute* or *chronic*.

(*A*) **Acute Enteritis.**—Acute enteritis is sometimes called *gastric remittent*, or *infantile remittent fever*—terms it is advisable to discard entirely, since they are frequently applied to very different diseases. Acute enteritis is meant to include all those cases where the essential features of an inflammation are present, varying in severity from a simple catarrh or muco-enteritis, to those severer forms possessed of special features, such as phlegmonous or diphtheritic. The more severe cases, especially in children, are sometimes called simple or English cholera, or *cholera infantum*.

Ætiology.—It is doubtful whether an idiopathic enteritis is ever met with; some cause is generally to be found.

Predisposing causes.—(*a*) The exposed situation of the intestinal tract to irritating substances swallowed, causes this disease to be one of frequent occurrence.

(β) The structure of the intestinal mucous membrane, with its delicate and susceptible epithelial cells, and slightly protected blood-capillaries, favours the occurrence of those changes which constitute inflammation.

(γ) Age especially predisposes to enteritis. For although it may occur at any period of life, infants and children during the period of dentition are peculiarly susceptible. A moderate intestinal catarrh may almost be regarded as a normal accompaniment of dentition, like to the increased activity of the salivary and other glands at that period. From the moderate it may easily pass into the serious or even fatal degree.

(δ) The season of the year appears to exercise an influence, for during the summer this disease is certainly much more frequent; and particularly so when there is extreme difference between day and night temperatures, or when the heat is associated with much moisture.

(ε) Occasionally this malady would appear to be epidemic.

Exciting causes.—These, whatever their nature, would appear to act by inducing a hyperæmia of the tissues, which thence pass into a state of inflammation.

1. Irritating ingesta of the most varied kind, such as abnormal, ill-cooked, or improperly digested food, and irritant drugs or poisons, often cause enteritis. Of these, improper food is by far the most common, especially during the first year of life. Cow's milk alone may be at that time sufficient to produce it, and it is rare for infants to escape an attack. An excessive flow of bile into the intestine is an occasional cause.

2. Exposure to cold may be followed by inflammation of the intestines, as it may be by inflammation of the lungs, kidneys, or pleura; the factor which determines the particular organ involved is unknown. There would seem to be some other factor than the mere determination to the viscera of an excess of cooled blood from the contracted cutaneous capillaries, which probably affects the nutrition of the tissue-elements *viâ* the nervous system.

The occurrence of inflammation and ulceration of the duodenum which follows extensive superficial burns, cannot be altogether explained by the hyperæmia of the intestines, which is said to follow the superficial injury.

3. Wounds, new-growths, and the mechanical results of intussusception, hernia, impaction of fæces, gall-stones, parasites, and other conditions, will lead to enteritis.

4. Inflammation of neighbouring parts may involve the intestines by extension, as from the stomach, peritoneum, or bile-ducts.

5. The specific poison of diphtheria not infrequently leads to enteritis of a characteristic nature. An inflammatory state of the intestinal mucous membrane is said to accompany or follow the exanthemata, and more especially scarlet fever; and it sometimes complicates septicæmia, particularly when this is of puerperal origin. In such cases the disease would seem to be set up, at least sometimes, by extension from the uterus along the peritoneum.

Anatomical Characters.—It probably never occurs that the whole length of intestine is the seat of inflammation, and it is not often that even the entire small intestine is so affected. It is far more frequent to find certain tracts, of a few inches or a few feet, involved. Speaking generally, the colon, cæcum, rectum, duodenum, ileum, and jejunum are affected, as regards frequency, in that order. In some situations special features are present, but the essential characters of inflammation always exist, whatever be the site.

Owing to the physical properties of the intestinal tissues, the appearances seen after death by no means necessarily correspond to what actually exists during life. Thus, the hyperæmic state of the mucous membrane, with the increased redness, varying from a more intense pink than normal up to a deep dark red, may leave but a trace *post mortem*, the vessels having become considerably emptied from the constriction of the vessels in *rigor mortis*. An increased vascularity, however, is one of the important features of the state under consideration, and it may sometimes be so intense as to lead to capillary rupture and formation of petechiæ in the mucous membrane. The tissue-elements of the gut, as a result of the irritant causing the inflammation, and with the accompaniment of an increased vascular supply, undergo changes in their appearance and behaviour. Thus the epithelial cells are in a state of cloudy swelling and increased activity in multiplication, each successive progeny approaching nearer and nearer to the embryonic type; the connective-tissue elements are similarly affected, and leucocytes transude into the tissues from the vessels. These new-formed cells constitute pus-corpuscles, which are thrown off from the surface of the mucous membrane, and crowd to a variable depth the tissues of the different coats. If the primary irritant to the inflammation be of a specific character, such as the poison of diphtheria, or of an extremely severe nature, such as an intussusception or hernia, then the new-formed cells become entangled in a fibrinous coagulable exudation from the blood, and form patches of membrane more or less adherent to the surface of the bowel, depending on the depth of tissue involved. In all cases there is some œdema of the intestinal walls from serous effusion, and the free surface of the membrane is covered with a glairy mucus, containing pus-cells, and frequently crystals of triple phosphates.

The epithelium of the follicles of Lieberkühn becomes extremely granular, and proliferates extensively, with the frequent result of blocking up the lumen of the gland, which thus becomes very prominent. The solitary and agminated glands are invariably much swollen, and very often the process of inflammation is most intense in their vicinity. Occasionally the mesenteric glands are similarly affected.

How this inflammation may terminate very much depends on the course; it may subside, and the bowel gradually assume its normal characters with no impairment of function; it may lapse into a chronic state; or it may pass on into ulceration, or even sloughing and gangrene.

To these various degrees of the inflammatory state different terms have been applied in no very definite way. Thus, when the mucous membrane alone is affected, a *catarrh* or *muco-enteritis* is said to exist; whilst the severer form, affecting all the coats, and attended with suppuration, such as occurs in the neighbourhood of an intussusception, is known as *phlegmonous*. When a membranous exudation is found in association with diphtheria, we have a true *diphtheritic* enteritis; and the expression *pellicular* may be more fitly applied to those cases where a similar membrane is formed, though not in connection with the diphtheria poison. Such a state is of not infrequent occurrence on the prominent edges of the valvulæ conniventes, and still oftener of the saccules of the colon, due to the presence of hardened fæces or impacted calculi. Both these latter forms are invariably associated with ulceration. The term *dysenteric* is very indifferently applied to more than one form of enteritis or colitis: the writer thinks it better limited to that form of inflammation due to the specific poison of dysentery, although the morbid appearances of such cases are almost or quite identical with some of the varieties enumerated above, the differences in the cases being dependent on their clinical history.

An enteritis associated with aphthæ is of common occurrence in children.

Symptoms.—That a considerable variation is met with in the kind and severity of the symptoms presented in cases of enteritis, is only to be expected when the great difference in degree and extent of morbid change that is met with is remembered. Whilst the pathological changes that take place in a limited part of the canal are identical with those that may be found in another, to a very large extent the symptoms that arise in the two cases may be widely different. For whereas one patient may suffer from an attack of intestinal catarrh, with but a trifling array of symptoms, another may succumb within a few days. There is no one symptom or even group of symptoms that is absolutely characteristic of the disease; even the general condition of the patient is not constant. In the milder forms of intestinal catarrh there may be slight pyrexia, with thirst and quickened pulse, but these symptoms may be scarcely noticeable; while, on the other hand, in the severe phlegmonous enteritis they are extreme, and the patient is in a state of considerable prostration.

The following symptoms, more or less marked, occur in different cases.

Stools.—Diarrhœa is in some respects the most constant symptom, though, when the affection is limited to the higher part of the canal, and space is given for the reabsorption of the excessive exudation, it may not only be wanting, but there may be actual constipation. The lower down the gut is inflamed, the greater the liability to diarrhœa, which hence becomes a marked character of colitis and proctitis. In the severe forms of the affection a more or less complete constipation may be due to the paralysis of the inflamed bowel, arresting the peristalsis, and allowing of the accumulation of the intestinal contents above the lesion; this is obviously more complete when the enteritis is associated with any state producing mechanical obstruction, such as intussusception, or ileus.

The character of the evacuations is very variable. As a rule they are semi-fluid when diarrhœa exists; or they may consist chiefly of a liquid with a few feculent flakes; but, when time has permitted a partial re-absorption of the fluid part, the stools become more consistent, and in cases of enteritis which are chiefly due to fæcal accumulation, solid, hard masses are passed.

Mucus, in greater or less quantity, is constantly present—being especially abundant in affections of the large intestine and rectum, when it is often discharged as complete tubular casts of the bowel.

Blood is not usual except in proctitis, or unless there be ulceration or hæmorrhoids; and pus is seldom noticed unless the rectum be inflamed.

Owing to the imperfect performance of digestion or absorption, the motions are liable to contain many abnormal constituents—as fat, when the duodenum and upper part of the jejunum are involved, or even masses of food scarcely changed; and the altered character of the intestinal contents, with the products of decomposition, are in themselves important features in maintaining a diarrhœa. As a rule, the discharges are paler than normal, or may be even colourless; the greenish tint so often seen in the enteritis of children is due to altered bile or blood-pigment. The odour is usually extremely offensive or even putrid; though sometimes, when the evacuations are very liquid and colourless, smell may be altogether absent.

Owing to a large production of gases, discharges of flatus are of very frequent occurrence.

Vomiting, except in the severe forms, is not a common symptom of enteritis, unless the stomach be involved. In phlegmonous enteritis, however, vomiting may be persistent, and even stercoraceous; and it is relatively more frequent in children than in adults. Short of actual vomiting, nausea is frequently complained of.

Pain and tenderness.—Pain in itself is a most uncertain symptom, perhaps being scarcely noticeable in the milder forms of catarrh; whilst in colitis, the colicky, griping pains, which may or may not be relieved by pressure, are characteristic. Still more is this the case when the rectum is affected, when the straining and tenesmus constitute one of the most distressing symptoms of the malady. When the peritoneum is involved, the pain and tenderness are marked and characteristic. Both may be generally diffused over the abdomen, or may be local in character, as over the cæcum; in a large number of cases the pain is referred to the umbilical region.

General symptoms.—Among the more general symptoms, or those associated with inflammation of special regions, are the phenomena of the febrile state in a more or less marked degree. The temperature may reach 104° F., or even higher; or in some cases it may be scarcely elevated. The appetite may be unaffected, especially if the upper part of the tract be free from the disease; whilst there may be complete anorexia when the reverse is the case. Thirst is of usual occurrence, and it becomes very marked when the evacuations are abundant and fluid. The tongue indicates rather the general state of the patient, and is a less reliable index of the actual state of the intestinal mucous membrane, than in corresponding affections of the stomach. It may be red, irritable, and glazed; or coated with a thick fur, with the edges and papillæ bright and prominent; in milder cases it can often scarcely be said to be affected.

The character of the pulse varies with the general state. Provided that the pyrexia be extreme, there is the usual dry skin and concentrated urine, with a tendency towards the production of the typhoid state, which usually is reached in fatal cases. In many cases the prostration is excessive, though the mind is usually unaffected to the end, and in a large number of cases there is a very marked irritability of temper. Notwithstanding the intimate sympathy between the alimentary tract and the brain, headache is of rare occurrence in enteritis. A persistent hiccough, presumably of nervous origin, is met with sometimes. In children the disease readily leads to a condition of collapse. The child lies in a languid, almost torpid, state; with the skin of the abdomen intensely hot and dry; whilst the extremities are cold and blue, the face is pinched, and the body generally appears shrunken. Frequently this state is interrupted by attacks of convulsions, especially if dentition be in progress. The child, too, is usually extremely fretful, and maintains an almost constant, short, feeble cry, evidently accompanied with pain.

When the disease affects the duodenum, jaundice, due to closure of the bile-duct, very often occurs. The intimate nervous relation between the rectum and base of the bladder explains the frequency of micturition, so commonly associated with proctitis.

Diagnosis.—The variability and oftentimes vagueness of the symptoms frequently admits of a diagnosis of enteritis being made only by a process of exclusion. The history of improper feeding, whether temporary or prolonged, often indicates the nature of the disease; though it cannot be denied that all rules of a rational dietary are frequently violated, both by children and adults, with apparent impunity.

Diarrhœa alone can by no means be taken to indicate the existence of intestinal inflammation, it being due to many causes which leave the intestines unaffected; and the same may be said of constipation, pain, vomiting, and other symptoms. It is rather to a group of symptoms, with the previous history, that the observer must look. The character of the stools, as already described, often indicates the region of gut affected; and the existence of extreme tenderness and pain, with a hard, quick pulse, and the abdominal decubitus together, point to the involvement of the peritoneum, which an exacerbation of temperature tends to confirm. The distinctive features of typhlitis, colitis, and proctitis have been already described sufficiently to form material for diagnosis in most cases. To distinguish between inflammation of the jejunum and ileum is usually impossible, nor, practically, is it a matter of importance. The history of the case, the course of the temperature, and the characteristic rash and headache, should serve to separate acute enteritis from typhoid fever, for which it is sometimes mistaken.

Prognosis.—This will clearly depend on the degree of severity of the affection, no less than on its seat and extent. Rest, which is of prime necessity to an inflamed organ, is almost incompatible with maintaining the due nutrition of the patient, and this fact renders the prognosis very uncertain.

A simple intestinal catarrh occurring in a healthy subject certainly tends, after a few days, to complete cure; but occurring, as it frequently does, in persons in ill-health, it is far more liable to pass into an obstinate chronic condition. In children, the opinion should be very guarded; for whilst in a large number of cases perfect recovery follows removal of cause and suitable treatment, others, for no very apparent reason, will, in spite of everything, progress to a fatal termination; and this is, of course, more likely to be the case where a strumous or tubercular diathesis exists. Enteritis in different degrees of severity constitutes one of the most, if not the most, important cause of infantile mortality.

In the severer forms, as they affect adults, opinion must be guided by the nature of the cause, and the general state of the patient. Recognising that the unfavourable tendencies of the patient are towards extreme prostration, to perforation with fatal collapse, or to chronic ulceration—according as these conditions are threatened, so may the prognosis be fairly made. The duration of extreme cases rarely extends beyond a few days, when, if death do not occur, the symptoms abate, and recovery, with oftentimes a tedious convalescence, follows, or a chronic condition of disease is established.

Treatment.—Although great variety exists in the degree of severity of the symptoms of acute enteritis, and a corresponding difference obtains in the treatment to be pursued, yet certain general principles may be first laid down, and the more special details adapted to certain conditions afterwards indicated. Inasmuch as the disease is one of a febrile nature, where, among other things, the tissue-waste is out of proportion to the repair, and at the same time the organs concerned with the preparation of the food are those mainly at fault, every effort should be made to minimise the bodily waste. This is best attained by keeping the patient in bed, which also offers the additional advantage of providing a uniform warmth.

As regards diet, in the greater number of cases of acute intestinal inflammation, the appetite is much impaired, even to complete anorexia. Providing the person attacked have been previously in good health, no harm is done by complete abstinence from food for twenty-four or even forty-eight hours. This gives a much better chance of rest to the intestine, and a better opportunity for the removal of any irritant ingesta which may have been the cause of the inflammation. The thirst during this period may be relieved by ice-cold water, with or without a little lemon-juice. It must not be forgotten that, with the mucous membrane and its glands inflamed, the conditions of normal digestion and absorption are materially interfered with, and articles of diet that ordinarily are most nutritious and easily digested, may and do become, under these altered circumstances, positively harmful. The aim in feeding the patient should be to give those materials which are most quickly absorbed, and leave the smallest amount of indigestible residue. Provided that the stomach be implicated—and it is rare that it is not so, either directly or indirectly—meat foods are badly borne; instead of the proteid constituents being digested in the stomach, they remain there and undergo putrefactive decomposition, and thus add fresh irritants to the canal lower down. If, however, as is largely shown by the state of the tongue, the stomach be tolerably free, then meat essences, made thin and allowed to stand till cold, may be given. The nausea or vomiting which is usually present is more easily overcome by giving the nourishment cold; and a few drops of lemon-juice are of great service if added to the beef-tea. Milk is very uncertain in the way it is tolerated by such patients. Ocasionally it is impossible to give it, the vomiting or diarrhœa being increased by it; but equal parts of milk and soda-water may constitute sufficient nourishment to last for several days in extreme cases, and may be well borne. Lime-water may be substituted for the soda-water, but, as a rule, effervescing fluids are more grateful. The milk should be as free as possible from cream, for fats in all forms are to be avoided, since the products of their decomposition are extremely irritating. A similar objection, though not to such an extent, may be made to farinaceous foods, for the lactic and butyric acids to which they give rise in the process of pancreatic digestion will further increase any existing inflammation. If given at all, it should be only in small quantities at a time; a remark which equally applies to all other food. Nutrient enemata may be of much use in some cases.

A very great deal may be done for the patient with drugs, both in the relief of symptoms, and in aiding the cure.

It is seldom advisable to check the diarrhœa in acute enteritis; and an aperient to begin with, except evidence exist of there being any peritonitis, or that the cæcum be impacted with fæces, is a rational treatment. Thereby the irritant, whatever it may be, is removed, and a better chance for recovery is given. Improper food is so commonly the cause, that the majority of cases are benefited by a preliminary purgation. This it may be necessary to repeat, especially if irritating results follow the nourishment that is given. Probably the best aperient in this case is calomel, in doses of two to four grains, given as powder. This undoubtedly cleans out the upper part of the small intestine, and it will be necessary to follow it up after a few hours with a quickly acting aperient of a saline character, or, better still, senna, if the latter can be borne. If the inflammation be confined to the colon, where, as already said, accumulations of fæces are the common cause, copious simple enemata, repeated every six or eight hours, are of great advantage; and this plan may be pursued in conjunction with the aperient given by the mouth. The object has been to clear out the alimentary canal, and provided that this has been done, abstinence from food for twelve hours, and some bismuth in an effervescing form, are frequently sufficient in milder cases to put the attack on the road to cure. The writer places great reliance on bismuth, either in the form of solution with an effervescing citrate of potash, and three or four minims of dilute hydrocyanic acid; or granular effervescing lime-juice and bismuth. The nausea or vomiting are best relieved by this treatment. Pain is of course a pressing symptom. Besides external applications of poultices or poppy-head fomentations, the internal administration of opium is very effective—five or ten drops of the tincture every four hours: the opium in these cases does not seem to interfere with the action of the aperients. Should there be peritonitis the opium must be increased in amount, to the end of giving complete rest to the gut. Several leeches applied to the anus, with the view of relieving the hyperæmia of the intestinal tract, are occasionally necessary in extreme cases. When the attack is distinctly attributable to cold, a profuse sweating induced by hot baths, and ten grains of Dover's powder, is often of great benefit. In those cases where, from the duration, character of stools, and previous treatment, there is reason to believe that the irritating causes are got rid of, the diarrhœa may then require special treatment, especially when the patient has been in ill-health, or is constitutionally debilitated, in which cases an ulceration of the bowel is more likely to follow. In such cases a powder, consisting of Dover's powder, 5 grains, and carbonate of bismuth, 10 grains, given every six hours, is very efficacious. Sulphate of copper, nitrate of silver, and vegetable astringents, are frequently used for the same purpose.

So soon as the more acute symptoms have subsided, the bismuth may be still continued and gradually given with a vegetable bitter, such as calumba. But ten to fifteen minims of the dilute hydrochloric acid in an ounce of water is almost an essential to the recovery of the digestive power of the stomach.

In consequence of the great liability to a second attack which this disease engenders, avoidance of well-known harmful articles of diet, and the use of warm clothing or flannel belts, are demanded as a prophylaxis.

In infants and young children the great liability to collapse, often rapidly fatal, must be borne in mind. Stimulants in some form are almost a necessity. The following prescription is usually used by the writer:—Liquoris Bismuthi ♏j-iij, Spiritus Ammoniæ Aromatici ♏ij-v, Tincturæ Cardamomi Compositæ ♏ij-v; Aquæ ʒj–ʒij according to age. Brandy in small quantities is often the means of saving life in these cases. When the collapse is not threatening, two or three drops of solution of corrosive sublimate, with syrup, ʒss. and water, ʒiss., every two or three hours, is of great service. It is a more convenient mode of giving mercury than in the form of grey powder. But in one form or another the writer believes mercury to be of prime necessity. Corrections of diet on the lines indicated above are of course essential. Hot baths and other means to keep the child warm must be followed.

In the severer cases, which are lapsing into the typhoid state, the general principles for that condition must be followed; but, except in such a state, alcoholic stimulants are rarely called for.

(*B*) Chronic Enteritis.

Ætiology.—1. A certain proportion of the acute cases lapse into chronic when the original cause persists; or when the structural changes resulting from an acute attack are permanent.

2. Those conditions which lead to a chronic state of congestion of the intestinal tract will thereby so affect the constitution of the tissues, with a consequent disturbance of function, as to constitute a chronic inflammation. The most important of these conditions is obstruction, either at the right side of the heart, or affecting the portal circulation in the liver.

3. Chronic enteritis is the occasional accompaniment of some general chronic disease, such as Bright's disease, when the altered nature of the arterioles, and circulation of a deteriorated blood, may readily be regarded as leading to a chronic inflammation.

4. Residence in tropical climates is a not infrequent cause of inflammatory disease of the bowels.

Anatomical Characters.—The intestinal mucous membrane, when it has been the seat of inflammation for any prolonged time, is thickened, tough, and of a grey or almost black colour, from a deposition of pigment, due to the chronic congestion. The epithelial cells are cloudy and ill-defined, and there is an infiltration of the mucous and submucous layers with new round-celled tissue, passing into the stage of connective tissue; hence the thickness and toughness. The lymphoid follicles are prominent and hard, and the intestinal glands are frequently blocked with cells and secretion, and form minute solid, though perceptible masses. The surface of the membrane will be more or less covered with a viscid glairy mucus, containing pus and imperfectly-formed epithelial cells; not unfrequently such mucus may be voided in the form of complete casts of the tube, and this is particularly the case in the pellicular form of colitis. Sometimes the muscular coat is thickened from connective-tissue formation. As a rule, therefore, the bowel is increased in thickness; but in children it not unfrequently happens that a chronic enteritis is associated with an atrophy of all the coats and the contained glands. It is unusual for a chronic inflammation of the intestine to exist in adults without coincident ulceration; but in children the disease may proceed to a fatal termination, and show no such condition after death.

Symptoms.—Whilst many cases with a persistent cause may be said to be chronic from their outset, it is not always easy to say exactly when an acute case has lapsed into a chronic state, very much the same symptoms being continued. In such affections of the small intestine, the diarrhœa may be wholly wanting, and the bowels may be very confined. This is due to the diminished peristalsis, from œdema of the muscular coat and impaired irritability. When, however, ulceration is extreme, and especially if it be the colon or rectum that is mainly affected, chronic diarrhœa is an invariable symptom. The remarks made on the character of the stools in acute enteritis are equally applicable to the chronic state, with the addition, that solid and liquid evacuations frequently alternate. Lasting as the disease does often for many months or even years, a general impairment of nutrition results; the function concerned in the elaboration of the food, as well as that by which the digested products are absorbed, are necessarily perverted, from the structural alteration of the organs concerned in their performance; and as a result the entire body suffers. The marasmus is speedily noticed in infants and children, whose growing tissues the less readily withstand malnutrition. Apart from the general ill-health produced, there would seem to be a special inclination for the mental qualities to become affected, so that the intellect may become dulled and sluggish, the temper irritable, and the patient may fall into a condition of marked hypochondriasis; this is particularly liable to be the case when the colon is the seat of the disease. The emaciated appearance; the dirty, muddy complexion; complicated often with a short, dry cough, dependent on reflex causes from the stomach, frequently lead a superficial observer to suspect the existence of phthisis.

Diagnosis.—The grounds on which a diagnosis can be made are sufficiently obvious from a consideration of the foregoing remarks.

Prognosis.—Chronic enteritis almost invariably tends towards a fatal termination, though this may be long delayed. As already said, it is, at least in adults, the colon that is chiefly the seat of this malady, and where it is almost always associated with ulceration, obstinately resisting all treatment, which at best is only palliative; the general nutrition is more and more deranged; and death from inanition finally terminates an existence of prolonged suffering and discomfort.

Treatment.—Owing to the unfavourable tendency of this disease, the treatment can be rarely more than palliative. The debilitating and wearying character of the malady emphatically calls for good feeding. The diet should be abundant, no less than nutritious. When the disease affects the large intestine, the ordinary digestive changes in the food have taken place, and the contents of the canal reach the colon in the normal semi-fluid condition; in this state they may be passed; but owing to the impaired movements of the affected bowel the fæces are apt to accumulate, and constipation results. This should be guarded against by simple enemata, and the soothing effect of injection of warm water only is often very marked. In those cases where the enteritis is a sequence of a congestion of the intestine, the treatment must be directed to relieve if possible the cause of that congestion. Since this is usually some such intractable condition as Bright's disease, cardiac dilatation, or cirrhosis of the liver, it is not very much that can be done.

Tonics—such as quinine, iron, bark, with sea air—are of undoubted benefit; and, so far as possible, causes of mental worry should be removed.

12. Intestines, Malformations of.—These may be (*a*) *congenital*; or (*b*) *acquired.*

(*a*) *Congenital.*—Though seldom of much clinical importance, congenital malformations of the intestines are often of great interest from a developmental point of view. The malformation may be of the nature of an excessive development. Thus certain parts of the canal—duodenum, colon, and appendix vermiformis—have very rarely been found double. The commonest of all these malformations are certain diverticula of the ileum, which may be found protruding from the free margin of the ileum anywhere within ten inches above the ileo-cæcal valve. The cæcal extremities of such processes may be connected with the umbilicus by thin fibrous cords, showing them to be unobliterated portions of the vitelline duct. They vary in length from half an inch to six inches, or even more; their structure is exactly that of the ileum; and they have been found the seat of typhoid ulceration, or of perforation from the irritation of foreign bodies that have become lodged in them. The vermiform appendix may vary from half to twice the natural size.

Deficiencies of development may affect the whole alimentary canal, or only certain parts. Andral records a case where only a straight tube joined the rectum and œsophagus. The ileum may open upon an ectopic bladder. The lower extremity of the canal is frequently imperforate. Thus the rectum may end in a cloaca common to the urino-genital organs; or the bowel may terminate in a closed extremity anywhere between the brim of the pelvis and immediately beneath the skin; the anal pouch, which develops from without inwards, is in the latter case absolutely wanting; and all degrees between this and a pouch that has just failed to establish a junction with the rectum may be met with, producing the lesion known as *imperforate anus.* The valvulæ conniventes are sometimes wanting, or very imperfect, over varying areas of the small intestines. Congenital constrictions of different parts of the canal are occasionally met with—in the duodenum, either close to the opening of the common bile-duct or at the junction with the jejunum; in the lower end of the ileum, where some abnormality in the closure of the vitelline duct appears to be the cause; or in the sigmoid flexure. Such constrictions may be multiple, of very short extent, the canal being much dilated above, and extremely narrowed and shrunken below. The ileo-cæcal orifice has been seen contracted to the diameter of a small cedar pencil. The cause of these lesions is very obscure, but at present they are ascribed to a prenatal peritonitis or enteritis, though they may be occasionally accounted for by the existence of prominent valve-like folds of the mucous membrane.

Hernial protrusions of the mucous membrane through the other coats, often very numerous, and varying in size from a pin to a walnut, have been seen in the colon, sometimes extending into the appendices epiploicæ. They are very liable to become developed in cases of long-standing constipation.

(*b*) *Acquired.* — The acquired malformations include the dilatations and contractions that are associated with stenosis; and the adhesions and abnormal communications established by ulceration and peritonitis, which have been already referred to.

When any symptoms are produced by malformation of the intestines they are usually those of obstruction; and the only condition that may be amenable to treatment is imperforate anus.

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13. Intestines, Malignant Disease of.—The new growths which are met with in connection with the intestine may, for the present purpose, most conveniently be divided into *malignant* and *non-malignant*—a clinical distinction irrespective of their minute structure. We will here discuss the former class, in which there are included those neoplasms which tend to produce a fatal result, as a rule, rapidly; and that are accompanied with a marked general perversion of nutrition.

ÆTIOLOGY.—Malignant growths of the intestine, as in other situations, whilst not wholly unknown in the earlier periods of life, are rarely met with before the age of forty.

From an examination of 9,000 fatal cases of cancer, the relative frequency of intestinal cancer to that of other organs was found to be as 1 to 25 (Tanchou).

Cancer of the intestine is nearly always primary, and very frequently runs its course without any secondary formations elsewhere. Occasionally the bowels are affected by extension from neighbouring parts, and this is especially liable to be the case in the rectum, when the uterus or vagina are the seat of the disease, and in the duodenum, which may become involved in an extension from the pancreas, liver, or stomach. Primary cancer of the duodenum is very uncommon. Very rarely small nodules are found in the solitary and agminated glands secondary to carcinoma existing elsewhere.

ANATOMICAL CHARACTERS.—Malignant disease may occur at any spot throughout the entire length of both small and large intestine, but is infinitely more often to be met with at certain special parts, notably the rectum, sigmoid flexure, cæcum, colon generally, and duodenum; the jejunum and ileum being rarely affected. There is undoubtedly a predilection for those spots where any delay may occur in the passage of the intestinal contents, such as the flexures of the large intestine; and this favours the idea that mechanical irritation is largely concerned in the causation of malignant growths.

The greater number of the growths included in the category of malignant are comprised in the group of carcinomata, and present the following varieties:—Schirrus, encephaloid, scirrho-encephaloid, and colloid. Others belong to the epitheliomata, and not a few to the adenomata and lymphadenomata. The former are perverted growths of the epithelial tissue; but sometimes tumours of the sarcomatous or connective-tissue type are met with, following a malignant course, and presenting many points of similarity to encephaloid. The microscopic characters of these new growths present no special features. *See* CANCER; and TUMOURS.

As a rule, malignant growths would appear to commence in the mucous and submucous coats of the bowel, and then gradually involve the other tissues; but the colloid form usually begins in the peritoneum, and extends inwards.

The mesenteric glands are invariably affected, and may come to form large tumours.

Following the general course of these neoplasms when found elsewhere, they may undergo degeneration and ulceration, thus suffering a diminution in bulk at one spot whilst they extend in other directions, and this is especially the case in the more rapidly growing varieties, as the encephaloid, adenoid, and malignant sarcomata. In the course of their development they may set up adhesions between the bowel and other parts, as the abdominal wall or uterus, and two or more coils of intestine may be thus involved.

The new-formed tissue may constitute an irregular mass of a very variable size and extent, of a nodulated or of a villous appearance, perhaps partially ulcerated, and extending into the passage of the canal, producing an obstruction. The scirrhus and encephaloid growths are liable to develop in an annular manner, involving the whole circumference of the bowel; the obstruction produced in such circumstances may be extreme, even to narrowing the lumen of the tube to barely the size of a probe. Occasionally, however, annular encephaloid growths occur with no stenosis, but rather a dilatation of the canal. The extent of obstruction may be altered by partial destruction of the new growth by sloughing, though the subsequent cicatrices that may result will again constrict the gut.

SYMPTOMS.—For a varying time before this disease definitely and unmistakably asserts itself, the patient complains of vague dyspeptic symptoms; a sense of uneasiness in the abdomen, not amounting to pain, and usually increased after meals; and marked irregularity in the action of the bowels, with or without flatulent distension. The persistent and gradual increase of these symptoms, especially if there be any loss of flesh, is very significant, and should excite suspicion.

Sooner or later, according to the duration of the case, the usual cachexia is established; and in the greater number of cases the patient rapidly emaciates, especially towards the end, though in cases of very short duration the wasting may not be so excessive. The emaciation depends not only on the general perversion of nutrition caused by the development of the cancer, but also on the direct influence it exerts on organs concerned in the digestion of nutriment.

The local signs and symptoms referable to the new growth itself are very variable in their occurrence, and often are singularly slight in comparison with the gravity of the cause. Thus pain may be completely wanting, and perhaps there is but little tenderness on pressure; when present the pain is usually of a dull character, and quite localised. When the rectum is affected, the pain is apt to be rather of a burning character, and to radiate into neighbouring parts; not infrequently in this situation the pain may be extreme, and with tenesmus may amount to a degree of suffering which is very rarely the case elsewhere.

The indications of the tumour produced by the new growth are very uncertain, being often little more than an ill-defined fulness in one region; at other times presenting a distinct hard irregular mass, of variable size, this last quality being partly dependent on fæces. Should the growth happen to be situated on the aorta or iliac arteries, an indistinct pulsation may be communicated to it. The percussion-note over the tumour is usually imperfectly tympanitic, from the existence of coils of intestines between it and the abdominal wall, the thickness of which will of necessity considerably modify the signs of the existence of the growth. The mass may present all degrees from free mobility to complete fixity, dependent on the nature of its seat, and also on the existence of adhesions to neighbouring parts.

Symptoms of intestinal obstruction are rarely wanting; though, as already said, in exceptional cases the bowels may be dilated at the seat of the growth. Vomiting, constipation of increasing severity, with signs of intestinal distension above the lesion, are among the most constant; occasional diarrhœa, determined by the chronic enteritis which exists, may alternate with the constipation; and rupture of the intestines has been met with. *See* INTESTINAL OBSTRUCTION.

The stools are usually characteristic of the obstruction, consisting of small separate masses, frequently hard and round, and often mixed with sloughed-off portions of the new-growth, or with blood that has escaped from the ulcerated surface. The nearer to the anus the growth is situated, the less change will there be in the blood, which sometimes may be considerable in amount.

If the peritoneum be involved, peritonitis is likely to arise; and ascites, often considerable, is usually developed with colloid cancer. Superadded to these symptoms will be those caused by the morbid condition of any other organ that may be affected, such as the liver, bladder, or uterus.

COURSE AND TERMINATIONS.—Malignant disease of the intestines in the majority of cases progresses continuously from its commencement to a fatal ending. It is difficult to state even an average duration, owing to the insidious onset and vagueness of the first symptoms; but the greater number of cases rarely go beyond twelve to eighteen months from the time when the disease is clearly established, whilst some may be fatal in a few weeks, and a few may last for years.

Death may result as the direct consequence of the cachexia; or from hæmorrhage, peritonitis, or other effects of the growth.

DIAGNOSIS.—An exact diagnosis is often not to be made, and the nature of the case remains throughout uncertain, if not actually as to the existence of a malignant growth, at least as to the seat of it. The insidious and ill-defined character of the earliest symptoms presents nothing diagnostic, though their progressive character and resistance to treatment would cause a suspicion, especially in a person over middle age, and in whom a gradual even though slight loss of weight is noticed. Even in the later stages, the symptoms are almost identical with those of chronic enteritis, which really co-exists with the new-growth to a greater or less extent; and in the not unfrequent cases in which a tumour is not to be felt, or is uncertain in its indications, the diagnosis becomes extremely difficult. Some cases also in which the new-growth is unrecognisable to palpation, and at the same time causes little or no obstruction, closely simulate in their course diseases of the supra-renal capsule; for the latter are not invariably accompanied by cutaneous pigmentation, and the rapid and progressive emaciation, with more or less persistent vomiting, may be common to both. It is true that the malignant cachexia is frequently productive of a characteristic *facies*, but this would equally occur in cancer of the capsules.

Supposing that the existence of an abdominal tumour be clearly ascertained, it is not always easy to determine its connection with the intestine, since the variability in position, in mobility, and in size (due to the accumulation, or the reverse, of fæces), precludes any diagnostic sign, although this very variability is regarded by some as almost indicative of intestinal cancer. In distinguishing between an intestinal tumour and one connected with the liver, pancreas, kidney, mesenteric glands, uterus, abdominal wall, or the inflammatory new-growths following a perityphlitis, an aneurism, or a simple fæcal accumulation, the history of the case, age, progressive nature of the condition, existence of tumour, signs of obstruction, and character of the stools, are the points to be considered in forming a diagnosis. Any one or even two of these points might equally indicate other lesions, but taken collectively, they will usually justify the formation of an opinion. A rectal cancer, that is accessible to the touch or even to inspection, need offer no difficulty, but it is otherwise where it comes to distinguishing a duodenal growth from one strictly limited to the pylorus. The vomiting in the latter case is more persistent than in the former, and there is a greater liability to hæmatemesis; but these are most uncertain signs, as also is the existence of jaundice, which oftener complicates the duodenal affection, from the greater chance of involving or pressing on the bile-duct; but jaundice is not a necessary accompaniment. A firm epigastric tumour, felt close to the margin of the thorax, and associated with distinct dyspeptic symptoms, may also be due to primary cancer of the head of the pancreas. The symptoms of obstruction are less marked at first, but the growth will probably involve the gut in its progress, and cause more complete stenosis. Owing to the destruction of the gland-tissue, the pancreatic juice is not secreted, and undigested fat may be found in the stools.

Similar difficulties may surround the investigation of a tumour situated in the right iliac fossa. Emaciation, constipation, and melæna might equally indicate a scirrho-encephaloid tumour of the cæcum, or the remains of a chronic perityphlitis. The history may help a little, but frequently the case remains throughout in doubt.

TREATMENT.—The extremely rare cases of reputed natural cure of malignant disease of the intestines, brought about by sloughing of the growth and subsequent cicatrisation of its site, afford no hope of our being able to artificially imitate the process, and the treatment remains at the best symptomatic and palliative.

The diet should be so arranged as to contain the minimum of indigestible residue, and permit the chief digestion and absorption in the stomach, if it be the upper part of the tube that is affected. But in the majority of such cases the utmost disinclination for food exists, even apart from any vomiting or pain its ingestion may produce, and hence, whatever the directions, the patient in the later stages practically takes nothing. The anorexia is frequently as marked even when the mischief is seated in the colon, and the area for digestion and absorption is uninterfered with.

In the earlier stages it may be advisable to insist upon as much nutritious food as possible by the mouth or in the form of enema, so as to offer the most prolonged resistance to the inevitable end; but at the same time there is no slight cause for thinking that the same course favours the speedier development of the new-growth. Preparations of iron may be given with the same view.

The symptoms dependent upon the obstruction we can do next to nothing to relieve; only the mildest aperients are permissible, to combat the constipation; while the vomiting is as a rule uncontrollable, and, indeed, is often a relief.

Hæmorrhage may require special attention, and the pain may be so severe as to necessitate free administration of morphia subcutaneously; in other cases belladonna is of value in alleviating the local discomfort, and acts favourably by allaying any spasm. But our best remedies offer no resistance to the progress of the disease, and but too often very little relief.

The special characteristics of cancer of the rectum, sigmoid flexure, or cæcum occasionally permit of operative interference—such as colotomy. *See* INTESTINAL OBSTRUCTION; and RECTUM, Diseases of.

14. Intestines, Malpositions of.—Displacements of the intestines, like malformations, are both *congenital* and *acquired*.

Among the former may be mentioned complete transposition of the viscera, the cæcum and ascending colon being on the left side, and the sigmoid flexure and descending colon on the right, the liver, spleen, stomach, &c., sharing in the change. Certain parts only of the intestinal canal may occupy an abnormal situation, as seen in the various congenital herniæ; or the displacement may be due to unusual length of the mesenteries, the cæcum and sigmoid flexure being the parts that present the most usual alteration from this cause. Thus the cæcum may occupy the left hypochondrium or left iliac fossa, or be found in the pelvic cavity, and, of course, other parts of the canal must correspond to these malpositions. The sigmoid flexure has been seen lying to the right side of the left kidney, which was situated immediately below the bifurcation of the aorta. Similar displacements are referable to adhesions, determined by intra-uterine peritonitis, which is frequently associated with syphilis.

The malpositions which the intestines may come to present from changes set up after birth are so variable as scarcely to admit of classification. Hernia, both external and internal, volvulus, and intussusception are among the well-recognised displacements; but there is scarcely any limit to the changes in position which the traction and pressure of tumours and the effects of peritonitis may produce.

Many of these conditions give rise to no symptoms, and may even fail to be recognised during life. The acquired malpositions lead to obstruction in varying degrees. *See* INTESTINAL OBSTRUCTION; and HERNIA.

15. Intestines, Morbid Growths of.—Owing to the variety of tissues that enter into the formation of the intestine, no less than to the origin of these tissues from two of the three primary layers of the blastoderm, the new-growths that may develop are exceedingly numerous.

It will be most convenient here to consider them from their clinical rather than from their genetic or histological point of view, and to divide them into *malignant* and *non-malignant* growths. The former have already been treated of, and the special neoplasms of tubercular and syphilitic origin are more conveniently referred to separately.

VARIETIES.—1. *Fibromata.* These growths, which are developed from the connective tissue of the submucous coat, are usually of small size, frequently pedunculated, though sometimes appearing as sessile, flattened nodules, of half the size of a pea projecting into the canal. The smaller ones may be scattered throughout the length of the bowel, whilst the larger ones (up to the size of a walnut) are fewer in number or single, and are usually found in the rectum. They present the ordinary microscopic characters of fibrous tissue.

2. *Lipomata.*—Polypoid growths of adipose tissue, springing from the submucous coat, are not of uncommon occurrence in any part of the intestines. Less often they are sessile and of small size.

3. *Myomata.*—Very rarely small growths are met with, chiefly composed of contractile fibre-cells, with a variable amount of connective tissue.

4. *Vascular tumours—Angiomata.*—Besides hæmorrhoids, other vascular growths are sometimes found, of an erectile character, similar to nævi of the skin.

5. *Mucous.*—It is to these growths that the term *polypi* is oftenest applied. They essentially consist of all the tissues of the mucous membrane, though differing in their vascularity, and also in their glandular elements. When these latter are excessive in amount, they are liable to present characters which connect them with malignant forms of new-growth, especially if their surface assume a villous character. Polypi are not limited to any one part of the canal, though undoubtedly they are most common in the rectum. Sometimes they are distinctively pigmented. They are occasionally multiple; and have been met with at all ages.

6. *Lymphoid growths — Lymphadenomata.*—Neoplasms whose structures correspond to that of the solitary or agminated glands, or of the lymphoid layer of the submucosa, are met with in association with these normal constituents of the intestinal wall, and quite independently of any leucocythæmia.

7. *Cysts.*—These have been rarely met with, and the contrast to their comparative frequency in the uterine mucous membrane is remarkable. Dr. Dickinson (*Tr. Path. Soc.* vol. xii. p. 138) records the occurrence of a colloid cyst of the size of an orange, between the muscular and mucous coats of the cæcum in a patient aged 75, so placed as to give rise to no obstruction or other symptoms. The contents were gelatinous and oily, and there were no cysts elsewhere.

EFFECTS AND SYMPTOMS.—As a rule, the growths mentioned above present very little interest, unless they be situated just within the rectum, and accessible to digital examination. They cannot be diagnosed, though they may give rise to certain symptoms, as, for instance, hæmorrhage from the vascular polypi and erectile tumours, or partial obstruction if they attain any size; but such symptoms are not diagnostic. One of their most interesting effects appears to be the liability that the polypoid forms, occurring in the small intestine, have of inducing intussusception, from interfering with the due progress of peristalsis. Prolapse of the rectum is similarly found to be occasionally due to polypi.

Treatment.—No treatment can be attempted, beyond that of the symptoms which may arise; or the removal of growths within reach of the anus.

16. Intestines, Paralysis of.—The peristalsis of the intestinal tube is normally dependent on automatic nerve-impulses, originating in the intrinsic ganglia of the canal, controlled by both reflex and direct impressions from the cerebro-spinal and sympathetic systems, the former acting *viâ* the vagus in an accelerating manner, the latter *viâ* the splanchnics in an inhibitory direction. The integrity of the involuntary muscular fibre is assumed.

Ætiology and Pathology.—A paresis of the intestinal movements may be brought about by (1) causes acting through the *nervous system*; or (2) through imperfection of the *muscular tissue.*

(1) *Nervous.*—Whilst it is possible that the intrinsic ganglia and nerves of the intestinal muscular coat may be the seat of degeneration, no known observations are recorded. Certain lesions of the brain are accompanied by symptoms of intestinal paralysis, but with no hitherto recognised regularity, and it is assumed that such lesions act by interfering with the function of the vagi. It is doubtful how far disease of the spinal cord produces actual paralysis of the intestines, though constipation may result, a circumstance that may be explained by assuming an interference with the centre that controls defæcation. *See* Fæces, Retention of.

(2) *Muscular.*—The irritability of the muscular tissue may be much weakened by degeneration (cloudy, fatty, or amyloid). Inflammation of the mucous or serous coat, especially the latter, is liable to determine granular change in the muscular fibres, which, aided by a coexistent œdema, largely impairs the contractile power of the tissue. The irritability is also liable to suffer from the over-stimulation of too powerful and too frequent purgative medicines; and the muscular fibres of a much dilated portion of the bowel are apt to become paralysed from distension and stretching. The general want of tone that the muscular and nervous systems manifest subsequent to debilitating diseases, want of food, hysteria, and other conditions, also finds expression in the alimentary canal, in diminished peristaltic action.

The *modus operandi* of certain astringent drugs upon the bowel is quite unknown, possibly through the nervous system, as appears to be the case with opium, and perhaps by affecting the muscular fibres or nerve-terminals. Lead, which would seem to cause both paralysis and spasm of the muscular coat, may act in this way.

Symptoms.—The prominent symptom of intestinal paralysis is constipation, though other signs of obstruction, such as vomiting, meteorism, &c., may be superadded. *See* Constipation; and Intestinal Obstruction.

Treatment.—As a rule this is directed to the primary cause, but great benefit has undoubtedly followed the special application of electricity to the abdominal parietes. Friction applied on systematic principles is of undoubted service.

17. Intestines, Perforation and Rupture of.—Ætiology.—The causes of perforation or rupture of the intestines may be arranged thus:—1. *External injuries*, such as blows, being run over, &c., though more liable to rupture the solid abdominal viscera, frequently cause the intestines to burst, especially the ileum or jejunum.

2. *Corrosive poisons*, when swallowed in any considerable amount, may destroy not only the walls of the stomach, but also of the upper part of the intestines.

3. *Extreme distension by flatus* above the site of a constriction may cause the bowel to burst.

4. *Ulcerations*, pre-eminently the so-called peptic ulceration, and less commonly typhoid and catarrhal ulceration, are liable to lead to perforation.

5. *Perforations* may be produced *ab extrâ*, by the bursting of abscesses or aneurisms into the canal.

Symptoms.—The most striking symptom which perforation of the bowel presents is collapse, and it is a noticeable fact that rupture of the hollow abdominal viscera is more liable to induce this condition than a similar lesion of such organs as the liver or spleen. The exact explanation of this collapse is not apparent.

Should the patient live twenty-four hours after the establishment of a perforation, signs of peritonitis will assert themselves—severe abdominal pain and tenderness, pyrexia, vomiting, and other symptoms. Supposing that the perforation follow an ulceration in the course of a previously high temperature, such as enteric fever, there will be a sudden and usually considerable fall in the body-heat; this may be the first indication that perforation has taken place.

Perforation or rupture of the intestines usually proves fatal within forty-eight hours of its occurrence, although cases are recorded which have lasted for weeks; very rarely recovery has taken place.

There are no reliable signs whereby rupture of the stomach may be distinguished from that of the intestines, nor is it of any practical importance. But the collapse and fall in temperature, with the history of the case, are quite sufficient to warrant the diagnosis of perforation of some part of the canal.

Treatment.—Rest is of primary importance, both in regard to the whole body, and the bowels themselves. This object is best attained by the free use of opium, commencing with a grain, and repeating it in a few hours until its influence is fully established. It is also desirable to cut off all food, except an occasional teaspoonful of meat essence; to give ice to suck; to administer nutrient enemata, and brandy and ether if the collapse be profound; and to apply warmth to the extremities.

18. Intestines, Spasm of.—The irregular and forcible movements of the bowels, usually accompanied with pain, are known as *colic.* Under ordinary circumstances we are unconscious of the peristaltic action, but when the contractions of the muscular coats become violent, more or less pain is likely to occur.

ÆTIOLOGY.—The determining causes of intestinal spasm are:—

1. The direct irritation of indigestible ingesta. 2. Exposure to cold. 3. Certain poisons—lead, strychnia, &c.—which probably affect the muscular fibres through the nervous system.

It is difficult to ascertain the exact condition of the contracted bowel, since the appearances seen after death are not an index of what existed during life; but it would seem that the spasm may start from several points in the course of the canal, and, after persisting for a variable time, either yield or travel on as a wave of spasmodic contraction. For how long a portion of bowel may remain contracted is quite conjectural.

SYMPTOMS.—The existence of a painless spasm of the intestines is very doubtful; as a rule it is the pain which indicates this condition, and except the contraction be maintained, no further symptoms may occur. Constipation, vomiting, meteorism, may all be present in varying degrees, dependent upon the extent of obstruction which is produced. Not infrequently fever, collapse, and prostration may co-exist, leading to the belief that a more serious condition is calling for treatment.

The specially painful spasm of the anal sphincters and lower portion of the rectum termed *tenesmus,* is associated with gouty congestion, with ulceration, and with most other lesions in that locality.

TREATMENT.—The external application of moist heat in the form of poultices or fomentations, preferably of poppy-head or other opiates, is of great value, for relaxing the spasm or removing the pain. Since an irritant is so frequently the cause, an aperient, such as castor oil or calomel, combined with opium, is essential. The collapse may be so severe as to call for energetic stimulation by brandy, ammonia, or ether.

19. Intestines, Syphilitic Disease of.—The intestinal canal is rarely the seat of the specific lesions of syphilis, except at the lower end of the rectum, and margin of the anus. Small gummata have been found in the submucous tissue of various parts of the bowel, but more often the ulcers to which these growths give rise by their degeneration and breaking down; radiating fibrous cicatrices of the mucous membrane have also been seen, produced by these syphilomata. It is doubtful whether there be any specific ulceration of the intestine which is not preceded by gummata, although small ulcers do occur in newborn children, the subjects of congenital syphilis.

Syphilitic ulceration and stricture of the rectum is not of infrequent occurrence. *See* RECTUM, Diseases of.

20. Intestines, Tubercular Disease of.—The specific lesions of the tubercular diathesis, namely, grey granulations or miliary tubercles, are of frequent occurrence throughout the intestinal canal. Regarding them as local developments of lymphoid tissue, the opportunity for their formation is most favourable, owing to the extensive distribution of this tissue throughout the submucous coat, and the special aggregations of it which form the solitary and agminated glands. The abundant supply of lymphatic vessels in the thickness of the walls of the canal, and the close connection of the serous surface with the lymphatic system, all predispose to the development and spread of a tubercular growth which may have become established in a subject of the diathesis.

ÆTIOLOGY.—As a primary growth tubercle very rarely attacks the intestines in adults, though it is of very frequent occurrence in children as part of a general tuberculosis. In adults, on the contrary, tubercular disease of the intestines is very commonly developed secondary to a similar affection of the lungs.

ANATOMICAL CHARACTERS.—The submucous layer and the peritoneal coat are the structures in which the tubercle originates; in the former situation it especially favours the ileum and cæcum, although it may develop throughout the entire length of the tube, whilst the peritoneal tubercle is about equally distributed. The mesenteric glands are always considerably involved. The rareness with which the stomach is affected by tubercle is in marked contrast to the frequency of the intestinal lesion.

In extreme cases of tuberculosis in children, death may take place before any changes in the tuberculous formation have taken place, and countless grey granulations, from the size of a pin's head to bodies microscopic, are to be found in the submucosa, and in the solitary and agminated glands. Later on, however, these non-vascular new-growths coalesce, and form distinct masses, which from lack of nutrition undergo caseous degeneration and break down, thus forming the tubercular ulcers. The ulcers tend to spread, and rarely to heal, and whilst they may be at first limited to the glands, they invade the adjacent mucous membrane, especially in a direction round the bowel, their extension being preceded by the development of fresh tubercles, to the progressive formation and destruction of which the spread of the ulcer is really due. Large masses of the mucous surface may be thus destroyed, leaving a ragged, flocculent surface, formed of the muscular fibres, or even of deeper structures, which lesions rarely proceed to perforation into the peritoneal cavity, adhesive peritonitis having established attachments to adjacent parts. The thickened, congested, irregular edges of the ulcers, with miliary tubercles close to the margin, are very distinctive; apart from the granulations, the ulcers themselves are not unlike those of dysenteric origin, or chronic follicular ulceration.

SYMPTOMS.—Until ulceration be established, there will be no symptoms of tubercular disease referable to the intestinal canal, and even when this stage is reached, there is nothing to distinguish it from ulceration due to other causes. There is the same pain and tenderness, often but little marked; usually an obstinate diarrhœa;

characteristic stools with occasional blood; and progressive emaciation. Added to these are the symptoms due to implication of other organs—lungs, brain, &c.—since tubercular ulceration of the bowels scarcely ever occurs alone.

TREATMENT.—Little can be done for intestinal tuberculosis. The course of the disease is almost invariably to a fatal end, and it is very rare for healing and cicatrisation to take place. The necessity for feeding the patient is almost contraindicated by the existence of a destroyed digesting and absorbent surface, whereby the food becomes a positive irritant. Such nourishment as is taken should therefore be in the most digestible and concentrated form, that as much as possible may be taken up from the stomach. Starch and opium enemata may do a little to check the diarrhœa, but their efficacy is soon lost. Hæmorrhage, should it set in, is scarcely amenable to treatment, though astringent enemata may be of some use, combined with the internal administration of acetate of lead and opium. No treatment has as yet been effectual in arresting the spread of tubercle, and until that be gained, there is nothing we can do that will permanently benefit the affected intestines; even palliative measures afford but little relief.

21. **Intestines, Ulceration of.** — Ulceration of the intestinal wall, from one cause or another, is of extremely common occurrence. The morbid processes involved in the production of the ulcers are in all cases essentially the same, namely, a molecular death and disintegration of the tissue, leaving a solution in continuity, of varying extent. The severe disturbance of tissue-nutrition which leads to ulceration, may be one of the later stages of inflammation:—(1), affecting previously healthy tissues; or (2), as a means for the removal of necrosed tissue; or (3), developed in new-growths.

VARIETIES: 1. *Primary inflammatory ulcers.*—Any enteritis, whether of the mildest character, or of a specific type such as diphtheritic, may lead to ulceration of the bowels. As a rule, the more severe the cause of the inflammation, the greater the liability to this complication; and the same holds in respect of any intestinal catarrh, developed in the course of any serious state, such as typhus fever or Bright's disease. The ulcer may appear either as a small abrasion of the epithelial layer, which gradually extends and deepens until the whole mucous coat is involved; or the first indication may be a thin glairy pellicle, adherent to the mucous membrane, which in time is thrown off, leaving a breach in the subjacent tissue. In other cases the destructive process commences in the thickness of the bowel, either from the rupture of small collections of inflammatory products, resulting from an enteritis, or from inflammation of the follicles. The escape of these products into the tube leaves behind an ulcer.

These lesions may be found anywhere throughout the bowels, although they are much more frequent in the large than in the small intestine, and one form of follicular ulceration, associated with the specific poison of dysentery, is practically limited to the latter situation. At those places where any delay is likely to arise in the passage of the fæces—the cæcum, sigmoid flexure, and rectum—and at those spots which are most prominent, such as the edges of the valvulæ conniventes, and the sacculus of the colon, where an enteritis is most likely to be produced, there will be the probable site of these inflammatory ulcers.

2. *Ulcers resulting from the separation of necrosed tissue.*—The process of molecular disintegration which takes place in the adjacent bodies of living and dead tissue, resulting in the separation of a slough and the leaving of an ulcer, takes place in the intestines as elsewhere. The causes leading to the death of circumscribed areas of tissue are various. Sometimes the vitality of a portion of the mucous membrane is destroyed by degeneration, such as amyloid, and an ulcer marks the spot of the removed patch. More frequently the local death is induced by cessation of blood-flow through a limited area; the cause of this stasis is not very apparent, though believed to be due to emboli. Under such circumstances the solvent power of the digestive juices may be exerted on the non-living tissues, which are thus removed, and an ulcer is left. To such ulcers the term *peptic* has been applied, and identical lesions are met with in the stomach. They almost invariably occur in the first part of the duodenum, above the point of entrance of the alkaline bile and pancreatic juices, although very rarely they have been seen in the jejunum. Ulcers of this character appear to be connected with large superficial burns, but how the relationship is established is not known. It is a singular fact in regard to them, that they are ten times more common in men than in women, which is quite the reverse of what obtains in the stomach, although the relative frequency of gastric and duodenal ulcers is estimated as thirty to one. Both the ileum and colon have been found ulcerated in amyloid degeneration.

3. *Ulceration of new-growths.*—Almost any neoplasm of the intestinal wall may ulcerate, though as a rule the more rapidly developed forms are more liable. Tubercular and typhoid growths primarily connected with the solitary and agminated glands, invariably end in this manner. Syphilitic gummata and malignant growths are especially prone to ulceration.

CHARACTERS.—The appearances presented by the various ulcers differ with the cause and the duration.

They may be single, as is generally the case with the duodenal ulcers; or innumerable, as the follicular ulcers of the colon. Typhoid and tubercular ulcers are as a rule multiple, and are most numerous at the lower end of the ileum, where the agminated glands are most abundant. Occasionally large surfaces of the mucous membrane are destroyed, with here and there small isolated spots of the membrane left, due to the spread and coalescence of many separately arising ulcers. In dysentery and chronic tubercular ulceration this is especially liable to happen. Many of the catarrhal and follicular ulcers are extremely small, not more than a line in diameter.

The peptic ulcers are distinguished by their very definite, 'clean-punched' appearance; the edges are slightly sloping, and but very little, if at all, thickened; whilst the mucous membrane immediately adjacent has a perfectly healthy appearance. In most of the other varieties the edges are thickened, irregular, and shaggy, frequently excavated and overhanging the base; the ulcerative process extending beneath the mucous membrane, which gradually dies and sloughs away as its nutrition is cut off. Dependent upon the depth and course of the ulcer will be the nature of its base, which may be formed of the muscular coat, of the peritoneum much thickened, or of adjacent structures with which adhesion has been established, such as the liver or abdominal wall. The floor of the ulcerated tubercular and malignant new-growths usually presents small nodules of the neoplasm, which are being developed coincidently with the ulceration. The buff or ash-grey pigmented sloughs, partially separated, give a characteristic appearance to the old-standing ulcers of dysentery and tubercle. The tubercular and typhoid ulcers of Peyer's patches present a certain difference in the direction in which they extend; whilst at first both are limited to the patch, the former tend to spread in an annular manner, whilst the latter have usually their long axis corresponding to the length of the bowel. This difference depends rather on the duration of the ulcer, than on any specific distinction due to the two diseases; for the more acute enteric lesion rarely spreads much beyond the area of the patch, which is in the long axis of the bowel, whilst the chronic tubercular ulcer follows the distribution of the lymphoid tissue outside the patches, and particularly along the course of the blood-vessels and lymphatics.

COURSE.—The course of an intestinal ulcer may be acute or chronic, lasting a few days or for years. Some of the simple ulcers of an acute intestinal catarrh belong to the former group; whilst the ulceration that accompanies chronic enteritis may be of indefinite duration.

The acute forms may either heal or go on to perforation; in the former case their existence can only be inferred, and catarrhal and follicular and enteric ulcers belong to this category. The peptic and typhoid ulcers are those most liable to perforate the gut, their duration being too short to allow of the formation of adhesions to neighbouring structures, as is very apt to be the case in the more chronic forms. Occasionally the perforation may lead to communication between one coil of intestine and another, between the duodenum and stomach, or between the bowel and bladder, without any rupture into the peritoneal cavity, which is the commonest end of a perforating typhoid ulcer. In chronic ulcers, where no adhesion or communication takes place, the base is thickened by a new-formed connective tissue, which is developed as fast as or even faster than the destructive process proceeds, and hence the intestinal wall adjacent to, and involved in such ulcers, is usually much thickened and indurated. Short of actual perforation or adhesion to other parts, the site of the ulceration most frequently is marked on the external surface of the bowel by a sub-acute peritonitis, which may produce a partial matting together of the intestines.

In the course of the healing of the larger ulcers, by the formation of a contracting cicatricial tissue, the gut may be considerably constricted, and a most formidable obstruction may be established. But this does not necessarily follow even large ulcers, such as those of typhoid fever; and the extent of depth of the destruction would seem to influence this result; when the superficial portion of the mucous membrane only is destroyed very little contraction follows, but when the deeper parts of the wall are involved the subsequently developed cicatrix tends to shrink considerably. Similar differences are seen in destructions of the skin and subcutaneous tissues.

SYMPTOMS.—The greatest diversity is met with in the symptoms of intestinal ulceration, and few, if any, can be regarded as characteristic. Inasmuch as the lesion may occur without producing any symptoms; or those that do exist may be determined by the course of, or by the conditions associated with the ulceration; or lastly, the results of this condition, such as perforation, may entirely obscure the actual ulceration itself: it frequently happens that the existence of an ulcer is not recognised. Nor may the severity of the symptoms be taken as a measure of the extent of the ulceration, for the most marked pain, tenderness, diarrhœa, and other symptoms may be produced by an area of typhoid ulceration that heals; whilst a perforating duodenal ulcer may give scarcely any indication of its existence, until within a few hours of a fatal ending. This course appears to be very characteristic of duodenal ulcers; and the writer has recorded a case of a young man who was suddenly attacked with all the symptoms of apparently intestinal colic, after constipation of a week's duration, no vomiting and no tenderness, the pain being relieved by pressure on the abdomen. Collapse set in, and death resulted in less than twenty-four hours from the commencement of the attack. The autopsy showed a perforating duodenal ulcer. Such a case is not singular, and may be preceded, as this case was by nothing beyond an occasional feeling of discomfort at the epigastrium, not serious enough to call for advice or treatment.

Such symptoms as diarrhœa, vomiting, pain, tenderness, and pyrexia are as much dependent on a co-existent enteritis or new-growth, as they are upon the ulcer. Doubtless the exposed surface of an ulcer offers the opportunity for increased peristalsis being induced, but this is not of necessity, for constipation may be present. Where the area of ulceration is extensive, the absorbing surface is by so much diminished, and thus while the general nutrition suffers, the unabsorbed products of digestion are liable to decompose and induce diarrhœa. Vomiting may arise from a duodenal ulcer, but not always, and when present it may be due to peritonitis; icterus may also complicate an ulcer in this situation, by involving the opening of the bile-duct, or by extension of the duodenal catarrh. Pain may be quite absent or quite insignificant, unless the rectum be the seat of the disease, when the pain and tenesmus are excruciating.

The passage of blood in the stools, especially if bright, is probably a most characteristic indication of ulceration, but it does not always occur, and it may be due to general venous congestion from partial obstruction. *See* Stools.

The symptoms due to perforation have been already described. *See* Intestines, Perforation and Rupture of.

Diagnosis.—From what has been said, the formation of a diagnosis of intestinal ulceration is frequently impossible, and an ulcer is assumed rather than proved to exist. In enteric fever ulceration is taken for granted as existing, though no special symptoms may indicate its presence. But if a severe and persistent diarrhœa, with liquid stools and shreds of mucus, and much pain and tenderness over the abdomen, supervene in a case of tubercular phthisis, it is a fair inference to assume ulceration of the intestines. In dysentery, like enteric fever, the ulceration is a specific part of the disease, and the diarrhœa, pain, and characteristic stools are in this case directly dependent upon the ulceration. Since there are no constant distinctive symptoms of ulceration, the ground for a diagnosis must remain uncertain.

Prognosis.—This largely depends upon the cause. Except through perforation or fatal hæmorrhage by erosion of vessels, death does not take place from the ulceration itself. But a tubercular ulceration is not to be expected to heal, and it may by its development hasten the end of a phthisical patient. The prognosis in typhoid ulceration will almost entirely be founded on the general state of the patient, since the indications of the ulceration itself may be so slight. The ulceration of malignant new-growths may be of actual benefit, by removing portions of the mass, and so diminishing obstruction. In all cases the liability to stenosis must be remembered; and the impaired health of body and mind in chronic ulceration may continue throughout life.

Treatment.—Since ulcers of the intestine are inaccessible to direct treatment, little can be done for them apart from the general conditions which they may complicate, or the treatment of the symptoms to which they may give rise.

Recognising that an ulcer, when it exists, may lead to perforation, the object will be to avoid all undue movements of the intestines, and hence aperients are forbidden, and opiates are indicated. The astringents that are likely to be used for the diarrhœa or hæmorrhage may exert a local action on the lesion, and for that purpose bismuth, sulphate of copper, and similar agents, are recommended. But rest is probably the only element of treatment that can affect the ulcerative process directly; whilst any improvement of the general condition will necessarily favour the healing—objects which can be best accomplished by the use of diet of the most bland description, or of nutrient enemata.

In the preceding article the diseases to which the intestines are liable have been treated of as affecting the canal as a whole: but it will be observed that when the structure and functions of particular regions of the bowel modify the character of the disease, special reference is made thereto; and, further, that when the affections of any portion require detailed description—as of the cæcum or rectum, the reader is referred to articles under those headings.

William Henry Allchin.

INTRA-THORACIC TUMOURS.—Under this general term are included all growths and diseases within the chest, which give rise to tumours or swellings, offering more or less mechanical interference with the functions of the thoracic organs, and for the most part manifesting themselves by external swellings. Aneurisms would thus be comprised in this general definition. The general features and pathology of aneurismal tumours are, however, so distinct as to require separate consideration (*see* Thoracic Aneurism). Other intra-thoracic tumours will be found described under the headings Lung, Malignant Disease of; and Mediastinum, Diseases of.

J. Risdon Bennett.

INTUSSUSCEPTION (*intus*, within, and *suscipio*, I receive).—A form of intestinal obstruction, in which one portion of the bowel passes into another portion. *See* Intestinal Obstruction.

INUNCTION (*in*, on, and *unguo*, I anoint). Synon.: Anointing.—This is a method of applying certain substances to the cutaneous surface, the object being to promote their absorption, either for the purpose of producing local effects, or of influencing the system generally. Inunction implies more or less friction, the substance employed being rubbed with the hand into some part of the skin. When used for local purposes, the part to be anointed must be chosen accordingly; but if it is intended to affect the system, a region must be selected where the cutaneous tissues are thin, such as the inside of the thighs, or the axillæ, so that absorption may take place more rapidly and easily. The rubbing must be carried on gently, and for a variable time according to circumstances; it may be aided by heat, being performed before the fire, or the part may be previously fomented.

Application and Uses.—The pharmaceutical preparations which are employed for inunction include glycerines, liniments, oils, ointments, oleates, and compounds made with vaseline, ozokerine, and other materials of a like nature recently introduced. If these are used for local purposes, they may be employed simply on account of the oleaginous ingredients, or to allow friction to be more easily carried on; but active ingredients are often combined in the preparations mentioned above, varying according to the object sought to be obtained, such as to produce a stimulant or an anodyne effect. Inunction for procuring absorption in order to affect the system, is almost entirely confined to the use of mercury, and on this subject the following observations were written for this work by the late Mr. Gascoyen:—

'Inunction is an old but very effectual plan of introducing mercury into the system by the skin. Although objected to as a dirty method, and therefore less practised than fumigation, it is often much more convenient, and can be used in many cases where the mercurial bath is impracticable.

'From half a drachm to one drachm of strong mercurial ointment, mixed with an equal quantity of lard, should be rubbed into the skin on the inside of the thighs, legs, and arms, before a fire at bedtime, using the different limbs on successive nights. The friction should be gentle, and continued for a quarter of an hour to half an hour, when most of the ointment will have disappeared; the surface must not be washed, and the patient should wear the same flannel under-clothing night and day. The ointment may be used every night until the gums give evidence of its action, when the quantity and frequency of application must be diminished. Sometimes it will produce an irritation of the skin, especially in fair or hairy persons. If this occur, the surface must be washed clean, and the rubbing discontinued.

'Inunction is a most convenient way of treating syphilis in young children. The ointment should be spread upon a flannel roller, and the body of the child swathed therein; occasionally the skin should be washed, and fresh ointment applied.

'Although but little practised now in this country, inunction is still largely employed on the Continent, and particularly in conjunction with the natural sulphur waters, for cases of old-standing syphilis.' FREDERICK T. ROBERTS.

INVAGINATION (*in*, in, and *vagina*, a sheath).—A synonym for intussusception. *See* INTUSSUSCEPTION; and INTESTINAL OBSTRUCTION.

INVASION, Modes of.—This expression signifies the manner in which a disease sets in or commences, and the mode of onset of an illness is frequently an important factor in forming a diagnosis as to the nature of the complaint. The following are the variations noticed in this respect:—1. The invasion may be absolutely or almost *sudden*, although slight symptoms may have been previously observed, indicating the presence of some morbid condition, but not sufficiently marked to attract attention. Or there may be distinct indications of some disease, but a secondary lesion suddenly occurs in its course. This mode of onset is exemplified by the immediate effects of injuries, apoplexy, syncope, rupture of the heart, cholera, many cases of hæmorrhage, and most forms of colic. Certain diseases of a paroxysmal type are also characterised by the occurrence of attacks, which come on more or less suddenly, such as asthma, ague, and epilepsy. Some cases of fevers, especially typhus and relapsing fever, as well as of inflammatory diseases, begin in a sudden manner. 2. Frequently the onset is *acute*, the symptoms coming on rapidly, and becoming speedily severe, though often preceded for a variable time by premonitory symptoms. This is illustrated by most cases of the various fevers, and the different forms of acute inflammation. 3. A *subacute* mode of invasion is not uncommonly noticed, this being less rapid, and the symptoms less marked than where it is acute. 4. Most affections are *chronic* in their onset, setting in gradually, and often imperceptibly, so that it may be a long time before the patient is aware that there is any deviation from health. FREDERICK T. ROBERTS.

IODISM.—DEFINITION.—Iodism is the term within which we include a variety of painful and inconvenient effects, following, under certain rare circumstances, the administration of iodine and its salts, but more especially the iodide of potassium.

DESCRIPTION.—Iodide of potassium being in part, at least, decomposed in the presence of ozone by the acids of the blood, we shall endeavour, in considering the symptoms of iodism, to determine which are due to the iodine, and for which the potash must be held responsible. The physiological action of iodine is mainly directed to the nutritive and glandular functions, to the skin and mucous membranes; whilst the salts of potash are not only diuretic and purgative, but, experimentally at least, powerfully depress the heart and spinal cord.

Rilliet, the most exhaustive writer on the subject, makes three forms of iodic intoxication: the first consisting of gastric irritation; the second, where nervous troubles come into more special prominence; whilst cachexia and rapid emaciation characterise the third. But the most orderly and convenient plan to pursue, will be to take into consideration, in regular order, the effects produced by iodine salts on the various organs and functions of the body, under various conditions of idiosyncrasy or retarded elimination.

1. *On the nervous system.*—Mental depression and diminution of muscular energy are not infrequently noted in patients taking iodide of potassium; whilst neuralgia, tinnitus aurium, and convulsive movements have also been described. It is probable that the potash is here the active agent.

2. *On mucous membranes.*—Much mucous irritation is occasionally observed; conjunctivitis, lachrymation, sneezing and running from the nose, frontal headache, and puffy swelling of the eyelids, closely simulating coryza, being the most common symptoms of iodism, and sometimes following a single small or moderate dose. Pharyngeal congestion, and irritable redness of gums and tongue, have also been described. These symptoms are doubtless due to the iodine.

3. *On the skin.*—The eruptions produced by iodide of potassium have recently attracted much attention, and they appear under several forms. Erythema has been observed; and most practitioners of experience must have seen the small round petechial spots, situated between the knees and ankles. These do not as a rule cause any inconvenience, and are usually accidentally discovered; but Dr. Stephen Mackenzie records the case of an infant of five months old, suffering from hereditary syphilis, who died of purpura after taking two and a half grains of iodide of potassium in a single dose. Some further points of interest, in connection with a case of this kind, reported by Dr. G. F. Duffey, will be found in the *British Medical Journal*, 1880, vol. i. p. 626.

A papular and pustular eruption resembling acne, and occasionally appearing in so great profusion as to excite the suspicion of small-pox, is not very uncommon. The late Dr. Tilbury Fox has noted 'a quasi-bullous disease,' summing up the description of his cases as follows: 'In some parts they resembled acne simplex; in others they vesiculated and subsequently simulated variolous pustules; at a later stage ecthyma; finally bullæ filled with milky contents, or discharging smegma; and these bullæ possessed peculiar solid bases wholly unlike true bullæ, and answering rather to large molluscum contagiosum tumours with semi-fluid instead of more solid contents.'

Dr. Fox believed this condition to be essentially distinct from hydroa, but Mr. Hutchinson has brought forward good evidence to show that the rare skin-affection going under that name must usually be looked upon as one of the symptoms of iodism. The same author mentions a case of deep and unhealthy ulceration of the legs following the prolonged use of iodide of potassium. It seems probable that the iodine rather than the potash must be held responsible for these symptoms. See *Archives of Dermatology*, 1880.

4. *On the nutritive and glandular systems.*—Patients taking iodide of potassium sometimes complain of nausea, anorexia, and a bitter taste in the mouth; but where cachectic symptoms supervene, indicated by rapid emaciation, nervous palpitation, insommia, and hypochondriasis, a ravenous desire for food has been observed. Vomiting, diarrhœa, and diuresis have also been described. Salivation is not an uncommon symptom. A time-honoured accusation against iodine is its supposed tendency to cause atrophy of the mammæ and testicles; of this, fortunately, there is no real proof, the disappearance of the testicle, which occasionally accompanies the absorption of inflammatory products in its substance, being sometimes unjustly attributed to the treatment pursued.

Pathology.—The only reason for the occurrence of many cases of iodism seems to be an individual peculiarity on the part of the patient, or in other words, that idiosyncrasy which so frequently interferes with our efforts for the treatment of disease. But now and then a more plausible explanation may be given, when we find cardiac or renal disease coinciding with the pustular rash of iodide of potassium. Retarded capillary circulation would naturally detain the drug within the blood; whilst the blocking of its usual means of exit from the system might be supposed to throw the onus of elimination on the glandular structures of the skin. Hence has been derived the plausible theory that iodine-acne is produced by direct local stimulation of the sebaceous structures; but, however true this may be in the slighter cases, Dr. Thin's careful examination of the skin of a patient suffering from a bullous rash, has shown the true pathological condition to be one of rupture of blood-vessels at certain localised points, with blocking by coagula, and escape of some of the constituents of the blood into the surrounding tissues. The sebaceous elements and sweat-glands were quite unaffected, and he believes the iodic papule, the so-called acne, the bulla, and the purpuric spot, to represent different stages of vascular injury. Drs. Duckworth and Vincent-Harris were unable in their observations to detect any rupture of vessels, but confirm Dr. Thin's report in all other essential respects.

Diagnosis. — Coryza, or any skin-eruption, suddenly occurring in a patient taking iodide of potassium, ought to be looked upon with suspicion, and treated by the immediate suspension of the drug. The slighter varieties of iodism are by no means uncommon, and may appear after a single small dose; but although ammonia has been confidently vaunted as a specific against such irregular manifestations of physiological activity, experience has been unable to confirm this, and we should place more faith in encouraging prompt elimination by very free dilution of the remedy.

Fortunately, the graver symptoms of iodism are decidedly rare, and we may all the more congratulate ourselves on this, when we remember how powerless we are to recognise the idiosyncrasy on which they depend. Trousseau, however, pointed out that iodine is always badly borne in exophthalmic goître; and Dr. Stephen Mackenzie is inclined to credit syphilis with some share in producing the purpura which proved fatal to his patient.

Robert Farquharson.

IRELAND, South of. *See* Queenstown. Glengariff is also deserving of notice.

IRITIS.—Inflammation of the iris. *See* Eye and its Appendages, Diseases of.

IRREGULAR.—This term is applied to cases of disease which do not run their regular or typical course, such as gout (*see* Gout); or to functions when they are disturbed with respect to time or rhythm—as the pulse, the bowels, or menstruation.

IRRIGATION (*irrigo*, I water).—A method of applying cold water as a therapeutical agent, which consists in causing it to fall drop by drop on one spot. *See* Cold, Therapeutics of.

IRRITABILITY (*irrito*, I provoke).—In physiology this word signifies the power of responding to a stimulus, as exemplified by the contractility of muscular tissue. In medicine irritability implies an undue excitability of an organ or tissue, from disease or disorder, such as of the brain, spinal cord, stomach, eye, or bladder.

IRRITATIVE FEVER. — The nervous disturbance consequent upon fretting of the system by various sources of irritation, gives rise to a pyrexia which is often called 'Irritative fever.' The febrile excitement so familiar to the surgeon as a consequence of wounds and injuries may be classed under this head. It may, however, be provoked by any kind of irritation, especially irritation applied to the mucous membrane of the alimentary canal. The rise of temperature which often accompanies irritation of the bowels by scybalæ or acrid secretions, and the febrile phenomena attendant upon dentition, may be quoted as familiar examples of irritative fever which must be within the experience of all.

The readiness with which pyrexia can be induced by these and similar causes must vary according to the intensity of the irritant, and the constitutional peculiarities of the individual upon whom it operates. As a rule, men are less susceptible than women, and women than children. In children, indeed, with their exalted nervous sensibility, feverishness from this cause is a common symptom. In young subjects mental emotion alone will often produce a rise of temperature, which may be a source of perplexity. In children's hospitals it is a common observation that the bodily temperature on the night of admission is high, even although the illness affecting the child is one not in itself usually accompanied by fever.

Dentition in young children is so frequent a cause of pyrexia, that the state of the gums should never be overlooked in any case where feverishness is a prominent symptom. Neglect of this precaution may cause some obscurity in the diagnosis. Thus, if a child, while cutting a tooth, have an attack of pulmonary catarrh, the temperature will almost certainly be high. In such a case the cough, combined with fever, rapid breathing, and a quick pulse, might naturally suggest the presence of pneumonia. On examination, however, it will be found that the pulse-respiration ratio is little perverted, the cough is loose and not hacking, and the history of the attack is not the history of pneumonia. On searching further for a cause of the pyrexia, tension and swelling of the gums will be noticed, and the difficulty will be at once explained.

Irritation of the stomach and bowels by acrid secretions or indigestible food is another common cause of irritative fever in children. The intense nervous disturbance excited in young babies by an improper meal induces a rapid rise of temperature, and may culminate in an attack of convulsions. Fæcal accumulation, or the irritation of worms in the bowels, may also, in children and delicate women, produce sufficient disturbance to give rise to fever.

In children the sensitiveness of the system to irritants varies according to the age of the child, according to the natural impressionability of its nervous system, and also according to the state of its general health. Thus, as a rule, the younger the child, the more sensitive is its nervous system; but even in young babies differences will be found in this respect, some being affected much less easily than others by reflex stimuli. In all, however, slow reduction of the strength, such as is produced by progressive chronic disease, gradually reduces nervous sensibility; and a child, enfeebled by an illness of long standing, may show a complete insensibility to all nervous impressions. In young subjects irritative fever, like other forms of pyrexia, is usually remittent; but its remissions are not always found at the same period of the twenty-four hours. There is not, for instance, always a fall of temperature in the morning and a rise at night. One of the peculiarities of this form of febrile disturbance is the irregularity of the fever. A high morning temperature in a young child should always suggest a reflex cause for the pyrexia.

Treatment.—The treatment of irritative fever must be directed to the relief or to the removal of the irritating source from which the fever proceeds. The use of febrifuge remedies may be also called for, if constitutional symptoms be marked or persistent.

Eustace Smith.

ISCHÆMIA (ἴσχω, I restrain, and *αἷμα*, the blood).—Deficiency of blood in a part, short of complete cessation of the circulation: partial anæmia. *See* Circulation, Disorders of.

ISCHIALGIA (ἰσχίον, the haunch, and ἄλγος, pain).—A synonym for sciatica. *See* Sciatica.

ISCHL, in the Saltzkammergut, Austria. A sheltered, bracing, mild, rather moist climate. Altitude 1,560 feet. Thermal common saline baths. *See* Climate, Treatment of Disease by; and Mineral Waters.

ISCHURIA (ἴσχω, I restrain, and *οὖρον*, the urine).—This word properly signifies the arrest of the secretion of urine (*see* Urine, Suppression of). It is also applied to mere retention of urine.

ISSUES. *See* Counter-irritation.

ITALY. *See* Climate, Treatment of Disease by; and Naples, Pisa, Rome, and San Remo.

ITCH. A popular name for scabies. *See* Scabies.

ITCHING. *See* Pruritus.

-ITIS. A terminal syllable used to indicate an inflammatory disease of a tissue, or organ; for example, Pleuritis, Hepatitis, or Cystitis.

J

JACTATION, or JACTITATION (*jactatio*, a tossing about of the body, or marked restlessness).—This is a condition mostly associated with certain severe febrile diseases, but also with some nervous affections, with severe pericarditis, or as a sequence of copious uterine or other hæmorrhages. A restlessness amounting to jactation may likewise be met with in some patients, when suffering from severe or long-continued pain. It must not be confounded with certain forms of chorea, in which a somewhat similar tossing about of the body may be encountered. The absence of pain and of marked febrile disturbance, together with the history of the patient, will, even in the cases where the general resemblance is closest, speedily enable the latter condition to be recognised.

JAUNDICE.—Synon.: Icterus; *Morbus regius*; *Morbus arquatus* (Celsus); Fr. *Ictère*; *Jaunisse*; Ger. *Gelbsucht*.

Definition.—Jaundice may be defined as a yellowness of the integuments and conjunctivæ, and of the tissues and secretions generally, from impregnation with bile-pigment.

Ætiology and Pathology.—All cases of

jaundice may be referred to one of two classes:—

1. Cases in which there is a mechanical impediment to the flow of bile into the duodenum, and where the bile is in consequence retained in the biliary passages, and thence absorbed into the blood.

2. Cases in which there is no impediment to the flow of bile from the liver into the bowel.

These two forms of jaundice have long been recognised; but there is much difference of opinion as to the mode of production of the jaundice in the second class of cases, although these are, perhaps, the most common in practice.

When there is any obstruction to the flow of bile through the hepatic or common duct, the way in which jaundice arises is sufficiently clear. The bile-ducts and the gall-bladder become distended with bile, which is absorbed into the blood by the lymphatics and the veins. If the hepatic duct of a dog be ligatured, and the animal killed after two hours, the lymphatics in the walls of the bile-ducts are seen to be distended with yellow fluid; the fluid in the thoracic duct is also yellow, and so likewise are the intervening lymphatic glands. In patients also who die of obstruction of the bile-duct, the lymphatics of the liver are often found to contain bile. On the other hand, two hours after ligature of the common duct, the serum of blood taken from the hepatic vein contains much more bile-pigment than that of blood taken from the jugular vein, which shows that in cases of obstruction of the bile-duct, bile is also directly absorbed by the veins.

But in a large proportion of cases there is no mechanical impediment to the escape of bile from the liver, and then an explanation of the jaundice is less obvious. Boerhaave and Morgagni long ago suggested that the jaundice in these cases was the result of a *suspended secretion.* They taught that the function of the liver was merely to separate the elements of bile which were already formed in the blood, and that when anything interfered with the function of the liver, the elements of bile accumulated in the blood, and the result was jaundice of the skin and other tissues. Although this view has been strenuously opposed by several excellent authorities, it is, in this country at all events, still generally accepted. It is advocated, for example, by Dr. George Budd, in his valuable treatise on diseases of the liver, although it is but right to add that Dr. Budd makes a special exception with regard to the biliary acids. 'The most skilful chemists,' he says, 'who have recently analysed the portal blood, have failed to detect the biliary acids in it, and have come to the conclusion that these at least are formed in the liver.' This opinion, that the liver manufactures the bile-acids, while it merely excretes the bile-pigment, was adopted by Dr. G. Harley, in his essay on jaundice.

There are, however, weighty objections to this view, some of which may be mentioned.

1. Although bile-pigment appears to be derived from the colouring matter of the blood, it has not yet been satisfactorily shown that bile-pigment, as such, exists ready formed in the blood of persons who have not jaundice. Frerichs denies that it ever has. Lehmann, who has investigated with great care the changes which the blood undergoes in passing through the liver, has never been able to detect the colouring matter of bile in portal blood, and infers that this, as well as the bile-acids, must be formed in the liver itself. The blood of the hepatic artery has been examined with a like result. It is obvious that if bile-pigment exists in healthy blood at all, its quantity must be very minute; and when we consider that the quantity of bile secreted by the human liver daily is about two pints, and yet that jaundice is not a normal condition, it seems impossible that all the bile-pigment secreted by the liver can be formed in the blood, and it is not probable that part is formed in the blood and part in the liver. The discovery by a few observers of a small quantity of bile-pigment in what appeared normal blood does not prove that it was formed in the blood. It is quite conceivable that it may have been formed in the liver, and have become subsequently absorbed.

2. The secreting tissue of the liver is often for the most part or entirely destroyed, so that bile is no longer secreted, and yet no jaundice results. If bile-pigment be formed in the circulating blood, it is difficult to explain what becomes of it in these cases.

3. If the constituents of bile are formed in the blood, intense jaundice ought at once to follow the extirpation of the liver in any of the lower animals, in like manner as urea accumulates in the blood after removal of the kidneys. But Müller, Kunde, Lehmann, and Moleschott have repeatedly extirpated the liver of frogs, and have invariably failed to find a trace of the biliary acids, or of bile-pigment, in the blood, the urine, or the muscular tissue.

These and other considerations make it very doubtful if any case of jaundice can with propriety be attributed to a suppression of the hepatic functions; and it is therefore necessary to seek for some other explanation of those cases of jaundice in which there is no obstruction in the bile-duct.

A solution of the difficulty has been proposed by Professor Frerichs, of Berlin. According to this distinguished observer, a large proportion of the colourless bile-acids found in the liver is either directly taken up by the blood in the hepatic vein, or is absorbed from the bowel. Under ordinary circumstances, these bile-acids become oxydised and assist in forming the large quantity of taurin found in healthy lung, and the pigments voided in the urine; but if these normal metamorphoses are interrupted by nervous agencies, or by poisons in the blood, the bile-acids, not being sufficiently oxydised, are converted into bile-pigment in the blood, and the result is jaundice. This view has been supported by two experiments intended to show:—first, that bile-pigment can be produced artificially from the bile-acids, by the action of concentrated sulphuric acid; and, secondly, that colourless biliary acids, when injected into the veins of dogs, are converted in the blood of these animals into bile-pigment. There is, however far from being unanimity among different observers as to the results of these experiments; and a decision of the points at issue does not appear to be of material importance for explaining those cases of jaundice in which there is no obstruction of the bile-duct, inasmuch as there are good grounds for believing that not only in jaundice, but in health, a portion of the bile-pigment, as well as of the bile-acids, formed in the liver, is absorbed into the blood.

Although the amount of bile secreted daily must vary in different persons, and in the same person under different circumstances, being modified by the quantity and quality of the food, the activity of respiration, and other conditions, there can be little doubt that but a small portion of that which is ordinarily secreted is discharged from the bowel. Observations on the lower animals and on man himself have shown that the quantity of bile secreted by the liver of a healthy adult averages forty ounces. It is generally admitted that the fæces contain but a fraction of the bile-acids (altered) corresponding to this quantity of bile, and it seems equally clear that much of the bile-pigment must also disappear in the bowel. There are grounds for believing that the bile-pigment which so disappears goes to form urinary pigment; while the fact familiar to all clinical observers, that the bile-pigment discharged from the bowel is greatly increased by calomel and other purgatives, without any corresponding increase of secretion of bile by the liver, seems to show that under ordinary circumstances much of the bile-pigment secreted by the liver is not discharged with the fæces. It may be added that in carnivorous animals and in snakes, although bile-pigment is secreted in abundance by the liver, the quantity discharged with the fæces is even relatively less than in man.

The question as to what becomes of the bile which is not discharged from the bowel has an important bearing on the pathology of the cases of jaundice now under consideration. A large proportion of it is again absorbed, either by the biliary passages, or by the mucous membrane of the bowel. From what is now known of the diffusibility of fluids through animal membranes, it is impossible to conceive bile long in contact with the lining membrane of the gall-bladder, bile-ducts, and intestine, without a large portion of it passing into the circulating blood. The constant secretion and reabsorption of bile is, in fact, merely part of that osmotic circulation constantly taking place between the fluid contents of the bowel and the blood, the existence of which is too little heeded in our pathological speculations and in therapeutics. The quantity of fluid which is being thus constantly poured out from the gastric and intestinal glands, the liver, pancreas, &c., and then reabsorbed is enormous; in twenty-four hours it probably far exceeds the whole amount of blood and fluid in the body. The effect of this continual outpouring is supposed to be to aid metamorphosis; the same substance, more or less changed, seems to be thrown out and reabsorbed, until it is adapted for the repair of tissue or becomes effete. How many times this cycle of movement is repeated, before the bile is extruded from the system, we have no means of knowing; but in the course of this osmotic circulation, much of the bile appears to become transformed into products which are eliminated by the lungs and kidneys, while at the same time this circulation assists in the assimilation of the nutritive materials derived from the food.

Here, then, we have an explanation of those cases of jaundice where there is no impediment to the flow of bile from the liver. Under normal conditions, the whole of the bile that is absorbed is at once transformed, so that neither bile-acids nor bile-pigment can be discovered in the blood or in the urine, and there is no jaundice. But in certain morbid states, the absorbed bile does not undergo the normal metamorphoses; it circulates in the blood and stains the skin and other tissues, and in this way we have jaundice without any obstruction of the bile-duct. The morbid states which, so far as we know, conduce mainly to this result are, for the most part, precisely those in which we might expect abnormal blood-metamorphoses, namely:—

1. Certain poisons, such as those of yellow fever, relapsing fever, pyæmia, and more rarely those of remittent fever, typhus, and scarlatina; also snake-poison, chloroform, &c.

2. Nervous influences, such as a sudden fright, violent rage, great or protracted anxiety, and concussion of the brain.

3. A deficient supply of oxygen, as happens in certain cases of pneumonia, or in persons living in confined and crowded dwellings.

4. An excessive secretion of bile, especially when conjoined with constipation. In this case, unless the bile be removed by purging, the quantity absorbed may be too great to undergo the normal metamorphoses, and the presence in the blood of the untransformed bile causes jaundice.

According to this view, the only pathological difference between jaundice from obstruction and jaundice independent of obstruction of the common bile-duct is that, in the former case, little or none of the bile secreted by the liver can escape from the body with the fæces, and consequently all that is secreted is absorbed into the blood, and the quantity thus absorbed is far too great to undergo the normal metamorphoses; while, in the latter case, bile passes into, and is discharged from the bowel, as usual, but that which is absorbed, which in quantity may not exceed what is absorbed in health, remains unchanged in the blood. As might be expected, the jaundice in the former case is usually much more intense than in the latter, although, when an obstruction of the bile-duct has lasted long, the jaundice often becomes paler, not from any diminution of the obstruction, but from the secreting tissue of the liver becoming destroyed, and comparatively little bile being secreted; while in cases where there is no obstruction of the bile-duct, the intensity of the jaundice will vary according to the amount of bile which is absorbed, and the degree of derangement of the blood-metamorphosis.

With these preliminary remarks on the pathology of jaundice, we may now proceed to enumerate its different causes, which may be classified according to the following tabular form:—

A. Jaundice from Mechanical Obstruction of the Bile-duct.

I. *Obstruction by foreign bodies within the duct.*

1. Gall-stones and inspissated bile.
2. Hydatids and distomata.
3. Foreign bodies from the intestines.

II. *Obstruction by inflammatory tumefaction of the duodenum, or of the lining membrane of the duct, with exudation into its interior.*

III. *Obstruction by stricture or obliteration of the duct.*

1. Congenital deficiency of the duct.
2. Stricture from perihepatitis.
3. Closure of orifice of duct in consequence of an ulcer in the duodenum.
4. Stricture from cicatrization of ulcers in the bile-ducts.
5. Spasmodic stricture.

IV. *Obstruction by tumours closing the orifice of the duct, or growing in its interior.*

V. *Obstruction by pressure on the duct from without, by:—*

1. Tumours projecting from the liver itself.
2. Enlarged glands in the fissure of the liver.
3. Tumour of the stomach.
4. Tumour of duodenum or pancreas.
5. Tumour of the kidney.
6. Post-peritoneal, or omental tumour.
7. An abdominal aneurism.
8. Accumulation of fæces in the bowels.
9. A pregnant uterus.
10. Ovarian and uterine tumours.

B. **Jaundice independent of Mechanical Obstruction of the Bile-duct.**

I. *Poisons in the blood interfering with the normal metamorphosis of bile.*

1. The poisons of the various specific fevers. *a.* Yellow fever. *b.* Remittent and intermittent fevers. *c.* Relapsing fever. *d.* Typhus. *e.* Enteric fever. *f.* Scarlatina. *g.* Epidemic Jaundice.
2. Animal poisons. *a.* Pyæmia. *b.* Snake-poison.
3. Mineral poisons. *a.* Phosphorus. *b.* Mercury. *c.* Copper. *d.* Antimony.
4. Chloroform and ether.
5. Acute atrophy of the liver?

II. *Impaired or deranged innervation interfering with the normal metamorphosis of bile.*

1. Severe mental emotions, fright, anxiety, &c.
2. Concussion of the brain.

III. *Deficient oxygenation of the blood, interfering with the normal metamorphosis of bile.*

IV. *Excessive secretion of bile, more of which is absorbed than can undergo the normal metamorphosis.*

1. Congestion of the liver. *a.* Mechanical. *b.* Active. *c.* Passive.

V. *Undue absorption of bile into the blood, from habitual or protracted constipation.*

Symptoms.—From what has been stated in the preceding section, it is obvious that jaundice is not a disease, but is a symptom of many different diseases. This view of the matter cannot be too strongly impressed upon the student and practitioner, whose efforts must in every case be directed to discover the fundamental malady. There are, however, certain phenomena connected with jaundice, independent of its cause, which deserve to be mentioned.

1. *Intensity of the jaundice.* Next to the liver itself, the skin is the tissue of the body which becomes most deeply jaundiced; but before it becomes affected a yellow tint is usually observed in the conjunctivæ. There must be a certain concentration of bile-pigment to produce a yellow colour of the skin; in the slighter and more temporary cases, the conjunctivæ only may be affected. Although after ligature of the common bile-duct in the lower animals it has been sometimes found that even the conjunctivæ do not become jaundiced for two or three days; in the human subject jaundice of both skin and conjunctivæ is usually observed within twenty-four hours of closure of the duct.

The colour of the skin varies from a pale sulphur or lemon-yellow, through a citron yellow, to a deep olive or bronzed hue. The tint varies according to the cause and its duration. When the cause is obstruction of the bile-duct, it is light at first, and increases in depth the longer the disease lasts; although in advanced cases, as already stated, the colour sometimes becomes paler, not from the obstruction yielding, but from the tissue of the liver becoming destroyed, and very little bile being secreted. In jaundice from obstruction also, the depth of tint often varies from day to day, not from any variation in the degree of obstruction, but according to the amount of bile secreted by the liver, and the eliminative activity of the kidneys. It is well to remember that what is called 'black jaundice' may result from any cause of obstruction—from gall-stone as well as from cancer. In these cases the greenish or almost black hue is due to the absorbed bile-pigment being vitiated and dark, or to the visage being also darkened from imperfect arterialization of the blood, the dark colour resulting from a mingling of the lividity with the colour of bile. When the jaundice is independent of obstruction to the flow of bile, the colour is rarely very deep, and yet these are often the most serious cases. The colour also varies with the age, the natural complexion, and the amount of fat in the individual. It is deeper in the old, the wrinkled, and the dark-complexioned than in young persons of fair complexion, and with plenty of fat. Lastly, it is important to remember that the colour often remains in the skin for some time after the cause of the jaundice has been removed, and that then its departure may be expedited by diaphoretics and warm baths.

2. The *secretions* are tinged with bile-pigment, but some much more so than others. This is notably the case with the urine, by which the greater part of the bile-pigment is eliminated from the body, and which acquires a saffron-yellow, greenish-brown, or brownish-black hue, according to the amount of pigment which it contains. The urine usually becomes yellow before the skin, or even the conjunctivæ; and when the cause of the jaundice is transient, it may happen that the whole of the pigment is eliminated by the urine, without any jaundice appearing in the skin. On the other hand, when once the skin has become yellow, it may remain so for some time after bile-pigment has quite or nearly disappeared from the urine.

Other secretions may contain bile-pigment as well as the urine. The cutaneous glands sometimes eliminate it in such quantity as to stain the linen yellow, but the amount discharged in this way is never great. Instances have been recorded where the secretion of the mammary glands has been tinged with bile-pigment, but they are not very common. Still rarer instances have been noticed where the saliva or the tears have been tinged. It is not a little remarkable that bile-pigment is not eliminated in cases of jaundice by the mucous membrane of the respiratory passages, or of the digestive tube. This is a matter of some practical importance, for, were it otherwise, the stools might contain bile-pigment even when there was complete obstruction of the gall-duct. Still, when either of these mucous membranes is inflamed, and throws off an albuminous or fibrinous exudation, the altered secretions may contain bile-pigment. Thus, when pneumonia coexists with jaundice, there is often bile-pigment in the sputa, which may be distinguished by the nitric-acid test from the greenish or yellow colour often presented by pneumonic sputa, owing to changes in the blood-pigment independent of bile. Indeed, in cases of jaundice bile-pigment may be detected in inflammatory exudations, as in the serum of a blister, before it appears in either the skin or even in the urine. It is probable that those rare cases where the saliva has been noticed to be yellow admit of a similar explanation; in many of them there has been mercurial salivation, a condition in which the saliva is not normal, but contains much albumen.

3. A *bitter taste* is not unfrequently complained of by persons who are the subjects of jaundice. It may denote the presence in the blood of the biliary acids, for taurocholic acid is intensely bitter. It is at all events not due to bile-pigments, which are tasteless. Moreover it is a common symptom in biliary derangements where there is no jaundice.

4. *Derangements of digestion*, such as flatulence, constipation, and an altered character of the motions, may be due to the absence of bile from the motions. Bile is an antiseptic, and when it is absent the intestinal contents undergo fermentation, gases accumulate in the bowels, the motions become putrid, and from the absence of bile they present a pale-drab or clay colour. Bile is also the natural stimulant of the peristaltic action of the gut, and consequently when the supply is cut off, the bowels are usually constipated; but in some cases the putrid fæces act as an irritant and excite diarrhœa. In those cases of jaundice where there is no obstruction of the common bile-duct, the motions may be but little altered.

When bile does not enter the bowel, the digestion of fat is interfered with. Jaundiced patients dislike fat, and do not assimilate it, and the fatty matter in the ingesta may sometimes be detected in the stools. Hence, whatever be the cause of obstruction of the bile-duct, the nutrition of the body suffers: the emaciation may be slow, but it is progressive, until all the fat disappears, and then the weight of the body may remain stationary for many months. With the emaciation there is always more or less muscular debility.

5. *Pruritus*, without any eruption, is a very obstinate and distressing symptom in many cases of jaundice. It is usually worse at night, and by preventing sleep, may wear out the patient. It is chiefly observed in cases of jaundice due to obstruction of the bile-duct. It is not due to the presence of bile-pigment in the blood, for in some cases it precedes the jaundice, and in others it comes and goes during the persistence of the jaundice. Moreover, in many cases of jaundice it is absent throughout, while it is not uncommon in biliary derangements where there is no jaundice.

6. *Cutaneous eruptions.* Urticaria, lichen, boils, or carbuncles are occasionally observed in connection with jaundice; and likewise that remarkable affection of the skin known as *Xanthelasma* or *Vitiligoidea*, the more severe forms of which are in fact almost invariably associated with persistent jaundice.

7. The *temperature* is not altered in jaundice, except when this occurs as a complication of some acute febrile disease, or when there is inflammatory action in the liver itself.

8. *Slowness of pulse.* A common result of non-febrile jaundice is retardation of the heart's action, and diminution of arterial tension. The pulse may fall to 50, 40, or even 20, and sometimes it is also irregular. This slowness of pulse is particularly noticeable when the patient is recumbent. When there has been antecedent pyrexia, the pulse usually falls on the supervention of jaundice. Slowness and irregularity of the pulse are chiefly observed in jaundice from obstruction of the bile-duct, and particularly in those common cases known as catarrhal jaundice; and accordingly they are not unfavourable symptoms, as might have been supposed. So far as the writer's experience goes, patients with this symptom invariably recover. It has not yet been explained why this condition of circulation should be present in some cases of jaundice, and absent in others. The natural explanation would be that it is due to some ingredient of the bile, which does not exist in the blood in all cases of jaundice. Some experiments of Röhrig have shown that the biliary acid salts paralyse the heart, and retard its action, while bile-pigment has no such effect. Slowness of the pulse, therefore, in jaundice may indicate the presence in the blood of unchanged biliary acids; but so far there are no observations to show that bile-acids are present in the urine in these more than in other cases of jaundice.

9. *Hæmorrhages.*—In many cases of jaundice the blood seems to become impoverished, by a diminution in the proportion of red corpuscles and fibrine; and hæmorrhages take place from the various mucous membranes, and into the substance of the skin. This hæmorrhagic tendency is particularly observed in conjunction with cerebral symptoms in cases of jaundice, where there is no obstruction of the bile-duct, but it also occurs in cases of mechanical jaundice of long standing, from any cause, when the secreting tissue of the liver has in a great measure disappeared.

10. *Xanthopsy* or *Yellow Vision.*—In rare cases of jaundice, all white objects appear to the patient yellow. The administration of santonin internally has also sometimes been followed by yellow vision, which has ceased as soon as the

colouring matter has been eliminated by the kidneys. This fact, as well as the observation that in several cases of jaundice, with xanthopsy, the conjunctival vessels have been preternaturally distended with blood, has led to the belief that the symptom is due to a tinging with bile-pigment of the humours of the eye. On the other hand, the circumstances that the xanthopsy may intermit, without any change in the jaundice; that it is usually absent when there is intense jaundice of the cornea and other tissues of the eye; and the statement that it may occur in typhus fever and in certain derangements of vision, such as night-blindness, when there is no jaundice, have led some authorities to regard it as a purely nervous symptom.

11. *Cerebral symptoms, and the Typhoid state.* Patients with jaundice are often irritable in their temper and hypochondriacal; and occasionally they are attacked with acute delirium, stupor, coma, convulsions, muscular tremors, subsultus, carphology, paralysis of the sphincters, a dry and brown tongue, and other indications of the typhoid state. These symptoms are most common in cases where there is no obstruction of the ducts, but they also occur in cases of obstruction, usually of long standing, where all or the greater part of the secreting tissue of the liver has been destroyed. Different opinions are held as to their cause. After death no lesion is found of the brain or its membranes, and they are, therefore, most probably due to some alteration of the blood. They are commonly attributed to poisoning of the blood with bile, either from suppression or re-absorption of the secretion. But the assumption that the elements of the bile are preformed in the blood has been already shown to be probably erroneous; and there is equally little evidence that bile is possessed of poisonous qualities, or that its presence in the blood, even to saturation, will give rise to cerebral symptoms. Many experiments have been performed on animals to show that bile is a deadly poison; but there is reason for believing that the bad results observed have been due to the injection into the areolar tissue of decomposing mucus contained in the bile. Bile, from which the mucus has been removed, has been repeatedly injected by Frerichs and other observers into the large veins of dogs, without cerebral symptoms or any bad results ensuing, except that death has in some instances been caused by the entrance of air into the veins. But it is scarcely necessary to turn to experimental enquiries on the lower animals for evidence on the matter, and in all these experiments there are sources of fallacy. There is ample proof that the blood of the human subject may be saturated with bile for months, or even years, without any cerebral symptoms resulting. Dr. Austin Flint, jun., is of opinion that the cerebral symptoms of jaundice are due to the retention of cholesterine in the blood, or to what he has designated *Cholesteræmia.* Cholesterine is one of the constituents of bile, and Dr. Flint regards it as an excrementitious product of nervous tissue, the elimination of which from the body is one of the functions of the liver, and the retention of which in the blood he believes to act as a poison like urea. But if the non-excretion of all the elements of bile does not give rise to cerebral symptoms, it is difficult to understand how they can result from the retention of cholesterine alone. In cases, for instance, of permanent closure of the bile-duct, cholesterine is not discharged from the liver into the bowel, nor does it accumulate in the biliary passages, and yet, if it be retained in the blood, cerebral symptoms rarely occur.

The cerebral symptoms in jaundice are often most severe when the jaundice is slight, and they may occur in diseases of the liver when there is no jaundice. They are best explained by the knowledge which we now possess of the function performed by the liver in disintegrating albuminous matter into less complex substances, such as urea and uric acid, which are eliminated by the kidneys. When this function of the liver is arrested or seriously impaired, urea is no longer eliminated in sufficient quantity by the kidneys; lithic acid and deleterious products of disintegrating albumen even less oxydised, such as leucin and tyrosin, and perhaps others with which we are as yet imperfectly acquainted, accumulate in the blood and tissues; the result is the development of symptoms of blood-poisoning similar to those which arise when the kidneys are unable to eliminate the products of albumen-disintegration, owing to disease of their own structure, or to an excessive formation of urea and other products, as happens in many febrile diseases. In acute atrophy, for example, the structure of the liver is destroyed, and its functions are arrested; leucin and tyrosin take the place of urea in the urine, and are also found in large quantity in the liver, spleen, and kidneys; while cerebral symptoms and the typhoid state are prominent features of the disease.

Diagnosis.—There is rarely much difficulty in the diagnosis of jaundice, but it is well to remember that certain conditions are sometimes mistaken for it, such as chlorosis; the anæmic aspect resulting from organic visceral disease (and particularly from contracted kidneys), from cancer, from exposure to malaria, from Addison's disease, or from lead-poisoning; an undue amount of sub-conjunctival fat; or an unusually dark colour of the ordinary urinary pigment, or the presence in the urine of abnormal pigments, such as those of santonin, turmeric, rhubarb, &c. In every case where there is the slightest doubt, it will be removed by resorting to the nitric acid test for bile-pigment in the urine. If this gives no result, the case is not one of jaundice.

But it is a more difficult matter to determine the cause of the jaundice, and yet this should invariably be the aim of the medical attendant, before forming a prognosis or proceeding to treatment. The scope of this article does not permit a lengthened analysis of the characters distinguishing the different forms of jaundice according to its cause, but the following remarks may be of some service.

1. In the first place it is always well to determine whether or not the jaundice be due to obstruction of the bile-duct. According to Dr. G. Harley this can be done by determining the presence or absence of bile-acids in the urine. Adopting the view that bile-acids are formed by the liver, while bile-pigment is preformed in the blood,

he contends that in jaundice from 'suppression' (or independent of obstruction) the liver does not secrete bile, and consequently no bile-acids being formed, none can enter the circulation or be detected in the urine; whereas in jaundice from obstruction, bile is secreted and absorbed into the blood, and a portion of the bile-acids not transformed in the circulation appears in the urine. But in addition to the strong improbability already urged that any form of jaundice is due to a *suppressed secretion* of bile, clinical experience is entirely opposed to the practical value of the test in question for throwing light on the cause of jaundice. Bile-acids have been found in the urine in cases of acute atrophy of the liver, where there is no obstruction of the bile-duct, and in very many cases of mechanical jaundice they are certainly absent. A more reliable indication of obstruction of the common bile-duct is furnished by the stools. When there is no obstruction, the stools almost invariably contain bile; but when the duct is obstructed, they are clay-coloured. The rule is not without exceptions, and there are several sources of fallacy. The jaundice usually persists for some time after the duct has become pervious, and thus bilious motions may co-exist with jaundice which has resulted from obstruction; or, if the motions be thin and watery, they may appear to contain bile from the admixture of jaundiced urine; or, not unfrequently, when the bile-duct is quite impervious, the motions are of a brownish tinge, owing to the presence of altered blood, which may closely resemble dark bile. A tumour corresponding to the region of the gall-bladder will favour the view that jaundice is due to obstruction of the bile-duct. Lastly, jaundice which persists and is yet slight, is most probably independent of obstruction, for jaundice from persistent obstruction speedily becomes intense.

2. It is always important to note the mode of commencement of jaundice. That which appears suddenly in a person whose previous health has been good, is most probably the result of obstruction of the duct by a foreign body, or it has a nervous origin. The former cause will be distinguished by biliary colic, vomiting, and clay-coloured stools. On the other hand jaundice coming on slowly, but ultimately becoming intense, with clay-coloured stools, points to pressure on the duct from without, or to a growth in its interior.

3. A history of previous attacks of jaundice of a similar nature is in favour of a catarrhal origin or of gall-stones.

4. Pain in severe paroxysms concurring with jaundice points generally to gall-stones or cancer; more rarely to hydatids, or to an aneurism of the hepatic artery. Cancer is distinguished from gall-stones by there being usually a history of failing health and emaciation before either the pain or the jaundice.

5. Jaundice concurring with enlargement of the liver is most probably due to cancer or cirrhosis; more rarely to pyæmic abscesses, or to waxy liver, with large glands in the portal fissure.

6. Jaundice concurring with ascites points to cancer or cirrhosis. The diagnosis of the latter will usually be assisted by the physiognomy, the slightness of the jaundice, the previous habits, and a history of alcoholic dyspepsia; while in cancer there are often darting pains, and the jaundice is usually intense.

7. Jaundice concurring with pyrexia is either secondary to some acute febrile disease; or is due to suppurative pylephlebitis, a suppurating hydatid tumour opening into a bile-duct, or inflammation of the bile-ducts. Temporary pyrexia may also occur during the passage of a gall-stone.

8. Cerebral symptoms associated with jaundice suggest acute atrophy of the liver, poisoning by phosphorus, some specific fever, pneumonia, or nervous shock.

9. Jaundice in a young person, preceded by symptoms of gastric catarrh, is most probably catarrhal.

TREATMENT.—There is no special treatment for jaundice; in all cases the treatment must have reference to what is believed to be its cause. The appropriate treatment will therefore be discussed under the head of the several diseases which give rise to it. Here it is only necessary to observe, that in all cases of jaundice from obstruction it is important to maintain the action of the kidneys, which are the main channel for the elimination of the bile; while portal congestion is obviated by appropriate purgatives. The part which the bile plays in assisting assimilation of nutriment may to some extent be supplied by ox-gall; and creasote will often check the diarrhœa excited by the putrefying fæces. Patients suffering from jaundice ought also to partake sparingly of fatty or saccharine food, or of alcoholic drinks.

CHARLES MURCHISON.

JEJUNUM, Diseases of. *See* INTESTINES, Diseases of.

JIGGER.—A popular term employed to designate the sand-worm or sand-flea. *See* CHIGOE.

JOINTS, Diseases of.—Diseases of the joints are classified according to the structure primarily or chiefly involved. They may commence in the synovial membrane, in the bone, or in the cartilage. Primary disease of the ligaments is rare, and is not clinically demonstrable. No form of joint-disease remains long confined to one tissue, so that when the disease is of some duration it will be found to implicate, more or less, every element of the joint-apparatus. In this article the diseases of joints will first be generally discussed; and the individual diseases will then be considered separately.

ÆTIOLOGY AND PATHOLOGY.—The larger articulations, those in constant use, and more especially the joints of the lower extremity, are the most frequently diseased. Thus the knee is more often the seat of disease than any other joint; the hip-joint comes next in order; and then the ankle and elbow. All kinds of joint-diseases are frequent in children and young persons. The first year of life appears, however, to be nearly exempt from these affections, and during the second year they are comparatively rare, perhaps because movement and risk of injury are at that period at a minimum.

Acute arthritis, however, is occasionally witnessed during the first year of life—during even the first six months. It is unconnected with syphilis or injury; very sudden in its appearance, and rapid in course; dangerous to life; and destructive to the articular ends of the bones by suppurative disorganisation. The causes of joint-disease in general are connected either with disordered nutrition, in which case it usually assumes an inflammatory type; or with disordered function. The latter may depend on the former, or be unconnected with it. Again, the cause may be local in its origin, or arise from some constitutional defect. Amongst the *exciting* causes, injury is by far the most frequent. This being often slight, and not followed by any immediate consequences, the connection is frequently overlooked. A blow, or a fall against the edge of a table or down stairs, may readily bruise the synovial membrane, in such exposed joints as the knee or elbow, without causing any external sign. A slight hæmorrhage takes place into the synovial cavity or the subsynovial areolar tissue, and serous effusion may speedily supervene; in this manner a common variety of acute or traumatic serous synovitis is produced. But although injury is the most fertile cause of joint-disease, the articulations may sustain most severe injury without becoming inflamed. It is rare to find any serious consequences result from dislocation; the joint usually perfectly recovering itself. Penetrating wounds of the joints are always serious injuries; they often occasion acute synovitis, and if septic changes occur, are followed inevitably by suppuration in the articulation, and danger both to the limb and life of the individual. Fractures often implicate the joint-surfaces, and prove a frequent source of stiff-joint. Plastic synovitis may be thus set up, causing adhesions; or suppuration takes place; or the callus formed for the repair of the fracture may interfere with the joint motion. Gunshot wounds often produce the severest form of inflammation of joints, suppuration being the usual result. When joint-disease follows an injury it is usually confined to one joint; but when joint disease originates from constitutional causes, more than one joint is often affected; or when only one, the constitutional nature of the cause is manifested in diseased conditions present elsewhere, or by traces of inflammation in other joints, due to the same cause. The deposit of tubercle in the synovial membrane and bone is a frequent cause of chronic joint-disease.

Joint-inflammations are of common occurrence in all kinds of fever; and also as sequelæ of the exanthemata. The great frequency of polyarticular serous synovitis in acute rheumatism is well known, as also in purpura and hæmophilia, where it is complicated with blood-extravasations. In pyæmia the joints are frequently the seat of sero-purulent and purulent effusions; as they also occasionally are in scarlatina. Puerperal synovitis is a variety of the pyæmic. In typhus monarticular arthritis is frequently met with, and the hip is the joint oftenest affected. Endocarditis and polyarthritis are very often associated together, and the endocarditis may precede and give rise to the joint-disorder by embolism. The fact that multiple joint-affections are met with both in pyæmia and in rheumatism suggests a connection, but what its nature may be is not clear. Although in articular rheumatism pus-formation is rare, we sometimes witness joint-suppuration in such cases; whilst pyæmia and metastatic abscess may originate from ulcerative endocarditis. In chronic synovitis, affecting two or more joints, the heart should always be examined, for traces of endocarditis will sometimes be found. In the exanthemata, typhus, and diphtheria, metastases in the shape of joint-inflammations more or less frequently take place. Joint-inflammation is of frequent occurrence in dysentery. With gonorrhœa a form of arthritis is associated which is called 'gonorrhœal.' Syphilis in the later stages frequently attacks a joint, the knee by preference, syphilitic deposits taking place in the bone or the subsynovial connective tissue, but synovial effusion is not common. A suppurative inflammation of the ends of the bone is not rare in children the subjects of inherited syphilis. In gout the joint-structures are affected; as a rule the perisynovial tissue becomes inflamed owing to deposits of urates. Similar deposits even occur in cartilages of encrustation. The great toe is most often affected, but the other tarsal, digital, and larger joints are frequently diseased.

Some ill-understood form of vaso-motor or trophic irritation appears to occasion arthritis, in locomotor ataxy. Effusion into the joint is preceded by pain, and the knee and shoulder joints are those generally affected. In some cases of the disease changes similar to those in rheumatoid arthritis have been observed, generally in the knee, shoulder, elbow, or hip. They occur early in the disease; arise suddenly; are often monarticular; and not rarely give rise to dislocation, especially in the shoulder. These characters distinguish the disease from ordinary rheumatoid arthritis. Severe inflammation of the joints of the paralysed limbs has been observed in cases of hemiplegia. The occurrence of joint-disorder, usually synovial inflammation, is frequent in chronic disease of the spine; and it also occasionally happens in acute myelitis, in the form of suppurative arthritis. In both cases the knee is most frequently affected.

ANATOMICAL CHARACTERS.—Joint-disease may begin as an inflammation of the synovial membrane, of the bone, or of the cartilage. Fibrous tissue having but slight tendency to inflame, it is improbable that primary disease affecting the ligaments can be otherwise than most exceptional; but these textures very soon become secondarily affected, from their intimate connection with the synovial membrane. The synovial membrane is perhaps more ready to inflame than any other tissue in the body, and in many joints it is much exposed to injury from without, while excessive joint-movement alone is sometimes sufficient to excite synovitis. Primary disease of the bone comes next in order of frequency. Cartilage is least likely to take on primary disease. Each of these tissues, however, becomes speedily affected by disease which has invaded or commenced in the other.

SYMPTOMS AND DIAGNOSIS.—The local symp

toms of joint-disease have reference to *impairment of function*, and *change in form*; together with *pain*, both local and sympathetic; and certain *physical signs*.

Impaired function.—Usually this is great in proportion to the natural mobility and importance of the joint, and most evident in the extremities. The earliest symptom in hip-joint-disease is a slight limp or halt, whilst in other joints mere stiffness occurs; the full range of movement is simply curtailed, before actual pain or swelling takes place. The position of maximum relaxation, namely, that intermediate between flexion and extension, is commonly assumed by diseased joints. Even in the earliest stages of disease, the interference with movement is often very great, amounting to a sort of vital anchylosis, produced by the action of the muscles, whose tension prevents the joint-surfaces moving upon each other—an effort to avert pain. This form of anchylosis disappears during narcosis. Muscular or vital anchylosis must be distinguished from the rigidity produced by structural changes. Both synovial effusion and peri-synovial infiltration mechanically hinder free joint-movement.

Changes in form.—Changes in form are due to the alterations in shape and texture of the joint-structures, and to effusions within its cavity. These changes may be best appreciated by careful measurements, and a comparison with the opposite joint. No true estimate of the amount of departure from the normal is otherwise possible. The practitioner is thus better able to diagnose the special character of the swelling, whether it be due to synovial effusion, and confined to the limits of the capsule, causing it to bulge at the least protected parts; or to chronic thickening of the synovial membrane, recognised on palpation by its elasticity and general diffusion; or to disease of the bone and periosteum, when the swelling is deep-seated and hard. By accurate comparison a fluid collection outside the joint, either an abscess or a bursal tumour, may be distinguished from intra-articular swelling.

Pain.—The character of the pain is an important symptom in diseases of the joints. In acute synovitis it is severe and lancinating. In bone-inflammation it is a dull aching pain, with marked local tenderness, liable to periodic exacerbations of an intense kind. Often the pain is of a shooting, starting character, wakening the sufferer from sleep. The pain is of this character and most severe in subarticular ostitis. Pyæmic suppuration and chronic synovitis are generally painless.

Physical signs.—When one hand is laid flat upon a diseased joint while the other moves it, certain sensations or sounds are often distinguishable. A peculiar soft crepitation due to the presence of blood-clot, must not be mistaken for the rougher sensations which adhesions afford, the friction-sounds of movable joint-bodies, or the grating of exposed bone. The rubbing of one granulation-surface upon another may be likened to that of two pieces of velvet. Abnormal movements, such as lateral motion in a ginglymoid joint, usually imply extensive joint-disorder. Displacement or partial dislocation, and alteration in form of the joint-surfaces occur as the disease progresses. A notable increase of local heat may be felt in all inflamed joints. When fistulous tracks exist around a diseased joint, they do not often afford direct evidence on being probed of the condition of the joint, but they generally prove the existence of articular suppuration, and disease of the bone.

With respect to the general symptoms of diseases of the joints, it need only be said here that the amount of pain or constitutional disturbance in acute cases varies according to the extent and acuteness of the disease, and the presence and amount of suppuration. In chronic disorders the associated constitutional condition should be investigated.

Complications and Sequelæ.—The complications which occur in joint-disease are generally connected with long-continued suppuration. Amyloid degeneration of the viscera is pretty certain to be present when suppuration has existed for a year or more in young people; less certainly in adults. Hectic fever, tuberculosis, or pyæmia may occur at any period. In the absence or failure of treatment, the patient, should he survive, will suffer from contraction, deformity, and imperfect growth of the limb, together with more or less complete loss of function.

Prognosis.—The prognosis in diseases of the joints will depend on many circumstances, and must be considered both as regards life and as regards function. First, with respect to *life*, the gravity of joint-diseases increases with the size of the joint affected. They are more serious in the lower than in the upper limb. Pyæmia is comparatively rare in acute joint-suppurations—why, it is impossible to say. When pus escapes from the interior of a joint into the surrounding tissues, pyæmia may occur. A continuous high temperature, or a large evening increase associated with hectic, are bad signs; the exhaustion, which depends on profuse suppuration with its attendant hectic fever, amyloid degeneration, and tuberculosis, being the most frequent causes of death in joint-disease. The prognosis as regards *function* is often difficult to determine. After an attack of simple acute or subacute serous synovitis, recovery is generally complete. Joint-function is usually completely lost after suppuration of traumatic origin, recovery being quite exceptional. When the suppuration is of a pyæmic nature, and the patient survives, the effusion may become absorbed, and the joint-motion be preserved. Chronic synovitis with thickening of the subsynovial tissue, due to infiltration with granulation-material, can seldom be cured except by operation, especially after suppuration has taken place. If recovery should ensue, the joint-function is lost, and deformity is always present. Increased mobility—'flail joint'—is a very rare sequence of joint-disease. It is occasionally seen in the shoulder, and also in the knee.

Treatment.—The treatment of diseases of the joints must be directed to preserve the life of the individual; and, as far as possible, the functions of the limb. Of the first and greatest importance among remedial measures is *rest*, which is best secured by fixation of the joint and limb in an appropriate apparatus. This is of cardinal importance to a diseased articulation, just as motion is a necessity for a healthy one. Immobilisation should not be continued longer than necessary; it will sometimes seriously damage even a previously healthy joint, immobilised on account of fracture of the limb; and a continuance of rest after all diseased action has subsided often exerts a very prejudicial influence. Rest, however, should be continued so long as pain and increased temperature persist.

Position.—The same means adopted to secure immobility must be utilised to obtain the best available position for the future function of the part, should anchylosis become inevitable. In the ankle the foot should be maintained at a right angle; the hip and knee must be extended in the axis of the body; the elbow is generally flexed to a right angle, the position in which the limb is most useful. Splints of various forms are used, and we possess in plaster-of-Paris and starch ready and invaluable means of producing an apparatus, which gives uniform and equable support of a simple and very perfect kind.

Extension exerts a beneficial influence, as well by immobilising the joint, as by its power to remove contraction and deformity. It relieves pain and abates the symptoms rather by keeping the joint at rest, and changing the surfaces of contact, than by any actual distraction of the joint-surfaces. A much greater weight than a patient could tolerate must be used before any such separation could occur. Extension often even increases the intra-articular pressure. By straightening the limb it removes the joint from its position of maximum relaxation, and puts the skin and tendons on the flexor aspect on the stretch, and alters the mutual accommodation of the joint-surfaces.

As there is almost invariably an increase of temperature in the affected joint, the application of *cold*, by means of ice-bags or coils of cold water tubing, is indicated. Cold acts most beneficially in all acute, and many subacute inflammations. Even in deep-seated joints like the hip, it will often soothe the pain and abate the symptoms, but it is more applicable to the superficial joints. Cold is both anæsthetic and prophylactic in its action. The sensations of the patient in respect of the continuance of cold applications must be consulted. In most cases they are grateful. In chronic joint-affections when an acute attack supervenes, threatening suppuration, cold should also be applied. Cold applications may in some cases be continued for weeks or months with advantage. When the acute symptoms have passed off, and it is desirable to encourage lymphatic activity and absorption, the cold must be discontinued, and compression, together with friction and warmth, substituted. Cold is not applicable to purely chronic cases without much pain or tenderness.

In some instances of acute and subacute arthritis *local depletion* by means of leeches or scarification is very useful, and this may be combined with hot *fomentations* in cases where cold is not well borne. In chronic inflammation of the bone the *actual cautery* sometimes procures immediate abatement of the pain, and, after a time, the subsidence of the inflammation. The button cautery may be used, or, still better, linear cauterisation, over the most sensitive points. Or an *issue* may be employed instead.

Compression by strapping, or with a thick layer of cotton-wool and a tightly applied bandage over it, is applicable to the chronic stages of joint-disease. It must be discontinued if it occasion pain. It is better calculated to remove fluid effusions than the plastic material poured out into the perisynovial tissue. For these cases the more continuous compression of a properly applied elastic bandage will prove more efficient; or the strapping known as 'Scott's dressing.'

Massage is a most valuable local means for the dispersion of chronic swellings of joints. It both removes the results of diseased action in the joint, and helps to restore its function. It is well suited to disperse serous effusions when the acute stage is over; for cases of plastic synovitis it is also useful, but not for cases of the type known as *tumor albus*. It produces a diminution of the sensibility of the part, and a local increase of temperature, and the lymphatics are stimulated to increased activity. There are several modes of employing massage. The first is centripetal stroking with the palm of the hand from the periphery of the affected part towards the centre of the body, called *effleurage*, one hand following the other in immediate succession. The amount of pressure varies with the circumstances of the case. This will readily disperse fluid effusions both of blood and serum. Friction-massage is another useful method, and is practised by pressing the palm firmly upon the surface, and then rotating it. This plan may be combined alternately with the last method, massage proper—*petrissage*—which is done by raising up the soft parts vertically from the bone with both hands, and compressing them, always in a centripetal direction.

Forcible movements. — Forcible movements, which break-down adhesions, are often most useful in cases of stiff joint arising after protracted immobilisation, after fracture in the vicinity of a joint, or after a severe sprain. Pain will be relieved in this way, and mobility restored in some instances, in a degree quite remarkable.

Constitutional treatment.—Where any general taint exists, this must be treated at the same time. A tendency to tubercle must be met by iron, tonics, good food, and fresh pure air. Gout, syphilis, or rheumatism must, when present as a diathesis, be appropriately treated.

Operative treatment.—Puncture alone, or combined with antiseptic washing-out of the articulation, may often be performed with advantage, to evacuate the fluid in a distended joint, or to diagnose the presence of pus and evacuate it when suppuration has taken place. Sufficiently free incisions, however, and the insertion of drainage tubes are generally to be preferred in cases of joint-suppuration; and with these should be combined the washing-out the joint-cavity with a three- or five-per-cent. solution of carbolic acid, or other adequate antiseptic. It has been proposed to substitute free incisions and drainage for excision of the joint, in certain chronic forms of disease, such as white-swelling, but excision is probably in most respects preferable. Excision is practised for chronic joint-disease not amenable to other means; it is not a substitute for amputation, but is intended to obviate its necessity. Subperiosteal resection, where practicable, possesses many advantages, especially in cases of traumatic origin. The attachments of the muscles and tendons, and the cellular interspaces between them, are thus left undisturbed. The chances of perisynovial suppuration are diminished, and the bleeding is reduced to a minimum. There is more complete bony reproduction of the joint-surfaces, and in young persons a new joint very similar to the normal is in some instances formed, while in all cases there is a probability of better subsequent function and position. The operation thus performed requires time and skill. It is scarcely applicable to the knee or even the hip, and is unsuited for cases of chronic synovial disease, where it is of the last importance to excise all the diseased granulation-material. The after-treatment of excisions is of great importance. Plaster-of-Paris bandages supply one of the most useful means of immobilisation, especially in those cases where anchylosis is sought for, as in the knee; and the splint should be unchanged, if possible, for four or five weeks. In the elbow, shoulder, and wrist, where mobility is the end aimed at, passive movement should be commenced as soon as the condition of the wound admits of it, namely in about a week or ten days. Galvanism must be used at a later period to restore the wasted muscular apparatus.

Amputation is only performed as a last resort. It is very rarely needed for joint-diseases in the upper limb, except perhaps the wrist, when the hand is permanently crippled. In the lower limb, amputation must be performed in those cases in which the patient has lost all strength and healing power, from the drain of a long-continued discharge. It is advisable where amyloid degeneration or incipient tuberculosis exists, or in any case, in short, in which the power of the patient is inadequate to furnish the amount of repair required in the expectant form of treatment, or in case of excision, always a more serious operation than mere amputation. Amputation should also be adopted in those cases in which the local disease, especially of the bone, is too extensive to admit of a good functional result after excision. In the very young excision is very undesirable, since the epiphysis is almost of necessity sacrificed, and the growth of the limb checked. Resection in some joints is practised to avert anchylosis, or to restore the lost function of the joint, as in the shoulder, elbow, and wrist. Various congenital and other deformities of the joints may be removed by osteotomy of the bones concerned.

The chief diseases of joints will now be separately considered in alphabetical order as follows:—1. Cartilages, Diseases of; 2. Congenital Dislocation; 3. Immobility; 4. Inflammation, Acute, of the Synovial Membrane: 5. Inflammation, Chronic, of the same; 6. Gonorrhœal Inflammation; 7. Gouty Inflammation; 8. Strumous Inflammation; 9. Loose Cartilages in Joints; 10. Nervous Affections; 11. Rheumatic Arthritis, Chronic; 12. Serous Effusions; and 13. Syphilitic Disease. Rheumatism in its several forms will be considered separately.

1. Joints, Cartilages of, Diseases of.—Primary chondritis as a form of joint-disease is neither clinically nor pathologically established. The cartilage has little tendency to active inflammation; it is not sensitive to pain; chronic changes take place in it as the result of impaired nutrition, rather than inflammation. The cartilages of encrustation are the residue, which does not ossify, of the mass of fœtal cartilage forming the bone-ends. We meet in the joints of the aged with depressions and fibrous scars, caused by partial atrophy of the cartilage; these changes do not occasion symptoms during life, beyond sensations of creaking and roughness in the joint when moved.

Almost all the changes which occur in the articular cartilages are secondary to synovitis and ostitis, and more or less passive. In serous synovitis the cartilage is softened and swollen, and becomes to a certain extent œdematous. In suppurative synovitis it becomes rough, sodden, and yellow; its cells burst; the intercellular substance fibrillates; and portions may necrose. The cartilage-changes in chronic synovitis have been already discussed, and others will be referred to later.

Young growing bones, like the periosteum covering them, readily inflame; and as soon as the inflammation invades the articular surface of the bone, the cartilage becomes loosened and necrosed, or invaded by the granulation-tissue springing from the bone. The cartilage is softened; its capsules burst; fibrillation occurs; and at different places it becomes thinned. Perforations occur in it, leading to the bone, giving it a sieve-like appearance. Where the inflammatory process is more acute, the whole of the encrusting cartilage may become at once detached from the bone beneath.

In these cases the pain, especially at night, is very severe. Involuntary starting of the limb causes intense suffering, wakening the patient from sleep with a scream. This symptom was formerly considered distinctive of ulceration of cartilage, a process which is wholly painless when it occurs without other disease in the joint, but it is probable the pain is due to pressure upon the inflamed bone, and it will sometimes greatly abate when the cartilage wholly disappears. Disease commencing near the epiphyseal cartilage often extends to the adjacent joint. Those joints in which the epiphyseal junction is within the capsule, as, for instance, the hip, run a double risk from bone-inflammation.

2. Joints, Congenital Dislocation of.—Description.—This is a curious and ill-understood affection of the joints. It is almost exclusively confined to the female sex. The hip-joint is nearly always the one affected, and the displacement is generally double. It has often been erroneously mistaken for morbus coxæ, and treated accordingly.

It probably occurs in early fœtal life from defective formation of the joint-surfaces. It is not discovered until the child begins to walk, which it generally only commences to do at a late period. When the hips are affected, the gait is accompanied by a most ungainly swaying of the body from side to side like the waddling of a duck. All that can be done is to supply a well-contrived artificial support to the pelvis and limbs.

Genu valgum and *genu varum* (knock-knee and bow-knee) are two forms of disabling and unsightly deformity of the lower limbs. They are often due to an abnormal development of the condyles or shaft of the femur, or the tuberosities of the tibia, and to changes of a rickety character at the epiphyseal junction. In extreme cases progression is greatly interfered with. The symptoms are painfully obvious.

Treatment. — Treatment of the limb by splints and apparatus and forcible straightening in plaster-of-Paris bandages succeeds in the milder cases, but in those of a severe type, or in persons of ten years or upwards, this plan is most tedious, and is usually attended by complete failure. The subcutaneous division of the internal or external condyle, according to the nature of the deformity, restores the joint-surfaces of the femur to their normal level, and is attended by the happiest results both to the form and function of the limb and joint. It is an easier and in many ways a more successful operation to divide the shaft of the bone with a chisel near its articular extremity, and thus procure the rectification of the limb.

3. Joints, Immobility of.—Synon.: Anchylosis; Fr. *Ankylose*; Ger. *Gelenkverwachsung*.

Ætiology.—This condition may be due to changes in the structures of the articulation—*true anchylosis*; or in those surrounding the joint—*false anchylosis*. It may be fibrous and incomplete, or bony and complete. False or spurious anchylosis—extra-articular—may depend on muscular spasm or rigidity; on cicatricial contractions; on paralytic or spasmodic affections; or upon prolonged disuse of the joint. It is often difficult, even under chloroform, to distinguish the presence of absolute bony anchylosis, as the fibrous form may be so strong and extensive as almost wholly to prevent movement. The two varieties are but degrees of the same process. Both may result from previous inflammatory changes in the joint, either of the nature of plastic synovitis, or of granulations springing from the bone and other joint-tissues, becoming further organised. Fibro-cartilaginous anchylosis is a common form in young persons. In time it usually becomes converted into true bony anchylosis.

The marked anchylosis which tonic spasm and rigidity of the muscles produce in the early stages of some joint-diseases, as in the hip-joint and knee, may be called *vital* or *physiological*. It is induced by an effort to avert pain; it disappears entirely during narcosis. A joint may become stiff and anchylosed by long fixation on account of some injury or disease elsewhere, especially if it be retained in a flexed position, as the muscles of the flexor side actually shorten when their points of origin and insertion permanently approach one another. The same thing may also happen in the myogenic affections due to paralysis; in which the cartilages and bones atrophy at the same time.

Treatment.—The treatment of diseases of joints should, in all cases where it is possible, be prophylactic against the occurrence of anchylosis. When this has taken place in an incomplete degree, an attempt to restore the function of the limb must be made by breaking down the adhesions by forcible or gradual extension, by passive motion, by massage, and by tenotomy of the tense tendons. Excision is indicated to restore motion in complete anchylosis of such joints as the wrist, the elbow, and the shoulder. In other cases of complete anchylosis, especially in the lower limb, surgical interference should be confined to an attempt to rectify a faulty position either by tenotomy, extension, forcible straightening, excision, or osteotomy. Amputation can only be needed in extreme and otherwise irremediable deformity.

4. Joints, Inflammation, Acute, of the Synovial Membrane of.—Synon.: Acute Synovitis; Fr. *Synovite*; Ger. *Synovitis*.

This is one of the most common of all joint-affections. Probably in half the total number of chronic joint-diseases the synovial membrane is first affected. The synovial membrane is very rich in vessels and cells; and much exposed to injury, and to the effects of joint-movement. An inflammation beginning at one point soon spreads over the whole synovial sac.

Description.—Acute synovitis is a very common result of injury; it also occurs in rheumatism, gout, pyæmia, and other diseases. It may be serous, sero-fibrinous, or purulent. Serous synovitis is the simplest and most common variety. Even a slight external injury is often sufficient to produce it; a sprain of the joint, or even excessive movement, may cause it, as well as the constitutional disorders already mentioned. The knee is very often affected, from its exposed position and the large area of the serous membrane lining it. The synovial membrane becomes injected and thickened, with œdema of the subsynovial tissue. The natural secretion is increased in quantity, and many cells are shed into the joint cavity, the capsule becoming swollen, tense, fluctuating, or elastic. The least protected parts bulge, from the pressure of the effused fluid, and the normal contour of the joint is lost. It is usually semi-flexed. A severe burning, cutting pain is experienced in it. It is exceedingly sensitive to pressure, and painful on the slightest movement. There is usually considerable fever. When the inflammation is more intense, the synovitis becomes sero-fibrinous. Flakes of lymph are mingled with the synovia; layers of false membrane cover the synovial membrane, which is considerably thickened and dull red in colour; and the constitutional disturbance is greater. Finally, it is but a short step from this to suppurative synovitis. If the irritant cause continue its action, the leucocytes filling the meshes of the synovial membrane are shed in larger quantity; the fluid becomes turbid and puriform; the fever and local symptoms increase very much in severity; the external parts become implicated in the inflammation within; and joint-suppuration or abscess is the result.

Treatment.—The treatment of the first two stages of synovitis is directed primarily to check the progress of the inflammation; and then to procure resolution, and absorption of the effused fluid. Fortunately the synovial membrane possesses very active absorbent powers; and early and efficient treatment, conjoined with removal of the source of irritation, will generally ensure a cure, with complete restoration of function. The chief means are cold applications; immobilisation till the acute stage is over; and then compression and friction, or in suitable cases counter-irritation. Gout, rheumatism, or other diathesis, must be appropriately treated at the same time.

In those cases in which the inflammation has persisted for some time, and plastic effusion has taken place on the surface and in the substance of the synovial tissue, the joint will remain for a long time stiff and thickened, and its function impaired, after all acute symptoms have subsided; whilst in those cases where the inflammation has continued long enough to invade the other joint-structures, a perfect cure may not be possible.

When suppuration occurs, the joint must be dealt with as any other abscess-cavity. Free incisions must be made into it, and it should be thoroughly washed out with some antiseptic solution, free subsequent drainage being provided for. In the more favourable cases, anchylosis in a convenient position will be obtained. Recovery of function is very rare. In other cases the suppuration continues; the cartilages of encrustation become necrosed and detached; the bone becomes exposed and carious; and either excision or amputation must be performed to save the patient's life or limb.

5. Joints, Inflammation, Chronic, of the Synovial Membrane of.—SYNON.: Chronic Synovitis.

Chronic synovitis may arise as the sequel of the acute disease; or, as is more frequent, it may depend on some constitutional dyscrasia, or at least some continuously acting irritant, although in the first instance it is generally excited by an accidental injury.

VARIETIES.—There are three chief varieties of this disease which are often co-existent, namely:—*Pannus Synovitis*, *Granulation Synovitis*, and *Papillomatous Synovitis*.

a. Pannus Synovitis.—In this variety a delicate membrane will be found, stretching from the inflamed and thickened synovial margins more or less over the surface of the cartilage, to which it may be in whole or in part adherent.

b. Granulation Synovitis.—The second, or granulation-form, is a more advanced stage of the disease. In it the synovial membrane is often completely replaced by granulation-material, which encroaches on the margins of the cartilages, and, as the disease progresses, invades them, and coalesces after a time with granulations springing from the inflamed bone. These granulations are pink or greyish-red, not so vascular as those in an ordinary wound. They have little tendency to cicatricial change, and are prone to soften down and form abscesses.

The synovial membrane often becomes enormously thickened from the granulation-material accumulated in it, and this form of disease is frequently associated with the tuberculous diathesis. Bodies identical with miliary tubercles are very often found in the semi-gelatinous or pulpy synovial membrane; the whole constituting what is known as *tumor albus*, or 'white-swelling.'

SYMPTOMS.—The more prominent symptom associated with the form of chronic synovitis just described is the presence of a uniform semi-elastic swelling, caused by the sero-fibrinous infiltration of the synovial membrane. The skin is whitish, tense and smooth, whence the name *tumor albus*. The amount of synovial effusion into the joint is usually limited; the pain is seldom severe; the amount of joint-movement is diminished; and there is usually contraction of the limb, and sometimes partial dislocation. When suppuration occurs, there is more pain and fever. The progress of the disease is generally very chronic, extending over months or years, and allowing the patient at intervals to take moderate exercise. Exacerbations take place, however, from slight causes, or without cause; attacks of subacute or acute inflammation supervene; and sooner or later abscesses form, communicating both with the cavity of the joint, which becomes totally disorganised, and with the surface.

Brodie's 'pulpy disease of the synovial membrane' is simply an exaggerated degree of granulation synovitis, in which the subsynovial tissue becomes enormously thickened by successive attacks of inflammation.

TREATMENT.—The disease is most rebellious to treatment, and scarcely curable amongst the poorer classes without operation. Sometimes the diseased tissue is got rid of by suppuration; and, if the patient's strength suffice, a cure by anchylosis, probably accompanied by considerable deformity, will ensue. Generally, however, the symptoms become worse; the general health gives way from the drain of the continuous discharge; or amyloid or some other intercurrent disease kills the patient. At any time, as in a suppurating wound, pyæmic symptoms or hectic may set in.

c. Papillomatous Synovitis.—SYNON.: Fimbriated disease of the synovial membrane; Papilloma, or Papillary Fibroma of the synovial membrane; Ger. *Gelenkzotten.*

This is a peculiar form of joint-disease dependent on chronic synovitis, in which numerous pedunculated bodies, cylindrical or fusiform, varying in size from a pin's-head to a large pea, project from the membrane, generally near the cartilage margins, or they may cover the entire surface. They are identical in minute structure with the synovial fringes. Some become detached, and fall into the cavity of the joint. The disease is essentially a hyperplasia of the synovial adventitia; and there may be dozens or hundreds of these bodies present in one joint. Occasionally they contain cartilage-cells, or osseous particles. The joints in the lower limb are most often affected.

TREATMENT.—The disease is scarcely remediable except by excision of the joint, which may be practised in those cases in which there is serious loss of function.

6. Joints, Inflammation of, Gonorrhœal. This disease is often called 'gonorrhœal rheumatism.' It is almost always observed in the male, very rarely affecting the female. Generally one joint, usually in the lower limb, is involved, as the knee or the ankle. It is not so common in the upper extremity. It may affect several joints in succession. It may occur at any period of a gonorrhœal or even a gleety discharge, of which the patient himself is possibly unaware. The fibrous tissues of the joint seem to be primarily engaged. Sclerotitis and inflammation of the internal layer of the cornea often coexist, but never either endo- or pericarditis.

Symptoms.—The joint affected is exquisitely tender on pressure; it is swollen rather from subcutaneous œdema than by intra-articular effusion, which is usually inconsiderable; and one side of the joint is often more affected than the other. The fever is not in proportion to the intensity of the local symptoms, the rise of temperature being slight. The course of the disease is slow and obstinate; but when cured it is not liable to return, except with a fresh attack of gonorrhœa. These characters distinguish it from ordinary rheumatism.

Treatment.—Rest, cold applications, and the internal exhibition of iodide of potassium constitute the best treatment for gonorrhœal inflammation of joint. *See* Rheumatism, Gonorrhœal.

7. Joints, Inflammation of, Gouty.—Gout frequently occasions synovitis, by the deposit of urate of soda in the perisynovial tissue, which excites a synovial effusion. The attacks are very acute and painful; and as they recur, the joint becomes more and more disorganised, from permanent deposits of urates in the cartilages and bone, as well as in the perisynovial tissue. The use of the joint is lost; and the 'chalkstone,' as it is called, acting as a foreign body, sometimes produces an abscess, or an ulceration very troublesome to heal. When the collection is quite superficial, it may often be evacuated by incision with great relief. *See* Gout.

8. Joints, Inflammation of, Strumous.—Scrofula and tubercle are often associated with joint-diseases. Scrofulous or strumous inflammation of a joint is a vague term, but we are without a better. It is a form of chronic inflammation in ill-nourished persons—nearly always children—who live under bad hygienic conditions, and are prone to deposits of tubercle. It is observed most frequently in the knee- and hip-joints.

Anatomical Characters.—This disease generally commences in the synovial membrane, which becomes thickened, and by degrees converted into a semi-gelatinous mass of granulation-tissue, yellowish-white or pink in colour; or the disease may originate in osteomyelitis of the end of the bone. After it has existed for some time, it is difficult to determine in what tissue it may have originated, and it is of no clinical importance to do so, for in any case the later stages of the malady present similar features. The cartilages are encroached upon from their margins and from their deep surfaces by the granulations, whilst active changes occur simultaneously in their substance, similar to those already described. The ligaments soften, and all the structures of the joint become involved. Frequently small masses of necrosed bone will be found in the cancellated structure, and the granulations have a great tendency to suppurate. In the thickened synovial membrane, and also in the ends of the bones, miliary bodies, identical with tubercles, may very frequently be detected.

Symptoms.—In strumous inflammation the joint is uniformly swollen, tense, elastic, with a white glistening surface, and enlarged veins shining through the skin. The patient can usually move about until suppuration has taken place, as the pain is never very severe in the intervals of the acute attacks of inflammation which supervene from time to time. Enlargement of the lymphatic glands, or marks of strumous ulceration elsewhere are seldom wanting; whilst sooner or later a large proportion of the individuals affected by this form of joint-disease show signs of general tuberculosis. Sometimes this state precedes, but generally it follows, the local joint-affection. Inherited syphilis appears to be a predisposing cause of strumous arthritis.

Treatment.—This must be mainly directed to improving the patient's general condition. A purely local treatment, short of a complete removal of the diseased structures, is not of the least use. When the joint has become disorganised, as before described, excision should be performed before the viscera become implicated. If other organs be involved, or the local disease be too extensive, then amputation becomes imperative. When not relieved, fresh foci of suppuration form; the patient becomes more and more exhausted; or some intercurrent disease sets in. It is rare for spontaneous cure to happen.

9. Joints, Loose Cartilages in.—Synon.: Fr. *Corps flottants articulaires*; Ger. *Gelenkmaüse.*

Description.—'Loose cartilages' in joints may originate either from chronic inflammation, or from traumatic causes. They may be single or multiple. The knee-joint is most frequently affected, and in it the most serious symptoms are produced. These bodies may be fibrous, lipomatous, chondromatous, or osteo-chondromatous. They may be produced from polypoid growths springing from the synovial membrane in certain forms of chronic synovitis, and in arthritis deformans; and they are then usually of the fibrous or osteoid variety. Lipomatous free bodies are rare, and are derived from the subsynovial fatty tissue, being produced in a fashion analogous to the appendicæ of the great intestine. The chondromatous and osteo-chondromatous are the largest and most important varieties of these bodies; hence the common term 'loose cartilage.' Portions of the joint-surface may sometimes become detached, as the consequence of an injury, by a process of quiet necrosis. They thus become loose in the joint. There is good reason to believe that some of these bodies may obtain nourishment from the surrounding synovial fluid, and that cartilage and even bone can be developed in them subsequently to their detachment.

Symptoms and Diagnosis.—The symptoms of loose cartilages in a joint vary very much. In some instances these bodies cause no inconvenience. In others they produce repeated attacks of excruciating pain, followed by synovitis, laying the patient up for weeks; whilst in the most severe cases the limb may become almost useless. When the knee is the joint affected, the patient experiences great insecurity in walking, the loose body from time to time becoming wedged between the joint-surfaces. The joint is thus 'locked.' The patient may suddenly fall, or faint with pain; an attack of synovitis follows; and with a frequent repetition of this process joint-disorganisation may finally result. The prognosis as regards function is always bad.

Treatment.—The treatment of loose cartilages may be either *palliative* or *radical*. The former method consists in applying support to the joint; limiting its movements; and fixing the loose body in some synovial pouch where it cannot interfere with the articular surfaces.

The *radical* method consists in excising the body—an operation, with few exceptions, almost exclusively practised upon the knee-joint. The body may be removed by a free direct incision into the joint, and squeezing the body through the wound at once. Or the indirect manner of operating may be adopted. This consists in subcutaneously incising the capsule of the joint with a long, narrow-bladed knife introduced at some distance from the articulation; forcing the body through this incision into the cellular tissue outside; and then closing the small external puncture in the skin. Three or four weeks later the 'cartilage' may be removed by a superficial incision, or left undisturbed, when it often becomes absorbed.

In appreciating the comparative value of these two plans, it may be said that the former has hitherto proved more uniformly successful *quoad* extracting the body, but that it has been more dangerous to limb and life—a danger, however, which antiseptic precautions will in future reduce to a minimum. The indirect method has been attended by a considerable number of failures in the extraction of the loose cartilage, especially if it be pedunculated; but it has hitherto proved a much less dangerous operation. The extremity should be immobilised afterwards for two or three weeks.

When some dozens of these bodies are present in a joint, many of them free, many attached, excision of the articulation is often the only remedy. This is a severe measure, and not to be lightly undertaken, in the joints of the lower limb at all events.

10. Joints, Nervous Affections of.—Synon.: Hysterical joint; Neuralgia of Joints; Arthralgia; Fr. *Arthralgie hystérique*; Ger. *Gelenkneurose*.

Description.—*Hysterical* affections present symptoms simulating real joint-disease so closely, that the strongest therapeutic measures have often been exerted, though in vain, for their cure. Prolonged immobilisation, blistering, the actual cautery, resection, and even amputation, have been practised upon joints in which there was not a trace of organic disease.

The existence of hysterical affections of joints is denied by some; but assuredly they do occur; and most often in young women, well-to-do in life, with disordered catamenia. The same thing occurs, but less frequently, in young men. The disease is not witnessed under the age of puberty. The hip and knee are the joints principally complained of—most frequently the latter. An all-important feature of a hysterical joint is that, while the local symptoms may be intense, the general symptoms are either absent, or in no sort of proportion to the local.

A special character of this disease is that deep pressure is often less painful than superficial pressure; and that the pain and tenderness are vague, shift from one point to another, and will disappear at a given spot when the patient's attention is directed elsewhere. There is pain on movement, but of an indefinite character, and not so limited or localised as in real disease. Nocturnal startings do not occur; the patient may enjoy uninterrupted sleep for hours. There is never a continuous rise of temperature, either general or local; the co-relation of the symptoms is not the usual one; the function of the joint is much more interfered with than the other features of the disease present would appear to justify. There is an exaggerated fear of examination; and the *facies hysterica* is often well-marked. There may be thickening around the joint, and even marked synovial effusion into it; but these conditions are passive in character, and generally due to the treatment employed. The limb is wasted and consequently weak, but never to the same extent as in real joint-disease. Exacerbations occur at the menstrual period. A careful inquiry should be made into the history and antecedents of the case. An examination under chloroform will often afford important evidence; and the patient's symptoms will be improved afterwards by the movements then practised on the joint.

Neuralgic pain in the articulations may arise under different circumstances. It may be the referred pain, unattended by local lesion, which is so frequent in the knee in cases of hip-joint disease. Neuralgic pains in various joints are observed in the preliminary or early stages of chronic myelitis. In the first stage of locomotor ataxy the knee may be affected by severe neuralgia when the disease is low down in the cord; or the shoulders when it is at a higher point. Lastly, so called neuralgia of a joint may really indicate some obscure lesion, as chronic inflammation of the bones entering into the formation of the articulation.

Treatment.—The methodical exercise of an *hysterical* joint is as plainly indicated as rest is imperative in a case of organic disease. The bowels should be regulated, as also the menstrual flow. Assafœtida, iron, and quinine are most important remedies; and healthy mental and moral influences are valuable adjuncts. 'Get up and walk' is a good prescription in many such cases. Very careful and repeated examination should always be made, to exclude any possible form of chronic inflammation, before pronouncing a joint to be hysterical. It must not be forgotten, however, that after slight injuries which produce some inflammatory symptoms, those of hysterical joint may supervene, and persist long after all traces of organic disease have disappeared.

The treatment of *neuralgia* connected with a joint will necessarily vary with its cause. *See* Neuralgia.

11. **Joints, Rheumatic Arthritis of, Chronic.**—Synon.: Osteoarthritis; Fr. *Arthrite avec usure des cartilages*; *Arthrite sèche*; Ger. *Altersabschleifung.*

Ætiology and Pathology.—The number of names that have been applied to this disease betrays the obscurity enveloping its pathology. In nature it is, however, essentially a senile degeneration, preceded by chronic inflammation; and is, in part, perhaps the result of wear and tear of the joint. It is most common in hard-working people, exposed to the influence of wet and cold, and in the aged. One or many joints may be affected; generally the fingers, the toes, the hip, and the knee. It may be set up by injury, such as a sprain, dislocation, or fracture; or it may arise without known cause. It is difficult to say which tissue is primarily at fault, but sooner or later all become involved. The synovial membrane inflames; papillary outgrowths form upon it; the cartilage swells; and the ends of the bones enlarge. After a time the quantity of synovial fluid diminishes; the joint-friction increases; the cartilages are rubbed away at the surfaces of contact; and afterwards the bone itself, which becomes denser by interstitial deposit, disappears. The surface is eburnated, and marked with striæ produced by friction; whilst deposits of new bone, which may often be felt externally, form around the margins of the joints, so that the area of its surfaces becomes greatly increased.

Symptoms.—The symptoms of chronic rheumatic arthritis chiefly consist in constant pain, of a dull aching character, and worse at night, Motion becomes more and more difficult and painful as the disease advances; but anchylosis never occurs. Rough crepitus is felt both by the patient and the surgeon when the joint is moved. *See* Rheumatic Arthritis.

Treatment.—The treatment of rheumatic arthritis can only be palliative, and consists in the use of warm douches and other warm applications, and the administration of iodide of potassium internally. The disease is incurable.

12. **Joints, Serous Effusion into.**—Synon.: *Hydrops articuli*; *Hydarthrosis*; Fr. *Hydarthrose*; Ger. *Gelenkwassersucht.*

This is a form of chronic serous synovitis, in which there are no obvious inflammatory symptoms. The joint sometimes becomes greatly distended; the ligaments are stretched; and in consequence there is a sensation of tension and feebleness in the articulation. The knee and elbow are most frequently attacked; and the disease is often associated with a gouty or rheumatic diathesis, or with rheumatoid arthritis. It is very difficult to cure. The joint may be punctured and the fluid drawn off, or, still better, it may be injected and thoroughly washed out with iodine (equal parts of the compound tincture and water) or a carbolic acid (2½ to 5 per cent.) solution; but relapses are common.

13. **Joints, Syphilitic Disease of.**—This disease may originate in children, in the form of a suppurative ostitis at the junction of the epiphysis and diaphysis. Other signs of congenital syphilis will help to establish the diagnosis. The disease runs a rapid course, and the joint is frequently destroyed. In the adult a chronic plastic synovitis, due to gummatous infiltration of the perisynovial tissue, or of the bone and periosteum, is the more common form. There is very little fluid effusion within the joint, but considerable impairment of mobility is produced by the thickening outside it. The progress of the disease is slow and painless, except at night or on motion. The history of the case; the presence of traces of syphilis elsewhere; and the effects of treatment, will help in establishing the diagnosis. The internal administration of mercury and iodide of potassium, combined with local pressure by means of strapping with mercurial plaster, speedily effects a marked improvement and cure.

William MacCormac.

JUGULAR VEINS, Physical Signs in connexion with. — The principal physical signs in connexion with the jugular veins are distension, pulsation, and venous hum. *See* Physical Examination.

K

KELOID.—Synon.: Fr. *Chéloïde, Kéloïde*; Ger. *Keloid.*—*Keloid* and *cheloid* are two words resembling each other in sound, and sometimes used indiscriminately, but differing altogether in origin and signification. *Keloid* is derived from κηλὶς, a mark or blemish; whilst *cheloid* derives its origin from χηλὴ, a crab's claw. The disease which we now recognise as cheloid was first described by Alibert under the name of *kelis*, with the synonyms, *cheloide* and *cancroide*, and is therefore sometimes referred to as the 'kelis of Alibert' (*see* Cheloid). The term keloid has, however, been applied by Addison to a blemish of the skin, resulting from a fibrous degeneration of the derma allied with scleriasis; hence the use of the term *kelis Addisonii.* Both diseases are really fibromata; but one, namely cheloid, is a tumour, while the other, kelis, is flat, and often resembles a cicatrix. There is another obvious difference between them: cheloid is restricted to the derma, whilst kelis follows the subcutaneous connective-tissue to the deeper parts of the body.

The early dermatologists described kelis under the name of *morphœa*, and by that name it is still distinguished by some modern writers.

Erasmus Wilson.

KERATITIS, or KERATODEITIS (κέρας, a horn, the cornea).—Inflammation of the cornea. *See* Eye and its Appendages, Diseases of.

KERION (κηρίον, a honeycomb).—A term applied to a pustular folliculitis of the scalp. The inflamed skin occurs in the form of one or several blotches of a deep red colour, prominent, and dotted over with yellow spots—the apertures of the follicles, from which the hair has been expelled, and which exude a copious muco-purulent fluid. The yellow spots are converted into hollows by the tumefaction of the framework of inflamed skin, and, no doubt, thereby suggested the idea of a honeycomb, whilst the muco-purulent secretion might in like manner be compared to honey. Another feature of the disease is the elimination of the hair from the inflamed follicles, and the subsequent baldness of the affected part. Kerion is sometimes associated with tinea capitis. *See* Skin, Diseases of; and Tinea.

Erasmus Wilson.

KIDNEYS, Diseases of.—Synon.: Fr. *Maladies des Reins*; Ger. *Nierenkrankheiten.*—The kidney is subject to a number of diseases, which will be considered in the following pages in alphabetical order. At the outset, however, it will be convenient to present an outline of the abnormal phenomena to which these affections may give rise.

Summary of Symptoms.—The facts upon which the diagnosis in diseases of the kidneys is founded, are of three classes, namely;—A. **Abnormal local conditions**; B. **Abnormalities of the urinary secretion**; C. **Abnormalities in other parts of the system, secondary to the local phenomena.**

A. **Abnormal local phenomena.** — These may be:—

a. Subjective. The patient may experience pain or uneasiness in the region of the kidney, on one or both sides; and abnormal sensations may be also referred to the ureter, the bladder, or the urethra. The pain may be influenced by attitude or by exertion; and be either constant, paroxysmal, or periodic. It may be aggravated, relieved, or unaffected by pressure.

b. Objective. Examination of the abdomen and pelvis, by means of palpation and percussion, may reveal the presence of a tumour connected with the kidney. The tumour may be solid or fluid; uniform or lobulated. Tumours of the kidney may generally be made out by palpation, and especially by tilting with the one hand the mass forwards from the lumbar region, upon the fingers of the other hand applied in front. In some cases the absence of the kidney from its normal position may be ascertained by percussion in the lumbar region. By careful observation of the relative form of the two sides at the back and in front, either the presence of tumour, or the absence of the organ, may be rendered distinct.

B. **Abnormalities of the urinary secretion.**—*a.* The urine may be altered in *quantity.* It may be increased, as in waxy degeneration of the kidney, or in advanced stages of cirrhotic and inflammatory Bright's disease; or diminished, either from obstruction to its escape, or from failure of secretion. The conditions leading to obstruction to outflow are certain diseases of the urethra, prostate, bladder, or ureters; the last-named inducing suppression only where both the ducts are simultaneously occluded, or where one kidney having been previously destroyed, the ureter of the other side subsequently becomes affected. The impaction of calculi, and the pressure of new-formations are the chief causes of these obstructions. The conditions leading to diminution or failure of secretion are the pyrexial state; obstruction of uriniferous tubules, as by inflammatory products; long-standing passive congestion, as in cardiac disease; and probably some forms of altered innervation.

b. The urine may be altered in *colour*, as from the presence of blood, pus, bile, purpurin; or of substances introduced into the system, such as logwood, rhubarb, senna, tar, and carbolic acid.

c. The *specific gravity* may be altered, being much raised when the proportion of water is small, or when an excessive amount of sugar or of urea is being eliminated, or when a large proportion of blood or of albumin is present. It is diminished whenever the proportion of water is excessive, or the elimination of urea diminished. It is thus an important feature of renal disease. In determining the specific gravity it is important to remember that, when the specimen has stood for some time, it may vary in different parts of the same column of fluid; that it varies with the temperature, being lower in warm than in cold fluid; and further that it varies at different times of the day, in relation to the state of the digestion.

d. The *reaction* of urine varies from the slightly acid standard of health, by being either too acid or alkaline. The acidity may be excessive when the urine is passed, or may become increased after it has been voided, in consequence of the acid fermentation. It may be alkaline when passed, from the presence either of fixed alkali or of ammonia. The ammonia results from decomposition of urea, and this change constantly occurs in urine which has been kept and allowed to decompose.

e. Albumin is a common morbid constituent of urine, either temporary or permanent. Temporary albuminuria may be artificially produced by the ingestion into the stomach, or by subcutaneous injection, of raw albumin of egg; and it sometimes results from derangement of the digestion, due to the use of indigestible articles of food. It occurs in certain blood-diseases, such as scarlet fever, erysipelas, diphtheria, and acute yellow atrophy of the liver, and is probably due to the irritation of the kidneys by the poisons proper to these maladies. It also occurs in some cases where fever is high and persistent, and is then to be explained by alteration of the condition either of the vascular walls, of the renal cells, or of the innervation of the kidneys. It also occasionally results from the use of certain drugs, such as turpentine and cantharides; certainly sometimes from nervous affections, such as exophthalmic goître, epilepsy, and injuries to or organic disease of the brain. Permanent albuminuria is met with in all the forms of Bright's disease; most abundantly in the inflammatory form; to a less extent, but constantly, in the albuminoid; to a still less extent, and sometimes altogether absent, in the cirrhotic variety. It also results from passive congestion of the kidneys, due to cardiac disease or other cause; as well as from suppurative nephritis and other diseases of the kidney, and from pyelitis. The ordinary albumin of the blood-serum is the form which usually appears in the urine. Now and then it is found, especially in the course of or after acute febrile diseases, that a variety of albumin occurs in the urine which is unaffected by heat and nitric acid, but which becomes coagulated by alcohol. This may either be from alteration of the substance itself, or from the presence of some material which interferes with the ordinary chemical reaction. *See* Albuminuria.

f. Urea is diminished in quantity wherever there is destruction of the renal epithelium, as in the different forms of Bright's disease, especially the cirrhotic and inflammatory varieties.

g. The *physical* and *chemical* characters of the urine are often much modified by conditions other than diseases of the kidneys themselves, and abnormal ingredients may be present, such as sugar or bile, but these alterations do not come within the scope of the present article.

h. Deposits are also frequently present in the urine, which are due to various causes apart from renal disease, namely, urates and uric acid, oxalate of lime, phosphates, cystine, xanthine, tyrosine, and leucine. Organic deposits are important in many affections of the kidney or its pelvis. In the first place the *epithelium* from the latter may be present in more or less abundance. *Pus* appears as a fine granular yellowish deposit, which becomes viscid and transparent on the addition of liquor potassæ. In ammoniacal urine it is sometimes found that the pus-cells have undergone this change within the bladder. Pus may be derived from the pelvis of the kidney, or from the kidney-substance itself. Deposits very similar in general appearance to pus are sometimes seen in cases of scrofulous kidney, but the microscopic appearances are different, the corpuscles being altered, and often associated with fibrous tissue. *Cancerous* deposits, showing distinct cancer-cells, are also sometimes met with. The presence of *blood* gives the urine a smoky, pinkish, or actually bloody appearance. *See* Hæmaturia.

Tube-casts are sometimes so numerous as to constitute a deposit quite visible to the naked eye. These casts are solid moulds of the uriniferous tubules, sometimes formed within the free lumen of the tube, but far more frequently within the basement-membrane, thus including the more or less altered epithelium. The simplest form of tube-cast is the hyaline, a clear structureless cast. Blood-casts are common, containing distinct red corpuscles. Epithelial and desquamative casts are opaque and granular, the granularity being due for the most part to the abundance of altered epithelium in their substance. Fatty casts are those which exhibit evidences of fatty degeneration of the epithelium. *See* Bright's Disease; Casts; and Urine, Morbid Conditions of.

C. **Symptoms occurring in other parts of the body.**—Very important symptoms occur in connection with renal diseases, affecting the organs of circulation and of digestion, the nervous system, and the skin; but these are for the most part associated with Bright's disease. *See* Bright's Disease; and Uræmia.

The several diseases of the kidney will now be indicated, and those will be discussed which are not described under special headings in other parts of the work.

1. **Kidney, Abscess of.**—Synon.: Renal abscess.—This is often used as a generic term including any accumulation of pus in connection with the kidney, whether in the substance of the organ, in its pelvis, or even around it. Strictly, it applies only to a collection of matter resulting from suppuration in the kidney-structure itself. *See* Kidney, Inflammation of Pelvis of; Kidney, Suppurative Inflammation of; Perinephritis; and Surgical Kidney.

2. **Kidney, Acute Atrophy of.**—Definition. This is a rare disease of the kidney, consisting in rapid exudation into the cells of the organ, followed by fatty degeneration and disintegration; caused by unknown conditions; characterised by sudden occurrence of copious albuminuria, with very numerous tube-casts, and frequently marked uræmic symptoms; and resulting apparently invariably in death.

Ætiology.—The causes of this affection are unknown, but it appears probable that it depends upon some form of blood-poison, the disease being frequently associated with acute atrophy of the liver. In most cases it would appear to follow the hepatic disease; in some it precedes it. It is much more common in the female sex than in the male; and is most frequent during pregnancy and after childbirth.

Anatomical Characters.—There are two stages in the progress of this disease, namely, (1) that of exudative infiltration and enlargement; (2) that of disintegration and atrophy. In the first stage the organ is enlarged, not markedly congested, the capsule strips off readily, the substance is flaccid, the cortical substance is swollen, the individual tubules are enlarged and white. On section the vessels are found mostly empty of blood, being compressed by the diseased tubules. The tubules are occupied by dense opaque material; and the individual cells are swollen and granular, their nuclei being hidden by molecular cell-contents. The tubules of the cones, as well as those of the cortical substance, are frequently affected. Many of the cells also are in a state of fatty degeneration, or broken down even at this stage. In the more advanced stage the organ is smaller than natural, and its capsule appears wrinkled. The kiddey is pale and flaccid. When cut into there escapes a quantity of débris, often containing oil-globules, quite visible to the naked eye. The stroma is intact, and sections can easily be made with a Valentin's knife. The sections show that many of the tubules are denuded of epithelium, and that the shrinking of the organ results from this disintegration. It is easy to find different tubules and cells in various stages of transformation, some showing the early stage of cloudy swelling, others the stage of fatty transformation, and others the disintegrating, almost deliquescent condition. The friability of the cells is quite extraordinary, the weight of a thin covering glass often sufficing to reduce them to molecular débris.

It will be observed that the changes, both in the organ and the individual cells, exactly correspond to those met with in acute atrophy of the liver.

Symptoms.—The symptoms characterising this affection have not yet been very fully studied. Diminution of urine, copious albuminuria, with deposit of casts corresponding to the changes in the kidney, are probably the chief renal symptoms. A tendency to hæmorrhages, jaundice, and uræmic nervous affections, and the series of symptoms proper to acute atrophy of the liver, are also observed.

Diagnosis.—There is probably no disease with which this is very liable to be confounded.

Prognosis and Treatment.—The prognosis must be unfavourable; and no treatment can be of any avail.

3. Kidney, Albuminoid Disease of. *See* Bright's Disease.

4. Kidney, Anomalies of.—The kidneys may present three kinds of anomaly, namely:—1. In number. 2. In form. 3. In situation. Only the first of these will be referred to here.

Anomalies in Number.—Sometimes one kidney, with the corresponding ureter, is entirely absent. In such cases the organ which is present is much above the normal size. There is generally no symptom present during life, but diseases of the pelvis of the kidney or the ureter are made more formidable in persons so affected, than in those normally developed. Occasionally one or more supernumerary kidneys are present. *See* Kidney, Malformation of; and Kidney, Malpositions of.

5. Kidney, Calculus in. *See* Renal Calculus.

6. Kidney, Cancerous Disease of. *See* Kidney, Malignant Disease of.

7. Kidney, Chronic Atrophy of.—This condition of the kidney arises under a variety of circumstances, but specially as a consequence of hydronephrosis, and of the different forms of Bright's disease. In hydronephrosis the atrophy commences in the cones, and spreads to the cortical substance. In all the forms of Bright's disease it commences at the surface and spreads inwards. In hydronephrosis atrophy is a result of the pressure of the renal secretion, as it accumulates in the dilated pelvis and within the tubules. In inflammatory Bright's disease it is due to interstitial changes, and the gradual absorption of the contents of the occluded uriniferous tubules. In cirrhotic Bright's disease it is a consequence of the contraction of the hypertrophied fibrous stroma, and the consequent destruction of vessels and secreting structures. In the waxy or albuminoid form it is due to the molecular absorption of the hyaline material and altered cells which occupy the uriniferous tubules, as a consequence of the degeneration proper to the vessels.

Anatomical Characters.—Although really atrophied, the hydronephrotic kidney appears large, and may form a mass several times the size of the normal kidney. It is lobulated on the surface, and may often be seen to be little more than a group of cysts containing watery fluid. In the earlier stages no change is observed, except flattening of the cones; in the later the cortical substance also is more or less wasted. This condition is usually seen only on one side, the other kidney being natural, or somewhat hypertrophied.

Atrophy from inflammatory Bright's disease is rarely far advanced when the fatal result occurs. Both kidneys are affected, and usually to the same extent. The capsule strips off readily. The surface presents a finely granular appearance. On section, the cortical substance is found relatively diminished. Many of the tubules are occupied by sebaceous-looking material. Many of them are diminished in size, and irregular in outline from absorption of their contents. The stroma is relatively increased; the vessels are little altered.

In the cirrhotic form the atrophy is often more advanced, and is commonly equal, or nearly so, on the two sides. The capsule is adherent, the surface granular and uneven. On section, the cortical substance is diminished, and it often contains many cysts. On microscopic examination the fibrous stroma is found markedly increased, many of the tubules and vessels are destroyed, while the smaller arteries are thickened.

In the albuminoid form the kidneys have in some cases been found greatly and nearly equally diminished in size. The capsule strips off readily; the surface is finely granular. On section the cortical substance is found diminished, the degenerated Malpighian bodies remaining singularly prominent, especially towards the surface, the stroma appearing relatively somewhat increased, and the hyaline contents of the tubules in process of absorption.

Symptoms.—No definite group of symptoms indicate the existence of atrophy. Those met with in the atrophic stages of the different affections are described under each disease.

Partial Atrophy of the Kidney results from embolism, new-formations, and other like causes; and is in many instances unattended by symptoms.

8. Kidney, Cirrhotic. *See* Bright's Disease.

9. Kidney, Congestion of. *See* Kidney, Hyperæmia of.

10. Kidney, Cystic Disease of.—Definition.—A chronic morbid state of the kidney, caused by conditions not fully ascertained; characterised in some cases by no symptoms, in others by the presence of tumours, and by symptoms resembling those of the cirrhotic form of Bright's disease; resulting in permanent change; and not amenable to treatment. The formation of cysts in the kidney may be unimportant, either from the small number of cysts, or from the co-existence of much graver disease of the kidney; but it may constitute a serious disease.

Ætiology.—Nothing is known as to the causes of cystic degeneration. It may be congenital, or may come on during adult life. The mode of origin of the cysts appears to be from the dilatation above obstructed points in the course of uriniferous tubules, or at their points of origin in the Malpighian bodies. Sometimes the cysts are new formations in connection with epithelium; and sometimes they arise from the fibrous stroma of the organ.

Anatomical Characters.—Renal cysts vary greatly in size, from minute, almost microscopic, cavities, to spaces capable of holding several pints of fluid. The true cystic kidney is large; its surface is uneven, and in colour resembles a piece of conglomerate. The capsule strips off, but often with some difficulty. On section its substance is found replaced by multitudes of cysts, scarcely any proper tissues remaining. The contents are sometimes watery, sometimes contain urinary constituents, sometimes are tinged with blood, and sometimes are gelatinous or colloid.

Symptoms.—In many cases cystic disease of the kidneys is unattended by any symptoms; and even when the disease is extensive and severe there are, as a rule, no constitutional symptoms until the case draws near its termination. Among local signs the most important is enlargement of the organs, which may sometimes be made out by means of palpation and percussion, in cases which are advanced, and in emaciated subjects. Both organs are generally equally enlarged. The urine is secreted in natural or in excessive quantity; its specific gravity is low; and it contains albumin, and sometimes blood. The termination of these cases is not unfrequently abrupt, with uræmic convulsions and coma.

Diagnosis.—The points which are of importance are the presence of bilateral tumour; with copious discharge of urine of low specific gravity, or containing albumin.

Prognosis.—The prognosis is always unfavourable.

Treatment.—Treatment can be directed only to the relief of symptoms.

11. **Kidney, Dropsy of.**—This is a synonym for hydronephrosis, in which urine, more or less altered, accumulates in the renal pelvis, as the result of obstruction of the ureter. *See* Hydronephrosis.

12. **Kidney, Embolism of.**—The impaction of emboli in the branches of the renal arteries gives rise to various lesions, of which the most common is the hæmorrhagic infarction; next to this inflammation and secondary abscesses; and more rarely gangrenous inflammation. These affections often do not manifest themselves during life by any distinct symptoms; or their existence may be revealed by sudden albuminuria and hæmaturia, and sometimes by general constitutional disturbance and local pain.

Ætiology.—The chief cause of renal embolism is disease of the valves of the heart. The emboli may be composed of coagulated fibrin; or of fragments of the tissue of the valve, which have been separated by ulceration. More rarely embolism is caused by fibrin which has coagulated between the meshes of the fleshy columns of the heart, or by coagula which have formed on the roughened inner coat of arteries. Among the remoter causes are those of endocarditis and endarteritis. This, in so far, vindicates the name which Rayer applied to these infarctions—'rheumatismal nephritis.'

Anatomical Characters.—1. *Of hæmorrhagic infarction.*—This may, for convenience, be described as passing through three stages:—(1) that of red consolidation; (2) that of fawn-coloured transformation; and (3) that of absorption or atrophy. The form of the masses is usually conical, or, as seen on section, wedge-shaped, the base being towards the surface. At first a patch is deeply congested, and presents a dark red colour. On microscopic examination the vessels are found congested, many ruptured; and blood is extravasated into the tubules. In the second stage this redness has passed away; a buff or fawn-coloured mass represents the red patch of the earlier stage. On microscopic examination the cells of the tubules are found to be destroyed, and within them, as well as in the stroma, blood-pigment may be found. In the third stage there is commonly a depression of the surface of the organ; and, on section, what had been the conical patch is represented by a fibrous cicatrix.

2. *Of the abscesses.*—In certain cases, especially in the course of pyæmia, emboli lead to abscesses. Throughout the organ such abscesses exist, and may be traced in various stages, which might be described as those of red consolidation, of ashy-gray consolidation, and of suppuration. In this condition the clot is not to be found at the apex of the cone of disease, but imbedded within it. Between the simple infarction and the abscess there is an intermediate form—a certain degree of suppuration occurring at the margin of the affected area.

3. *Of gangrenous patches.*—Very rarely it appears that, in consequence of the impaction of an embolus, gangrene of the affected district occurs, with more or less suppuration.

Symptoms.—The symptoms of the embolic infarction are often very indistinct, but the condition may sometimes be diagnosed. When valvular disease of the heart or extensive calcareous affection of the arteries exists, and when in addition to this sudden albuminuria or hæmaturia appears, with some degree of fever, and pain in the region of the kidneys, there is every reason to conclude that an embolus has been impacted. This condition is rarely one of importance in the case, for much graver maladies coexist with it. The occurrence of abscess in the kidney may sometimes be surmised when sudden albuminuria or hæmaturia becomes superadded to the other symptoms of pyæmia. Gangrene of the kidney or a portion of it is not likely to be capable of diagnosis during life.

Diagnosis.—The diagnosis of renal infarction turns upon the points above referred to. It is important to distinguish it from Bright's disease, and from passive congestion. From the former it is distinguished by the suddenness of the onset, the shortness of its duration, the absence of dropsy, and the presence of cardiac or vascular disease; from the latter by the suddenness of its development, and by the absence of signs of stasis in other organs.

Prognosis.—The prognosis in cases of infarction is favourable so far as the kidneys and their functions are concerned, but unfavourable in this respect that there is a tendency to the impaction of emboli in other more important parts, particularly in the brain.

Treatment.—No special or particular treatment can be directed in this condition.

13. Kidney, Fatty Disease of.—Definition. A chronic affection of the kidney, consisting in simple fatty degeneration of, or infiltration into, the renal epithelium, without inflammation; characterised by no symptoms as yet clearly ascertained.

Ætiology.—Fatty kidney results in some cases from long-continued exhausting disorders; from senile marasmus; from starvation; from poisoning with phosphorus; and perhaps from excessive indulgence in fatty food.

Anatomical Characters.—The organs are of about the natural size, their surface is smooth, and the capsule strips off readily. There is no congestion, and scarcely any stellate veins are visible. The organ is more soft and flexible than natural, and the surface is mottled with numerous deposits of sebaceous-looking material. On section the relative size of the cortical substance and the cones is seen to be preserved; and beyond a general pallor there is no change except the abundant deposition of sebaceous-looking material, mostly in the tubules of the cortical substance, but also in those of the cones.

On examining a section with a low power of the microscope, the characteristic fatty opacity is well-marked, and by careful scrutiny it may be generally made out that the fatty material is not in the canal of the tubule, but within the epithelial cells. The Malpighian bodies, the vessels, and the stroma, under a higher power, appear natural; and in transverse section of the tubules, a clear lumen may be made out. It will thus be observed that there is no inflammatory desquamation of the cells, nor exudation filling up the lumen of the tube.

Symptoms.—Little is known of the clinical features of this affection. But the quantity of the urine appears to be diminished. There is certainly no albuminuria, and apparently no other important change in its composition. Dr. Lang, of Dorpat, has shown that a little free oil is sometimes found in the urine.

Diagnosis.—It is scarcely possible to diagnose this affection with certainty; but diminution of the urine, without albuminuria, and with the presence of oil in the urine, especially if associated with the signs of fatty liver, and with any of the known causes of fatty degeneration, may lead to the establishment of the diagnosis.

Prognosis.—The renal affection is not generally an important element in the prognosis, other conditions of more importance being present.

Treatment.—General tonic treatment, and the removal of the cause when known, are the only indications.

14. Kidney, Gouty.—This is a form of contracted granular kidney, occurring in gouty subjects, and attended with the deposit of urates in the renal tubules. *See* Bright's Disease; and Gout.

15. Kidney, Granular.—A synonym for a chronic form of Bright's disease, where the kidney presents a granular appearance. *See* Bright's Disease.

16. Kidney, Hæmorrhage in connection with.—Blood may escape into the substance of the kidney, as the result of embolism or injury; into the tubules, giving rise to blood-casts; or into the renal pelvis, especially from injury to the mucous lining by calculi. The only diagnostic indication of this event is the presence of blood in the urine, intimately mixed with it, or sometimes in clots. A coagulum of blood may block up the ureter. *See* Hæmatinuria, Paroxysmal; and Hæmaturia.

17. Kidney, Hydatid Disease of.—Definition. — A chronic parasitic disease of the kidney, caused by the reception into the system of the ova of the Tænia echinococcus, and the development in the kidney of the corresponding cystic form; consisting in the formation of hydatid cysts—'echinococcus hominis'—in the substance of the organ; characterised in some cases by no symptoms, in others by renal tumour, or by the discharge of cysts with the urine, after symptoms resembling those of renal calculus; and resulting sometimes in recovery, sometimes in death, either by perforation into the lung, intestine, or other part, or by suppuration.

Ætiology.—The tape-worm form is the Tænia echinococcus, which inhabits the intestine of the dog. The frequency of hydatid-disease is determined by the frequency of the occurrence of the tape-worm in the dogs, and by the habits of the people. It is common in Iceland, in Egypt and in South Australia. In England it is not common; in Scotland it is very rare. *See* Hydatids.

Anatomical Characters.—The affected organ is enlarged, sometimes greatly. It is often connected by adhesions to neighbouring parts. A globular tumour projects from the surface, and extends into the substance of the kidney, inducing corresponding atrophy. The cyst has an outer covering of fibrous tissue derived from the organ; and an inner coat—the cyst proper, which may be barren, that is, devoid of daughter-cysts, or may contain within it numerous smaller cysts and processes growing inwards from the walls, containing scolices which may give origin to the corresponding tape-worm. In either case the cyst-wall is somewhat tensely expanded by a clear liquid, rich in chloride of sodium. The cyst enlarges gradually, and may burst in various directions, but most frequently into the pelvis of the kidney, or into the lungs and bronchi. Sometimes suppuration of the cyst occurs, and accordingly one finds on *post-mortem* examination the remains of a shrivelled and sunken cyst, with caseated contents, in which are imbedded remains of daughter-cysts and hooklets from the scolices.

Symptoms.—The course of hydatid-disease of the kidney is always chronic. It may be prolonged for many years. The advance is insidious. Attention is sometimes drawn, first to the presence of a tumour, sometimes to the evidences of its rupture. When rupture takes place into the pelvis of the kidney, daughter-cysts passing along the ureter give rise to symptoms resembling those of renal colic; but the discharge of the cysts, and the results of the microscopic examination, reveal the true cause of the irritation. After such a discharge the cyst may atrophy; sometimes it happens that a second or even a third discharge occurs after a shorter or longer interval. When the discharge is by the lung, pain and cough occur, due to irritation of the pleura. Then the expulsion of the hydatids takes place; sometimes this also results quite favourably. The special features of a hydatid tumour are its globular form and its elasticity. When suppuration occurs, fever supervenes, attended with local pain.

Diagnosis.—The diagnosis of hydatid of the kidney depends upon the presence of a tumour of a special kind; and is made certain by the discharge of cysts or hooklets.

Prognosis.—The prognosis is always doubtful.

Treatment.—Medicine is of no avail. The best treatment is the removal of the fluid contents of the cyst by aspiration. When such removal is effected the parasites die, and the cyst shrivels up.

18. Kidney, Hyperæmia of.—Definition. An acute or chronic affection of the kidney, consisting in active or passive congestion of its vessels, with secondary changes; characterised by the appearance of albumin, and sometimes of blood and of hyaline tube-casts in the urine, the quantity of urine being generally diminished, and its specific gravity natural; resulting in recovery if the cause be removed, but in the passive form commonly continuing or recurring till the fatal result is induced, partly by the original, and partly by other causes.

Ætiology.—Active congestion, that is congestion due to increased influx of arterial blood, may be caused by inflammation; by various blood-poisons, such as those of scarlet fever, measles, typhus; and by some medicinal substances, such as cantharides, turpentine, cubebs; also probably by agencies which paralyse the muscular fibres of the small arteries—as is sometimes seen in the course of exophthalmic goître—or which increase the blood-pressure in the renal arteries. Passive congestion, which implies congestion due to hindrance to the efflux of venous blood from the organ, may be caused by any obstruction to the circulation. It is most commonly met with in cases of cardiac disease, where the right chambers of the heart are dilated. It also results from such diseases of the lungs as are followed by dilatation of the right side of the heart—for example, emphysema. It also sometimes arises, though much more rarely, from obstruction in the course of the inferior vena cava, or in the renal veins, as from pressure of aneurismal or other tumours, or from the formation of a thrombus.

Anatomical Characters.—In the *active* form of renal hyperæmia, the anatomical changes are probably less marked after death than during life. The kidneys are generally of fully the normal size; the capsule strips off readily; and the surface is smooth. On section the vessels are found congested; the Malpighian bodies frequently standing out prominently, being distended with blood. The vessels of the cones are also overfilled. More or less evidence of inflammatory change is to be found in the tubules, the epithelium being granular and opaque, and the lumen of the tubules, especially those of the cones, being filled up with coagulated fibrin. Blood is sometimes found extravasated into the convoluted tubules. The stroma is unaltered. Sometimes there is congestion of, or even extravasation into the mucous membrane of the pelvis of the kidney and of the ureter. In *passive* congestion the anatomical changes are more marked, and vary with the duration and intensity of the affection. In the slighter forms, or in those of short continuance, the kidney is of fully the natural size; its capsule strips off readily; the surface of the organ is smooth; and there is evidence of congestion. On section, the congestion is seen to occupy the veins and the Malpighian bodies; sometimes there are evidences of extravasation of blood; and sometimes fibrinous coagula are found in the tubules.

In the more chronic forms, although the capsule strips off readily, the surface is somewhat uneven; congestion is still marked on the surface, but scarcely so distinctly as in the earlier stage. On section the organ feels firmer than natural; it is in a condition which may be best described by the term induration. Its small veins and Malpighian bodies are dilated and full of blood; the fibrous stroma is relatively increased, especially towards the surface of the organ; some of the tubules are wasted, some are blocked up with exuded material, and some exhibit evidence of disintegration and fatty degeneration of the epithelium. The condition of the stroma thus approaches that of cirrhosis of the kidney; the condition of the tubules approaches that of inflammation. There is no definite boundary line between the conditions anatomically; still the combination of the changes confirms the inference which must be drawn from the study of the clinical history, that these hyperæmic changes, though approaching to, are not identical with the processes properly included under the term 'Bright's disease.'

Symptoms.—The symptoms of *active congestion* are the presence of albumin in the urine, occasionally accompanied by hyaline tube-casts, and sometimes by blood in greater or less quantity. It occurs commonly as a transient, or occasionally, as a recurring condition, and unless when it betokens a commencing inflammatory action, is rarely of much practical importance.

In *passive congestion* albuminuria is again the leading symptom; the urine is generally somewhat reduced in quantity, of about normal specific gravity, often of acid reaction, depositing urates. The amount of urea is little below the normal. Tube-casts are usually scanty, and may be wanting; when present they are hyaline or sometimes bloody, and occasionally contain altered epithelium. The other symptoms are those of obstruction to the circulation; occlusion of, or pressure on, the veins; disease of the heart; emphysema of the lungs; and general dropsy.

Diagnosis.—The question relating to diagnosis, which is of most practical importance, lies between hyperæmia and inflammatory Bright's disease. In making this distinction, the points to which we have to attend are the general condition of the patient, in respect to the possible causes of such an affection, the presence of cardiac or pulmonary disease, or of venous obstruction. In congestive affections the urine is scanty, as it often is in Bright's disease, but it is of high colour, of natural specific gravity, and rarely deposits blood, renal epithelium, or tube-casts.

Prognosis.—The prognosis depends entirely upon the conditions inducing the congestion. In the active form it usually rapidly subsides; in the passive form, it is persistent, or at best, if temporarily got rid of, is almost sure to recur.

Treatment.—When the renal congestion is very intense, dry cupping, local blood-letting, the hot air or the warm vapour bath, or warm applications over the kidneys, may be indicated; but the treatment is mostly that of the diseases which are inducing the congestion. Thus, in the case of cardiac disease digitalis and iron, in the case of pulmonary disease digitalis with squill, and if necessary, a little blue pill or carbonate of ammonia, are indicated. The general management should be that proper to the obstructive disease which has induced the congestion.

19. Kidney, Hypertrophy of.—True hypertrophy, that is to say, increase of all the elements, or of the essential elements of the kidney, occurs only in one organ as a rule, and that by way of compensation for atrophy of the other.

Simple increase of bulk of the kidneys often results to a certain extent from congestion, inflammation, the various forms of Bright's disease, new formations, and accumulation of the secretion.

Anatomical Characters.—These present no peculiarity beyond the enlargement, the organ weighing sometimes eight or nine ounces, the renal artery and vein being proportionately enlarged, with a corresponding coarseness of structure.

Symptoms.—Hypertrophy of the kidney is without symptoms, but it might so happen that the enlargement of the organ could be detected on physical examination.

20. Kidney, Infarction in.—*See* Kidney, Embolism of.

21. Kidney, Inflammations of.—Inflammation of the kidneys and their pelves presents many varieties. The kidneys themselves exhibit, first, tubular inflammation, acute or chronic; second, inflammation of the stroma, acute or chronic; third, suppurative inflammation of the substance of the organ, septic or non-septic. The renal pelvis is also liable to acute or chronic inflammation. It will serve no useful purpose to discuss these in a general article, and therefore the reader is referred to the several special articles. *See* Bright's Disease; Kidney, Suppurative Inflammation of; and Kidney, Inflammation of Pelvis of.

22. Kidney, Inflammation of Pelvis of. Synon.: Pyelitis; Fr. *Pyélite*; Ger. *Nierenbeckenentzündung*.

Definition.—An acute or chronic disease of the pelvis of the kidney, caused by extension of inflammation or of irritation from the neighbouring parts, by renal calculus, by cold, or by blood-poisoning; consisting in inflammation of the mucous membrane, frequently associated with changes in the other coats and in neighbouring parts; characterised by the presence of mucus or pus in the secretion, with local pain, and more or less constitutional disturbance; sometimes resulting in recovery, sometimes in long-continued illness, and occasionally in death.

Ætiology.—Pyelitis is caused by:—(1) extension of inflammation from neighbouring parts of the urinary tract sometimes from the kidneys, sometimes from the bladder; (2) stagnation and decomposition of the urine in the renal pelvis; (3) mechanical irritation, as from calculi and gravel; (4) exposure to cold; (5) certain blood-poisons, such as those of pyæmia, diphtheria, and typhus; (6) the action of certain other poisons.

Anatomical Characters.—Three types of pyelitis may be recognised, namely:—(1) the *acute*; (2) the *chronic*; and (3) the *calculous*.

(1) *Acute.*—The mucous membrane is congested, and its surface coated with mucus, sometimes with a bloody, sometimes with a diphtheritic layer. The membrane itself may be more or less extensively destroyed; and the characteristic tailed cells of the pelvis of the kidney may be thrown off in excessive quantity. Besides these cells, the cavity contains mucus or muco-purulent material in quantity.

(2) *Chronic.*—In this condition the mucous membrane is much thickened, often of a slate-grey colour, with ecchymoses, and sometimes with ulcerative abrasions of the surface. The other coats of the pelvis and ureter may also be distinctly thickened, and the lumen of the ureter may be more or less narrowed. The cavity contains purulent material, with *débris* of broken-down mucous membrane; and sometimes, the ureter being obstructed, great accumulation of pus takes place, so as to expand the pelvis and lead to partial atrophy of the kidney (*pyonephrosis*).

(3) *Calculous.*—In this form the mucous membrane may present either of the conditions above described, but one always finds mingled with the other materials calculi of greater or less size.

Symptoms.—The symptoms of *acute* pyelitis may be either well-defined, or masked. There may be uneasiness or acute pain in the loins and along the line of the ureter; sometimes distinct rigors, with other febrile symptoms, occur; and the urine is cloudy, depositing mucus or muco-purulent material, or sometimes blood. The most characteristic feature is the presence in the urine of the angular tailed cells which line the pelvis of the kidney. The condition may gradually subside, or may become chronic; or in rare cases, and where important complications exist, it may prove fatal.

In *chronic* pyelitis there is often an aching feeling, or well-defined pain in the region of the

ureters. There is constitutional disturbance, debility, fever, hectic; the urine is opaque, and deposits pus—generally grey, sometimes tinged with blood. This condition may go on for long periods, sometimes terminating in recovery, but often persisting and proving fatal by exhaustion, by extension to the kidney-substance or to the cellular tissue, or by concomitant complications.

The *calculous* form differs from the others in respect of its cause; and in being attended by more pain, by more tendency to hæmorrhage, and sometimes by the presence of crystals, gravel, or calculi in the deposit.

If the escape of the pus should be prevented in any of the three forms of pyelitis, owing to obstruction of the ureter, and pyonephrosis result, a fulness or fluctuating tumour may be detected in the renal region, and this in some instances subsides at intervals, with a copious discharge of pus in the urine.

Diagnosis.—From cystitis, pyelitis is distinguished by the absence of vesical pain, and of frequent calls to micturition; and by the presence of the lumbar uneasiness, and the more intimate admixture of the foreign materials with the secretion. From renal inflammation it is distinguished by the absence of tube-casts; the seat of the pain; and the presence of the characteristic cells of the renal pelvis. From strumous kidney it is sometimes almost impossible to differentiate simple pyelitis. Indeed the two conditions are not unfrequently associated together, but the presence of other evidences of strumous disease, the enlargement of one or both kidneys, and the presence of copious *débris*, in addition to the pus, often suffice to distinguish the one from the other.

Prognosis.—In the slighter and acute forms of pyelitis, the prognosis is generally favourable. In the chronic variety it must always be guarded, the amount of danger being determined in some measure by the cause, the constitutional conditions, and the complications.

Treatment.—The first essential is that the patient should have rest, and that the urinary secretion should be copious and bland. In order to secure this a diet largely composed of milk and simple diluents, or in some cases exclusively of milk, and the avoidance of stimulating foods and drinks, are to be insisted on. As to medicine, if the urine be excessively acid, alkalies should be administered; if it be alkaline, mineral acids should be given. Various remedies which appear to diminish irritation, such as the uva ursi, pareira brava, buchu, triticum repens, copaiva, and sandal-wood oil, ought to be employed. In the acuter cases the application of poultices to the loins, and the internal administration of henbane or opium, are to be recommended.

In the chronic forms of pyelitis a similar line of treatment should be perseveringly followed; and in cases which owe their origin to the presence of calculi, the remedies appropriate to the diathetic condition should be employed. Astringents may possibly be useful in checking too copious a discharge of pus.

23. **Kidney, Malformations of.** — The commonest malformation of the kidneys is *lobulation*, which is a relic of the fœtal condition. Next comes the undue development of one organ. Sometimes there are two pelves belonging to each kidney, or two ureters. A not very rare anomaly is the *horse-shoe kidney*, which consists simply in the union of the two kidneys, by a band of renal tissue, at either end, usually the lower. This abnormality is often attended by anomalies in the arrangement of the ureters and vessels. A very rare condition is that in which there is a *central union* between the two organs, owing to the development of supplementary renal structure opposite their pelves. None of these malformations lead to any important symptoms, except by pressure upon the duct or vessels, under superadded abnormal conditions of the organs themselves, or of neighbouring parts.

24. **Kidney, Malignant Disease of.**—Definition.—A chronic disease of the kidney, caused by the circumstances which induce cancer elsewhere; consisting in the formation of nodules of cancer, or the infiltration of the organ with the new formation; characterised by a renal tumour, cachexia, and frequently by alteration of the urine; and resulting in death.

Ætiology.—*Primary* renal cancer arises from causes not yet ascertained. It occurs at two epochs of life, namely, in early childhood and in adult age. Children under four years appear specially liable. The male sex is more frequently affected than the female; the right kidney more commonly than the left.

Secondary cancer of the kidney is most frequently associated with carcinoma of the liver, the stomach, the mamma, the testicle, or the uterus; sometimes of the supra-renal bodies, or the mesenteric glands.

Anatomical Characters.—All the varieties of cancer have been met with in the kidney, but the medullary is by far the most common. It is sometimes primary, sometimes secondary. The *primary* affects usually one kidney, most commonly the right; the organ is often much enlarged, weighing sometimes as much as sixteen or seventeen pounds, and this even in young children. In ten children Dr. Roberts found the average weight 8¾ lbs.; in ten adults he found it 9¾ lbs. Such large tumours occupy a great part of the abdomen, and push the colon forward. The cancer is in some cases scattered in separate nodules; in others it is infiltrated through the mass. It commences always in the cortical substance, and is developed from the fibrous stroma. In the scattered cases the remaining portions of the kidney are quite sound. The cancer may involve the sub-mucous tissue of the mucous membrane of the pelvis, the ureters, and the veins. The lymphatic vessels and glands also become secondarily affected. Sometimes it affects the peritoneum, colon, and it has even involved the skin.

When the renal affection is secondary, it constantly affects both organs, and rarely leads to such enlargement as is seen in the primary disease. It occurs in the form of numerous nodules, developed in the stroma or along the vessels. The remaining renal tissue is commonly healthy, but it may be inflamed or otherwise altered.

Symptoms.—The symptoms of primary cancer generally become quite distinct when the disease advances, but in the earlier stages they are very indistinct. The urine itself is, as a rule, natural in quantity, of acid reaction, normal specific gravity and colour; but from time to time blood appears, its amount varying from a mere trace to a very serious hæmorrhage. Sometimes the blood is in clots, and this bleeding may be the earliest symptom; and it occasionally happens that carcinomatous elements may be discovered in the urinary deposit, but it is very difficult to be sure of their presence.

Examination of the abdomen reveals the presence of a tumour, occupying and extending from the region of the kidney. The tumour is generally nodulated, of tolerably firm consistence, and dull on percussion. The colon lies in front of the mass, which is capable of being tilted forward by pressure on the renal region. When the left kidney is affected, the spleen is displaced upwards. As a rule, there is persistent constipation, and some pain, together with the general symptoms of the carcinomatous cachexia.

Diagnosis.—Carcinoma of the *left* kidney may be confounded with enlargement of the spleen; with perinephric abscess; perhaps sometimes with disease of the mesenteric glands; or with obstruction of the colon, and retention of fæces.

From splenic tumour it is distinguished by its lower position, and the absence of the splenic notch; the normal condition of the blood; and the presence of blood in the urine; also by the nodulated character of the tumour itself, and by the position of the colon.

From perinephric abscess it is distinguished by the absence of fever, and of fluctuation; as well as by the less rapid advance of the disease.

From tumours of the mesenteric glands renal cancer is distinguished by its situation, being more towards the side and the lumbar region. The mass also is less nodular than in mesenteric growths, which are composed of groups of glands.

From carcinoma of the intestine, with accumulation of fæces above it, it is distinguished by the position of the mass, and by its characters on palpation; as well as by absence of the signs proper to the intestinal disease.

Carcinoma of the *right* kidney may be confounded with tumour of the liver, especially in children; but the presence of a space of clear percussion, more or less extended between the liver and the tumour, should remove all doubt. If the diseased kidney touches the liver, reliance must be placed on the symptoms proper to renal or to hepatic disease.

Cancer of the kidney is to be distinguished from tumour of the ovary, by its more fixed condition, and the history of its growth.

Prognosis.—The prognosis is in all cases unfavourable; the duration varies with the form of cancer. Dr. Walshe thinks eight months the average, but that probably is too short.

Treatment.—Treatment is, of course, merely palliative—morphia, belladonna, henbane, applied externally or injected subcutaneously to relieve pain; ergotine and other preparations of ergot, acetate of lead, and gallic acid to check hæmorrhage; and iron as an astringent and blood-tonic. The bowels require careful attention; and sometimes there may be so much ascites as to warrant tapping.

25. Kidney, Malpositions of.—The kidney may be congenitally displaced, but the important anomaly coming under this head is the *movable kidney*, which demands special consideration.

Definition.—The movable kidney is a condition especially affecting women; consisting in the undue mobility of one, or rarely of both kidneys; characterised in some cases by no symptoms, in others by uneasiness or pain and general nervous disturbance, and by the presence of a tender reniform tumour, with clear note on percussion in the renal region of the affected side; resulting, as a rule, in frequent recurrence of the symptoms without danger to life.

Ætiology.—Movable kidney is more common in the female sex, and especially in those who have passed through many pregnancies, but it is not exclusively associated with women, for it occurs (although rarely) in males, and also in children. The right kidney is much more frequently affected—65 out of 91 cases (Ebstein). Its occurrence is probably mainly due to laxity of the abdominal parietes, and unusual length, or irregular distribution, of the renal vessels.

Anatomical Characters.—The kidney is not necessarily changed in its structure, but its position may be altered in any direction.

Symptoms.—In many cases no symptoms occur in movable kidney. But in some, whenever the displacement occurs, much uneasiness or even considerable pain is experienced. The writer has known a man unable to work in consequence of the pain induced by the displacement, and losing a day's work regularly once a week or once a fortnight. The sensations are generally rather of the nature of vague uneasiness than of actual pain, except when the organ is touched, and then there is pain of a peculiar and sickening kind. On percussion over the renal region posteriorly a clear note may be elicited on the affected side, and sometimes a flattening may be made out at the part. The urine sometimes becomes altered during the attacks, depositing mucus and in one case in the writer's practice a little blood. Careful palpation reveals a tumour, of characteristic renal form; and now and then pulsation of the renal artery may be felt. The morbid condition may recur at intervals during many years, and is in some cases apparent for a time, and then absent for a very long period. It is liable to be brought on by effort, but often appears without discoverable cause. Occasionally it is found that the displaced kidney owes its position to the existence of carcinoma or other disease of the organ.

Diagnosis.—The malady may be confounded with tumour of a malignant nature, originating either in the abdomen or the pelvis. The diagnostic points are, the fever; the peculiar tenderness; the mobility; the occasional disappearance; the unchanging character of the tumour; and the occurrence of a clear percussion-note and flattening in the renal region of the affected side.

Prognosis.—The prognosis is favourable.

Treatment.—The treatment should be by means of bandages or trusses, to support the abdominal walls, and keep up a pressure upon the kidney, so as to retain it in its normal situation. In the case of the working man above referred to, complete immunity from the displacement was obtained by the use of a bandage with a pad so arranged as to keep up a pressure upon the organ.

26. **Kidney, Morbid Growths of.**—The only really important morbid growths of the kidney are cancer and tubercle. Syphilitic new formations occasionally occur, but give rise to no characteristic symptoms. Growths of fibrous, fatty, bony, muscular, and glandular tissue have all been met with in a few cases. Hydatid disease may also be mentioned.

27. **Kidney, Parasites of.**—The parasites which have been described as existing in the human kidneys are Hydatids, Strongylus gigas, Pentastoma denticulatum, and Bilharzia hæmatobia.

The Strongylus gigas is a large nematode worm, and is extremely rare in man. The Pentastoma denticulatum is the larval form of P. tænioides, one of the Arachnida. It was found in one case by Wagner. Bilharzia hæmatobia is a trematode worm, about three or four lines in length; and inhabits the branches of the portal system, and the minute veins of the pelvis of the kidney, ureter, and bladder. The parasite also affects these structures themselves. So common is it in Egypt, that out of 363 *post-mortem* examinations, Griesinger found it 117 times.

Symptoms.—Hydatid-disease gives rise to a tumour. The symptoms produced by the presence of Bilharzia in the kidney are hæmaturia, with irritation of the urinary tract. This parasite is the cause of the endemic hæmaturia of certain regions. The other parasites do not originate any definite symptoms.

Treatment.—In the treatment of patients affected with Bilharzia hæmatobia, the internal use of oil of turpentine, and of the extract of the male shield fern, is recommended. It is stated that when the bladder is affected, injections of iodide of potassium, twenty or thirty grains dissolved in tepid water, repeated every second or third day, have been found useful. *See* Kidney, Hydatid Disease of; Strongylus gigas, &c.

28. **Kidney, Suppurative Inflammation of.**—Definition.—An acute or sub-acute disease of the kidneys; caused by injuries, extension of disease from the bladder, and perhaps exposure; consisting in inflammation and suppuration in the kidney; characterised by constitutional disturbance, with local pain or tenderness, and various alterations of secretion; and usually resulting in death.

Ætiology.—The commonest causes of this disease are renal calculus, leading to inflammation of the pelvis of the kidney; or inflammation of this part, propagated upwards from the bladder or urethra. Next in frequency is pyæmia, which induces metastatic abscesses. Comparatively rarely the inflammation is a result of embolism of the renal arteries; of injuries; and perhaps of exposure to cold.

Anatomical Characters.—The affected organs are generally above the natural size. The capsule may strip off readily, but often, as it is being stripped, leads to tearing of the substance, and liberation of pus. The surface is frequently discoloured in patches. The abscesses may be described as passing through several stages. There is first the stage of congestion, with exudation into the stroma of the organ; secondly, the stage of grey consolidation; and thirdly that of suppuration. Occasionally sloughing occurs. Sometimes perinephric abscess results, from perforation of the capsule. Drying up of the pus, with shrivelling of the affected area, is sometimes met with.

Microscopic examination reveals in some cases at an early stage the presence of colonies of bacteria in certain districts within the tubules, causing irritation first in them, then in the stroma, and thus inducing suppuration.

Symptoms.—The most important clinical features of suppurative nephritis are the constitutional disturbance, accompanied by pain in the region of the kidneys, and tenderness on pressure, with scantiness of secretion; the urine being albuminous or bloody, or sometimes purulent, and depositing tube-casts.

Diagnosis.—From pyelitis, suppurative inflammation of the kidneys is distinguished by the presence of tube-casts, and the absence of the characteristic angular cells of the calices of the pelvis. From perinephritis, it is diagnosed by the absence of distinct tumour, and by the history of the case.

Prognosis.—The prognosis is generally grave.

Treatment.—The strength should be supported by suitable food, by tonics, and stimulants when necessary; and in some cases benefit may be derived from poulticing, fomentation, or from the application of leeches. Under suitable conditions it might be desirable to open a renal abscess, and evacuate the pus.

29. **Kidney, Syphilitic Disease of.**—Syphilis may produce in the kidney, as in other organs, congestion, inflammation—either simple or gummatous, with the cicatrices and nodules resulting therefrom, and waxy or amyloid degeneration.

Ætiology.—Nothing is known as to the conditions which determine the action of the syphilitic poison upon the kidney.

Anatomical Characters.—There is scarcely ever an opportunity of studying the appearances of the kidney in cases of congestion—probably over-filling of the vessels, with slight inflammatory conditions of the tubules, is all that would be found. The simple interstitial inflammation is characterised by thickening and swelling of the fibrous stroma, in patches here and there. Gummatous inflammation is rare, but when it does occur, it forms masses of the ordinary gummy character. Either of these conditions may lead to the formation of syphilitic cicatrices, which may appear on the surface of the organ, or be imbedded in the cortical substance. Their formation is attended by the destruction of tubules in the affected parts.

Symptoms.—Albuminuria, slight in amount and of temporary duration, occurring along with other syphilitic congestive affections, has appeared to the writer to indicate renal congestion. Various slight cases of inflammatory Bright's disease, have appeared to be due to the syphilitic poison. The symptoms of the interstitial and gummy inflammations are not ascertained, although probably albuminuria attends them also. The symptoms of waxy degeneration are described under Bright's Disease.

Diagnosis.—The diagnosis of syphilitic disease of the kidney depends upon the co-existence of renal symptoms with evidences of syphilis, while other diseases of the kidney are excluded.

Prognosis.—This is favourable so far as danger is concerned, except in the case of severe waxy degeneration.

Treatment.—Iodide of potassium has been found to be useful in this as in other syphilitic affections, at least in the congestive and inflammatory conditions. Should it fail to give relief, the bichloride of mercury may be given in moderate doses, and continued cautiously even when albuminuria is present.

30. Kidney, Tuberculosis of.—Definition. A chronic disease of the kidneys and ureters; caused by tubercular infection, or by strumous inflammation of the structures involved; consisting in the formation of nodules of tubercle, or in strumous inflammation of the substance of the gland, and of the mucous membrane; characterised by some constitutional disturbance, sometimes by renal tumour, and by various alterations of the urine, particularly deposit of caseous purulent *débris*; and resulting usually in death.

Ætiology.—The direct causes of tubercular disease of the kidney are unknown. It is more common in children and young people than in those more advanced in life, but it—especially the scrofulous form—may occur later on. Men are decidedly more frequently affected than women. The kidneys are rarely equally involved; the right is commonly worse than the left. One organ may be quite free from disease.

Anatomical Characters.—Under this term are included both tubercle proper, and strumous inflammation. Tubercle proper occurs in the form of minute miliary nodules scattered throughout the substance of the organ, as a local manifestation of a general true tuberculosis. Strumous inflammation leads to the formation of larger masses, involving either the mucous membrane of the pelvis of the kidney, or the cortical substance. When the former is its seat, it leads to a thickening of the mucous membrane, commencing in patches which gradually extend, and ultimately undergo ulceration. When the cortical substance is affected, the organ becomes enlarged; presents a markedly lobulated surface; and on section conical masses of altered tissue are found to correspond to the prominences of the lobules. Some of them are solid and cheesy; others are softened in the centre; while others are completely softened, so that on section a quantity of puriform *débris* flows out, leaving a cavity with white walls, rendered shaggy by the shreds of fibrous tissue which project from them. Sometimes scarcely any renal structure is left. Occasionally what remains shows the characters of waxy degeneration. The disease commences in the stroma of the organ; the tubules are compressed, but are rarely the seat of inflammatory changes. When the mucous membrane of the pelvis of the kidney and the ureter is affected, the membrane is thickened at certain parts, and afterwards becomes ulcerated; and the lumen is diminished, or completely choked up by granular *débris*. Frequently both the mucous membrane and the substance of the kidney are affected. It occasionally happens, when one kidney is exclusively affected, that shrinking of the gland takes place; and a putty-like material, rich in cholesterine, or perhaps even calcareous nodules are found, occupying the smooth-walled cavities produced by the disease. Tuberculosis of the ureters, prostate, vesiculæ seminales, bladder, and testicle not unfrequently co-exists.

Symptoms.—When tubercle occurs in small nodules it produces no symptoms, and even in the inflammatory form the constitutional symptoms are, in the earlier stages, not very well-marked; but as the disease advances, fever, passing gradually into the hectic type, is developed. The local symptoms may be negative, but there is frequently pain in the affected organ, with tenderness on pressure; and in some cases a tumour may be felt in front, or percussion may reveal an increased area of dulness in one or both renal regions. The secretion may be normal, or even sometimes excessive in quantity, when the disease is not far advanced. It may be acid or alkaline, of fair specific gravity, albuminous, and sometimes bloody. It often contains a puriform material, with *débris* of renal tissue. Sometimes there are masses of cheesy material, which are eminently characteristic, occurring in no other form of disease of the urinary tract. Occasionally the urine becomes suppressed, and symptoms of uræmia precede the fatal termination. Sometimes a tumour may be felt; and on percussion behind, it may be found that the renal dulness is more extensive on one side than the other.

Diagnosis.—The evidences on which we rely in the diagnosis of tubercular disease of the kidney are the presence of pyelitis, combined with those of tubercular disease in other parts, and above all the deposit in the urine of the characteristic fragments of cheesy tissue above described.

Prognosis.—The prognosis is very unfavourable, on account both of the local and of the constitutional conditions.

Treatment.—The treatment is merely palliative, to relieve pain or uneasiness; and to seek to improve the general health, by administering remedies which are useful in strumous affections.

31. Kidney, Tumour of.—Any enlargement connected with the kidney, which reveals itself on clinical examination, is regarded as a renal tumour. This may be due to mere hypertrophy of the organ; any form of cystic disease; accumulation of any fluid in the renal pelvis, or in the kidney itself; or a solid new-growth, especially malignant disease. For a description of the signs of these several conditions, the reader is referred to their respective headings in this article.

T. Grainger Stewart.

KIESTINE (*κύω*, I am pregnant; and *ἐσθής*, a pellicle).—Synon.: Fr. *Kyestéine*; Ger. *Kyestein.*—This substance was formerly believed to be peculiar to, and always present in, the urine of women in pregnancy, and it was held, therefore, to be significant of that condition.

Recent investigations show that it may be absent all through pregnancy, or present only during certain months, usually from the second to the seventh; that it may be present in the urine of anæmic persons, male as well as female; and therefore that it has not the diagnostic value which was formerly attached to it.

Kiestine is a nitrogenised body allied to caseine; and, according to Dr. Braxton Hicks, the amount deposited from urine containing it can be augmented by the addition of rennet. Chemically and microscopically it is a variable body. Fat, mucus, crystals of the phosphates, infusoria, and granular matter have been found in it. If urine capable of yielding kiestine be set aside in a tall glass, a cloud, apparently of mucus, becomes visible in the middle of it on the second or third day. This soon rises to the top, and an iridescent pellicle is seen forming on the surface. When this has fully formed, it begins to fall through the fluid in the form of flocculi, until the whole is deposited at the bottom in a whitish layer. Another pellicle containing triple phosphates succeeds this, and putrefactive changes proceed.

No reliance can be placed upon the presence of kiestine as a proof of pregnancy.

Alfred Wiltshire.

KINÆSTHESIS (*κινέω*, I move, and *αἴσθησις*, sensation).—The sense of movement.

In view of the conclusion that the term 'muscular sense' ought to be abolished, as being in several respects misleading, when applied, as it often is (*see* Muscular Sense) by different writers with totally different significations, partly referring to some and partly to all the impressions which we derive from our moving members, or from movements generally, the writer (*The Brain as an Organ of Mind*, p. 543, and *Appendix*) has proposed to employ the above term as the designation of an important but confessedly complex sense-endowment. He regards it as a form of sense, 'whereby we are made acquainted with the position and movements of our limbs, whereby we judge of "weight" and "resistance," and by means of which the brain also derives much unconscious guidance in the performance of movements generally, but especially in those of the automatic type.' In regard to the various components of this endowment he adds:—'Impressions of various kinds combine for the perfection of this "sense of movement," and in part its cerebral seat or area coincides with that of the sense of touch. There are included under it, as its several components, cutaneous impressions, impressions from muscles and other deep textures of the limbs (such as fasciæ, tendons, and articular surfaces), all of which yield conscious impressions of different degrees of definiteness; and in addition there seems to be a highly important set of "unfelt" impressions, which guide the motor activity of the brain by automatically bringing it into relation with the different degrees of contraction of all muscles that may be in a state of action.'

Kinæsthetic centres or mechanisms would, therefore, in accordance with this view, exist in the brain, just as visual or auditory centres also exist. The cerebral seat or locus pertaining to the movement-sense would perhaps be more diffused, though it would otherwise hold much the same relative rank as the several cortical mechanisms for the more special senses.

Disorders of Kinæsthesis.—In certain cerebral and spinal diseases the sense of movement is known to be blunted, or actually abolished, in some parts of the body; and that in regard either to the whole, or only to some of its component impressions. Concerning perversions or exaltations of this endowment, however, we as yet know almost nothing.

Total abolition of the endowment in the limbs, on one side of the body, exists in certain rare cases of hemianæsthesia, where there is also complete loss of tactile sensibility. On the other hand, it is partially impaired in both lower extremities, not unfrequently, in cases of locomotor ataxy; whilst in another class of cases, without coexisting anæsthesia, there would seem to be an absence of the ordinary unconscious impressions emanating from muscles in action, and as a consequence motor defects of an ataxic order, so long as the movements attempted are not guided by sight impressions. Incoördinate movements pertaining to this latter category are decidedly rare, and stand in need of further investigation.

H. Charlton Bastian.

KIN-COUGH (Dutch, *Kienkhoeff*). Also *Chin-cough*. Both of these words are synonyms for whooping cough. *See* Whooping Cough.

KING'S EVIL.—A popular name for scrofula, originating in an idea formerly held that the disease could be cured by the king's touch. *See* Scrofula.

KISSINGEN, in Bavaria.—Common salt waters. *See* Mineral Waters.

KLEPTOMANIA.—Insanity characterised by an irresistible impulse to steal. *See* Insanity, Legal; and Criminal Irresponsibility.

KREUZNACH, in Germany.—Common salt waters containing Iodine. *See* Mineral Waters.

KYPHOSIS (*κυφὸς*, bent).—A synonym for angular deformity of the spine. *See* Spine, Diseases of.

L

LABIO-GLOSSO-LARYNGEAL PARALYSIS (*labium*, a lip; *γλῶσσα*, the tongue; and *λάρυγξ*, the throat).—There are two forms of this disease, which have to be considered separately, namely, (*A*) the chronic form; and (*B*) the acute form. It will be convenient to discuss the chronic form first.

(*A*) Chronic Labio-Glosso-Laryngeal Paralysis.—Synon.: Fr. *Paralysie glosso-labio-laryngée* (Trousseau); Ger. *Progressive Bulbarparalysie* (Wachsmuth).

Definition.—A progressive symmetrical paralysis of the lips and adjacent facial muscles, of the tongue, pharynx, and sometimes also of the larynx; with or without conspicuous wasting; and often associated with muscular atrophy elsewhere.

History.—First described by Dumesnil, in 1857, and by Duchenne in 1860, the disease was made generally known by Trousseau's lecture, published in 1863. By the latter writer it was termed 'labio-glosso-laryngeal paralysis.' The awkwardness of the German version of the term led Wachsmuth, in 1864, to designate it 'progressive bulbar paralysis,' and German literature has given wide currency to the term, which is, however, open to the objection that the term 'bulbar paralysis' has been applied to all paralyses of the nerves arising from the medulla oblongata.

Ætiology.—Of the causes of the affection little is known. It is a disease of later life, being almost unknown under forty. Males are affected more frequently than females. The disease, as such, does not appear to be inherited, but in many cases there is a family history of other affections of the central nervous system. Of immediate causes, exposure to cold, mental anxiety, and imperfect nourishment have been supposed to exert an influence in some cases.

Anatomical Characters.—The tissue of the affected muscles is pale; fatty tissue may be in excess; and the muscular fibres often, but not always, present granular degeneration. They are frequently narrowed; whilst the tissue between them may be increased in quantity, and may contain pigmentary products of degeneration. The motor nerve-fibres to the muscles are grey, translucent, and under the microscope, degenerated. Their nuclei of origin in the medulla oblongata are also diseased. The motor cells are shrunken and atrophied; their processes are lost; and the intermediate tissue is degenerated. The hypo-glossal nucleus is examined most readily, and the change in it is striking, as well as in the nucleus of the spinal accessory (larynx). The anatomical change which underlies the affection of the lips has not yet been detected. There is some uncertainty of the precise origin of this part of the facial nerve. Guided by Duchenne's clinical observation and conclusion that these fibres, from their affection with those of the hypoglossal, must arise near the nucleus of the latter, Lockhart Clarke believed he had traced them to a group of cells close to the hypoglossal nucleus. Later researches, especially those of Pierret and Meynert, have rendered this conclusion doubtful. It is certain, however, that a large number of the fibres of the facial descend to the level of the hypoglossal nucleus. They diverge from the middle line, close to which the hypoglossal nucleus is situated, and some at least pass towards the lower part of the column of cells, which, above, gives origin to the motor fibres of the fifth nerve. But the physiological association of the movement of the tongue and lips is most close. We cannot narrow the tongue without contracting the orbicularis. Hence it is certain that the lower facial nucleus and the hypoglossal nucleus, whether contiguous or not, are closely connected; and that this connected part of the facial suffers, in this disease, in the same manner as the hypoglossal. The same fact is almost certain of the motor nucleus of the glosso-pharyngeal. When there is muscular atrophy in the limbs, a corresponding degeneration may be found in the anterior cornua of the spinal cord, often conjoined with sclerosis in the lateral columns, and in the anterior pyramids in the medulla. There is every reason to believe that, in the chronic form, the atrophic changes in the nerve-elements are the primary alteration.

Symptoms.—The symptoms have the distribution indicated by the name given to the disease by Trousseau, the affected parts being the lips, tongue, throat, and larynx. They are, so to speak, arranged about the tongue as a centre. It is in this organ that the earliest symptoms commonly present themselves, as a trifling indistinctness of speech, due to an imperfect articulation of those sounds in which the tongue is most concerned—dental and palatine sounds. The tongue can be still protruded, although perhaps not quite so far as normal. The lips then become weak, and sounds in which the lips are concerned are imperfectly articulated. The vowels *o* and *oo*, in the pronunciation of which the orbicularis contracts, cannot be well sounded. The lips are not brought together so perfectly, or separated so promptly, as in health, and the labial explosives, *b* and *p*, become *f*. Whistling is impossible. The lower part of the face loses its expression, the lips are habitually separated, and the saliva cannot be perfectly retained. The difficulty in articulation is soon increased by the weakness of the palate, which ceases to shut off the nasal cavity, so that a nasal resonance accompanies sounds from which it should be absent. The paralysis of the tongue increases until the organ can no longer be protruded. Deglutition becomes impaired, partly (according to Duchenne, wholly) from the weakness of the tongue, but probably in part also from that of the constrictors of the pharynx. The soft palate ultimately hangs motionless, and, during the act of swallowing, does not close the posterior nares, so that liquids regurgitate into the nose. Food is apt to lodge in the upper part of the pharynx, and crumbs or liquid to get into the larynx. The laryngeal muscles subsequently become weak, and the glottis cannot be closed. Coughing is, therefore, imperfect; air is driven through the larynx, but there is no sudden opening of a previously closed glottis, and hence no explosive cough. In proportion as the glottis is paralysed, phonation is interfered with, but is rarely altogether lost. As the disease progresses the speech becomes almost unintelligible, being reduced to unarticulated vocal sounds. It is to be noted, however, that the habitual articulation is rarely the best possible. Words can be distinctly articulated by a deliberate effort which are scarcely at all articulated in ordinary speech. The saliva can neither be swallowed nor retained within the mouth, and is constantly dribbling over the lower lip, below which the patient has to hold a handkerchief continually. It has been thought that the quantity of saliva is increased, but the evidence of this is insufficient. The condition of the tongue varies much in different cases. In some it is, throughout, large, broad, flabby, and soft to the touch. In others it is conspicuously wasted, and covered with wrinkles and furrows from the shrinking. In some cases the lips retain their normal size; in others they are distinctly thinner than natural. This striking contrast between different cases led Duchenne to distinguish two varieties, the *atrophic* and the *paralytic*. Most later writers have, however, rejected this distinction, on the ground that, *post mortem*, muscular wasting has always been found, whether the tongue was large or shrunken. In the former condition fatty tissue prevents the wasting from being conspicuous during life. There is certainly, however, a marked contrast between the appearance of the tongue in the two cases. In the affected muscles the electrical irritability is usually little changed; they still contract to the faradaic current, even when the atrophy is conspicuous. Erb found, however, in one case, indication of the reaction of degeneration, in undue readiness of contraction to the anodal (positive) closure. Other muscles of the head are rarely affected. Those in the upper part of the face always escape. But in many cases muscular atrophy in the limbs, in greater or less degree, is associated, with or without 'contracture.' So, too, in cases of ordinary muscular atrophy, commencing in the limbs, the lips, tongue, and throat are often affected towards the end of the case, in the same manner as in the disease now under consideration. Death, in labio-glossal paralysis, is usually the result of asthenia, due, in part, to the difficulty in deglutition. Sometimes the patient dies in a paroxysm of coughing, occasioned by an ineffectual attempt to swallow liquids or saliva.

Diagnosis.—Before labio-glossal paralysis was well known, the difficulty in swallowing was ascribed to a chronic inflammation of the fauces, but this mistake is now scarcely possible. The symptoms have to be distinguished from those due to other diseases of the medulla, and to disease elsewhere. Many acute lesions, in the region affected in this disease, may cause similar symptoms, but these are distinguished by their sudden onset. Compression of the medulla may also give rise to symptoms of similar distribution, but these are commonly unilateral, and often accompanied by a preponderant affection of the muscular part of the spinal accessory, and by great weakness, without wasting, in the limbs. Occasionally movements of the tongue are impaired by disease of the cerebral hemispheres. The movements of the tongue are especially represented in the lower part of each ascending frontal convolution. When this is diseased on one side, the loss is soon compensated for by the centre in the opposite hemisphere, but a symmetrical bilateral lesion in this situation may cause complete paralysis of the tongue, as in a case recorded by Dr. Barlow. Such paralysis also is acute in onset.

Prognosis.—The prognosis is most grave. The disease consists in a slow degeneration of the nerve-elements, and although, in some cases, a temporary arrest may be obtained, it is doubtful whether, in any instance of this form, considerable improvement has occurred.

Treatment.—The degenerative tendency of chronic labio-glosso-laryngeal paralysis is usually beyond the reach of remedies. Therapeutical efforts must be directed to the endeavour to retard it by nervine tonics, quinine, strychnine, arsenic, nitrate of silver, and the like. The writer is unable to agree with Erb's condemnation of strychnia as harmful in these cases, although he has seen little benefit from its use. Electricity may be tried, although too often it is unsuccessful. Faradisation should be applied to the affected muscles, if they still react to it. Erb strongly recommends the application of the voltaic current through the throat, the positive electrode being placed on the back of the neck, the negative stroked down the side of the pharynx externally, and such a strength being employed as shall produce reflex movements of deglutition. Change of air is desirable in the early stage, and rest is imperative. Food must be carefully regulated; easily digestible varieties being reduced to a semi-solid condition. In the later stages, should swallowing be impossible, nourishment must be administered by an œsophageal tube, or, what is better, by a catheter introduced through the nose. Belladonna or atropine may, to some extent, check the troublesome flow of saliva.

(*B*) Acute Labio-Glosso-Laryngeal Paralysis. — Synon.: Acute bulbar paralysis; *Myelitis bulbi*.

Definition.—Paralysis of similar distribution to that of the chronic form, with or without conspicuous wasting, of sudden onset, and due to an acute process.

Ætiology.—The causes of this affection are for the most part those which lead to acute lesions elsewhere in the brain, especially degeneration of vessels, syphilitic disease, and injuries. It is a disease chiefly of late life.

Anatomical Characters.—Little is known of the exact condition in cases of acute onset which have recovered with persistent labio-glossal paralysis. In cases which have died rapidly, foci of softening in the medulla have been found; and there is reason to believe that such softening, from vascular occlusion, is the most common cause of the condition. Probably a small hæmorrhage may also give rise to it. The symmetry of the symptoms in the acute form, and their limitation to the parts which are affected in the chronic disease, show the close relation of the central structures, so that they are all affected by the one lesion. The wasting in some of the cases of this variety is very much slower than that which follows an acute lesion of motor grey matter elsewhere. It is possible that the ascending fibres from the nuclei concerned may pass up close to the middle line, in a situation in which all may be damaged by a single lesion.

Symptoms.—The onset is sudden, often with headache and giddiness, rarely with loss of consciousness. The patient suddenly finds a difficulty in swallowing and in articulation, with inability to protrude the tongue. Respiratory disturbances—cough, dyspnœa, and hiccough—may be present. There may be convulsions and weakness in the limbs, sometimes with tingling, but very rarely with loss of sensibility. Many cases which present these symptoms die rapidly in the course of a few hours or days. In those which recover, a paralysis of the tongue, lips, throat, and larynx may remain, identical in all respects with that which characterises the chronic form, and there may or may not be conspicuous wasting. The course is, however, not progressive. The patient may remain in the same condition for a considerable time, and even exhibit marked improvement.

Diagnosis.—The diagnosis of the acute form of labio-glosso-laryngeal paralysis calls for little remark. It must be remembered that the symptoms may deviate from the type more than in the chronic variety, as the lesion sometimes produces irregular effects. It is chiefly liable to be confounded with the impairment of movements of the palate and tongue sometimes left after double hemiplegia, from which the history suffices to distinguish it, the two attacks of hemiplegia usually occurring at different times. The rare symmetrical affection of the surface-centres for the tongue, mentioned above, is also not simultaneous on the two sides, and it is associated with at least transient hemiplegic weakness.

Prognosis.—If the patient recover from the immediate effects of the lesion, the prognosis of the paralysis of the lips, tongue, and other parts is better than in the chronic form, inasmuch as recovery of slightly damaged structures may lead to a considerable degree of restoration of power. The prognosis is also better if there is any reason to ascribe the mischief to syphilitic disease. Nevertheless, in some acute cases the paralysis remains absolute, although even in these there is not the tendency to increase which is seen in the chronic variety.

Treatment.—Any causal indication must be carefully sought for in acute labio-glosso-laryngeal paralysis, and treated, especially evidence of syphilis. In other conditions the treatment is that for the lesion which is supposed to exist. Electrical treatment of the muscles is of great importance, in order to prevent, as far as possible, secondary degenerations, which are apt to occur before the partially damaged structures have recovered. The remarks regarding feeding in the chronic form are equally applicable to the acute variety.

W. R. Gowers.

LACHRYMAL APPARATUS, Diseases of (Δάκρυμα, a tear).

The lachrymal apparatus consists of the gland, with its excretory ducts; and of the puncta, the canaliculi, the lachrymal sac, and the nasal duct, through which superfluous tears are conveyed into the nose. The diseases of this apparatus are almost limited, with the exception of growths affecting the gland itself (*see* Orbit, Diseases of), to the excessive secretion of tears, and to impediments to their escape into the nose. To excessive secretion, or to impeded outflow, the common term *epiphora* has been applied; but the great majority of cases of epiphora are due to the latter of the two causes.

Epiphora.—*Excessive secretion of tears* is described by authors as an affection for which it is not always possible to discover an adequate cause, and it may perhaps be sometimes due to the prolonged operation of emotional influences. In most instances, however, it is associated with some kind or degree of conjunctival irritation, and is to be regarded only as a reflex phenomenon hence arising. It is well known that any temporary or accidental irritation, such as may arise from the intrusion of a foreign body into the conjunctival sac, is apt to be followed by a copious secretion of tears, which assist in dislodging the offender; and irritations of a more chronic kind, produced by congestion or irregularity of the lining membrane of the lids, may have a similar effect.

Impediments to the escape of the tears, causing them to collect in the conjunctival sac, or even to flow over the cheek, may depend upon displacement of the puncta, so that these apertures are no longer applied to the conjunctival surface, from which they normally remove superabundant moisture by capillary attraction. Such displacements affect chiefly the punctum of the lower lid; and may be consequent either upon conjunctival swelling, by which the lid is pushed away from the eye, or upon paralysis or weakness of the orbicularis muscle, which allows the lid to fall by the action of gravity. In some cases epiphora will depend upon obliteration or occlusion of the puncta. The former condition is incurable; the latter may be produced by plugs of inspissated mucus, which may be removed by the careful employment of a probe.

But the most ordinary cause of obstruction is stricture of the nasal duct; in which condition the tears are arrested a little below the sac, and the sac consequently becomes over-distended. In this condition, the sac can be seen and felt as a small lump, situated just beneath the *tendo oculi*. When pressure is made upon this lump, a fluid, consisting of tears mixed with more or less mucus or muco-pus, will regurgitate into the eye, and the lump itself will disappear. The danger in such cases is that the continued distension of the sac will in time excite inflammation of its lining membrane, leading to the formation of pus, and this to an opening upon the cheek, producing what is called a *lachrymal fistula*. Such an opening never heals until the duct is again pervious, and it is liable to undergo periodic attacks of unsightly inflammation.

Treatment.—In all cases of lachrymal hypersecretion, the first thing to be done is to search under the lids for any concealed foreign body which may be lurking there. If none be detected, examination must be made for conditions likely to be irritating; and they are to be treated, if they exist, by mild astringent or other suitable local applications. There is probably no medicine which can be said to exert any positive effect in diminishing the amount of the lachrymal secretion.

If the displacement of the lid can be cured by treatment addressed to its causes, the tears will usually return to their accustomed channel. If the displacement be incurable, as happens in some cases of paralysis of the *portio dura*, or of chronic ectropion, the patient may often be relieved by slitting open the canaliculus as far as the caruncle, so as to carry back the aperture to the secretion which it is designed to remove.

The treatment of stricture of the nasal duct can often be only palliative. The patient should acquire the habit of emptying the distended sac by finger-pressure many times a day, and of wiping away the fluid; while, to diminish the irritation of the mucous membrane, a drop of any mild astringent lotion may be applied to the inner corner of the conjunctiva two or three times a day, immediately after such pressure has been made. Perhaps the lotion most generally suitable for this purpose is a solution of acetate of lead in distilled water, of a strength not exceeding three grains to the ounce.

When a radical cure is desired, the canaliculus must be slit up, and the patency of the duct restored by the passage of probes through the stricture. If fistula has already formed, or even if the sac is the seat of an abscess, no other plan is available; but for the necessary details the reader is referred to works on ophthalmic surgery.

R. BRUDENELL CARTER.

LACTATION, Disorders of.—The disorders of lactation are numerous. Sometimes the quantity of the lacteal secretion is excessively small and quite inadequate for the support of the child. At other times it is so abundant that the milk will flow from one nipple as the infant is sucking the other; and when the child is removed from the breast, the secretion continues from both sides. The term *agalactia* is applied to the former, and *galactorrhœa* to the latter condition.

1. **Agalactia** signifies either a total suppression of the mammary secretion, or a very scanty supply. It results generally from anæmia.

The *treatment* should be directed towards improving the health of the patient as much as possible, by a generous diet, and tonics, particularly those containing iron. Certain drugs have been employed as galactagogues, and, it has been said, with benefit. The leaves of the castor-oil plant, boiled, have been used as a local application—the liquid for fomentation, and the leaves as a poultice; and a strong decoction of the same plant has been given as a drink. It is doubtful, however, whether such remedies are efficacious. *See* GALACTAGOGUES.

2. **Galactorrhœa** occurs in two forms. In one the composition of the milk is normal, but the quantity excessive; in the other form the increase in the bulk of the secretion is due to a preponderance of the watery part of the fluid.

Remedies employed to reduce the amount of the mammary secretion are termed *galactophyga*, and the chief of these are belladonna and iodide of potassium. Belladonna is employed as an outward application, as well as administered internally. The extract rubbed up with glycerine may be spread on lint, and thus applied to the breasts, or the emplastrum belladonnæ may be used. The child should not be put to the breast too frequently. If the excessive secretion continue for any length of time, great emaciation may result; and to this condition the term *mammary diabetes* has been applied. Under such circumstances lactation should be entirely stopped as soon as possible. Strapping the breasts tightly immediately after they have been emptied is of use. Every care must be taken to avoid the formation of a mammary abscess; and if the breasts get hard and knotty a breast-pump should be employed to free the tubes.

3. **Depressed nipples** are generally produced by the pressure of stays. If this condition be observed during pregnancy, periodic attempts should be made to draw the nipples out by means of a glass nipple-shield, to which an india-rubber tube and teat is attached.

4. **Fissures and excoriations of the nipples** often lead to abscess, and it is said that it may sometimes lead to malignant disease. To avoid the occurrence of these, astringents should be applied to the nipples during pregnancy, in order to harden them. Eau-de-cologne and water, brandy and water, or a weak solution of tannin may be employed for this purpose.

Sometimes an abrasion on the surface forms an ulcer or a crack at some part of the nipple, most frequently at its base, which gives rise to great pain during suckling. The remedies for these cracks are astringent applications, such as tannin, flexible collodion, or a weak solution of nitrate of silver. Care should be taken to sponge these away before the infant is again put to the breast; and a nipple-shield with an india-rubber teat will be found of great service.

For abscess and other morbid conditions of the mammary gland supervening during lactation *see* BREAST, Diseases of; MILK FEVER; and NIPPLE, Diseases of.

CLEMENT GODSON.

LACTEAL VESSELS and GLANDS, Diseases of. *See* MESENTERIC GLANDS, Diseases of.

LAGOPHTHALMOS (*λαγὸς*, a hare; *ὀφθαλμὸς*, the eye).—This term is derived from an old supposition that the hare sleeps with its eyes open; and is applied to a condition in which there is inability to close one or both eyes. Lagophthalmos may be due to paralysis of the orbicularis, in which case it will be attended by falling of the lower lid, and will generally be associated with paralysis of other muscles supplied by the *portio dura* (*see* FACIAL PARALYSIS); to the contraction of cicatrices; to spasm of the upper eyelid (*see* THIRD NERVE, Diseases of); or possibly to congenital malformation of the lids. In paralytic lagophthalmos, the treatment is that of facial paralysis. Where there is contraction or deformity, each case must be considered on its own merits, with regard to the possibility of obtaining relief from a surgical operation.

R. Brudenell Carter.

LARDACEOUS DISEASE (*lardum*, bacon).—A synonym for albuminoid disease, which is so called from the resemblance of the cut surface of an affected organ to raw bacon. *See* Albuminoid Disease.

LARVALIS (*larva*, a mask). — A term usually associated with porrigo. The thick incrustation which is sometimes seen covering the face of children affected with eczema, and constituting a hideous mask to the features, is an example of *porrigo larvalis*, or rather *eczema larvale*, as likewise is ordinary milk-crust.

LARVATED (*larva*, a mask).—A term applied to certain diseases, when their ordinary characters are masked or concealed; as, for example, typhoid fever. *See* Typhoid Fever.

LARYNGEAL PHTHISIS.—A morbid condition of the larynx, supposed to be of a tubercular nature, and either associated or not with pulmonary phthisis. *See* Larynx, Diseases of; and Phthisis.

LARYNGISMUS STRIDULUS (*larynx*, the windpipe; *stridor*, a noise).—A form of obstructed breathing, attended with a peculiar stridor or crowing sound during inspiration, and dependent on spasm of the muscles of the glottis. *See* Larynx, Diseases of; 9. Spasm.

LARYNGITIS.—Inflammation of the larynx. *See* Larynx, Diseases of; 3. Inflammation.

LARYNGOSCOPE, The. (λάρυγξ, the larynx, and σκοπέω, I look.)—Definition.—An instrument for illuminating the interior of the larynx and trachea, and reflecting those parts so as to present their image to the eye of the observer.

Description.—The apparatus for laryngoscopy consist of a small round plane mirror, set on a metal stem and fixed in a wooden handle, for introduction into the throat; and, for concentrating and reflecting the light into the throat, a concave reflector to be worn in front of the forehead, or perforated for wearing in front of the eye of the observer. With this throat-mirror and reflector, any lamp, or even a candle, is available; but brilliant illumination contributes so much to the distinctness of the image that some apparatus to condense the light is also desirable. Either a special apparatus with a bull's-eye lens, or a globe of water, such as a plain round decanter, forms a powerful condenser, and with it the concave reflector may be dispensed with, the light being concentrated directly by the globe of water on the throat of the patient.

Application.—In practising laryngoscopy, the first object is to throw a brilliant light into the pharynx. Sunlight falling directly, or reflected from an ordinary looking-glass, through the mouth into the throat of the patient; bright daylight; or the concentrated light of a lamp or candle, are each of them available for this purpose.

The patient being placed beside and a little in front of the lamp, when the reflector is used; or opposite the window, or lamp and concentrator, if direct light is employed, the operator seats himself opposite him, and adjusts the reflector which he is wearing, or the concentrator in front of the lamp, so that when the patient sits upright, with his head inclined slightly back, his mouth widely open, and the tongue put out, the light shall be concentrated on the back of the pharynx and velum palati.

The first object being thus attained, the next is to throw the light into the larynx. While the patient breathes deeply and quietly, his protruded tongue, protected by a napkin or handkerchief to prevent its slipping, is held steadily but gently forward, either by his own hand, or by the disengaged hand of the operator; and the throat-mirror, *previously warmed* to prevent the condensation of moisture on its surface, held like a pen, is passed into the patient's throat and held with its back steadily pressing against and raising the soft palate and uvula at such an angle that it throws the light into the larynx. This angle will vary according to the position of the patient and the part of the larynx which we wish especially to examine; and the inclination of the mirror must be altered, it must be raised or lowered, brought forward or advanced further in the pharynx, as may be necessary; the operator observing what part is reflected in the mirror, and in moving it being guided by his knowledge of the relation of the various parts of the larynx to each other. Unless the tonsils are enlarged, no part of the fauces or pharynx, except the soft palate and uvula, should be touched; and the operator must be specially careful that the lower edge of the mirror does not come in contact with the back of the pharynx. He must remember also that, while steady pressure can be borne, titillation of any part of the fauces will induce retching. If a patient's nervousness induces retching, or if a spasmodic action of the muscles of the tongue makes it rise, his nervousness must be calmed, he must be induced to take a deep inspiration through the mouth, to accomplish which he will raise the soft palate and depress the tongue, the traction on which must also be slackened. Enlarged tonsils may present an insuperable obstacle to successful examination; in slighter cases either a very large round mirror which presses the tonsils on one side, or a small ovate mirror, should then be used. More frequently a pendulous epiglottis hanging back over the upper part of the larynx impedes the view; in such a case the patient must utter, or try to utter, in a high falsetto tone, a prolonged 'eh,' or he must force a laugh or a cough, and the mirror must be held lower in the pharynx, in a more vertical position.

For the topical treatment of laryngeal diseases, in addition to the laryngoscope the practitioner requires a laryngeal probe or sound, brushes on whalebone or stout wire handles, curved at a suitable angle, for applying solutions; a caustic-holder, similarly curved, for applying solid substances; an injector to apply a shower of fluid or spray; and a scarifying instrument. For the operative treatment of polypus, &c., a set of special forceps, a laryngeal écraseur, special knives, and other instruments are necessary;

while, for use by the patient, a spray-producer or atomiser, and a simple inhaler will be required.

THOMAS JAMES WALKER.

LARYNX, Diseases of. — The functions and peculiar anatomical position of the larynx give to its diseases a special importance; and in addition to such objective and subjective symptoms as are common to affections of other organs, we find here modifications of respiration, vocalisation, and deglutition.

The principal diseases and disorders which affect the larynx may be conveniently enumerated and described in the following order:— 1. Aphonia; 2. Disorders of circulation; 3. Inflammation; 4. Lepra; 5. Lupus; 6. Malignant disease; 7. Paralysis; 8. Polypus; 9. Spasm; and 10. Syphilitic disease. *See* also CROUP; DIPHTHERIA; and TRACHEA, Diseases of.

1. Aphonia. — SYNON.: Fr. *Aphonie*; Ger. *Stimmlosigkeit.*

DEFINITION.—Speaking in a whisper, the sound being produced without closure of the vocal cords.

Various modifications of the note, tone, and quality of the laryngeal voice result from changes in the larynx; and if no air passes through the larynx or mouth, as when a patient breathing through a tracheotomy tube attempts to speak, all sound is abolished, the movements of the lips alone being used in the endeavour to form words. Aphonia is the term applied to the voice produced in the mouth when the laryngeal note is withdrawn from it; and this symptom occurs not only as a result of disease, but as a common functional disorder constituting functional hysterical aphonia. In these cases there is no morbid change in the larynx, no affection of its nerves or muscles. The word *paralysis* should never be applied to this or other similar affections without the prefix *simulated*; the power to exercise the voice exists, but the patient holds it in abeyance. The affection is much more frequent in women than in men. It commonly originates in an attack of catarrh, when, owing to the relaxation and congestion of the laryngeal mucous membrane, vocalisation is inconvenient and requires an effort, and the patient whispers to rest his voice, precisely as an exhausted phthisical patient does, even when there is no laryngeal complication. The habit thus originated is maintained for months or years, as long as the unhealthy mental, emotional, and physical condition which we term hysteria lasts; and this may be the only phenomenon of that condition. Like other nervous and hysterical symptoms, nervous aphonia may lead us to suppose the existence of more serious disease; but the patient suffering from nervous aphonia frequently closes the vocal cords in laughing and coughing, while in speaking she never emits even a husky uncertain laryngeal sound. The laryngoscope is of the greatest value for the diagnosis. The interior of the larynx is seen to be free from disease; the vocal cords move during respiration; but when the patient is asked to say *Ah* or *Eh*, they remain apart, or are brought together for an instant (showing that there is no loss of power) and again separated and allowed to remain open, while an apparent effort is made to utter the sound. *See* VOICE, Disorders of.

TREATMENT.—Well-regulated and interesting employment, or amusement and remedies adapted to the general condition of the patient, must be employed; and the patient must be convinced that she has the power to speak, a power which she does not exercise, usually under the belief that she has it not. The mere expression of a confident opinion, or the promise of a successful result to some system of using the voice may suffice; but usually some measure directed to the part is necessary to induce the patient to exercise her will upon the laryngeal muscles, and to speak, and of those which may be used none is so effective as, or more innocent than, electricity, especially when applied to the interior of the larynx. Frequently one application of electricity, particularly when accompanied by the circumstance of a laryngoscopic examination in a dark chamber, makes a sufficiently profound impression on the mind of the patient to restore the voice; the slight pain of the operation occasionally inducing her to exclaim *Oh!* while her attention is diverted from her supposed inability to speak. In using this remedy in these cases, no practitioner can deceive himself into the belief that he is restoring power to a paralysed part and it is to be regretted that, in describing the treatment of these cases, this belief should be implied, and should have led to a distrust of those who merit the confidence of the public and the profession, from their special skill in the diagnosis and treatment of laryngeal diseases.

2. Larynx, Disorders of Circulation of.— *Anæmia* of the larynx does not exist as a separate disease. Like the pallor of the gums, it is described as one of the symptoms of incipient phthisis.

Congestion of the larynx requires a passing notice. Hyperæmia of some portion of the mucous lining of the larynx results from overexertion of the voice, exposure to cold, the action of irritants, or any cause obstructing the circulation through the larynx; and it may be consecutive to laryngitis. It causes more or less persistent hoarseness, and a sense of discomfort in the throat; and it excites what is commonly called a 'tickling cough.' The absence of any more serious source of these symptoms is proved by the laryngoscope.

TREATMENT.—Treatment of congestion of the larynx is unnecessary, beyond resting the voice, if the congestion is merely temporary. If more persistent, at the same time that the voice is rested, and attention paid to any general cause of the congestion which may exist, such as disordered digestion, astringents should be applied locally. The larynx may be brushed out daily with a solution of two scruples of sulphate of zinc, or of chloride of aluminum, in the ounce of water; or a solution of nitrate of silver, ten grains to the ounce, may be used; while the patient should inhale three or four times a day the spray of a solution of alum or tannic acid, of a strength of eight grains to the ounce.

3. Larynx, Inflammation of.—The several varieties of laryngitis will be treated of under the following headings: — (*a*) **Acute**; (*b*) **Chronic**; (*c*) **Tubercular**; (*d*) **Spasmodic**; (*e*) **Œdematous.**

(*a*) **Acute Laryngitis.**—Synon.: *Laryngitis catarrhalis, Angina interna, Cynanche laryngea*; Fr. *Laryngite aigue catarrhale*; Ger. *Kehlkopfentzündung.*

Definition.—Inflammation of the mucous membrane, or of the mucous lining and subjacent cellular tissue of the larynx; acute in its onset; rapid in its course; disturbing the functions of respiration, vocalisation and deglutition; and accompanied by inflammatory fever.

Ætiology.—Like all laryngeal diseases, laryngitis is more common among males than females, and among children than adults. Gout, syphilis, and anything which depresses the constitution, may be regarded as predisposing causes. The most frequent exciting cause is exposure to cold; laryngitis is, indeed, one of the regular sequences of catarrh. It occurs as a complication of exanthematous fevers—in measles, usually of the simple catarrhal or stridulous variety; in scarlatina, of an erysipelatous or œdematous character; in small-pox, variolous pustules being found in the larynx; and in enteric fever and typhus, the consecutive laryngitis being of a destructive type, and leading to rapid ulceration. A very bad form of erysipelatous inflammation of the larynx occurs as a rare complication of erysipelas; and the œdematous variety may result from an extension of diffuse inflammation of the cellular tissue of the neck. Traumatic laryngitis follows scalds, the application of irritants to, and wounds of the larynx.

Anatomical Characters.—In acute laryngitis the blood-vessels are dilated; the mucous membrane is swollen, and its consistency altered; its cells are infiltrated by the fluid exuded from the blood; and its surface possibly eroded, even in the mildest cases. In the more severe (*parenchymateuse*) form of laryngitis, the cellular tissue is similarly involved; the exudation is extensive; and the functions of the muscles being seriously interfered with, the movements of the arytænoid cartilages and vocal cords are greatly impeded.

Symptoms.—When laryngitis supervenes on catarrh, the patient feels and shows that there is more serious illness. He is restless and anxious; experiences a feeling of constriction about the rima; complains of sore-throat in swallowing; and points to the larynx as the seat of pain. The breathing is altered, having more or less the characteristics of laryngeal obstruction, namely, the long-drawn hissing inspiration, prolonged expiration of the same character, but with less of the sibilant sound, and diminution or complete abolition of any pause between each respiratory effort. The voice also is altered, becoming husky and uncertain, deeper in tone, and croaking in quality. The patient likewise suffers from cough, of the same character as the voice; from the imperfect closure of the vocal cords it wants sharpness, is husky, and sometimes is accompanied by a hollow, clanging sound, constituting what is commonly called the croupy cough. The expectoration varies according as the inflammation involves the larynx alone, or extends to the trachea and bronchi. In the former case it is usually clear, thin, tenacious mucus, which is *hawked*, rather than coughed up, mixed with the saliva, which is freely secreted but not swallowed. Sometimes the expectoration contains harder pellets, secreted in the ventricles of the larynx; whilst, if the trachea and bronchi are involved, the usual thick expectoration of bronchitis is also coughed up. Deglutition is painful and difficult; while, on inspection, the throat shows only a little redness, quite inadequate to account for the dysphagia. Accompanying these symptoms there is a rapid pulse, and slight rise of temperature, though the tongue may be moist, and other indications of inflammatory fever slight.

With the laryngoscope the whole interior of the larynx is seen to be of a bright red colour, the vocal cords alone usually retaining their white appearance, but with bright vascular patches; in severer cases the swelling, caused by the infiltration of the mucous membrane and subjacent cellular tissue, is also perceptible.

If the case progress untowardly, the restlessness and anxiety increase; suffocative paroxysms occur, and recur with increasing frequency; the patient's whole attention appears concentrated on the effort of breathing; he dreads to speak or swallow, and if obliged to say anything, he takes first a laboured inspiration, and then with a straining effort, painful to witness, brings out what little voice is left. Gradually, as the aëration of the blood becomes more imperfect, drowsiness comes on; the eyes, staring in the previous stage, are half closed by the drooping lids; the face, bathed in perspiration, becomes livid; and death occurs, probably in a paroxysm of suffocative dyspnœa.

Complications and Sequelæ.—The complication of laryngitis with other inflammatory diseases of the respiratory system will be referred to immediately, but there are two symptoms, namely, œdema and spasm, which complicate laryngitis, and by their prominence give a distinctive character to the disease. *See* Œdematous Laryngitis.

Diagnosis.—Acute laryngitis, whether simple, stridulous, or œdematous, is apt to be confounded with that form of inflammation which is characterised by the formation of a false membrane in the larynx, namely, croup or laryngeal diphtheria. If practicable, a laryngoscopic examination, showing the absence of false membrane, is the most certain means of diagnosing simple from pseudo-membranous laryngitis; but even where perfect casts of the trachea, bronchi, and primary bronchia were expectorated, the writer has seen the larynx absolutely free from false membrane, and simply inflamed. The absence of diphtheritic membrane in the fauces, of acrid excoriating discharge from the nostrils, and of glandular swellings, as well as the mode of accession of the symptoms, would lead us to regard the case as simple laryngitis; while the presence of any of these symptoms, or the prevalence of an epidemic of diphtheria, would lead us to suspect false membrane. Even after due consideration of these points, and of the character of the voice, cough, &c., in certain cases we are unable to say whether we have to deal with simple, or with pseudo-membranous laryngitis. The stridulous laryngitis or false croup of children is further distinguished from true croup, by the sudden accession of the symptoms at night; by the *noisy* clanging character of the cough, as distinguished from the *husky*, suppressed, though possibly clanging cough of croup; by the similar absence of huskiness in the voice; and by the progress of the case, true croup or diphtheria increasing in intensity, while, from the first sudden onset of the symptoms, false croup diminishes, unless complicated with lobular pneumonia or other severe disease. From laryngismus stridulus acute laryngitis is distinguished by the presence of slight pyrexia, and other indications of primary inflammatory affection of the larynx and air-passages; by the absence of indications of any other affection of the nervous system, or of a tendency to convulsions; by the usual occurrence of the attack in the night only; by the slighter affection of the breathing; and by the frequent *croupy* cough, which is the prominent symptom, and which is wanting in laryngismus.

PROGNOSIS.—In mild attacks of laryngitis all the symptoms exist only in a slight degree, and disappear in a few days under simple treatment. Such is the ordinary course of the false croup of children. In adults laryngitis may occur in any degree between the mildest form and that in which, the symptoms being all most intense, it may prove fatal in a day or two, or even in a few hours. The danger depends in great measure on the amount of œdema present, and this on the extent to which the submucous tissue is involved. Those cases which are consecutive to diffuse cellular inflammation of the neck, or to scarlatina or erysipelas, are most unfavourable; so also are those in which there is renal disease. Laryngo-typhus is especially fatal, as is also the œdematous laryngitis resulting from scald in children. Although mild laryngitis usually terminates favourably in a few days, it is necessary that every case should be sedulously watched, as at any period dangerous symptoms may set in and prove rapidly fatal. The disease is most deadly in the young. Acute may pass on to chronic laryngitis, and occasionally, but rarely, may cause chronic ulceration.

TREATMENT.—As soon as the first indications of even slight laryngitis are observed, the patient should be confined to a warm room; poultices should be applied to his throat; he should inhale the steam of either plain water, or of water containing a few drops of iodine; and small doses of liquor morphiæ hydrochloratis and liquor ammoniæ acetatis should be given every three or four hours, 4 or 5 minims of antimonial wine being added if secretion seem deficient. Should the symptoms increase in intensity emetics may be administered, and a blister should be applied on each side of the thyroid cartilage. The diet should be chiefly liquid; and, as a rule, no stimulants are required. Should the dyspnœa become urgent, tracheotomy must be performed; and this may be called for so suddenly, that as soon as a case of laryngitis comes under his care, the practitioner should be ready for the operation. After the trachea has been opened, the patient is to be kept with the same care in a warm moist atmosphere; a sponge continually changed and wrung out of hot water containing a little tincture of iodine should be kept in front of the tube; and the air should be warmed and moistened as it is drawn through the sponge, which also catches the secretions coughed through the tube. With due care in the performance of the operation and after-treatment of the patient, in cases of simple laryngitis, tracheotomy is almost always successful, but it should not be resorted to unless the case is urgent. Laryngoscopic examination will materially help the practitioner, who may live at a distance from his patient, as to the safety of leaving him without a tube in his throat. Circumstances may lead to the postponement of the operation until the patient is *in extremis*, but even then it should be resorted to. The writer has twice operated upon patients who were believed to have just died, with the effect of restoring them to life for some days, although in neither case was the result ultimately successful, both being cases of diphtheria, which killed the patients, notwithstanding the relief to the laryngeal obstruction.

Simple cases of false croup in children are usually relieved by warm poultices to the throat, or by an emetic, the last remedy being very effectual. Where *œdema* complicates laryngitis, very active treatment is required. In the slighter cases, the spray of a solution of 8 or 10 grains of tannic acid in an ounce of water, or of alum, 10 grains to the ounce, or of a saturated solution of chlorate of potash, should be inhaled; if the case is more severe, scarification by a long curved bistoury, with a cutting edge only at the point, will in most instances give relief. If by the laryngoscope the œdema has been proved to be infraglottic, scarification is not practicable. Should the symptoms become urgent, tracheotomy must be performed in such a case; and in any case of œdema, the urgency of the symptoms may decide the practitioner to prefer it to scarification. The treatment of traumatic œdema, the result of scald of the throat, is usually unsatisfactory; it must be surgical, by scarification or tracheotomy. Scarification is sometimes followed by severe hæmorrhage, and the surgeon who undertakes either this operation or tracheotomy, must be prepared to meet any emergency that may arise.

(*b*) **Chronic Laryngitis.**—DEFINITION.—Low persistent inflammation of the mucous membrane and subjacent tissue of the larynx, occasionally confined to the glandular structures only.

ÆTIOLOGY.—Specific forms of chronic laryngitis, to be separately considered, result from tubercle, syphilis, &c. The simple form almost always depends on exposure to cold, and the too early and frequent use of the voice, or other want of care, after acute laryngitis; it is also a definite result, according to Cohen and others, of over-feeding. The variety called 'follicular' or 'glandular' laryngitis depends on habitual over-exertion of the voice, not unfrequently coupled with excessive use of alcohol or tobacco; it is a complaint of public speakers and singers.

ANATOMICAL CHARACTERS.—The mucous membrane of the larynx is swollen and hyperæmic; the vessels are dilated, usually in patches; the vocal cords are usually least affected, though they may present streaks of congestion; ulceration is rare in simple chronic laryngitis, but there may be abrasions of the surface. In glandular or follicular laryngitis, sometimes called 'clergyman's sore-throat,' the mucous membrane generally is but little thickened; but in the parts richest in glands, that is over the arytænoid cartilages, at the base of the epiglottis and parts of the ventricular bands, the racemose glands are hypertrophied; the surrounding vessels dilated; the ducts and cul-de-sacs enlarged, and their orifices closed, so that the secretions accumulate and sometimes escape by ulceration. Usually a similar condition of the follicles of the pharynx accompanies this form of chronic laryngitis.

Symptoms.—The symptoms of chronic laryngitis are hoarseness and aphonia after slight exertion of the voice; a hacking cough, with but little of the brassy, laryngeal character; either no expectoration, or only a little tenacious mucus; a sense of dryness, with slight pain in the throat; and occasionally dyspnœa on unusual exertion.

Complications and Sequelæ.—Very rarely ulceration may take place; or a sudden accession of acute symptoms with œdema may occur, and this may be followed by suppuration and necrosis of the cartilages.

Diagnosis.—In cases of chronic disease of the larynx a laryngoscopic examination is almost always practicable; without the laryngoscope, diagnosis and treatment can be only guesswork; with it the appearances described above are clearly recognised.

Prognosis.—Chronic catarrhal laryngitis may subside spontaneously, but is usually persistent unless properly treated. It may lead to permanent hypertrophy of the mucous membrane and thickening of the cellular tissue, and this may be general, or limited so as to resemble a tumour. It sometimes gives rise to warty growths. Glandular laryngitis is very obstinate. Neither form of non-specific chronic laryngitis is in itself dangerous to life.

Treatment.—Any imprudence in diet or hygiène must be corrected, and the voice rested as much as possible. About every other day the larynx should be brushed out with a solution of nitrate of silver, 40 grains to the ounce of water; and the spray of a solution of tannic acid and alum, or the steam of boiling water containing a drachm of tincture of iodine, or about 10 drops of fir-wool oil, dissolved in spirit, in the pint of water, should be inhaled three or four times a day. In obstinate cases, inhalations of the terebinthinate balsams, mixed with two or three times their bulk of ether, as recommended by Dr. Symonds, may be used, the warmth of the hand being sufficient to volatilise such solutions prepared according to his formulæ. Attention must be paid to the general health, and to the state of the digestive organs.

(c) Tubercular Laryngitis.—Synon.: Laryngeal Phthisis; Fr. *Phthisie Laryngée*; Ger. *Kehlkopftuberculose.*

Definition.—A specific inflammation of the larynx, depending on the presence of tubercle; accompanying, and sometimes preceding, tubercle of the lungs; and leading to destructive ulceration of the soft parts, and to caries and necrosis of the cartilages of the larynx.

Ætiology.—Pulmonary consumption may be complicated by simple laryngitis, but the disease specified above is itself tuberculous, its predisposing causes being those which favour the development of tubercle in persons of scrofulous constitution, and the exciting causes the same as those of simple laryngitis.

Anatomical Characters.—The majority of pathologists are agreed that, even in the earliest stages of tubercular laryngitis, minute deposits of miliary tubercle will be found; and these may generally be seen causing slight eminences, differing from the follicles in glandular laryngitis, in that from the first they become centres of ulceration of the mucous membrane. This destructive process extends to the deeper parts, involving the fibrous tissues; the articulations suppurate, and the ligaments and cartilages are destroyed; and prominent granulations and fungous growths occasionally spring from the ulcers near the vocal cords. The epiglottis is usually the first cartilage attacked, then the arytænoids and the cricoid, the last being the most liable to necrosis. Occasionally abscesses form, the necrosed cartilage being included in them; and ultimately every tissue of the larynx becomes involved.

Symptoms.—In tubercular laryngitis the symptoms specially dependent on the condition of the larnyx are hoarseness and weakness of the voice; cough, at first frequent and tickling, later husky, laboured, and ineffectual; difficulty in swallowing, often distressing, from the early affection of the epiglottis and upper parts of the larynx; expectoration, varying according to the extent to which the lungs are affected, and sometimes, in the later stages, including portions of cartilage; little difficulty of breathing at first, but later, from œdema, spasm, or great destruction of tissue, urgent dyspnœa, which may necessitate tracheotomy. To these symptoms, sooner or later, are usually added those of advancing pulmonary phthisis. A pale œdematous condition of the aryepiglottidean folds is usually the first indication of laryngeal phthisis observed with the laryngoscope; then swelling and ulceration of the epiglottis, followed by ulcers about the arytænoid cartilages. The view of the disease, as it extends lower, is usually prevented by the secretions, and the swollen condition of the epiglottis and upper parts of the larynx.

Complications and Sequelæ.—These have been sufficiently indicated in the description of the pathology and symptoms of the disease.

Diagnosis.—Tubercular must be diagnosed from simple chronic laryngitis by the early occurrence of œdema and ulceration; and from acute œdema by the mode of onset of the symptoms. From syphilitic disease the diagnosis is more difficult; there is no distinction in the appearance of the ulcers, but in syphilis there is less œdema, and the ulcers may heal, and present cicatrices. The detection of tubercle in the lungs, or other indications of the tubercular diathesis, will help to determine our opinion.

Prognosis.—Tubercular laryngitis is never cured; but the rapidity of its progress may some times be checked. If it precede the deposit of tubercle in the lungs it may last in its early stage for years: if it supervenes on pulmonary consumption the downward progress is very rapid.

TREATMENT.—This must have reference to the diathesis on which the disease depends, and to its local manifestation. The constitutional treatment is fully discussed in the articles PHTHISIS, and SCROFULA. The local treatment must be directed to mitigate the severe pain, and if possible to the cure of the disease. Rest must be obtained for the vocal organs, whilst the food should be such as to cause little inconvenience or pain in swallowing. Artificial feeding by enemata or even by the œsophagus tube may be needed. Soothing applications include ice and iced water; demulcent gargles (*see* GARGLES); the insufflation of a powder composed of 3 grains of starch to 1-6th grain or more of morphia; or the application by the brush of a mixture of bismuth, gum, and 1-6th grain of morphia. Soothing inhalations of conium, benzoin, chloroform, or hops may also be used (*see* INHALATIONS). Occasionally, to promote the healing of ulcers, mild solutions of perchloride of iron, nitrate of silver, or sulphate of copper, may be tried. A leech or two over the larynx, followed by a poultice, may prove useful in some cases.

(*d*) **Spasmodic Laryngitis.**—SYNON.: False Croup; Croup. Fr. *Laryngite ou Angine striduleuse*; Ger. *Pseudo-croup.*

DEFINITION.—A mild degree of inflammation of the larnyx and air-passages; occurring chiefly in young children; accompanied by attacks of laryngeal spasmodic cough and breathing, which come on usually at night; and commonly terminating favourably in a few days.

Spasm of the glottis occurs as a purely nervous affection, as in laryngismus stridulus, but the complaint defined above is a variety of laryngitis; it is one about which practitioners are continually consulted, and is what mothers mean when they talk of a child being liable to croup.

ÆTIOLOGY.—Any of the ordinary causes of catarrh will, in a child with a tendency to this affection, induce an attack. The age of the child is material in producing this tendency, as is also family proclivity; false croup occurring usually in children of from two to six or seven years old. It occasionally complicates the eruptive fevers, and especially measles.

SYMPTOMS AND TREATMENT.—A child, having previously shown signs of catarrh or slight bronchitis, and having probably been a little hoarse, wakes up suddenly from sleep with a clanging, spasmodic, not husky, cough, and with dyspnœa, characterised by the cooing sound with each inspiration which indicates spasmodic closing of the larynx, or by a complete spasm with convulsive movements of inspiration, lasting for a few seconds. The voice is not affected, or if altered it is not husky, but is simply emitted with difficulty, from the difficulty in regulating the action of the vocal cords. There is not more pyrexia than generally accompanies a severe cold. Under simple treatment the attack usually subsides, and the child drops asleep. The attack may be repeated on one or two following nights; but the first is usually the most violent, and that which most alarms the little patient and those around him. These are the symptoms of an ordinary attack of false croup, but its essential cause being some degree of inflammation of the air-passages, it is clear that this may go on to a severer form, and the child, first attended for false croup, may die from pneumonia or other inflammatory affection of the respiratory system, the symptoms produced by the severer affection of the lung combining with and complicating those dependent on the larynx. The persistent dyspnœa, and other symptoms, must in such a case be traced by the practitioner to their proper sources, or he may erroneously suspect and adopt treatment for graver laryngeal disease than actually exists.

(*e*) **Œdematous Laryngitis.**—SYNON.: *Œdema glottidis*; Œdema of the Larynx; Fr. *Laryngite œdemateuse*; Ger. *Kehlkopfoedem.*

DEFINITION.—Inflammatory exudation into the submucous areolar tissue of the larynx, of serous, sero-purulent, or sero-gelatinous fluid.

The exudation usually attacks first the aryepiglottic folds and the epiglottis, and it may extend thence to the ventricles and other parts of the larnyx, the vocal cords themselves being seldom affected. The submucous tissue below the vocal cords, lining the cricoid cartilage, may be the sole seat of the exudation; a form of œdema which has been attributed usually to a gouty constitution. Whether occurring in the course of acute laryngitis, or, as is more frequently the case, supervening on chronic laryngitis, œdema of the larynx is of the greatest importance, being least fatal when an accident of chronic disease. Œdema complicates laryngitis of an asthenic type, such as cases consecutive to the exanthemata, and is always present in the cases due to scalds from drinking boiling fluids. It is this form of laryngitis which occurs in persons labouring under Bright's disease, the œdema in these cases not being passive dropsy, but the result of inflammation.

ANATOMICAL CHARACTERS.—The mucous membrane in œdematous laryngitis is rather attenuated than thickened, and but little injected, unless it occurs as a complication of the superficial form of inflammation. Especially in scalds there is but little hyperæmia; but there is death and vesication of the mucous membrane with excessive œdema.

SYMPTOMS.—The symptoms indicative of laryngitis exist in an increased degree when this is complicated with œdema, the swelling of the epiglottis interfering especially with deglutition, and that of the aryepiglottic and ventricular bands causing very dangerous dyspnœa. By examination with the finger, and far better by the laryngoscope, we observe further the physical condition caused by the swelling. The epiglottis is felt, or seen, misshapen, rounded like a chestnut, or its two sides swollen so as to resemble two mucous bladders pressed together in the middle line; and, unless this hides the rest of the larynx, the aryepiglottic folds will be recognised as two long rounded swellings, passing from before back, and nearly meeting in the centre, the swollen ventricular bands being visible only when there is little œdema above.

Treatment.—The treatment of œdematous laryngitis has already been described under the head of acute laryngitis.

4. Larynx, Lepra of.—Definition: A specific affection of the larynx, met with only in cases of lepra of long standing, and associated with a similar affection of the buccal mucous membrane, the tongue, and the palate.

Ætiology.—The causes are identical with those of lepra in other situations.

Anatomical Characters. — The disease spreads from the mouth to the epiglottis, which becomes thickened, and is fixed from the infiltration of its mucous membrane. Other parts of the larynx afterwards present the same anatomical changes. The tubercles may ulcerate and cicatrize.

Symptoms, Complications, and Diagnosis.—The symptoms of laryngeal lepra are those of chronic inflammation; and if the tubercles ulcerate, the ulceration is very slow, and not of the destructive character of syphilis. As lepra of the larynx occurs only when the disease of the skin has been long established, its diagnosis is clear. It usually exists for a long time, even years, before it ulcerates, and even after this it is very slow in its progress, and not fatal.

Treatment.—As in other forms of lepra, treatment is almost useless; the fissures and ulcers are said to be relieved by touching with solid lunar caustic. *See* Lepra.

5. Larynx, Lupus of.—Definition: A rare specific form of inflammation and ulceration of the mucous membrane of the larynx, always associated with lupus of the skin.

Ætiology.—The causes of this disease, and of lupus of the skin, are identical.

Anatomical Characters.—In lupus of the larynx great numbers of small red round papules are first formed. These become abraded; and the abrasions gradually form ulcers, which penetrate deeply into the substance of the epiglottis, being triangular in form, with the apex directed forwards. Similar ulcers are found at a later stage in other parts of the larynx.

Symptoms, Complications, and Diagnosis.—The symptoms of lupus of the larynx are those of chronic inflammation; but there appears to be no tendency to œdema or to those affections of the cartilages which occur in syphilitic and tubercular laryngitis, from which the disease is further distinguished by the peculiar form of the ulcers and the papules, and the presence of lupus of the skin. It lasts for many years.

Treatment.—Lupus of the larynx must be treated locally by caustics or the galvanic cautery; and constitutionally in the same way as other forms of lupus. *See* Lupus.

6. Larynx, Malignant Disease of.—The larynx is rarely the primary seat of cancer (except in the form of epithelioma), although it is frequently involved by the spread of the disease from the œsophagus, pharynx, and neighbouring parts. The disease occurs usually as a general infiltration of the tissues, and does not form a polypoid tumour. It gives rise to symptoms of dysphagia, and of laryngeal obstruction, added to those of malignant disease in other situations. The symptoms only occur when the larynx is either attacked primarily, or invaded secondarily, by the disease; mere mechanical pressure by growths external to it not interfering with its functions, although they may displace the organ to a very great extent.

Treatment.—The obstruction to respiration may demand the performance of tracheotomy; and if the lower part of the trachea is free from disease, the operation will prolong life. If the trachea itself is extensively affected, the insertion of the tube may increase rather than relieve the dyspnœa. Removal of a cancerous larynx was first practised by Billroth, and has since been performed by several Continental surgeons. The results of the operation have, however, been so unfavourable that it cannot be recommended in this form of disease.

7. Larynx, Paralysis of.—Definition: Loss of power in the laryngeal muscles, occurring in connection with disease or poisoning of the nervous centres, or with pressure upon or disease of the laryngeal nerves, caused by aneurism, enlarged cervical or bronchial glands, or other intrathoracic tumours.

Varieties and Treatment.—The commonest effect of disease of or pressure upon the recurrent laryngeal or motor nerve of the larynx is paralysis of the *ab*ductors, causing the vocal cords to approximate in the middle line, in a relaxed state. They are not tense even when an attempt is made to speak; and during respiration a narrow chink is left, with relaxed edges, causing very stridulous breathing and, possibly, fatal asphyxia. Paralysis of the *ad*ductors, unilateral or bilateral, when one or both vocal cords are seen at all times relaxed and drawn aside, is a consequence of disease of the superior laryngeal nerve, which supplies the cricothyroid and arytænoid muscles. These varieties of paralysis are readily recognised by the laryngoscope; and they usually cause aphonia, without necessarily dyspnœa. When these cases are of long standing, the muscles become atrophied as in other paralysed parts. The condition usually depending on serious disease without the larynx, treatment can be of little avail. Tracheotomy may be called for to avert asphyxia. Cases are recorded where the local use of electricity has cured paralysis, but these were probably cases like those previously described, where paralysis of the adductors is simulated. *See* 1. Aphonia; Pneumogastric Nerve, Diseases of; and Appendix.

8. Larynx, Polypus of.—Synon.: Growths of the Larynx; Fr. *Tumeurs, Kystes, et Polypes du Larynx*; Ger. *Kehlkopfpolypen*.

Definition.—A morbid growth attached to the walls of the larynx, and projecting into its cavity, in the form of a tumour.

Ætiology.—The invention and use of the laryngoscope, leading to accurate diagnosis, has established the fact that tumours of the larynx are of much more frequent occurrence than was formerly supposed. They are most common in adult males who habitually over-exert the voice;

but they occur in either sex, and at any age, from infancy upwards. Inflammatory attacks, syphilis, and anything leading to habitual congestion of the larynx, favour their development.

ANATOMICAL CHARACTERS.—Growths of various kinds occur in the larynx. (*a*) *Papilloma*, or warty growth, having a base of connective tissue, and coated with epithelium, may occur either as a solitary separate filament, or a group of filaments, or as an agglomeration of little rounded eminences, the whole forming a perfectly defined tumour. It is frequently multiple; increases rapidly; has a tendency to recur when removed; and is of friable texture. It is most common at the anterior commissure of the vocal cords, but these growths may be attached all over the larynx.

(*b*) *Fibroma* is usually solitary, its size varying from that of a grape-seed to that of a pigeon's egg or more, either sessile or pedunculated, with a bright smooth surface, becoming lobulated as the tumour increases.

(*c*) *Mixed fibrous and fibro-cellular tumours*, *sarcoma*, and mixed *lipoma* and *fibroma*, externally resemble fibroma, their nature not being recognisable until after removal.

(*d*) *Adenoma*, or glandular tumour, is described by Türck as distinguishable from fibroma by its swelling, and altering in colour. It increases rapidly, and is of a dark pink colour at first, becoming whitish as it increases.

(*e*) *Myxoma*, or *mucous polypus*, is rare. It presents a smooth, moist-looking, semi-translucent, rounded surface; and, according to Brûns, consists of a slimy matrix, with intersecting fibrillæ, inclosed in the altered mucous membrane.

(*f*) *Cystic polypus* is usually the result of a change in some other tumour. It may, however, occur as a primary growth; and a case is recorded where such a growth caused the death of an infant, thirty-six hours after birth.

(*g*) *Epithelioma* is not uncommon, presenting the usual structure and appearance of epithelioma elsewhere.

SYMPTOMS.—Polypus may cause absolutely no inconvenience. The most constant symptom is a modification of the voice. It usually excites dry cough, often spasmodic and croupy. The breathing is but little affected until the growth attains some size, when dyspnœa will set in, at first only on exertion, occasionally spasmodic; as the growth increases, it becomes constant, and at last fatal if the disease is unrelieved. Tumours attached below the vocal cords are rare; when they exist, and are large enough to interfere with the breathing, expiration is as noisy and difficult as inspiration. These growths are usually painless; they may be so situated as to interfere with swallowing, but this is not usual. In addition to these symptoms, the growth can be seen with the aid of the laryngoscope, and felt with the laryngeal probe or sound, and sometimes with the finger. Occasionally portions of a papilloma are expelled by coughing.

DIAGNOSIS.—A certain diagnosis can only be arrived at by a physical examination, unless, indeed, portions of the growth are expectorated. Most forms of growth may be diagnosed by their appearance in the laryngoscope. The point and extent of attachment may be determined by the skilful use of a laryngeal sound or probe.

PROGNOSIS.—The importance of these growths varies with their situation and rate of increase. A few months have sufficed for the growth of tumours, from their origin to their attaining a size sufficient to threaten suffocation; in other cases they may exist for years without giving rise to any symptom beyond dysphonia or aphonia. As soon as a polypus causes dyspnœa, it has become dangerous. Although a polypus under observation for some time has been seen to grow smaller, and cases occasionally occur where the more friable variety is spontaneously expelled, the disease must practically be regarded as incurable, except by operation or other local treatment.

TREATMENT.—A small stationary fibroma or other tumour, giving rise to but little inconvenience, requires no treatment. Small papilliform growths are amenable to treatment by strong caustic solutions. Almost all other tumours must be removed by operation. Removal may be effected by instruments introduced into the larynx from above with the aid of the laryngoscope; or, where the disease is very extensive, an artificial opening into the larynx (thyrotomy or division of both thyroid and cricoid) may be necessary, the growth or growths being removed through this opening. If the growth is removed *per vias naturales*, it may be crushed through at its base by a properly constructed écraseur; it may be seized and torn off by forceps; or it may be cut off by knives or scissors. The particular operation, and the instruments to be used, must be determined by the circumstances of the case. Tracheotomy may be necessary as a palliative measure, where, for some reason, a curative operation cannot be adopted; or it may be required as a preliminary to the radical operation. Where the choice lies between tracheotomy and an operation for removal of the tumour, the latter must always be selected. Removal of the larynx for recurrent sarcoma has been successfully practised in this country by the late Dr. Foulis; and the operation is available where milder measures for the cure of these growths prove ineffectual. After extirpation the voice can be restored by the insertion of an artificial glottis.

9. **Larynx, Spasm of.**—In the description of other diseases of the larynx, this has been referred to as a frequent and often fatal complication. Spasm is a most urgent symptom when the larynx is irritated by the lodgment of a foreign body or other irritant. It may result from pressure on, or disease of the pneumogastric nerve; from hysteria; and as a manifestation of a more general affection of the nervous system, in which case it constitutes the following special malady.

Laryngismus stridulus.—SYNON.: Child-crowing; Spasmodic croup; False croup; Fr. *Spasme de la glotte*; *Pseudo-croup nerveux*; Ger. *Kehlkopfkrampf.*

DEFINITION.—Short or more prolonged accessions of suffocation; depending on tonic spasm of the adductor muscles of the larynx, and usually of the diaphragm and other respiratory muscles; causing closure of the glottis, and a sudden arrest of inspiration; and ending in a shrill crowing sound, as the inspiratory act is resumed and concluded. It is unaccompanied by any inflammatory affection of the larynx or air-passages; and is often associated with other convulsive affections.

ÆTIOLOGY.—Anything causing excessive reflex irritability, rachitis, chronic hydrocephalus, and other organic affections of the brain or medulla oblongata, predispose to this convulsive affection. It is undoubtedly sometimes associated with chronic enlargement of the thymus; and with the irritation of teething. A sudden fright, irritation of the larynx by the accidental entrance of food, or some such slight agitation as that caused by a child being tossed in the air, may excite the attack.

ANATOMICAL CHARACTERS.—This is purely a nervous disease, and there is no anatomical change in the larynx.

SYMPTOMS.—With or without premonitory indications of a tendency to convulsive affection, such as drawing in of the thumbs and great toes, or clenching of the hands; often during sleep, and with no evident exciting cause, or at any time in the day; a child is suddenly attacked with difficult breathing, inspiration being accompanied by the crowing sound characteristic of laryngeal spasm. This may continue for some time, and then gradually subside. The spasm may be short, or it may be longer and more intense, inspiration being proportionately difficult. It may be complete, and the act of inspiration cease entirely, until just as death seems imminent, the spasm relaxes, and with a crowing inspiration breathing is re-established. In the worst cases, and sometimes in the first attack, death does actually occur.

DIAGNOSIS.—The diagnosis of this disease from stridulous laryngitis or real false croup, with which it is in this country frequently confounded, and that even by recent authors, is considered under 3. *a*, Acute Laryngitis. The symptoms caused by a foreign body lodged in the larynx closely simulate laryngismus stridulus. The nature of the case is decided by its history; and, unless the age of the patient precludes it, by a laryngoscopic examination.

PROGNOSIS.—The milder forms of this malady yield to suitable treatment, and disappear as improvement takes place in the condition inducing the attack. Severer forms, if not fatal in a first, may be so in a subsequent attack. When the spasm depends on some incurable organic change in the nervous system, the case is of course hopeless from the first.

TREATMENT.—Attention to the diet and general management of the child, regular bathing, and the administration of remedies suitable to correct faults of digestion, are necessary. The persevering use of bromide of potassium has been found beneficial by the writer; and chloral hydrate is of undoubted value. For the immediate treatment of the spasmodic attack, prompt immersion in a warm bath, the administration of an emetic, or the use of an anæsthetic vapour may be resorted to; and should breathing not be re-established as the spasm ceases, dashing cold water on the face and chest, friction, application of strong ammonia and vinegar to the nostrils, and especially artificial respiration, must be adopted, with the object of restoring the function. Tracheotomy may be requisite, but the practitioner is, unfortunately, seldom present when the indications for the operation arise.

10. **Larnyx, Syphilitic Disease of.**—Syphilis affects the larynx differently according to the stage of the disease at which the organ is attacked. Erythematous maculæ, raised mucous patches or condylomata, and superficial ulceration, like that seen in the fauces and pharynx, may occur as secondary symptoms; but the larynx is more commonly and more seriously affected in advanced stages of syphilis. It may then be the seat of small tubercles, varying from the size of a millet-seed to that of a pea; or ulceration may occur, following upon an eruption or upon gummata. The ulcers are usually multiple, deep, and sharp-edged, presenting much the appearance of tubercular ulcers; and the cartilages are frequently necrosed. Sometimes the disease begins with perichondritis, leading to suppuration and subsequent caries and necrosis of the cartilages, external fistulæ occasionally communicating with the diseased larynx.

SYMPTOMS.—Secondary syphilitic affections cause hoarseness and sometimes loss of voice, with some harshness of breathing, but there is usually neither pain, cough, fever, nor much dyspnœa. The more serious tertiary affections may give rise to all the symptoms caused by tubercular ulceration, but the constitutional symptoms are those of syphilis, as distinguished from consumption.

COMPLICATIONS AND SEQUELÆ.—Although amenable to treatment, and therefore curable, syphilis is more liable than any other affection of the larynx to leave serious consequences. Not only are the cicatrices of the healing ulcers liable to contract the opening of the larynx, and to cause adhesions which may permanently obstruct respiration, but the specific deposits occasionally occur in such a form, that even without ulceration, they produce stenosis or contraction of the larynx or trachea. Tumours of the larynx appear sometimes to result indirectly from syphilis; and, as just mentioned, aërial fistulæ may be left after necrosis of the cartilages.

DIAGNOSIS.—The secondary affections of the larynx are easily recognised in the laryngoscope, and there are usually other indications of the constitutional taint. Syphilitic must be distinguished from tuberculous ulceration by the concomitant symptoms of the disease, the presence of gummatous tumours, and the occurrence of cicatrisation of the ulcers; the œdema and general thickening are also less than in tubercle. From ulcerated epithelioma it may be distinguished by the history; by the fact that the cancroid growths usually extend from the pharynx and œsophagus to the larynx; by the cancroid ulcer being solitary, while syphilitic ulcers are usually multiple; and by the appearances of the sores and their base. Frequently in these cases the amount of secretion prevents a satisfactory view of the parts, and our diagnosis must then be arrived at without the aid of the laryngoscope.

PROGNOSIS.—The prognosis in cases of laryngeal syphilis must vary according to its form, but unless the case is complicated by some other vice in the system, we may hope to cure it by appropriate treatment. If left to itself, the tertiary form of the disease will probably ultimately destroy the patient. Where it occurs in a person of scrofulous constitution, the prognosis will be less favourable; and if to this be added abuse of alcohol, and irregular living, the chances of recovery are small. At any period of this, as of other laryngeal disease, sudden urgent symptoms are liable to arise, resulting in a fatal termination, a consideration which must induce us always to give a guarded opinion.

Treatment.—Local treatment is seldom necessary for the secondary syphilitic affections of the larynx, and we must trust to mercurial inunction and other constitutional remedies. Should a mucous condyloma, from its situation, affect the voice or breathing in a very grave degree, a solution of bichloride of mercury, one grain dissolved in a drachm of weak spirit, may be carefully applied with a brush. Syphilitic ulceration of the larynx requires persevering treatment by iodide of potassium; and where it does not yield to this remedy, appropriately combined with quinine, cod-liver oil, &c., mercury must be employed, the best method being by mercurial inunction, or the hypodermic injection of the bichloride. A prolonged course of the drug being necessary, the patient must pay great attention to his mouth, sucking alum frequently, so as to avoid ptyalism. The local application of a solution of 10 grains of sulphate of copper to the ounce, and touching isolated ulcers with solid nitrate of silver or sulphate of copper, will be beneficial; astringent, sedative, or other medicated, and especially iodine, inhalations should also be employed. In old cases of syphilis, warty growths are sometimes seen in the larynx, which may be cured by frequent topical applications, combined with constitutional treatment. When the dyspnœa is dangerous, tracheotomy must not be delayed. It will usually prove successful, although the destruction of tissue and cicatrisation may be such as to necessitate the permanent wearing of the tube. Operations for the division of cicatricial bands and adhesions may be required. They should be undertaken only by a skilful and practised laryngeal operator. Two or three cases have been operated upon successfully, where the vocal cords were united in their whole length by a web of adhesions. Heine has removed the larynx for stenosis resulting from syphilis; but extirpation must not be adopted where tracheotomy is available.

Thomas James Walker.

LATENT (*lateo*, I lie hid).—This word is applied to cases of certain diseases in which their usual characteristic features are obscured and concealed; for example, *latent pleurisy*, *latent scarlatina*. Symptoms are also said to be latent when they do not occur under circumstances in which they ought to appear. For instance, *cough* may be *latent* in certain cases of phthisis.

LEAD, Poisoning by.—Synon.: Plumbism; Fr. *Intoxication saturnine*; Ger. *Bleivergiftung*.

Pure metallic lead has probably no injurious action on the system; but owing to the ease with which it oxidises and forms salts, all of which are poisonous, lead-poisoning is of common occurrence amongst all persons whose occupation brings them much in contact with metallic lead and its alloys; among those engaged in industries in which lead-salts are manufactured or largely employed; as well as from contamination, accidental or otherwise, of articles of food, drink, or luxury, with lead or its compounds.

Acute poisoning with lead is not common, nor are any of the lead salts actively poisonous. The acetate or sugar of lead is popularly believed to be a virulent poison, but it is by no means so. There are very few fatal cases on record, even from swallowing quantities amounting to an ounce of the acetate or its equivalent. The symptoms are in the main those of irritant poisoning, the chief difference being that constipation is the rule, and diarrhœa the exception.

The *chronic* form of poisoning by lead is of infinitely more importance and prevalence. The sources of it are extremely numerous and varied, and it is almost impossible to specify all individually. The following are among the chief, classified according to the primary form of the poison.

1. **Metallic Lead, Poisoning by.**—Lead-poisoning occurs among lead-miners, metallurgists, and workers in lead or its alloys, such as plumbers, solderers, type-founders, compositors, and manufacturers of lead toys (toy-soldiers). It has been observed also among fishmongers, from using lead counters; in pot-boys; as the result of packing articles of food or luxury in lead-foil; and from contamination of articles of drink by shot used for cleaning bottles, siphon soda-water bottles, &c.

Under this head may also be included the very frequent contamination of *drinking water* by lead pipes and cisterns. Pure water, freed from gases and excluded from contact with air, does not act upon lead, but in presence of air the lead becomes speedily acted on, and the water contaminated. An oxide of lead is formed, which being partially soluble in water, allows the action to go on. From its solution the oxide is in great measure precipitated by carbonic acid, which is absorbed. The lead falls as an oxycarbonate, though the presence of carbonic acid in the water keeps a certain quantity in solution. The purer the water the more rapid the action. The presence of certain salts in the water considerably modifies its action on lead. Thus the nitrates, nitrites, and chlorides, by forming soluble compounds with lead, increase the solvent action of the water; and as these salts usually result from sewage-contamination, such water is rendered still more dangerous by passing through lead pipes. Other salts, usually found in spring and river waters, act as protectives by forming insoluble lead-compounds, which being deposited as a crust in the interior of the pipe or cistern, prevent further action. Of this class are the sulphates, phosphates, and carbonates. Hence waters, unless containing much less than the average proportion of lime-salts, after a time cease to be contaminated to any great extent, though the presence of carbonic acid in the water renders a solution of the crust possible in some measure. Waters so deficient in lime-salts as the Loch Katrine water supplied to Glasgow cannot safely be conveyed in lead pipes. Galvanised iron, earthenware, or slate may in many cases be advantageously substituted for lead, if not possible in all. Lead covers to cisterns are very objectionable, as the water which rises by evaporation condenses and drops back contaminated. The electrolytic action of solders also helps to contaminate water with lead.

2. **Oxides of Lead, Poisoning by.**—The most important oxide of lead in this relation is litharge or plumbic oxide (Massicot), which is largely used in making glass and glazes for earthenware and iron. Those engaged in glass-making and grinding, glazing, pottery, &c., suffer. Owing to the solubility of lead-glazes, articles of food if acid may be contaminated. Litharge is also used for hair-dyes, japanning, &c., whence poisoning may result.

The 'red lead,' which is a mixture of lead oxides, has caused poisoning, by being used to colour wafers, adulterate snuff, and make putty or cement for tanks, &c.

3. **Lead Salts, Poisoning by.**—Of these the most important in this relation is the carbonate, or 'white lead.' Those engaged in the manufacture, grinding, and packing of white lead are the most frequent sufferers, and also those who largely use it, such as painters, glaziers, plumbers, glazed card manufacturers, lacquerers, lace manufacturers, and those who apply it as a cosmetic (clowns, &c.). The acetate of lead has been used for correcting the acidity of wine and cider, and has been a frequent source of lead-poisoning. Poisoning has also occurred among seamstresses from using silk thread adulterated with it; in dye-works, where it is largely used; from using it as a hair-dye; and from long-continued medicinal administration. Lead colours, chromates, &c., have also caused poisoning, by being used to colour confectionery. From these and similar sources lead may be introduced into the system by inhalation, ingestion into the stomach, and apparently also by cutaneous absorption.

SYMPTOMS.—The affections caused by lead are frequently termed *saturnine*, owing to lead being the symbol of Saturn, the malign planet of the astrologers. They are of a manifold character, and do not always occur in regular order or sequence.

Saturnine cachexia.—As a rule, after long-continued introduction of lead into the system, a saturnine cachexia is developed, characterised by anæmia, an earthy or dull hue of the skin, digestive derangement, dryness of the mouth, frequently a styptic or sweetish astringent taste, coated tongue, and fetid breath. The teeth are discoloured, and frequently appear elongated from retraction of the gums. At the margin of the teeth and the gums a bluish or violet line is developed. This, which is regarded as the specially diagnostic indication of lead-poisoning, was first described by Burton, and is shown to be due to the formation of a lead sulphide in the parts.

Lead Colic.—SYNON.: *Colica Saturnina*; Fr. *Colique de Plomb*; Ger. *Bleikolik.*—Following the symptoms just described, but sometimes without marked prodromata, a very characteristic affection occurs, namely, lead colic. This is known by many other synonyms, of which the more common are Painter's colic, Devonshire colic, Colica Pictonum, the last being derived from the inhabitants of Poictou, among whom in modern times it was first extensively prevalent, owing to adulteration of wine with lead-salts.

Patients affected with lead colic exhibit a cachectic look, earthy hue, blue line on the gums, coated tongue, and fetid breath; and suffer from nausea and, occasionally, vomiting. The bowels are obstinately confined, or scanty hard motions are passed with difficulty. Paroxysms of excruciating pain occur in the abdomen, which feels hard, and is retracted in the region of the umbilicus. The pain is of a truly colicky nature, and is relieved by pressure. The countenance is anxious, and the skin is covered with cold perspiration. The respiration is shallow, and the pulse generally slow and hard, though this is not always the case. The urine is not unfrequently almost or entirely suppressed.

Lead Palsy.—SYNON.: Fr. *Paralysie saturnine*; Ger. *Bleilähmung.* After repeated attacks of lead colic, or it may be after one, and sometimes without antecedent colic, various other affections occur. One of the most common of these is a form of paralysis termed lead palsy, or, from its special features, 'dropped wrist.' The paralysis shows itself more particularly in the extensor muscles of the forearm, or region of distribution of the musculo-spiral nerve; and in consequence, when the arm is raised, the hand drops by its own weight. The paralysis generally commences in the extensor digitorum communis, and gradually extends to the other muscles supplied by the musculo-spiral, with the remarkable exception of the supinator longus. The paralysis does not necessarily confine itself to the forearm, for in advanced cases it may attack other muscles in the arm, the muscles of the leg, and the dorsal muscles; showing itself by preference in the extensor muscles of the body, and giving rise to a peculiar stooping, tottering gait. Aphonia occasionally results. The paralysed muscles undergo atrophy, and ultimately cease to react to faradisation or galvanisation, the faradic excitability being lost before the galvanic, as in peripheral paralysis generally.

Other phenomena.—Tendinous swellings of an oval or elongated shape frequently form on the tendons at the back of the wrist, and contrast prominently with the atrophied muscles. Neuralgic pains in the muscles and joints are often complained of. In the more advanced cases various forms of encephalopathies occur. Epileptiform convulsions are common; and psychical affections are not unfrequent, in the form of delirium, mania, or melancholia. Apparently in causal relation with lead-poisoning, disease of the kidneys and albuminuria may occur; and gout is frequently seen among those who work in lead. Abortion occurs to a large extent among women employed at white-lead works; according to Paul, in the proportion of sixty per cent. of those so employed.

The tendency is to recovery, if the cause of the symptoms is removed; but if not, the paralytic and other affections become incurable, and death occurs in a miserable state of cachexia.

Anatomical Characters.—There are no very characteristic appearances of chronic lead-poisoning. Lead is found in almost every organ and tissue in the body, the greatest quantity, according to Heubel, being found in the bones; next in the kidneys, liver, brain, and spinal cord; and to a less extent in the muscles.

Among the appearances which have been described are constriction and apparent thickening of the muscular coats of the large intestine; and an atrophic condition of the intestinal mucous membrane has been found by some authors (Kussmaul and Maier). These authors have also found an increase of the connective tissue, and atrophy of the nervous tissue in the abdominal ganglia of the sympathetic. The paralysed muscles exhibit atrophic degeneration, with hyperplasia of the connective tissue, and disappearance of the striæ, and the nerve-trunks likewise exhibit various stages of atrophy. We possess, as yet, no very reliable knowledge of the condition of the nerve-centres. The subject is one still requiring much investigation.

Pathology.—The mode of action of lead, and the causation of its characteristic symptoms are subjects still under discussion. Henle is of opinion that lead acts primarily on the non-voluntary muscular fibres throughout the body, while Heubel thinks that the primary action is on the nerve-centres. From this, as secondary consequences, are deduced the colic, due to irritation by compression of the intestinal nerves, and the constipation from cessation of the intestinal secretion by contraction of the blood-vessels. To the arterial ischæmia so produced the paralysis is attributed (Bärwinkel). Hitzig thinks that the paralysis of the extensors is due to a peculiar disposition of the veins, which favours the deposition of lead there. This is a mechanical theory which has little to support it except a dilated condition of the veins, and is utterly insufficient to account for the occurrence of paralysis in other regions, besides being in contradiction to the fact that lead is not specially deposited in the muscles, as this theory would necessitate. That the paralysis is due to degeneration of the nerves is in harmony with the symptoms and electrical reactions of the muscles, and is supported by the post-mortem appearances; but whether the peripheral degeneration is primary, or secondary to central degeneration in the anterior horns of the spinal cord, is not as yet satisfactorily determined.

Treatment.—In *acute* lead-poisoning from any cause the stomach must be emptied by the stomach-pump, or by emetics—of which sulphate of zinc is to be preferred. Solutions of the alkaline or earthy sulphates—of which the best is sulphate of magnesia—are indicated, with the view of forming the comparatively insoluble sulphate of lead, and expelling it from the intestines.

As regards *chronic* poisoning by lead, prophylaxis is the most important consideration. The great principles in lead-works are the inculcation of cleanliness; avoiding eating with unwashed hands, or in working clothes, or in workshops; moist grinding; free ventilation; precautions against dust rising, or wearing of flannel respirators where it is unavoidable; and occasional doses of sulphate of magnesia, acidulated with sulphuric acid. Sulphuric acid lemonade has been recommended as a drink.

Workmen who begin to show signs of lead-poisoning should at once give up the work, and take to some other employment. As regards water-contamination, what has already been said on this subject will suffice to indicate the prophylactic measures.

In the treatment of lead colic, purgatives are indicated, and opium may be necessary to allay the excruciating pain. The sulphate of magnesia is the best purgative. Iodide of potassium is generally given with the object of removing the lead from the system, and is on the whole satisfactory in its results. A combination of the iodide with sulphate of magnesia is very beneficial. Sulphur baths are also recommended.

The local paralytic affections require local, in addition to the general treatment. Unless the muscles are in an advanced state of atrophy, and give no response to electrical stimulation, good results may be obtained by the use of the galvanic current applied to the muscles and to the musculo-spiral nerve. Faradisation has also been found beneficial, and is recommended by Duchenne, but the preference is to be given to the continuous current.

D. Ferrier.

LEAMINGTON, in Warwickshire.—Sulphated common salt waters. *See* Mineral Waters.

LEECHING. — The local abstraction of blood, by means of leeches. *See* Blood, Abstraction of.

LENS, Diseases of. *See* Cataract.

LENTIGO.—A synonym for freckle. *See* Freckles.

LEPIDOSIS (*λεπὶς* or *λέπος*, a scale).—A term adopted by Mason Good to distinguish the group of squamous affections of the skin; amongst which is included lepra vulgaris or lepriasis. The term is now obsolete.

LEPOTHRIX (*λεπὶς* or *λέπος*, a scale, and *θρὶξ*, a hair).—Definition.—A term applied to a hair in which there is loosening and partial detachment of the overlapping edges of the scales of its cuticle.

Such hairs are usually met with in the axilla, and their peculiar conformation is attributable to the heat and dampness of that region, which causes maceration of the hair, particularly when it is of feeble structure. Sometimes the scales completely surround the hair; very commonly one side of the shaft is more affected than the rest, and presents the appearance of a fringe; and not unfrequently the scales are roughened with earthy and saline crusts deposited by the sweat.

Treatment.—The treatment most suitable for this evil is saponaceous ablution, followed by the use of a lotion composed of two to four drachms of oxide of zinc to half a pint of lime-water.

Erasmus Wilson.

LEPRA (*λεπὶς* or *λέπος*, a scale).—The term lepra was used in the plural, *λέπραι*, by Hippocrates, to imply its constitution of multiple patches. Willan adopted the term as significative of a squamous eruption, and in this sense it has been regarded as the lepra Græcorum. The foreign schools, however, prefer to name it psoriasis, a term now commonly associated with it in Great Britain; whilst they assign the word 'lepra' to the elephantiasis of the Greeks, the so-called 'true leprosy.' Hence whilst the operation of time has transferred the word 'psoriasis' to the lepra of the Greeks, it has conveyed the term 'elephantiasis' of the Greeks to the lepra of the Arabs; and common consent reserves the word lepra or leprosy for the elephantiasis of the Greeks. Thus, the terms, lepra, psoriasis, elephantiasis græcorum, and leprosy are somewhat confusedly intermingled, and one mode of extrication from the dilemma would appear to be to consider lepra as synonymous with leprosy, and to abandon its use in connexion with the lepra of the Greeks, now termed psoriasis; although the adoption of Mason Good's term 'lepriasis' would no doubt be the better alternative. For himself, however, the writer prefers the more classical course of retaining the term 'lepra,' the type of roughness, for the lepra Græcorum and the lepra vulgaris of Willan; giving to genuine leprosy, the great disease, its Greek designation, elephantiasis; and attaching psoriasis to squamous eczema, the 'psora' of the ancients, to which it properly belongs. The elephantiasis Arabum or 'elephant leg,' must be left out of consideration, as being an error of nomenclature, taking its origin in a blunder of translation of the Greek writings by the Arabian authors. *See* ELEPHANTIASIS ARABUM. ERASMUS WILSON.

LEPROSY (λεπρὸς, rough).—DERIVATION AND SYNONYMS.—The term leprosy had its origin at a time when diseases of 'roughness' comprehended a large majority of affections of the skin; and it was, in fact, a generic name for 'skin diseases.' Hence the indefiniteness of the word as we meet with it in the Bible, where 'leprosy' in one connexion represents a trivial disorder, and in another a serious disease; and in a similar sense, a leper, in many instances, was nothing more than a person afflicted with a cutaneous complaint. In modern times leprosy has been found a convenient designation for that terrible disease described by the Greek fathers of medicine as elephantiasis—a disease widely spread over the world, and, according to the saying of Aretæus, so much greater than the rest of diseases as the elephant is bigger than all other animals—a disease which is universal in its diffusion through the frame, and in which all the tissues of the body are implicated to a greater or less extent. The terms *leprosy* and *lepra* are consequently quite distinct from each other; leprosy and elephantiasis being synonymous; whereas the term lepra, or rather λέπραί, in the plural, was applied by the Greeks to scaly white spots of the skin, a disease of roughness as in elephantiasis, although a disease of roughness in a very different sense. But the analogy of the two words, both in derivation and sound, has given rise to some confusion, and the confusion is increased by a misapplication of the term elephantiasis. Thus we find that whilst the elephantiasis of the Greeks has the signification of leprosy, the lepra of the Greeks is a trivial affection, sometimes styled lepra vulgaris, and very commonly, although erroneously, psoriasis. The word elephantiasis has also been applied to a local disease of hypertrophic growth known as elephantiasis Arabum; whilst the Arabians, amongst whom leprosy is also found, call that disease lepra. It therefore follows that leprosy, elephantiasis Græcorum, and lepra Arabum are synonymous terms.

The synonyms of leprosy are numerous, as may be inferred from the extensive distribution of the disease throughout the world, and its identification in different countries by different names. Amongst the most important of its synonyms are:—*Elephantiasis; Lepra; Lepra elephantia; Black Leprosy; Red Leprosy; Elephantiasis tuberosa, anæsthetica, nodosa, mutilans, leontina, satyria; Joint-evil; the Myckle Ail* or *Great Disease*, its English name in ancient times; *la Lèpre* in France; *der Aussatz* in Germany; *Spedalskshed*, throughout Scandinavia; *Likpra* in Norway; and so forth.

GEOGRAPHICAL DISTRIBUTION.—The countries in which leprosy prevails most extensively are:—Hindostan, China, the islands of the Indian Ocean, some of the Polynesian Islands, Madagascar, Africa, the West Indies, parts of South America, Norway, Sweden, and parts of Canada. Therefore, although most abundant in hot climates, it is likewise frequently met with in the North. For thirteen centuries it was endemic in Great Britain; the last case still lingered on the borders of Scotland so late as the beginning of the nineteenth century; now an indigenous example is nowhere to be found in the British Islands.

ÆTIOLOGY.—The cause of leprosy is endemic. The disease has been met with from time immemorial in certain countries and localities; therefore the cause must be one which will be capable of abiding in different countries and in different climates—climates as various in character as the northern regions and the tropics. Time was when leprosy prevailed in Great Britain, and it took up its abode there for thirteen centuries; but the disease has gone, and therefore we may presume that the cause has ceased. Whether it has ceased in consequence of drainage and more general cultivation of the soil, is a question to be carefully considered. Hitherto indigenous leprosy has been unknown in the Australian colonies; but a well-marked case of elephantiasis tuberosa has recently come under the writer's attention, having its origin in New Zealand. The patient was a man of distinguished note in Australia; he had been draining very extensively in New Zealand, and he had lived for several years amidst the exhalations of the fresh-opened soil of the marshes. The example is not solitary. An English lad was born and brought up on the verge of a marsh in the West Indies. He was sent to London on account of debility; the diagnosis was elephantiasis. A few years afterwards, his father, an officer of police, followed him home, a victim of the same disease, which had become developed since the departure of his son. The writer could multiply cases of this kind considerably, and has had the conviction forcibly borne in upon him, that the cause of leprosy is miasma. No other cause is of such general distribution, suiting every climate and every part of the world, unless it be such countries as have been relieved of the cause by land-culture and improvement. Leprosy has been assumed to be caused by bad food, and by a fish diet. There can be no doubt that an improper diet may be quite equal to the production of debility and disease, and might predispose, like any other lowering course, to the invasion of a miasma; but the disease prevails amongst the well-nourished as well as amongst the ill-nourished, and in countries where fish is rarely or never eaten; whilst fish in moderation must be regarded as a most healthful and nutritious article of diet. Leprosy is now believed to be hereditary, and it has the character of being non-contagious. Nevertheless there are some curious histories on record of the first appearance of leprosy in a population after the immigration of foreigners from a leprous country, as in the example of the importation of negroes into the district of Surinam in South America, and the origin and spread of the disease among the Sandwich Islanders after an immigration of the Chinese. This and other questions of cause must still remain unsettled until further information is obtainable. A specific form of bacillus has recently been found in leprosy, the lymphatics being believed to be the channels of infection. See *Lancet*, July 30, 1881.

Anatomical Characters.—The morbid anatomy of leprosy centres chiefly in the integument and in the nervous system. Danielssen and Boeck found the sheaths of the cutaneous nerves thickened and distended with exudative deposits, and similar changes were seen in the spinal cord. They also discovered tubercular matter in several of the internal organs, glands, and viscera. Virchow is of opinion that the pathological element of elephantiasis differs in no essential respect from that of the gummata of syphilis, nor indeed from that of lupus and glanders. Granulation-tissue is the characteristic element of all the three; the granulation tumour of elephantiasis is, however, more permanent than others of the same class, and tends in a less degree to degeneration and softening. Dr. Moxon, in a well-marked case of elephantiasis tuberosa that fell under his examination in Guy's Hospital, regarded the pathology of the disease as especially evinced by the integument, which he found atrophic and disorganised, the nerves apparently healthy, but the cutaneous nerves and veins alike involved in dyscrasic degeneration. 'We are struck,' he observes, 'with the small amount of morbid change proper to elephantiasis. The immediate cause of death was amyloid or lardaceous disease of the alimentary canal, liver, kidneys, and spleen, with marasmus in the most extreme degree. The amyloid change occurs in the same places as in other lingering but not otherwise mortal maladies.'

Symptoms.—Leprosy makes its beginning so lightly and so unobtrusively, that it is perhaps rarely detected in its earliest stage. At that period there might, after close examination, be discovered a few symptoms of debility, such as weariness, chilliness, failure of appetite, sleepiness, and lassitude. But these symptoms subside after a while, and the patient recovers his wonted energy and power; some months later similar symptoms return, but somewhat intensified; and several such recurrences may be experienced before any more obvious symptoms are made evident. The symptoms resemble those produced by malarious poison, and may be regarded as indicating the incubation of the leprous virus.

These premonitory symptoms of leprosy acquire force after repeated recurrence; and then two other symptoms make their appearance, namely, a hyperæmia of the skin, and a defective sensibility of the peripheral branches of the spinal nerves. The hyperæmia of the skin generally assumes the form of circular spots, sometimes of uniform size, at other times of blotches of irregular shape and varied extent. The isolated spots appear commonly on the trunk of the body and fleshy parts of the limbs, whilst on the face and neck, and on the hands and feet there is an uniformly diffused redness. What has already been said with regard to the progressive development of the constitutional symptoms must be repeated with respect to the local signs of the disease. At first only the face, hands, and feet may be congested, with a few spots on the trunk of the body. Then the hyperæmic congestion will subside and remain quiescent until another exacerbation of the leprous fever is imminent, when the spots will be increased in number and deepened in colour.

The redness of leprosy is dull coppery or purplish in tint; as it subsides it leaves on the skin a pigmentary stain; the affected integument is puffy with serous infiltration; the pores are dilated as if from hypertrophy of the follicles; and in general appearance the skin resembles the rind of an orange. At a more advanced stage of the cutaneous disorder the hyperæmic congestion becomes centrifugal, and the circular spot is developed into a ring; even the pigment disappears from the centre of the blotch, leaving a bleached centre surrounded by a belt which is slightly tumid, of a dull red hue, and deeply pigmented. Eventually the whole of the affected part may be represented by a white blotch. Blotches of all the three kinds may be seen at the same time dispersed over the body, some being red only, some melasmic, some leucasmic, according to their age; and others of irregular figure, arising from the blending of the circular spots, or spread out into rings of various extent.

The distribution of the maculæ or blotches of leprosy on the surface of the body corresponds with the nerve-territories of the integument, and the same may be said with regard to the face, and the extremities below the elbows and knees. On the face the parts specially affected are the superciliary regions, the nose, and the ears; and on the arms the territory of the ulnar nerve. In all these regions the blotches soon become blended; and the redness, pigmentation, and infiltration are more general than elsewhere. The suffused redness of the skin has suggested the term elephantiasis erythematosa; and this state of congestion is frequently accompanied by prominence of the follicles, and more or less desquamation and exfoliation of cuticle. In some situations the hyperæmic blotches are moistened by a greasy exudation; in others they are dry, parched, and rough.

In all the affected parts of the skin there exists a certain degree of numbness or anæsthesia. In the early stages of the disease there is scarcely any pain; nevertheless, if the ulnar nerve be pressed against the inner condyle, the pain is frequently acute, and the same occurs from pressure on the peroneal nerve. As a consequence of imperfect innervation, the fingers are frequently slender and benumbed; they are brown from pigmentation; and the metacarpal space between the forefinger and thumb is hollowed, from defective nutrition of the abductor muscle.

Varieties.—Starting with one uniform series of premonitory symptoms, leprosy after a while evinces a remarkable tendency to pursue an elective course. In the great majority of cases the prime seat of manifestation of the disease is the integument and mucous membrane; this constitutes the form of the disease known as *elephantiasis tuberosa*. In a smaller number of cases the affection of the nervous system, and particularly loss of sensation, are most conspicuous; and this constitutes the group called *elephantiasis anæsthetica*: whilst a sub-group of *elephantiasis anæsthetica* is remarkable for dislocation and amputation of the members at the joints; constituting *elephantiasis nodosa*, joint-evil, or *elephantiasis mutilans*.

In the tegumentary or tuberous group, the conspicuous symptom is the development and gradual growth of solid papules or tubercles in the skin. These originate in the centre of the hyperæmic spots already mentioned, and do not make their appearance until after the disease has existed for several months. At first they are reddish in colour; afterwards they differ little in tint from the surrounding skin. They range in size from two lines to half an inch in diameter; and are slightly convex at the summit, and hard to the touch. Their development follows the progressive exacerbations of the leprous fever; they grow while the febrile process continues, and become stationary when it abates; each exacerbation, however, adds to their bulk, and forces them on to maturity. Having reached the mature stage, they soften and break up; an ulcer is formed, which discharges for a while; and then the ulcer heals. A common seat of the tubercles is the region of the eyebrows, which they denude of hair; they also give a frowning aspect to the countenance, and when of large size add a leonine fierceness to the expression, which has suggested the term *elephantiasis leontina*. Similar phenomena to those already described manifest themselves in the fauces, the nasal cavities, and the larynx—at first hyperæmic maculæ, then tuberous prominences, and next ulceration, so that the symptoms in this region are usually severe. The voice is hoarse; the nasal passages are clogged; occasionally the septum ulcerates; and sometimes the nasal bones fall in. Tubercles likewise form along the edges of the eyelids; the conjunctiva is inflamed and thickened; the cornea becomes opaque; and sometimes the eyeball is destroyed. The lips are rendered protuberant by the tubercles, and ulcerate like the rest. The external ear is likewise enlarged and studded with tubercles, and the lobule of the pinna is remarkably elongated, suggesting, with the large tubercles on the forehead, the features of the typical satyr. Finally, the leprous congestion extends to the scalp; the hair falls off, as it does on the eyebrows; and the term *elephantiasis alopeciata* receives some corroboration. On the trunk of the body the ulcers are frequently of considerable extent; and occasionally the limbs have the appearance of being stripped of integument from the shoulders to the hands.

The ulceration of elephantiasis is not, however, restricted to the softening of tubercles; instead of, as in this instance, beginning from without, it starts in its most extensive forms from within. There is at first a general swelling of a part, such as the heel or the joint of a great-toe; a blister is raised on the skin covering the swelling; the cuticle is rubbed off; and an ulcer is quickly established. All this may occur without pain and almost without the knowledge of the patient. A large quantity of a glairy, colourless fluid is poured out by the ulcer; the sore is asthenic and sluggish; in the case of a joint the bone may be exposed, and very probably the end of a phalanx will be forced through the opening, to be followed in due time by the rest of the bone; then the ulcer contracts; the cavity closes up; and the integument heals. After a time a similar process commences in the great-toe of the opposite foot, or in the joint of a thumb, and runs the same course—either the extrusion of a bone or the healing up of an asthenic sore, after a continuance of several weeks or months. The joints of the phalanges of the feet and hands are similarly attacked from time to time, and a considerable amount of deformity of these members results. But it is worthy of note that while these morbid processes are all of them subject to the periodical canon of the disease, they alternate in their occurrence; and it is to be further noted that an excessive discharge from one of these ulcers has a derivative influence, and communicates a sense of relief to the whole system.

Elephantiasis anæsthetica differs from elephantiasis tuberosa in the more decided manifestation of disorder of the nervous system. There are the same premonitory symptoms, the same hyperæmic spots and blotches on the skin, the same pigmentary maculæ; but there is an absence of tubercles and ulceration, the numbness and anæsthesia are more decided, a general state of atrophy creeps through the system, and the sufferer is prostrated by exhaustion. Neuralgic pains, which are not wholly absent in elephantiasis tuberosa, are more obtrusive in elephantiasis anæsthetica. A sense of dulness and heat pervades the surface; and there are sensations of tingling and prickling, and of burning heat. Whilst the integument is insensible, there are deep-seated burning pains, sometimes of a bone or joint, and sometimes of the vertebral column. These pains are greatest at night; they prevent sleep, and give rise to restlessness and frightful dreams. Moreover, the skin, robbed of its sensation, is prone to vesication and excoriation, and the latter frequently ends in ulceration. The

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anæsthesia is often so great that the contact of fire or of the severest caustics occasions no sensation.

Elephantiasis mutilans is more local in its characters than either of the preceding; it is wanting in the tegumentary manifestations of elephantiasis tuberosa, and although essentially anæsthetic in its nature, the anæsthesia is local, and affects chiefly the limbs. In this form of the disease loss of the bones of the hands and feet is a conspicuous symptom; and not unfrequently the limb is lopped off painlessly at the ankle or knee, or at the wrist or elbow. When the phalanges and metacarpal or metatarsal bones are alone attacked, the last phalanx, probably from its higher vascular organisation, is generally spared; this may be the case even when the bones of the wrist are eliminated; and the hand or foot in this case is crumpled up, resembling a confused bunch of tips of fingers or toes. Often the bones are ejected; in these cases the integument heals in the most complete manner, and it is in similar cases, where considerable reparative power is obviously present, that spontaneous cure is most likely to occur. In elephantiasis anæsthetica the nervous system is too deeply and seriously implicated to admit of spontaneous cure; and in elephantiasis tuberosa the tegumentary system, both cutaneous and mucous, is likewise too extensively damaged to render cure a rational expectancy.

Prognosis.—The prognosis of leprosy is essentially unfavourable. A disease which tends to the continuous degeneration of the skin and mucous membrane, with general dyscrasia of the entire organism; which is impelled onwards by a law of periodic progression; and which has no tendency to spontaneous resolution, must necessarily be fatal, the only question being one of duration. A very few instances are on record in which individuals afflicted with this disease have survived, and these principally from amongst the cases of elephantiasis mutilans; but such instances must be regarded as the rare exception, rather than the rule. The tuberous form of the disease is more rapid in its termination than the anæsthetic form; and the duration of life in both ranges from about ten to twenty years.

Treatment.—The treatment of leprosy resolves itself into, first, the employment of means intended to promote improvement in the general health; and, secondly, the adoption of such empirical remedies as have acquired a favourable reputation for the cure of the disease. In the first category we must place the removal of the patient from the locality wherein the disease has been engendered, and possibly to one where the disease is unknown. Next would follow a liberal and generous diet, such as animal food and beer; with active exercise. Thirdly, tonic and nutritive remedies, such as cod-liver oil, iron, quinine, strychnine, bitters, and phosphates, should be given. Nitric acid has been praised by one physician, and acetic acid in combination with carbolic acid by another. There can be no doubt that under a generous regimen the patient will improve in health and strength; the periodical exacerbations of fever will be less frequent, and hope will gleam in the mind, both of the physician and the patient; but cure, alas! is as distant as ever.

Specific alteratives have been exhausted with equal want of success. Iodine has failed. Danielssen and Boeck administered arsenic largely; and the perchloride of mercury has been extensively used by Beauperthuy. When these and other remedies are employed judiciously, in combination with a generous diet, moderate exercise, and thorough stimulation and inunction of the skin, the symptoms invariably improve for a time; but the disease as certainly falls back into chronic sluggishness and smouldering inactivity when they are relinquished or neglected.

The principal empirical remedies which have been recommended in this disease are:—the asclepias gigantea; hydrocotyle asiatica; veronica quinquefolia; chaoulmoogra oil, and gurjun balsam. The asclepias or rumex gigantea, the mudar of Hindostan, has received the name of vegetable mercury. The part of the plant employed medicinally is the root-bark, reduced to powder; and the dose of the latter is half a drachm daily. The hydrocotyle asiatica, in the form of powder of the dried plant, is given in doses ranging between one and six grains daily, and is also administered as an infusion, a syrup, and an extract; its active principle is vellarine. The medicinal part of the veronica quinquefolia is its root, and ten ounces of the root has been mentioned as a quantity sufficient to cure a leprosy. The chaoulmoogra oil is procured from the seed of an Indian tree, the chaoul moogra or gynocardia odorata. It is administered both internally and externally, the dose for the former purpose being six to twelve minims, three times a day. A tincture of the plumbago rosea has also been found serviceable in cases of anæsthetic leprosy; the dose being one drachm three times a day.

More recently Dr. Joseph Dougall has recommended gurjun balsam or wood oil as a very promising and successful remedy. It is an oleo-resin, obtained from one of the species of the dipterocarpus tree of India; and is given in the form of an emulsion, in combination with an equal proportion of lime-water, the dose of the emulsion ranging between two and four drachms twice a day. Or it may very conveniently be administered in capsules, each containing a drachm.

The local treatment of leprosy consists in stimulation of the skin by means of hot-air baths, followed by frictions and inunction with bland and stimulating oils. Ointments and liniments of the specific remedies already mentioned, namely, mudar, hydrocotyle, and gurjun, have been used for this purpose, as well as for dressing the ulcers. Danielssen and Boeck employed counter-irritants in the course of nerves presumed to be affected, with cupping and moxæ to the spine in anæsthetic leprosy; whilst they treated the tubercles of tubercular leprosy with the acid nitrate of mercury, and with a strong solution of potassa fusa. Beauperthuy found benefit result from the acrid irritating oil of the shell of the cashew nut (*Anacardium orientale*) used as a blister to the tuberous skin; a copious exudation followed the application, and relieved both the local and the constitutional symptoms. The gurjun treatment is accompanied by energetic frictions with a liniment composed of equal parts of the balsam and lime-water, the same as the emulsion taken internally; and asthenic ulcers are pencilled with a solution of chloride of zinc.

A review of these various methods of treatment, and a consideration of the personal attention required by the patient suffering under this terrible disease, are suggestive of the observation that it can only be effectually treated in an institution devoted especially to the purpose.

Erasmus Wilson.

LEPTOMENINGITIS (λεπτὸς, delicate or thin, and *méningitis*).—A term signifying inflammation of the pia mater. By its use, in association with arachnitis and pachymeningitis, we are enabled accurately to indicate the precise seat of inflammation involving the meninges of the brain or spinal cord. There is a practical convenience, warranted by pathological facts, in retaining the term arachnitis, although anatomists are not now disposed, as they were formerly, to believe in the existence of an arachnoid membrane, distinct, externally from the dura mater, and internally from the pia mater. *See* Meninges, Diseases of.

LEPTOTHRIX (λεπτὸς, delicate or slender, and θρὶξ, a filament or hair).—*Leptothrix buccalis* is a name assigned by Robin to certain vegetable parasites or minute filaments, which can be recognised by means of the microscope, amongst the epithelial scales of the tongue or other parts of the mouth; and especially between the teeth, or in the hollows of decayed teeth. They occur in healthy persons, as well as in the sick, and have in this situation really no pathological signification. Organisms of the same kind are, however, now commonly named *bacilli*, and have during the last two or three years been recognised as exceedingly common in many organic solutions, and also within the blood and tissues of animals and of man suffering from splenic fever (*see* Pustule, Malignant). Some regard them as constituting a distinct genus, whilst others believe them to be only one of the multitudinous forms that may be assumed by bacteria, when growing in certain kinds of media. *See* Bacteria; and Micrococci.

Dermatologists also employ the term leptothrix to indicate a morbid thinness and weakness of the hair.

LESION (*lædo*, I hurt.)—This word originally signified a hurt or an injury; but its use is now extended to comprehend all organic changes of a morbid character, affecting an organ or tissue.

LETHARGY (λήθη, oblivion, and ἀργία, idleness).—A disorder of consciousness, which consists of prolonged and profound sleep, from which the patient may be momentarily aroused, but into which he falls off again immediately. *See* Consciousness, Disorders of; and Trance.

LEUCE (λευκὸς, white).—This term has been applied to blotches in the skin of a white colour; and hence it has alternately been confounded with lepra alphoides, with vitiligo, and with the leucodermic blotches of leprosy. It seems, however, more than probable that the pathological condition intended to be signified by this word, is a circumscribed scleriasis, namely, that which we at present term *morphœa alba*. *See* Morphœa.

Erasmus Wilson.

LEUCIN (λευκὸς, white).—Leucin, the chemical composition of which is $C^{12}H^{13}NO^{4}$, is a product of decomposition of albuminous bodies. It may be obtained from them by the action of caustic alkalies, or by long boiling with sulphuric acid. It is found in the secretion and substance of the pancreas, in the spleen, thymus, thyroid, suprarenal bodies, lymphatic glands, salivary glands, liver, kidneys, and brain. It is also found in old scales of the epidermis, and in ichthyosis, old toe-nails, and sebaceous cysts. Pathologically it occurs in abundance in the urine and liver of those who die of acute yellow atrophy; and, it is said, in the urine of those suffering from severe typhoid and variola, although there is no chemical proof of this. Leucin is thought by some physiologists to be a stage in the decomposition of albuminous matters into urea. Under the microscope it is seen as round balls, having some resemblance to drops of oil, sometimes hyaline, sometimes with radiating marks, sometimes with concentric rings. The test for leucin with the microscope is very untrustworthy taken alone. Nearly every urine can be made to give this evidence. If leucin is to be looked for, it must be separated by the following process. The urine is precipitated with acetate of lead, filtered, and the excess of lead removed from the filtrate with sulphuretted hydrogen. The filtrate must be next evaporated to dryness; the residue extracted with boiling alcohol and filtered; and the filtrate evaporated to a syrup. If leucin be present, it separates in the form of the crystals described above. Chemical tests must now be applied to the crystals. A small portion is evaporated to dryness in a platinum crucible with nitric acid; and if leucin be present, a colourless, almost invisible, residue is left, which becomes yellow or brown when warmed with a few drops of soda solution. Leucin is almost always found associated with tyrosin. *See* Tyrosin.

J. Wickham Legg.

LEUCOCYTHÆMIA (λευκὸς, white, κύτος, a cell, and αἷμα, blood).—Synon.: *Leukæmia* (Virchow); *Splenopathia leucocythæmia* (Huss); Fr. *Leucocythémie*; *Diathèse lymphogène à forme leucémique* (Jaccoud); Ger. *Leucocythämie*.

Definition.—A chronic disease, in which there is a considerable and permanent increase in the number of the pale blood-corpuscles; usually associated with enlargement of the spleen, sometimes also with that of the lymphatic glands, and with disease of the medulla of bone.

The term leucocythæmia proposed by the late Dr. Hughes Bennett is a convenient and significant designation, the essential feature of the disease being the excessive proportion of leucocytes in the blood. The term *leukæmia*, proposed by Virchow, is less obviously accurate, since the blood (as Parkes urged) although appreciably paler than normal, is not white.

Excess of leucocytes in the blood, slight or transient, is known as leucocytosis, and is met with in many morbid states. Permanent excess, sometimes considerable, but rarely very great, also occurs, associated with a primary enlargement of the lymphatic glands—'lymphatic leucocythæmia.' These cases differ in many important respects from the cases of leucocythæmia associated with primary enlargement of the spleen; so that it is most convenient to describe them in connection with lymphadenoma, and to consider here only cases of splenic leucocythæmia. *See* LYMPHADENOMA.

HISTORY.—Pallor of the blood, as if pus were mixed with it, was noted by Bichat in the beginning of this century; and the combination of this appearance with enlargement of the spleen, was observed by Velpeau in 1827. The dependence of this alteration in the blood on an excess of pale corpuscles was described by Donné in 1844, and interpreted by him as due to imperfect transformation of white into red corpuscles. In 1845, two cases of the disease were published together, the one by Dr. Craigie, the other by Dr. Hughes Bennett; and to the latter appears to belong the credit of recognising the salient features of the affection as a distinct malady. A month later, however, Virchow published another case, independently and admirably worked out. In all these cases the change in the blood was only recognised after death. It was first observed during life in 1846, by Dr. H. W. Fuller, and subsequently by Dr. Walshe. In Germany the first case was diagnosed during life, by Vogel, in 1848. Since then numerous cases and descriptions of the disease have been published, of which the more important are those of Virchow, Hughes Bennett, Vidal, Huss, Ehrlich, and Mosler.

ÆTIOLOGY.—In only a small proportion of cases of leucocythæmia can any causation be traced. Race, as such, seems to be without influence. Heredity has only been traced, as a history of splenic disease in ancestors or collaterals, in one or two isolated instances. The disease is twice as frequent in men as in women. It may occur at all ages. It is very rare under the age of ten, and the numbers gradually rise, taking both sexes, to the decade between thirty and forty, when nearly one-third of the total occur (46 out of 154 cases). After forty they fall in each decennial period. In females, however, the maximum is reached in the period between forty and fifty; and of eleven cases over sixty collected by the writer, only one was in a woman. Position in life appears to exercise no influence on the occurrence of the disease. Depressing influences, inanition, over-exertion, and especially depressing mental emotion, are antecedents which have been occasionally noted. Sexual processes, in women, appear to have a distinct influence. The disease has been seen to be most frequent, in them, during the climacteric decade, and practically to cease when the menstrual epoch is over. In some cases the disease has commenced during pregnancy; in a larger number it has succeeded parturition. Injury to the spleen seemed, in one or two recorded cases, to be the cause of the disease. Small-pox, typhoid fever, acute rheumatism, pneumonia, and syphilis, have been supposed to be causes of the affection, but the ætiological relation is doubtful. Of all antecedent conditions, intermittent fever is incomparably the most frequent. In one-fourth of the total number of cases (150) analysed by the writer, there was a history either of ague or of residence in an ague district. The interval between the malarial affections and the disease varied from a few months to thirty years. The fact that, in many cases, a long period elapses, and that the attacks of ague, in some instances, were trifling, makes it probable that, in the cases in which the patients had merely lived in an ague district, the malarial influence, which did not cause ague, led to morbid changes which eventuated in the leucocythæmia. One patient under the writer's care, a middle-aged woman, had lived in a malarial district only during the first few years of her life, but, shortly before her birth, her mother had suffered from an attack of ague.

ANATOMICAL CHARACTERS. — *Blood.* — The blood, as seen after death or during life, is paler than normal, and may even be greyish-red in colour. In extreme cases coagulation is imperfect; a grumous chocolate-brown mass results. After defibrination three layers form—red corpuscles, pale corpuscles, and liquor sanguinis. Under the microscope the pale corpuscles are seen to be in great excess: instead of two or three *per* field, as in the normal, there may be several hundreds. Enumeration (*see* HÆMACYTOMETER) shows that not only are the white corpuscles increased, but the red are lessened out of proportion to the increase in the white, so that the total number of corpuscles is always diminished. Instead of the normal 5,000,000 per cubic millimètre, there may be only 2,500,000 or even 1,150,000 (50 and 23 per cent. of the normal). The proportion between the white and red varies, being 1–20, 1–10, 1–5, 1–2, or 1–1; or the white may be the more numerous. The apparent is greater than the real excess of white, in consequence of the closer contact of the red. It was proposed by Magnus Huss to regard as leucocythæmia only those cases in which the proportion is greater than 1 to 20, and the rule has been largely followed; but it must be remembered that in commencing cases the proportion may be smaller than this. The greatest change hitherto recorded was a reduction of the red from 5,000,000 to 470,000 per cubic millimètre (9 per cent. of the normal), and an increase of the white to 680,000 per cubic millimètre instead of 15,000, the normal average. The pale corpuscles may be of normal size; but usually some are large; and often many are smaller than normal (the *globulins* of Donné), especially when the lymphatic glands are affected. Reagents bring into view one to four nuclei. Some of the corpuscles present obvious fatty degeneration. The red corpuscles are usually normal in appearance, sometimes unduly pale. Nucleated coloured corpuscles have been seen in a few cases, believed to be intermediate forms between the white and red corpuscles. The specific gravity of the blood is lessened from 1,055, the mean in health, to an average of 1,042; the change being due to an increased proportion of water, from 790 parts per 1,000 in health, to 840 in leucocythæmia. The fat and fibrin are increased, and the latter sometimes presents a peculiar granular appearance. The iron is lessened. Abnormal constituents have also been found in the blood, such as the albukalin of Reichardt, mucin, a substance analagous to glutin, hypoxanthin, lactic and formic acids. Minute octohedral crystals have been found in the blood and in many organs after death, about ·016 mm. in length. Their nature is uncertain. Since they have been found only after death, it is conjectured that the substance of which they consist is held dissolved during life. They are not peculiar to this disease.

Organs.—The *spleen* is always enlarged, sometimes extremely. Its weight varies from twice to fifty times the normal—1 lb. to 18 lbs. The average of 72 cases analysed was about 6 lbs. The average length is nearly 12 inches. The enlargement is commonly uniform; the shape of the organ being preserved. The surface is smooth, but often presents traces of local peritonitis, in the form of yellowish opaque patches. It is frequently adherent to the diaphragm, omentum, abdominal wall, intestines, or liver. Its consistence is usually increased, rarely diminished. The cut surface is smooth, and yields comparatively little blood; it is brownish-red, or even brownish-yellow, marbled with paler lines, due to thickened trabeculæ. The Malpighian follicles are not usually conspicuous. In cases which begin with enlargement of the lymphatic glands, and which are really cases of primary lymphadenoma, the Malpighian follicles may be so enlarged as to constitute small growths. There is rarely an area of distinct softening. Wedge-shaped, yellowish-white, caseous portions are frequent, and are evidently infarcts; when recent they are deep red. The histological change in the organ is an overgrowth of the splenic pulp; the trabecular tissue is increased; and so also is the retiform tissue of nucleated fibres and cells, among which the lymphoid corpuscles lie. The Malpighian bodies may not be discoverable with the microscope, or they may be found to have undergone fatty or lardaceous degeneration. The infarct-like masses present the splenic tissue-elements in a state of fatty degeneration. In many cases the crystals, already described, have been found in the spleen in great abundance. This organ has been found by analysis to contain glutin, glycocoll, hypoxanthin, xanthin, leucin, and tyrosin.

The *lymphatic glands*, some or many, are enlarged in one-third of the cases of primarily splenic leucocythæmia (51 out of 157 cases). The order in which the several groups are affected is, beginning with the most frequent, the mesenteric, cervical, inguinal, axillary, retro-peritoneal, thoracic, portal, and iliac. In only five cases was the change universal. The enlargement is not considerable, the individual glands rarely attaining the size of a walnut. They are usually smooth, soft, grey, or reddish-white on section; rarely caseating or suppurating; sometimes presenting hæmorrhagic extravasations. Their minute structure differs little from the normal. Lymphoid corpuscles lie in an adenoid reticulum, which is rarely increased, as it is in lymphadenoma.

With respect to the *alimentary canal*, the gums are occasionally swollen and ulcerated, the swelling being due to infiltration of the gum with leucocytes, or to an actual lymphoid growth. The tonsils and follicles of the tongue are sometimes enlarged by lymphoid growth; and there may be a similar change, usually slight, in the lymphoid tissue of the wall of the stomach, and much more considerable in the solitary and agminated glands of the small intestine. These growths frequently ulcerate. Similar changes are also found in the large intestine. The *peritoneum* sometimes presents similar growths. The *liver* is enlarged in at least two-thirds of the cases, varying in weight from 5 lbs. to 14 lbs. In some cases of slight enlargement no structural change beyond congestion has been found; frequently, however, there are disseminated lymphoid growths, minute, greyish-white, commonly interlobular in position, often surrounding branches of the portal vein. The capillaries are always distended with pale corpuscles. Fatty degeneration of the liver-cells is also common. The *kidneys* are abnormal in at least one-half of the cases. They may be simply pale from anæmia; pale and enlarged, from granular degeneration of the cells, and distension of the capillaries with leucocytes; or they may present minute growths similar to those in the liver, and situated between the tubuli of the cortex, especially near the glomeruli. Marked fatty degeneration of the kidney has also been found. The *suprarenal bodies* have been found diseased in several cases, and in one or two there was bronzing of the skin. The *thymus* and *thyroid* glands have also been found enlarged. The *heart*, as in other cases of intense anæmia, may present granular and fatty degeneration. Extravasations of blood have been found beneath the endo- and pericardium. Its capillaries are often distended with leucocytes. Pericardial effusion is common. The *lungs* may present simply distension of capillaries, or hæmorrhagic infarcts, or actual growths, similar in structure to those found elsewhere. These commence at the bronchi and infiltrate adjacent tissues. Rarely they may break down and form cavities. Pleural effusion is very common, and lymphoid growths have been found on the membrane. In the *brain*, hæmorrhages, usually multiple, constitute the most frequent change. Minute growths in the membranes, distension of the meningeal vessels with pale blood, and their obstruction by masses of leucocytes (Bastian), have also been recorded. The *skin* is, in rare cases, the seat of growths. The *bones* have lately been found diseased in many cases (Ranvier, Neumann, &c.). The marrow is grey or reddish-grey, diffluent, and presents lymphoid cells and blood-corpuscles. Sometimes cells intermediate between white and red corpuscles have been found in it. The vessels are fewer than normal. The change may be found in all the bones, most marked in those which possess most spongy tissue, as the ribs and vertebræ, but also considerable in the long bones. Externally the bones may be normal or enlarged. The compact substance may be reduced in thickness, and even perforated (Mosler). The *retina* is frequently diseased. Hæmorrhages may be found, especially in the nerve-fibre layers, and adjacent to them the retinal elements may be degenerated. The capillary vessels are filled with pale corpuscles, and actual lymphoid growths have also been found.

Symptoms.—Of the early symptoms of leucocythæmia, the most frequent are those due to the splenic enlargement, namely, abdominal fulness, pain, or an actual tumour. Next in frequency is weakness. Hæmorrhage, especially epistaxis, often occurs early, but rarely before other indications of ill-health. The change in the blood causes pallor of skin and mucous membranes, shortness of breath, and all the indications of anæmia. To its defect a large number of the symptoms to be described are due. The altered characters of the blood, readily observable during life, have been already described. The temperature is frequently, but not invariably, raised. It is commonly higher in the evening than in the morning; the evening rise usually reaching 101°–104°. The morning fall may be considerable or slight. Sometimes periods of considerable pyrexia alternate with others in which there is little fever. The cases in which there is most pyrexia are usually, but not always, those of most rapid course. The enlargement of the spleen presents the typical characters of a splenic tumour. It may occupy the whole left half of the abdomen, extend even beyond the middle line, descend into the iliac fossa, and even into the pelvis, so as to be perceptible by vaginal examination (Spencer Wells). It may vary in size from time to time. Friction may sometimes, and a *bruit de souffle* rarely, be heard over it. It usually causes an unpleasant sense of distension, is often tender, and sometimes is the seat of spontaneous pain. By its pressure it may raise the heart, cause considerable dyspnœa, and interfere greatly with the functions of the stomach. The distension of the abdominal wall may cause lines, similar to those of pregnancy, to appear over the spleen, and their position is sometimes distinctly determined by the course of vessels. The enlargement of the glands is rarely sufficient to give rise to other symptoms than the obtrusive evidence of their presence. The glands thus present, in this disease, a marked contrast to their condition in lymphadenoma. They often lessen in size before death. The alteration in the bones is usually unattended by symptoms. Rarely they become distinctly enlarged and tender. The action of the heart is disturbed by both the anæmia and the displacement. The pulse is frequent; and palpitation is common. The circulation is impeded; effusion of serum into the cellular tissue of the body is almost invariable in the later stages of the disease. Slight ascites is frequent, and great effusion is sometimes due to the pressure of enlarged glands on the portal vein. Hydrothorax is also common. The most striking circulatory symptom is hæmorrhage, which occurs in a large proportion of cases, most frequently from the nose, and less frequently from the bowels, stomach, lungs, uterus, into the skin, brain, joints, cellular tissue, or peritoneum. The hæmorrhagic tendency is so great that slight injuries may give rise to serious loss of blood; the extraction of a tooth, or the puncture for paracentesis, has thus led to death; while most cases in which excision of the spleen has been attempted have been fatal from the same cause. The respiration is usually interfered with, partly from the splenic enlargement, and partly from the anæmia; that due to the former is increased by the recumbent posture. The anæmic dyspnœa may be unnoticed when the patient is at rest, although any considerable movement causes an agony of breathlessness. The dyspnœa is also increased by changes in the lung, bronchial catarrh, and the frequent pleural effusion in the later stages. Cough is frequent, and may be an early symptom of the disease. The change in the gums, already described, may lead to ulceration—the 'leukæmic stomatitis' of Mosler; but it is more rare in this disease than in lymphadenoma. The gastric functions are chiefly interfered with by the pressure of the spleen, which causes dyspepsia, and often vomiting. Diarrhœa is extremely common, and may be accompanied by hæmorrhage. The enlargement of the liver may be recognised during life, but rarely gives rise to subjective symptoms. Jaundice only results from compression of the bile-ducts by enlarged glands. A yellowish tint of skin is, it may be remarked, frequent, apart from true jaundice—the 'icterus lienalis'; it probably results from the anæmia, the altered blood being unable to destroy the bile-pigment absorbed into it from the intestine. The urine varies in amount, but is usually strongly acid, and of high specific gravity. The amount of urea is unaltered, that of uric acid is increased. Hypoxanthin, lactic acid, and formic acid have been found in it. Albumin is rare, apart from structural changes in the kidneys. Menstruation is usually arrested. The functions of the nervous system are disturbed by the altered blood; languor, tinnitus, and vertigo are frequent; and slight mental failure, delirium, and coma are occasionally met with. The graver symptoms are probably due to capillary obstruction by masses of leucocytes, or to small hæmorrhages. Besides the noises in the ears, deafness is common, especially towards the end. In the fundus oculi, changes may usually be seen with the ophthalmoscope. The pallor of the blood in the retinal and choroidal vessels is conspicuous. The retinal veins become very broad, and are often tortuous. Extravasations of blood are almost invariable at some period, usually striated, sometimes rounded. Yellowish or white spots are sometimes seen, due to the collections of lymphoid cells already described. Occasionally the retina is irregularly thickened, so that the vessels present conspicuous antero-posterior curves. These changes constitute the 'leukæmic retinitis' of Liebreich. The extent to which sight is interfered with depends on the degree to which the neighbourhood of the macula lutea is involved. The skin is strikingly pale, or sometimes, as already stated, greenish yellow. Occasionally a peculiar dark pigmentation is present. Sweating is common.

Complications.—The most frequent complications of leucocythæmia are pleural effusion, œdema of the lungs, lobar pneumonia, bronchial catarrh, pericardial effusion, dilatation of the heart, venous thrombosis, cerebral hæmorrhage, and fatty degenerations; and the more rare are cirrhosis of the liver; parenchymatous degeneration of the kidneys, giving rise to the symptoms of subacute Bright's disease; renal calculi; persistent or intermittent erection of the penis, the former probably due to thrombosis in the corpora cavernosa; œdema of depending parts; ascites; furuncles; and erysipelas. The various hæmorrhages are rather to be regarded as symptoms of the disease than as complications.

Duration.—Cases of splenic leucocythæmia vary in duration from six months to seven years.

One or two recorded cases ran their course in less than six months. The average duration of sixty-three cases was two years. The actual duration of the affection is probably longer than this, because the disease has often reached a considerable degree before the symptoms became troublesome.

Causes of Death.—The most common causes of death in leucocythæmia are loss of blood, asthenia, diarrhœa, cerebral hæmorrhage, pneumonia, and pleurisy. In asthenia the actual end is often due to cardiac failure. The hæmorrhage most frequently fatal is from the nose, the next most frequent from the bowels.

Pathology.—The pathology of leucocythæmia is still involved in obscurity. We are imperfectly acquainted with the normal life-history of the blood-corpuscles. For a full discussion of the facts which have been ascertained, and the theories built upon them, the reader is referred to the writer's article on the disease in Reynolds' *System of Medicine*, Vol. v. It is only possible here to give a brief outline of the pathology of the disease which these facts and theories suggest. Recent researches make it probable that the red corpuscles arise from a transformation of the smaller lymphoid cells—*globulins* of Donné, hæmatoblasts of Hayem—and that this transformation takes place to a large extent in the splenic pulp and in the marrow of bones, tissues which have many histological characters in common. If these tissues are diseased, the transformation may not take place, and the unchanged lymphoid cells may develop into the ordinary leucocytes, which are either retained in these tissues, increasing their bulk and changing their structure still further, or pass into the blood. Both results probably occur. Hence we assume a primary change of the splenic pulp, which is increased further by the retained leucocytes. Where the hæmatoblasts arise, is still uncertain—they are probably in part developed in the splenic pulp and marrow of bones, from pre-existing cells, and from the protoplasmic trabeculæ of the tissues (Klein); probably in part they come from the true lymphatic structures, the glands, Malpighian follicles of the spleen, &c. Primary disease of these lymphatic structures constitutes lymphadenoma; and the splenic pulp may be normal, and the leucocytes are only in slight excess, or are not more numerous than they should be. In true splenic leucocythæmia, the glands and Malpighian follicles are not primarily diseased, but they may suffer secondarily, when lymphatic growths arise in organs; and this secondary affection is in part the result of the accumulation of leucocytes. That the enlargement of the spleen is not, as has been thought, merely the result of the accumulation in it of pale corpuscles from primarily diseased blood, is shown by the increased consistence of the organ, and by the fact that the splenic tumour precedes the change in the blood. There is some reason to believe, that as the spleen alone may be diseased, so, in some rare cases, the marrow of bones may alone be diseased, and may give rise to a primary 'myelogenic leucocythæmia,' but this is not yet proved. That the disease may be primary in both the marrow and the spleen, is highly probable, from recorded facts. It is certain, however, that the marrow is, in most cases, not affected primarily, and may be unaffected throughout, or may suffer secondarily, as do the glands. The same is true of the collections of lymphatic tissue elsewhere in the body. The cases in which the lymphatic glands enlarge early—'lymphatico-splenic leucocythæmia'—are, for the most part, if not entirely, cases of composite nature. The spleen presents a double change—growths in the follicles, such as are associated with the glandular growths in lymphadenoma (Hodgkins' disease), and increase in the splenic pulp, as in pure splenic leucocythæmia. In such cases there may be a large increase in the pale corpuscles of the blood.

Diagnosis.—The diagnosis of leucocythæmia rests on the existence of enlargement of the spleen, and a considerable excess of leucocytes in the blood. In all cases of splenic tumour, the blood should be examined; if the proportion of white corpuscles to the red is greater than 1 to 20, the case is certainly one of leucocythæmia. But if the proportion is less than this, leucocythæmia cannot with certainty be excluded, because it is probable that, in all cases, the splenic tumour and anæmia precede the leucocytal excess, and the latter may be in process of development. To ascertain the actual state of the blood, it is always desirable to enumerate the corpuscles with the hæmacytometer. Repeated examination, to ascertain that the proportion of pale corpuscles is not increasing, is necessary before impending leucocythæmia can be excluded. In cases in which the lymphatic glands enlarge early, the question arises whether the case is one of splenic leucocythæmia, or of Hodgkins' disease. In the latter, as just stated, the enlargement of the spleen depends, not on an increase of the splenic pulp, but on overgrowth of the Malpighian follicles; the splenic enlargement is less than in leucocythæmia, and is less uniform. In the composite cases alluded to above, in which, with enlargement of the glands and splenic follicles (lymphadenoma), there exists also overgrowth of the splenic pulp, and a considerable leucocytal excess in the blood, the two morbid processes are conjoined, and the affection may be termed lymphadeno-splenic leucocythæmia. These cases are distinguished from the simple splenic affection by the early enlargement and firmness of the glands. In simple splenic leucocythæmia the affection of the glands is usually late, and rarely considerable. The diagnosis of the disease from conditions in which a considerable excess of pale corpuscles exists, without enlargement of the spleen, is usually easy, because such excess is transient, soon passes away, and is not associated with a splenic tumour.

Prognosis.—The prognosis of a disease which depends on a primary affection of the blood-forming organs is necessarily most grave. No means of arresting the progress of the developed disease has yet been discovered. The immediate prognosis is less serious in proportion as the evidence of organic changes in the blood-forming organs is slight, and in proportion to the early stage of the disease. Neither age, sex, nor causation affords prognostic information. The greater the number of white corpuscles and the deficiency of red, as ascertained by counting, the worse the prognosis. The size of the spleen, alone, affords little information. Hemorrhages are of grave augury, but epistaxis least so.

Treatment.—The knowledge of the causes of leucocythæmia, slight though it is, suggests important prophylactic measures—the prevention of ague, and the careful treatment of all who have been exposed to malarial influences. Splenic tumours resulting from such exposure should be systematically treated; the subjects of them should exercise great care to avoid exposure to cold, injuries, and all causes of portal congestion. These precautions are especially necessary in women at the menstrual periods; and if such women bear children, their state during pregnancy and after parturition should be carefully supervised, and lactation prohibited. Whether there is simple anæmia or leucocythæmia, every effort should be made to reduce the size of the splenic tumour, by quinine, cold affusion, ergotine, and especially by voltaic electricity, a most powerful agent. By obtaining contraction of the spleen, expelling retained leucocytes, and perhaps stimulating directly its functional action, we render its condition less abnormal. In a case of anæmia splenica no remedies improved the blood-state till the spleen was galvanised, when the red corpuscles at once began to increase. Remedies which do good in ordinary anæmia have slight influence in this disease. Iron is almost useless; cod-liver oil, however, has seemed to do some good. Arsenic has been largely tried, but without benefit in pronounced cases. Its undoubted value in lymphadenoma suggests its further trial in early cases; it should be given in the largest doses that can be borne. Phosphorus has been recommended, but in almost every case of pronounced leucocythæmia it has been powerless for good. Nevertheless, its influence in improving the blood-state in lymphadenoma warrants further trial in the early stage of the disease. Iodides, bromides, and mercury are useless. Change of air may slightly improve the patient's state, but has no influence on the disease. Transfusion has been tried, but the results are not encouraging. Excision of the spleen has been suggested. The operation has been performed with success in cases of anæmia splenica, but in actual leucocythæmia the operation has been invariably fatal—in most cases from uncontrollable loss of blood, the result of the hæmorrhagic tendency. Further trial of it, in such cases, is not justifiable. In early cases, where there is no considerable excess of pale corpuscles, and the red are not reduced below sixty per cent. of the normal, it might be successful; but it is questionable whether, in such cases, the ultimate issue without interference is sufficiently certain to justify the performance of so grave an operation. Special symptoms may require treatment. Hæmorrhage must be checked by the usual methods, and crystals of perchloride of iron may be applied to accessible places (Jenner). For vomiting, a posture which will relieve the stomach from pressure, and counter-irritation, are useful. Aperients should be employed with caution; and under no circumstances should the yellow tint of the skin lead to the use of mercurials. For the œdema, digitalis and other diuretics are best. For the splenic pain, counter-irritation, sedative liniments, and hypodermic injections of morphia may be used. In proportion to the anæmia, physical rest is important, that the diminished supply of oxygen may not be rendered inadequate for the need of the tissues, by muscular exertion. W. R. Gowers.

LEUCOCYTOSIS (λευκὸς, white, and *κύτος*, a cell).—A condition of the blood, in which the white corpuscles are appreciably but moderately increased. *See* Blood, Morbid Conditions of.

LEUCODERMA (λευκὸς, white, and *δέρμα*, the skin).—White or achromatous integument. *See* Pigmentary Skin-Diseases.

LEUCOMA (λευκὸς, white).—A white opacity of the cornea, generally referable to inflammation or ulceration of that structure. *See* Eye and its Appendages, Diseases of.

LEUCOPATHIA (λευκὸς, white, and *πάθος*, a disease).—Synon.: Albinism, Achroma, Leucoderma, Leuce, Leucasmus.

This disease is sometimes general, but frequently partial; in the latter form constituting *cutis variegata* and 'piebald skin.' The whiteness is referable to absence of pigment, which may be simply due to an arrest of function of the rete mucosum, or to an organic alteration of the integument. *See* Pigmentary Skin-Diseases.

LEUCO-PHLEGMATIC TEMPERAMENT. *See* Temperament.

LEUCORRHŒA (λευκὸς, white, and *ῥέω*, I flow).—Synon.: Fr. *Leucorrhée*; Ger. *Weisser Fluss*; Lat. *Fluor Albus*; Pop. 'The Whites'; 'White Discharge.'

Definition.—A non-hæmorrhagic discharge, of pale colour, escaping from the female genital fissure.

Ætiology.—Leucorrhœa is a symptom rather than a distinct disease; and is found resulting from all the morbid processes that lead to hyper-secretion from the genital mucous surfaces, or from the glands opening upon them, whether the mucous membranes be injured or entire. It is, however, a source of much discomfort and deterioration of health, and so demands special treatment.

Symptoms.—Leucorrhœa presents several distinct varieties according to the seat of its cause; and the symptoms of each variety require separate consideration.

1. **Vulvar Leucorrhœa.**—In this variety a glairy viscid secretion is found bathing the apposed surfaces of the pudenda, stiffening into a crust on the surface of the labia majora or on the insides of the thighs, and sometimes glueing the lips more or less firmly together at their margins. It is usually derived from the muciparous glands covering the internal surfaces of the labia majora and the nymphæ; but in cases of special eruptions and general vulvitis it may come from the vestibular surface; and in still rarer cases it is poured out from the glands of Bartholin. Vulvar leucorrhœa is met with at any period of life, but is most common in the young, *infantile leucorrhœa* almost always being of this variety. In cases of gonorrhœal infection

in the female, the vulva is usually the seat of a profuse discharge that is apt to become purulent, but it is rarely confined to this situation, spreading both into the urethra, and upwards into the higher spheres of the genital mucosa.

2. **Vaginal Leucorrhœa.**—The discharge in cases of vaginal leucorrhœa is most frequently white in appearance, of acid reaction, and due to a secretion from the general surface of the vaginal mucous membrane. Its whiteness, on microscopic examination, is found to be owing to the presence of quantities of scaly epithelial cells, many of which are crowded with fatty particles, whilst others have been quite dissolved in consequence of the fatty degeneration. Sometimes the discharge has a more yellowish tint, and then it is found to contain quantities of pus-cells among the epithelial scales. In the former group of cases we have to do with a simple catarrhal condition of the vaginal mucosa; in the latter there are red granulation-like spots scattered over the membrane, which has here lost its epithelial covering. Vaginal leucorrhœa is a complaint to which women are specially liable during their reproductive life. The catarrhal form is extremely common in young married females; whilst the other form occurs rather about the ménopause, or, if occurring earlier, is complicated with some of the other varieties of leucorrhœa. Apart from specific causes, it may be brought on by sexual excesses; by the presence of a foreign body, such as a pessary; by a displaced uterus; by a chill; or by any condition that interferes with the circulation in the pelvis. In a large proportion of cases it is secondary to the next variety of leucorrhœa.

3. **Cervical Leucorrhœa.**—The discharge that comes from the canal of the cervix uteri is transparent, like unboiled white of egg, very tenacious, and of alkaline reaction. It may still present these characters as it escapes from the pudenda; but it generally becomes somewhat clouded as it passes through the vaginal canal, and gets acted upon by the acid secretion from the vaginal walls. Independently of this change in the vagina, it is sometimes found already more or less opaque as it lies within the cervical canal, and may be seen of a yellowish or greenish or reddish tint in various cases. The clear cervical leucorrhœa is seen under the microscope to be made up of a viscid magma, having entangled in it large numbers of columnar epithelial cells, which have a tendency to arrange themselves in rows. These are easily seen to be the ciliated epithelial cells that cover the normal mucous membrane, but deprived for the most part of their cilia. They are accompanied by smaller rounded cells like mucous corpuscles or wandering cells, partly derived from the interior of the crypts, and partly shed from the general surface from which the epithelium has been removed. In almost all cases some of the epithelial cells and mucous corpuscles are charged with fatty particles, and surrounded with granules, resulting from the breaking down of some of their number. The more turbid the fluid, the more the cells are found to have undergone such degeneration; and where the discharge is profuse, fluid, and of yellowish colour, it has more the characters of a purulent fluid in which the relatively few cylindrical cells are changed in form, becoming oval or rounded, and nearly all reduced to a compound granular mass. The more deeply tinted discharges owe their discoloration to the admixture of blood, the red corpuscles of which can easily be recognised. Apart from the leucorrhœas of specific origin, this is the commonest of all the varieties. It may be found in females of any age, but specially affects women during their reproductive history, and more especially those who have been mothers. We can understand the special liability of the cervix to catarrhal affections, when we remember that all intra-uterine discharges pass through and may irritate it; that it is exposed to damage during the transit of the fœtus in parturition; that vaginal affections easily pass into it by continuity of structure; and that it may readily be injured by foreign bodies in the vaginal canal, or even by fretting of its orifice against the vaginal wall in cases of displacement or excessive mobility.

4. **Intra-uterine Leucorrhœa.**—Here also the discharge is transparent, like white of egg, and alkaline in its reaction, but it is more fluid than the secretion from the cervical canal, and may escape as a clear liquid from the genital fissure. In cases of long standing, more particularly where there exists some organic disease in the uterine parietes, the fluid becomes turbid, purulent, and more frequently than in any other variety of leucorrhœa tinged with blood, even alternating with irregular discharges of blood. Under the microscope we see many cylindrical epithelial cells, not infrequently ciliated; along with groups of smaller cells, partly cylindrical, partly rounded, that have been discharged from the uterine follicles; all imbedded in a mucous fluid. Where the discharge is more turbid, the epithelial cells are seen to be undergoing fatty degeneration, and to be accompanied with wandering cells, pus-globules, and crowds of free fatty particles. This uterine leucorrhœa may be found at any period of life, but as an independent affection it is found almost exclusively in virgins or young married women, or in women who are ceasing, or have ceased, to menstruate. In the last-named class of cases the cervix is often atrophied, and its orifices narrowed; and the intra-uterine secretion may accumulate for a time, and be expelled with some degree of suffering. Most frequently it is found associated with cervical leucorrhœa, the endo-cervical affection having passed up to the endometrium, or, more rarely, *vice versâ*. Perhaps the most frequent form of it is found in women who are subject to a leucorrhœal discharge before or after the menstrual periods; and in the cases of amenorrhea where a pale discharge escapes at the usual menstrual periods, this has its source in the interior of the uterus proper.

5. **Tubal Leucorrhœa.**—Doubtless some small portion of the fluid that escapes in certain cases of leucorrhœa is furnished by the Fallopian tubes; but despite the elaborate attempts of Hennig and others to establish a distinction between it and the other varieties, it remains rather as a subject of pathological interest than of clinical importance, and need not occupy us further here.

DIAGNOSIS.—The statements of a patient in regard to a leucorrhœal discharge cannot be relied on in establishing a diagnosis as to its source. If it be white and flaky we may judge that it is vaginal; if more transparent, and escaping in half-coagulated flocculi, we may conclude that it is cervical; whilst a clear and more continuous and fluid discharge would be more justly referred to the uterus proper. But it is never safe to trust merely to the appearance of the discharge as it escapes from the vulva, for it may have become modified as it lay in or traversed some part of the canal, or may be compounded of fluids derived from different surfaces. The seat of the discharge must therefore be exposed. In the vulvar variety it suffices to separate the labia and occasionally to expose the navicular fossa and the orifices of the Bartholinian ducts, by passing the finger into the anus. The vaginal form of leucorrhœa requires for its detection the use of a speculum, duck-bill or tubular; and the cervical, one of these or a bi-valve speculum. For the diagnosis of intra-uterine leucorrhœa it is sometimes helpful to remove some of the fluid for microscopic examination by means of a fine syringe. Unless a clear history of infection can be obtained, it is almost impossible to establish a distinction between a gonorrheal discharge and the simpler catarrhal leucorrhœa. In the former there is a very notable tendency to spread through all the contiguous mucous surfaces, though the vulva may be predominantly affected. In children suffering from the infectious discharge, traces of the injuries that are usually inflicted at the period of infection should be sought for.

Treatment.—In instituting our treatment of leucorrhœa it is of the first importance to have in view the *constitutional* condition of the patient; to use means to counteract any diathetic tendency—tuberculous, strumous, or syphilitic; and to raise as far as possible the general standard of the patient's health, by the administration of tonics, and the enforcement of a suitable diet and regimen. It is partly in this way that a change of residence is often useful; and in making a change, it is well for the patient to go to some of the spas, such as Ems or Kissingen, the waters of which are helpful in reducing congestions and catarrhs of the pelvic viscera. In young women of relaxed habit of body, it may be enough to prescribe quinine and iron or arsenic, and the daily use of a cold sponge bath; and in infantile leucorrhœa, cod-liver oil and iodide of iron should be administered.

In the great majority of cases of leucorrhœa, some kind of *local* treatment becomes an absolute necessity. Sometimes it is enough to pay strict attention to cleanliness, washing the pudendal surfaces with a soft sponge, or syringing the vaginal canal with tepid water; and even when astringent applications are to be made, the surfaces should first be subjected to a detergent stream of water. Where there is marked congestion of the uterus it is best to make the injections with hot water, and to keep the stream passing through the vagina for at least five minutes at a time; the immediate relaxation of the blood-vessels and hyperæmia being followed by contraction of their walls, which favours the cessation of the discharge. The astringents most serviceable for checking *vulvar* and *vaginal* leucorrhœas are alum, aluminated iron, acetate of lead, sulphate of copper, sulphate of zinc, borax, and infusions of oak-bark, matico, and other vegetables charged with tannin. They are best applied in the form of an injection with a Higginson's syringe, having a vaginal nozzle attached to it; or of a douche through a long india-rubber tube, with a stop-cock for regulating the flow fitted close to the vaginal nozzle, and the other extremity opening into a wide receptacle, or fitted to a filler into which the fluid is poured. Where there is a difficulty in using the injection, and where it is desirable to keep up a more prolonged application of the medicament, it may be introduced into the vagina in the form of pessaries made with cacao-butter or with gelatine. Topical applications to the canal of the cervix and cavity of the uterus ought always to be made through the speculum, and without such applications it is a hopeless task to undertake the cure of *cervical* leucorrhœa. Here, more concentrated or more powerful astringents or escharotics become necessary. Nitrate of silver in the form of a stick of caustic is easily applied, but its repeated application may lead to mischief. Zinc-alum, dried sulphate of zinc, sulphate of copper, perchloride of iron, or tannin may be introduced in the form of rods or arrows made with starch and gum. If a uterine sound or stiletto be dipped in water and a thin film of cotton wadding wrapped round the point to the length of about two inches, the adherent mucus can be cleared away, and the same or another sound mounted with wadding can be charged with fuming nitric acid, or the acid nitrate of mercury, or strong carbolic acid, or a solution of perchloride of iron, or tincture of iodine, and carried through the speculum along the cervical canal. In *intra-uterine* leucorrhœa it becomes necessary to carry the application right up in the same way to the interior of the uterus. It is usually best to begin with one of the stronger liquids, apply it a few days after a menstrual period, and follow it up with applications of iodine. So long as the stilette or sound with the dry wadding passes easily through the os internum, it is usually necessary to continue from time to time the intra-uterine application.

Alexander Russell Simpson.

LEUKÆMIA. *See* Leucocythæmia.

LEUTERBAD (Locite), **in Switzerland.** Thermal earthy waters. *See* Mineral Waters.

LICE, Diseases due to. *See* Pediculus.

LICHEN (λειχὴν, an eruption).—This term was originally assigned to lichens of the vegetable kingdom from the idea, which is by them suggested, of adhesion to the bark of a tree. Subsequently the term became transferred to a diseased state of the skin, but the precise nature of that disease is unknown at the present day. The affection which most nearly realises the signification of the term is lepra vulgaris, or possibly a centrifugal cluster of papulæ. In the latter sense the term was adopted by Willan, and since his time it has been generally accepted as the type of a papular eruption of the skin. With this acceptation lichen is a folliculitis attended with prominence in the form of a minute pimple; and may be associated with eczema—as in the instance of lichen simplex, lichen circumscriptus, lichen agrius, and lichen tropicus; or with urticaria—as in lichen urticatus. It may, however, be independent of these, as in lichen pilaris, lichen planus, and the eruption described by Hebra, under the name of lichen scrofulosorum. *See* Appendix. Erasmus Wilson.

LIENTERIC (λεῖος, smooth, and ἔντερον, the intestine).—A form of diarrhœa in which the stools contain much undigested food, in consequence of its having passed rapidly along the alimentary canal. *See* Diarrhœa; and Stools.

LIGHTNING, Effects of.—The effects produced by lightning differ only in degree from those produced by the discharge of static electricity, generated in the laboratory. With a Leyden jar of sufficient size a small animal may be killed, and in larger animals the effects of shock and local injury may be produced. By lightning a person may be killed outright, and a post-mortem examination may reveal no lesion whatever. The mode of death in these cases seems to be by the shock to the brain and nervous system generally. Effects not distinguishable from ordinary concussion of the brain may be observed, and the person struck may remain insensible, with slow respiration, scarcely perceptible pulse, and dilated pupils, for periods varying from a few minutes to more than an hour. This may be followed by complete recovery; or there may remain paralysis of the limbs, usually the lower, or occasionally derangements of the special senses—blindness, a metallic taste in the mouth, noises in the ears, and an odour in the nose. The brain may be more or less permanently affected, and we read of delirium, mania, and loss of memory as results of the lightning-stroke. Various objective phenomena have also been observed. The electricity on its way through the body may produce a number of mechanical effects. Wounds like those produced by a blunt stabbing instrument may mark the points of entry and of exit; bones have even been broken, the membrana tympani has been ruptured, and internal viscera have suffered in a similar way. Patches of erythema, urticaria, superficial ecchymoses, and scorchings of the surface having a curious tree-like and branched arrangement, have all been described; and this last phenomenon has apparently given rise to the assertion that delineations of trees standing in the neighbourhood of the accident have been traced photographically on the body of the victim. Lightning is apt to be attracted by any metal worn about the body. Watch-chains are frequently broken and fused, and by the intense heating of these metallic conductors the clothing has been set on fire. Watches have been broken and partially fused, and have forcibly burst through the pockets in which they were contained. Steel articles, such as pocket-knives, have been rendered magnetic. The clothing is sometimes burnt and torn to a great extent, and strong boots have been found burst open, or thrown off the feet to a distance, or nails in the soles have been driven out of them. The remote effects of lightning are due to the mechanical injuries produced by it: permanent paralyses may result from injury to the nerves, and inflammatory action may be set up by the injury inflicted on internal or external parts. One case is recorded in which the whole of the hair on the head and body, as well as the nails of both hands, came off after a lightning stroke. It has been asserted that *rigor mortis* does not occur in persons killed by lightning, and that the blood remains fluid for a very long time after death, but neither of these facts has been substantiated.

Treatment.—The treatment of those who have been struck by lightning consists in first rousing and keeping up the respiration and circulation. The cold douche is often of great value, and this, combined with friction of the limbs, warmth to the extremities, and the administration of stimulants, either by the mouth or in the form of enemata, would seem to be the measures best calculated to restore the suspended animation. Secondly, special injuries must be subsequently treated according to their nature.

G. V. Poore.

LINEÆ ATROPHICÆ (Lat. Atrophic lines).—A form of scleroderma. *See* Scleroderma.

LIPOMA (λίπος, fat).—A fatty tumour. *See* Tumours.

LIPPSPRINGE, in Germany.—Earthy waters. *See* Mineral Waters.

LISBON, West Coast of Portugal.—Warm, moist climate, with very variable temperature. Mean temperature in winter, 54° Fahr. Prevailing winds, N.E.–S.E. in spring; S.W. rainy. *See* Climate, Treatment of Disease by.

LISDOONVARNA, in Ireland.—Sulphur waters. *See* Mineral Waters.

LITHIASIS. LITHIC ACID DIATHESIS (λίθος, a stone). *See* Gout; and Uric Acid Calculus and Diathesis.

LITHONTRIPTICS (λίθος, a stone, and τρῖψις, friction).—Synon.: Fr. *Lithontriptiques*; Ger. *Steinauflösende Mittel.*

Definition.—Lithontriptics are therapeutical measures used for the purpose of dissolving calculi in the urinary tract.

Enumeration.—The chief lithontriptics are: Water, Potash, Lithia, Borax, Phosphate of Soda, Soap, Lime-water, Nitric Acid, Phosphoric Acid, Hydrochloric Acid, Sulphuric Acid, and Mineral Waters, such as those of Wildungen.

Action.—Lithontriptics dissolve stone in various ways. Some of them possess a simple solvent action, as in the case of water. Others unite with the calculi so as to form a more soluble compound, as in the case of the union of potash or lithia with the uric acid of a calculus, producing urate of potash or lithia, which is more soluble than uric acid itself. In the case of phosphatic calculi dilute nitric acid combines with the bases of which they are composed to form a more soluble compound.

Uses.—Lithontriptics may be employed for the purpose of dissolving calculi either in the kidney or in the bladder. They may either be taken internally, so as to act upon the calculi through the medium of the urine; or be injected directly into the bladder. This latter treatment can only be adopted in the case of a vesical calculus, and is inapplicable in the case of a renal calculus. The most useful of all lithontriptics is water, and especially distilled water. When this is taken in large quantities, the urine becomes very dilute, and small calculi may be partially dissolved, so as to be reduced in size and ejected through the natural passages. If the calculus is composed of uric acid, potash or lithia is the best remedy for internal administration, the urates of these bases being more soluble than the urate of soda. In the case of phosphatic calculi, acid remedies are employed instead of alkaline; but it is exceedingly difficult to render the urine acid by means of acids given by the mouth, unless they are administered in quantities likely to derange the digestion. In place of mineral acids, benzoic acid and benzoate of ammonia have been employed, as benzoic acid passes out of the body in the form of hippuric acid, giving an acid reaction to the urine. On account of this difficulty, acids have been directly injected into the bladder, in order to act directly upon the stone; for which purpose nitric acid, largely diluted, is the one which has been most generally employed. This procedure, however, is now rarely had recourse to, as it is much easier to crush the stone by mechanical means.

T. Lauder Brunton.

LITHURIA (λίθος, a stone, and οὖρον, the urine).—A condition in which a deposit of uric acid or urates takes place in the urine. *See* Uric Acid Calculus and Diathesis; and Urine, Morbid Conditions of.

LIVER, Diseases of.—Synon.: Fr. *Maladies du Foie*; Ger. *Krankheiten der Leber.*

The liver is an organ which has always occupied a prominent place, both with the profession and the public, as being the seat of important diseases, as well as the origin and source of numerous symptoms and ailments. Not only is it concerned in the formation of one of the principal secretions, namely, the bile, but, according to most physiologists, it has a peculiar *glycogenic* function; and some authorities now maintain that it is in this organ that urea is formed. Moreover, a large quantity of blood passes through it, in connection with the portal circulation, by means of which the blood returning from the stomach, intestines, pancreas, and spleen is distributed throughout the liver, and thence conveyed to the inferior vena cava. Hence, hepatic affections, by interfering more or less with the physiological functions or anatomical arrangements of the organ, may give rise to diverse phenomena, not only of a local character, but associated also with the general system.

Summary of Diseases.—The individual affections of the liver will be treated of separately, in alphabetical order, but it may be well to indicate here beforehand their general nature. The first great division is that into *functional* and *organic*. *Functional* hepatic disorders are regarded by many eminent physicians as being of peculiar significance, and as demanding special attention, particularly with reference to those disorders which influence the secretion of the bile. The main *organic* diseases of the liver, in which there is some more or less obvious anatomical change, may be summarised thus:—1. *Congestion*, either active or mechanical. 2. *Hæmorrhage* into the organ, or so-called *apoplexy*. 3. *Acute inflammation*, usually terminating in *abscess*, rarely in actual *gangrene*. 4. *Chronic inflammation*, ending in the condition termed *cirrhosis*, in which the liver is hardened, granular, and usually contracted. 5. *Hypertrophy*. 6. *Atrophy*, either *acute*—which is a very fatal disease; or *chronic*, the latter being of different kinds. 7. *Biliary accumulation*. 8. *Malpositions* and *malformations*. 9. *Infiltrations*, including *fatty* and *albuminoid* disease. 10. *New growths*, especially hydatids, syphilitic formations, and cancer. Tubercle is occasionally found in the liver.

Ætiology and Pathology.—Taking a general survey of the causes which originate hepatic diseases, and of the circumstances under which they arise, the most important may be indicated thus:—1. An affection of the liver may be merely a local manifestation of some constitutional or general malady, as in the case of cancer, tubercle, syphilis, or albuminoid disease. The last-mentioned is remotely due to causes which need not be discussed here; but it may be mentioned that the liver is an organ very liable to suffer from albuminoid change. 2. Some local injury or irritation may originate hepatic disease, either from without, as a blow or stab; or from within, as sometimes happens in the case of biliary calculi. 3. Certain animal parasites entering the body are prone to lodge in the liver. This applies especially to hydatids, originating from the *Tænia echinococcus*. 4. From the intimate connection of the liver with the alimentary canal, and the existence of the portal circulation, hepatic disorders are very liable to arise from improper diet, as well as from digestive derangements in the stomach and bowels, and constipation. 5. Abuse of alcohol, and especially indulgence in ardent spirits, occupies an important position in the ætiology of disorders and certain diseases of the liver. Undue use of hot condiments is also regarded as an element of some consequence. 6. Long-continued exposure to a high temperature in tropical climates is a powerful cause of hepatic derangement and disease, particularly if accompanied with too free indulgence in alcoholic stimulants. 7. Diseases of the liver may arise by extension from neighbouring structures; or by the convection of morbid materials from more or less distant parts. The latter may be best illustrated by pyæmia; and secondary affections of this kind are believed to be particularly frequent in the liver, when the morbid products are conveyed directly from the alimentary tube, in consequence of some disease of its walls, such as ulceration. 8. Obstruction to the circulation, due to certain forms of cardiac disease, is an important cause of some hepatic affections. 9. Disorders of the liver are often attributed to various hygienic errors, exposure to cold, and other causes, but how far this conclusion is justified in particular cases is a matter of question.

Clinical Signs.—So far as the actual diseases of the liver are concerned, it is unnecessary here to regard any symptoms resulting from disturbance of the glycogenic functions, as these belong to a different category. The clinical phenomena to be looked for lie within a limited range, and may be grouped under the following heads:—1. *Morbid sensations*, referred to the hepatic region, or to the shoulder, such as pain of various kinds, tenderness, sense of weight, throbbing. 2. *Symptoms due to interference with the biliary functions*, particularly jaundice and its accompanying phenomena. 3. *Symptoms resulting from more or less obstruction to the portal circulation.* These include digestive disorders, due to congestion or catarrh of the mucous membrane lining the stomach and intestines; hæmorrhage from this membrane in some cases; ascites, which is a most important symptom; enlargement of the spleen; congestion of the womb in women; hæmorrhoids; and, in certain conditions, dilatation of the veins of the abdominal wall. 4. *Symptoms produced by the pressure, or interference with neighbouring structures, of an enlarged liver.* Thus, it not uncommonly extends upwards, checking the movements of the diaphragm, and pressing upon the lung, hence causing dyspnœa. Or it may compress vessels and other structures; or in some cases it even interferes with the heart's movement. 5. *Physical signs.*—These indicate enlargement or contraction of the liver; changes in situation or shape; or changes in physical characters. 6. *General symptoms.* These may be more or less independent of the hepatic disease, this being merely a part of a general malady; or the liver-affection may give rise to pyrexia, wasting, and other symptoms. Hepatic derangements are supposed to originate many general symptoms, not obviously connected with this organ; and they have even been made accountable for the gouty state.

The individual diseases of the liver will now be discussed in alphabetical order.

FREDERICK T. ROBERTS.

LIVER, Abscess of.—SYNON.: Hepatic abscess; Fr. *Abcès du Foie*; Ger. *Leberabscess.*

Though of such importance as to require a separate notice, abscess of the liver is not an independent affection, but is only the consequence of inflammatory action set up in that organ.

ÆTIOLOGY.—As abscess of the liver is comparatively rare in temperate climates and frequent among Europeans in tropical ones, it has naturally been attributed to the effects of heat, or of alternations of heat and cold. Being occasionally associated with malarious fever, and frequently with dysentery, it is supposed that it may be induced by the same causes as those diseases. The opinion has been often advanced that abscess of the liver is always secondary to dysentery, or to ulceration of the bowels. That it may occasionally be so it would be difficult to deny, with reference to what is known of its occasional causal connection with operations on the rectum. But although dysentery and hepatic abscess are frequently associated, this association is very rare except in the tropics; nor is it there very constant. Thus dysentery is extremely common in children, while abscess of the liver is equally rare among them; indeed, abscess of the liver is very unusual under the age of twenty, and is more common after the age of twenty-five than below it. The proportion of cases in which liver-abscess and dysentery are associated is extremely variable; it is more frequent in one year than in another, and also at one period of the year than at another. Although dysentery is the commoner affection, yet occasionally the number of cases of hepatitis, with a certain proportion of deaths from abscess, may greatly exceed the number of cases of dysentery. There are many fatal cases of abscess in which the bowels have been found perfectly healthy; abscess of the liver, on the other hand, can scarcely be considered to be very frequent in dysentery. Yet dysentery and abscess of the liver seem to arise in the tropics from very much the same causes; and something is there impressed on the constitution which seems to render the system, even for some years after a return to Europe, somewhat inclined to liver-abscess.

Abscess of the liver is an occasional result of pyæmia, and connected at times with surgical operations, especially with those performed on the rectum. It has been induced by falls or by direct violence; or by the impaction of a gall-stone, especially where it has been rough and spicular.

The *predisposing* causes are the same as those of hepatitis—drinking, irregular life, exposure, and residence in the tropics.

ANATOMICAL CHARACTERS.—The course of formation of hepatic abscess seems to be the following:—The liver is first loaded in some portion or portions with an excess of blood; then follows exudation of lymph and pus, forming small deposits, of which two or three coalesce, while the liver-substance breaks down. The abscess extends in this mode. It is usually lined by a membranous cyst, which is very thin when the formation of the abscess has been rapid, and of greater consistence when the abscess is old. The abscess may be of almost any size, from that of a small orange up to a huge cyst containing ten or twelve pints of pus. Six hundred ounces of pus have been withdrawn from an abscess in five months. Most commonly the abscess is single, but frequently there are several abscesses. They are most common in the right lobe. They may have reached the surface or have burst, or they may be only discoverable on making an incision into the organ after death. In the great majority of cases, if the abscess has not been exposed to the air, its contents are laudable or healthy, inodorous pus. In some cases the pus is of the colour of chocolate. It is said that streaks of bile have sometimes been observed. Slight pinkish streaks are not so rare. An abscess may open through various channels. Sometimes it finds its way to the surface, and discharges itself through the skin. This usually happens lower down than the ribs. The abscess may open into the peritoneal cavity, and has done so into the pericardium. In such cases the result is fatal. It passes occasionally into some portion of the bowels, and as this causes the least constitutional disturbance, it is a favourable mode of discharge. Very frequently, when the abscess is near the convex side of the liver, the diaphragm and the surface of the liver become adherent—as in this case the abscess has not usually been very deep-seated—and the abscess opens itself through the lung. This offers a fair chance of recovery. There are still other possible points of exit, but these are chiefly matters of curiosity.

When the abscess has burst, cicatrisation commences, and has sometimes been traced when the case has terminated fatally. But it is remarkable that well-marked cases of complete cicatrisation have not often been recorded—various membranous formations and slight depressions in the liver being now considered to be the results of syphilitic hepatitis. There is a strong presumption that liver-abscess is occasionally absorbed without having ruptured, and also that it may remain latent for a long period. In cases where the abscess has been partially absorbed, a white fibrous sac has been found, containing a little pus and sometimes cheesy matter; and in some cases in which there has been strong presumption that the abscess had existed for four or five years, the walls of the abscess have been found much thickened, and almost cretaceous. Although a portion of the liver has been converted into abscess, the remaining portion of it may be healthy, or somewhat indurated from former attacks of congestion; and it is wonderful how in favourable cases, where the contents of an abscess have been absorbed or evacuated, the remaining healthy portion of the liver executes its work.

In addition to the formation of ordinary hepatic abscesses, suppuration may take place extensively throughout the liver, after lobular hepatitis, as in a case recorded by Dr. Quain (*Path. Soc. Trans.* 1853); and also in the portal canals, or beneath the investing capsule of the liver.

Symptoms.—These are more urgent when acute hepatitis runs into abscess, than when abscess is the consequence of repeated attacks of illness, as is most commonly the case. The general symptoms are a pale, muddy complexion; a look of anxiety, and a state of low, irregular feverishness, the pulse being generally about 100, and the temperature increased by a degree or two. There may be one or two shivering fits, or accesses of fever simulating ague. The appetite is impaired; there is vomiting, with irritability of the stomach; the tongue has generally a white coating, but in some cases is almost clean. The throbbing pain which usually accompanies the formation of pus is scarcely ever present. There is occasionally pain in the shoulder or shoulder-blade, but this is uncertain. A certain amount of pain, usually dull, is felt in the liver, often increased on pressure; attended with more or less, and sometimes with very considerable, enlargement of the organ. There is also fulness or bulging of the right side; and at the last, possibly, fluctuation. If abscess form on the upper side of the liver, there is more or less pressure on the diaphragm, causing shortness of breath, and occasionally leading to local inflammation, attended with acute pain. But such symptoms, which are more valuable taken collectively than individually, may not be present in a marked degree. The state of the biliary secretion is very often normal, or nearly so; and the condition of the urine offers no certain indication, although bile-pigment is sometimes present in it. Jaundice is comparatively rare. In some of its more insidious forms, hepatic abscess may come on without being preceded by fever or ushered in by shiverings; but even in such cases a general falling off of the health is always observable.

As has been already pointed out, the abscess may burst in various directions; or it may be opened by a surgical operation. As a general rule the result is more favourable—probably because the opening being small the pus escapes gradually—when the abscess finds an opening for itself, than when it is evacuated artificially. In the latter case the discharge usually lasts for some months—nay, for more than a year in some instances; and although the patient improves up to a certain point, he is very likely to sink in the end. When the patient sinks, it is usually from general exhaustion of the system. Pyæmia is of extremely rare occurrence.

Complications.—Abscess of the liver is often complicated with dysentery, or with diarrhœa; and less frequently with malarious fever. Sometimes there is a certain amount of pleurisy or pneumonia. This is more frequent in acute cases than when the formation of abscess has been slow.

Diagnosis.—A positive diagnosis is difficult to make in the early, and sometimes in the later, stages of hepatic abscess. The writer has known an iron-worker burst an abscess through his lungs when at work, the presence of which was not suspected; also a medical man submit his side to examination by several of his brethren, bear any amount of pressure, and yet die two days after choked by the bursting of an abscess. Nevertheless, an experienced physician will from the symptoms be able to guess the presence of abscess of the liver before any palpable signs appear. These are, first, the general aspect of the patient; then the enlargement of the side. It is only in a more advanced stage that fluctuation can be made out. As to the diagnosis after the abscess has burst, if it breaks through the lung the peculiar chocolate-colour expectoration is at once characteristic. If the abscess bursts into the pleura or peritoneum, the diagnosis is not so positive, but the sudden collapse usually shows what has happened. When the abscess bursts through the bowels, especially in small amounts at a time, the fact is rarely recognisable, except by the gradual improvement of the patient. It seems to be certain that hepatic abscess has sometimes been confounded with a distended gall-bladder: with care, however, such a mistake can scarcely happen. It may be confounded with cancer or with hydatids of the liver; but in these affections—and particularly in the last—there is very little constitutional disturbance, and in cancer a nodular protuberance may very generally be recognised. The only other mistake that is occasionally made is, that of confounding abscess and the effects consequent on its presence, when it points upwards, with pneumonia or pleurisy near the base of the right lung; but with careful auscultation the affection of the lung or pleura ought to be made out by their physical signs.

Prognosis.—This is generally very unfavourable. Yet there is always a chance of recovery if the pus finds for itself an exit, as through the bowels or lungs, or even if exit to it is given artificially. The statistics of the results of making artificial openings are not very encouraging. The operation, however, frequently appears to prolong life. The most favourable mode of exit is through the lungs. The discharge of pus may continue for six months, and yet recovery take place. Absorption of the abscess probably sometimes occurs, though this is a very rare termination. Such absorption is, obviously, chiefly a matter of inference. If a patient recovers from an attack of liver-abscess, his health may return to its usual standard. There is reason to believe that individuals have lived thirty or forty years after the occurrence of abscess; and the writer knew a man of 75, who had had abscess forty-five years before.

Treatment.—To avert the formation of abscess, the ordinary treatment for hepatitis is the only one that can be adopted. When abscess has once formed, or even wherever there is good ground for suspecting this, the time for all active treatment has gone by. The patient must have his strength supported by mild nutritious diet and wine. He must be treated symptomatically. Usually it is sufficient to secure regular action of the bowels, and thus help the sound remaining portion of the liver to perform its function. Mineral acids, quinine, and other tonics, may all be useful. Counter-irritation over the liver is often tried, but it may be doubted whether in this condition of things it is a measure of any importance, although some think that it may help to limit the extent of the abscess. The course of the disease must be watched. The only mode of interference that we can pursue is that of helping to give exit to the contents of the abscess. Towards expediting this little can be done until fluctuation becomes evident, and then interference is to be delayed as long as possible, as nature will probably select the most convenient spot for the exit of the pus, and, after all, the presence of other undetected abscesses in the liver may make operative procedure useless. The abscess may point in an intercostal space, below the edge of the ribs, at the epigastrium, and even as low down as the umbilicus. A great deal has been written about modes of opening the abscess, and of ascertaining first whether it has formed adhesions, and various modes have been suggested for ensuring adhesions. However these are not matters of much practical importance. It is usual to make an opening whenever there is distinct bulging between the ribs; but it is better, when it is at all possible, to wait and operate, if it can be managed, below the ribs. However near the surface the abscess may appear to be, a lancet is seldom sufficient, and a good-sized trochar and canula should be employed. The aspirator, and everything that will help to prevent the introduction of air, should be taken advantage of, and the precautions of the antiseptic method most strictly observed. For there is always a chance of gangrene after a time supervening round the opening, and the risk of this seems to be greater the higher up the opening is made. The evacuation of an abscess usually produces amelioration of the general condition, whether it be permanent or not.

Change of climate may operate favourably when the patient is suffering from the long-continued drain of an open abscess; and if we are to judge by the number of patients suspected of having liver-abscess who have been sent to sea and who have arrived in Europe with their symptoms relieved, we may almost venture to say that a long sea-voyage under favourable circumstances assists absorption. In favourable cases the sequelæ of liver-abscess must be treated like those of hepatitis. J. Macpherson.

LIVER, Albuminoid Disease of.—Synon.: Fr. *Dégénérescence amyloïde du Foie*; Ger. *Amyloide Entartung der Leber*.

Definition.—A disease characterised by painless, more or less considerable, enlargement of the liver; due to the existence in its structure of a peculiar homogeneous substance, the exact nature of which is not known, but which has a marked relation to certain cachexias and constitutional maladies.

Ætiology.—Albuminoid disease of the liver occurs in association with certain cachexias, especially those of constitutional syphilis, scrofula, rickets, scrofulous diseases of bones and joints, and other diseases attended with protracted suppuration. It has been noticed in connection with chronic dysentery, but the records of the Seamen's Hospital do not confirm such association. In many cases of chronic ague, with marked cachexia, which have been admitted into the hospital just named, there was an enlarged, hard liver, pointing to albuminoid change; but there was probably in these cases the superaddition of syphilitic taint. Rokitansky speaks of the disease as congenital in children born of syphilitic parents.

Anatomical Characters.—The liver has its normal shape; is more or less enlarged, sometimes to such an extent as to fill the greater part of the abdominal cavity; and is hard, resistant, and inelastic, with a smooth glistening surface. The organ cuts like bacon, hence the name 'lardaceous.' The cut surface is grey, or fawn-colour, or pale red; but sometimes it is yellowish, and this appearance, in conjunction with the consistence of the organ, has led to the name 'waxy.' From the incised veins a little pale blood usually oozes. The application of solution of iodine to the cut surface causes change of colour, which has been described as blood-red, reddish-brown, mahogany brown, walnut, by different observers. The addition of sulphuric acid induces a blue colour, best seen in a delicate section placed under the microscope. Supposing a lobule of the liver to be divided into three zones, the characteristic iodine stain will be seen, in less advanced stages of the disease, to be limited to the middle zone, where the hepatic artery is distributed: the vessels and cells here being filled with the new material, which afterwards may extend so as to implicate the entire lobule. The structures invaded by the new material have, in a section examined microscopically, a lustrous, transparent, and somewhat swollen appearance. When the entire lobule is affected, the aspect is homogeneous. The appearance of an albuminoid liver may be modified by the co-existence of fatty change, or cirrhosis, or syphilitic disease. The spleen is generally, and the kidneys are occasionally, implicated. Cornil has used some new colouring matters, namely, two methyl-anilin violets, discovered by Lauth, and a violet discovered by Hoffman, as tests of albuminoid degeneration. The normal tissues of the liver and other organs do not decompose the violets, but when amyloid degeneration is present, the affected parts become of a violet-red, the normal structures assuming a violet-blue tint. In the examinations of specimens by Cornil the hepatic cells were unaffected, a result in opposition to generally received views, as just stated, and to his own previous investigations. In all cases the walls of the capillaries, or of the hepatic arteries and veins, were affected. Methyl-green has been more recently used for the same purpose.

Symptoms.—Palpation, in marked cases of albuminoid disease of the liver, will readily detect a large, hard, resistant tumour, having the normal outlines of the liver; the smoothness of its surface; and the extent to which it encroaches upon the abdominal cavity. Pressure does not elicit any tenderness, nor is there usually any pain; at most, in advanced cases, there is only a sense of tension and fulness, as in other hepatic enlargements. The painless nature of the tumour is distinctive. The disease does not interfere with the portal circulation, and does not therefore directly cause ascites. When this occurs it is the result of general cachexia, induced by the constitutional malady, and perhaps by associated renal complication. The dropsy generally affects the legs in the first instance, and afterwards the serous cavities, and is not a prominent symptom unless the kidneys are implicated. In this case the urine is usually of low specific gravity and albuminous, and the anæmia very marked. The system of bile-ducts not being obstructed by the disease, there is no jaundice; or if this occur, which is a rare event, it is from pressure on the duct externally by enlarged lymphatic glands. The evacuations are, however, frequently of a pale yellow, and at times of a clayey, colour, which may be accounted for by the extensive impairment of secreting structure, and the consequent secretion of a poor, colourless bile. A lardaceous state of the spleen is a frequent accompaniment of the liver affection, and gives rise to increased volume and hardness of the organ, which may be detected by palpation in the left hypochondrium. Vomiting, without the usual indications of gastric derangement, as furred tongue, &c., and diarrhœa, are symptoms not uncommon in advanced cases, and are due, according to Frerichs, to the implication in the disease of the vessels and villi of the stomach and intestines.

Diagnosis.—The peculiar features of the enlargement, its painless character, the concurrence of the constitutional maladies already noticed, especially if with implication of spleen and kidneys, will distinguish this from other hepatic enlargements. If there be associated cirrhosis or syphilitic disease, the diagnosis will be difficult; but, as Bamberger remarks, an error will not be of moment as regards prognosis and treatment.

Prognosis and Duration.—The disease may run on for months or even years, but it generally proves fatal, either by intercurrent affections, or by anæmia, general dropsy, and exhaustion, such result being more rapidly determined when the kidneys are involved. In the early stage of the malady an arrest of mischief, if not a cure, may possibly be effected.

Treatment.—It is only in the earlier stages of albuminoid disease of the liver that treatment can avail, and then it must be directed especially to the associated cachexia. Whether this be syphilitic or strumous, the preparations of iodine are indicated; the iodide of potassium, the tincture of iodine, or, where the anæmia is marked, iodine in combination with iron. The syrup of iodide of iron in drachm doses, three times a day, has proved useful, if not in reducing the tumour, at least in improving the general condition of the patient. The iodine mineral springs, as Woodhall Spa, Kreuznach, Adelheidsquelle, &c., are indicated, although they contain but infinitesimal doses of iodine and bromine. The baths of Aix-la-Chapelle, Ems, and Weilbach have each had their supporters in the treatment of this malady. Hydrochlorate of ammonia, in ten to twenty grain doses, three times a day, continued for some time, has been found to be efficacious in reducing large, hard livers (Budd, Begbie). The general therapeutical indications are pure air; plain, nourishing diet; the regulated use of alcoholic stimulants; and adequate protection of the skin by warm clothing and other measures. Stephen H. Ward.

LIVER, Apoplexy of.—By this is meant hæmorrhage in the liver, in the form either of isolated patches of extravasation or of general effusion, the whole of the hepatic parenchyma being converted into a dark-red pulpy mass. This affection is rarely met with in this country, but has been often observed abroad in warm climates and malarious districts, as a result of disease of the liver, or prolonged and intense congestion It occurs also in some cases of scurvy. Abercrombie believed that the puerperal condition predisposed to hepatic apoplexy. It has been observed also, according to Frerichs, in some new-born infants after long labours, and in cases of this kind it is usually associated with pulmonary atelectasis. A rapidly fatal case of hepatic apoplexy was reported by Andral, in which there were no indications of any efficient cause of the hæmorrhage. (*Clin. Med.*, 3 ed., t. ii., p. 259.) Extravasation of blood into the substance of the liver, together with a pulpy condition of more or less of the parenchyma, may be produced by the application of violence to the hepatic region.

Symptoms.—The symptoms that have been observed in cases of hepatic apoplexy are pain in the right hypochondriac region, and excessive tenderness; jaundice; bilious vomiting; melæna; a cold and bloodless condition of the skin of the face and limbs; and in some cases syncope.

This affection is almost invariably fatal when due to prevailing disease of the liver, or to extensive laceration. W. Johnson Smith.

LIVER, Atrophy of, Acute Yellow.—Synon.: Fr. *Atrophie jaune aiguë du Foie*; *Ictère grave*; Ger. *Acute Atrophie der Leber*.

Definition.—This is a general disease, likened by Trousseau to a pyrexia. The jaundice, being so prominent a symptom, formerly drew attention too exclusively to the liver; but the same degeneration which seizes upon the liver, likewise attacks all the glandular and muscular organs of the body. The morbid change is a parenchymatous degeneration, called by Virchow and his school a parenchymatous inflammation. It consists in a filling of the cells of a gland with albuminous granules, in such numbers as altogether to hide the nucleus; the albuminous granules are quickly followed by oily particles and drops. In the muscular tissue, the striation is lost, and its place taken by granules, placed irregularly or running lengthwise. These morbid appearances are found in poisoning by phosphorus, arsenic, antimony, alcohol, and other agents, and in all fevers, though in a less degree than in acute yellow atrophy. Buhl was the first to point out that the pyrexial changes were the beginnings of acute yellow atrophy.

ÆTIOLOGY.—Acute yellow atrophy is perhaps the rarest of all the diseases common to this climate. Of its causes, next to nothing is known. It seems to be more common in women than in men; and in pregnant women than in others.

It has been shown that in pregnant and suckling quadrupeds and laying hens, the liver and kidneys often show cells infiltrated with fat, a fact which may throw some light on the disposition of pregnant women to acute yellow atrophy. Emotional disturbances, such as grief and trouble, and bad hygienic conditions, have been thought by some to predispose to this disease. Others believe that all cases may be traced to phosphorus-poisoning.

ANATOMICAL CHARACTERS.—After death it is not uncommon to find the liver of natural size, or even enlarged, in the early stages of acute atrophy. Later on the organ shrinks, so that in extreme cases it may weigh as little as nineteen ounces. It decreases in all diameters, but the left lobe is especially shrunken. The capsule is often wrinkled. On section, there is no longer any appearance of lobules, but an ochre-coloured surface without definite structure, but often reddened. Under the microscope, the liver-cells are found, in the early stages, to be filled with granules, so as completely to hide the nucleus; part of these granules are soluble in acetic acid, others are not. Later on, all trace of liver-cells may be lost, nothing but a granular and oily detritus and pigment being seen under the microscope. If the organ be set aside, it often becomes covered with crystals, stated by Frerichs to consist of leucin and tyrosin.

The spleen is enlarged and soft in the great majority of cases. The stomach and alimentary canal are filled with dark-red or tarry contents, the outcome of hæmorrhage; the tubular glands of the stomach are filled with fattily degenerated epithelium. The muscular tissue of the heart shows likewise fatty degeneration; and the tubules of the kidneys are filled with epithelium in various stages of fatty degeneration.

SYMPTOMS.—Acute yellow atrophy is commonly preceded for some days or weeks by a simple jaundice, in which nothing peculiar can be made out. Delirium and convulsions then suddenly set in, followed by deep coma, stertorous breathing, and dilated pupils. During the first part of the disease the pulse is natural in frequency, but with the appearance of the convulsions and delirium it rises to 120 or 130. The skin is always yellow, rarely deeply coloured. The urine is natural in quantity, bilious, containing leucin and tyrosin, and towards the end of the disorder, containing no urea, chlorides, or phosphatic earthy salts; a kind of peptone is present. There is almost always constipation; the stools being at first pale, afterwards black from admixture of blood. Vomiting is very constantly present; at the end of the disease, of a black coffee-ground matter. The right hypochondriac and epigastric regions are painful and tender. The liver, at first natural in size, or even larger than natural, decreases daily in dimensions, so that at last percussion may give no liver-dulness at all. With the decrease of the liver, the spleen increases in size. A hæmorrhagic diathesis likewise sets in, as shown by petechiæ on the skin, epistaxis, hæmatemesis, and melæna. The temperature is commonly low, until just before death.

DIAGNOSIS.—The diagnosis is beset with difficulties, and may remain doubtful even after death. Poisoning by phosphorus can hardly be distinguished from acute yellow atrophy, unless the patient own to having taken the drug. The prodromal stage cannot be distinguished from simple jaundice.

PROGNOSIS.—The prognosis is extremely bad: only a very few suspected cases are known to have recovered.

TREATMENT.—The treatment must be conducted upon general principles. A few cases, in which the diagnosis of acute yellow atrophy has been thought justifiable, have recovered, and these have been treated with the mineral acids and purgatives, aconite, quinine, and camphor. These are therefore the remedies which may be recommended to be used. Local symptoms, such as vomiting or bleeding, must be treated as in other diseases. J. WICKHAM LEGG.

LIVER, Atrophy of, Chronic.—Chronic atrophy of the liver is seen in many wasting diseases, and in old age; the liver then often shrinks, becoming tougher in consistence, but rarely granular on the surface. The cut surface is dark red or pale brown; the acini are either invisible, or else smaller than natural. Frerichs thinks that the blood-vessels are all dilated. The increased toughness seems due to the atrophy of the liver-cells, the meshes of the connective-tissue network being thus brought nearer to each other.

The symptoms of chronic atrophy are merged in those of the primary disease, against which all treatment must be directed.

J. WICKHAM LEGG.

LIVER, Biliary Accumulation in.—ANATOMICAL CHARACTERS.—When a permanent obstruction to the flow of bile into the duodenum has been set up, serious changes take place in the gall-ducts and the liver itself (*see* GALL-BLADDER AND GALL-DUCTS, Diseases of). At first the liver swells, apparently from the pent-up secretion. It becomes of a deep bilious or olive-green colour, the central parts of the acini being the deeper coloured; on section the dilated ducts are seen, and bile or a colourless fluid wells out of them. Increase in the consistence of the liver commences; and if the obstruction continue, the organ wastes, becomes much tougher, and shows a granular surface. This increase in consistence is due to an overgrowth of the connective-tissue of the liver, as in cirrhosis, only to a less degree. The amount of over-growth depends upon the kind of obstruction. It is greater when a rough angular gall-stone is the cause, than when an hydatid tumour with its smooth walls presses upon the gall-ducts. This overgrowth springs at first from the gall-ducts, which are greatly thickened, and thence spreads over the connective tissue of the portal canals.

The liver-cells atrophy, as in cirrhosis. They vary much in size. Their contents seem to be chiefly fat and pigment-granules, though neither is of very great amount as a rule. The arrangement in rays around the hepatic venule is quite lost. One of the most important functions of the liver is the preparation of glycogen, and this function seems to be abolished in long-continued jaundice. In animals whose bile-ducts were tied, the writer found the glycogen to disappear not many hours after the ligature was applied; and after puncture of the fourth ventricle, no sugar appeared in the urine.

In some cases of complete obstruction to the bile-ducts, the liver-cells have been found altogether destroyed, nothing but a fatty detritus being seen under the microscope. This is not owing simply to *post-mortem* changes in the liver; but is possibly due to the long-continued action of the bile-acids circulating in the blood upon the liver-cells themselves, as Leyden has pointed out. It is not owing to the simple solution of the liver-cells in the bile, for the bile has not the power of dissolving these cells, as Th. von Dusch has asserted.

Symptoms.—As regards the clinical phenomena of biliary accumulation in the liver, there are, of course, all the symptoms of jaundice and of the disease which leads to it. In addition, the liver at first swells, and may be detected below the ribs for two or three fingers' breadth, but rarely more; it is often painful on palpation. Later on, the liver retreats within the boundaries of the chest. Ascites often shows itself, owing to the disturbance of the circulation in the liver; and the spleen often swells. All these symptoms are, however, liable to be interfered with by the primary disease.

Treatment.—The treatment must be directed to the cause of the obstruction of the ducts.

J. Wickham Legg.

LIVER, Cirrhosis of.—Synon.: Granular liver; Hobnailed liver; Gin-drinker's liver; Interstitial hepatitis; Fr. *Cirrhose du Foie*; Ger. *Cirrhose der Leber*.

Definition.—A chronic disease of the liver, in which the organ becomes hardened, and usually more or less diminished in size, at the same time assuming a granular or hob-nailed appearance; these changes resulting from an increase in the connective-tissue, usually caused by abuse of spirituous liquors. The name *cirrhosis* was first given by Laennec to the hardened and shrunken liver, on account of the yellow colour of the granulations in this disease.

Ætiology.—The most common cause of cirrhosis is, undoubtedly, the abuse of spirituous liquors. Spirits, unmixed with water, seem to be more potent in causing cirrhosis than wine or malt liquors. Next after these, but at a great distance, come syphilis, and the immoderate use, it is said, of spices—such as curry, or of coffee. In some rare cases no cause is apparent. The disease is far more common among men than women; it is very rare indeed amongst children. In one of these cases, the child asked the nurse for gin soon after admission into the hospital. Cirrhosis has also been seen among the lower animals, a proof that alcohol is not the sole cause.

Anatomical Characters.—The seat of the disease in cirrhosis is the capsule of Glisson. The connective-tissue, which accompanies the vessels entering at the portal fissure, and which forms a covering for the liver beneath the peritoneum, takes on a very active overgrowth. One result of this overgrowth is a compression and atrophy of the secreting cells of the liver. Another is a hindrance to the flow of blood through the liver; for, although new vessels do indeed form in the new connective-tissue, yet these are by no means enough to carry on the circulation, in the place of those obliterated or destroyed by the advancing overgrowth of connective-tissue.

There are several varieties of cirrhosis. In the first—that which is most common—the liver is shrunken, it may be to one-half or one-third of its natural size. This shrinking is often greatest in the left lobe, so that this may become a mere appendage to the right. At the sharp edge of the liver, there is often nothing left but a semi-transparent tissue, containing none of the elements of the gland. False membranes often join the surface of the liver with the diaphragm or other neighbouring parts. The surface itself is greatly roughened. It shows numberless granulations, varying in size from a poppy-seed to a hazel-nut. The fibrous investment of the liver is greatly thickened; and the peritoneum tears off either in layers, or leaving a granular surface behind. The liver is exceedingly hard and tough; and on section, the cut surface is seen to be made up of yellow islets, imbedded in a white translucent tissue. These yellow bodies are the representatives of the granulations seen on the outer surface, and they are the remains of the natural liver-tissue, separated from one another by the new white connective-tissue. This is by far the commonest variety of cirrhosis, but there are others. One form is *hypertrophous* cirrhosis, in which the liver is greatly increased in size, sometimes more than double its natural weight; but the surface is smooth, and the capsule, though thickened, leaves a smooth surface when torn off. There is toughening of the liver, though not to so great a degree, and the same appearance of the cut surface as in ordinary cirrhosis. In another variety the organ is shrunken, but the surface is smooth, and on section are seen only pins'-points of yellow tissue in the white translucent overgrowth. Whether the hypertrophous variety ever becomes shrunken is still undecided. A third variety is *fatty* cirrhosis, which may be mistaken at first sight for fatty liver, but the touch shows how tough it is. It sometimes floats in water. There is no everted edge, and on section no acini are to be made out; but the cut surface is indistinct, pale, and yellow. The surface of the liver is smooth.

Under the microscope, using a low power, the tissue of the cirrhosed liver is seen to be broken up into islets, separated by broad bands of what looks like a highly nucleated connective-tissue. The separation between the two appears sharply defined. In some cases the liver-cells may be seen infiltrated with fat. With higher powers, the most striking object in the field is the great abundance of what were once called nuclei, but now lymphatic corpuscles, in the new-formed connective-tissue: these vary little in size or shape, being nearly all round or roundish. The prevailing opinion now is that they are emigrated leucocytes. They are arranged sometimes in clusters, sometimes in lines, and sometimes indefinitely. The origin of the clusters is uncertain; but it seems tolerably clear that the linear disposition arises from the obliteration of vessels carrying bile or blood. The connective-tissue itself is highly fibrous; sometimes homogeneous or granular. The liver-cells themselves undergo great changes. They lose their natural polyhedral shape, and become oblong, oval, or spindle-shaped. Between them the new connective-tissue gradually insinuates itself, and the cells become lost in the advancing overgrowth. These changes in the liver-cells are of course best seen at the spot where the liver-tissue and the connective-tissue join.

Symptoms.—The first approaches of cirrhosis are commonly very insidious. Often one of the first symptoms is a dull pain in the neighbourhood of the liver. This is accompanied by signs of a chronic gastric catarrh, of which morning sickness is, for the diagnosis of intemperance, of the greatest importance. The patients are commonly of a sallow, often almost jaundiced, complexion. They grow thinner, and their strength fails. Some patients suffer from piles: in others diarrhœa occurs. Later on the belly begins to swell, and ascites appears; the legs may become œdematous, from the pressure of the fluid in the belly on the anterior wall of the inferior vena cava. The urine is high-coloured; often deposits urates; and sometimes contains albumin from contracted kidneys.

An important point in the diagnosis is to determine whether the liver is of small size, and growing smaller. This is often difficult, on account of the ascites; the difficulty may sometimes be overcome by laying the patient on his left side. In the earlier stages the hard edge of the liver may at times be felt, and even though the ascites be great, by suddenly depressing the walls of the belly with the fingers. The percussion-dulness of the liver in the nipple line may be reduced to two inches or even one inch in height.

Although in the new-formed connective-tissue of cirrhosis fresh vessels form to take the place of those obliterated, yet these by no means suffice to carry on the circulation through the liver. Portal obstruction therefore arises, which relieves itself in various ways; most commonly fluid is poured out into the cavity of the peritoneum, causing an ascites, or into the cavity of the intestines, causing a diarrhœa, which should not be lightly checked. In other cases it is relieved by hæmatemesis, or by hæmorrhoidal discharge. That which is most fortunate for the patient is the formation of a varicose communication between some radicles of the portal system and the general veins; as between the hæmorrhoidal and the hypogastric, the veins of the stomach and the œsophageal. Most important of all, however, is a vein discovered by Sappey. It arises from the left branch of the portal vein, and passes up the falciform ligament close to the ligamentum teres to join the epigastric and internal mammary veins. It is by no means the same as the old obliterated umbilical vein, although so near to it. The vein just mentioned will often be found dilated after death.

As a rule the spleen is enlarged in cirrhosis. The enlargement may be very great, but the organ is commonly about twice or three times the natural size. After death the spleen is found of softer consistence than natural, sometimes pulpy. The cause is obscure; the reason commonly given is the hindrance to the flow of blood through the liver acting on the splenic vein. The spleen, however, does not always swell when there is obstruction to the portal circulation, for example, in nutmeg-liver.

Ascites is a symptom which sooner or later is sure to come on. It appears to arise from the venous stasis in the subperitoneal tissues. Fluctuation, and the movement of the fluid on change of posture are very clear. The fluid, like all other dropsical effusions, contains albumin, salts, sometimes urea, sometimes sugar; and in jaundice bile-pigment. After the ascites has set in, the feet may begin to swell, from the pressure of the fluid on the vena cava. The upper limbs and face are free from œdema. In some cases albumin is present in the urine, from coincident Bright's disease.

The patients often complain greatly of flatulence, which adds much to their distress, and dyspnœa. Hæmatemesis and piles are of frequent occurrence. Diarrhœa when it comes is, as above mentioned, salutary, and should not be checked unless extreme. The urine is scanty and high-coloured; often turbid from urates; and bile-pigment is present when jaundice sets in. Jaundice may or may not be seen, according as the pressure of the new connective-tissue does or does not involve the bile-ducts.

Diagnosis.—The diagnosis depends upon the history of intemperance; the size and consistence of the liver; the size of the spleen; and the appearance of ascites and other dropsies. Of importance also is the peculiar sallow earthy complexion; and the occurrence of hæmorrhages from the stomach or intestines. The diagnosis is often easy; while at other times it is very hard or well-nigh impossible to make. Cirrhosis may be confounded with portal thrombosis; obliteration of the hepatic duct; nutmeg-liver; syphilitic disease, cancer, or hydatids of the liver; and chronic peritonitis.

Prognosis.—It is rare for a patient suffering from cirrhosis of the liver to live longer than a twelvemonth after the symptoms have become so pronounced as to allow a diagnosis to be made.

Death is in nearly all cases the end of the disease.

Treatment.—In the early stages of cirrhosis it is most important to induce the patient to give up his habits of intemperance, for without this, treatment will be of little avail. Next the use of alkaline purgatives, with or without vegetable bitters, such as chiretta or calumba, will be very useful. A course of the waters of Carlsbad is often most useful, or other alkaline or iodised waters. The diet must be mild; and exercise on horseback or on foot should be recommended.

In the later stages of the disease the great object will be to keep up the strength of the patient. For the ascites, which often becomes the patient's great trouble, diuretics, especially copaiba, and mercurial alteratives may be employed. Paracentesis should be put off as long as possible, as the end of the disease often arrives soon after the tapping, though in some cases the ascites is cured by this operation. The flatulence should be combated by regulation of diet, charcoal, small doses of hydrochloric acid, and carminatives. The bowels must be kept open, but not severely acted on.

J. Wickham Legg.

LIVER, Congestion of. *See* Liver, Hyperæmia of.

LIVER, Contraction of.—A small liver is met with in cirrhosis, in nutmeg-liver, and in long-continued obstruction to the gall-ducts, in all of which an over-growth of the connective-tissue of the capsule of Glisson is seen. Any kind of pressure on the liver from neighbouring organs will likewise beget wasting. A small liver is seen in old age, and in the marasmus of wasting diseases. The liver likewise wastes if the portal vein be obstructed, or the capillaries in the liver be obstructed, as in pigmented liver. A shrunken liver cannot be looked upon as a disease by itself. J. Wickham Legg.

LIVER, Enlargements of.—Anatomical Relations.—In proceeding to determine whether the liver is enlarged or not, the following points must be remembered. Normally, the dull sound yielded by percussion extends upwards in front, in a line drawn towards the nipple, to about the sixth rib; laterally, in the axillary region, to the eighth rib; and by the side of the spine, to the eleventh rib. The lower border of the liver corresponds in front and at the side to the lower border of the ribs; and the dulness behind merges into that caused by the right kidney. The left lobe of the liver extends across the epigastrium to the left of the mesial line; the dull sound caused by its upper border merging in that produced by the heart. The upper part of the convexity of the liver rises to a little more than an inch above the sixth rib, the lung dipping down in front, and giving rise to a modified percussion sound; but for practical clinical investigation it is better to take the line of absolute dulness. The extent of the dull sound from above downwards in the right mammary line is nearly four inches, and at the side about four inches and a half. In the middle line in front it extends from the base of the ensiform cartilage to about two fingers' breadth below its point. It should be remembered that the limits of the liver present, compatibly with health, considerable variation; that the organ is relatively larger in early than in adult life; that it is depressed in inspiration, and ascends in expiration; that it is somewhat lower down in the erect than in the recumbent position; and that there is temporary distension during digestion.

Diagnosis.—There are various sources of fallacy which may lead to an erroneous conclusion as to the size of the organ. Thus, an intestine distended with flatus may get in front of the anterior border of the organ, and lead to the supposition that there is contraction, when the contrary is the case. When there is ascites to any extent, it is difficult to make out the boundaries of the liver. In this case, however, by placing the patient on the left side, so as to let the fluid gravitate in this direction, a diagnosis may often be effected; also, by suddenly pressing the finger down below the ribs, and thus displacing the fluid, one may sometimes detect the enlarged organ. A rigid right rectus muscle is liable to be taken for a tumour; to obviate this source of fallacy, the patient should lie on his back with his thighs drawn up, and his attention should be diverted by conversation whilst the examination is being made. Sources of fallacy may exist in the liver itself, as in malformations or malpositions of the organ; or they may be outside it, either in the abdomen or chest. Malignant disease of the stomach, omentum, or pancreas; a kidney greatly enlarged by cancerous deposit; or fæcal accumulations in the colon, may be mistaken for hepatic enlargement. The following considerations will assist in arriving at a correct diagnosis—(*a*) enlargements of the liver, however much they may extend beyond, generally occupy the normal site of the organ, and however irregular the surface, the usual outline may be traced; (*b*) such enlargements usually follow the movements of the diaphragm in full respiration. Effusion into the right pleura may be mistaken for enlarged liver, especially as this organ may be depressed by it, and so appear to extend beyond its limits in the downward as well as in the upward direction. In pleuritic effusion, however, the dulness on percussion will vary with the position of the patient, and the upper line of dulness will in effusion be straight, in hepatic enlargement convex. Pleuritic effusion and hepatic enlargement may, however, co-exist. Pneumothorax, emphysema of the right lung, thoracic tumours, and even extreme pericardial effusion, may depress the liver, and affect the diagnosis.

Enumeration.—Dr. Bright arranged enlargements of liver under two heads, according to the surface of the organ, namely, smooth and irregular. Dr. Murchison considered this classification open to the objection that an enlargement usually smooth is at times irregular, and *vice versâ*, and he proposed the division into painless and painful enlargements; but to this similar objection may be taken. The principal enlargements of the liver are associated with the following diseases of the organ.

1. *Hyperæmia or Congestion.*—The enlargement is not usually, particularly in acute cases, very great; but in chronic cases, and in conges-

tion from obstruction to the circulation, it is often considerable, the organ extending downwards nearly to the umbilicus, and across into the left hypochondrium. The normal contour of the liver is preserved; the surface is smooth; and the resistance is increased. Pain and tenderness are often present, especially in acute congestion.

2. *Obstruction of the bile-ducts.*—Obstruction of the bile-ducts, whether temporary from inflammation or impaction of gall-stones, or persistent, will be attended with some enlargement, smooth and normal in shape, of the liver; with, perhaps, also, distension of the gall-bladder, causing a pyriform tumour, which projects downwards from the anterior border of the liver, and is, in some cases, of considerable size.

3. *Abscess.*—The presence of numerous pyæmic abscesses in the liver will give rise to an enlargement of the organ, with tenderness on pressure over the right hypochondrium. Tropical abscess, when deep-seated, may give rise to like results; but when large and near the surface will, if under the ribs, cause prominence of the right hypochondrium, with obliteration of the intercostal spaces; or when pointing below or to the left of the ribs, will present an elastic, fluctuating tumour, with, perhaps, redness of surface.

4. *Hydatid disease.*—Hydatid of the liver is marked by nearly the same physical signs as abscess; a large hydatid cyst causing, according to its site, either bulging of the right hypochondrium, or an elastic tumour either below or to the left of the right lower ribs. The tumour in some cases gives a sense of fluctuation, and the peculiar vibratory tremor known as hydatid-fremitus. A hydatid cyst may attain much greater magnitude than is ever reached by abscess, and may occupy the greater part of the abdomen. Unlike abscess, hydatid disease, unless the cyst is suppurating, is unattended by pain or constitutional disturbance.

5. *Simple hypertrophy.*—Simple hypertrophy of the liver, resulting from an increase of the size or number of the secreting cells, causes a painless enlargement, having the normal shape of the organ, but attaining at times to twice its normal size.

6. *Fatty degeneration.*—This morbid condition of the liver causes a painless enlargement, not usually very great; with preservation of the normal outline and smooth surface of liver; but with diminished resistance.

7. *Albuminoid degeneration.*—In albuminoid disease the liver preserves its shape; is large; usually has a quite smooth surface; and is hard and resistant to the touch. Enlargement from this cause is sometimes very great, and second only to that which results from malignant disease. The surface in albuminoid disease is sometimes irregular, from co-existence of cirrhosis or syphilitic cicatrices. The spleen is usually enlarged.

8. *Malignant disease.*—In malignant disease the liver is not always enlarged; and in the infiltrated form, the surface may be smooth. Usually, however, especially when the disease is advanced, there is enlargement, with loss of normal shape; and the surface is hard and resistant, and covered with nodules, or large knobs and protuberances. The greatest enlargement—sometimes such as to occupy the greater part of the abdominal cavity, is attained in this disease. Pain, varying in character and intensity, seated in the liver or distal, is also generally present.

9. *Cirrhosis.*—In some cases of cirrhosis the liver may be found enlarged, as in the so-called 'hypertrophous' form. *See* LIVER, Cirrhosis of.

STEPHEN H. WARD.

LIVER, Fatty Disease of.—DEFINITION. A disease attended with painless enlargement and diminished consistence of the liver; due to the presence of a large quantity of fat or oil in the secreting structure; and occurring in connection with phthisis and other wasting diseases, or in persons of luxurious and indolent habits, in whom there is usually an abundant development of fat in the tissues and other organs.

ÆTIOLOGY.—Fatty liver may either be due to degeneration of cell-structure through faulty nutrition, or it may result from infiltration of the cells with fat, transmitted through the portal vessels from without (fatty infiltration.) Fatty degeneration is met with in association with other hepatic diseases, as albuminoid disease and cancer. The fatty liver which results from poisoning by phosphorus would, according to the experiments of Voit and Bauer, appear to be due to degeneration, as the dogs upon which they experimented had been kept without food previously, and were starved during the time phosphorus was administered; showing that the fat could not have come from other parts of the body, or been introduced in food, but must have resulted from the metamorphosis of tissue-material. It is with fatty infiltration that we are more particularly concerned. The fat may come either from within or from without the body. The former case is illustrated when the greater part of the fat of the tissues and organs is absorbed, as in the emaciation of advanced phthisis. Louis, who first established the association of fatty liver with phthisis, found it to exist in about one-third of the cases of this disease, and met with it much more frequently in phthisical females than in males. His observations have been amply confirmed by subsequent observers. Fatty infiltration of the liver also occurs in connection with other wasting diseases, and is not infrequent in patients who have been long bed-ridden. From a therapeutical point of view, the medical practitioner is more interested in the disease under consideration, when fat is introduced from without the body. The affection of the liver is then associated with development of fat in other organs and in the tissues generally. Persons thus affected are usually given to undue indulgence in eating and drinking; to eating not only too much food, but food rich in oil and fat, and drinking beer, but especially spirits to excess. Want of exercise of mind and body, a heated atmosphere, and general luxurious habits, materially assist in determining the affection. In illustration of this cause may be adduced the oft-cited experiments of Magendie, who induced very fatty livers in dogs by feeding them exclusively on butter; and also in the production of the *foie gras* in geese, by penning them up in a heated atmosphere and cramming them.

Anatomical Characters.—In fatty disease the liver is more or less enlarged, but seldom to any great extent; the surface is smooth; the borders are rounded; the substance pits on pressure; and the organ is either of pale yellow or drab colour, or, when partially affected, has a mottled appearance. A portion placed in water floats, showing a diminished specific gravity. On cutting into the organ, the knife is greased; and a greasy stain is imparted to blotting paper applied to the cut surface. A portion when held in the flame of a lamp or candle, will, when the water is driven off, burn. It is, however, as Frerichs remarks, only by the microscope that the degree to which the liver is implicated can be determined. In slighter grades, fat-granules and globules are seen to be limited to the outer zone of the lobules in the vicinity of the portal vessels; but in advanced cases the whole of the cells will be found to be filled either with separate globules, or with a single large drop of fat. In less extensive infiltration the liver may be marked by red spots, corresponding to the hepatic veins. Fat in limited quantity is always present in the human liver, so that the term fatty can only be applied when it is in excess.

Symptoms.—In the lesser grades of the disease, there are scarcely any distinctive symptoms, either objective or subjective. When the affection is more pronounced, percussion will indicate more or less enlargement, usually in the downward direction; and palpation may detect a rounded border and diminished consistence, and will, at any rate, determine that the organ is not unduly hard, has no irregularity of surface, and does not differ materially in shape from the healthy liver. There is seldom, if ever, any pain; at most, in marked cases, a sense of tension and of uneasiness on lying on the left side. Jaundice is a rare event; and ascites and enlargement of the spleen cannot be classed as symptoms of the disease. In cases of fatty infiltration, dependent on luxurious habits, as regards diet, &c., there is usually more or less development of fat in other organs, as well as in the omentum and subcutaneous cellular tissue. There is also a greasy condition of skin, with peculiar odour, resulting from abnormal oily secretion from the sebaceous follicles. Dr. Addison considered a peculiar condition of the skin—presenting to the eye a bloodless, almost semi-transparent, and waxy appearance, and to the touch a feeling of smoothness, looseness, and flabbiness—as indicative, if not pathognomonic, of fatty degeneration of the liver. In cases where the liver is much enlarged, and there is much abdominal fat, the upward pressure may interfere with the action of the diaphragm, and cause, especially after meals, embarrassment of breathing. The functional symptoms likely to be present in advanced cases are irregularity, generally sluggishness, of the bowels; more or less dyspepsia; and, perhaps, loss of appetite. In some cases a weak or irregular, or intermitting action of the heart, with tendency to faintness or giddiness, points to implication of this organ, and is indicative of possible fatal consequences.

Diagnosis.—The enlargement of the liver, with preservation of its normal shape, without hardness or irregularity; the absence of pain, jaundice, ascites, or enlargement of the spleen; and its association either with the emaciation of phthisis or other wasting diseases, or with the habits of the gourmand and general development of fat in the body, will usually enable us to distinguish fatty from other hepatic enlargements.

Prognosis.—The prognosis of fatty disease of the liver is affected by the associated general condition of the patient, and will, of course, be unfavourable in phthisis.

Treatment.—The general therapeutical indications in fatty liver resulting from luxurious habits of living, point to reform in the direction of diet, air, exercise, &c. Rich, oily, and fatty articles of food are to be avoided; whilst sugar and starch should be taken in moderation. Beer, in all forms, is objectionable, and so also is alcohol, unless well-diluted, and taken only at meals. Champagne is objectionable, but other light French wines are admissible. Exercise, either on foot or horseback, should be had recourse to daily, but must be regulated according to the soundness of the heart and circulation. Free exposure to pure air, and avoidance of heated rooms, are desirable. The functions of the skin must be promoted by adequate clothing, and by the use of the bath, or by sponging with soap and warm water. The bowels must be attended to, and dyspepsia met by antacids and vegetable bitters. The Carlsbad waters—the warm Sprudel especially—are indicated, being supposed to act upon the redundant fat. Stephen H. Ward.

LIVER, Functional Disorders of.—Introductory Remarks.—The late Dr. Copland, in his *Dictionary of Practical Medicine*, arranged these disorders under three heads, according to the nature of the biliary secretion. 1. Diminished secretion of bile; 2. Excessive secretion of bile; and 3. Vitiated biliary secretion. Dr. Budd, whilst recognising the functions of the liver as threefold, namely, as to changes effected in the blood, the formation of sugar, and the secretion of bile, almost restricts what he says upon the subject of functional disorders to abnormal conditions of the secretion—excessive, defective, or unhealthy bile. The late Dr. Murchison, in his lectures on *Functional Derangements of the Liver*, showed that the classification heretofore adopted, does not represent the present state of knowledge of the functions of the organ. He summarises these functions under three heads:—1. The formation of glycogen, which contributes to the maintenance of animal heat, and to the nutrition of the blood and tissues. 2. The destructive metamorphosis of albuminoid matter, and the formation of urea and other nitrogenous products, which are subsequently eliminated by the kidneys; these changes also maintaining the animal heat. 3. The secretion of bile, a large portion of which is reabsorbed, assisting in the assimilation of fat, and other elements; whilst a part, passing downwards, stimulates the peristaltic action of the intestines, and arrests decomposition. The author just cited arranged the phenomena of functional derangements of the liver under nine heads. 1. Abnormal nutrition. 2. Abnormal elimination.

3. Abnormal disintegration. 4. Derangements of the organs of digestion. 5. Derangements of the nervous system. 6. Derangements of the organs of circulation. 7. Derangements of the organs of respiration. 8. Derangements of the urinary organs. 9. Abnormal conditions of the skin. The above heads, however, represent for the most part functional and general symptoms resulting from functional hepatic disorders, rather than these disorders themselves. The arrangement under three heads, representing the three principal functions of the organ, is that which the writer proposes to adopt.

ÆTIOLOGY.—It is scarcely necessary to remark that functional disorders of the liver are often secondary to structural diseases of the organ, or to diseases of the thoracic and abdominal viscera, febrile affections, malaria, and other causes. It is with the causes which induce these disorders when primary, that we are here concerned. Prominent among such causes are errors in diet, and the undue use of alcoholic liquors. Habitual over-eating, and especially indulgence in rich, fatty articles of food, such as rich soups, entrées, and pastry; and the undue use of sugar, fish or flesh containing much oily matter, are very apt to disturb the function of the liver. Excess in the use of alcoholic drinks is another cause, in this country, in frequent operation. The combination of sugar with alcohol much enhances the mischief. Hot, sweetened grog; sweet new wines, as champagne, unless dry; Madeira, and sweet sherries; port-wine; liqueurs; and malt liquors, particularly mild ales and stout, are ready causes of hepatic derangement. Want of exercise, whether the result of necessity or of indolent habits, is another common exciting cause of hepatic functional disorders; and its effect is enhanced when it is associated with errors in diet. Living habitually in a high temperature, whether in a warm climate or in over-heated rooms, is another cause, and is intensified when associated with the causes already alluded to. Depressing nervous and emotional influences must not be forgotten in considering the ætiology of the subject.

SYMPTOMS.—The phenomena which are observed in functional derangements of the liver may now be briefly indicated, according to the particular hepatic function which is disordered.

1. **Disorders of the Glycogenic Function.**—Disorders relating to the glycogenic function fall under the subject of diabetes, and need here only be alluded to. *See* DIABETES.

2. **Disorders of the Metabolic Function.** In reference to derangements from faulty function connected with albuminoid disintegration, &c., the writer quite concurs with, and will concisely state the views advanced by Dr. Murchison. One of the immediate results of such faulty function is the non-conversion of nitrogenous matters into urea, and the production of lithates and lithic acid, inducing a condition of blood to which this authority fitly applied the term *lithæmia*. This lithæmia may be relieved for a time by elimination by the kidneys, showing itself in deposits in the urine, on cooling, of lithic acid, lithates, and pigmentary matter. These deposits are not unfrequent in persons in good health, especially after any excess or error in diet; and they are more or less constant in subjects of gouty habit of body, and in those who are predisposed to hepatic derangement, or who induce it by habitual over-stimulating diet. These deposits may exist for years without causing much discomfort; but after a time, the excessive quantity of lithic acid and lithates cannot be eliminated by the kidneys; and they accumulate, causing disturbances in different parts of the organism, and giving rise to various more or less distressing symptoms. Of these symptoms the more prominent are:—epigastric oppression, flatulent distension of stomach and bowels, heartburn, acid eructations, sense of weariness and tendency to sleep after meals, furred tongue, unpleasant taste in the mouth, especially in the morning, appetite often good, sometimes the contrary, an excessive secretion of viscid mucus in the fauces and back of the nose, constipation and vitiated secretions. Palpitation, irregular or intermitting pulse, frontal headache, vertigo, noises in the ears, restlessness at night, irritability of temper, and hypochondriasis, are other symptoms that are not unfrequently present.

Gout, whether openly expressed, latent, or irregular, is associated with the symptoms just mentioned, and is one of the results of lithæmia, and of faulty hepatic function.

Urinary calculi are another result of lithæmia, at all events, those which consist of lithic acid or its salts, and which are the most frequent. Sir H. Thompson confirms this view, and shows that the formation of these calculi is to be prevented by remedies and a *régime* directed to the liver rather than to the kidneys.

Biliary calculi are also a result of functional hepatic derangement, and are frequently associated with a gouty habit of body, and with lithic acid deposits and calculi.

Lithæmia predisposes to local inflammations. Individuals who are subject to deposits of lithic acid and lithates are more liable than others to severe local inflammations; and in reference to this fact, Dr. Murchison made the practical observation that in such persons the lithates cease to be eliminated on the advent of a local inflammation or ordinary febrile catarrh, to be again discharged freely on the subsidence of the pyrexia. In such cases, he added, the retention of lithates in the system has probably determined the attack.

Some diseases of the skin, as eczema, psoriasis, lichen, and urticaria, are unquestionably often induced and maintained by lithæmia and the hepatic derangement from which it results.

To conclude this portion of the subject, the functional derangement under consideration, as Dr. Murchison remarked, 'by the production of peccant substances which are not readily eliminated, and which, therefore, accumulate in the system, may in the long run lead to many of the most serious maladies, both acute and chronic, to which our race is subject.'

3. **Disorders of the Biliary Function.**—Disorders referable to faulty biliary secretion may be divided into (*a*) those due to *excessive* secretion; and (*b*) those due to *deficient* secretion. It is scarcely necessary to arrange those due to vitiated bile under a separate head, as the secre-

tion may be vitiated, whether it be redundant or deficient.

(*a*) *Excessive* secretion of bile is characterised by bilious diarrhœa—copious, fluid, bilious evacuations, nausea, or not unfrequently vomiting; twisting, griping pains in the abdomen; and perhaps some febrile symptoms. The bile in some cases seems to be peculiarly acrid, and causes much smarting when it is voided. The urine is generally high-coloured, and loaded with lithates. There is frequently headache, and either irritability of temper or depression of spirits. Disturbances of circulation, in the form of irregularity of pulse, and palpitation of the heart, are also occasionally present. As has been stated under the article LIVER, Hyperæmia of, this excessive secretion of bile, with the attendant symptoms, is usually the result of congestion of the liver.

(*b*) *Deficient* secretion of bile is characterised by dyspeptic symptoms, such as furred tongue, unpleasant taste in the mouth, loss of appetite, and flatulence. The action of the bowels may be irregular, but is usually costive; and the evacuations are of a pale yellow, or drab, or whitish colour, and often of offensive odour. The complexion is usually sallow and anæmic, not often jaundiced. Disturbances of the circulation, in the form of languid or irregular pulse, and of the nervous system, as headache, languor, drowsiness, and hypochondriasis, are frequent concomitants. The urine is generally dark-coloured, turbid, and loaded with lithates. There is also, in cases of long standing, loss of flesh. Indeed, the functions of the bile in promoting the assimilation of fat, in stimulating the peristaltic action of the intestines, and as an antiseptic, are well illustrated in the symptoms which attend protracted deficiency of the secretion.

TREATMENT.—Among the remedies which promote the expulsion, if not the secretion of bile, mercury and its preparations hold a prominent place. For notwithstanding the results of experiments upon animals, few practitioners will be content to give up the advantage which their clinical experience has taught them is to be derived from the judicious use of mercury. It is possible that the drug merely effects the expulsion of the bile; the result, however, is unquestionable. In excessive secretion of bile a single full dose of calomel, followed in a few hours by a saline draught, will cause a free downward discharge; and in the lithæmic condition of system, indicated by turbid urine containing copious lithates, the same treatment will afford ready relief. In smaller doses, repeated at intervals, and combined with other aperients, as colocynth, or rhubarb, mercury will be followed by beneficial results in less active functional derangement. In some cases mercury is inadmissible, or disagrees, and, in any case, it is well not to repeat it too frequently, or to continue it for too long a time, as its protracted use is apt to impair digestion and nutrition, and weaken the function of the organ which it at first relieves. Of late years a valuable addition to the list of cholagogues has been made in podophyllin. A quarter of a grain to a grain of the resin may be given for a dose, combined with a little hyoscyamus or half a grain of extract of cannabis indica to prevent griping, and a grain or two of rhubarb or watery extract of aloes, or, if it is desirable to quicken the action, with some extract of colocynth, or it may be given in solution as a tincture. When the drug acts favourably it produces one or two bulky evacuations, with copious excretion of bile, followed by a feeling on the part of the patient that the bowels have been thoroughly emptied. Its action, however, is at times neither satisfactory nor certain, and it causes occasionally much griping, irritation, and tenesmus, and subsequent depression. Taraxacum is useful as an aperient, and probably alterative, in functional hepatic disorders, and may be given in cases where the gouty or lithic acid diathesis exists, in combination with alkalies, especially the bicarbonate of potash. The fresh extract, in ten to fifteen-grain doses, acts better than the juice. Nitro-muriatic acid is indicated in cases of torpid liver associated with oxaluria (*see* LIVER, Hyperæmia of). The saline aperient draught has of late been in a great degree superseded by one or other of the aperient mineral waters, the Friedrichshall, Pullna, Hunyadi, &c. These should be taken in the morning, fasting, and their effect is quickened by the addition of some warm water. The action of these waters, as of the saline purgative, is to cause a drain from the intestinal vessels, and thus to relieve the congested hepatic portal system. The waters of Carlsbad, Marienbad, and other similar springs contain no sulphate of magnesia, and owe their aperient effect to the sulphate of soda which is the preponderating ingredient. This drug does not act by stimulating intestinal secretion, but, according to Buckheim, by retaining the water in which it is dissolved and that which it meets with in the bowel, and so constituting a solvent which loosens and softens and carries down dried fæcal masses, and tenacious mucus. The amount of carbonate of soda associated with the Glauber's salt in these waters renders them antacid, and assists in determining a diuretic as well as aperient action. The mineral waters, or the salts obtained from them by evaporation, may be taken at home in the morning, in conjunction with sufficient warm water. For those individuals especially who are suffering from hepatic congestion or merely functional disorder, especially if the result of irregular habits in eating and drinking, a visit to and course of waters at one of the spas will, if means permit, be desirable. Change of scene, regularity in diet, and absence from mental harass, are, of course, important elements in the success of a more or less protracted stay at such places; and it is remarkable how readily many individuals, who are quite unmanageable at home, submit to strict hygienic arrangements under fresh influences. Cheltenham, Leamington, and Scarborough in this country, and in addition to those already named, Homburg and Kissengen on the Continent, are amongst the spas which enjoy special renown in the treatment of liver-affections. *See* MINERAL WATERS.

In no class of disorders do general remedial or hygienic agents act more beneficially than in functional derangements of the liver. Pure air.

exercise, strict attention to the functions of the skin, and suitable diet, are the curative means on which we must mainly rely. In all cases it is of moment to promote the healthy action of the skin and lungs. This is to be done by exercise on foot or horseback. The latter is peculiarly advantageous, as it stimulates directly, by a series of succussions, and by contraction of the abdominal muscles, the liver and intestines, and may be had recourse to, in moderation, by those who are not very vigorous. Walking promotes the general circulation, excites the action of the skin, increases the frequency and fulness of the respirations, and indirectly tends materially to relieve a congested or indolent state of liver. The action of the skin must also be maintained by adequate clothing in all seasons of the year, and by daily use of the sponge-bath, followed by active friction of the entire surface of the body.

The diet should be of a light nourishing character; and rich gravies, made dishes, soups, sauces, pastry, raw vegetables, and such articles, should be carefully avoided. The nitrogenous foods suit best, especially where there is associated lithæmia; starchy and saccharine articles being objectionable. The stronger spirituous drinks are to be entirely avoided; but the lighter wines, as claret, hock, and light dry sherry, may be taken at meals in moderation.

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LIVER, Gangrene of. *See* Liver, Abscess of; and Inflammation, Acute, of.

LIVER, Hydatid Disease of.—Synon.: Echinococci of Liver.

Anatomical Characters.—The liver is the organ most frequently affected with hydatid disease. There is usually but one cyst, but there may be two, three, or more; and the size of the cyst may vary from that of a pea to that of a child's head. The cysts may exist in either lobe of the liver, but they are more frequent in the right; and they may be attached to the upper or under surface, or project from the border, or lie buried in the substance of the gland. This is more or less modified in form, and increased in size, according to the magnitude and site of the cyst. When the cyst is small and deep-seated, there will be no appreciable change in the liver, and the disease may be latent for years. When, however, the cyst is very large, it, with the liver, may constitute a tumour, which may encroach upon the thorax, and also fill a great part of the abdomen. Pressure of the cyst may induce atrophy of a portion of the liver, but, at times, hypertrophy is the result. The bile-ducts have occasionally been found to be obliterated, or a communication to have been effected between them and the cysts. When at the surface of the organ, the cysts as they enlarge may induce inflammation and thickening of the peritoneum, and adhesion to neighbouring structures.

Symptoms.—A hydatid cyst, when sufficiently large and near the surface, generally exhibits itself as a tumour of variable size, situated either in the right hypochondrium or in the epigastric region; evenly globular in its early stages; firm, resisting, yet elastic, and, at times, with a sensation of fluctuation. Briancon and Piorry noticed a vibration or trembling—hydatid fremitus—which is felt when the surface is compressed gently by three fingers of the left hand, and sharp percussion made with the right hand over the middle finger. Frerichs does not consider this sign of much importance, it having been present in only one-half of his cases. If the tumour is situated behind the liver, it will, as it develops, push this organ forwards, flatten it, and increase the area of dulness. The tumour may last for a considerable time, and go on increasing to some extent, and yet the patient remain free from constitutional disturbance, perform all his functions well, and keep in good condition as regards flesh and strength. When, however, it has attained a very large size, it will give rise to various symptoms; to a feeling of tightness and distension; if it press upwards, to embarrassed breathing, cough, and palpitation; if upon the abdominal viscera, to interference with their functions. Pain is not generally present, but in some cases there is a gnawing pain, either at the epigastrium, or extending forwards from the lumbar region. Œdema of the lower extremities may occur when the tumour presses upon the inferior cava.

Diagnosis.—Hydatid tumour of the liver is not always easily diagnosed; but the characteristic features already noticed, and its compatibility (in many cases up to an advanced stage) with a good state of health, will generally point to its nature. Abscess of the liver will be distinguished by local and remote pain; the frequent antecedence or co-existence of dysentery; and severe constitutional symptoms, such as hectic fever, rigors, &c. It must, however, be remembered that hydatid cysts are liable to become inflamed and to suppurate, when the diagnosis will not be so readily made. Cancer of the liver will generally be marked by irregularity of surface; the presence of pain; the cachectic aspect; and the rapidity of progress. Aneurism of the abdominal aorta may form an epigastric tumour, of even, spherical shape; but the pulsations, frequently very forcible, coupled, probably, with bruit, audible along the course of the vessel before and behind, will determine the diagnosis. The site, the pyriform shape and uniform size, and the usual accompaniment of jaundice, will distinguish from hydatid disease the tumour caused by a distended gall-bladder. Frerichs thinks that hydatid disease of the liver is more frequently confounded with localised pleuritic effusion at the base of the chest than with any other affection. He remarks that the same signs—dulness on percussion, absence of vocal thrill, intercostal fluctuation—would be present in both cases. He rests the diagnosis on the fact that the line of dulness would present a curve which would look upwards in the one case, downwards in the other.

Prognosis and Terminations. — Hydatid tumour of the liver may last for years, and be compatible with an average state of health; or at an early or advanced period of its existence, it may terminate in one of the following ways:—1. It may, from its bulk and position, press upon and interfere with the functions of different organs. Pressure on the large venous trunks may induce ascites and dropsy of the lower extremities; pressure upon the stomach and intestinal canal may obstruct functions connected with the assimilation of food, and induce failure of flesh and strength, and ultimately death from exhaustion. 2. The tumour may contract adhesions with the diaphragm; ulcerative action through this may be set up, and either (*a*) discharge of the contents of the sac may take place into the pleura, and fatal pleuritis result; or (*b*) further adhesions and ulceration may effect communication with the lung, pneumonic symptoms ensue, and the contents of the sac, mixed with the products of inflammation, be expectorated. 3. A rare result is adhesion to, and ulceration into the pericardium, with escape of contents, and rapidly fatal results. 4. Adhesion may be effected with some part of the alimentary canal, and the contents of the sac be discharged by vomiting or by stool. 5. Rupture of the sac may be caused by a blow or otherwise; the contents be discharged into the peritoneum; and fatal peritonitis result. 6. The tumour may contract adhesions with the parietes; point externally; and be opened or effect an opening by natural process, inflammation and suppuration having been previously set up in the sac. 7. Budd and Frerichs notice a possible cure from the obliteration of the sac by the formation within it of a putty-like matter, which involves or perhaps results from destruction of the cysts. 8. Communication may be effected between a cyst and one of the bile-ducts, and then the result will usually be fatal, although there are one or two cases recorded of recovery. 9. Similar cysts may be formed in other parts or organs of the body. 10. As a possible rare event may be mentioned communication of the sac with the ascending vena cava, escape of the contents into this, transfer of the contents to the right side of the heart, impaction in the pulmonary artery, and fatal asphyxia.

Treatment.—So long as a hydatid tumour induces no distressing symptoms, and does not affect the functions of any organs, there is no pressing cause for interference. When, however, it is rapidly increasing, is accompanied with pain or distressing distension, and especially if by upward pressure it is causing difficulty of breathing, and other symptoms, it will be well to have recourse to tapping. If there be any doubt about the nature of the tumour, the exploratory needle may be first introduced, and should a clear fluid, free from albumen, escape, the case may be fairly pronounced to be one of hydatid disease. It is now, indeed, considered the best treatment not to wait for urgent symptoms; but when the disease is well developed, the cyst yet perhaps single, and the walls elastic, to let out the contents. This is best and most safely effected by puncturing with a fine trochar or with an aspirator. Certain precautionary measures must, however, be attended to. Prior to tapping, a broad flannel roller should be firmly applied round the abdomen, commencing from below and carrying the bandage up to the tumour, so as to assist in fixing this. It is considered desirable not to quite empty the cyst, as by doing so the chance of air entering the cyst is increased. This result may also be further prevented, and adhesion of the cyst to the parietes promoted, by applying a compress of lint over the wound and fixing it firmly with the remainder of the bandage which has been already partially applied. The patient should be kept quiet in bed for a day or two, and rest should be further ensured by the administration of morphia. The late Dr. Murchison discountenanced the use of chloroform for this operation, as the pain is but trifling, and the chloroform may induce vomiting, which would interfere with the subsequent rest of parts, so desirable to ensure a successful result. It is not necessary to wait for the adhesion of the cyst to the parietes before puncturing, as the use of a fine trochar diminishes the risk of escape of the contents of the sac into the peritoneum; and, moreover, the escape of a certain amount of fluid will not usually induce peritonitis. A large proportion of cases thus treated have been successful. When a hydatid cyst has suppurated, it should be opened with a large trochar or a bistoury, and kept open. Puncture and subsequent injection of the cyst with some stimulating fluid; gradual opening of the cyst by applications of caustic potash, so as to ensure adhesion with the parietes; and a large incision with a view to effective removal of contents, are methods of treatment which have been practised, but cannot be recommended in comparison with simple puncture with a fine trochar. Dr. Hilton Fagge and Mr. Durham treated several cases successfully by acupuncture, and by passing a galvanic current through the contents of the cyst; but it seemed probable that the result was due to the acupuncture, and not to the galvanic influence. Treatment by special medicinal agents, administered internally, has been fairly tried. Of these, common salt and iodide of potassium in large doses may be mentioned. They have, however, proved useless.

Stephen H. Ward.

LIVER, Hyperæmia of.—Synon.: Congestion of the Liver.

Definition.—Uniform enlargement of the liver, with preservation of its normal shape; caused by over-distension with blood, the result of mechanical obstruction to the return of blood to the heart, or of direct afflux of blood through the portal vessels; attended with a sense of fulness and oppression in the right hypochondrium and in the epigastric region, a dusky and sometimes jaundiced complexion; and terminating, if not relieved, in organic changes in the hepatic parenchyma.

Ætiology.—Congestion of the liver may be either *active* or *passive*. Niemeyer limits the term 'congestion' to the latter, and applies the term 'fluxion' to the former. *Active hyperæmia*, or congestion, results from—1. Excess in eating and drinking, especially in persons of sedentary and indolent habits. Determination of blood to the liver occurs, to some extent, in the process of digestion in connection with ordinary meals, and if these consist of rich and irritating materials, and are repeated too often, or if the liver is stimulated between meals by the imbibition of spirituous liquors, the hyperæmia may become excessive and continuous. 2. Long exposure to a tropical or sub-tropical temperature will, perhaps, induce hepatic congestion, but such influence may be long resisted by persons of temperate habits; and it is probable that the association of irregularities in eating and drinking mainly contributes to the result. 3. A chill, after exposure to heat, may induce active hepatic congestion, which, in hot climates, may result in suppurative hepatitis. 4. It may be excited by injuries to the liver—such as contusions or wounds. 5. It occurs in connection with suppressed menstruation, especially in women of full habit of body, and who are approaching the period of 'change of life.' 6. Hyperæmia of the liver with enlargement occurs in connection with typhus fever, the acute exanthemata, puerperal fever, scurvy, &c. It is also a result of prolonged exposure to malaria, with or without attacks of pronounced ague. This influence is the main cause of the enlarged livers with which 'old Indians' return to this country. *Passive hyperæmia*, to which the term *mechanical* is applied by some authors, is due to interference with the return of blood from the liver through the hepatic vein and inferior cava to the heart. Such interference may be due immediately to dilatation of the right heart, with affection of the tricuspid valve; to obstruction to the circulation in the course of the pulmonary arteries, caused by different diseases of the lungs; or farther on, in the line of the circulation, to disease of the mitral or aortic valves. The affections of the lungs which interfere with the pulmonary circulation are either acute, as pneumonia, and then the hepatic hyperæmia may pass off with the disease; or they are chronic, as emphysema, and fibroid disease, and then the hyperæmia will persist. Mechanical congestion of the liver may result from direct obstruction to the flow of blood by the pressure on the vena cava of aneurismal or other tumours. Mere weakness of the heart's action often keeps up a certain amount of passive congestion.

Anatomical Characters.—A hyperæmic liver is increased in size about equally in all directions; its resistance is also increased; its peritoneal investment appears distended and shining. On making an incision blood oozes out freely, and the cut surface is dark red, either uniformly so, or spotted with intervening lighter spaces. In the active form of congestion there is engorgement of the portal vessels at the periphery of the lobules; in the passive or mechanical form, the central vessels of the lobules—the hepatic veins—are engorged. In the latter form, when it is due to a persistent cause, as disease of the mitral valve, and has lasted some time, the cut surface gives the characteristic appearance to which the term *nutmeg-liver* has been applied. The dark centres contrast with the pale circumference of the lobules, the light and dark parts are clearly defined, varying according to the section; the surface gives an appearance which resembles closely that of a cut nutmeg. The central dark spots result from distension of the hepatic veins, and deposition of bile-pigment in the adjacent hepatic cells, which are more or less atrophied by pressure; the lighter spaces correspond to the interlobular veins, the light colour being due, according to most pathologists, to the presence of fat in the cells at the circumference. Dr. Wickham Legg, however, states, as the result of an examination of twenty cases of nutmeg-liver, that the fat was not in excess in the majority of them. In addition to the atrophy of the cells by pressure of dilated hepatic veins, there is hypertrophy of the interlobular hepatic tissue, with lymphoid bodies scattered through it and, in later stages, through the liver generally, and it is on this latter cause, as in cirrhosis, that the shrinking of the liver in advanced cases depends. The term 'red atrophy' has been applied to this advanced stage of nutmeg-liver, but, as Dr. Legg remarks, it is objectionable, as having been previously used by Virchow to designate a state of liver met with in wasting diseases, such as typhoid fever. The term 'atrophic nutmeg-liver' answers well. 'Varicose atrophy,' used by some writers, is based upon the dilated condition of the central vessels and their radicles.

Symptoms and Sequelæ.—In slight cases of hyperæmia the liver does not extend much beyond its normal limits, but it may perhaps be felt below the borders of the ribs and across the epigastrium. In severe cases, and especially in passive hyperæmia from obstructed circulation, the organ often attains a considerable size, and is found, on percussion, to extend upwards into the mammary region, downwards nearly to the umbilicus, and across into the left hypochondrium. Its resistance is generally increased, and, in old-standing cases resulting from malaria and hot climate, it has an amount of hardness which characterises, and probably indicates, albuminoid degeneration. There is often, especially in acute cases, tenderness on pressure. The patients do not exactly speak of pain, but of a sense of oppression and fulness in the right hypochondriac and in the egigastric regions, and of uneasiness from the pressure of clothes, or on lying on the left side. In most acute cases there is marked functional and general disturbance; a furred tongue, nausea, vomiting at times of bile, bilious diarrhœa, sallowness of complexion, or some amount of jaundice. In some cases the bile seems to be peculiarly acrid, and causes much griping and distress as it passes downwards, and smarting as it is voided. The urine is high-coloured, and loaded with lithates. The patients often complain of headache, are irritable, depressed in spirits, and feel languid and drowsy. Disturbances of circulation are indicated, in severe attacks, by irregularity of the pulse, and palpitation of the heart. When jaundice, in any marked degree, is present, there is probably catarrh of the bile-ducts, and transient obstruction of these ducts, and then the evacuations are devoid of bile. The hyperæmic condition of liver induced in India or other tropical regions, as the result of high temperature and malarious influence, may terminate in chronic enlargement, and possibly in damaged structure of the organ. The symptoms which mark this are cachexia and anæmia, with sallowness of complexion; a weak circulation, indicated by great susceptibility to changes of temperature, by chilliness and coldness of the lower extremities; disturbances of nervous system, shown by irritability, depression of spirits, disinclination for effort of any kind, headache, giddiness; and other symptoms. Dyspeptic symptoms are present. The bowels are either constipated or relaxed; the stools in either case showing a deficient or vitiated secretion of bile. The urine sometimes contains bile, frequently oxalate of lime, and excess of urea. The skin is dry and harsh. Individuals with such a condition of liver may prolong their existence for years; or the serious interference with nutrition may induce increasing loss of flesh and strength, and premature death.

In the mechanical form of hyperæmia there are, in addition to special gastric and hepatic symptoms, other symptoms indicative of the pulmonary or cardiac affection on which it depends. The complexion is more or less dusky, and there is a certain amount of lividity mixed with the jaundiced hue. The liver, which may have become much enlarged, will, if observed carefully in any protracted case, often be found again to diminish as the atrophic change takes place. Ascites may now become a prominent symptom, whilst, as Niemeyer remarks, the general dropsy resulting from associated heart-affection may be yielding to treatment.

Diagnosis.—Hyperæmia of the liver, when it is the result of obstruction to the circulation caused by diseases in the chest, is easily recognised. Also, when of the active kind and acute, it is not likely to be mistaken for any other cause of enlargement. It is only when the congestion is chronic, and the liver hard and resistant, that an erroneous diagnosis may be made, but the previous history of the case, and associated general symptoms, will lead to a right conclusion. It might be mistaken for albuminoid disease, but then it may be really undergoing this degeneration.

Prognosis.—Active hyperæmia of the liver usually ends favourably on removal of the exciting cause, and under appropriate treatment. The following considerations will, however, influence the prognosis. 1. An attack of hyperæmia in an individual of intemperate habits may be but the early stage of cirrhosis. 2. A similar attack, occurring in India, may, as Dr. Maclean remarks, be but the commencement of acute hepatitis, which may end in suppuration. 3. The prognosis in the mechanical congestion, dependent upon disease in the chest, will be influenced by the nature and stage of such disease.

Treatment.—An attack of acute hyperæmia of the liver will usually be relieved quickly by rest; by restriction to a bland, fluid diet; and by ensuring free action of the bowels by a dose of calomel, followed after a few hours by a saline aperient, either in the form of a draught, or of one of the more active mineral waters. A single sufficient dose of calomel, four or five grains, will often rapidly relieve attendant gastric irritation and vomiting, and ensure a free downward discharge of bile. Should there be much tenderness on pressure over the liver, the application of sinapisms or turpentine stupes, followed by hot poultices, will be beneficial. So long as any acute symptoms continue, the patient should be kept quiet in bed; the diet should be light and fluid; and stimulants should be rigorously excluded. The portal system must be kept relieved by a dose of Pullna or Friedrichshall water, or a saline draught, every or every other morning, preceded the previous night by some mercurial preparation, if the secretion seem to require this. Podophyllin may be advantageously substituted for mercury, in some cases, but it is uncertain in its action. Its griping effect is counteracted by the addition of a little extract of hyoscyamus or half a grain of extract of cannabis indica, and its action will be quickened by adding a little compound colocynth pill. When the acute stage of hyperæmia is passed, taraxacum often acts well as a purgative and alterative; combined, in subjects of gouty habit, whose urine is more or less charged with lithates, with bicarbonate of potash, or, in other cases, with nitro-muriatic acid. This acid, in torpidity and chronic enlargement of the liver, is one of our most effective remedies. It acts by altering and promoting the biliary secretion, and by improving the tone of the digestive organs. In the chronic enlargement of liver of 'old Indians,' and in that which results from malarious poison, and also in other forms of chronic congestion, it often acts very beneficially. It may be used both internally and externally. Ten to twenty drops of the dilute acid of the pharmacopœia may be given two or three times daily, combined with taraxacum, quinine, or other drug, according to indications. The external use of the acid has been advantageously had recourse to at the Seamen's Hospital for years, either in the form of compress over the abdomen, or by sponging the surface of the body, or by the use of baths to the lower extremities. The fluid for the bath or compress is prepared by adding eight ounces of the dilute acid of the pharmacopœia to a gallon of water of about 98° Fahr. The compress may be applied by soaking a flannel roller of sufficient length, about a foot in width, in the prepared acid, and wringing it so that it merely remains damp. The roller should be then applied round the body, covered with a piece of oiled silk, and worn constantly—subject, however, to renewal of acid night and morning; or the lower extremities may be immersed in the fluid for about twenty minutes, night and morning, and the inner sides of the thighs and the body be sponged at the same time. Earthenware or wooden baths should be used; and the sponges and towels after each bath must be well washed in cold water, or they will be destroyed by the acid. At times the external use of the acid causes purging; and in several cases, at the Seamen's Hospital, severe irritation of the skin, with copious papular eruption, resulted, and the remedy had to be discontinued.

Chloride of ammonium and iodide of potassium must be mentioned as drugs that have been found serviceable in reducing livers enlarged by chronic congestion. In the hyperæmia resulting from disease of the mitral or aortic valves, or from chronic lung-changes, it is sufficient to remark that the chest-symptoms will often be most effectually relieved by treatment directed especially to the liver.

Much benefit will result in many cases of hyperæmia by a course of mineral waters at one of the German or English spas. Marienbad, the cool springs of Carlsbad, rather than the Sprudel, Kissingen, Cheltenham, Harrogate, &c., are indicated in active hyperæmia; the more tonic waters in the more chronic forms of congestion. A more detailed notice of the different spas and waters in relation to liver-affections is given at the end of the article on Functional Disorders of the Liver. *See* MINERAL WATERS.

STEPHEN H. WARD.

LIVER, Hypertrophy of.—In true hypertrophy of the liver, the increase in the size of the organ is due to enlargement and multiplication of the secreting cells, without any morbid change having taken place in these, and without the deposit around them of any morbid material. The parenchyma of an hypertrophied liver is generally firm and vascular, in some few instances pale and flabby. The hypertrophy may be *partial* or *general*. *Partial* hypertrophy may either result from localised irritation of the liver, as in tight-lacing; or it may compensate for some other portion of the organ reduced or entirely destroyed by disease, as in the large irregular lobules of hepatic tissue formed in advanced cases of syphilitic hepatitis. *General* hypertrophy has been found in some cases of diabetes mellitus; in leukæmia; and, according to Dr. Jules Simon, in a certain cachectic condition produced under the combined influences of deprivation, scrofula, and residence in a damp locality. Whether true hepatic hypertrophy can be caused by residence in hot climates, or by prolonged exposure to malaria, seems, according to Frerichs, to be open to doubt. It is probably due in some instances to prolonged congestion of the liver, and as a result of such a condition may occasionally be met with in drinkers and free livers, and in the subjects of pulmonary and cardiac diseases. W. JOHNSON SMITH.

LIVER, Induration of.—The liver is commonly hardened whenever it is small. Simple induration is a state in which new connective-tissue seems to replace the proper hepatic tissue throughout large tracts of the liver. Often the organ becomes small and lobulated; at other times it is increased in size, and a case has been known in which it weighed eight pounds, constituting a connective-tissue hypertrophy of the liver. The diseased part presents the appearance of a completely homogeneous, whitish-yellow, firm, hard mass; which under the microscope is seen to be made up of connective-tissue, in which no, or very few, elements of liver-substance can be made out.

J. WICKHAM LEGG.

LIVER, Inflammation of, Acute.—SYNON.: Acute Hepatitis; Fr. *Hépatite aiguë*; Ger. *Acute Leberentzündung*.

It is usual to divide acute inflammation of the liver into *perihepatitis*, involving the investing membrane of the liver and Glisson's capsule; and *hepatitis*, in which the parenchyma of the liver is engaged—in other words, into superficial and deep-seated; but, practically speaking, perihepatitis is rarely more than an accompaniment of hepatitis, of peritonitis, or of an acute attack of a neighbouring organ. We shall not treat of the two separately, as they are constantly associated with each other.

ÆTIOLOGY.—Acute hepatitis is by no means a common affection in Europe, and even in the tropics congestion is far more frequent than acute inflammation. The chief causes of hepatitis are exposure to heat, and to changes of temperature—both of which have a large share in what is called tropical influence—irregular habits of life, and spirit-drinking. Irregular action of the liver and of the bowels predisposes to it. Men in the tropics are far more subject to the disease than women or children—in fact acute hepatitis is exceedingly rare in children. The disease is uncommon in men under the age of twenty, and appears to be most frequent between the ages of twenty-five and thirty-five. Independently of the cases in which it appears to be connected with dysentery, many authors believe hepatitis to be induced by the same causes as those which produce tropical dysentery and tropical fever—in other words, by malarious influences. Hepatitis or perihepatitis are sometimes occasioned by falls, or by external violence, which may operate in producing them either directly or secondarily.

ANATOMICAL CHARACTERS.—The liver when inflamed is usually represented as softened and congested, sometimes having a granular appearance. When cut into, more blood flows from it than usual. It is sometimes infiltrated with serous fluid, with lymph, or occasionally with small spots of pus. While portions of the liver are involved in inflammation, other portions may be unaltered; but most generally it is inflamed or congested throughout, in some parts in red patches, while in other parts there are patches of a yellowish colour. These may be traced in their changes until they are converted into abscesses, which may be single, or less frequently multiple; usually these are enclosed in a cyst, which varies from the thinnest half-formed membrane to a tolerably tough one. If there has been much perihepatitis, the liver is very commonly adherent to the diaphragm or to the neighbouring viscera by organised lymph, and its capsule is thickened.

With reference to the distribution of its blood-vessels, it has been presumed that congestion of the liver is mainly caused by obstruction to the hepatic veins, consequent on affections of the heart or lungs, or by some obstruction of the vena portæ, or morbid alteration of the blood which it conveys. In inflammation, again, the capillaries of the hepatic artery are believed to be primarily engorged. But these matters are not very certain. As regards suppurative inflammation, Budd maintains that it is the result of purulent matter taken up from ulcerating surfaces of the bowel, and conveyed to the liver by the vena portæ.

SYMPTOMS.—These vary much in their degree of acuteness. There is frequently in the commencement chilliness, or even some shivering, followed by fever. The appetite is impaired, and there may be loathing of food. The tongue is white, and usually has a thick white coat. The bowels are sometimes constipated; more frequently there is diarrhœa. Sometimes there is great thirst, along with irritability of the stomach, with bilious vomiting. A certain degree of jaundice has been often set down as a symptom of hepatitis, but it is very unusual. There is frequently pain in the right shoulder, but by no means always. There is often a short dry cough. There is generally some fever; the pulse is usually from 100 to 110, and the temperature of the body is increased two or three degrees; but there is seldom present that amount of irritation which one would expect to find, when inflammation is so acute that it may end in suppuration. In the region of the liver the symptoms are various. Sometimes there is sharp lancinating pain, especially when the convex surface is most affected; more frequently there is a dull, heavy pain, which is increased when the patient endeavours to lie on his left side. There is generally pain in the liver on pressure. On careful examination the viscus will often be found to be increased in bulk, but by no means always so. It may be enlarged upwards and backwards, or below the edge of the ribs, or towards the epigastrium. If the inflammation is at all acute, or if there be perihepatitis, which may involve the lower surface of the diaphragm, there may be shortness of breathing, which is often very distressing. The acuteness of suffering depends very much on whether the surface or the deeper portion of the organ is most involved in the inflammation. The urine is commonly high-coloured, and contains an excess of bile-pigment. Sometimes albumin is present, but on the whole nothing very definite is known on this point.

As regards the duration of the symptoms, if there only be perihepatitis, they will probably subside in three or four days. Deep-seated hepatitis may end in about ten days in resolution, or in the formation of abscess (*see* Liver, Abscess of); or the disease may be protracted in a less acute form for weeks or months, producing enlargement or partial induration of the liver. In such cases, and indeed in the less acute form of hepatitis, it is often difficult to draw a distinction between chronic congestion and chronic inflammation.

Diagnosis.—Hepatitis is not very likely to be confounded with other affections. If the surface is particularly involved, when there is much shortness of breath, and the pains are lancinating, it may be confounded with local pleurisy or pneumonia. The auscultatory sounds, as also the position of the patient, will show whether the lungs are affected—for with pneumonia, with intercostal neuralgia, with inflammation of the stomach, or with the passage of gall-stones, he will not lie on the affected side, as in hepatitis; nor is there in these diseases the excessive irritability of stomach that there is in inflammation of the liver. The pain of gall-stones comes on more suddenly, is more acute, and disappears more rapidly. Sometimes hepatitis has been confounded with enlargement of the gall-bladder, but usually the pyriform shape and prominence of that organ when over-filled should be enough to distinguish it. As for the diagnosis between hepatitis and perihepatitis, it is chiefly of importance as regards the prognosis. The pain in the latter is usually more acute, less of a dull pain, and is less persistent. The parenchyma of the viscus is less sensitive than its surface, as has appeared to the writer, on handling and cutting off two or three inches of liver which had protruded through a wound.

Prognosis.—The prognosis of hepatitis is grave, but its termination is generally favourable in temperate climates, especially when the case is one rather of perihepatitis than of hepatitis. In the tropics the disease is much more formidable. There is always the risk of its running into abscess; or, if that be avoided, of a state of chronic hyperæmia of the organ, with enlargement and constant tendency to relapse supervening. The complication with dysentery or chronic diarrhœa is frequent and unfavourable. The ratio of mortality differs much in different places, and in the same place in different seasons; and it is difficult to ascertain the absolute mortality of hepatitis, as long as congestion and inflammation of the liver are not distinguished in statistical returns. However, hepatitis (if cholera be excluded) has long been, and continues to be steadily, the greatest source of mortality among our soldiers in India. The French found it a very fatal disease in Algiers, and it has always been one of the most serious diseases of hot countries.

Treatment.—The activity of treatment must be regulated by the acuteness of the case, and by the presence or absence of complications, such as dysentery. In former days repeated venesection used to be employed. We now find leeches applied over the liver or to the anus at least as effectual. Emollient cataplasms are to be kept constantly applied to the side. The bowels should be freely acted on with the neutral salts. The action of ipecacuanha in large doses is very useful, whether it produces nausea or operates on the bowels. It is particularly indicated where there is dysenteric complication. The general feeling is that the induction of vomiting operates unfavourably, but in the early stage of the disease we do not think a certain amount of it injurious. It seems to relieve the liver to some extent. Calomel and opium, and the exhibition of calomel in small doses, to touch the gums, was the old treatment in India; while the French trusted mainly to the exhibition of calomel, ipecacuanha, and opium. Both modes of treatment were believed to yield satisfactory results. The popular idea that if the patient was once salivated he was secure from the formation of abscess had no foundation in fact. If there is much general fever, the use of an ordinary diaphoretic mixture, with a larger proportion of tartar emetic, will be found useful; if nausea is produced, so much the better. When the symptoms become less acute, the steady use of moderate saline aperients, or of iodide of potassium—in short, the ordinary treatment for congested liver, should be adopted. Counter-irritants and blistering, or the application of tincture of iodine over the liver, are of more use in this than in the earlier stages. The nitro-muriatic acid bath has long been a popular remedy in the chronic stage of hepatitis. The body may be immersed, but a bath for the feet, or sponging the side with a solution of the acid, will usually be found as efficacious. The internal use of the mineral acids the writer believes to be more effective. Change of climate exercises a singularly beneficial effect; especially that obtained by a sea-voyage. Sudden exposure to cold, however, after a return from a warm climate, must be particularly guarded against.

The treatment of the sequelæ of hepatitis becomes practically that of congestion of the liver. The steady use of saline aperients, or a resort to the saline-alkaline, or to alkaline baths, as Carlsbad, Marienbad, Elster, Vichy and others, will be found beneficial. In the acute stage the diet must be low, and limited chiefly to fluids. Great attention must be paid to diet during convalescence also; attention to this will help materially in preventing the disease from becoming chronic; and, indeed, there is no better prophylactic against hepatitis than a carefully regulated diet, with abstinence from spirituous drinks. J. MACPHERSON.

LIVER, Inflammation of, Chronic.—This is usually only another name for cirrhosis. Sometimes the name is given to a perihepatitis, a thickening and opacity of the capsule enclosing the liver, and beneath which the liver-substance is found hardened and tough, due to an overgrowth of the connective tissue from the capsule. Most pathologists, however, look upon cirrhosis as a chronic inflammation of the liver, and the name is usually restricted to this state. *See* LIVER, Cirrhosis of. J. WICKHAM LEGG.

LIVER, Malformations of.—Abnormalities in the form of the liver are not common, and are more often acquired than congenital. The following are some of the most frequently observed malformations that are *congenital*, and due to some original defect:—A more or less quadrangular liver; a rounded liver; reduced proportions or total absence of left lobe; prolongation of the left lobe in the form of a narrow tongue-like process towards the region of the spleen; abnormal grooving of the surfaces of the liver; extreme depth of normal fissures. Another occasional variety of hepatic malformation consists in extensive lobulation, and the existence of one or more additional small lobes—a condition met with in the livers of rodent animals. An extreme instance of this extensive lobulation was observed by Dr. Dickinson, and is recorded in the *Transactions of the Pathological Society* (vol. xvii., p. 160). Acquired malformation may be due to hepatic abscess; to hydatids of the liver; to new-growths; to some form of chronic inflammation (cirrhosis, syphilitic disease); or, finally, to compression of the organ by tight-lacing and other means.

W. JOHNSON SMITH.

LIVER, Malignant Disease of.—DEFINITION.—Development in the liver of cancerous or sarcomatous growths, either primary, or secondary to similar growths elsewhere; causing, generally, enlargement of the organ, with irregularity of its surface; attended with pain, often with jaundice and ascites, with marked cachexia and progressive emaciation; and having usually a rapidly fatal termination.

ÆTIOLOGY.—Sex has no influence in the causation of hepatic cancer; the disease occurs as often in males as in females. It is very rare in early life, but cases are recorded. Of eighty-three cases analysed by Frerichs, forty-one were between forty and sixty years of age, and the remainder in nearly equal proportions above and below that period. Climate, habits of life, over-indulgence in the use of spirituous liquors, do not seem to play any part in determining the malady. The influence of hereditary tendency to cancer must not, however, be overlooked.

ANATOMICAL CHARACTERS.—The malignant growths which affect the liver are usually the carcinomata—the true cancers; and of these, in nearly all cases, the schirrous and medullary or encephaloid forms; the colloid being rarely met with, and then only as a secondary deposit. Of the sarcomata, the melanotic and round-celled or medullary sarcomata are met with occasionally. Cancer may occur as an infiltration of the liver-tissue, when large masses of the liver are uniformly affected, and little or no irregularity of surface results. It usually, however, occurs in circumscribed masses, smaller nodules or larger protuberances, varying in size, to use a familiar comparison, from that of a pea to that of a child's head. These masses are more or less numerous, and usually distinct; or they may encroach upon one another, and give an appearance of coalescence. When near the surface, they give rise to the marked irregularity which is very characteristic of the disease; and when large and numerous, cause considerable increase in the size of the liver. The masses on the surface are sometimes flattened, and have a central depression which has been designated as 'cancer navel.' The growths may be firm and of brawny or even cartilaginous consistence, as when scirrhus prevails; or they may be of medullary softness, when an incision will yield freely the so-called cancer-juice. The cut surface is either white, or reddish-white, or darker red when blood has been recently extravasated, or of varying colour, from altered blood-pigment, when the extravasation of blood has been of longer date. The portal and hepatic veins are sometimes invaded by the cancer, and a clot is formed in them, which becomes cancerous. Colloid cancer of the liver occurs rarely as a secondary invasion from the stomach or peritoneum. Melanotic sarcoma or melanosis exists occasionally in conjunction with the disease in other parts of the body. Malignant disease of the liver is primary in about one-fourth of all cases; secondary in the remainder; and in about one-half of the cases in which it is so, the primary disease has been seated in structures connected with the portal system.

SYMPTOMS.—In the earlier stage of this disease, the symptoms may be merely subjective, and then diagnosis will be difficult. When the disease, however, is far advanced, a prominent irregular swelling may be seen, raising the abdominal parietes, and occupying often a large portion of the abdominal cavity. Lesser grades of the disease may be detected by palpation and percussion. The liver will be found to extend more or less beyond its normal limits; to be hard and resisting; and, in a large proportion of cases, irregular. In a few cases, however, when the disease is infiltrated, the surface will perhaps be smooth throughout. At times there is no enlargement of the organ, and the portion affected lies under the ribs, so that physical examination does not help us. There is often tenderness on pressure, especially when the peritoneal coat is inflamed. Usually, but not always, there is pain in the liver itself; sometimes merely a feeling of tightness and fulness; at other times a gnawing, aching pain; and some patients have described the pain as 'burning.' There is frequently also pain shooting back to the spine, over the sacrum, or about the angle of the right scapula. A sensation as of a cord drawn round the right hypochondrium has been complained of. There is sometimes pain radiating down to the lower part of the abdomen; and occasionally wandering pains in the extremities and body generally are complained of. When the stomach is intact, there may be no material disturbance of its functions, but usually derangement is manifested by loss of appetite, nausea, vomiting, and other symptoms, which will be intensified if the stomach is implicated in the disease. The bowels are, as a rule, constipated in the earlier stage, but towards the close there is often dysenteric diarrhœa. Jaundice occurs in nearly one-half of the cases of malignant disease of the liver, and is due to compression of the bile-ducts by cancerous masses within the organ, or by an enlarged lymphatic gland in the portal fissure. When once established it is permanent, and the colour of the patient varies, being pale yellow, or deep olive-yellow, or greenish, or sometimes of the dark hue which has given rise to the term 'black jaundice.' The stools in such cases are white or clayey in appearance; and the urine deep-coloured from bile-pigment. The condition of urine, when there is no jaundice, is variable; in the earlier stages of the disease it is generally scanty and pigmented, and loaded with lithates; in the last stage, according to Dr. Parkes, copious, pale, and deficient in urea. This condition he attributes to the utter failure of digestive and nutritive power. Ascites is present in more than half of the cases, and is due either to compression of the portal vessels, or to inflammation of the peritoneum. Sometimes the large size of the tumour, especially if ascites to any extent be present, may cause much pressure upwards, and give rise to distressing chest-symptoms, such as embarrassed breathing, or palpitation. Hæmorrhage not unfrequently occurs in advanced cases. The blood may come from the stomach or bowels, and be due to portal obstruction; or may be of passive character, as in scurvy or purpura; and the bleeding may take place beneath the skin, or come from the stomach or bowels. In the latter case the hæmorrhage is accompanied, according to Frerichs' experience, by intense jaundice, and usually by somnolence and delirium. The complexion of patients suffering from the disease under consideration, when there is no jaundice, is usually sallow, anæmic, earth-coloured. There is, in a large majority of cases, progressive, and towards the close, often extreme emaciation. Generally there is no fever, but a sort of hectic may occur when the cancerous development goes on rapidly, and involves several organs. When the disease of the liver is secondary to, and complicated with cancerous affections of other organs, as the stomach—which occurs in a considerable proportion of cases—pancreas, uterus, or mammary gland, symptoms will exist indicating such complications, but need not be specially dealt with here.

Diagnosis.—When hepatic cancer is somewhat advanced, and the liver large and irregular on its surface, the diagnosis will be easily effected. In the early stage, on the contrary, and in cases in which, throughout, the liver is not perceptibly enlarged, one must be cautious in giving a hasty or too decided opinion. Inherited tendency to cancer; the age of the patient; in women the period of 'change of life;' a sallow, earthy aspect; progressive emaciation; and pain in the right hypochondrium, point with fair probability to the disease. But nearly the same conditions and symptoms may be associated with aggravated hypochondriasis, or chronic tendency to gall-stones; and in the latter case, the difficulty of diagnosis is increased, as gall-stones are often associated with cancer. Permanent closure of the bile-duct from other causes gives rise to persistent jaundice and other symptoms, as in the case of closure by pressure from a cancerous mass. Enlargement of the liver from malignant disease may be confounded with the following hepatic enlargements and malignant tumours:—1. Albuminoid or lardaceous disease. In this affection the hard, perfectly smooth surface, with preservation of normal shape of the liver, absence of pain in the tumour, and of jaundice, will be sufficiently distinctive, unless the liver is rendered somewhat uneven by other associated affections. 2. In a not very advanced stage of cirrhosis, as also of malignant disease, the liver may be enlarged, and its surface uneven, and in both diseases there is great resemblance in the aspect and general cachectic state of the patient, and similar disturbance of gastric and hepatic function. In cancer, however, the ascites is generally but slight, and the liver, instead of contracting, as it usually does in cirrhosis as the disease progresses, continues to increase, and is marked by large nodules and protuberances, which contrast with the smaller elevations in cirrhosis. In cancer the skin is often perspiring; in cirrhosis it is harsh and dry. Intemperance is not an element in the ætiology of cancer, as it is in cirrhosis. In the latter disease, as also in lardaceous liver, the spleen is frequently enlarged. 3. Hydatid tumour is to be distinguished from a localised cancerous mass by the presence of more or less distinct fluctuation; and the absence of pain, and of serious functional and constitutional symptoms. 4. A tumour caused by hepatic abscess would probably give evidence of fluctuation; be associated with or consecutive upon dysentery; and often attended by rigors, hectic fever, and characteristic shoulder-tip pain. 5. Malformations and malpositions of the liver have been mistaken for cancerous enlargement, especially in females about the period of 'change of life.' 6. A highly-distended gall-bladder has been mistaken for a cancerous projection from the liver; but the smooth, oval swelling, and the site of the enlargement, are distinctive, and, as Frerichs says, a practitioner who made an erroneous diagnosis in such case would be wanting in the *tactus eruditus*. 7. Cancer of the omentum would present a movable tumour, separable, probably, from the liver by a slight area of tympanitic resonance. 8. Cancerous deposits in the left lobe of the liver may be readily mistaken for cancerous affections of the stomach. The following points will assist in diagnosis:—

(*a*) Percussion in the greatest thickening of the stomach-walls gives a tolerably clear, tympanitic sound; in cancer of the left lobe of the liver, the sound is much more deadened, and is only somewhat tympanitic on stronger percussion stroke; (*b*) careful examination of the liver, and of the stomach, when full and when empty, will also lead to a correct conclusion; (*c*) even when the liver and stomach are both affected, careful examination may often make out the boundaries of disease in each. 9. Malignant tumour of the right lobe may be mistaken for malignant enlargement of the right kidney. Percussion will generally give a tympanitic sound, from the presence of intestine between the kidney and liver. The hepatic tumour is also distinguished from this and other abdominal tumours by its following the movements of the diaphragm in respiration. But when the renal enlargement is very great, diagnosis is not easy. Three or four years ago a sailor was brought into the Seamen's Hospital with an immense tumour occupying the greater part of the abdomen. This was diagnosed by all who saw it as malignant disease of the liver. After death, however, it was found that the liver was quite healthy, much compressed and narrowed, and spread out over the upper part of an enormous, cancerous kidney. 10. Malignant disease of the ascending or transverse colon will constitute a movable, and generally somewhat tympanitic swelling; and fæcal accumulations in the colon may be removed, but not always readily, by aperients and injections. Percussion, too, will often elicit a resonant space between the enlarged intestine and the liver.

PROGNOSIS.—The prognosis is always unfavourable. The disease when once fully pronounced runs its course rapidly, the fatal termination being seldom deferred beyond a year. Schirrus has usually a longer duration than medullary cancer.

TREATMENT.—This can be but palliative, and directed to rendering the inevitably fatal course as smooth as possible, by relieving distressing symptoms. Remedies which in other hepatic affections are valuable, such as cholagogues, or mineral waters, are here useless, if not worse. The diet should be plain and nourishing; and the moderate use of wine and alcohol is not contra-indicated, as in other disorders of the liver. Serious gastric and other derangements must be met by appropriate remedies; it being always borne in mind that we have to soothe the patient, and not add to his distress by the exhibition of nauseous drugs. For the relief of pain, the various preparations of opium are indicated, and, as a rule, morphia acts the best. It may be administered either internally, or by the hypodermic method, and must be repeated when pain demands it. Local applications over the liver, as poultices, spongio-piline, &c., with solution of opium sprinkled over the surface, are useful, especially when the peritoneal coat is inflamed. Tapping should not be had recourse to for the relief of ascites, unless this becomes so great as to interfere by upward pressure with the functions of the lungs or heart. The fluid soon reaccumulates, and the effect of the operation is to hasten the fatal termination.

STEPHEN H. WARD.

LIVER, Malpositions of.—Abnormalities in the position of the liver are much less rare than abnormalities in its form. The more frequent forms of *congenital* displacement are these: Lateral transposition, the liver being found on the left instead of the right side of the abdomen; eventration, the organ being exposed in front of the abdomen of a fœtus; the presence of more or less of the liver in the chest, through congenital deficiency of the diaphragm. In *acquired* displacement the liver may be either depressed or elevated, some rotation of the organ on its transverse axis taking place in an opposite direction in each case. Depression may be caused by pressure from above, as by effusion in the right pleural cavity, and probably to some slight extent by considerable pericardial effusion, or cardiac hypertrophy. Elevation of the liver, which takes place more frequently, may be due to pregnancy, ascites, or the presence of some large abdominal tumour. Curvature of the spine, whether lateral or angular, usually gives rise to some change in the position of the liver. In Potts' disease the organ is often forced downwards towards the crest of the right ilium.

By tight-lacing both the position and the form of the liver may be altered. The organ may be forced downwards, and at the same time so twisted on its transverse axis that its convex surface looks directly forwards, and its concave surface directly backwards. When tightly compressed the upper surface of the right lobe becomes marked by the ribs, and presents transverse puckerings. At the same time the right lobe is bent upon itself, the concavity of its lower surface being much increased. The hepatic tissue corresponding to the summit of the arch thus formed gradually wastes, until at last the lobe is divided into two portions by a deep transverse groove, which portions are connected merely by a membranous band, composed of thickened serous membrane, and the corresponding portion of the hepatic capsule.

W. JOHNSON SMITH.

LIVER, Morbid Growths of.—Several morbid growths have been met with in the liver, of which the following are the most important:—

1. **Simple Cysts.** — These formations are not often met with in the liver. There may be a single cyst, which is usually large; or a number of small cysts scattered throughout the organ. In the latter case the condition is analogous to that of the so-called cystic disease of the kidney, and indeed is sometimes associated with this affection. The cyst-wall consists of a fibrous membrane projecting in folds into the cavity of the sac, and lined on its inner surface by pavement-epithelium. The cyst almost always contains thin clear fluid, and is not connected with any bile-duct or vessel.

2. **Dermoid Cysts.**—Mr. Hulke has recorded an instance in which several dermoid cysts in a withered condition were found attached to the surface of the liver.

3. **Erectile Tumours.**—An hepatic erectile or cavernous tumour consists of a small red or bluish-red formation, of a more or less globular shape, of reticulated structure, and containing

fluid blood or soft coagula. Growths of this nature are often multiple, and each of about the size of a filbert; they are usually found either along the anterior margin of the liver, or on the upper surface of the organ, near the attachment of the suspensory ligament. Each tumour is enclosed in a capsule of delicate connective-tissue. Though seated at the periphery of the liver, an erectile tumour seldom projects beyond the surface of the organ. Much remains to be made out as to the pathological significance of these tumours, especially with regard to their relation to malignant disease. There is some difference of opinion as to their connection with the hepatic vascular system. Virchow and Wilks hold that they are in communication with minute branches of the hepatic artery; whilst Frerichs states that they cannot be injected through this vessel or through the hepatic veins, but only through branches of the portal vein.

4. **Lymphatic Formations.**—The liver is sometimes found studded in all parts with minute patches of tissue of soft consistence, each patch being made up of an aggregation of lymphoid cells disposed in the meshes of a delicate reticulum. These patches of tissue are in close connection with small vessels, from the walls of which, according to Frerichs, they are developed. This condition is associated with leukæmia.

5. **Tubercle.**—Tubercle, as met with in the liver, occurs only in the form of minute miliary granulations, scattered throughout the whole organ, but accumulated more especially on the surface. These growths have been rarely observed in the liver, and in most of the instances in association with acute general tuberculosis.

6. **Cancer.**—Different forms of cancer are liable to affect the liver; but this class of diseases is so important that they require separate consideration. *See* Liver, Malignant Disease of.

7. **Hydatids.**—This is an important disease affecting the liver, which demands notice in this connection, but it is discussed in a separate article. *See* Liver, Hydatids of.

8. **Benign Growths.**—Fibrous and other growths have been in rare instances found in the liver, but they do not give rise to any clinical signs. W. Johnson Smith.

LIVER, Nutmeg.—Synon.: Fr. *Foie noix de muscade*; Ger. *Muscatnussleber*.—Nutmeg-liver consists in a chronic passive congestion of the organ, a state which may always be brought about when there exists any impediment to the circulation of the blood through the heart or lungs. The radicles of the hepatic vein become filled with blood, and thus the centre of each acinus shows a deep red, while the outer parts are either yellow or of natural tint. A nutmeg appearance is thus given to the liver, which is often shrunken and tough, with adherent capsule, and granular surface. Under the microscope the centre of the acinus is seen to be filled with dilated blood-vessels, which, pressing on the liver-cells, cause them to atrophy, so that in advanced stages of the disease they disappear altogether, and the centre of the acinus is made up of blood-vessels only, but there is no increase of the connective tissue in the same situation. The capsule of Glisson now and then takes on an overgrowth, just as in cirrhosis; and the connective tissue between the lobule and around the vessels is considerably increased. It is to this overgrowth of the connective tissue that the shrinking and hardening of the liver are due.

Symptoms.—The liver may sometimes be felt during life under the ribs, more often not. Slight jaundice is often present. The spleen is not enlarged, but is small—the opposite condition to that found in cirrhosis.

Treatment.—This must be directed to the condition of the heart or lung upon which the obstruction to the circulation depends. Nutmeg-liver may always be suspected when there exists any impediment to the return of blood from the hepatic veins. J. Wickham Legg.

LIVER, Pigmentation of.—In subjects who have succumbed to intense malarious fever, and in some who during life had suffered from frequent attacks of intermittent or remittent fever in hot climates, the liver may be found to be stained by pigment, either diffused throughout the whole organ, or dispersed here and there in irregular patches. This pigmentation of the liver is always associated with a similar condition of the spleen, and frequently with staining of the nervous centres, the lungs, the kidneys, and the lymph-glands. Hepatic pigmentation is one of the chief post-mortem phenomena of the condition known as 'melanæmia,' in which the blood, especially that of the portal system, is pervaded by granules of pigment of a black or deep-brown colour, some of which are free and isolated, some held together in irregular masses by a pale jelly, and others enclosed in cells. In the pigmented liver these granules are to be found in the portal blood, in the walls of the capillaries, and outside the vessels, scattered amongst the hepatic cells, but not within these cells. In an early stage of the hepatic pigmentation the staining affects only the periphery of each lobule, but, as the disease progresses, the deposit gradually extends to the centre of the lobules, and attacks the hepatic venous system. The arterial capillaries also contain similar pigment-granules.

Symptoms.—The size of the affected liver varies in different cases, and according to the severity and the stage of the disease. The organ is sometimes congested and swollen; it often remains of normal size; in some few instances it finally becomes atrophied. The main symptoms of this condition of the liver are occasional intestinal hæmorrhage, diarrhœa, and ascites. These symptoms in well-marked cases of melanæmia are usually associated with albuminuria, due to pigmentary affection of the kidneys, and with more severe symptoms due to cerebral complications, such as delirium, coma, and paralysis. Melanæmia has been met with mostly in warm climates, and occasionally during severe epidemics of intermittent and remittent fever in some parts of the North of Europe. In this country it has been very rarely observed. *See* Blood, Morbid Conditions of.

W. Johnson Smith.

LIVER, Syphilitic Disease of.—The liver occasionally becomes diseased during the tertiary stage of syphilis, or the period of gummy deposits, the hepatic affection being associated at some period with osseous and cutaneous lesions, and with syphilitic cachexia.

ANATOMICAL CHARACTERS.—*Syphilitic hepatitis* may attack both the capsule (*perihepatitis*) and the internal prolongations or septa of the capsule (*parenchymatous hepatitis, syphilitic cirrhosis*). In some cases a small portion, in others a greater part or the whole of the organ, is affected. In the milder form and less advanced stages of the disease the capsule is slightly thickened, and marked by a few isolated white patches, while the surface of the liver is here and there slightly grooved and indented. After prolonged inflammatory action the liver becomes much deformed, and is made up of a number of small lobes bounded by deep depressions, the parenchyma on section being found to be traversed by well-marked bands of tough and retractile connective-tissue. The secretory structures of the liver do not undergo very much change in this disease, and notwithstanding the retractile properties of the fibrous tissue forming the white bands, the vessels and ducts usually remain permeable. The liver-cells occasionally become loaded with fatty elements, and in some rare instances undergo albuminoid degeneration. In cases of syphilitic hepatitis, the liver is almost always bound to the diaphragm, and sometimes to the adjacent viscera, by firm adhesions.

Deposition of *gummy tumours*—'the encysted knotty tumours of the liver,' as they were named by Dr. Budd—occurs more frequently than syphilitic hepatitis, with which condition, however, it is often associated. In this form of syphilitic disease, the liver presents on section, especially in its deeper parts, a number of globular growths, more or less firm in consistence, of a yellowish-white colour, and varying from the size of a pin's head to that of a large walnut. A large deposit of this kind is usually soft or cheesy at its centre, and becomes more and more firm towards its periphery, where it is surrounded by a greyish and translucent zone of incipient connective-tissue, which passes gradually into apparently healthy parenchyma. A full description of the minute structure of these hepatic gummy tumours will be found in a report by Dr. Payne on three specimens shown before the Pathological Society in 1870 (*Transactions of the Pathological Society*, vol. xxi. p. 207). In each tumour it was found that the soft central portion was composed of granular and almost amorphous material, in which were imbedded certain round or irregular translucent bodies of large size, which probably represented collections of degenerated liver-cells. The soft central portion passed imperceptibly into fibro-nucleated structure. The surrounding fibrous zone was found to be composed of dense connective-tissue, in crescentic and irregularly-shaped interspaces, containing masses of fatty globules or granular matter. This fibrous structure was not strictly defined from the structure of the more central parts of the tumour, and on the outside passed into the interstitial connective-tissue of the liver, and became converted into masses of nucleated tissue, each of which masses appeared to be formed around a small branch of the portal vein or hepatic artery. Dr. Payne supports the view held by Virchow concerning the pathogenesis of hepatic gummy tumours, and holds that the amorphous central portion is to be regarded, not as a deposit of tissue lowly organised from the first, but as fibrous tissue in a more or less advanced stage of involution and decay.

Whether true *hepatic cirrhosis* may be caused by syphilis is open to doubt, since in most cases supposed to be of syphilitic origin it has been found impossible to exclude with confidence the idea of a probable alcoholic origin.

Albuminoid degeneration of the liver has not unfrequently been observed in the subjects both of acquired and of inherited syphilis, and very often in syphilitic subjects who had not been previously affected with caries or necrosis of bone, with cutaneous ulceration, or with profound or prolonged suppuration. This condition of the liver, when associated with syphilis, is probably due rather to cachexia and debility, than to any essentially syphilitic influences. The almost if not quite obsolete views that the amyloid disease is to be attributed to the action of mercury, or to the combined action of this medicinal agent and syphilis, are opposed by the facts that this condition of the liver has often been observed in a syphilitic fœtus, and also in adults who had not previously been treated with mercury, and never in non-syphilitic subjects of mercurial poisoning.

SYMPTOMS.—The symptoms of syphilitic hepatitis and gummy tumours in the liver are in most instances obscure, so that these complications of advanced syphilis are often overlooked. The liver in some cases is enlarged, in other cases reduced in size. In the former instance it will often be found on abdominal percussion that the relative proportions of the right and left lobes have been much altered, and that there is considerable deformity of the whole organ. Firm globular elevations on the surface of the liver may sometimes be felt through the anterior abdominal wall. Advanced syphilitic hepatitis is usually associated with slight and slowly increasing ascites, and sometimes with œdema of the lower extremities. There is seldom any well-marked jaundice. The patient often complains of a sense of weight and uneasiness in the right hypochondrium, or, in some few cases, of severe pain. In almost all cases there is some hepatic tenderness. The most constant symptoms are of a dyspeptic character; the abdomen often becomes painful and distended; and there is very often, at an advanced stage of the disease, obstinate and profuse diarrhœa.

DIAGNOSIS.—The slow progress of the disease; the absence of any severe pain in the region of the liver; a clear history of syphilis, and the presence of syphilitic lesions at some part of the body; no history of cancer; and the absence of any indications of malignant disease, whether on the surface of the body or in the abdominal cavity, all serve to support the diagnosis of syphilitic, as opposed to cancerous disease of the liver. In ordinary cirrhosis of the liver the progress of the disease is more rapid; the dyspeptic symptoms more severe; the ascites more abundant; and the indications of alcoholism are generally well marked.

Treatment.—The treatment of syphilitic disease of the liver is that usually carried out in cases of tertiary syphilis.

W. Johnson Smith.

LIVER, Tubercular Disease of. *See* Liver, Morbid Growths of.

LIVER-FLUKE.—A common name for the *Fasciola.* *See* Distoma.

LLANDRINDOD, in Radnorshire, South Wales. — Saline, sulphated, and chalybeate waters. *See* Mineral Waters.

LOBULAR (*lobulus*, a little lobe).—Of or belonging to a lobule. A term generally applied to morbid conditions affecting individual lobules of organs which are thus constituted, such as *lobular pneumonia*, *lobular pulmonary collapse*, and *lobular hepatitis.*

LOCAL.—This term is used in contradistinction to the word *general.* Thus, in connection with *morbid conditions*, it is applied to those which are confined to, or seem specially to affect, a particular part. Again, *local causes* are such as act upon a limited portion only of the body, such as a blow or a burn. *Local treatment* implies the application of remedies in the same sense.

LOCK-JAW.—A popular synonym for tetanus. *See* Tetanus.

LOCOMOTOR ATAXY (*locus*, a place, and *moto*, I move; ἀ, priv. and τάξις, order).—Synon.: *Tabes dorsalis*; Fr. *Ataxie locomotrice*; Ger. *Graue Degeneration der Hinterstrange des Rückenmarks.*

Definition.—A disease of the spinal cord, characterised by a peculiar unsteadiness in the performance of voluntary movements; or a loss, to a greater or less extent, of the power to control and co-ordinate the action of muscles necessary for the *steady* performance of these movements.

Ætiology.—The causes of locomotor ataxy are so various, that in persons who are predisposed to it, almost anything that seriously depresses the nervous power, especially of the spinal cord, will become an exciting cause. Such are cold, wet, excessive fatigue, bad or insufficient diet, depressing emotions of the mind, and, as the writer thinks, onanism, or the long continuance of other forms of sexual excess. Suppression of habitual perspirations, particularly of the feet, and the removal of hæmorrhoids, have in many instances immediately preceded the disease. But prolonged exposure to cold and wet appears to be one of its most common causes. Syphilis is regarded by some as the chief predisposing cause; and the disease is certainly very much more frequent in males than in females.

Anatomical Characters.—The spinal cord is invariably altered in structure. Generally, the membranes are much congested, and the writer has often found them thickened posteriorly by exudations, and adherent to each other and to the posterior columns. The *posterior* columns, especially in their outer regions, and the nerve-roots are the parts that are chiefly affected. The morbid change consists of atrophy and disintegration of the nerve-fibres, to a variable extent; with hypertrophy of the connective tissue. Oil-globules surround many of the blood-vessels. The posterior nerve-roots undergo the same kind of degeneration, which sometimes extends to the surfaces of the lateral columns, and even along the edges of the anterior. Sometimes the writer has found the extremities of the posterior cornua, and even the central grey substance, more or less damaged by disintegration.[1] The pathological change seems to travel from the centre to the periphery—from the spinal cord to the posterior roots. In the cerebral nerves, however, the morbid change takes an opposite direction—from the periphery towards the centres. Sometimes it extends as far as the corpora geniculata, but seldom as far as the corpora quadrigemina.

Symptoms.—In most cases the unsteadiness begins in the lower extremities; but generally—after a certain but variable time—it involves the upper extremities, the hands and arms being the parts most affected.

As the writer has pointed out, this unsteadiness, or muscular inco-ordination, occurs under two consecutive forms. It first makes its appearance as a simple unsteadiness of gait; the patient walks like a person partially intoxicated. He likewise frequently complains of heaviness in his legs; and of fatigue after walking or after standing. With his legs close together, and his eyes shut, he sways about and would fall if not supported. Later on he finds that he cannot walk without looking at his feet. When the upper extremities become affected, the patient is unable to dress himself, to button his clothes, to write, or to pick up a pin.

After a time a second kind of disorderly movement supervenes. This arises from a spasmodic and jerking action of the muscles, which the will puts in motion, but is unable to control; the patient cannot regulate *the degree of their contraction.* When put in motion the muscles contract beyond the degree intended, and flex or extend the limb with an uncontrollable jerk. All the voluntary movements are hurried and precipitate. The patient seems to be walking upon springs; he proceeds with a kind of prancing gait, and brings his heels to the ground with a kind of kick. If he attempts to take hold of an object he probably will thrust it from him by a spasmodic jerk of his arm. The disease is progressive at an advanced stage. The patient cannot walk or stand without assistance, and even then, if he attempts to advance, he jerks his legs about in the most disorderly manner.

The ataxy or disorderly movement is accompanied by some of the following symptoms, namely:—Strabismus, diplopia, amblyopia, amaurosis, ptosis, contraction of both pupils or only of one; shifting pains in different parts of the body, but chiefly in the extremities; cutaneous and muscular anæsthesia, and loss of the sense of temperature; incontinence of urine, and dysuria; loss of electro-muscular contractility, in a variable degree; abolition of the patellar-tendon reflex; spermatorrhœa, with loss of sexual power and desire; occasionally, but not often, paralysis of the first, fifth, seventh, eight, and ninth cerebral nerves; œdematous swelling of the joints, chiefly of the knees; and cardiac and gastric disturbance.

[1] See *Lancet*, June 10, 1865.

All these symptoms are never found together in any one case of locomotor ataxy, but occur in different groups in different cases, as the following examples will show. The symptoms made their appearance in the order of time in which they are mentioned.

Case 1.—Strabismus and diplopia; pains in the legs, with numbness of toes; ataxy, or unsteadiness of gait; numbness of fingers, followed by pains in the arms, with unsteadiness of muscular movements; incontinence of urine; both pupils contracted to the size of pins'-heads.

Case 2.—Darting and shifting pains in legs, with numbness and heaviness; pains in abdomen and chest; ataxy; pains and numbness in hands and arms, followed by ataxy; analgesia; incontinence of urine, alternating with dysuria; hæmorrhoids; loss of sexual power.

Very frequently the pains in the limbs are, for a variable period, the only precursors of the other symptoms. They are of two kinds—the first is of an aching, gnawing character, and is often mistaken by the patient for rheumatism. The other kinds of pains are acute and lancinating, like electric shocks, shifting from one part of the body to another. They recur in paroxysms, lasting for a few hours or a few days, and suddenly disappear for a variable period.

In other cases the ocular disturbances are the first symptoms that make their appearance. They consist of strabismus, or amblyopia, ending frequently in amaurosis. In a large proportion of cases, paralysis of either the third or the sixth cerebral nerve, with diplopia, is found during the first stage of the disease. The peculiarity of this paralysis is its periodicity. It may last for a few days, or a few weeks or months, and then disappear as suddenly as it came; or it may continue uninterruptedly throughout the disease. Sometimes the strabismus is double, but more frequently it is limited to one eye. Even when there is no perceptible strabismus, there is sometimes double vision, when the patient turns his eyes in a particular direction. Ptosis and dilatation of the pupil are also frequently present. In some cases one pupil is dilated, while the other is contracted. Amblyopia sometimes appears at a very early period, and increases till it terminates in amaurosis.

Cutaneous anæsthesia usually accompanies the ataxy, and affects chiefly the arms, fingers, legs, and toes. The patient says that he seems to be walking on something soft, and does not feel the ground properly; unless he looks at his feet, he scarcely knows that they have reached it. Sometimes he feels as if he were 'walking on air,' on his ankle-joints, or on his hip-joints, when the numbness extends up the legs and thighs. Analgesia, or loss of sensibility to pain, in a greater or less degree, is very common; or painful impressions are felt with unusual slowness. The writer has known cases in which several minutes have elapsed before the prick of a needle has been felt.

Disorders of the urinary organs are generally intermittent in their attacks. Usually the dysuria and incontinence recur alternately in the same stage of the disease. Spermatorrhœa is commonly one of the early symptoms in locomotor ataxy. It is followed by loss of sexual power, with or without loss of sexual desire.

Affection of the joints in locomotor ataxy was first described by M. Charcot, of Paris. The knee-joint is almost always the seat of the disease, which appears suddenly as an elastic œdematous swelling. Like the diplopia, strabismus, and urinary troubles, it may be intermittent—may remain only for a short time, or continue uninterruptedly and result in permanent deformities, with disease of the bones and cartilages of the joint.

The strabismus, amblyopia, and shifting intermittent pains were considered by Duchenne as the first stage of ataxy, which may last for months or years. The next stage is when the ataxy or unsteadiness of gait makes its appearance, either accompanied with or soon followed by anæsthesia or analgesia, generally in the lower extremities. In the third stage many of the symptoms become more marked and more general, the ataxy or muscular inco-ordination extending to the upper extremities. This division into three distinct stages does not, however, apply to all cases.

Diagnosis.—In the early stages of the disease, especially before the muscular ataxy has made its appearance, and when only two or three other symptoms are present, the diagnosis is extremely difficult, even to those who have great practical experience of the disease. Several of the symptoms, such as strabismus, amblyopia, anæsthesia, and the so-called 'rheumatic' pains, which precede frequently for a long time the motor ataxy, may be found in other disorders which differ essentially from this malady. But there is often in some of these symptoms a certain peculiarity which may assist us in the diagnosis. For instance, in a great many cases the strabismus is accompanied by amblyopia; and when it is single, the amblyopia is on the corresponding side. Moreover, the sudden attacks and equally sudden cessation of the pains, their rapid shifting from one place to another, or their remarkable proneness to fix, sometimes for hours, on some particular spot, are not without their significance.

Prognosis and Treatment.—The prognosis is generally very unfavourable. An early diagnosis is of the greatest importance, as it is chiefly at the first invasion of the disease that the patient is most benefited by treatment. An important object is to protect the patient from cold and wet, and keep him in an equable temperature. The whole of the body should therefore be enveloped in flannel. A good and generous diet, with wine or beer, seems best suited for the patient. Of the different medicines that have been used, nitrate of silver seems to have the most specific influence on locomotor ataxy. One-eighth of a grain gradually increased to one grain three times a day, after meals, is the best mode of exhibition. If it should irritate the bowels or the bladder, it may be combined with morphia, cannabis indica, or belladonna. The oxide of silver is a useful substitute for the nitrate, when the latter disagrees. Dry-cupping along the spine has been found useful. For the relief of the severe limb-pains there is nothing so efficacious as the subcutaneous injection of morphia. The writer has always found that constipation aggravates the pains. Sulphur baths have been used with some relief. Cod-liver oil and phosphorus may also be prescribed. Rest has been strongly recommended; and the constant galvanic current is certainly sometimes beneficial.

J. Lockhart Clarke.

LORDOSIS (λορδὸς, bent).—A term applied to abnormal curvature of the spine forwards. *See* Spine, Diseases of.

LUCID INTERVALS.—No better definition of this state has been given than that of Lord Thurlow, who calls it 'an interval in which the mind having thrown off the disease had recovered its general habit.' It must be regarded as extremely unlikely that a perfect restoration to reason can take place in the course of any long-continued insanity, without full opportunity having been afforded of testing its nature. The law more readily recognises the restoration of the mind to a state of civil capacity such as will render testamentary acts valid, than such temporary recovery as would restore responsibility for crime. If a civil act be rationally performed, the law accepts that as *primâ-facie* proof of the capacity of the agent; but juries very seldom convict the accused of a crime if insanity is proved to have existed within a short period of its commission. John Sibbald.

LUHATSCHOWITZ, in Moravia.—Muriated alkaline waters. *See* Mineral Waters.

LUMBAGO (*lumbi*, the loins).—Synon.: Fr. *Lumbago*; Ger. *Lendenweh.*—Muscular rheumatism, affecting the muscles and fasciæ of the lumbar region. *See* Rheumatism, Muscular.

LUMBAR ABSCESS. — Definition. — A variety of spinal abscess, usually due to caries of the upper lumbar or lower dorsal vertebræ; in which the pus, instead of taking the course followed in psoas abscess, becomes enveloped by the muscles and fasciæ of the lumbar region, and usually points in this situation; or by infiltrating the cellular interspaces of the abdominal muscles, gains the front of the abdomen, and descends *above* Poupart's ligament. The last-named feature is a diagnostic point of some moment, since psoas abscess, although commencing in the same manner, is usually characterised by making its way *below* Poupart's ligament.

Ætiology.—The origin of lumbar abscess is often ascribed by the patient to a wrench or a blow—statements which must be taken with some caution, since it will be noticed that the patient rarely remembers any injury having happened, until long after well-marked symptoms have arisen. Curvature of the spine is almost invariably present. In children it is almost always the result of scrofulous osteitis; and it has been by some ascribed, in adults, to sexual excesses.

Description.—Lumbar abscess may commence in the soft parts, but when dependent on spinal caries is preceded by the usual symptoms of Potts' disease, which have been coming on slowly and insidiously for a period varying from three to six months.

Owing to the numerous tendinous expansions, and dense aponeurotic structures and fasciæ of the lumbar region, the pus, which has formed in connection with the spine, meets with many obstructions, resulting in singular deflections, before it gains the surface (*see* Lumbar Region). Most frequently it perforates the quadratus lumborum muscle, and points at the edge of the sacrolumbalis. Here it shows itself as a broad, flat, slightly elevated, fluctuating tumour; having a somewhat irregular surface, owing to the tendinous structures which traverse its cavity. Occasionally the pus of a lumbar abscess makes its way downwards and forwards above Poupart's ligament, or between the abdominal muscles, and points at the outer edge of the rectus abdominis muscle; and indeed there would seem to be no intermuscular or interaponeurotic space which it may not permeate. In other instances, it may be first observed by palpation of the abdominal walls; may simulate cæcal abscess, a malignant growth, an intestinal collection, an aneurysm, or other abdominal tumour; or may burst into the cellular tissue of the abdominal cavity. In children, owing to the relatively small size of the pelvis, there is a chance of the pus mounting over the iliac crest, or sideways over the glutæi muscles.

Prognosis.—The prognosis is precisely the same as that mentioned in the article on psoas abscess. *See* Psoas Abscess.

Treatment.—The treatment is the same as that indicated in psoas abscess, namely, free antiseptic incision. There are, however, cases where spontaneous evacuation of the pus, and treatment by the prone couch have led to good results; and, moreover, there are cases of spontaneous cure. Edward Bellamy.

LUMBAR REGION. — This region, to which it is somewhat difficult to assign precise limits, may conveniently be described, for practical purposes, as bounded (with reference to the surface of the body) superiorly by the last rib, below by the posterior half of the upper edge of the crest of the ilium, and externally by the posterior margin of the external oblique muscle. The series of lumbar spines would thus superficially separate the right from the left lumbar region. All the structures lying between the skin and such abdominal viscera as are in relation with the parietes, enter into the formation of the lumbar region, the symmetry of the two sides being broken by the fact that the right kidney lies lower than the left. These structures are met with in the following order from the surface:—1. the skin; 2. the cellular tissue; 3. the lumbar aponeurosis; 4. the musculo-aponeurotic layer; 5. the bones; and 6. the visceral layer. The blood-vessels and nerves are distributed amongst these tissues.

1. *The skin.*—The skin of the lumbar region is remarkable for its extreme thickness, and want of sensibility and mobility, being firmly fixed to the spines of the vertebræ.

2. *The cellular tissue.*—The cellular tissue consists of two laminæ, a superficial and a deep, the former very adherent to the skin, whilst the deeper is strengthened by several processes, derived from the aponeurotic layer.

3. *The lumbar aponeurosis.*—The lumbar aponeurosis, the strongest in the whole body, deter-

mines in a great measure the form of the region. It is attached firmly to the spinous process of the lumbar vertebræ, and its anterior surface gives origin to, and binds down the erectores spinæ muscles. The aponeurosis of the transversalis is here divisible into three vertical laminæ, namely, the posterior, which assists in the formation of the lumbar aponeurosis; the middle lamina, attached to the tips of the transverse processes of the lumbar vertebræ, and forming with the preceding a sheath for the erectores spinæ; and the anterior, attached to the bases of the transverse processes of the vertebræ, and forming, with the middle lamina, the sheath of the quadratus lumborum. The aponeurosis is limited by the posterior border of the external oblique muscle.

4. *The musculo-aponeurotic layer.*—The musculo-aponeurotic layer consists, on either side of the mesial line, of the mass of the erector spinæ muscle and the transverso-spinales internal to and below it; whilst between these muscles are the branches of the lumbar vessels and nerves. Beneath these lie the transverse processes of the lumbar vertebræ, the inter-transversales muscles, the laminæ of the vertebræ, with the ligamenta subflava; and, in a plane anterior, the quadrati lumborum, and ilio-lumbar ligaments. The psoas muscle enters the lumbar region.

5. *The bones.*—These consist of the lumbar vertebræ, with the inter-vertebral discs and ligaments, enclosing the cauda equina with its investments.

6. *Visceral layer.*—In front of the bones lie the pillars of the diaphragm; the inferior vena cava to the left, and the aorta to the right; on either side, the chain of the sympathetic, the lumbar glands, and the receptaculum chyli, and the commencement of the thoracic duct; and the commencement of the azygos major vein.

In front of the quadratus is a space occupied in its superior third by the kidney, and its lower two-thirds by the colon. About half the kidney lies in this space, of which the right is rather the lower of the two. The right colon is entirely enclosed in the peritoneum, whilst the left has only a partial investment of that membrane. The kidney lies external to the psoas, and upon the quadratus, corresponding with the outer side of the sacro-lumbar muscular mass. Certain anomalies in the relation of the kidneys are sometimes met with: they occasionally descend into the iliac fossæ, or they may float, owing to extreme length of the blood-vessels, which penetrate the hilum, and may then be felt loosely situated amongst the other abdominal viscera. On the psoas lie—the ureter internally; obliquely the spermatic or ovarian vessels, and the sympathetic; and externally the genito-crural nerve.

Blood-vessels.—The *arteries* which perforate and supply this region are the lumbar arteries. The *veins* correspond with the arteries; they anastomose, however, with the renal veins.

Nerves.—The nerves of the region are derived from the lumbar plexus, formed by the five lumbar nerves and last dorsal; whilst the sympathetic system is derived from the solar, renal, hypogastric, and lumbo-aortic plexuses.

Pathological and Clinical Relations.—The lumbar region is of great surgical importance, from the relation to its anterior aspect of certain abdominal viscera; from the numerous fasciæ which enter into its formation, and their relation to abscesses, growths, and bloody or urinary effusions; and from the fact that the operations of colotomy, nephrotomy, nephrectomy, and the opening of perinephritic abscesses are performed within its boundaries. Spina bifida has a great predilection for this region. Penetrating wounds in the lumbar region are liable to involve the cauda equina, owing to the wide separation which exists between the laminæ of the lumbar vertebræ. With regard to abscesses, connected with caries of the lumbar vertebræ, their situation is generally determined by their origin. When the posterior portion of the bodies or spines are affected, the pus is conducted backwards, being confined by the fascia lumborum. If the transverse processes or the anterior portion of the bones be the seat of disease, the pus will point anteriorly on the abdominal wall, being either bound down by the fascia transversalis, or conducted forwards between the abdominal muscles, in which case the pointing always takes place *above* Poupart's ligament. Renal or perinephritic abscesses often point at the border of the quadratus lumborum muscle, and may there be opened. Lumbar hernia protrudes at the so-called 'triangle of Petit.' The operations practised in the lumbar region are lumbar colotomy, nephrotomy, and nephrectomy. Of lumbar colotomy there are several modifications, but it is generally performed in the descending colon, which is usually uncovered by peritoneum posteriorly.

Other pathological and clinical relations of this region, which have many points in common with those of the iliac region, are referred to under that heading. Edward Bellamy.

LUMBRICUS.—By many practitioners this term is still employed to designate the large round-worm (*Ascaris lumbricoides*). The title is entirely a misnomer, having originated with Tyson (*Phil. Trans.* 1683) who called the common species *Lumbricus teres hominis.* All the larger round-worms infesting man and animals are apt to be called lumbricoids. Notwithstanding their general resemblance to ordinary earth-worms, their organisation is totally different. Occasionally, in practice, patients seek to deceive the medical attendant, by placing one or more earth-worms in the night-stool or chamber-pot. Quite recently the writer encountered an instance where a large garden lobworm (*L. terrestris*), about a foot in length, had been carefully selected for this purpose. The practitioner should not only be familiar with the differences of character presented by true and false worms of this kind, but should bear in mind that earth-worms cannot live in the human bladder and intestines. *See* Ascarides; and Round-worms.

T. S. Cobbold.

LUNACY, Law of.—The medical practitioner is frequently required to perform duties in connexion with lunacy, the satisfactory discharge of which requires that he should have some acquaintance with the legal enactments by which they are regulated. The statutes differ slightly in the three divisions of the kingdom. It will therefore be necessary, after describing what is required under the law in England, to show where its requirements differ from those which exist in Scotland and Ireland. The details to be given here will only include what is necessary for the information of the general practitioner. Anyone who intends to devote himself specially to the treatment of the insane, or to receive one or more persons of unsound mind into his house, must comply with regulations which we cannot here set forth, but which are fully described in works upon the subject. When a person living in his own home is under treatment for insanity, the medical attendant is justified by the common law, in adopting any measures of restraint which may be necessary for safety or the proper treatment of the malady. This has been decided by the courts of law in recent cases. If, however, it is proposed to place the patient in an asylum, or to remove him to the charge of any person who is to derive profit either directly or indirectly from the proceeding, it is necessary that certain forms should be carefully observed.

In the case of a Chancery lunatic, an order by the 'Committee of the Person,' having annexed to it an office copy of the appointment of the Committee, is sufficient authority for the reception of the lunatic either into an asylum or a private house. In the case of other private patients, it is necessary to have what is called an 'order' and two medical certificates, as in the annexed form.[1] The order may be signed by anyone having a reasonable right to interfere, provided he is neither of the medical men signing the certificates, nor father, son, brother, partner, or assistant to either of them, nor professionally or pecuniarily connected, or to be connected in any way, with the person under whose charge the patient is to be placed. The person signing the order must have seen the patient within a month of the date of the order; and the order continues available for one month from the day of its date.

The medical certificates must be signed by registered practitioners in actual practice in England. They must have no interest, directly or indirectly, in the patient, in the establishment or house to which he is to be sent, or in his subsequent treatment; and they must not be in partnership with one another, nor otherwise professionally connected. A certificate when granted remains valid for seven days from the date of examination. The necessary form is here given. The words in italics describe a supposititious case, and are introduced merely to illustrate the manner in which the blanks must be filled up.

This document may be altogether in writing; but it is both desirable and convenient for all concerned that the regular printed forms should be used.[1]

Great care must be taken to have every detail of these documents complete and accurate; for it frequently happens that what may appear to many a trifling error renders a certificate invalid, and thus entails much inconvenience and sometimes distress. The foot notes attached to the certificate will be found sufficient as guides in the more important details, but the following hints will also be found useful:—1. The medical qualification must be given in full; 2. The house at which the examination was made must be accurately named, giving the name of the street, if there be any, and the number of the house; 3. The residence of the patient must be described with similar precision; and 4, The *name* of the person must be given, from whom the 'other facts' are obtained. The opinions at which the medical man must arrive before signing a certificate are two, and they are quite distinct. He has first to determine whether the patient is of unsound mind, and next whether it would be proper to place him under restraint. The determination that a person is insane does not necessarily imply that it is proper to place him under restraint. In stating the facts upon which the certificates are founded it must be borne in mind that they must be such as will appear to the Commissioners in Lunacy to be sufficient evidence of insanity; and great care must be taken to state them both intelligibly and accurately. There must be sufficient in the facts observed by the medical man himself to justify the opinion to which he certifies, the facts communicated by others being only accepted in corroboration of it; these may indeed be altogether omitted without invalidating the document. On this point the Commissioners have laid it down that the Legislature has been careful to guard against the facts communicated by others exercising undue influence upon the mind of the medical man in granting his certificate, 'by requiring that this certificate shall be directly deducible from examination on a particular day and at a specified place, and that the opinion expressed therein as having been formed on such particular day shall be set forth as the result of his having observed at that time in the person under examination some specific fact indicating insanity.' In the statement of the facts observed, it is therefore necessary that at least one such fact or combination of facts should be mentioned as could not be affirmed of a person of sound mind. A frequent error is the stating of facts in such an imperfect manner that, though they may have been real indications of insanity as observed, the manner in which they are recorded makes them appear insufficient. It is sometimes stated, for example, that a patient 'believes himself to be possessed of great wealth;' but it is necessary that we should also state whether this is or is not a well-founded belief. And it is not infrequent to find this necessary adjunct absent from the statement. One actual statement of facts, for instance, was 'his appearance, manner, mode of speaking, as well as his conduct,' a detail of circumstances which had probably proved conclusively enough to the writer that the patient was insane, but which afforded no substantial information to those who merely read the statement. When the case is urgent, and it is found impracticable to obtain certificates from two medical men, the patient may be received into the asylum or house upon a single certificate. But this entails the necessity of obtaining two additional certificates from other medical men within three clear days after the reception of the patient.

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[1] MEDICAL CERTIFICATE.

Sched. (A.) No. 2, Sects. 4, 5, 8, 10, 11, 12, 13.

I, the undersigned, *William Harvey*, being a (a) *Member of the Royal College of Physicians of London*, and being in actual practice as a (b) *Physician*, hereby certify, that I, on the *third* day of *March* 1875, at (c) *number* 8 *Kent Street, Norwich*, in the county of *Norfolk*, separately from any other Medical practitioner personally examined *Edward Harris* of (d) *number* 8, *Kent Street, Norwich, Grocer*, and that the said *Edward Harris* is a (e) *person of unsound mind* and a proper person to be taken charge of and detained under Care and Treatment, and that I have formed this opinion upon the following grounds; viz.:—

1. Facts indicating Insanity observed by myself (f) *He states that his daughter, who has lived in his house for years, is a person unknown to him, who has been placed in the house as a spy, and made to look like his daughter. He states also that he believes Parliament intends to ruin him.*

2. Other facts (if any) indicating Insanity communicated to me by others (g) *His daughter, Mary Harris, informs me that he has been sleepless and restless and much depressed in mind for the last week, and that he has on that account been unable to attend to his business.*

Signed, Name, *William Harvey*
Place of abode, 31, *Chapel Street, Norwich.*

Dated this *third* day of *March* One Thousand Eight Hundred and Eighty.

(a) *Here set forth the qualification entitling the person certifying to practise as a physician, surgeon, or apothecary, for example:*—Fellow of the Royal College of Physicians of London, Member of the Royal College of Surgeons of England, Licentiate of the Apothecaries' Society, *or as the case may be.*

(b) Physician, surgeon, *or* apothecary, *as the case may be.*

(c) *Here insert the street and number of the house (if any) or other like particulars.*

(d) *Insert residence and profession, or occupation (if any) of the patient.*

(e) Lunatic, *or* an idiot, *or* a person of unsound mind.

(f) *Here state the facts.*

(g) *Here state the information, and from whom.*

[1] These forms can be obtained at the law-stationers. As they are frequently wanted with the least possible delay, we mention the names of Messrs. Shaw and Sons, Fetter Lane, and of Messrs. Knight and Co., 90 Fleet Street, as firms in the habit of supplying them.

A private patient may be discharged from the asylum or house in which he has been detained, on the written authority of the person who signed the order for his admission. If a patient should die while under detention it is necessary to give notice of the death to the Coroner and to the Commissioners in Lunacy.

In the case of pauper lunatics the procedure is somewhat different from what is required for private patients. Anyone aware of the existence of an insane pauper in a parish, ought, if the case is a proper one for asylum treatment, to give notice to the relieving officer or the overseer. When a district medical officer under the poor law becomes aware of such a circumstance it becomes his statutory duty to give this notice in writing within three days after obtaining such knowledge. The relieving officer or overseer may then place the patient in an asylum upon one medical certificate, accompanied either by the order of a justice of the peace, or by an order signed conjointly by himself and an officiating clergyman of the parish.

In order to place a patient in an asylum in Scotland, a petition accompanied by a statement and two medical certificates has to be presented to the sheriff.[1] In the case of a private patient the person signing the petition must state the degree of kinship or other relation in which he stands to the patient. In the case of a pauper the petition must be signed by the inspector of the poor. In either case, if there be reasonable ground for so doing, the patient may be placed in the asylum on what is called a 'certificate of emergency,' signed by one medical man. If, however, the order of the sheriff is not obtained within three days thereafter, the patient must be discharged. In the case of a patient placed for profit in a private house in Scotland, the fact must be reported to the General Board of Lunacy for Scotland, and the sanction of the Board obtained.

The procedure required for placing a patient in an asylum in Ireland is generally similar to what is required in England. For admission to a private asylum, an order and two medical certificates must be filled up and signed, subject to regulations resembling those already described as enforced in England; but the facts indicating insanity do not require to be stated in the certificates. Pauper patients are placed in district asylums, and are admitted to these institutions on application being made at the asylum of the district in which the patient resides. The necessary form is obtained at the asylum. It consists of (1) a declaration to be made before a magistrate, that the patient is insane and destitute, and has no friend able or willing to pay for his board in an asylum; and to this is annexed a statement descriptive of the patient; (2), a certificate by a magistrate, and a clergyman or poor law guardian, in corroboration of the declaration; and (3), a medical certificate of insanity. When these forms have been filled up, it is necessary to wait until it is notified to some of the friends of the lunatic that there is room for him at the asylum. The procedure specially designed for the committal of dangerous lunatics is, however, frequently adopted in placing paupers in asylums. As this necessitates the lodgment of the patient in an ordinary prison, it is evidently a course which ought to be avoided, and which the medical practitioner ought specially to discourage. According to this procedure the patient requires to be apprehended by the police, and brought before two justices of the peace. They call to their aid the medical officer of the Dispensary District, and either discharge the patient or order his removal to the asylum. Patients who are not destitute, but whose friends are unable to pay the rates of board charged in private asylums, are received into district asylums at low rates, upon application being made at the asylum in a similar manner to that already described for paupers. The chief difference between the two forms is that in the case of patients not destitute, the medical certificate requires to be signed by two medical men instead of only by one.

JOHN SIBBALD.

LUNATIC (*luna*, the moon).—SYNON.: Fr. *Lunatique*; Ger. *Mondsüchtig*.—A designation given to persons suffering from mental disorder, because such subjects were formerly believed to be peculiarly affected by lunar influences. The term is used popularly as synonymous with insane. In medical literature it is seldom employed, but the legal relations of the word are important. The adjective lunatic is also used to signify that the object with which it is associated is connected with insanity, as *lunatic asylum*. *See* INSANITY.

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[1] The regular printed forms for Scotland may be obtained from Messrs. T. and A. Constable, 11 Thistle Street, Edinburgh.

LUNGS, Diseases of.—SYNON.: Fr. *Maladies du Poumon*; Ger. *Krankheiten der Lungen*. Under this title there will be described in the following pages, with certain exceptions, the various morbid conditions which affect the pulmonary organs. Pulmonary phthisis is so common a disease, so complex and variable in its pathology, and so closely associated in its ætiology and symptoms with the entire organism, that it will be most conveniently described apart from the other diseases of the lungs (*see* PHTHISIS). Certain other diseases which involve the lungs, if not the lung-tissue proper, and which in some nosological systems are described as pulmonary diseases—namely, asthma, diseases of the bronchi, and diseases of the pleura, will also be found described apart from the present connection, and under their several headings. Again, disorders of respiration, such as dyspnœa, orthopnœa, and 'Cheyne-Stokes respiration,' although frequently associated with diseases of the lungs, are in other instances referable to some morbid condition of other parts, such as the blood, the heart and circulation, or the nervous apparatus of breathing, and they will therefore be discussed in a distinct article (*see* RESPIRATION, Disorders of). The more important special clinical phenomena of disease of the lungs—namely, cough, expectoration, hæmoptysis, and the various physical signs, also demand more detailed and complete consideration than can be devoted to them in connection with the various pathological conditions to which they are due. *See* COUGH; EXPECTORATION; HÆMOPTYSIS; and PHYSICAL EXAMINATION.

After the separation of these subjects from that of diseases of the lungs, there remain for consideration under this head a large number of morbid conditions, which rank of the very first importance in practical medicine, and which will now be enumerated. The morbid processes which affect the lungs may be readily divided into two great groups—namely, first, those which are not essentially different from similar processes in other parts of the body; and, secondly, those which are quite peculiar to these organs.

First, with respect to the former group, the lungs, like the other great viscera, may present any of the ordinary morbid conditions, which affect either entire organs, or the several tissues of which they are composed. Thus the lungs may be the subject of various injuries, leading to *perforation* or *rupture*, and may present certain *malformations* and *misplacements*. They may undergo such alterations of nutrition as end in *atrophy*, *hypertrophy*, or certain *degenerations*. Disturbances of circulation give rise to well-defined pathological conditions, such as *anæmia*, *congestion*, *hyperæmia*, '*apoplexy*,' *embolism*, *infarction*, *œdema*, and *hæmorrhage*. The inflammatory process leads to a greater variety of pathological changes in the lungs than in perhaps any other organ, and which are known as *catarrhal*, *croupous*, and *chronic pneumonia*, *abscess*, *cirrhosis*, *gangrene*, and some forms of *phthisis*. *Morbid growths* of all kinds, including *malignant disease*, may involve the lungs, whether primarily or secondarily. *Syphilis*, besides actually involving the lungs, occasionally determines or modifies the occurrence of other pathological processes within them. Various *parasites*, especially *hydatids*, are occasionally tenants of the pulmonary organs.

Secondly, the morbid conditions which are *peculiar* to the lungs are such as depend upon their special structure, relations, and functions. Thus the relation between the pulmonary tissue and the pressure within and around the lungs may be so disturbed as to lead, on the one hand to *collapse* or *compression*, or on the other hand to *emphysema*. Their communication with the atmosphere, and the constant interchange that is going on between the contents of the lungs and the external air, have an important influence upon the origin, distribution, progress, and treatment of many of the diseases which affect them; whilst the length and complexity of the respiratory passages and their liability to disease, lead to many disturbances of the pressure, the circulation, and the nutrition within the lungs, and thus to collapse, hyperæmia, inflammation, and even destructive disease. The relation of the lungs to the circulation has an equally important influence upon them from a pathological point of view. Constituting as they do the channel of communication between the right and the left sides of the heart, the pulmonary vessels are involved in all the disturbances which affect the cardiac circulation, whether due to actual disease of the valves or of the walls, or to simple functional derangement of that organ. Congestion, œdema, embolism, infarction, hæmorrhage, and some forms of inflammation of the lungs, are the ordinary results of such circulatory disturbance of a temporary kind; and when it is more protracted, *brown induration*, as well as diseases of the bronchi and pleura, are likely to result.

Such are the principal conditions which determine and influence diseases of the lungs; and we shall here enumerate these in the alphabetical order in which they will be found referred to in the following pages:—1. Abscess. 2. Albuminoid Disease. 3. Anæmia. 4. Apoplexy. 5. Atrophy. 6. Brown Induration. 7. Cancer. 8. Cirrhosis. 9. Collapse. 10. Compression. 11. Congestion. 12. Consumption. 13. Degenerations. 14. Embolism. 15. Emphysema. 16. Gangrene. 17. Hæmorrhage. 18. Hydatids. 19. Hyperæmia. 20. Hypertrophy. 21. Induration. 22. Infarction. 23. Infiltrations. 24. Inflammation — Croupous, Secondary, Catarrhal, and Chronic. 25. Inflation. 26. Malformations. 27. Malignant Diseases. 28. Malpositions. 29. Morbid Growths. 30. Œdema. 31. Perforation. 32. Rupture. 33. Syphilitic Disease; and 34. Tuberculosis.

LUNGS, Abscess of.—SYNON.: Fr. *Abcès du Poumon*; Ger. *Lungenabscess.*

DEFINITION.—Circumscribed suppuration of the pulmonary tissues.

ÆTIOLOGY AND PATHOLOGY.—An acute primary inflammation of the lungs may occasionally lead to the formation of abscess. Much more commonly, however, pulmonary abscesses are the result of secondary or infective inflammations, and they are then, for the most part, associated with pyæmia.

Of acute primary inflammations of the lung, as causes of abscess, we have to consider those due to mechanical injuries, and those associated with acute pneumonia and with gangrene. With regard to the former it is only necessary to remark that mechanical injuries, as fractured ribs, penetrating wounds of the thorax, the lodgment of foreign bodies, &c., may cause suppuration, and so occasionally lead to the formation of abscess. That acute pneumonia may, in rare cases, terminate in abscess of the lung, has already been stated. Such a result appears to be favoured by a bad constitution, and by any circumstances which tend to impair the general health, either before or during the disease. The abscess is more common in the upper than in the lower lobes. Lastly, circumscribed gangrene of the lung occasionally terminates in abscess. This takes place by the evacuation of the necrotic tissue through the bronchi, and the formation of a pyogenic membrane from the walls of the cavity, which generates pus. The cavity may ultimately close by granulation and cicatrisation. Abscesses of primary origin are usually single.

Secondary or infective abscesses of the lung owe their origin to the dissemination of infective substances, derived from some focus of primary inflammation, by means of the blood-vessels or lymphatics. They are usually due to a general pyæmic process; and consequently the blood-vessels are the channels by means of which the infective substances are conveyed to the lungs. These substances are sometimes sufficiently large to block the pulmonary vessels, the formation of the abscess being preceded by a process of hæmorrhagic infarction. In other cases the suppuration occurs without any evidence of such infarction taking place. These abscesses are almost invariably multiple. They vary in size from a pin's head to a walnut, and are usually most abundant near the surface. They are commonly surrounded by a thin zone of dark red consolidation; and when adjacent to the pleura, this membrane over them is always inflamed.

Symptoms and Physical Signs.—The formation of abscess in the lung is rarely attended by any marked clinical phenomena, the symptoms of the disease, in the course of which the localised suppuration takes place being, for the most part, but little modified by its occurrence.

When acute pneumonia terminates in abscess, either the rapid fall of the temperature which constitutes crisis does not occur, or, what is more common, its occurrence is followed by pyrexia of an irregular type. The physical signs of consolidation also persist, and there is usually great prostration. Sometimes, owing to the opening of the abscess into a bronchus, pus is coughed up; and then, if the communication with the bronchus remain free, signs of cavity are discoverable. Before such partial evacuation of its contents, the detection of the abscess by physical examination is usually impossible. The expectoration of sputa containing large quantities of pus, and often a little blood, may continue for some weeks; the signs of prostration may gradually increase; and death may ensue in the course of from two to three months, and often earlier. Partial or complete recovery may, however, take place, the cavity becoming quiescent and secreting only small quantities of pus; and complete cicatrisation may ultimately occur. In exceptional cases the abscess opens into the pleural cavity.

Abscesses of the lungs occurring in the course of pyæmia rarely give rise to any special symptoms or physical signs. They are usually much smaller than primary abscesses; and death commonly ensues before any of them have attained sufficient magnitude to influence the general phenomena of the disease.

Diagnosis.—The diagnosis of abscess, occurring in the course of pneumonia, rests mainly upon the persistence and characters of the pyrexia; upon the physical signs of excavation supervening on those of pulmonary consolidation; and upon the expectoration of sputa containing pus. Pyæmic abscesses rarely admit of diagnosis. Their existence may be suspected if, in cases of pyæmia, pleural friction-sounds are audible over different portions of the chest.

Prognosis.—Abscess resulting from pneumonia very commonly proves fatal in from one to three months; it may, however, as already stated, ultimately terminate in partial or even complete recovery. The development of abscesses in the lungs in the course of pyæmia does not appear to influence the general prognosis.

Treatment.—Abscesses of the lungs rarely admit of any special treatment. Their occurrence, however, indicates the importance of doing all that is possible to maintain the strength of the patient. T. Henry Green.

LUNGS, Albuminoid Disease of.—In advanced cases of albuminoid disease, the lung-tissues may present more or less of this morbid change; but it is of no practical importance, for it does not give rise to any evident symptoms, nor does it have any specially injurious effect upon the patient.

LUNGS, Anæmia of.—Synon.: Fr. *Anémie du poumon*; Ger. *Lungenanämie*.

Definition.—A deficiency of blood in the lungs.

Anæmia of the lung may be *general* or *local*.

Ætiology.—Besides hæmorrhage and the other causes of general bloodlessness, there are certain local causes which produce anæmia of the lung. In senile atrophy, and in pulmonary vesicular emphysema, anæmia is associated with destruction of capillaries. Local or partial anæmia of the lung is the immediate result of embolism of the branches of the pulmonary artery. It rarely happens that the main vessel is entirely obstructed by an embolus; but it, or more commonly one of its main divisions, may be compressed or obliterated by the invasion of a malignant growth or aneurism. Aneurism of a branch of the pulmonary artery within the lung usually causes anæmia of the portion to which the vessel is distributed.

Anatomical Characters.—In extreme anæmia, as after death from hæmorrhage, the lungs and the bronchial mucous membrane are exceedingly pale from absence of blood. They are of course lighter in weight than natural, but in other respects unchanged. In the general disease known as anæmia, the lung partakes with other organs of the general deficiency of red blood; but in this condition, it being not so much in bulk as in quality that the blood is deficient, the lungs are of normal weight, but paler and more moist than natural, sometimes slightly œdematous.

EFFECTS.—The consequences of pulmonary anæmia, when long-continued, are atrophy of its texture, as in senile atrophy and vesicular emphysema, and in local deficiency of blood from partial obstruction of a large branch of the pulmonary artery. In complete obstruction of vessels from embolism, death and sloughing of the deprived area of lung is the consequence. The sudden arrest of circulation through a limited portion of the lung, gives rise to stress on the collateral circulation, the result of which is often hæmorrhage.

SYMPTOMS.—The dyspnœa and palpitation observed in anæmia are traceable to the anæmic condition of the lungs, and have their rationale in the necessity for an increased diligence of respiration, to enable the diluted blood to gather sufficient oxygen for carrying on the various combustion-processes of life. The remarkable gasping and restlessness seen in cases of fatal hæmorrhage, are really the signs of asphyxia from pulmonary deprivation of blood. The symptoms of general or local pulmonary anæmia dependent upon emphysema, embolism, &c., are lost in those of the more important diseases.

TREATMENT.—There is no special treatment for pulmonary anæmia. R. DOUGLAS POWELL.

LUNGS, Apoplexy of.—A synonym for extravasation of blood into the lungs. *See* LUNGS, Hæmorrhage into.

LUNGS, Atrophy of.—SYNON.: Senile emphysema; Fr. *Atrophie du Poumon*; Ger. *Lungenatrophie.*

DEFINITION.—A wasting of the constituent elements of the lungs, from defective nutrition.

VARIETIES.—Atrophy of the lung may be:—(*a*) *general*, in which all the tissues of the whole of both lungs are wasted, as in senile atrophy; or it may be (*b*) *local*, in which all the tissues of a portion of the lung are wasted, as in the atrophy that results from a local diminution of blood-supply; or (*c*) it may be *partial*, in which some of the tissues are atrophied coincidently with increased growth of other tissues, as in some cases of so-called 'hypertrophous emphysema,' and in 'cirrhosis' of the lung.

ÆTIOLOGY.—The cause of simple atrophy of the lungs is that general failure of nutrition which is natural to advanced age. Hereditary predisposition may determine an earlier failure of nutritive change in the lungs. The strongly-marked tendency of vesicular emphysema to recur in successive generations is certainly in favour of such a tendency to premature impairment of tissue being inherited.

Over-stretching of the walls of the air-cells in emphysema, with the consequent impediment to circulation, is an important cause of subsequent atrophy in this disease. Collapse and anæmia of lung from pressure from without, or from the pressure of a growth or aneurism upon one of the pulmonary vessels, cutting off the blood-supply, or on a large bronchus, diminishing the respiratory function, may cause atrophy of the whole or of a part of one lung.

ANATOMICAL CHARACTERS.—The appearance of an atrophied lung may be best seen in a case of natural or senile atrophy. The lung is small, light, anæmic, more or less deeply pigmented, drier in texture and less firm and resisting than natural, pitting on pressure from want of elastic resilience, and capable of being squeezed into a very small compass. The air-cells appear to be increased in size; and at some portions, if the lung be inflated and dried, large cells may be seen, evidently resulting from the coalescence of two or more infundibula. Across such cells filaments, the remnants of small bronchi and blood-vessels, may extend. The pulmonary artery and its branches are diminished in size, and the bronchial tubes are also thinned.

Microscopical characters. — The atrophic process commences at the vesicular septa, which project inwards to subdivide the infundibula, or alveolar spaces of the lung, into true air-cells, or alveoli. The process is one of simple withering and obliteration of capillaries, dependent on diminished respiratory function and blood-volume. The septa dwindle down to mere ridges upon the infundibular walls; and these walls in their turn become thinned even to perforation and coalescence of several air-spaces. Thus, without any corresponding enlargement of lung, there is an apparent enlargement of air-cells from the simplification of structure. A certain degree of fatty degeneration, affecting especially the minute vessels and the nuclear remains of the pulmonary epithelium, is associated with this simple atrophy, as with all other atrophic processes.

When atrophy of the lung is associated with, or the result of, other diseases, as emphysema or forcible collapse, the process is essentially the same, but is combined in the former case with over-stretching of the air-cells, and more or less thickening of the fibrous tissues derived from the bronchial and perivascular sheaths, from repeated congestions. Thus we have a larger and heavier lung; and, in the later stages, more marked fatty degeneration of its fibrous texture.

In cases of atrophy from the long-continued pressure of fluid in the pleura, the pleura is always thickened from the original inflammation, and fibrous processes are directed inwards from it between the lobules, so as to render difficult any subsequent expansion of the lung.

In the case of atrophy from compression of the lung by fibrous growth or fluid effusion, we have again often a heavier lung from increase of fibrous tissue. It is obvious that the increase in weight must always be due to attendant, often determining, disease.

EFFECTS AND SYMPTOMS.—The consequences of the partial atrophy of lung which accompanies the 'large-lunged' emphysema of advanced middle life are very grave. Extensive obliteration of the pulmonary capillaries, without a corresponding diminution in the blood-volume, induces a stress of circulation, a mechanical congestion, which ultimately tells back through the right heart upon the whole venous system. The damaged elasticity of the lung impairs the mechanism, as the atrophy of the alveoli impairs the function of respiration. In senile emphysema, however, the lung-atrophy, being but a part of a general atrophy of all the tissues and of the blood, causes no discomfort, provided no extra effort is attempted and no bronchitis supervene. Local atrophy of the lung has its symptoms merged in those of the predominant disease.

Physical signs.—In senile atrophy of the lungs the chest-capacity is diminished in all directions to accommodate the small lungs. The lower ribs are approximated and their obliquity greatly increased; the upper intercostal spaces are depressed. The chest-movements are very limited. The percussion resonance is generally increased over the chest, except over the præcordial region, which is less covered by lung than natural. The respiratory murmurs are simply enfeebled, not altered, unless there be some bronchitis present. It has been said that there may be some effusion into the pleura in atrophy of the lung, to fill up the space vacated by the shrunken organ. The mechanism of such an effusion is, however, quite inconceivable.

Complications.—There are no complications necessarily incident to senile atrophy of the lung. Bronchitis not uncommonly, however, supervenes, and proves fatal to the patient.

Treatment.—The treatment of senile atrophy of the lungs simply consists in shielding the aged person from the causes of bronchitis.

R. Douglas Powell.

LUNGS, Brown Induration of.—The condition recognised by this name by Virchow and Laennec, is one which is sometimes observed after prolonged congestion of the lungs, particularly that which results from disease connected with the mitral orifice. The morbid change consists mainly in excessive pigmentation, the pigment accumulating not only in the interlobular tissue, but also in the alveoli and minute bronchi, where it is enclosed in enlarged epithelial and granular cells. At the same time the capillaries are dilated, the interstitial tissue is increased, and probably the alveolar walls are thickened. The pigment is granular, and of a yellowish colour; it is derived from the blood; and seems to be of the nature of hæmatoidin. It may become brownish, reddish, or even black; and ultimately may be found free. The extent and degree of brown induration vary much in different cases. When the change is marked, the lungs are enlarged, heavy, firm, incompressible, and inelastic, not collapsing on exposure. They present various tints, from yellowish to reddish-brown. This alteration in colour is also evident on section, and red spots are often seen, shading into black, while a brownish fluid may be expressed. Brown induration is associated with congestion of other parts of the lungs, and often with infarctions. It cannot be clinically recognised apart from these conditions, unless the affected organs should present physical signs of consolidation in cases of known pulmonary congestion from mitral disease. No special treatment is called for.

Frederick T. Roberts.

LUNGS, Cancer of.—*See* Lungs, Malignant Disease of.

LUNGS, Cirrhosis of.—A synonym for chronic pneumonia. *See* Lungs, Inflammation of.

LUNGS, Collapse of.—Synon.: Apneumatosis; Fr. *Affaissement pulmonaire*; Ger. *Lungencollapsus.*

Definition.—Simple diminution in size of the whole or of a part of a lung, with reduction of the volume of the contained air, and caused by interference with its free entrance in inspiration.

Ætiology.—The causes of collapse of the lung are either *intrinsic* or *extrinsic*; and frequently the two classes of causes are combined. The *intrinsic* causes present actual obstruction of the respiratory passages, and include all diseases of the larynx, trachea, and bronchi, attended with inspiratory dyspnœa, whether due to the pressure of external tumours, to affections of the passages themselves, or to the presence of inflammatory products, blood, and foreign bodies within them. To this class of cases belongs the collapse of the lung which is apt to follow infantile bronchitis, when the tubes become obstructed, and there is no power to expectorate. All causes that interfere with respiratory efficiency favour the occurrence of the condition named. A plug of mucus may be drawn, in inspiration, deeper and deeper into the bronchial tubes, which it obstructs, and acting like a 'ball plug,' allows the expulsion of air in expiration, but interferes with inspiration; the air not being replaced, apneumatosis is developed; and as there is no air behind the plug of mucus, cough is powerless to expel it. In children, bronchial inflammation is exceedingly common, and the smaller tubes being proportionately smaller in the child than in the adult, the danger of collapse is increased. When children under five years of age die of bronchitis and allied affections, apneumatosis is almost invariably present; and 25 per cent. of the total mortality of infants may be safely set down to this cause. Partial collapse of the lung from pressure on the respiratory passages will be found described in the article Mediastinum, Diseases of. The *extrinsic* causes of pulmonary collapse are certain conditions of the walls of the chest, which diminish the force of the inspiratory act, such as paralysis or debility of the inspiratory muscles, and softness of their bony attachments. Muscular paralysis is seen in injuries to the cord. Debility of the respiratory muscles may often be observed before death. Collapse of the lung is sometimes, although rarely, met with in adult life, when great prostration occurs in the course of fever, and respiration is impeded by pulmonary congestion. Asssociated as it is with softness and weakness of the ribs, rickets is one of the most frequent causes of collapse of the lungs. The action of the inspiratory muscles may be still further interfered with by abdominal distension, or by the binding up of the abdomen of the infant with tight bandages. The danger of collapse is lessened when the ribs have gained firmness and fixity, and when, raised by the respiratory muscles, the thoracic cavity is enlarged, and the lungs are consequently expanded.

Anatomical Characters.—The whole of one lung or of one lobe may be affected, but a lobule or a part only of the lung is usually involved, the affected lobules being abruptly separated from those adjoining. As a rule several patches of collapse occur in each lung, having a darker colour and more depressed surface than the healthy parts. The lower margins of the left lower lobe are most frequently affected. The collapsed portions of lung are similar to the liver in consistence; they resist pressure, are non-crepitant, are smooth on section, and sink in water. The bronchi are filled with mucous fluid; there is an entire absence of air in the collapsed parts. On inflation the affected portion assumes a natural appearance, unless considerable congestion exists; whereas in pneumonia inflation cannot restore the lung to its natural appearance. In pneumonia pleurisy is rarely absent; but in collapse, uncomplicated with diathetic disease, the pleura is invariably healthy.

Symptoms.—The symptoms of collapse of the lung vary greatly with the cause, rapidity, and extent of the morbid condition. In severe cases, for example, in the collapse that follows bronchitis in very young subjects, the symptoms are peculiar. There is great prostration, debility, restlessness, and sleeplessness. The temperature falls; the surface becomes cold, blue, or dusky; the eyes become shrunken; and the pulse is quick and small. There is a constant feeble whining cry. Respiration is very quick and shallow, as high as 70 to 80 or even 100 per minute. The rhythm is changed, the interval being between inspiration and expiration, instead of after expiration. There is no pain as in pleurisy. The cough is constant and impotent; is often followed by a cry of impatience; and differs much from the suffocative cough of bronchitis.

On examining the chest, the lower part is found retracted and diminished in diameter. The intercostal spaces sink in inspiration, and move outwards slightly in expiration. When the collapse is extensive the percussion is dull and resistant, unless the affected lobules are interspersed among the healthy ones. The respiratory murmur is lost over the affected parts, though conducted breath-sounds, of a bronchial character, and rhonchi are generally audible almost universally. In the simpler cases of collapse of the lungs, such as occur in pertussis during the severe fits of coughing, some of these symptoms and signs may be suddenly developed, and again speedily disappear.

Diagnosis.—Apneumatosis may be distinguished from croupous pneumonia by the comparative rarity of the latter disease in infancy; and by absence of the great heat of skin, and of fine crepitation on auscultation. From extensive miliary tuberculosis it is diagnosed by the absence of advancing symptoms of constitutional disorder, though the two conditions may co-exist. In pleurisy the dulness on percussion, and the absence of respiratory sounds at the base, are much more marked than in apneumatosis. Congenital collapse or *atelectasis*, is a condition which has to be diagnosed from infantile collapse or *apneumatosis*. Readily separable by symptoms, these two conditions may be indistinguishable by physical signs. In atelectasis the lung retains, in whole or in part, its fœtal condition, nature having failed to establish respiration and fit the child for its new mode of existence. In apneumatosis the once permeable lungs cease to admit air, and thus death from apnœa occurs without any apparent structural change being discoverable, save that the respiratory organs bear the appearance of fœtal, unexpanded lungs.

Prognosis. — The prognosis in collapse of the lung is favourable if the affection is recent, and the child healthy, with fair muscular power, and under favourable hygienic conditions. On the contrary, the disease is generally fatal if it involve a considerable extent of lung, especially if it supervene on atelectasis. Death usually occurs from slow asphyxia, the effect being the same as if the size of the lung were reduced by the removal of the affected parts. As much as half of the entire lungs has been found involved, thus fully accounting for the quickened respiration, the distress, and the dyspnœa, and for the bloodlessness and extreme pallor, with cold, blue extremities. The fatality of whooping-cough in infants is mainly due to the ready collapse of the lungs, specially when the child is badly nourished and breathing impure air. The natural course of the disease is from bad to worse; more lung is involved each day; and death occurs after two or three weeks from slow asphyxia. If collapse follows acute bronchitis death often ensues rapidly, but if recovery takes place the lungs are slow to regain activity, and the seeds of future mischief remain. After an attack of pneumonia complete absence of breath-sounds may exist for a time, and then suddenly —after a blow, shock, or violent cough—air enters the collapsed portion of lung, and the respiratory sounds assume a normal character.

Treatment.—When this affection was looked upon as a form of pneumonia it was treated by depletion. Now that we realise that it is not of an inflammatory character, our object must be not to lower vitality but to diminish excessive secretion. Slight counter-irritation, by means of stimulating embrocations, is useful. An emetic of ipecacuanha will help to remove accumulation if the patient is not too weak. Expectoration may be promoted by small doses of the same drug. When the lungs are extensively involved, vital power must be kept up by the help of ammonia, steel, phosphates of iron, port wine, and beef-tea; and the food must be so designed as to be digestible by the stomach of the infant.

E. Symes Thompson.

LUNGS, Compression of.—Synon.: Fr. *Compression du Poumon*; Ger. *Lungencompression.*

Definition.—Diminution in size of the whole or of a part of a lung, associated with reduction of the volume of the contained air, and caused by pressure on the pleural surface.

Ætiology.—Compression of the lung may arise in the course of numerous diseases or injuries affecting the chest; the compressing influence being either gaseous, liquid, or solid.

First, the admission of *air* to the pleura from without, through a perforating wound, as from a sword or bayonet thrust; or from within, as by rupture of an air-cell, or the extension of pulmonary ulceration through the pleura, produces in either case compression. If no previous pleurisy has existed the compression is complete; but if, on the other hand, long-standing pleurisy has caused adhesion, compression cannot take place, or will be but partial. Pneumothorax arising without perforation may be due to the evolution of gas from gangrene, or to the decomposition of pleuritic fluid; or the gas may be directly secreted within the pleura, taking the place of serum absorbed after pleuritic effusion. Besides the causes named, perforation may arise from fractured ribs with pulmonary laceration, or from contusion of the lung without fracture; from ulcerative perforation of lung, either tuberculous or gangrenous; from pulmonary apoplexy, hydatids, cancer, empyæma, abscess; from rupture of the lung in whooping-cough; from perforation of the lung from without, by diseased and suppurating bronchial glands opening into the pleura and bronchi; and from rupture or ulceration of the œsophagus, opening into the pleura. Of this long list, omitting the surgical cases, nine out of ten are due to phthisis.

Secondly, compression may arise from the presence of *fluid*, such as pleuritic effusion, acute or chronic; passive, non-inflammatory effusion, as in hydrothorax; or blood, as in hæmatothorax.

Thirdly, compression of the lung by *solids* is seen in the case of various tumours of the chest, whether originating in the mediastinal structures, in the lungs, or in the thoracic parietes.

In a fourth class of cases compression of the lung is the result of the enlargement of neighbouring parts, other than the thoracic viscera; and especially of the abdomen, as in ascites, and tumours of the liver, spleen, or ovaries.

Anatomical Characters.—Compression of the lung may be either general or local, complete or partial. A lung compressed by pleuritic effusion is found to be reduced in volume, non-crepitant, dense, and quite insusceptible of inflation. The blood is coagulated in the affected lobes, the clot being often decolourised and adherent to the walls of the vessels, many of which are impervious, or altogether obliterated; while the pervious vessels and the air-cells of the adjacent parts are distended, and emphysema is produced. In other cases, the compressed lung proves to be anæmic, tough, and dry.

In cases of slow recovery from chronic empyæma the lung is often found bound down and thickened, having very little normal pulmonary tissue remaining. The thoracic cavity vacated by the shrunken lung is occupied by the displaced heart, and sometimes by the extension of the sound lung across the middle line.

When perforation occurs with admission of air from the bronchi to the pleural cavity, the atmospheric pressure distends the pleura, and tends to displace the mediastinum and the other lung. The heart, too, being unsupported, is pressed against the healthy lung, and may be displaced to a very considerable extent.

Symptoms and Physical Signs.—The symptoms of compression of the lung vary greatly in accordance with its causes, the rapidity of onset, and the extent and degree of compression. If pleuritic effusion be very rapid, the dyspnœa may be exceedingly urgent. After perforation of the pleura with sudden collapse of the lung, there also occur acute pain, dry cough, and painful spasms of the intercostal muscles. The pulse is frequent, feeble, and often irregular. Symptoms, more or less acute, of inflammation may follow. In other instances the symptoms are those of hydrothorax, or of intrathoracic tumour.

The physical signs of compression of the lung are chiefly those of the associated cause, such as pneumothorax, pleurisy, hydrothorax, or intrathoracic tumour; and partly certain phenomena characteristic of the physical condition of the lung itself. The latter vary considerably with the degree and extent of compression, but they may be described in general terms as follows:—Either increased clearness of the percussion sound over the area of compressed lung, with tubular or rarely even tympanitic quality, especially in children, or in extreme cases of compression complete loss of resonance; indefinite, weak, but occasionally rather blowing or tubular respiratory sound, sometimes mixed with scanty, dry, subcrepitant rhonchus; and exaggerated loudness and ringing quality of vocal resonance. A further description of these symptoms and signs will be found under the headings of the various causes of compression referred to.

Diagnosis.—The diagnosis of compression of the lung is in general simply the diagnosis of the condition on which it depends.

Prognosis.—The prognosis depends on the cause of the compression. Thus in pneumothorax it is unfavourable, though recovery may take place. In hydrothorax the prognosis is unfavourable, as it is usually an evidence of formidable, if not incurable, organic disease. In pleurisy, if the effusion has been rapid, met by prompt treatment, and uncomplicated with hectic, complete recovery may take place without much compression of lung or distortion of chest; but incompletely-cured pleurisy is too frequently the first incident in the history of phthisical disease. In empyæma the prognosis is more favourable than in pneumothorax or hydrothorax.

Treatment.—Little need be said as to the treatment of lung-compression. It resolves itself into that of the intercurrent or causative diseases. Bearing in mind the injury done to the lung by compression, efforts should be made to relieve the lung before it has been irremediably bound down. The early adoption of paracentesis thoracis is the most practical means of gaining this end in pleuritic effusion. Remedies calculated to remove effusion and thus relieve the lung should be given, remembering that the more speedy the relief given to the lung the more complete will be the cure. Suitable movements of the chest might be ordered subsequently, with the view of promoting expansion of its walls and of the lung. E. Symes Thompson.

LUNGS, Congestion of.—*See* Lungs, Hyperæmia of.

LUNGS, Consumption of.—*See* Phthisis.

LUNGS, Degenerations of.—Changes of

a degenerative character in connection with the lungs constitute an important element in some pulmonary diseases, or they may be the sole morbid condition present. They are of the following nature :—

1. *Albuminoid.*—This is only occasionally noticed, in marked cases of general albuminoid disease.

2. *Fibroid.*—Changes leading to a more or less fibroid condition of the pulmonary tissue are of common occurrence, but it is not always easy to determine whether they should be regarded as due to a chronic inflammatory process, or to degeneration, and pathologists differ in their views on this point. As a degeneration, the fibroid change may be considered as most important in connection with emphysema, and it is regarded by some authorities as an element of much consequence in the causation of many cases of this disease. It also follows long-continued congestion, and collapse or compression of the lung from any cause. Of course much fibroid or fibrous tissue is found in the lungs in many cases of phthisis, and in connection with pleuritic adhesions and other conditions, but this state must be looked upon mainly as of inflammatory origin. The effects of these changes are to make the lung-tissue firmer and tougher, but at the same time to diminish or destroy its elasticity, the elastic tissue being more or less displaced. Hence, if the lungs be exposed to any distending force, they cannot recover themselves properly, and the air-vesicles remain more or less permanently dilated.

3. *Fatty.*—This degeneration is also regarded by some pathologists as one of the main elements in originating many cases of emphysema of the lungs, and also as one of the actual conditions in this disease. Here, again, the lung-tissue is impaired in its elasticity and resisting power to distension, but it is not tough. Granular fat may be visible under the microscope.

4. *Pigmentary.*—The lungs become the seat of more or less pigmentation with increasing age. They are also markedly affected in certain occupations in which carbonaceous matters are inhaled. In so-called brown induration of the lungs there is an abundance of pigment.

5. *Senile.*—The lung-tissue undergoes atrophy, with more or less loss of elasticity, owing to wasting of the elastic tissue with increasing age, and even a fatty degeneration may take place. Hence, in such subjects emphysema is readily set up by causes which would have no effect on younger persons.

6. *Secondary.*—Under this head may be included those degenerative changes which take place in morbid formations in the lungs, such as inflammatory deposits, tubercle, or cancer. These belong mainly to the fatty or caseous variety of degeneration, but calcification may also occur.

FREDERICK T. ROBERTS.

LUNGS, Embolism of.—*See* LUNGS, Anæmia of; and LUNGS, Hæmorrhage into.

LUNGS, Emphysema of.—SYNON.: Fr. *Emphysème du poumon*; Ger. *Lungenemphysem.*

DEFINITION.—An excess of air in the lungs, whether due to a dilated condition of the air-sacs, or to the presence of air in the interlobular tissue.

VARIETIES.—There are two kinds of emphysema of the lungs, namely :—

A. **Vesicular Emphysema.**

B. **Interlobular Emphysema.**

A. **Vesicular Emphysema.**—Pulmonary vesicular emphysema exists in three forms, namely, 1. *partial lobular*; 2. *lobular*; and 3. *lobar.* The last form involves the whole of a lobe, or the whole of one or both lungs. The first form is rarely seen alone, but is generally associated with the second form, which is very common, and is found in connection with diseases, such as bronchitis, which are attended with violent or long-standing cough. The third form is by far the most important, and will be more especially referred to in the present article. It more frequently attacks both lungs than one, and the lower as well as the upper lobes. It is a serious malady, and sometimes destroys life at an early period. Its features are characteristic: the lung-substance has a peculiar doughy feel; pits on pressure; is wanting in healthy crepitation; and has a colour very closely resembling that of a calf's lung. It has been described as 'large-lunged vesicular emphysema.'

ÆTIOLOGY.—*Determining causes and mechanism.*—With reference to the determining causes of emphysema there are two theories, namely, the inspiratory theory, and the expiratory theory. On the first view the dilatation and rupture of the air-sacs are accounted for by the over-distension of the lungs in inspiration. On the second view these changes are considered to be caused by the strain to which the lung-tissue is subjected in violent expiratory efforts, especially the act of coughing. It has been thought by others that emphysema must be looked upon as a complemental lesion, arising in consequence of the over-distension to which the healthy portions of the lungs are subjected in cases of pulmonary collapse. Without entering into any critical examination of the theories as to the mechanical causes of emphysema, it may perhaps be sufficient to say that there can be little, if any, doubt that the lobular forms of the disease are mainly produced by expiratory efforts, such as violent cough, or blowing wind instruments. They have their seat in those parts of the lungs which become most distended by such acts. With regard to the lobar form of the disease, however, this explanation of its mechanism does not suffice. In this affection the inspiratory power is that which distends the lungs. The pulmonary tissue has lost a portion of its elasticity, it yields to distension, and no longer re-acts perfectly when the distending power ceases. Further distension follows; reaction diminishes still more; until at length in some instances the lungs become greatly enlarged.

In senile cases the loss of elasticity of the chest-walls aids in preventing the pulmonary reaction.

ANATOMICAL CHARACTERS AND PATHOLOGY.—In the early stages of emphysema there is simply a dilatation of the air-sacs; an increase in the size of the alveoli; and a diminution in the height of the alveolar walls, which yielding with the distending cavities, become partially obliterated. As the disease progresses the air-sacs become more distended, and the walls of the alveoli sometimes completely obliterated, so that the air-sacs are quite smooth, instead of honeycombed. Then follows perforation of the air-sacs—at first slight, here and there an oval opening being discoverable; afterwards the openings become more numerous and larger. The subsequent progress of the disease is attended with further distension of the air-sacs, and rupture of the fibres of their walls. The openings thus caused coalesce, until at length the walls are simply represented by membranous shreds, and even large vesicles may form. These changes, varying in degree, characterise all the forms of emphysema. In the lobar form, however, perforation takes place to a much greater extent *quoad* the amount of dilatation, than in the lobular or partial lobular form.

The emphysematous lung is anæmic, its blood-vessels become widely separated, and often ruptured and atrophied. The bronchial tubes are sometimes dilated, especially in old-standing cases, and in these there is frequently found an increased development of the circular muscular fibres.

The pathology of emphysema involves some important points for consideration. The great question is whether there is any degeneration of tissue preceding or attending the affection. When the disease is partial, and has followed or is attended by bronchitis, or some other affection in which there has been violent or long-standing cough, the emphysema may be the result of mechanical violence, without pre-existing degeneration of the lung-tissue. When, however, it is of the lobar form, degeneration is probably the primary step in the affection. The facts which tend to confirm this view are:—(1) the insidious manner in which the disease sometimes comes on, and the development which it attains, without any previous history of violent or long-standing cough; (2) the frequency with which it attacks the whole of both lungs; and (3) its hereditary character. The exact nature of the degeneration has not been satisfactorily made out. Fatty matter has been found in a few instances, but not in all cases. The degeneration is probably one primarily involving the elastic fibres and other structures of the walls of the air-sacs. Whatever be the nature of the degeneration, there can be no doubt that lobar emphysema is a malady resulting from some form of mal-nutrition of the lung-tissue. There is reason to believe too that this form of emphysema is sometimes associated with gout.

There is a form of lobar emphysema which is met with in old age, and which differs in some respects from that already described. The lungs are not so large; they are universally distended, however, to a greater or less extent; and they present a somewhat atrophied appearance. The alterations, of which they are the seat, are probably the result of those changes which age produces in the chest-walls, impairing their elasticity. This loss of elasticity may also affect the lung-tissue. *See* Lungs, Atrophy of.

A knowledge of the changes produced by emphysema affords an explanation of the peculiar character of the respiratory movements and sounds, as well as of the other physical signs and symptoms of the disease. The lungs being the seat of general expansion, the thorax is kept abnormally distended. Thus it can undergo but little enlargement at each inspiration. As there is no impediment to the passage of air to the air-sacs, inspiration is accomplished rapidly. Not so, however, with expiration. The lung-tissue has in great measure lost its elasticity, and reacts slowly after distension; and this results in laboured, slow, and ineffectual efforts to expel the air. Further, as the lungs are more or less riddled with perforations, their aërating surface is diminished, and this necessarily causes dyspnœa, whenever any increased demand is made on the respiratory function. The quantity of blood circulating through the lungs, even from the earliest stages of the affection, is also diminished; and the destruction of the capillary vessels, which ensues when the disease is more developed, further decreases the vascularity of the pulmonary tissue. Hence its pale, anæmic appearance after death, a circumstance which serves to explain how rarely it is the seat of pneumonic inflammation.

Symptoms.—A constant and generally gradually increasing dyspnœa is one of the most important and most frequent of the symptoms of emphysema. Cough with expectoration is generally more or less present. Hæmoptysis is rare, and when it does occur, is slight. The patient usually complains of no pain, but of a feeling of oppression, or a 'smothering in the chest.' In severe cases of lobar emphysema this last symptom and the dyspnœa are often the only circumstances which attract the attention of the sufferer to his malady. In other instances, however, and especially when the disease is only partial, a close examination will elicit the fact that there have been bronchitic symptoms. Few cases of emphysema exist for any length of time without the occurrence of asthmatic seizures. In advanced cases the aspect is peculiar. The countenance is dusky, leaden, and puffy. The nostrils are dilated, and expand widely on inspiration, whilst the angles of the mouth are drawn down. The voice is feeble. The whole body has a cachectic appearance, and is sometimes much wasted. General dropsy often ensues.

Physical Signs.—Amongst the most important of the physical signs of emphysema are the following:—The upper part of the chest and the clavicles are prominent; the neck seems shortened; the fossæ above the clavicles are deepened; there is increased curvature of the dorsal spine and the sternum is arched. The gait is stooping; the ribs are prominent; and the intercostal spaces are depressed. There is indeed a general increase in the size of the chest, usually most marked at the upper part. These are the features of the disease when it is extensive. If partial, or confined to one lung or part of a lung, the prominence of the chest exists on one side only, and the other symptoms and signs are less marked. The movements of the chest in respiration are peculiar. The breathing is for the most part superior thoracic, but the chest is not much expanded on inspiration, for the lungs are already inordinately distended. The lower end of the sternum and the lower ribs are drawn in during inspiration. In some cases during inspiration there is marked protrusion of the abdomen. The respiration presents other features. The inspiration is short and quick, and is followed by a prolonged and often wheezing expiration. Coughing is performed feebly, and expectoration is attended with difficulty. Percussion and auscultation elicit important diagnostic marks of the disease. When it is general there is increased, and in some instances almost tympanitic, resonance over the whole of the chest, most marked towards the apices of the lungs, and along their anterior borders; and in partial cases almost confined to these spots, or to one side. The præcordial region is generally resonant, owing to the distended lungs coming between the heart and the wall of the chest; and the cardiac impulse can often be felt beneath the lower end of the sternum. The respiratory murmur is faint, and characterised by peculiarities which a knowledge of the anatomical condition of the lungs and of the chest-walls enables us to explain. The inspiratory murmur is short, and is followed by a prolonged expiratory murmur. This latter is unlike the sound heard in any other affection, and is, in fact, pathognomonic of emphysema. In some advanced cases the respiratory sounds are scarcely audible, if the bronchial tubes are free from mucus, and no spasm exist. Laennec described a *râle* which he thought was peculiar to emphysema. He called it 'râle crepitant sec à grosses bulles.' A *râle* such as Laennec described is often heard in emphysema, but it is not a dry *râle*. It is probably produced in the finest bronchial tubes, and is a modification of the sub-crepitant *râle* of bronchitis. Although valuable in aiding diagnosis when present, yet from its frequent absence and the difficulty of distinguishing it from the ordinary sup-crepitant *râle*, it loses much of its diagnostic import.

Complications and Sequelæ.—Bronchitis is one of the most frequent of the diseases associated with emphysema of the lungs. It is rare for the latter affection to exist for any length of time without the supervention of the former. Bronchitis presents some peculiarities when it affects an emphysematous lung. It is rather the result of congestion than of inflammation. It often attacks the finer bronchial tubes; and when severe, is attended with profuse secretion; a circumstance which, coupled with the fact that expectoration is less easily accomplished than when the lungs are healthy, seriously complicates the affection, and increases the danger of death from apnœa. The inflammation sometimes runs on very rapidly, and copious purulent or puriform expectoration occurs. Even when this is the case, an examination of the tubes after death may reveal but little vascularity of the mucous membrane. These severe bronchitic attacks are very apt to be attended by the formation of fibrinous clots in the heart and the large vessels arising therefrom. Bronchitis, in a sub-acute or chronic form, is a very constant cause of winter cough in emphysematous patients.

Asthma, occurring with greater or less severity, is a frequent attendant on emphysema. The attacks come on for the most part during the night, and may possibly be due to the congestion of the lungs which takes place during sleep, or when the body is long in the recumbent posture. This congestion probably sets up an irritation, which gives rise to reflex spasm of the bronchial muscular fibres.

Secondary affections of the heart are constantly met with in advanced cases of emphysema. Many pathologists have believed that the right cavities alone become affected; but more recent observations have shown that the cardiac disease is not confined to one side. There is, in extensive emphysema, a general hypertrophy of the heart, with dilatation of all the cavities, especially of the ventricles. But hypertrophy is not the only change which takes place; valvular disease is frequently found. The deposits and thickening which occur about the valves are no doubt secondary to the changes in the muscular walls, and must be attributed to the general mal-nutrition produced by the disease. It is not difficult to understand how it happens that in emphysema there is general cardiac hypertrophy. The impediment which exists to the circulation of the blood through the lungs necessarily gives rise to an overloaded state of the right side of the heart; hence results increased action of the right cavities, and hypertrophy of their walls. Again, the overloaded state of the venous system, and the consequent impediment to the capillary and arterial circulation, call for increased action of the left ventricle; and this is followed by its dilatation and thickening. There exists also another cause, which probably has some influence in producing this cardiac hypertrophy, namely, the altered position of the heart. This organ is pushed downwards and towards the median line, and its impulse is often felt strongly in the epigastrium. The position of the ventricles is therefore changed, and the direction of the axis of their cavities is altered with reference to that of their great vessels. This must lead to embarrassment of the circulation.

As a consequence of the changes in the heart and venous system in emphysema, dropsy often results. Many cases go on for a long time without any dropsical symptoms, whilst in others there is only slight œdema of the legs. In advanced cases, however, there is frequently general dropsy.

General emphysema is attended in its progress with symptoms of cachexia and anæmia. In some cases there is much wasting of the muscular system, even before dropsical effusions occur. Further, the patients often have a sallow and anæmic appearance, not unlike that met with in renal and other serious organic diseases. There has been an impression that emphysema and phthisis are incompatible diseases, but recent researches have shown that this view is not correct. Indeed, in a large proportion of cases of death from phthisis, patches of emphysema, lobular or partial lobular, are met with; and doubtless have been produced by the fits of coughing so common in the disease. But the great question is whether tubercular deposit ever takes place in lungs which are the seat of lobar emphysema; and this question must be answered in the affirmative, although the concurrence of the two diseases is rare. Pneumonic consolidation is very uncommon in an emphysematous lung, and probably acute so-called sthenic pneumonia never attacks the organ in such a condition.

Pleurisy not unfrequently exists in connection with emphysema; pleuritic adhesions being often found after death. The occurrence of pleurisy must, however, be considered as an accidental circumstance. In the most extensive cases of emphysema pleuritic adhesions may not be found.

TREATMENT.—This must be referred to under two heads, namely (1) the treatment of *the disease*; and (2) that of *the secondary affections*, which follow or are associated with it.

(1) *Treatment of the disease.*—Too little attention has been paid to emphysema of the lungs as a substantive disease. Considered in the main as the result of bronchitic affections, the treatment has been chiefly directed to the control of these attacks; and in regard to the partial forms of emphysema, this is a most important object. But in reference to lobar emphysema, if we recognise the fact that it is primarily due to some degeneration of tissue, it is obvious that the treatment should be directed to check, if possible, this process. It can scarcely be expected that when once perforation and rupture of the air-sacs have taken place, the normal condition of the lung can be restored. But whilst we admit this, it is by no means implied that the disease is beyond control. That condition of lung-tissue which precedes the perforations—the simple distension of the air-sacs—admits of great amelioration, and further degenerative changes may be, if not prevented, at least much retarded.

The main principles of treatment should be such as guide us in the management of other constitutional diseases attended with degeneration. All measures which tend to invigorate the system, to give tone to the heart, and improve the condition of the blood, should be resorted to. Amongst the remedies for internal administration the most useful is iron. It should be given in small and continued doses. Quinine is valuable, as are also the various bitters and other remedies for dyspepsia, from which emphysematous patients often suffer. Cod-liver oil is very useful in some cases. Strychnia has been recommended with the view of improving the tone of the muscular fibres of the bronchial tubes. It has not been found useful in this respect; nor need we wonder at this, for the disease is one primarily of the air-sacs, and not of the bronchial tubes, and if the muscles of the latter are secondarily affected, it is rather with spasm than paralysis. Small doses of strychnia given for dyspeptic symptoms may be useful.

Breathing condensed air has been strongly advocated, and no doubt it has afforded in some cases decided temporary relief, but no permanently good effects have apparently ever followed its use. *See* AIR, Therapeutics of.

The regulation of the diet, and the general management are most important. The diet should be nourishing, and a moderate amount of stimulants should be allowed. The food should be easy of digestion, and nutritious in proportion to its bulk. The stomach should never be overloaded, as that condition will give rise to dyspnœa. Errors of diet must be avoided, and the functions of the bowels should be carefully regulated. Another point is to give the lungs as little work as possible, and to let the patient breathe a pure air. All violent exercise, or physical exertion of any kind, must be strictly prohibited; moderate exercise is, however, to be recommended. Moderate walking, yachting, carriage exercise, riding at a quiet pace, and on an easy horse, are important adjuvants in the general treatment of emphysema. The condition of the skin should be carefully looked to; warm clothing should be constantly worn; and the greatest care should be taken to ward off bronchial inflammation. Residence during the winter in a warm and dry climate is to be recommended.

2. *Treatment of secondary affections.*—Amongst the most important of the affections secondary to emphysema is bronchitis. No depressing measures should be used in this disease, but such as will promote expectoration, and check the secretion of the bronchial tubes, if, as is very frequently the case, this be excessive. Ammonia, the various stimulating expectorants, and iron are the most valuable remedies, together with moderate counter-irritation (*see* BRONCHI, Diseases of). The dyspnœa attendant on emphysema admits only of palliative treatment, but is often greatly improved by the observance of the rules laid down for the general management of the disease. The dyspnœa is always increased by the presence of bronchitis; by the stomach or bowels being overloaded; and by the general over-distension of the venous system, which necessarily ensues as a consequence of the impediment to the flow of blood through the lungs. Care should be taken to prevent any flatulent distension of the stomach or intestines, and to keep up a good action of the bowels, liver, and kidneys. For the relief of the asthma which frequently exists in connection with emphysema, full doses of iodide of potassium are often useful. Stramonium may also be smoked, and other measures beneficial in ordinary spasmodic asthma may be tried (*see* ASTHMA). In reference to the treatment of the dropsical symptoms, which follow as a secondary consequence of emphysema, the reader is referred to the article DROPSY.

B. Interlobular Emphysema.—This condition, in which the excess of air in the lungs is contained not in the alveoli but in the connective tissue between the lobules, is described under the head of EMPHYSEMA, SUBCUTANEOUS.

A. T. H. WATERS.

LUNGS, Gangrene of.—SYNON.: Fr. *Gangrène du Poumon*; Ger. *Lungenbrand.*

DEFINITION.—Death of a portion of the substance of the lungs.

Gangrene of the lungs is of two kinds, namely: (1) *diffused*, in which the whole of one lobe or lung is affected; and (2) *circumscribed*, in which a portion only of a lobe undergoes gangrenous change.

ÆTIOLOGY.—Gangrene is sometimes a result of acute pneumonia. It has been known to follow the inhalation of noxious gases. When it occurs independently of these causes, it is an evidence either of extreme constitutional depression, or of pressure interfering with the circulation and nutrition of the lung. An aneurism or mediastinal growth, pressing upon the main arterial, venous, and nervous trunks at the root of the lung, is perhaps the most common cause of diffused gangrene; whereas the more circumscribed form of the disease is a sequela of acute and limited pneumonia, cancer, or rapid phthisis in a debilitated subject. In pulmonary apoplexy gangrenous change sometimes occurs, the gangrene being limited to the portion of lung involved in the originating extravasation of blood. Pneumonia caused by a foreign body in the air-passages is apt to run on to gangrene. The diffused gangrene that occurs in drunkards and lunatics, in asthenic fever, measles, small-pox, and typhus, evidences excessive nerve-prostration and loss of nutritive power. In children gangrene of lung sometimes follows cancrum oris, as well as the eruptive fevers.

Anatomical Characters.—The colour of a gangrenous lung is dark, dirty olive, or greenish brown. It is moist or wet; and either of the consistence of engorged lung, or softer and more diffluent. The odour is that of external gangrene or decomposed flesh, and is distinctive during life, rendering the room in which the patient lies horribly offensive. When scattered patches of gangrene occur, there is often in one part a solid mass of greenish lung-tissue, and in another a central sloughy or gangrenous cavity, surrounded by a broad rim of soft, infiltrated lung. The seat of circumscribed gangrene is usually the periphery of the lung, and the lower lobes. If a bronchus open into the gangrenous patch, inflammation of the bronchial membrane is set up. In rare cases the pleura is involved, and pyo-pneumothorax induced. Sometimes the pulmonary arteries are found plugged, and more often the bronchial arteries. In those rare cases in which recovery takes place interstitial pneumonia is set up, leading to encapsulation of the gangrenous spot; the sloughs are ejected; and cicatrisation follows, as in pulmonary abscess.

In diffuse gangrene the whole of one lung is sometimes involved. The pulmonary tissue is then converted into a black, putrid substance, saturated with blackish purulent fluid; or the gangrenous part merges gradually into œdematous or hepatised tissue.

Embolism, arising from the introduction of putrid matter into the veins, and leading to abscess in various organs, may follow either form of gangrene. Secondary gangrenous change is frequently met with in other parts of the same or of the opposite lung.

Symptoms.—It is seldom possible to diagnose gangrene of the lung until the purulent discharge reaches a bronchus and is ejected. Then the sputa are found to soon separate into layers—a frothy superficial one, a liquid middle, and a lower sediment. The smell of the sputa and breath is pathognomonic. The dyspnœa and prostration are usually great. The physical signs are those of softening and excavation, percussion being either dull or tympanitic, and loose crepitation being soon replaced by gurgling and perhaps amphoric breathing. The passage of the circumscribed into the diffused form may be traced by watching the physical signs.

Diagnosis. — Suppurative ulceration of the bronchial cartilages gives rise to great fœtor of breath. Sometimes a gangrenous odour in the breath occurs when the putrefactive change is limited to the secretions, the lungs being free; and it is present also in pyo-pneumothorax with internal fistula. These several diseases must be excluded by a careful estimation of the history and the physical signs.

Prognosis. — The prognosis of pulmonary gangrene is hopeless in the diffused form; and should be made very cautiously, even when the symptoms or signs point to a limitation of the mischief.

Treatment.—Besides the general treatment which co-existing disease may require, special attention must be given to the removal of the gangrenous odour from the atmosphere of the room, from the sputa, and from the patient, who is apt to exhale from the skin a similar odour to that given off in the breath. Sulphurous acid, carbolic acid, or chloride of lime fulfil the first indication; Condy's fluid the second; and this may also, when diluted, form a useful wash, gargle, or drink. The sulpho-carbolates, when administered freely, have a distinct value in removing the fœtor from the skin, and making the patient less unapproachable.

When a gangrenous abscess of the lung exists, and it is evident that the passage of fœtid matters through the bronchi is setting up dangerous irritation, leading to exhausting discharge, or threatening to poison the system, the question of tapping the gangrenous cavity should be entertained. The introduction of a drainage-tube sometimes affords immediate relief in such cases; the fœtor of breath ceases; the offensive secretions, being no longer locked up in the lung, lose their putrescent character; and the relief to the constitution is great. An accurate diagnosis is in such cases essential, the danger of the operation being greatly enhanced if the abscess is at a distance from the chest-wall, and if the lung is not adherent to the costal pleura. The operation should only be performed when there is but little prospect of recovery without it, but must not be delayed until the vital powers are too reduced to allow of ultimate convalescence.

Every attempt must be made to support the strength by nourishing food and stimulants: bark and ammonia, quinine and acids, iron and cod-liver oil being indicated. The inhalation of creasote or carbolic acid in spray may be tried, or of turpentine given off from hot water.

E. Symes Thompson.

LUNGS, Hæmorrhage into.—Synon.: Extravasation of blood into the lungs; Pulmonary apoplexy; Fr. *Hémorrhagie du poumon*; Ger. *Lungenblutung*.

Ætiology and Pathology.—In the article Hæmoptysis will be found enumerated the causes which lead to pulmonary hæmorrhage. In the present article only those extravasations of blood into the lungs are included which do not depend upon direct injury to the organ, or upon exposure and rupture of vessels in the course of destructive disease affecting it. Hæmorrhage into the substance of the lungs may be *diffuse*, *punctiform*, or *circumscribed*.

(1) *Diffuse pulmonary apoplexy.*—The diffuse extravasation of blood into the lungs is an extremely rare condition. Some cases have been recorded, however, in which it has arisen from primary disease of a branch of the pulmonary artery. The lung-tissue is broken down by the hæmorrhage into it; and the patient soon succumbs.

(2) *Punctiform hæmorrhage*, and (3) *circumscribed* or *nodular pulmonary apoplexy*, are not of uncommon occurrence, and are attendant upon the same morbid conditions of the lung. Mitral disease of the heart, mitral stenosis especially, but also mitral regurgitation, are the chief remote causes of these two forms of pulmonary apoplexy.

In certain purpuric states of system, which we need not here specify, punctiform hæmorrhage in the lungs is possible; the purpura much more frequently affects, however, the pleural surface or bronchial mucous membrane. Mechanical congestion of the lungs from the above-mentioned forms of heart-disease is by far the most common condition upon which this minute and interstitial form of hæmorrhage supervenes, giving rise to no additional symptoms, but causing considerable and peculiar pigmentation of the lung. The interstitially thickened lungs acquire a brownish tint, from the absorption of the blood-spots, leaving hæmatin behind, and the appearance has given rise to the term *brown induration* of the lungs. *See* LUNGS, Brown Induration of.

Nodular or circumscribed pulmonary apoplexy is often associated with the petechial hæmorrhage just described, and like it mostly supervenes upon the mechanical congestion of the lungs arising from heart-disease. There are two ways in which this form of hæmorrhage may be produced. The first way is by rupture of capillaries or small veins under the heightened pressure of the pulmonary circulation. An effusion of blood thus occurs, which fills up one or more lobules, and coagulates to form the dark firm consolidations so characteristic of the lesion. Or a branch of the pulmonary artery becomes obstructed by an embolus, for instance, by a fragment of coagulum conveyed from the right auricle, or from one of the systemic veins; and its territory becomes at once filled with blood, in the following manner. The pulmonary arterial vessels do not communicate with one another, each branching separately to its capillary distribution; the pulmonary veins, on the contrary, inosculate freely, and, moreover, are not provided with valves. Thus when the onflow of blood is arrested through the obstructed branch, venous regurgitation through the capillaries from collateral pressure fills up the precluded vascular area with stagnating blood, and the intra-alveolar tissues become speedily occupied with its effused corpuscles. In some cases the vessel may not at first be accurately closed by the embolus; the onward current is then retarded instead of being quite arrested; the mechanism is, however, practically the same.

ANATOMICAL CHARACTERS.—A lung, the seat of this form of hæmorrhage, is usually toughened and heavy. Some hard, and more or less square, flat surfaces may be felt and seen raised above the general surface of the lung, which has shrunk below their level. The pleura covering such patches is darkened in colour, and presents flakes or granulations of lymph, impairing its translucency and smoothness. On making a vertical section through one of the surfaces, it is found to form the base of a more or less conical mass, which has a firm damson-cheese-like section, and is sharply defined from the surrounding tissue. In its axis is seen a branch of the pulmonary artery, occupied by partially altered clot. There is usually some staining of the pulmonary tissue immediately surrounding the apoplectic nodule, from imbibition. Such hæmorrhagic nodules vary greatly in number and size; there are usually several in each lung, of about the size of a walnut; but one may occupy a whole lobe. They also vary in appearance according to the date of their occurrence; their colour, at first that of dark blood-clot, passes through pale chocolate or catechu tint to yellowish red or pale yellow, as the colouring matter becomes gradually absorbed. The whole extravasation may be gradually and completely absorbed, leaving the restored lung but little damaged; or a shrunken fibrinous deposition or blood-cyst, with surrounding induration, may mark the site of former hæmorrhage. It should be added that these extravasations, although generally near the pleural surface of the lung, are not always so, but may occur deeply in its substance.

SYMPTOMS.—Amidst the distressing symptoms which are attendant upon the conditions leading to pulmonary apoplexy, it would be difficult to single out any diagnostic of this special lesion. An exacerbation of dyspnœa already terrible enough, or a sudden failure of pulse, may perhaps be noted. Dark scanty hæmoptysis is, however, the pathognomonic sign, the frothy mucous expectoration containing some streaks, or small clots of dark coagulated blood. Some circumscribed patches of dulness, with bronchial breathing and neighbouring crepitation, may be made out, especially in the mammary and mid-axillary regions.

PROGNOSIS AND TREATMENT.—These lesions are among those which close the scene in the heart-disease to which they are accessory; they are therefore irremediable. Sometimes when, from any cause, their occurrence appears to have been hurried forward; when the lividity is great, the dyspnœa urgent, and yet the disease is not of long duration; wet-cupping or bleeding from the arm will certainly give great temporary relief, and perhaps avert immediate danger.

R. DOUGLAS POWELL.

LUNGS, Hydatids of.—SYNON.: Fr. *Kystes hydatiques du poumon*; Ger. *Lungenechinococcus.*

DEFINITION.—A disease due to the presence of hydatids in the lungs.

ÆTIOLOGY.—Hydatid cysts in the lungs rarely occur in this country as a primary disease of the lung, but they are not unfrequently met with as an extension of disease from the liver.

The general causes of hydatid disease are elsewhere discussed, but the circumstances which determine the localisation of the hydatid are not clearly ascertained. In Australia, where the affection is very common, it is met with sometimes in the lung without any other organs being affected; although in many cases in which the lungs are diseased, evidence of the existence of the same disorder elsewhere is not wanting. In 100 cases, the liver was the organ affected in 70, the lung in 12. The great prevalence of the disease in Melbourne is said to be due to drinking from water-holes frequented by sheep, and from eating watercress or uncooked salads containing the ova of the parasite.

Anatomical Characters.—The general anatomy of hydatid disease will be found in the article describing this parasite (*see* Hydatids). Single sacs of acephalocysts are by far most usual, varying in size from a pigeon's egg to a man's fist. Sometimes the upper, and sometimes the lower lobes are the seat of the cysts. They are developed in the interstitial pulmonary tissue; as growth proceeds, the neighbouring parenchyma is converted into fibro-cellular tissue, and undergoes obsolescence. The parent sac, containing the echinococci, is adherent to the surrounding tissue.

If the parent sac be destroyed by inflammation and consequent suppuration, a communication is established between the cavity and the bronchi, through which the daughter-cysts may be ejected; just as in more common instances they may escape from the liver after perforating the diaphragm and lung. Not unfrequently the pulmonary sac communicates with a similar sac in the liver. It is natural to infer in such cases that the disease originated in the liver. Indeed, it has been stated that primary hydatid of the lung is unknown.

Symptoms and Physical Signs.—Hydatids may exist in the lung for a considerable time without giving rise to any noticeable symptoms; but as the tumour enlarges, and presses upon the surrounding tissues, hæmoptysis occurs, as also bronchitis, pneumonia, or even gangrene. Sometimes the cysts perforate the pleura and cause pneumothorax, or make their way through the diaphragm into the abdominal cavity. The more usual course is the converse of this, namely, that a hydatid of the liver exists perhaps for years, causes abdominal distension, and eventually discharges its contents through the diaphragm into a bronchus; then expectoration of blood occurs, with gooseberry-like skins, varying in size from a nut (in which case the cyst may be expelled whole) to an orange (in which case the sacs are shrivelled and empty), causing strangling and suffocating cough during expulsion.

If the site of the tumour be superficial, altered breath-sounds and percussion-note may be observed, but if it be deeply seated, the physical signs may escape detection. If bronchitis or pneumonia be set up, the signs and symptoms of these disorders mask those of the originating disease. Often the symptoms are like those of rapid phthisis, namely, cough, muco-purulent expectoration, hæmoptysis, night-sweats, and emaciation. The meaning of these symptoms is apparently confirmed by the physical signs, namely, dulness on percussion; absence of breath-sounds, or prolonged expiratory murmur; and, when the cysts burst, gurgling and pectoriloquy. Unless the daughter-cysts or hooklets are expectorated, there is nothing to point unmistakeably to the nature of the disease. When perforation of the diaphragm occurs, hepatic symptoms or those of pleurisy occur. The patient looks anxious; the features are collapsed; the skin is clammy and livid; the extremities are cold: incessant paroxysmal cough occurs, with vomiting; and by degrees sallowness and jaundice make their appearance. Symptoms of acute pneumonia may occur—of consolidation, followed by excavation; the expectoration being at first rusty, then bile-tinged, muco-purulent, and fœtid, and containing, besides shreds of lung-tissue, entire cysts or portions of them.

Diagnosis.—It may be difficult to distinguish a large hydatid cyst from pleuritic effusion, as the lung may be displaced, the chest bulges, and the intercostal spaces become prominent and fluctuating. The rounded outline of the dull space, the absence of acute symptoms, the history of gradual onset, the absence of ægophony, and of alteration of physical signs on change of posture, will guide the decision; and an exploratory puncture, which gives exit to a clear saline, non-albuminous fluid, containing possibly hooklets or fragments of cysts, will confirm the diagnosis. The conduction of the heart-sounds and impulse, and the tense unyielding condition of the bulged side on palpation, may lead to the suspicion of mediastinal tumour; but in the case of hydatids there is seldom any visible venous engorgement, or laryngeal or œsophageal pressure-sign, as in aneurismal or other mediastinal growths. There is, moreover, generally a freedom from cachexia or constitutional disturbance. In circumscribed abscess the neighbouring lung is rarely so free from disease as in hydatid.

Prognosis.—Although the symptoms may be so severe as to threaten immediate death from suffocation, recovery occurs in at least half the cases in which hydatid disease begins in the lung, and one-third of those in which it spreads from the liver. If the cyst is allowed to burst of itself, recovery takes place in from 30 to 40 per cent. of cases. But the mortality is greatly reduced by early tapping.

Treatment.—Palliative treatment must be directed mainly to the mitigation of pain, and other urgent symptoms. Curative treatment consists in destroying the vitality of the cyst. If the fluid contents are drawn off, or allowed to escape, the death of the hydatid may occur, or inflammatory action, leading to suppuration. If the fluid re-collect and pressure-signs recur, iodine or other stimulating fluid may be injected. The iodide or bromide of potassium with kamela have gained among Australian physicians reputation in these cases, especially when combined with the use of the trochar.

E. Symes Thompson.

LUNGS, Hyperæmia of.—Synon.: Congestion of the Lungs; Fr. *Hypérémie du poumon*; Ger. *Lungenhyperämie*.

Definition.—Excess of blood in the lungs, whether local or general.

Varieties.—Pulmonary hyperæmia may be **active, passive, or obstructive.**

The morbid appearances and symptoms are different in these three kinds of hyperæmia, and they may, therefore, be best considered separately.

A. **Active Hyperæmia of the Lungs.**—Synon.: Active congestion; active affluxion.

Definition.—A determination of blood to the lungs.

Anatomical Characters.—Active hyperæmia or congestion may affect any portion of the lung, which remains crepitant and little changed, save that it is more crimson in colour, and contains slightly more blood than natural. The condition is indeed rather a vital or physiological one; and, as in active hyperæmia of the skin, may present no *post-mortem* appearances. On section, however, the lung usually exudes some frothy serum, tinged with blood; and sometimes, especially when the hyperæmia is local and arises from collateral stress of circulation, there is found hæmorrhage into the lung. The mucous membrane of the bronchial tubes is minutely injected, or it may be quite natural in appearance.

Ætiology.—The causes which produce inflammation of the lung will also produce active hyperæmia, namely, cold, irritation, adjacent inflammation, &c. Increased action of the heart during violent effort or excitement, whether from mental emotion or from drink, will produce the same effect. It is said that the pressure of blood in the pulmonary artery increases more rapidly than that in the aorta during exertion (Colin). Hæmoptysis from pulmonary hyperæmia is commonly produced by the excessive imbibition of stimulants. Predisposition, either hereditary or in consequence of present disease, renders these last-named causes much more readily operative. Obstruction to the passage of blood through one portion of the pulmonary system of vessels, for example, by embolism, or by destruction of capillaries, will cause increased collateral activity of circulation. Sudden suppression of menstruation may cause active determination of blood to the lungs. Sudden diminution of the atmospheric pressure within the chest, as during violent inspiratory effort, whilst the trachea is closed, for instance, in croup, laryngismus, or whooping-cough, may cause active determination of blood to the lungs.

Effects.—Several important effects may be produced by active hyperæmia of the lungs. Hæmorrhage is rarely extensive, unless there be attendant organic lesion present. Active hyperæmia of the lung constitutes the first stage of exudative or croupous pneumonia, with fibrinous exudation into the air-cells. Pulmonary œdema may result from the excessive blood-pressure, the serum exuded being frothy and blood-tinged. Vesicular catarrh is not so distinctly a consequence of hyperæmia, with which, however, it is often associated.

Symptoms.—The symptoms of active pulmonary hyperæmia are dyspnœa; more or less pyrexia; cough; and sometimes copious hæmoptysis, in which case precedent organic disease must be suspected. The rusty sputa of the first stage of pneumonia is that most typical of pulmonary hyperæmia.

Diagnosis.—The diagnosis would rest mainly upon the suddenness of attack, and the evidence of a sufficient determining cause, with or without predisposition.

Prognosis.—Active hyperæmia, save in some cases of collateral afflux, is necessarily a transient affection, subsiding in a few hours, or passing on to inflammation.

Treatment.—The first point in the treatment of this condition is to secure absolute rest in bed, with silence, and removal of all causes of excitement. Derivatives; mustard or linseed poultices to the chest; perhaps cupping, or even blood-letting; warmth to the extremities; saline purgatives; and a low diet, without stimulants, may all be employed. The special cause of the hyperæmia should be treated. As a rule astringent medicines should be avoided. Digitalis is useful to calm the circulation, especially after excitement from alcohol. If the pyrexia be very marked, pneumonia may be expected, and saline diaphoretics are especially indicated.

B. **Passive Hyperæmia of the Lungs.**—Synon.: Passive or hypostatic congestion.

Definition. — An incomplete stagnation of blood in the lungs.

Ætiology.—Passive or hypostatic congestion of the lung is a condition of hyperæmia affecting by preference the most depending parts of the lung. Failure of heart-power, an inability to propel the blood clear through the pulmonary capillaries, is the chief cause of this condition. In states of exhaustion from low fevers, especially typhus and typhoid; after severe surgical operations; in extreme old age; or towards the end of prostrating illness, this failure of heart-power, and consequent stagnation of blood in the lower parts of the lung, usually the bases, is apt to supervene, and is one of the common modes of death. An altered condition of the blood, so as to render its passage through the capillaries more difficult, is also stated to be a cause of this form of congestion of the lungs and of other organs. In uræmic and icteric conditions, and in the febrile state, the blood does not pass through the capillaries with the same facility as in health, and hypostatic congestions are more apt to occur. Finally, when the vessels have lost their tone, and the heart fails in power, gravitation exercises its influence in attracting the blood to the most dependent parts.

Anatomical Characters.—Passive hyperæmia almost always affects the bases of both lungs, although often not in an equal degree, the difference depending mainly upon the position of the patient during the last days of life. The affected lung is dark-coloured, and engorged with dark blood. Its tissue is more or less deeply stained with blood, and is less crepitant than natural, yielding also more readily than natural under the pressure of the finger. If thoroughly washed, however, in a gentle stream of water, the lung-texture will be found to be but little altered. This condition very readily passes into a low form of pneumonia, and thus portions of the lung may be found consolidated, having much the appearance and consistence on section of a congested spleen (splenification, hypostatic pneumonia). The bronchial tubes and pleura are affected by *post-mortem* staining.

Symptoms.—The symptoms of this form of congestion of the lungs are lividity, especially of the lips and extremities; and quickened, shallow breathing; superadded to those of extreme prostration. Dulness on percussion, with enfeebled breathing and moist crepitant *râle*, are found over the bases of both lungs, but in greatest extent on that side to which the patient has been inclining.

Treatment.—Passive hyperæmia of the lungs being never the primary affection, and always being a sign of failing power, its treatment consists in vigorously supporting the patient by alcoholic stimulants frequently administered, with nutritious food. Nutritive enemata are often of great value. In all exhausting diseases this condition should be anticipated, and warded off if possible by timely support and stimulants, and above all by frequently turning the patient from one side to the other, thus calling in the aid, rather than permitting the hindrance, of gravitation to the circulation through the lungs. Of medicines, ammonia, ether, bark and quinine are of the greatest value; and musk, sumbul, and lavender may be useful adjuncts.

C. Obstructive Hyperæmia of the Lungs.

Synon.: Mechanical congestion.

Definition.—Hyperæmia from obstruction to the escape of blood from the lungs. Mechanical congestion of the lungs is a condition differing essentially from either of the two preceding.

Ætiology.—The origin of this form of hyperæmia is purely secondary and mechanical, and is included in that of the primary disease. The obstruction may be at the mitral valve, as in mitral stenosis or regurgitation; or, again, the obstruction may be at the left ventricle, when this cavity is dilated and imperfectly emptied, as in the advanced stages of constrictive or regurgitant aortic disease. Whether there be an absolute narrowing of the blood-channel between the pulmonary and systemic circulations, that is, at the mitral orifice or at the commencement of the aorta; or whether, from enlargement of the mitral orifice or from disease or injury of its valve, regurgitation be permitted, so that each contraction of the right ventricle is met and opposed, more or less, by a counter rush of blood from the left ventricle—in any case, and still more in the combination of two or more of these causes, it is clear that the pulmonary circulation can only go on at an increased pressure by the contraction of the right ventricle becoming more vigorous; and that hyperæmia must result from the damming back of the blood through the pulmonary veins.

Of the causes named, mitral constriction is that which leads most simply to obstructive hyperæmia of the lungs.

Anatomical Characters.—It is obvious that obstructive hyperæmia is of general distribution, affecting the whole of both lungs. The result of the heightened blood-pressure from increased force of injection into the lungs, to overcome an impediment to the escape of blood from them, is most felt in the pulmonary capillaries. These capillaries gradually become lengthened, tortuous, and dilated even to three times their normal dimensions (Rindfleisch). From chronic engorgement of the lungs, the nuclei of the interlobular areolar tissue and of the connective tissue surrounding the minute vessels and bronchi, and pervading the parenchyma, proliferate. The thickened and tortuous capillaries intrude upon the air-spaces; and the elasticity of the lungs being also impaired, their vital capacity is diminished. It is stated that the muscular fibres, which proceed from the bronchial terminations to form loops upon and encircle the infundibula, become hypertrophied (Rindfleisch), thus, perhaps, compensating for a diminution in the more mechanical elastic property of the lung. Sometimes minute hæmorrhages take place into the parenchyma of the lung; sometimes larger escapes of blood fill the alveoli of circumscribed patches (pulmonary apoplexy.) The total result of the intimate changes described, is an uniform increase in the size and weight of the lungs, with an increased density and toughness. On section the lungs are found to be more pigmented and solid-looking than natural, sometimes of a brownish hue (brown induration); they are, however, crepitant throughout, except here and there, where they may present the firm, dark, damson-cheese-like section, fading to brown-red, of recent pulmonary apoplexy. There may be some œdema present. The pulmonary arteries and veins are enlarged and congested; and the bronchial mucous membrane is usually the seat of chronic catarrh. Patches of atheroma are frequently to be seen in the larger branches of the pulmonary artery.

Symptoms.—Dyspnœa and cough, both brought on or increased by effort, with palpitation, and oppression or tightness, usually referred to the epigastrium, are the most constant symptoms of obstructive hyperæmia of the lungs. Patients suffering from this condition have repeated attacks of bronchial catarrh, and hæmoptysis is of common occurrence. The hæmoptysis may be considerable, but usually the expectoration is streaked with blood or contains small dark coagula.

This form of hyperæmia commonly occurs before middle life, during the usual period of mitral heart-disease. The signs of heart-disease, and most often of constriction of the mitral valve, are present. The subjects of this disease are often undersized and badly nourished; the pigeon-breasted type of chest being common, especially in those cases in which the disease manifests itself early in life. Small, frequent pulse; more or less lividity of lips; and other signs and symptoms of the cardiac disease, of which the pulmonary condition is the consequence, are to be observed. A fine inspiratory crepitant *râle* over the lungs may be heard. During the repeated bronchial catarrhs, with increased pulmonary hyperæmia, to which such patients are especially prone, all symptoms are much aggravated.

Diagnosis.—The existence of obstructive heart-disease suggests the presence of corresponding hyperæmia of the lungs. The fine crepitant *râle* and the hæmorrhagic symptoms and signs more positively point in the same direction.

Prognosis.—The prognosis rests chiefly upon the heart-condition present. Increasing frequency of catarrhal complications, and especially of hæmoptysis, shows the turning of the balance against the patient. The condition may in favourable cases continue for years, especially when dependent upon simple constriction of the mitral valve.

TREATMENT.—The treatment is essentially that of the heart-disease; with the avoidance of all causes which hasten respiration, and which tend to produce catarrhs, to which these patients are so especially prone. R. DOUGLAS POWELL.

LUNGS, Hypertrophy of.—DEFINITION.—Enlargement of the lungs, with increased functional power. A condition only clinically met with as a compensatory affection of one lung, or of a portion of one lung, to make up for more or less loss of pulmonary tissue by disease.

ÆTIOLOGY AND PATHOLOGY.—The process by which hypertrophy of the lung comes about is almost a mechanical one. Destructive disease having removed a large portion of one lung, or permanent collapse or blocking of such portion having occurred from any cause, the diminished power of the affected lung to occupy its apportioned space in the chest-cavity during inspiration, is compensated for by an increased expansion of the healthy lung, together with a certain recession of the softer parts of the chest-wall on the affected side. The increased expansion of the healthy lung encourages an increased afflux of blood, which is at the same time determined through it by the partial obstruction to circulation through the diseased lung. These changes taking place gradually, the increased function and increased afflux of blood are, in accordance with our experience of similar conditions in other parts, attended with increased nutrition of the lung, and its true hypertrophy is thus little by little established.

Hypertrophy of the lung, therefore, is not a diseased condition, but an excessive development in consequence of injury to some other portion of the same or of the opposite lung. Its occurrence may be best noted during the gradual absorption or removal of a pleural effusion, which has long compressed the opposite lung. Any disease, however, which, after destroying or placing in abeyance a certain proportion of one lung, becomes arrested, tends to cause hypertrophous development of the remaining lung. Chronic pneumonia, cirrhosis, arrested phthisis, and atelectasis in the child, are the chief diseases of the kind. While disease is actively progressive the conditions present—namely, fever, anorexia, and pleuritic pains, are unfavourable to the extra development of the sound lung, but when these unfavourable conditions subside, the hypertrophy proceeds with great rapidity, and may be established in a very few months. The effect of the rarefied air of mountainous regions is to develop the natural capacity and function of the lungs.

ANATOMICAL CHARACTERS.—An hypertrophied lung is larger and heavier than natural; and its anterior and inferior margins are thick and rounded, and are found to extend beyond their normal thoracic limits both laterally and inferiorly. The texture of the lung is firmer and more resilient than usual; and it is plentifully supplied with blood. The air-cells are slightly enlarged, but not obviously dilated; and on microscopic examination the nutrition of the alveolar walls and capillaries is found to be perfect; there being neither the thinning of the alveoli, nor the excessive growth of fibrous tissue met with at different stages of so-called 'hypertrophous emphysema.' Nor are the capillaries tortuous and dilated as in the indurative 'hypertrophy' of the lung from heart-disease.

Extent of lung affected.—We have considered, for the sake of simplicity of description, those cases in which the whole of one lung is hypertrophied, and such cases are very common. But a single lobe of a lung may become hypertrophied, the seat of the hypertrophy depending upon the seat of the disease to which it is compensatory. But, except when the pulmonary destruction is limited and circumscribed, other conditions come into play, and we are more apt to get emphysema than hypertrophy. It may be said then that hypertrophy of the lung is (at least so far as we can appreciate it clinically) a one-sided affection, except in those cases in which it has been occasioned by some general external cause, as rarefied air.

PHYSICAL SIGNS.—The side on which is the hypertrophied lung is expanded, both relatively (the opposite side being usually flattened and contracted) and absolutely. The nipple-level is raised. There is increased percussion-resonance over the side, extending across the median line, so that sometimes the line of resonance indicating the inner margin of the enlarged lung will reach the mid-clavicular vertical line of the opposite side. The lower limits of resonance are also extended in front and behind. The respiratory murmur has that peculiar coarse vesicular character, with somewhat prolonged expiration, which is known as 'puerile' or 'exaggerated' respiration. The heart is more or less displaced towards the contracted side, and the displacement is often apparently increased by the heart becoming on the one side covered by the expanded lung, and on the other side unduly exposed by the recession of the diseased lung. This is especially the case when the hypertrophy affects the left lung. There are no morbid sounds heard over the enlarged lung unless (as in many cases of phthisis) it becomes or has been affected by disease. With the expansion of the lung the general symptoms improve, and the dyspnœa lessens.

DIAGNOSIS.—The diagnosis has to be made between hypertrophy of the lung; hypertrophous emphysema; and mere dilatation. The unilateralness of the hypertrophy; its arising secondarily to some disablement of the opposite lung; the absence of precedent or present general bronchitis or asthma; together with the observation of its occurrence being commensurate with improvement in the condition of the patient, are the main features distinguishing it from large-lunged or hypertrophous emphysema. Nor could the puerile breathing of hypertrophy be easily confounded with the short, weak, or inaudible inspiration, and wheezy prolonged expiration of emphysema. In persons of broken constitution, with contractile disease of one lung, the opposite lung may become dilated and assume the shape and dimensions of hypertrophy; but the breathing of the patient does not improve, the respiratory sounds are enfeebled, and it is clear that the condition present is one of emphysema rather than true hypertrophy.

PROGNOSIS.—The prognosis is always ***pro*** *tanto* favourable to the patient, the hypertrophy being an important element of his recovery.

Treatment.—Compensatory hypertrophy of the lung is a condition carefully to be encouraged, when all active symptoms attendant upon the original disease are past. Mild courses of calisthenics, and a temporary sojourn at some elevated health-resort during the warm season, are most valuable, if not attempted too soon. Abundance of fresh air throughout the year, with the careful avoidance of fresh catarrhs, such as may be obtained by spending a winter and spring or two seasons at the South of France, in Italy, or at Madeira; or a well-planned sea-voyage to Australia, are excellent ways of spending months of convalescence. A generous unstimulating diet is indicated, and tonic remedies and cod-liver oil are useful, more especially in the early stages of the wished-for hypertrophic development. R. Douglas Powell.

LUNGS, Induration of.—*See* Lungs, Inflammation of.

LUNGS, Infarction of.—*See* Lungs, Hæmorrhage into.

LUNGS, Infiltrations of.—Certain morbid formations in the lung assume the arrangement of an infiltration, the tissues, especially the interlobular cellular tissue, being permeated with the morbid material. In some instances it involves even the epithelial cells. The best examples of this arrangement are observed in connection with certain cases of the fibroid change; in infiltrated cancer; and in those forms of pulmonary disease where the lung-tissue is the seat of a deposit of substances introduced from without, being inhaled in various occupations, such as particles of carbonaceous matter and coal-dust, stone-grit, iron-filings, particles of cotton or wool, and other materials. Albuminoid disease, and some forms of pigmentary change also present a kind of infiltrated arrangement. These conditions need not be further considered here, as they are discussed in their several appropriate articles.

Frederick T. Roberts.

LUNGS, Inflammation of.—Synon.: Pneumonia; Fr. *Pneumonie*; Ger. *Lungenentzündung.*

Definition.—The term 'pneumonia' has been employed simply to designate inflammation of the lung-tissue. Inflammatory processes in the lungs, however, occur under such diverse circumstances, and are accompanied by such diverse clinical phenomena and histological changes, that 'pneumonia' used in this sense includes widely different diseases.

Varieties.—Pneumonias are divisible into the following varieties:—A. **Acute Pneumonia**; B. **Secondary Pneumonias**; C. **Broncho, Catarrhal, or Lobular Pneumonia**; and D. **Chronic or Interstitial Pneumonia.** In addition to these there are those intense and concentrated forms of pulmonary inflammation which lead to the formation of *abscess.*

There are certain other forms of lung-consolidation which have sometimes been described as pneumonic, but which are really, for the most part, non-inflammatory in their nature, and will, therefore, be only briefly alluded to in the present article. These are:—(1) that condition of collapse and hyperæmia, mainly due to weak inspiratory power, feeble circulation, and gravitation, which is so common in the more dependent portion of the lungs in many acute and chronic diseases (*see* Hypostasis). (2) Consolidations of the lung resulting from mechanical congestion and embolism, such as are met with in certain diseases of the heart, &c. *See* Lungs, Hyperæmia of.

The several varieties of pulmonary inflammation must now be considered separately in the order just indicated.

A. **Acute Pneumonia.**—Synon.: Fr. *Pneumonie aiguë*; Ger. *Croupöse Pneumonie.*—This is pneumonia *par excellence.* It is the disease to which some would be inclined to restrict the application of the term. It is often termed *croupous* pneumonia, from the supposed resemblance of the histological process to that of croup. It is also known as *lobar* pneumonia, inasmuch as a large area of the lung is usually involved in the inflammation.

Definition.—Pneumonia may be described generally as an acute disease, characterised clinically by sudden onset, severe febrile symptoms, cough, expectoration, and dyspnœa; by the physical signs of pulmonary consolidation; and by a rapid abatement of the general symptoms between the fourth and tenth days. Anatomically it is characterised by an acute inflammation of the lung-tissue, and by the accumulation of the inflammatory products within the alveoli, which products consist, in the main, of a fibrinous exudation and leucocytes.

Ætiology.—*Atmospheric influences.*—Conditions of weather and climate are probably the most important of all known agencies in the causation of pneumonia. The influence of cold and damp in increasing the liability to acute inflammatory diseases of the chest is well known. This influence is marked in pneumonia, although to a much less extent than in bronchitis. Pneumonia is more common in temperate climates than in those regions which are characterised by great heat or extreme cold. Climates and seasons which are liable to sudden changes of temperature, and winds from the north and north-east, appear to be especially favourable to this disease.

Age.—Acute pneumonia is met with between the ages of one and five years. Here, however, it is liable to be confounded with broncho-pneumonia and with collapse of the lung, so that the results of statistics are less reliable at this than in the subsequent periods of life. It may be stated notwithstanding, that acute pneumonia is less common during infancy than has been generally supposed, and that amongst the pneumonias which are so frequent during this period of life the broncho-catarrhal forms preponderate. After the age of five years the liability to pneumonia diminishes, but it again becomes exceedingly frequent between the ages of twenty and forty, during which period the liability to the disease reaches its maximum. It is also quite common in old age.

Sex.—In adults more males than females suffer. This is probably owing to the former being more exposed to atmospheric influences. In early life this difference does not obtain.

Social position, &c.—Pneumonia is more common amongst the poor and badly fed, and amongst those whose occupation necessitates an irregular mode of life and great exposure, than amongst the upper classes of society.

Constitution, and health. — Those who are constitutionally weak, and those whose general health has been impaired by some temporary cause, are more prone to the disease than the strong and vigorous.

Previous diseases. — True pneumonia, as is well known, sometimes occurs in those who are the subjects of other disease. It is impossible to speak with certainty as to the relation which subsists between the pneumonia and the disease in the course of which it supervenes. In some cases it may be merely an accidental complication; whilst in others the previous disease may exercise more or less influence in the causation of the pneumonia. Most of the pulmonary consolidations, however, which occur in the course of other diseases do not belong to the category of true pneumonia, but are either local inflammations, caused by some abnormal state which the pre-existing disease has induced; or conditions of hyperæmia and collapse, in which an inflammatory process plays but little part.

Exciting causes.—In many cases of acute pneumonia evidence of the existence of any exciting cause is entirely wanting. Of discoverable causes, that which is most common is a sudden chill, or less frequently, more prolonged exposure to cold and damp. Excluding cold, no conditions can be mentioned which have any marked influence in determining the disease.

Anatomical Characters.—The changes occurring in the lungs in acute pneumonia are commonly described under the three following heads :—

1. *Stage of engorgement.*—This is the stage of inflammatory hyperæmia and œdema, and it is characterised microscopically by overfulness and slight tortuosity of the pulmonary capillaries, and by swelling of the alveolar epithelium. The lung is of a dark red colour; it is heavier and less crepitant than natural; it pits on pressure; and its cut surface yields a reddish, frothy, tenacious liquid.

2. *Red hepatisation.*—Here there is an exudation of liquor sanguinis and blood-corpuscles. The exuded liquids coagulate within the alveoli and terminal bronchioles, the coagulum enclosing numerous white and a few red blood-corpuscles. The alveolar epithelium is swollen and granular. It is stated by some German pathologists that the coagulum is in part produced by changes in the epithelium. The lung is now much heavier than in the preceding stage, and is increased in size, so as to be often marked by the ribs. It is quite solid; sinks in water; and cannot be artificially inflated. It is remarkably friable, breaking down with a soft granular fracture. The cut surface has a markedly granular appearance, seen especially when the tissue is torn, and due to the plugs of coagulated exudation matter which fill the alveoli. The colour is of a dark reddish-brown, often here and there passing into grey. This admixture with grey sometimes gives a marbled appearance. The pleura covering the solid lung always participates more or less in the inflammatory process. It is opaque, hyperæmic, and coated with lymph.

3. *Grey hepatisation.*—This stage is characterised by a continuance of the process of inflammatory cell-emigration, and by cell-proliferation. The white blood-corpuscles continue to escape from the vessels, and the alveolar epithelium multiplies. The alveoli thus become more completely filled with young cell-forms, so that the fibrinous exudation is no longer visible as an independent material. Many of these cells, especially those in the vicinity of the alveolar walls, are larger than leucocytes and nucleated. These are evidently the offspring of the alveolar epithelium. The fibrinous exudation now disintegrates, and the young cells rapidly undergo fatty metamorphosis. The alveolar walls themselves, with few exceptions, remain throughout the process unaltered; although very occasionally, when this stage is unusually advanced, they may be found here and there partially destroyed. Owing to these changes, the reddish-brown colour of the lung becomes altered to a greyish or yellowish white. The granular appearance is much less marked; the solid tissue is much softer and more pulpy in consistence; and a puriform liquid exudes from the cut surface of the organ. This stage, when advanced, has been termed 'suppuration' of the lung.

Although these three stages of the pneumonic process have been described as succeeding one another in orderly succession, it must be remembered that each stage does not occur simultaneously throughout the whole of the affected area of the lung. The changes advance unequally, so that whilst one portion of the lung is in the stage of red hepatisation, another may be in the grey stage—hence the mottled, marble appearance of the consolidation. The rapidity with which the several stages succeed one another is also subject to marked variations. In some cases the pneumonic consolidation very rapidly becomes grey, whilst in others the time occupied in the transition is much longer. These differences will be again alluded to when considering the clinical history of the disease.

Resolution.—The natural and almost invariable termination of the histological process is in *resolution*—the lung gradually returning to its normal condition. This is effected by the fatty and mucoid degeneration, and consequent liquefaction, of the inflammatory products which have accumulated within the alveoli. As the liquefaction proceeds, the circulation in the alveolar walls is gradually restored; the softened products are removed by absorption, and to a much less extent by expectoration; and the lung ultimately regains its normal characters. The other exceptional modes of termination in *gangrene, abscess*, and *chronic pneumonia* will be alluded to subsequently.

Site.—The local lesion in acute pneumonia is in the majority of cases limited to one lung. When double, one lung is usually involved before the other. The right lung is more commonly affected than the left. The part of the lung usually involved is the lower lobe (about 75 per cent.) The consolidation may extend upwards and implicate the whole lung. Pneumonia of the upper lobes is more frequently double than basic disease. It is quite rare for the pneumonic process to commence in two different portions of the lung. When the consolidation is met with in both lungs, or commencing in the upper and middle lobes, the pneumonia is often either a secondary affection, and has supervened in one whose health has been previously injured, as by alcohol; and such distributions of the local lesion should always make the physician look carefully for evidence of some pre-existing disease.

Pathology.—Acute pneumonia is undoubtedly to be regarded as a general disease, of which the pulmonary inflammation is the prominent local lesion. The view that it is a strictly local affection of the lung, to which the pyrexia and other symptoms are secondary, is altogether untenable. The truth of this statement becomes obvious from a study of its natural history. The disease, as will be seen subsequently, runs a typical course. The pyrexia bears no definite relation to the lung-affection. It frequently precedes it by a considerable interval, and commonly disappears suddenly, and long before the resolution of the pulmonary consolidation.

Respecting the exact nature of the disease, however, we are at present unable to speak definitely. It is maintained by some observers that, like the specific fevers, it is due to a specific cause. Pneumonia, whilst differing from these fevers in not being contagious, resembles them in the typical character of its clinical phenomena, and to a less extent, of its local lesion. The changes in the lung occurring in pneumonia cannot be induced by artificial injury of the organ, and it must therefore be admitted that there is something special in the inflammatory process. Pneumonia appears to be most closely allied to tonsillitis and acute rheumatism, and like these diseases the circumstances under which it originates are certainly exceedingly diverse.

Symptoms.—The onset of acute pneumonia is in the majority of cases sudden, not being accompanied by any premonitory symptoms. Much less frequently certain premonitory symptoms precede the more severe phenomena which characterise the invasion of the disease. These symptoms include general malaise, headache, chilliness, pains in the back, and loss of appetite.

Invasion.—The invasion in adults is, in almost all cases, announced by a rigor. This rigor is more marked in pneumonia than in almost any other disease. The rigor is usually single, and is rarely repeated, either at the commencement or in the course of the illness. In very old subjects the rigor is very frequently absent, and in children its place is often taken by convulsions or vomiting. The rigors or other phenomena marking the invasion of the disease, together with the attendant pyrexia, are usually quickly followed by symptoms pointing to the lung-affection. These symptoms commonly supervene in the course of from twelve to twenty-four hours, although in exceptional cases not until after the lapse of two or three days. The earliest of them are pain in the side, dyspnœa, and cough. These more local symptoms, together with the pyrexia, acceleration of pulse, thirst, and prostration, gradually develop up to the second day of the disease, by which time (and sometimes before this) the pulmonary lesion is usually sufficiently far advanced to yield unequivocal physical signs. The general aspect and symptoms of the patient are now tolerably characteristic. The flushed and sometimes dusky face, anxious expression, hurried breathing, hot skin, rapid pulse, short frequent cough, and marked prostration, supervening quickly upon the well-marked initial rigor, indicate pretty clearly the nature of the disease.

Pain.—The pain in the side, which is increased by deep inspiration and by cough, usually corresponds in situation with that of the affected lung, although it is occasionally experienced in other parts. This symptom may occur coincidently with, although it more commonly succeeds, the rigor. In quite exceptional cases it precedes it, being the first symptom noticed. Respecting its cause—it is probably due to the implication of the pleura in the inflammatory process.

Respiratory phenomena.—Increased frequency of respiration, dyspnœa, and cough, are early and prominent symptoms. The respiration—usually regular—ranges from 30 to 50, and in children reaches even to 70, whilst the pulse may be only from 90 to 120. This perversion in the pulse-respiration ratio is important in diagnosis. The breathing is shallow; inspiration is abrupt; and when the pain in the side is severe, respiration is sometimes irregular. The accelerated respiration is accompanied by marked expansion of the *alæ nasi*, and by more or less dyspnœa. There is, however, no definite relation between the last-named symptom and the frequency of the respiratory act. Owing to the pain, and to the frequency and difficulty of breathing, speech is interfered with and often rendered exceedingly difficult. Cough is an almost constant symptom, except in the very old. It is short and hacking, rarely paroxysmal like that of bronchitis. It is usually in the early stages attended with severe pain in the side, so that the patient endeavours to repress it. The cough, except in children, and often in the old, is attended by expectoration. The sputa of pneumonia are very characteristic. They are viscid, glairy, and remarkably tenacious, so that they cling to the mouth of the patient, and adhere closely to the sides of the vessel containing them. In colour, they present various shades of red, brown, and yellow, owing to the admixture of blood. The appearance so well known as 'rusty,' is that most commonly met with. Sometimes they are much more diffluent, and of a dark purple colour, somewhat resembling prune-juice. The characteristic sputa are usually met with on the first or second day of the disease, but their appearance is often preceded by a frothy aërated expectoration like that of bronchitis. The amount expectorated is small, and sometimes the pneumonic is associated with more or less of the frothy catarrhal sputa throughout the whole of the disease. During the period of resolution the sputa become less viscid and more catarrhal in character, and they usually contain small particles of black pigment. The histological elements met with in the sputa are leucocytes, red blood-cells, and altered epithelium from the alveoli and air-passages; and towards the decline of the disease, fat-granules, pigment, and occasionally fibrinous masses, which are casts of the alveoli and terminal bronchioles.

Pulse.—The pulse in adults usually ranges from 90 to 120, and it may be even more frequent. It is commonly much more rapid in children, and less so in the old. In the early stage of the disease it is often full and strong, but it soon becomes smaller and easily compressible. It may be irregular, intermittent, or dichrotous. The smallness of the pulse is probably due partly to diminished cardiac power, and partly to the diminished amount of blood which is propelled from the left ventricle, owing to the overloading of the right cardiac cavities which results from the obstructed circulation in the lungs.

Pyrexia.—The pyrexia of pneumonia is continuous, with slight morning remissions and evening exacerbations. The temperature rises very suddenly with the invasion of the disease, to from 102° to 105° Fahr.; and this high temperature is maintained until the period of crisis. This sudden rise and maintenance of a high temperature is very characteristic. The amount of elevation varies in different cases. As a rule it does not exceed about 104° or 105° Fahr., but temperatures of 107° have been known to terminate favourably. In fatal cases it may reach 109° shortly before death. The maximum temperature is usually met with on the second or third day of the disease, but it occasionally occurs immediately before the crisis. The daily variations are usually as follows:—The temperature is lowest about 7 or 8 A.M. In the forenoon, or somewhat later, it commences to rise, and attains its maximum in the early evening. It then falls, but a slight exacerbation occasionally occurs again at midnight, after which it gradually falls. The difference between the highest and lowest temperatures is usually not more than 1° Fahr. The pyrexia runs, for the most part, a uniform course until the period of crisis, when the temperature falls rapidly, in the manner to be hereafter described.

Nervous system.—Headache, restlessness, and sleeplessness are almost always prominent symptoms. Slight delirium is also common, especially towards evening, when the pyrexia is at its maximum. Sometimes the delirium is more marked and violent. It constitutes a more prominent symptom in the old, and in the debilitated and intemperate. In drunkards it is constantly present, and here it often assumes the character of delirium tremens. Convulsions are common in children, especially at the period of invasion. They are rare in the adult. These nervous symptoms are sometimes so prominent as to mask the nature of the disease.

Digestive organs.—The symptoms of acute pneumonia referable to the digestive system are similar to those met with in other severe febrile diseases. There is loss of appetite and thirst. The tongue is more or less thickly coated with a white fur, and it tends in severe cases to become dry and brown. Herpes often appear about the lips, and sometimes on other parts of the face, about the third or fourth day of the disease. Vomiting, which is a common symptom of invasion in the child, is an occasional complication, as is also diarrhœa; constipation, however, is the rule.

Urine.—The quantity of urine is considerably diminished, and its specific gravity increased, so that abundant urates are deposited. The excretion of urea is greatly increased, and it may amount to as much as seventy-five grammes in the twenty-four hours. The uric acid is likewise augmented. The chloride of sodium is much diminished, and during the height of the disease it may entirely disappear. Slight temporary albuminuria is perhaps more common in pneumonia than in almost any other acute febrile affection. The amount is usually in direct proportion to the severity of the disease. Bile-pigment is occasionally met with.

COURSE AND TERMINATIONS.—The symptoms which have been described continue with often increasing severity up to about the end of the first week of the disease, sometimes longer, when an improvement usually occurs. This improvement may take place quite suddenly, and the disease rapidly terminate in health—termination by *crisis*; or the recovery may be more gradual—termination by *lysis*. In other cases *death* occurs either before or after the crisis. The disease may also terminate in *gangrene* of the lung; in pulmonary *abscess*; or in *chronic pneumonia*. These several modes of termination must be considered separately.

Complete recovery.—This is the most common termination of acute pneumonia in young and healthy adults, and the improvement usually occurs quite suddenly—by *crisis*. The time at which this crisis takes place, as indicated by the sudden fall of temperature, varies from the third to the twelfth day. In the majority of cases it is on the fifth, sixth, or seventh day; it is occasionally as early as the third day; and sometimes it is prolonged into the middle of the second week. The old doctrine that the crisis always occurs on the odd days is untenable.

The supervention of the crisis is sometimes indicated by a change in the pulse, which becomes softer, and somewhat irregular in force and rhythm. The most marked phenomenon attending it is the abrupt fall of the bodily temperature. This fall may commence either during the morning remission or the afternoon exacerbation. It appears to be most common late in the afternoon. The temperature very often reaches the normal standard in from sixteen to twenty-four hours, usually within forty-eight hours; the morning remission and evening exacerbation occurring during the period of defervescence. The temperature not unfrequently falls to 1° or 2° Fahr. below normal, and may remain so for two or three days. Occasionally a marked increase in the pyrexia is observed immediately before the commencement of defervescence.

With the fall of temperature all the symptoms rapidly improve. The skin becomes moist and often perspires profusely. The amount of urine increases. The respiration falls in frequency; and, to a less extent, the pulse. The cough becomes looser, and the expectoration more copious; the sputa gradually losing their tenacity and rusty colour, and becoming more bronchitic in character. They are now usually mingled with more or less black pigment. An improvement in the physical signs is sometimes observed at the same time; more commonly, however, this does not take place till one or two days later. The patient often falls into a deep sleep, and on waking, with the exception of great weakness, declares himself pretty well and begins to ask for food. In some cases, however, the amount of prostration following the crisis is so great that the return to health is more gradual, and a condition of collapse may ensue which may even terminate in death.

In the majority of cases acute pneumonia terminates abruptly in the manner above described. Sometimes, however, recovery is more protracted, and defervescence may not be complete till the end of the second week, the temperature falling more gradually—by *lysis*. The critical fall of temperature is occasionally interrupted by more or less marked exacerbations, due either to the implication of fresh portions of the lung, or to the supervention of one of the complications to be hereafter alluded to. In some cases, again, after the occurrence of the crisis, the temperature assumes a hectic type, and does not quite reach the normal standard for perhaps two or three weeks; the irregular fever being due probably to the contamination of the blood by the absorbed pneumonic products (Parkes). Lastly, a distinct relapse may occur after the completion of crisis; but the relapse is in most cases shorter and less severe than the primary attack.

Death.—When pneumonia terminates fatally, it usually does so towards the end of the first, or quite at the beginning of the second week. Death is commonly due partly to failure of cardiac power, and partly to apnœa. Apnœa is the least important element in the causation of dissolution. The danger from it increases with the extent of lung involved, and it is consequently usually greater in double than in unilateral disease. Failure of cardiac power is undoubtedly the most important means by which pneumonia destroys life (Juergensen). There are several conditions in the disease which tend to damage the contractile power of the heart. First and foremost of these is the pyrexia. The severe pyrexia of pneumonia, like that of other acute febrile diseases, produces more or less granular degeneration of the cardiac muscular fibres. It also necessitates increased frequency of the cardiac contractions, in order to supply the increased demand for oxygen, and to remove the excess of carbonic acid. Owing to this increased frequency, the length of diastole—the period during which the heart rests and is nourished—is shortened. The condition of the lung itself constitutes another important element tending to damage the contractile power of the heart, and especially of the right ventricle (Juergensen). The lung-consolidation not only presents more or less obstruction to the pulmonary circulation, and hence necessitates increased action on the part of the right ventricle; but owing to the diminished respiratory surface, this ventricle is obliged to do more work in order that the proper interchange of gases may be effected in the lungs.

Such being the modes by which pneumonia tends to destroy life, it will be readily understood that the earliest and most important signs of unfavourable augury are on the side of the circulation. The pulse becomes more frequent, small, irregular, and often dichrotous. The frequency of the respiration, the dyspnœa, and the cyanosis increase. The cough becomes feeble and ineffectual. Owing to the engorgement and failure of power of the right ventricle general pulmonary œdema usually supervenes, so that moist *râles* are audible at both bases. The extremities become cold, and there is often profuse perspiration. The mind wanders, and a condition of partial coma supervenes before the close. In some cases a rapid rise of temperature takes place before the fatal termination, whilst in others there may be a considerable fall in the thermometer.

Pneumonia may also terminate fatally from the state of collapse which follows the crisis. Lastly, in those exceptional cases in which the pneumonia tends to become more or less chronic, death may occur during the third or fourth week. Death may also result from the complications.

Gangrene.—This is quite rare. It is most common in chronic drunkards, and in those of debilitated constitution. Its occurrence appears to be due partly to blocking of vessels, and partly to the septic influence of altered inflammatory products. It is usually limited to a small area of the pneumonic lung; and is either diffuse, or becomes limited by a zone of inflamed tissue. It commonly supervenes late in the disease; and the most reliable signs of its occurrence are marked fœtor of the expectoration, and great prostration. Portions of lung-tissue are occasionally found in the sputa. It is almost invariably, but not necessarily, fatal.

Abscess.—This is somewhat more common than the preceding. *See* Lungs, Abscess of.

Chronic pneumonia.—Acute pneumonia in very exceptional cases becomes chronic, and leads to induration of the lung. *See* D. Chronic Pneumonia.

Physical Signs.—The earliest physical signs of acute pneumonia are usually discoverable within forty-eight hours of the invasion of the disease. They often appear within twelve or twenty-four hours; but occasionally, when the local lesion is deeply seated, nothing abnormal is to be detected until the third or fourth day. It will be well to describe them in the order in which they commonly make their appearance. The time occupied in their evolution will vary according to the rapidity with which the several stages of the pneumonic process succeed one another.

The earliest abnormal physical signs are due to the pain caused by the movement of the affected side; to the hyperæmia of the pulmonary capillaries; and to the commencing exudation into the air-vesicles. The respiratory movements of the side are more or less impaired. This is partly owing to pain, and partly to diminished elasticity of the lung-tissue. The breath-sounds are usually somewhat weak and harsh, but not distant; although, as stated by Stokes, they are occasionally in the earliest stage harsher and louder than natural. Percussion during this stage is usually not markedly altered. The resonance, however, is sometimes quite appreciably tympanitic, but as the disease progresses the tone becomes impaired. The tympanitic quality of the resonance is caused by the diminished elasticity of the still air-containing lung. The vocal fremitus is increased. The most important sign, however, of the congestive stage is *fine crepitation*. This *râle* consists of a number of fine, dry, crackling sounds, following one another in rapid succession, which have been aptly compared by Dr. C. J. B. Williams to the sounds produced by rubbing the hair between the fingers close to the ear. It occurs during the later period of this stage, when the process of exudation from the pulmonary capillaries is commencing to take place. Its production is probably due to the partial agglutination of the walls of the air-vesicles and their forcible separation during the inspiratory act. The *râle* is almost exclusively limited to inspiration. It is intensified by deep inspiration and also by cough, and it is sometimes necessary to make the patient cough in order that it may be produced. A precisely similar *râle* is often heard with deep inspiration in portions of the lung which have been imperfectly expanded. Such imperfect expansion is common in the posterior parts of the lungs of patients who have been confined to bed from acute or chronic disease, and in whom, owing to muscular weakness, inspiration is incompletely performed. The *râle* produced under these circumstances is distinguished from pneumonic crepitation inasmuch as it completely disappears after a few deep inspirations, whereas the pneumonic *râle* when once established persists until the consolidation of the lung is tolerably complete.

The physical signs of the stage of hepatisation are due to the more or less complete consolidation of the lung. The fine crepitation which characterised the later periods of the preceding stage continues during the process of consolidation, but ceases as the filling of the air-vesicles becomes complete; although it may often still be heard at the confines of the more firmly consolidated lung. It occasionally happens, however, when the consolidation is very rapidly induced, that no crepitation is heard throughout the course of the disease until the period of resolution. When the lung has become consolidated, the expansive movement of the corresponding portion of the chest, which was before diminished, ceases. The intercostal spaces, although sometimes slightly more prominent than in the healthy side, are still depressed and not obliterated as in pleural effusion. When the amount of exudation is very considerable, slight enlargement of the side is necessarily produced. The situation of the cardiac impulse is not altered. The vocal fremitus is usually increased. To this general rule, however, there are exceptions, and it not unfrequently happens that it is unaltered, and it may even be completely absent. This diminution in the vocal fremitus is sometimes due to the blocking of the smaller bronchi with the inflammatory exudation, but more frequently it appears to result from an accumulation of mucus. In the latter case it may sometimes be restored by cough. Coincidently with the increase of vocal fremitus there is usually increased vocal resonance, and sometimes whispering pectoriloquy (Walshe and Wilson Fox). The percussion-sound now is much more deficient in tone, and it is often more or less amphoric. This amphoric quality is probably obtained from the columns of air in the larger bronchi and trachea. There is also a great increase in the sense of resistance, but neither the dulness nor the resistance are so marked as in pleural effusion. In basic disease percussion under the clavicle often yields a distinctly amphoric note, whilst the lower portions of the chest may be almost absolutely dull. The auscultatory sign of this stage is bronchial breathing This is usually remarkably superficial, high-pitched, and metallic in quality (tubular breathing). Sometimes, however, it is less metallic and softer (diffused blowing—Walshe). These respiratory phenomena, like the vocal resonance and fremitus, may be absent over larger or smaller areas of the consolidated lung, owing to the obstruction of the bronchi by catarrhal secretion. The slight pleurisy which constantly accompanies the pneumonia is rarely susceptible of physical demonstration during this stage. This is probably owing to the immobility of the solid lung. During the period of resolution, as expansive power returns, friction-sounds are occasionally audible.

Resolution usually commences in those portions of the lung which were the last to become consolidated. The most important and the earliest of the signs of resolution is the return of crepitation. The crepitation, however, differs from that met with in the earlier stages of the disease. It is larger, coarser, and more liquid in character—*redux crepitation*; and its liquid character gradually increases until it may become distinctly bubbling. When resolution is very rapid, redux crepitation may be absent (Wilson Fox). The bronchial breathing now loses its metallic ringing quality; the percussion-dulness gradually disappears; and the respiration regains to a great extent its normal characters.

The commencement of resolution and of the improvement in the physical signs occasionally takes place, as already stated, coincidently with the establishment of crisis; but more commonly it is not observed until from twenty-four to forty-eight hours after the temperature has reached the normal standard. The time occupied in the completion of resolution varies. Sometimes all physical signs almost completely disappear in twenty-four hours. Usually, however, resolution is less rapid, and marked signs of consolidation remain for periods varying from two or three days to two weeks. A slight amount of dulness and some weakness of respiration often persist at the posterior and inferior portions of the lung for even still longer periods. This is especially the case if the pneumonia is complicated with pleurisy. When marked signs of consolidation exist after the third week, there always exists more or less probability that the pneumonic process may become chronic.

VARIETIES. — The three following varieties of pneumonia present clinical phenomena somewhat different from those which have been described.

a. Latent pneumonia.—Pneumonia has been termed *latent* when the characteristic symptoms of the disease are absent, or but little pronounced; or when they are masked by some other clinical phenomena. It is in the pneumonia of the aged that marked latency is so often observed. Here invasion may be unattended by rigor or other prominent symptoms. Cough, expectoration, pain, and dyspnœa may be completely wanting. If cough be present the sputa often do not present the rusty tinge, but are simply transparent or muco-purulent. Pyrexia, some increased frequency of breathing, great prostration, and more or less muttering delirium, are the principal symptoms. The fever, however, is usually much less than in adults. This latent course of pneumonia it is important to bear in mind, as it indicates the necessity of making a most careful physical examination of the chest in all severe acute illnesses of the aged. In the pneumonia of drunkards and of young children, also, the accompanying nervous phenomena may be so prominent as to mask the nature of the disease.

b. Asthenic (*typhoid*) *pneumonia.*—When pneumonia occurs in those who are debilitated by previous disease, by the abuse of alcohol, by age, by privation, or other causes, the phenomena of invasion are usually not pronounced, and symptoms of intense prostration occur early. In many respects the course of the disease closely resembles that which has been just described as so common in the aged. The initial rigor and pain in the side are often observed; but cough is slight; and the expectoration, instead of the rusty-brown tint, may present a dirty brown or prune-juice appearance. Various symptoms of an asthenic type soon become prominent; the most important of which are low delirium, alternating with stupor; tremors; and paralysis of the sphincters. The tongue is brown and dry; sordes form on the teeth; the pulse is exceedingly rapid and feeble; and there is often slight jaundice and albuminuria. Death usually supervenes some time during the second week of the disease. After death the lung is usually found to be less firmly consolidated and less granular than in sthenic forms of pneumonia. The stage of grey hepatisation in some cases is exceedingly advanced, constituting what has been termed 'suppuration' of the lung (Sturges).

c. Intermittent pneumonia.—An intermittent variety of pneumonia is sometimes met with in malarial districts, which appears to be one of the results of malarial infection. According to Grisolle it occurs in intermittent and remittent forms. The former is characterised mainly by the complete intermissions which occur in the pyrexia. The temperature falls suddenly at the end of twenty-four hours; profuse sweating occurs; and the physical signs of the pneumonia almost entirely disappear. A return of the pyrexia and physical signs takes place at the expiration of twenty-four or forty-eight hours, followed by another intermission, and this by a third or fourth, the disease presenting either a quotidian or a tertian type. Both lungs are liable to be involved. In the remittent form there is a much less complete disappearance of the physical signs during the remission.

COMPLICATIONS.—*Pleurisy.*—Pleurisy of slight intensity and unaccompanied by effusion is, as already stated, almost invariably met with in acute pneumonia over those portions of the lung which are consolidated. This is natural to the disease, and cannot be regarded as a complication. Pleurisy of greater intensity, and attended by effusion, occurs in from five to fifteen per cent. of the cases. Signs of effusion are not usually discoverable before the third or fourth day of the disease. The amount of liquid varies with the extent of the lung-consolidation. When this is considerable, involving nearly the whole lung, there is but little room for effusion. The supervention of pleurisy does not commonly materially modify the course of the disease. It may, however, protract the period of defervescence. Its influence in interfering with the disappearance of the physical signs has been already alluded to. When pleurisy occurs on the side opposite to the pneumonia it constitutes a more dangerous complication.

Bronchitis.—This is also a common complication, especially in the aged and in young children. Many cases, however, which have been described as acute pneumonia associated with bronchitis, have doubtless been cases of bronchopneumonia. The bronchitis almost invariably affects both lungs. Its supervention is attended by an increase in the cough and in the amount of expectoration. When it involves the smaller tubes generally, it constitutes a serious complication.

Pericarditis.—This is less frequent. It may result from the direct extension of the inflammatory process from the pleura, or it may be a part of the general disease. It is a grave complication, and greatly increases the mortality.

Jaundice.—A slight yellowish tinge of the conjunctiva, and even of the skin, is not unfrequent in pneumonia, and has no clinical significance. It is probably in most cases owing to the congestion of the liver which results from the impeded pulmonary circulation—the distended portal veins pressing upon the bile-ducts. Much more extensive jaundice is also occasionally met with, which appears usually to be due to duodenal catarrh, and is attended by gastric symptoms. In other cases, especially in asthenic forms of the disease, a non-obstructive jaundice sometimes occurs, resulting from changes in the red blood-corpuscles. This is commonly associated with nervous symptoms, such as stupor, delirium, and a tendency to collapse, which are of grave prognostic import.

Parotitis.—This is a very rare and exceedingly serious complication. According to Grisolle, it is usually unilateral; the inflammatory process is very acute; and commonly leads to suppuration or gangrene.

DIAGNOSIS.—The diagnosis of acute pneumonia, although usually easy, is sometimes attended with difficulty. It cannot be made with absolute certainty before the appearance of the physical signs of pulmonary consolidation, although some of the phenomena of invasion are so characteristic, that the nature of the disease is often tolerably evident before abnormal physical signs are discoverable. The phenomena which are of the most diagnostic value at this early stage of the disease are the pyrexia, the altered pulse-respiration ratio, the pain in the side, and the cough. The sudden and rapid rise of the bodily temperature, which usually reaches its maximum in forty-eight hours, is very characteristic; such a rapid attainment and maintenance of a high temperature being perhaps more common in pneumonia than in any other disease (Wilson Fox). Of the other symptoms, the increased frequency of respiration, and especially the alteration in the pulse-respiration ratio, are of the most valuable diagnostic import (Walshe). When physical signs of pulmonary consolidation are discoverable, which they usually are within forty-eight hours, the diagnosis becomes certain.

Difficulties in diagnosis may arise in those cases in which the local process in its earlier stages is deeply seated. Here, characteristic physical signs may be wanting for four or five days, during which time some doubt may exist as to the nature of the disease. Then, again, in those latent forms of pneumonia which have been already described the disease may be easily overlooked, unless a careful examination be made of the chest.

The diagnosis of pneumonia from other diseases of the lungs is rarely difficult. The disease with which it is most liable to be confounded is pleurisy. In pleurisy, however, there is not, as a rule, such a sudden and rapid attainment of a high temperature as in acute pneumonia; and when effusion has taken place, the physical signs are in most cases sufficiently distinctive. In pleural effusion the bulging of the side; the obliteration of the intercostal spaces; the displacement of the heart; the absolute dulness and sense of resistance on percussion; the weak and distant character of the respiration; and the diminished vocal fremitus and resonance, contrast with the signs of pulmonary consolidation.

Another disease with which pneumonia may be confounded is that somewhat rare form of very acute phthisis, in which a large area of the lung becomes rapidly consolidated—the consolidation being often in the main indistinguishable histologically from that met with in acute pneumonia. Here, however, although the whole lung may be involved, the disease usually commences in the upper lobes, so that abnormal physical signs are more marked at the apex. The onset of the disease also is commonly much less sudden, and its course is more protracted. Then, again, the rapid consolidation of the lower portions of the lungs which sometimes supervenes in more chronic forms of phthisis, might be mistaken for the consolidation of acute pneumonia; but the history of the case, a careful examination of the upper lobes of the lungs, the irregular course of the pyrexia, and the protracted duration of the disease, will easily serve to distinguish them. It may be stated generally that, in all acute consolidations of the lung, a protracted course of the pyrexia, and the occurrence of marked exacerbations and of remissions of the fever at irregular intervals, afford grounds for the supposition that the consolidation is phthisical.

The diagnosis of acute pneumonia from broncho-pneumonia and collapse of the lung, will be considered when treating of broncho-pneumonia. *See* Broncho-Pneumonia.

Prognosis.—The mortality from acute pneumonia varies at different periods, the disease being more fatal in some years than in others. This is probably partly owing to variations in what is called 'epidemic influence.'

Of all the circumstances which influence the prognosis of pneumonia, that which is perhaps the most important is the state of the general health. In weakly subjects, and in those whose constitutions have been damaged by previous disease, by privation, or by their mode of life, acute pneumonia is exceedingly dangerous. The prognosis is, however, especially grave in those injured by the long-continued abuse of alcohol, the mortality being, according to Huss, from 20 to 25 per cent.

In healthy children the mortality from pneumonia is comparatively small. The fatality formerly ascribed to the disease at this period of life was probably owing in great measure to the inclusion of cases of collapse and broncho-pneumonia in the statistics; the latter disease being exceedingly fatal. Healthy young adults rarely die; after the age of thirty the mortality increases considerably; and in the old pneumonia is an exceedingly fatal disease.

Pneumonia is more fatal in females than males, the mortality being in the proportion of three to two. Pregnancy renders the disease more dangerous.

The danger of pneumonia increases somewhat with the extent of lung implicated. It is, however, the implication of both lungs which renders the prognosis especially grave. With regard to the situation of the consolidation it may, perhaps, be stated generally that pneumonias commencing in the upper lobes are rather more serious than basic disease. The gradual extension of the consolidation late in the disease, and the spreading of the inflammatory process from one centre to another, constitute elements of gravity. When resolution is much protracted, the fact that the disease in very exceptional cases terminates in an indurative consolidation of the lung is not to be forgotten.

The mortality of pneumonia is greatly increased by the existence of complications. The prognostic importance of these has already been considered.

Of individual symptoms the pulse is of chief importance. A pulse which in the adult is persistently over 120, and in the child over 140, is of grave significance. Marked irregularity in force and rhythm is also unfavourable, especially in the young. Dichrotism may occur temporarily in quite favourable cases, but if it persists it indicates danger. The variations in respiration are of less import. An extreme quickness of breathing, marked dyspnœa, and cyanosis are not uncommon in cases which terminate in recovery; at the same time such symptoms must have more or less unfavourable significance. Sputa of a dark prune-juice colour are of somewhat evil augury; as is also an abundant liquid puriform expectoration. The indications from the pyrexia are of less prognostic value in pneumonia than in most other acute diseases. A temperature of 105° or 106° Fahr. does not in itself indicate danger. Greater elevation is grave. In many fatal cases the temperature never attains 102°. The significance of a protracted defervescence has already been alluded to. On the side of the nervous system, it is to be remembered that slight delirium is not uncommon; but when it is marked, and especially when it occurs late in the disease, it is most grave. It is of greater significance in adults than in children. Tremors and a tendency to coma are also unfavourable. A dry, brown tongue is unfavourable, especially when associated with only a moderate degree of pyrexia. Gastric catarrh and diarrhœa add to the danger. A slight amount of jaundice is not of bad import. The existence of albuminuria, or the appearance of albumen in the urine early in the disease, is unfavourable.

Treatment.—In considering the treatment of acute pneumonia, it is of the utmost importance to bear in mind the true nature of the disease. All rational and successful therapeutics must be based upon the recognition of the fact, that it is a general, and not a local, affection which we wish to influence. The 'heroic' methods of treatment by venesection, tartar emetic, &c., so much in vogue in the past, had for their object the controlling or cutting short of a local affection of the lung; hence the unfavourable results which attended them. As these methods have been abandoned, and there has existed a more correct appreciation of the pathology of the disease, the mortality attending it has diminished.

When discussing the pathology of pneumonia, reasons were adduced for the belief that it owes its origin to a specific cause. Whether this be so or no, the disease is so closely allied to the specific fevers, that in attempting to influence its course by treatment, we must be guided by the same general principles. As in these fevers, our object must be to endeavour to conduct the pneumonia to a favourable termination. We cannot arrest its progress, but we can often do very much both to maintain the strength of the patient, and to modify those elements in the disease which tend to destroy life.

The modes by which pneumonia tends to destroy life have been already considered. Failure of cardiac power is the great source of danger. The causes of this failure it is important to bear in mind when treating the disease, and the reader is referred to what has been already stated respecting it. The natural course of the disease is also to be remembered. In the strong and robust pneumonia usually terminates in health. It is in those who are debilitated by age, privation, mode of life, the abuse of alcohol, or pre-existing disease, that such great mortality attends it. It is a question of the intensity of the disease on the one hand, and of the resisting power of the individual on the other. Such considerations as these not only indicate the importance of doing all that is possible to husband and support the strength of the patient, but also of not interfering too actively with the disease, unless circumstances arise which, if uninfluenced by treatment, would tend to rapidly prove fatal.

Such being the general principles which should guide the practitioner in the treatment of acute pneumonia, the manner in which they are to be best carried out may now be indicated.

The patient should be kept in bed. The room should be large and airy; and the temperature about 60° to 62° Fahr. It should be well-ventilated: a plentiful supply of fresh air is most important, and although due care should be exercised in the ventilation, there is not the same necessity to keep the patient scrupulously protected from draughts, as in the treatment of acute bronchitis.

The diet should be carefully regulated, nutritious, and easily digestible, consisting of milk, milk with the white of egg, beef-tea, meat essence, and such-like articles, given in varying quantities and at varying intervals, according to the condition of the patient. With the object of promoting the appetite, it is well to keep the mouth cleansed with glycerine and lemon-juice. Small quantities of wine, as hock, dry sherry, champagne, or burgundy, given occasionally with food, are often useful as stimulants to the appetite and digestive process. Some acid and bitter, as hydrochloric acid and orange-peel, may also be prescribed for the same purpose. If in the early stage of the disease there is great constipation, loaded tongue, nausea, or other gastric symptoms, the administration of a small dose of calomel, or of blue pill and colocynth, is often followed by marked improvement, both in the power to take food, and in the general condition of the patient. The exhibition of purgatives, however, requires great care, as they occasionally set up a catarrhal condition of the intestine, and consequent diarrhœa, which may prove more or less persistent. It is important, therefore, except in such cases as those above indicated, to procure all necessary evacuation of the bowels either by a small dose of castor oil, or of colocynth and hyoscyamus, or by simple enemata.

Everything should be done to husband the strength of the patient, and the services of an efficient nurse will often do very much towards the attainment of this object. Perfect rest must be enjoined, and all unnecessary speaking be forbidden. There are two circumstances which often tend greatly to interfere with rest—the pain in the side, and the cough. The former of these may usually be relieved by the application of large hot linseed poultices, or of hot fomentations to the side. These must be frequently changed, and great care should be exercised in their renewal not to disturb or inconvenience the patient. If these means do not succeed, from one-eighth to one-sixth grain of acetate of morphia may be administered hypodermically; or a small blister or three or four leeches may be applied to the seat of the pain, and the hot applications then renewed. Cough is not usually a troublesome symptom, and unless it greatly disturbs the patient, it is better not to interfere with it. If necessary, a linctus, containing from two to four minims of liquor morphiæ hydrochloratis and a similar quantity of vinum ipecacuanhæ, given occasionally, in often beneficial. By means of the treatment above indicated, and by keeping the room quiet and darkened, the patient will often procure a sufficient amount of sleep. This can very frequently be promoted by carefully sponging the whole surface of the body, a portion at a time, with tepid water, the last thing at night. Should it be necessary, some narcotic must also be administered, but with great caution, so as not to interfere with freedom of expectoration; and it should only be had recourse to when other means have failed, and in the absence of contra-indications. Hyoscyamus and bromide of potassium may be safely used for this purpose; and should these fail, opium may also be given. This should be prescribed in a sufficiently large dose to ensure sleep, and is perhaps best administered hypodermically, as acetate of morphia. Chloral is usually contraindicated, on account of its depressing effect upon the circulation.

A very large number of cases of pneumonia terminate in health without the necessity of any further interference on the part of the physician than has been described. Frequently, on the other hand, circumstances arise indicative of danger, which require to be met by more active treatment. The chief source of danger, as already stated, is failure of cardiac power, and consequently all symptoms of such failure must be carefully watched for. Apnœa is less important, except in those cases where both lungs are extensively involved.

Any sign of cardiac failure will in the first place suggest the advisability of administering alcohol. The exhibition of small quantities of wine with food has been already recommended as sometimes useful in stimulating the appetite and assisting digestion, in cases where there are no symptoms of asthenia; but when such symptoms arise, alcohol must be employed in larger quantities. It may be stated generally that a pulse of over 120 or 130 calls for the employment of stimulants. Brandy appears in most cases to answer best. The amount administered must depend upon its effects; and although in most cases from four to eight ounces in the twenty-four hours will be sufficient, if the asthenia persist it must be given in very much larger quantities. Bark and camphor have also been employed as stimulants, and in some cases they are useful in addition to the alcohol.

In the treatment of failure of cardiac power, however, it is important to attempt to modify, as far as possible, those conditions upon which such failure principally depends. The most important of these conditions is the pyrexia (Juergensen). Various remedies have been employed with the object of diminishing pyrexia. Of these aconite, tartar emetic, and veratrum, although they all have more or less effect in relieving both the frequency of the pulse and the temperature, tend to weaken the heart, and are consequently contraindicated in pneumonia. Digitalis is perhaps less objectionable, but its liability, in the large doses in which it must be administered, to depress the circulation, renders its exhibition somewhat dangerous.

The two remedies which appear to be of most value in reducing the pyrexia of pneumonia are quinine, and the external application of cold. Quinine has been used more largely in Germany than in this country. It must be given in large doses—thirty grains or more. It is usually best to administer one dose early in the evening, and not to repeat this until after an interval of twenty-four hours; and it is often well at the same time to give a full dose of alcohol (brandy, an ounce to an ounce and a half). Quinine thus given undoubtedly in many, although not in all, cases produces a marked reduction in the temperature, and it is desirable to employ it when such a reduction is indicated.

A much more efficient agent in diminishing the pyrexia than quinine is the external application of cold. This mode of treatment also has been much more largely employed abroad than in this country, and here it is only in quite exceptional cases, where the temperature ranges very high (106° or 107° Fahr.) that its employment would be considered justifiable. The following is the method of procedure recommended by Professor Juergensen:—When the temperature reaches 104° Fahr. the patient should be placed in a bath at a temperature of 60° Fahr., and be kept there from seven to twenty-five minutes—according to the effect on the temperature. The pulse must be carefully watched, and stimulants be administered both before, during, and after the bath. If necessary the temperature of the water must be gradually reduced to 42° Fahr. The cooling process usually continues for about a quarter of an hour after removal from the bath. The bath must be repeated when the temperature again rises to 104° Fahr. Juergensen recommends this treatment before the supervention of symptoms of cardiac failure, with the object of diminishing the injury to the heart caused by the pyrexia. When there is marked asthenia, and the heart's action is already much enfeebled, such treatment requires to be employed with great caution, owing to the temporary depression caused by the cold, and the increased work at first thrown on the heart from the contraction of the peripheral blood-vessels. Under these circumstances the propriety of employing it is probably doubtful.

There are other methods by which cold may be applied externally with the object of reducing temperature, namely, by packing the patient in a wet sheet; by the application of ice-bags to the spine; and by sponging the surface of the body with cold water. These, however, are less effectual than the bath, and they often cause more distress to the patient. The effect of such treatment is not only to reduce the bodily temperature, but also the frequency of the pulse and respirations, and it often induces quiet sleep.

Although failure of cardiac power is the chief source of danger in pneumonia, dyspnœa is occasionally a most grave symptom, especially in those cases in which both lungs become involved. This dyspnœa is due partly to the lung-consolidation, and partly to the pyrexia; hence it will be only partially relieved by anything which reduces the temperature. It has long been known that the dyspnœa of pneumonia is diminished temporarily by venesection, and at the present day this is probably the only symptom for the relief of which the practice of bleeding would be considered at all justifiable. In considering the advisability of removing blood in those cases in which dyspnœa constitutes an urgent symptom, it must, however, be borne in mind not only that the relief is merely temporary, but that the loss of blood must tend more or less to weaken the patient, and hence to favour that condition of asthenia which is of all things the most to be feared. Bleeding is certainly only to be thought of when the dyspnœa threatens life, and when at the same time the strength, as indicated by the pulse, is good; and it should not exceed the removal of eight or ten ounces of blood. Such cases are certainly not common; and when they do occur, it is a question whether it would not be safer practice to endeavour to relieve the dyspnœa by reducing the temperature (either by the cautious application of cold or by quinine), than to have recourse to the lancet.

Of the complications delirium sometimes calls for treatment. Active delirium is not common in pneumonia, except in those who have been intemperate. When marked it is always indicative of danger. In its management the practitioner must be guided by the general condition of the patient. It is usually accompanied by asthenia, and hence calls for the exhibition of stimulants. The influence of an experienced nurse is most important. If the pyrexia is considerable, the advisability of wet packing or of the cold bath should be considered. In many cases simply sponging the surface of the body with cold water produces a soothing effect. The application of ice to the head for a short time may also be tried. If these means fail in quieting the patient, and the delirium is very violent and prevents sleep, it may in some cases be advisable to administer an opiate. This should only be done, however, as a last resource, and when there is marked asthenia it is quite unadvisable. The opiate should be given in one full dose sufficient to procure sleep. Morphia administered hypodermically, or given with ammonia or brandy by the mouth, is perhaps the best form of exhibiting it.

Of the management of other complications occurring in the course of pneumonia there is nothing special to be remarked; they must be treated on general principles. The existence of bronchial catarrh often requires small doses of ipecacuanha, ammonia, and salines. Diarrhœa and gastric symptoms are to be met by careful dieting, chalk, bismuth, and, if necessary, other astringent remedies. In pneumonia, as in other acute diseases, the administration of an opiate enema is an efficient and safe means of checking diarrhœa. Pericarditis rarely admits of any special interference.

Convalescence.—During the period which immediately succeeds the crisis, the utmost care is required to support the patient, and to prevent any serious amount of prostration, which at this time sometimes supervenes. Stimulants are usually required for some days after the temperature has attained the normal standard. Convalescence in most cases is quickly established. Solid diet is soon desired, and may be safely given. Tonics —such as quinine, iron, and cod-liver oil—and change of air are useful in assisting the restoration to health.

B. **Secondary Pneumonia.**—DEFINITION.—Secondary pneumonia is a local affection, not a general disease. It is an inflammation of the lung occurring in those who are the subjects of some other disease; the pneumonic process standing in more or less causal relation to the disease in the course of which it supervenes.

Intercurrent Pneumonia.—Before proceeding to consider secondary pneumonia as thus defined, it is to be remarked that the general disease—acute pneumonia—occasionally occurs in the course of other diseases as an *accidental* complication, its occurrence not being influenced by the pre-existing condition. Such pneumonias may be termed *intercurrent*, and they are to be distinguished from the local secondary affections. They often closely resemble, in their clinical features, the acute disease as it has been already described; although in some cases they are more or less modified by the disease in the course of which they occur.

Hypostatic Pneumonia.—There is also a class of consolidations of the lung very common in those who are the subjects of other diseases, which are often described as secondary pneumonias, but which are really for the most part non-inflammatory in their nature; and will, therefore, be very briefly alluded to in the present article. These are those consolidations so often met with at the bases and more dependent portions of the lungs, in the course of both chronic and acute diseases, and also in the aged and cachectic. They have been termed *hypostatic pneumonias*, and consist, in the main, of collapse, hyperæmia, and œdema of the lung-tissue, resulting from weak inspiratory power, feeble circulation, and gravitation. The consolidation thus mechanically induced is increased by more or less exudation of liquor sanguinis and blood-corpuscles into the alveoli; which exudation is due to the damage to the walls of the capillaries caused by the blood-stasis (Cohnheim). There is also some swelling and proliferation of the alveolar epithelium. The frequent occurrence of this epithelial activity in collapsed and œdematous lung-tissue is discussed at greater length under the head of bronchopneumonia.

ÆTIOLOGY.—Secondary pneumonias, as already stated, bear a causal relation to the disease in the course of which they supervene. They would seem to owe their origin almost exclusively to some abnormal condition which the pre-existing disease has induced. They occur in the course of many diseases, and sometimes appear to constitute the acute affection which determines dissolution. There is one disease in which such pneumonias are especially frequent — namely, Bright's disease. Pneumonia occurring in the course of Bright's disease, however, sometimes closely resembles the acute primary affection, and the Bright's disease is probably merely one of the elements concerned in its causation; but more frequently it is simply the local affection about to be described.

ANATOMICAL CHARACTERS.—The changes occurring in the lung in secondary pneumonia are, for the most part, precisely similar to those of the acute primary disease. In many cases, however, the consolidation is less dense; and epithelial activity sometimes constitutes a more prominent feature in its production. The pleura is usually implicated, but not so invariably so as in primary pneumonia. When associated with Bright's disease, the consolidation often passes rapidly into the stage of grey hepatisation. With regard to the situation of the consolidation, it is more frequently situated in the upper and middle lobes, and is more often double, than is that of the primary disease.

Symptoms. — The clinical phenomena of secondary pneumonia differ from those of the acute primary disease, the symptoms so characteristic of the latter being almost entirely wanting. The symptoms which do exist are often but little pronounced, and the disease may even run an almost latent course. This latency of symptoms is often partly due to their being masked and modified by those of the disease to which the pneumonia is secondary.

The onset of the pneumonic process is usually unattended by rigors or other marked phenomena. Cough, expectoration, pain, and dyspnœa are often slight, and they may even escape observation. If cough be present, the sputa may be free from blood, and simply watery or mucopurulent. The pyrexia is moderate, the temperature often not being more than 100° Fahr. Not unfrequently slightly increased frequency of the respiration, with occasional cough, and symptoms of increased illness, are all that exist to indicate that pneumonia has supervened.

Diagnosis.—Owing to the frequent latency of the symptoms of secondary pneumonia, the diagnosis often rests, for the most part, upon the existence of physical signs of pulmonary consolidation. When the consolidation occupies the posterior and inferior portions of the lung, it may be impossible to distinguish it from simple hypostasis. *See* Hypostasis.

Prognosis.—The supervention of pneumonia in the course of a chronic disease usually, but by no means invariably, indicates that the disease will shortly terminate in death. The pulmonary inflammation appears to determine dissolution. Pneumonia occurring in acute diseases materially increases the gravity of the prognosis.

Treatment.—The treatment of secondary pneumonia usually resolves itself into that of the disease in the course of which it occurs. Warm applications to the chest, small doses of ammonia, and alcoholic stimulants may sometimes favourably influence the pneumonic process.

C. **Broncho-Pneumonia.** — Synon.: Catarrhal inflammation of the lungs; Lobular pneumonia; Fr. *Pneumonie lobulaire*; *Broncho-pneumonie*; Ger. *Bronchopneumonie.*

Definition.—Broncho-, catarrhal, or lobular pneumonia is inflammation of the lung-tissue associated with, and usually secondary to, inflammation of the bronchial mucous membrane. In the earlier stage the pulmonary inflammation is commonly limited to scattered groups of air-vesicles, hence the term *lobular* which is applied to this form of pneumonia. As the process advances, the inflammatory nodules may gradually coalesce so as to produce larger tracts of consolidation. The inflammatory products which fill the alveoli consist principally of cells, derived from the epithelium of the alveoli, and from the bronchial mucous membrane; exudation and emigration play a much less prominent part in the process than they do in acute pneumonia. Owing to this preponderance of epithelial products, and to the association of the pulmonary with the bronchial inflammation, the process is also known as *catarrhal* pneumonia.

Ætiology.—Broncho-pneumonia, as already stated, is invariably associated with bronchial catarrh. In some cases it would appear that the injury which produces the bronchial inflammation produces at the same time inflammation of the alveolar walls, but much more frequently the bronchitis precedes the pneumonia, and gives rise to it in a manner to be hereafter described. Whatever causes inflammation of the bronchial mucous membrane may thus be a cause of broncho-pneumonia.

Bronchitis is frequently followed by broncho-pneumonia, especially in childhood and in old age. All those conditions which favour the occurrence of bronchitis must therefore be enumerated amongst the causes of this form of pneumonia. Of these conditions it will be sufficient to mention here the marked influence of cold and damp, and, to a less extent, of heart-disease and emphysema; also the inhalation of irritating gases, and of an atmosphere containing irritating particles of solid matter.

It is the bronchitis associated with certain infectious diseases which is most liable to be followed by broncho-pneumonia. This is especially the case with that accompanying measles and whooping-cough. In both these diseases this form of lung-complication is exceedingly frequent. It also sometimes occurs in connexion with the bronchial catarrh of influenza and diphtheria.

All conditions which tend to impair the general health favour the occurrence of broncho-pneumonia. The weakly and debilitated suffer most. Bad air and insufficient food are most important predisposing causes. A state of malnutrition not only renders the bronchial mucous membrane abnormally liable to become inflamed, but also diminishes the power of the respiratory muscles, and thus aids in the production of pulmonary collapse, a condition which, as will be seen presently, is especially favourable to the pneumonic process. Owing to the general debility and weakness of the thoracic parietes in rickets, bronchitis in the subjects of this disease is exceedingly liable to be followed by broncho-pneumonia.

Broncho-pneumonia is most common during the first four years of life—the period when bronchial catarrh, measles, and whooping-cough are so frequent. It is also common in old age. In young adults it is comparatively rare. Sex has no influence.

Anatomical Characters.—The appearances presented by the lungs after death vary. The bronchi always exhibit signs of more or less bronchial catarrh. This may involve the whole of the bronchial mucous membrane, but it is usually most marked in the smaller tubes. These are found containing a thick, tenacious, and often puriform secretion, which is occasionally here and there drier or inspissated. The mucous membrane of these tubes is more or less softened, swollen, red, and thickened, and often presents irregular superficial erosions. Owing to this inflammatory swelling the tubes stand out prominently on section of the lung. Cylindrical dilatations of the tubes are also frequently met with.

The lung-tissue itself exhibits, associated in various degrees, collapse, congestion, œdema, emphysema, and pneumonic consolidation. The bluish, non-crepitant, depressed portions of collapse, which become darker and more friable with age, are usually most abundant in the lower lobes and margins of the lungs. The collapse sometimes involves the whole of one lobe, but more commonly it is limited to much smaller areas of the lung. When scattered and limited in its distribution, there is usually more or less emphysema of the intervening portions of the lung; when very extensive in the lower lobes, the emphysema is most marked in the upper.

Those portions of the lung in which the pneumonic process has supervened most commonly appear as scattered nodules of consolidation, varying in size from a small pea to a hazel nut. These are ill-defined and pass insensibly into the surrounding tissue, which is variously altered by congestion, collapse, and emphysema. They are of a reddish-grey colour, slightly elevated, smooth, or very faintly granular, and soft and friable in consistence. As they increase in size they may become confluent, and thus are produced larger tracts of consolidation. In a more advanced stage, the nodular and more diffuse consolidation becomes paler, firmer, and drier, and somewhat resembles in colour the greyish-yellow hepatisation of acute pneumonia. The cut ends of dilated bronchi, filled with pus, are occasionally seen in the centres of the pneumonic nodules.

Microscopical characters.—When examined microscopically this consolidation is seen to consist of an accumulation within the alveoli of a gelatinous mucoid-looking substance, small cells resembling leucocytes, and epithelial elements. In many cases much of this accumulation is precisely similar to that contained in the smaller bronchi; and it is evidently the inflammatory and richly cellular bronchial secretion which has been inhaled. At the same time it is in the highest degree probable that it is partly the result of exudation and emigration from the pulmonary capillaries; such exudation and emigration, however, do not play nearly such a prominent part in the process as they do in acute pneumonia, and a fibrinous coagulum is rarely met with. Associated with this material are large epithelial elements, probably the offspring of the alveolar epithelium. These vary considerably in number. In some portions of the consolidation they may be very few, whilst in others they may constitute the predominant change. These differences probably depend upon how far the inhalation of the bronchial secretion constitutes a part of the process. The epithelium covering the alveolar walls is more or less swollen and granular, and is often loosened from its attachment.

Many of the nodules of consolidation met with in the lungs after death from broncho-pneumonia, differ somewhat from those which have been described. They are smaller and softer, of a more yellow colour, less prominent, and less granular; and on scraping, a puriform liquid is obtained from them. These consist almost exclusively of puriform secretion inhaled from the bronchi; and there is an almost complete absence of epithelial elements, and of other evidence of alveolar inflammation. Some of these nodules are merely the cut ends of dilated bronchi filled with pus.

The pleura is usually more or less injected, and a little lymph with small ecchymoses are commonly met with. These appearances are most marked in the vicinity of the sub-pleural pneumonic nodules.

The subsequent changes which take place in the lungs vary. When the disease does not end in death, resolution is the most common termination. The contents of the alveoli undergo fatty degeneration, and are removed by expectoration and absorption, the lung gradually regaining its normal characters. This process, however, is less readily effected than in the consolidation of acute pneumonia; and it often occupies such a lengthened period that some thickening of the bronchial and alveolar walls, and dilatation of the smaller bronchi remain. In still more chronic cases the fibroid thickening is much more marked, and considerable irregularly-distributed pigmented induration and bronchial dilatation may be produced (*see* Chronic Pneumonia). In these chronic forms the contents of the alveoli sometimes caseate, and the caseous products and thickened alveoli may, in exceptional cases, disintegrate, and thus lead to the destruction of the lung. Such a result comes under the category of phthisis, and will therefore not be described in the present article.

Pathology.—The inflammation of the bronchial mucous membrane, which is invariably associated with broncho-pneumonia, in the great majority of cases precedes and is the principal cause of the pneumonic process. In exceptional cases it would appear probable that the same injury which produces the bronchial inflammation produces at the same time the inflammation of the air-vesicles. Inflammation of the bronchial mucous membrane may give rise to broncho-pneumonia in two ways:—(1) By causing, in the first place, collapse of the lung-tissue; and (2) by the direct extension of the inflammation from the bronchi to the air-vesicles. The pneumonic process being the result of the bronchitis almost invariably involves simultaneously both lungs.

1. *Broncho-pneumonia consecutive to collapse.* Collapse of the lung-tissue greatly favours the occurrence of broncho-pneumonia, and usually the pneumonic process is principally confined to those portions of the lung in which collapse has taken place. This is particularly the case in young children. Although it would be beyond the scope of the present article to discuss at length the relation which subsists between bronchial catarrh and pulmonary collapse, the mode of production of the latter may be briefly indicated. There are two circumstances principally concerned in the production of the collapse

which is consecutive to bronchitis—the narrowing of the bronchial tubes, and the weakness of the inspiratory power. The mucous membrane of the bronchi becomes considerably swollen as the result of the inflammatory process, often being thrown into folds; and its surface is covered with thick tenacious mucus. These conditions may cause so much narrowing of the smaller tubes as to render the entrance of air exceedingly difficult, and they may even completely prevent it. In addition to the bronchial narrowing the power of inflating the lungs is usually diminished. This is due partly to the general debility which so often exists prior to the bronchitis, and partly to the damage to the respiratory muscles caused by the febrile process. The superficial character of the respiration due to the fever also aids in the production of the collapse, as does also any weakness of the osseous structures of the thorax, such as exists in rickets. The collapse thus induced is especially frequent in the posterior and inferior portions of the lungs—those portions in which normally the inflation of the lung is the least complete. Commencing here the process may gradually extend upwards till large areas of both lungs become involved. In other cases, owing to a more irregular distribution of the bronchial obstruction, the collapse is limited to small isolated portions of the lung. These portions vary in size from a hemp-seed to a walnut. They are commonly more or less wedge-shaped, with their apices towards the bronchus leading to the group of collapsed lobules; and the lung-tissue around them usually presents various degrees of congestion and emphysema.

The tendency of the pneumonic process to occur in the collapsed portions of the lung is due partly to the hyperæmia which is induced by the collapse, and partly to the irritation of inhaled bronchial secretion. Collapse of the lung-tissue invariably induces more or less congestion. This is owing to the absence of the expansion and contraction of the air-vesicles, which normally aid the pulmonary circulation, and also to the impediment to the blood-flow resulting from imperfect aëration. This congestion is quickly followed by œdema, and the bluish-purple collapsed portions of the lung become deeper in colour, less resistant, and more friable in consistence. In lung-tissue thus altered an inflammatory process, characterised partly by exudation and partly by epithelial activity, is prone to supervene.

Another circumstance which often appears to play a prominent part in the causation of the pneumonic process, is the presence within the alveoli of the inflammatory products of the bronchial mucous membrane. Such products are frequently found in the lungs in cases of broncho-pneumonia. They occur in scattered groups of air-vesicles, and are evidently inhaled. They are found both in the air-containing and in the collapsed portions of the lung, but especially in the latter, the presence of collapse necessarily interfering with their removal by expectoration or absorption. These inhaled products are often found filling small groups of alveoli *without any evidence of subsequent inflammation*, and there can be no doubt that many of the patches of consolidation which are usually described as pneumonic are in reality non-inflammatory in their nature, and are thus produced. At the same time, owing to the irritation of the inhaled secretion, it tends to induce inflammatory changes within the alveoli, and these changes are frequently largely owing to its presence. Juergensen accounts for the pneumonic process occurring in isolated spots in the collapsed lung by regarding the inflammation as being determined by the inhaled bronchial secretion.

2. *Broncho-pneumonia independent of collapse.* Although the pneumonic process is usually consecutive to collapse it may occur independently. This may be owing either to the direct extension of the inflammation from the bronchi to the air-vesicles, or to the influence of inflammatory products inhaled from the bronchi. In other cases it is possible that the injury which causes the bronchitis causes at the same time the inflammation of the pulmonary alveoli.

SYMPTOMS.—The symptoms of broncho-pneumonia are, to a great extent, those of capillary bronchitis. They vary according to the severity of the bronchitis, and according as this is associated or not with other disease. In the severe forms of capillary bronchitis of childhood, and in that associated with measles, the implication of the lung usually gives rise to early and marked symptoms, and the disease runs a comparatively acute course. In the less severe forms of bronchial catarrh, on the other hand, and in that associated with whooping-cough, the supervention of a pneumonic process commonly occurs later; the symptoms are less pronounced; and the course of the disease is much more chronic. Although various gradations are met with between these more acute and the chronic forms, it will be advisable, for the sake of description, to consider them separately.

Acute broncho-pneumonia.—The more acute forms of broncho-pneumonia occur especially as a complication of measles, and in the simple capillary bronchitis of childhood. In measles the pneumonic process commonly supervenes towards the end of the first, or beginning of the second week, but it may be much later.

The early symptoms are those of severe catarrh of the smaller bronchi—pyrexia, frequent cough, accelerated respiration, slight action of the nares, &c. Such symptoms precede, for a varying length of time, those due to the implication of the lung-tissue. The earliest symptoms of the pneumonic process are by no means well-defined, and consequently the time at which the lung becomes involved cannot be fixed with certainty. Rigors and vomiting are but rarely observed.

Usually an increase in the acceleration of the respiration, or in the dyspnœa, are the first signs of the pulmonary implication. The breathing becomes very rapid, and commonly causes much distress, the child tossing about and being exceedingly restless. This dyspnœa is more marked at some times than at others, and is occasionally more or less distinctly paroxysmal. The respiration is superficial, inspiration being short, and the expansion of the thorax imperfect. There is marked action of the accessory respiratory muscles, and the upper portions of the thorax are raised, whilst the lower are retracted during the inspiratory act; the action of the nares is very pronounced.

An increase in the pyrexia which attended the pre-existing bronchitis is, with few exceptions, observed as the lungs become involved, and such increase is to be regarded as one of the most valuable indications of the existence of a pneumonic process. The maximum temperature of acute simple bronchitis is seldom higher than 102° Fahr., whereas that of the secondary pneumonic process is often 104° or 105°. This increase usually occurs more or less gradually;—there is rarely the sudden rise of temperature met with in acute pneumonia. Unlike the temperature of this disease also, the fever of broncho-pneumonia runs no definite course. It varies with the extent of the lung-implication, and with the rapidity with which this implication is effected. There is no regular diurnal variation; the remissions and exacerbations are often considerable; and they occur at irregular times, the temperature being sometimes higher in the morning than at night. The cough, which before the implication of the lung was paroxysmal in character, gradually becomes less and less so, and it now often causes much pain to the patient. The sputa are bronchitic in character, usually very tenacious, and occasionally streaked with blood; as, however, expectoration rarely occurs in the child, they are not often seen. The pulse is much increased in frequency, in children under five years often being 150. It may in the earliest stage of the disease be moderately full and strong, but it quickly becomes soft, small, and feeble. In addition to the above, there are often symptoms referable to the digestive organs. Of these diarrhœa is the most important. This is quite frequent, especially when the disease follows measles. It is very readily induced by medicines and by improper feeding; and as it greatly weakens the patient, it is important that this liability to it should be kept in mind. Vomiting, as already stated, is very rare as an initial symptom; it is, however, common in the course of the disease, especially as a result of cough, the bronchial secretion, together with the contents of the stomach, often being expelled.

As the implication of the lungs increases, the breathing becomes still more rapid and superficial; the dyspnœa is more marked; the expression is anxious; the face is pale; and symptoms of carbonic-acid-poisoning become evident. Strength now fails; the face and lips become cyanotic; and the extreme restlessness gives place to apathy and a semi-comatose condition, which is interrupted from time to time by ineffectual efforts to cough. With the rapid failure of strength and increasing cyanosis, cough almost ceases; the pulse becomes exceedingly feeble; and the child, often extremely emaciated, may die exhausted, and in a condition of more or less profound coma. Sometimes death occurs suddenly during a paroxysm of cough, or with convulsions.

Chronic broncho-pneumonia.—The symptoms of the more chronic forms of broncho-pneumonia, such as occur especially after whooping-cough, and also after bronchial catarrh of moderate severity, differ somewhat from those of the acute disease. The pneumonic process commonly supervenes later, and the course of the disease is much more protracted. As in the acute forms, pyrexia and increased frequency of respiration are the earliest indications of the pulmonary implication. In these cases, however, there is usually but little if any fever prior to the pneumonia; it comes on very gradually; and the maximum temperature is much lower than in the more acute forms, commonly not being more than 102° Fahr. The course of the pyrexia also is still more irregular, lengthened periods of very slight fever being interrupted from time to time by slight exacerbations. Loss of appetite, great emaciation, increasing difficulty of breathing, and loss of strength, characterise the disease. Such symptoms may continue for months, and the child ultimately die, or recover with more or less damaged lungs.

When broncho-pneumonia occurs in adults and in the aged, the symptoms are for the most part much less pronounced than in the child. In strong adults the disease is perhaps most common after diphtheria, and here the pulmonary symptoms may be well-marked; but in the debilitated, and especially in the old, the course of the disease is much more latent, very slight pyrexia (100° Fahr.), slight cough and dyspnœa, and marked debility being the principal symptoms observable.

In the aged and feeble, broncho-pneumonia is very frequently associated with that form of lung-consolidation which results from weak inspiratory power, feeble circulation, and gravitation (hypostatic pneumonia). It has already been stated that this consolidation, which consists mainly of collapse, hyperæmia, and œdema of the lung-tissue, favours a catarrhal swelling and proliferation of the alveolar epithelium. Hypostatic consolidation may exist quite independently of bronchial catarrh; but when such catarrh occurs in the aged and feeble, gravitation often determines the supervention of the pneumonic process, which under such circumstances is consequently not infrequently unilateral.

When the more acute varieties of broncho-pneumonia terminate fatally, they usually do so from the tenth to the fourteenth day of the disease. Death, unlike that from acute pneumonia, is mainly due to the interference with the respiratory function and, to a much less extent, to failure of cardiac power (Juergensen). The interference with the respiration is much greater than in acute pneumonia, for, in addition to the diminution of the respiratory area, due to the pulmonary consolidation and collapse, there is the much more important cause of interference—namely, the impediment to the entrance of air, caused by the swelling of the bronchial mucous membrane, and the accumulation of secretion in the bronchial tubes. These interferences with respiration necessitate increased action of the respiratory muscles; but with the progress of the disease these muscles become weakened, partly by the fever, and partly from the imperfect supply of oxygen. With this failure of respiratory power the incompleteness of oxygenation necessarily increases, until the supply of oxygen may become so small as to lead to complete muscular paralysis. The damage to the heart, as in acute pneumonia, is due partly to the diminished respiratory area, and partly to the fever; but this damage is a much less important element in the causation of dissolution in broncho-pneumonia, than it is in the general disease. (Juergensen). In chronic broncho-pneumonia death may not occur for some months, and then it results as much from general failure of strength as from interference with the respiratory function.

When the disease does not terminate in death, improvement in the symptoms is always gradual. The temperature falls slowly, several days, and occasionally some weeks, being occupied in the completion of defervescence; and this gradual decline is usually interrupted by more or less marked and frequent exacerbations and remissions of the fever. The cough and dyspnœa diminish, and the appetite gradually returns; but restoration to health is always protracted; and the child remains for some time especially liable to repetition of the bronchial symptoms.

Sometimes recovery from the broncho-pneumonia is not complete, andthe disease leads to induration of the lung, dilatation of the bronchi, &c. (*see* Chronic Pneumonia). Emphysema and acute tuberculosis are occasional sequelæ. That the disease sometimes terminates in phthisis, especially in children and in those who inherit weak lungs, appears to the writer to be indisputable.

Physical signs.—The physical signs of broncho-pneumonia are in the main those of capillary bronchitis. Imperfect expansion of the thorax, elevation of the upper portions, and recession of the lower, during the inspiratory act; moist and dry *râles*, audible over both sides; and the absence of any marked alterations in percussion-resonance, are the principal signs observable, not only in the earlier stages, but throughout the whole course of the disease. The recession of the chest-walls is increased by collapse. The supervention of the pulmonary implication is indicated rather by the symptoms—increase in the pyrexia and in the dyspnœa—than by any marked alteration in the physical signs. The difficulty of detecting the lung-consolidation is due to its usually being limited, in the earlier stages, at all events, to small areas, which are surrounded by healthy or emphysematous lung, so that resonance on percussion is but little impaired. It is only when these small areas have coalesced into larger areas of consolidation, that any marked alterations in percussion-resonance are discoverable. The impaired resonance due to collapse is not to be distinguished from that due to pneumonic consolidation; and, inasmuch as the collapse is so often symmetrical, involving both bases posteriorly, the difficulty of appreciating it is increased. Much more valuable aid in physical diagnosis is in most cases to be obtained from auscultation. Over those portions of the lung where consolidation has taken place the moist bronchitic *râles* tend to assume a somewhat metallic quality; they also become finer, though not so fine as true pneumonic crepitation; and they are more superficial. The detection of these superficial, somewhat metallic fine moist *râles*, heard with inspiration, and often with expiration, over small areas of the lungs, is a most valuable and often the only physical sign of the pulmonary implication. If large areas become consolidated, there is, in addition to this, some impairment of resonance on percussion.

Complications.—These are few. It is scarcely necessary again to state that bronchial catarrh is always present. Pleurisy is less common than in acute pneumonia. Slight inflammation of the pleura is, however, usually found *post mortem*, over those portions of the lung which are consolidated. Pleuritic effusion is rare. Intestinal catarrh is a very important and common complication. The liability to this in the child, and the mechanical congestion resulting from the obstructed pulmonary circulation, must be borne in mind in explaining its frequency.

Convulsions occasionally occur, and are of unfavourable augury. The nervous phenomena in some few cases have been described as simulating those of tubercular meningitis. Catarrhal laryngitis, associated with much spasm and laryngeal stenosis, is sometimes observed, especially after measles.

Diagnosis.—The diagnosis of broncho-pneumonia is occasionally difficult. This difficulty is mainly owing to the co-existence of capillary bronchitis. The recognition of the pulmonary implication in its earlier stages is often impossible. The increase in the pyrexia, and in the frequency of respiration, are the symptoms of the most diagnostic value. Owing to the small areas of lung involved, any alteration in the physical signs of the capillary bronchitis may be entirely wanting. The occurrence of extensive collapse in the earlier stages gives more marked physical signs of consolidation, and hence renders the diagnosis more easy. It is almost impossible to diagnose certainly, either by symptoms or by physical signs, between the collapse and the pneumonic consolidation. This, however, is of but little practical importance, inasmuch as the collapse is usually associated with, and often the immediate precursor of, the pneumonic process.

The diagnosis of broncho-pneumonia from the pulmonary consolidation of acute pneumonia may occasionally be difficult in the later stages of the former, when an extensive area of the lung has become consolidated. The history of the case, and especially the course of the pyrexia, will usually suffice to distinguish them.

The distinction from acute tuberculosis sometimes presents much difficulty, as does also the recognition of tuberculosis and phthisis as an occasional result of the disease. A careful consideration of the earlier symptoms, and the existence or not of marked predisposition, are here most important. Slight and irregular pyrexia, existing before the supervention of lung-symptoms, is greatly in favour of tuberculosis. In some cases, however, the phenomena of these diseases are so analogous that a certain diagnosis is impossible.

Prognosis.—Broncho-pneumonia is much more dangerous than the acute primary disease, and the mortality from it is much greater. The more chronic forms are more fatal than the acute. The two circumstances which have an especial influence upon prognosis are the age of the patient, and the general health. Before puberty, the younger the patient the graver the prognosis. In children under five years, the mortality is exceedingly great (probably about 20 per cent.) The disease is also especially fatal in weakly children, and in all those who are constitutionally feeble, or debilitated by previous illness. The existence of rickets materially increases the gravity of prognosis. The danger also increases greatly with the extent of lung involved, much more so than is the case in acute pneumonia. Of the value of the several symptoms as influencing prognosis, after the description which has been given of the disease and of the modes in which it tends to cause death, it is hardly necessary to speak further. Symptoms of imperfect aëration of the blood are those most to be feared.

Treatment.—In the treatment of bronchopneumonia, it is important to bear in mind:—1st, that the disease is invariably associated with, and is in the main induced by bronchial catarrh, and by its so frequently attendant collapse; 2ndly, that its occurrence is especially favoured by everything that weakens the patient; and 3rdly, that it tends to destroy life principally by interfering with the function of respiration, which interference necessarily increases with the consequent weakening of the respiratory power. Such being the facts, it is obvious that the main object of treatment will be, first, to control bronchial catarrh, and endeavour so to modify it as to prevent the occurrence of collapse; and, secondly, to support as much as possible the strength of the patient, with the object of preventing not only collapse, but also that increased interference with the function of respiration which results from weakening of the respiratory muscles.

It would be out of place in the present article to enter into a detailed description of the management of acute bronchitis (*see* Bronchi, Diseases of). It will be sufficient to indicate the more important means of controlling the disease, with especial reference to the prevention of the so frequently attendant collapse.

The patient should be kept in a warm room, the temperature of which should never be allowed to fall below 60° Fahr. The room should be well, but carefully ventilated; and protection from draughts is important, much more so than in the treatment of acute pneumonia. It is also advisable to keep the air moist by means of a steam kettle, as the exhalation of water from the lungs is thus diminished, and the bronchial secretion consequently rendered less tenacious, and more easily removed by cough. The diet, which must be regulated according to the age of the patient, should be nutritious and easily digestible, the importance of supporting the strength being kept in mind. When the disease follows measles, the liability to gastro-intestinal catarrh must not be forgotten. Small doses of ipecacuanha with salines should be administered frequently. The chest should be enveloped in lightly made linseed and mustard poultices; or, what in the case of very young children answers better, it should be rubbed three or four times daily with some stimulating liniment, and kept wrapped in cotton-wool covered with oil-silk. When the secretion in the tubes is abundant, its removal may be much aided by small doses of carbonate of ammonia. This may be either combined with the ipecacuanha and saline mixture, or given separately in a little milk. Senega, as an infusion, and chloride of ammonium may also be given with the same object. The last-named drug appears to have the effect not only of rendering the secretion less tenacious and more easily removable, but also of diminishing its formation. An occasional emetic dose of ipecacuanha often materially relieves the patient, when numerous *râles* audible over the chest, and increased dyspnœa, indicate an accumulation of the secretion. This, however, must not be given when there is marked exhaustion present. The exhibition of opiates is as a rule contraindicated. When the cough is feeble, and the secretion abundant, they do much harm. In the more chronic forms of the disease, however, and especially when following whooping-cough, where the cough is often violent, and there is but little bronchial secretion, opiates may be cautiously given with advantage, as may also bromide of ammonium.

With the object of reducing the temperature, and also of increasing the expansion of the lungs, much may be done by the external application of cold. This method of treatment appears to be especially valuable in increasing the depth and force of respiration, and thus in preventing the occurrence of collapse. Its utility has been strongly advocated by both Bartels and Ziemssen. The method recommended by these physicians consists in the application of cold wet compresses round the chest, which treatment may be continued from half to three or four hours. It is often necessary to repeat the application at intervals for some days, as the beneficial effect is only temporary. This treatment produces a marked reduction of the temperature, and also a diminution in the frequency, but an increase in the depth, of the respirations; the distress being thus considerably relieved, and the patient often falling into a sound sleep. Owing to the depression produced by the cold if too long continued, its effects require to be watched, and when symptoms of exhaustion appear, the cold should be discontinued, to be renewed again subsequently.

Another method of treatment by cold is that recommended by Juergensen, and considered by him very preferable to the preceding, as being more effectual and causing less discomfort. This is a treatment by baths and cold affusion. The child is first placed in a bath at a temperature of from 77° to 86° Fahr. for twenty minutes; and then from 10 to 20 quarts of water at 36° Fahr. are to be quickly thrown over the back and chest. This causes several deep respirations, and thus is valuable in preventing collapse; but it appears to have less effect in reducing temperature than the treatment by cold compresses.

Whilst these various means are being employed, it is all-important to support the strength of the patient. Brandy is here most valuable, and it is to be remembered that children bear stimulation well. The brandy is best given in milk, the quantity being proportioned to the age of the patient. An infant may begin with from five to ten drops every two or three hours. Under its influence the pulse usually improves, the respirations become less frequent, and the distress and cyanosis diminish. The administration of brandy is usually advisable before and during the treatment by cold. When prostration is extreme, or deglutition difficult, both the brandy and other nutriment may be administered by the rectum.

In the chronic forms of broncho-pneumonia these more active methods of treatment are but rarely called for. Here attention to nutrition is most important, and small doses of cod-liver oil in the later stages, even before the complete disappearance of the pyrexia, are often useful. When the disease leads to induration of the lungs and dilatation of the bronchi, the treatment resolves itself into that of chronic pneumonia.

Convalescence, it must be remembered, is always slow, and there is a tendency to relapse. Great care is consequently requisite during this period. All causes of catarrh must be carefully guarded against; and the restoration to health assisted by nutritious diet, cod-liver oil, and iron. A change of air is especially valuable.

D. Chronic Pneumonia.—Synon.: Chronic Inflammation of the Lungs; Cirrhosis of the Lung; Fr. *Pneumonie interstitielle*; Ger. *Lungencirrhose.*

Definition.—Chronic pneumonia is a comparatively rare disease, characterised by a gradual increase in the connective tissue of the lung, which leads to an induration of the pulmonary texture, and to progressive obliteration of the alveolar cavities. It is commonly associated with catarrh and dilatation of the bronchi, and often with ulceration of the bronchial walls, and excavation of the indurated lung. Cough, expectoration—often abundant, but varying with the bronchial catarrh—dyspnœa, gradual impairment of nutrition, and occasional accessions of slight pyrexia, are the most prominent clinical phenomena accompanying the disease, which runs an exceedingly chronic course, often subject to long periods of quiescence, but tending to terminate fatally in from five to fifteen years.

Chronic pneumonia is also known as *interstitial* pneumonia. In its most marked form it constitutes the disease which received from Corrigan the name of *cirrhosis*. The term 'fibroid phthisis,' which is sometimes applied to it, is altogether inapplicable.

Ætiology and Pathology.—It is exceedingly doubtful if chronic pneumonia is ever a primary and independent disease. It probably in all cases owes its origin to some antecedent inflammation of the pulmonary or bronchial textures, or of the pleura. It may be stated generally that all inflammatory processes in the lungs, as in other organs, which become chronic, lead to an increase of the connective-tissue elements, and consequently to fibroid induration of the organ. In the lungs by far the most common cause of such induration is pulmonary phthisis. In all cases of phthisis, excepting those which are the most acute, there is more or less fibroid growth; and the extent of this growth is, for the most part, in direct proportion to the chronicity of the disease. Those forms of phthisis which are the most chronic, and in which the fibrosis reaches its maximum, have been termed 'fibroid phthisis.' The most chronic cases of phthisis are, it must be admitted, somewhat closely allied to some forms of chronic pneumonia. The two diseases, however, differ pathologically in this respect—that whereas much of the pulmonary consolidation of phthisis tends to undergo molecular death and disintegration, that of chronic pneumonia exhibits no such tendency; but any destruction and excavation of the indurated lung which may take place, is due to secondary inflammation and ulceration commencing in the bronchial walls. In considering the pathology of chronic pneumonia, therefore, it is necessary to exclude in the first place the pulmonary induration of phthisis. Chronic pneumonia must also be separated from that form of pulmonary induration which is produced by long-continued mechanical congestion, namely, brown induration; and from those more localised indurations due to bronchitis, peri-bronchitis, old infarctions, and syphilis.

There appear to be four conditions which may give rise to chronic pneumonia, namely:—1. *Acute pneumonia.* 2. *Broncho-pneumonia.* 3. *Pleurisy.* 4. *The inhalation of irritating particles of solid matter.* Each of these must be considered separately.

1. *Acute pneumonia.*—Chronic pneumonia is an occasional, though quite rare, result of the acute primary disease. The pulmonary consolidation of acute pneumonia almost invariably undergoes complete resolution. This resolution is usually effected rapidly, in from seven to fourteen days. Occasionally, however, the course of the disease is more protracted, and the consolidation persists beyond the third week. When thus protracted, the hepatised lung tends to become slightly indurated, owing mainly to thickening of the walls of the alveoli. This indurated hepatisation differs but little in its physical characters from ordinary red and grey hepatisation; it is simply somewhat firmer and more resistant. In very exceptional cases this small amount of induration commencing in the alveolar walls may gradually increase, so as ultimately to give rise to that extensive fibrosis of the lung which constitutes what is known as chronic pneumonia.

2. *Broncho-pneumonia.*—Broncho-pneumonia appears to be a somewhat more frequent cause of the disease than the preceding (Wilson Fox). The greater liability of this form of pneumonia to lead to pulmonary induration is to be accounted for partly by its longer duration and greater tendency to become chronic, and partly by the existence of bronchial dilatation with which it is so frequently associated. That bronchial dilatation is favourable to an indurative pneumonic process has been especially insisted upon by Dr. Wilson Fox. Dilatation of the bronchi is exceedingly common in the simple bronchitis of childhood, and especially in that associated with whooping-cough and measles; it is also a direct result of pulmonary fibrosis. In whatever way originating, its existence favours the persistence of the catarrhal and pneumonic processes. The removal

of secretion is rendered more difficult; the retained secretion tends to increase and keep up the irritative process, both in the dilated bronchi and also in the pulmonary alveoli; and this persistence of the bronchial and pulmonary inflammation leads to fibroid thickening of the bronchial and alveolar walls. In this way more or less disseminated patches of indurative consolidation are produced, which as the process proceeds gradually increase, so that ultimately they may involve large areas of the lung. The progressive tendency of the process is probably partly to be explained by the fact, already stated, that pulmonary fibrosis is a cause of bronchial dilatation, so that fibrosis once established, by inducing further dilatation of the bronchi, favours the extension of the bronchial and pulmonary inflammation.

3. *Pleurisy.*—Pleurisy in very exceptional cases leads to the development of a chronic pneumonia. It appears to be in those cases of pleurisy which are more or less chronic, and in which the lung remains long collapsed from the effusion, that such a result is most liable to occur. The induration of the lung thus induced is often, however, exceedingly partial, consisting merely in some increase of the interlobular connective tissue originating and extending inwards as dense bands from the thickened visceral pleura. In other cases pleurisy probably gives rise to a much more general fibrosis.

4. *Inhalation.*—The inhalation of irritating particles, such as occurs in the trades of miners, potters, stone-masons, grinders, &c., is the cause of the fibrosis of the lungs common amongst persons so employed. The continuous irritation of the inhaled particles induces a bronchial and alveolar inflammation, and ultimately fibrous growth in the bronchial and alveolar walls, which, gradually extending, may involve large areas or even the whole of the lungs.

ANATOMICAL CHARACTERS.—The histological changes met with in the lungs in chronic pneumonia may be described generally as consisting in the development of a fibro-nucleated tissue from the walls of the alveoli, from those of the bronchi, and from the interlobular connective tissue; which new growth, as it increases, and from its tendency to contract, gradually replaces and obliterates the alveolar structure. The character of these changes, however, varies somewhat according to the inflammatory antecedents in which they originate. When chronic pneumonia is the result of acute pneumonia, the principal change takes place in the walls of the alveoli. These become thickened by the growth of a small-celled tissue, in which, associated with the spheroidal cellular elements, there are sometimes elongated fusiform cells, such as are found in embryonic tissue which is in process of forming a fibrous structure. This new growth, in its earlier stages, usually contains new blood-vessels; but later the tissue contracts, and the vessels become to a great extent obliterated. The growth differs from the non-vascular growth of phthisis, inasmuch as it has but little tendency to undergo molecular death and disintegration. The alveolar cavities, where not obliterated, are either empty, or contain exudation-products and a few epithelial cells.

When secondary to ordinary broncho-pneumonia, or to that induced by the inhalation of irritating particles, the new fibroid growth also originates principally from the alveolar walls. Here, however, the growth in the earlier stages is less uniform, and the peri-bronchial and interlobular connective tissues play a more prominent part in the process. The new peri-bronchial tissue invades the walls of the adjacent alveoli, and materially increases the fibrosis.

In the chronic pneumonia resulting from pleurisy, the change, as already stated, is often more localised, consisting in the development of dense fibrous bands passing inwards from the thickened pleura. These are developed from the interlobular tissue. In other cases the fibrosis is more general.

In whichever of the pulmonary structures the new fibroid growth originates, as it increases, all the connective tissue of the lung may become involved, and the alveolar cavities be completely obliterated. The new growth, like that met with in the inflammatory indurations of other organs, although in the earlier stages of its development it may be richly cellular and contain new blood-vessels, tends gradually to become less cellular, denser, and more contractile. In its more advanced state it often consists either of closely packed wavy fibres, or more frequently of a dense homogeneous or obscurely fibrillated material, associated with which are a few small round or fusiform cells. Sometimes the new growth is found richly cellular, even in the most advanced stages of the disease.

The macroscopical appearances of the lung vary with the extent of the fibroid change. In the earliest stages of the induration resulting from acute pneumonia, where there is merely a slight thickening of the walls of the alveoli, the consolidation very much resembles that of red or grey hepatisation. It differs in being firmer and less friable in consistence, and is somewhat less granular. In the later stages, and in all cases where the fibrosis is extensive and general, the lung is diminished in size, dense, firm, fibrous, and even cartilaginous in consistence. The cut surface is smooth; and the large amount of irregularly distributed black-pigment usually present, gives to it a peculiar grey, marbled appearance. Numerous dilated bronchi traverse it in all directions.

When the disease is secondary to broncho-pneumonia the fibrosis in the earlier stages is much less general, as it usually is also when the result of pleurisy. Sometimes dense tracts of fibrous tissue are found intersecting the lung in various directions. As the disease advances, however, a large area, or even the whole lung, may become involved.

The bronchi are almost invariably found dilated in those portions of the lung where the induration is advanced. In some cases some dilatation of the tubes is observed in parts which are not involved in the induration. This dilatation is often very considerable, and the dilated tubes sometimes form large cavities, which may occupy a large portion of the indurated lung. The walls of the tubes are much thickened, and the mucous membrane is often ulcerated. This secondary inflammation and ulceration of the bronchi occurs especially in the dilated portions, and it appears here to be induced by the irritation of the retained and putrid secretion. It may extend into and involve the indurated lung, and so lead to more or less excavation. The mucous membrane sometimes sloughs, and the gangrenous process may involve the lung. The large cavities so common in these lungs are in the main, however, dilated bronchi. *See* BRONCHI, Diseases of.

The pleura of the affected lung, except in the earliest stages of the disease, is much thickened and adherent.

Site.—Chronic pneumonia is in the majority of cases unilateral. The whole lung may be involved or only a portion. In the latter case the base is much more commonly affected than the apex. When due to the inhalation of irritating solid particles, both lungs are usually implicated.

SYMPTOMS.—In the earlier stages of chronic pneumonia the symptoms are often very obscure, and it is not uncommon to meet with advanced and extensive fibrosis in which the lung-affection must presumably have been of much longer duration than the symptoms accompanying it. In some cases the symptoms are directly continuous with those of some more acute pulmonary inflammation—an acute or a bronchopneumonia. Under these circumstances a prolongation of some of the phenomena of the original disease indicates the supervention of the pulmonary fibrosis. The pyrexia does not entirely disappear. There may be merely slight elevation of temperature towards evening, or the course of the fever may be very irregular. The cough usually persists, as does also some increase in the frequency of the respiration and pulse; and the patient, instead of improving, gradually loses strength and flesh. At the same time the physical signs of the pulmonary consolidation remain, and gradually give place to those of pulmonary induration. Where chronic pneumonia is secondary to pleurisy, a continuous sequence in the symptoms is less commonly observed. When the result of the inhalation of irritating solid particles, the symptoms of bronchial catarrh are predominant.

When the fibrosis is fully established the symptoms are usually more pronounced. They vary considerably, however, according to the extent of the lung involved, the quiescence or activity of the indurating process, and the presence or absence of bronchial catarrh. When bronchial catarrh is absent, and the disease is perfectly quiescent, a considerable area, or even the whole of the lung, may be involved without producing any marked pulmonary symptoms, and slight dyspnœa, with some general impairment of nutrition and failure of strength, may be almost the only phenomena present. Such quiescence and immunity from symptoms, however, although common in the course of the disease, is rarely observed over very lengthened periods.

With the existence of catarrh of the bronchi, much more marked symptoms are observable. Inflammation of the bronchi is especially favoured by the dilatation of the tubes, and it is almost invariably present, to a greater or less extent, during the course of the disease; with it is usually associated activity of the indurating process. The dilatation of the bronchi and secondary ulceration of their walls, which are so frequent, are also most important factors in accounting for the symptoms. The course of the disease now often simulates that of chronic phthisis, but it is for the most part more chronic, less regularly progressive, and more frequently interrupted by periods of quiescence. The dyspnœa is now more marked, and cough becomes a troublesome symptom. The cough may be more or less constant, and it is usually attended by expectoration. Its characters vary, however, according to the extent of bronchial dilatation and excavation. When there are numerous dilated bronchi in the lower portions of the lung, the secretion accumulates within them, and its removal by expectoration becomes exceedingly difficult. Under these circumstances the cough is violent and paroxysmal. The patient may remain for several hours with but little or no cough, and then occurs a violent paroxysm, which results in the expectoration of large quantities of muco-purulent secretion. This violent paroxysmal cough and copious expectoration, occurring at long intervals, are exceedingly characteristic of bronchial dilatation in the lower portion of a lung. According to Niemeyer, the paroxysm occurs when the secretion which accumulates in the lower portions of the lung reaches and irritates the more healthy bronchi which retain their sensibility, the dilated tubes being so altered as to be completely insensible. The sputum may be simply puriform, but when there is much bronchial dilatation, owing to its accumulation and retention in the tubes, it usually undergoes putrefaction. It then often has a greyish or greenish-black colour, and is usually more or less fœtid. This fœtor exists quite independently of gangrene, although it is more marked when gangrene is present. Hæmoptysis is not unfrequent, but it is usually small in quantity. It is probably in most cases due to ulceration of the bronchial walls.

Pyrexia is usually present to a greater or less extent in the course of the disease. The fever, however, is exceedingly irregular, and there are often long periods of perfect immunity. During the pyrexial periods the maximum evening temperature is rarely more than 101° or 102° Fahr., and it may be only 100°. The morning temperature is often normal. The pyrexia appears in most cases to be due to inflammation and ulceration of the bronchi, and to the activity of the indurating process.

With the progress of the disease the patient gradually emaciates. The digestion becomes impaired, and diarrhœa is often present. Dropsy is a common symptom, although it is rarely extensive, and is, for the most part, confined to the lower extremities. It appears in most cases to be due to the anæmia and impeded pulmonary circulation. The pulmonary obstruction may also give rise to some enlargement of the right side of the heart, and cyanosis. Lardaceous disease of the viscera is occasionally met with. Death usually results from the general failure of strength, or from some intercurrent affection of the opposite lung.

Physical signs.—In the earliest stage of chronic pneumonia, when it is the result of a more acute pneumonic process, the physical signs are, in the main, those met with during the acute consolidation. It is the persistence of the signs of the pulmonary consolidation after the acute attack which indicates the possibility that the disease may become chronic. Dulness on percussion; increased vocal fremitus; bronchial breathing; and the existence of *râles*, which are larger, moister, and more metallic in quality than those of fine crepitation, are observable during this stage. When the induration is fully established, the physical signs are those of contraction and consolidation, with usually those of more or less dilatation of the bronchi, of a whole or a portion of the lung. The retraction is well-marked, and commonly affects the whole side, although when the lung is not universally involved it may be more limited. Expansion is exceedingly deficient, or completely absent. The heart is much displaced towards the affected side; the diaphragm and the abdominal viscera are drawn up; and the opposite lung encroaches considerably across the middle line in front. Percussion is hard, wooden, and high-pitched, sometimes more or less amphoric. The vocal fremitus is usually increased; and there is often bronchophony or pectoriloquy. The respiratory sounds will vary according to the extent of the bronchial dilatation and excavation, and the amount of secretion. They are for the most part bronchial; usually large and loud; and often distinctly cavernous. When there is much secretion in the dilated bronchi, high-pitched bubbling *râles* are heard, which are often amphoric and cavernous. These may be audible only after cough. The opposite lung is usually hyper-resonant, and the respiration exaggerated.

Diagnosis.—The diagnosis of chronic pneumonia rests mainly on the physical signs. The diseases with which it is most liable to be confounded are chronic phthisis, and retraction from pleurisy. In the most chronic forms of phthisis, where the fibrosis of the lung is considerable, the diagnosis from non-phthisical consolidation may present some difficulty. This difficulty, however, rarely exists except in those cases in which the chronic pneumonia involves only the upper portions of the lung. Here the situation of the consolidation is very greatly in favour of its phthisical nature. This probability is infinitely increased if the other lung be affected. In unilateral basic disease, and in induration of the whole of one lung, the other lung being healthy, the question of phthisis can rarely present itself. Disease of the larynx is in favour of the phthisical, fœtidity of the sputa of the non-phthisical nature of the consolidation.

The retraction resulting from pleurisy with effusion may also be occasionally confounded with chronic pneumonia. Here, however, there are rarely the physical signs of dilatation of the bronchi, and the vocal fremitus is more commonly diminished. The presence of abundant fœtid sputa, of pyrexia, emaciation, &c., in chronic pneumonia will also in most cases render the diagnosis easy.

Prognosis.—Chronic pneumonia, when it involves a considerable area of the lung, usually tends ultimately to terminate in death, although under favourable circumstances life may be prolonged for many years. When the induration is more limited, and remains quiescent, the general health and duration of life may sometimes be but little affected. The most important element in the prognosis is the condition of the bronchi. The existence of bronchial inflammation, as evidenced by profuse expectoration, is always unfavourable, as it not only weakens the patient, but is usually attended by extension of the induration, and ultimately leads, in the dilated tubes, to ulceration of the bronchial walls and surrounding tissue, and occasionally to gangrene. Pyrexia, as another evidence of inflammation of the bronchi and indurated lung, is likewise unfavourable, as is also hæmoptysis. The latter indicates deep ulceration, and it may in exceptional cases endanger life. The general condition of the patient must also be taken into account in making a prognosis. Failure of strength and of digestive power, diarrhœa, and dropsy, are all of unfavourable augury.

Treatment.—In considering the treatment of chronic pneumonia, it is in the first place important to bear in mind that the usual origin of the disease is some more acute pulmonary inflammation. Hence the necessity for the most careful management and supervision of such inflammations in their later stages, with the object of procuring a complete resolution of the pneumonic products.

When the fibrosis of the lung is established, it is hardly necessary to remark that the new growth is incapable of removal, and by treatment we can only hope to influence the extension of the disease, and control the bronchial catarrh with which it is so frequently associated. The frequency and gravity of bronchial catarrh has been already insisted upon, and its management, in the majority of cases, constitutes the most important element in the treatment. In that class of cases in which the disease owes its origin to the inhalation of irritating particles of solid matter, the removal of the patient from the source of irritation is obviously called for.

In the attempt to prevent and control bronchial catarrh, the question of climate must necessarily present itself, and very much may usually be done by residence at some suitable station. One not subject to vicissitudes of temperature, and at the same time dry and moderately bracing, is most likely to be beneficial. The patient should be warmly clad, and everything should be done, by means of diet and medicine, to improve the general health, inasmuch as the better the state of nutrition, the less is the liability to bronchial inflammation. Cod-liver oil and iron are often useful for this purpose. If an attack of acute bronchial catarrh supervenes it should be treated at once, and the importance of quickly controlling it should not be forgotten. In the medicinal treatment of the more chronic catarrhal process, which is so often associated with profuse secretion, much may usually be gained by the use of inhalations, of which turpentine, creasote, iodine, and carbolic acid are, perhaps, the most generally useful. These not only tend to diminish the amount of secretion, but induce coughing, and so assist in its evacuation. They also materially lessen fœtor. Turpentine may be administered internally with the same object. When the cough is excessive and prevents sleep, opium and chloral are most valuable. Counter-irritation, especially inunctions with iodine, appear sometimes to be serviceable. Gastric disturbance, diarrhœa, hæmoptysis, &c., must be treated, as they arise, on general principles.

T. HENRY GREEN.

LUNGS, Inflation of.—This term is used somewhat ambiguously. It is sometimes employed as synonymous with emphysema in its general sense. More correctly it has been limited to that condition in which the lungs are acutely and temporarily distended more or less with air from various causes, such as plugging of the bronchial tubes, a condition which is usually called 'acute emphysema.' It cannot be said to give rise in itself to any definite symptoms; but it can be made out by physical examination, the signs being those indicating excess of air in the lungs.

When this condition exists, the aim in treatment should be to get rid of any obstruction leading to the imprisonment of the air, and to help the lungs in expelling it. It must be remembered that, even after a considerable degree of distension, the lungs may return to their normal dimensions.

Inflation is also a term applied to that expansion of the lungs with air, which is aimed at in the practice of artificial respiration.

FREDERICK T. ROBERTS.

LUNGS, Malformations of.—There are no malformations of the lungs which can be regarded as of much importance from a clinical point of view. As anatomical peculiarities, the shape of these organs, or the arrangement of their lobes, may be abnormal. In a case which came under the notice of the writer, one of the lungs was improperly developed and unexpanded, in connection with the almost complete absence of one of the divisions of the pulmonary artery. The form of the lungs is frequently more or less altered, as the result of various organic diseases of these organs. FREDERICK T. ROBERTS.

LUNGS, Malignant Disease of.—SYNON.: Fr. *Carcinome du Poumon*; Ger. *Lungenkrebs*.

DEFINITION.—Malignant disease affecting the pulmonary tissues.

ÆTIOLOGY.—Malignant disease of the lungs is of more frequent occurrence than was at one time supposed. But there are not sufficient trustworthy statistics to enable us to determine its relative frequency to other forms of thoracic organic disease. It has been met with in persons of all ages, from childhood to extreme old age; but the middle periods of life, from 20 to 60, are the most liable; and the two sexes are about equally obnoxious to the disease. As a primary disease, originating in the lungs, cancer is undoubtedly rare, though much less rare as first manifesting its presence in those organs, either by local or general symptoms. In by far the larger number of cases the disease in the lungs is a secondary affection, consequent on the transmission of cancer-cells, or blastema, from other parts; and in this way, with the exception of the liver, the lungs are more frequently implicated than any other internal organ. Thus, after the removal of an external cancer, pulmonary symptoms are among the most frequent and earliest indications that the disease has invaded internal organs.

ANATOMICAL CHARACTERS.—The right lung has been considered to be more frequently affected with malignant disease than the left. This, however, does not accord with the writer's experience. Of thirty-nine cases tabulated by him, the left lung was the principal seat in fourteen, and the right in nine only, whilst of the remainder either both lungs were affected, or the disease was confined to the mediastinum. Of the several varieties of cancer encephaloid is by far the most common in the lungs; colloid and epithelioma are the rarest; and scirrhus holds a middle place. The intermediate varieties of these leading forms are also occasionally seen.

SYMPTOMS AND DIAGNOSIS.—In proceeding now to describe the various aspects under which these several varieties are presented to the clinical observer, their natural history and diagnosis, it is not proposed to maintain any precise distinction between primary and secondary forms, nor to discuss the minute anatomy or general pathology of the several species, such questions having been considered in other parts of this work. The object of the writer is to treat the subject from a clinical point of view. It is important, however, to observe, *in limine*, that cancer may either commence in, or eventually implicate any or all of the pulmonary textures; although undoubtedly both the primary localisation and the spread of the disease are influenced by the particular species. Both the early symptoms and the subsequent progress of the case will often be materially modified by the particular tissue that is mainly implicated. If the disease first manifests itself in the form of sub-pleural growths, both the early symptoms and the subsequent phenomena will differ from those which present themselves when the disease commences in the deeper tissues of the lungs. And it is observable, that when the disease commences as disseminated deposits in the lungs, these deposits are frequently most numerous in the vicinity of the pleura, so that this membrane is very early implicated, in many cases, when it is not the primary seat of disease.

For clinical purposes we cannot do better than divide intra-thoracic cancerous growths into three groups. 1. Where the disease is *disseminated* through the lungs, either in the form of isolated scattered nodules of varying magnitude, or as spreading along the mucous membrane and sides of the bronchial tubes and vessels, through a greater or less extent of the lung. 2. Cases where the growth is more *localised*, occurring, for the most part, in large masses. 3. *Mediastinal tumours* involving the various structures at the root of the lungs, and eventually giving rise to symptoms of pressure and distress of a more or less serious character.

1. **Disseminated Malignant Disease.**—In the disseminated form of pulmonary cancer the symptoms vary considerably, according to the

seat of the growths. When the pleural surface is chiefly implicated, both the symptoms and the physical signs are essentially those of pleurisy, though the degree of febrile disturbance is usually very slight, and but little or perhaps no false membrane may be effused. The exudation is generally clear serum, or serum mixed with blood; and it may have a greenish or brown colour, but is rarely purulent or even semi-purulent. As the effusion increases in amount, the ordinary consequences of compression of the lung ensue, but dilatation of the side is generally much less marked than in simple pleurisy with effusion, in consequence of there being less giving way of the intercostals. The fluid generally returns speedily after paracentesis.

When the mucous and submucous membranes of the bronchi and the surrounding connective tissue are the chief seats of the disease, the physical signs are those of bronchial irritation and emphysema, which, however, may, for some time, be quite disproportionate to the dyspnœa and other symptoms of ordinary bronchitis. The expectoration is, for the most part, scanty, and either simply mucous or mixed with blood; or small bronchial casts may be expectorated. Examination with the microscope will occasionally reveal characteristic cancer-cells. The resonance of the chest may remain normal, when auscultation proves that there is a diminution of air entering the lung. But there will not be the hyper-resonance of emphysema. Wheezing and dry and moist sounds vary much with the amount of constriction of the tubes, and the amount and character of the secretion. But in advanced cases of this kind, by the spread of the disease along the interlobular septa and through the lung, its condition becomes similar to that of a cirrhotic lung, and the clinical aspects of the case may be greatly altered. Perhaps the most characteristic symptom of this class of cases is dyspnœa insidiously increasing, especially on exertion, without corresponding symptoms of either congestion of lung or compression. Of the general symptoms the most characteristic is that of steadily-advancing debility, which is common to other forms of cancer. And it is from asthenia, or from general cachexia, that the patient usually dies, before much or any disintegration of tissue takes place. It is the scirrhous variety of cancer which most often thus follows and implicates the bronchi.

In the distributive form, characterized by numerous masses, varying from the size of a millet-seed to that of a pea, scattered throughout the lungs, the clinical phenomena, both local and general, may very closely simulate those of tubercle, with recurrent attacks of bronchial irritation and congestion, and febrile disturbance. But as a rule, to which, however, some remarkable exceptions have been met with, there is little if any increase of temperature, nor is there the quickened breath and frequent dry cough of tubercle. The dyspnœa is chiefly on exertion, and seems more due to feeble circulation and general debility than to either pulmonary disease or febrile disturbance. Indeed the absence of local signs of inflammation, or symptoms of functional disturbance, are frequently remarkable. Signs of bronchial irritation in some of these cases have been early noted and prominent symptoms; in others they have been slight and variable. The apices of the lungs, though often implicated, are not specially and early invaded as in tubercle, but rather the bases. If the cancerous growths are rapidly developed and extensively distributed through the lungs, both the signs and general symptoms become greatly modified, and the case proves speedily fatal. The similarity to acute tuberculosis is sometimes very close, especially in those instances in which there is marked febrile disturbance, and recurring slight hæmoptysis.

2. **Localised Malignant Disease.**—The second class of cases of malignant disease of the lungs, in which the disease manifests itself in the form of isolated masses of larger size, is the most common. There may be one such tumour or several, at first assuming a rounded form, but as they gradually invade the lung, acquiring an indefinite shape, and involving a large portion or even the whole of the lung. Such tumours, being most frequently of the encephaloid varieties of malignant disease, often grow rapidly, and as rapidly disintegrate, giving rise to hæmorrhage and destruction, not only of the mass itself, but also of the surrounding tissues. In this way vomicæ may be formed, or portions of lung may become gangrenous. The symptoms and progress of these cases necessarily vary much. If the growth or growths have attained any considerable size, there is dulness on percussion, and an absence of respiratory murmur over the affected portion of lung. The presence and character of other physical signs depend very much on the patency or occlusion of the bronchi. When, as is often the case, these are completely occluded, nothing whatever may be detected on auscultation, and all vocal fremitus may be absent; the implicated portion being completely shut off from the rest of the lung, and from all communication with the trachea. If, however, the bronchi remain patent, or—as the result of breaking down of the cancerous mass—if communication with the larger bronchi has been re-established, we have evidence of abundant secretion, and the ordinary phenomena associated with a cavity. In such circumstances microscopic examination of the expectorated matters may give decisive evidence of the nature of the case. On the other hand, before any such consequences have arisen, we may have in the case of a large tumour involving the whole or the greater part of one lung, auscultatory signs which are with difficulty distinguishable from those of extensive pleuritic effusion. In other instances, where the portion of lung implicated in the cancerous growth is limited and well-defined, the physical signs may so closely resemble those of phthisis as to lead astray the most expert. Thus we may have limited dulness on percussion, with absence of respiration; followed by signs of surrounding irritation, slight hæmoptysis, cough, expectoration, and indications of a cavity. In some rare instances there have been limited flattening and altered form of the chest-walls, such as characterise chronic phthisis. Copious hæmoptysis, except in connection with extensive destruction of lung-tissue, is not common in cancer

of the lung. The diagnosis in these instances, where the local signs so closely resemble phthisis, must be based mainly on the constitutional symptoms, and the history of the case. There is considerable difference as to the progress and mode of termination in the whole of the class of cases now under consideration. Long before the local changes have advanced far enough to admit of a decisive diagnosis, the patient may die from rapidly-increasing debility and emaciation, with more or less of hectic fever, and even typhoid phenomena; or he may be carried off by rapidly-occurring pleuritic effusion. In other instances cancer developing in other organs is the cause of death. Indeed, in a large proportion of cases the manifestation of malignant growths in the neck, the axilla, or other parts, places beyond question the nature of the case. So long as the growth is confined to the substance of the lung, and does not implicate the nerve-trunks and larger vessels, there is usually little pain, paroxysmal dyspnœa, or disturbance of the heart's action, excepting such as may be due to feebleness of muscular power. Nor is there generally any external œdema, or distension of the superficial veins. The reverse of all this characterises the cases in which the mediastinum and the roots of the lungs become involved.

3. **Mediastinal Tumours.**—This form of malignant disease of the lungs is described under a separate heading. *See* MEDIASTINUM, Diseases of.

PROGNOSIS AND TREATMENT.—The subject of the prognosis and treatment of malignant disease of the lungs in its various forms, will be more conveniently discussed in the article MEDIASTINUM, Diseases of.

J. RISDON BENNETT.

LUNGS, Malpositions of.—Among malpositions may be regarded those conditions in which the lung is contracted more or less within its normal limits; or, on the other hand, distended so as to pass beyond its usual boundaries. One or both organs may be thus affected. These alterations may result either from more or less diminution of the amount of air in the lungs, as in cases of compression or collapse; from excess of the same, as in emphysema and hypertrophy; or from diseases which affect their structure. The lung may also be displaced by the pressure of tumours, in addition to being compressed. The most important malposition of the lung, however, is that known as *hernia*, in which a portion of the organ projects into the neck, or through some part of the chest-walls, or through the diaphragm into the abdominal cavity. If the hernia passes towards the surface of the body, it may be made out clinically, being indicated by a soft and compressible swelling, localised, resonant on percussion, and rendered more prominent by a cough. Pulmonary symptoms might possibly be present. It is impracticable to detect a hernia of the lungs through the diaphragm. FREDERICK T. ROBERTS.

LUNGS, Morbid Growths in.—The formations in the lungs which belong to the class of morbid growths may be thus enumerated, in the order of their importance:—1. *Tubercle.* 2. *Cancer.* 3. *Syphilitic gummata.* 4. *Hydatids.* 5. *Rare formations,* such as sarcoma, enchondroma, osteoid and myeloid growths, hæmatoma, lymphatic formations, &c. Most of these are discussed under their appropriate headings, and it is unnecessary to allude to them any further here. Those belonging to the last group are usually rather of pathological interest than of clinical importance, as they rarely give rise to any local symptoms or physical signs during life, and are merely discovered, as a rule, at the *post-mortem* examination. It is a question how far some of these growths are to be regarded as being of a malignant nature. In some cases they are secondary to similar growths elsewhere, or the lung may be involved by extension. Lymphatic formations in the lungs are sometimes observed in cases of Hodgkin's disease.

EFFECTS.—It may be useful to indicate the effects, if any, which morbid growths may produce in connection with the lungs. 1. The lung-tissues may merely be more or less displaced and compressed; or, in course of time, become absorbed or atrophied, in proportion as the growth progresses. 2. The distribution of air in the lungs may be modified by the mere presence of a growth, so that in one part it is in excess, and in another part deficient. 3. Similarly, the circulation of blood may be disturbed, leading to congestion in one part, and anæmia in another. 4. Morbid formations are very liable to cause local irritation. Hence they may induce bronchial congestion and catarrh, localised acute pneumonia and its consequences, or chronic interstitial pneumonia, which may lead to the formation of a fibrous capsule around a growth. 5. Certain formations are liable to undergo degenerative and destructive processes, either in themselves, or along with the pulmonary tissues. In this way they originate ulcerations or cavities, and may give rise to products, which are not only injurious to the lungs, but also infect distant parts to which they may be conveyed. After destruction reparative processes not unfrequently take place, with loss, however, of the involved portions of the lung-structures. It must be remarked here that some morbid growths seem to become infiltrated through the pulmonary tissues without destroying them; and under appropriate treatment the growth is absorbed, leaving the involved portion of the lung intact. This applies, for instance, to some cases of syphilitic infiltration. 6. Growths in the lungs sometimes extend beyond these organs, so as to interfere with neighbouring structures, causing irritation, pressure, or destructive effects. Thus, local pleurisy, pressure on vessels or nerves, destruction of bones, and other consequences may ensue. In short, the growths become then practically intra-thoracic tumours, and produce similar effects.

SYMPTOMS.—What has been stated as to the effects of morbid growths in the lungs will readily explain the clinical signs which they tend to originate. They may be of such little consequence that they produce no sign whatever during life, not interfering in any way with the respiratory functions, or being themselves in insufficient amount to be discoverable by physical examination. Indeed, some formations may invade the lungs to a considerable extent so insidiously that no evident symptoms are induced.

The writer has known cases in which the lungs were extensively implicated in secondary cancer without any symptoms, except some feeling of shortness of breath on exertion. Usually, however, various degrees and combinations of the ordinary pulmonary symptoms may be anticipated—namely, pain in some part of the chest, cough, expectoration, the sputum sometimes containing fragments of the growth, hæmoptysis, and dyspnœa. Pressure-symptoms in connection with other structures are induced in some cases. Physical examination may detect the disease when there are no symptoms; or these may coexist with physical signs, which either reveal the presence of the morbid formation itself—such as alteration in the shape and size of the chest, deficient expansion, dulness, bronchial or other abnormal breath-sounds, modified vocal fremitus and resonance; of its effects on the lungs; of the formation of cavities; or of its effects on neighbouring parts. The particulars relating to these points are discussed in other articles. Definite general symptoms are associated with many forms of morbid growth in the lungs.

Treatment.—The principles of treatment of morbid growths in the lungs are, first, to get rid of them, if possible, by medicinal means, as in the case of syphilis; secondly, to treat their effects; thirdly, to treat local symptoms which may arise; and fourthly, to treat the general symptoms. Frederick T. Roberts.

LUNGS, Œdema of.—Synon.: Fr. *Œdème du Poumon*; Ger. *Lungenödem.*

Definition.—Infiltration of the pulmonary tissue with serous fluid.

The serous fluid is effused from the pulmonary capillaries into the pulmonary textures, and into the alveolar and bronchial spaces.

Ætiology.— The causes of this exudation are manifold, but of two sorts:—(*a*) *Disordered circulation*:—1. active congestion, attendant upon inflammatory conditions of the lungs and bronchi; 2. passive congestion; 3. mechanical congestion—in heart-diseases, emphysema, or pressure upon the pulmonary veins; 4. want of tone of vessels after inflammatory conditions, as pneumonia or bronchitis, or pressure upon the vagus nerve or pulmonary plexus; 5. afflux of blood to the lungs in croup, and during the asthmatic paroxysms determined by the ineffectual efforts at inspiration. (*b*) *Morbid conditions of the blood*:—in albuminuria, and to a less degree in other diseases in which the condition of the blood is altered or impaired—for example, scurvy, purpura, anæmia, hydræmia—the lungs partaking of the general disposition to dropsy.

Anatomical Characters.—In cases of œdema pulmonum, the lungs are usually large, filling the thoracic cavity, and sometimes indented by the ribs. They are heavy; their pleural surfaces are wet; and the pleural cavities contain an excess of serum. Both lungs are as a rule affected, their lower and most dependent portions chiefly; and one lung, on the side to which the patient has last inclined, is more highly œdematous than the other. The higher the degree of œdema, the less crepitant the lung, and the more distinctly the surface pits on pressure. A portion cut from a simply œdematous lung will, however, almost always float in water; but at the base of the lung there is usually some collapse in addition to the œdema, and a portion removed therefrom sinks. On section the lung exudes abundant thin serum, and more or less frothy fluid, with which the bronchial tubes are also occupied. On first making a section, the succulent tissue will break down easily under the finger; but, after the excess of fluid has been squeezed out, the lung feels toughened. Œdema may be found at any portion of the lung—at the apex, for instance, determined there by the inflammatory process. The transition between œdema and inflammatory consolidation is very gradual Œdema is also very apt to pass into, or to be complicated with, a certain degree of inflammation. The degree of friability, and of compressibility, and the application of the water test, are the readiest methods of distinguishing between the two. If a portion of œdematous lung be examined under the microscope, the alveoli are found to contain more or less numerous large granular cells, but these are never so numerous as to occupy entirely the alveoli.

Symptoms.—The symptoms of œdema of the lungs are—in addition to those of the disease which has produced it—dyspnœa, which may amount to orthopnœa; troublesome 'retching' cough; and difficult, yet tolerably abundant, frothy, serous expectoration. The percussion-note is deadened at both bases, although the dulness is usually more extensive at one base than the other; the vocal fremitus is diminished; the respiratory murmur is enfeebled or lost; and a fine bubbling crepitation is heard.

Diagnosis.—The diagnosis of pulmonary œdema is not usually difficult. The absence of pleuritic pains and of fever, and the double-sidedness of the disease, together with the absence of any true bronchial breathing or ægophony, will exclude pneumonia or pleurisy. The presence of dulness will also distinguish the condition from simple capillary bronchitis, with a certain degree of which, however, it is often combined. The general condition of the patient, and the presence or absence of those diseases or circumstances which are known to produce œdema of the lungs, must be carefully taken into consideration. If, for instance, after an asthmatic paroxysm we hear some fine bubbling *râles* over the bases of the lungs, and find the patient expectorating an unusual quantity of frothy serous fluid, we may suspect pulmonary œdema rather than bronchitis.

Prognosis.—The prognosis in œdema of the lungs depends mainly upon the general or local conditions with which it is associated. It is of very grave purport in chronic Bright's disease, or in heart-disease. It is also a grave complication in chronic bronchitis, showing failure of heart-power. It is, however, often a transient and unimportant affection when it succeeds to acute chest-affections, as pneumonia or bronchitis, or to asthma. As a complication of acute chest-affections, it is rarely recognised clinically.

Treatment.—The treatment of pulmonary œdema is, in all important cases, derivative. Poultices are to be applied to the chest, with sufficient mustard to produce redness. Dry-cupping will often give great relief. Blisters should be avoided. Watery purgatives should be administered, according to the strength of the patient. Diuretics are useful in some cases, especially the vegetable diuretics, such as digitalis, juniper, and scoparium, as also nitric ether; and the same is to be said of diaphoretics, for example, acetate of ammonia, warmth, air baths. Moderate stimulation and support must be kept up. Kidney or heart-disease if present will mainly determine the exact treatment. If there be failure of cardiac power, æther, ammonia, and alcoholic stimulants are required; and if the heart's action continues hurried or irregular, digitalis is especially indicated. When we suspect a loss of tone of vessels, as after bronchitis or pneumonia and in anæmic states, perchloride of iron with some mineral acid is to be recommended.

In all cases rest in bed or on a couch is necessary. R. DOUGLAS POWELL.

LUNG, Perforation of.—SYNON.: The term *pneumothorax* is almost equivalent.

DEFINITION.—The formation of an opening through the pulmonary pleura, communicating with the interior of the lung.

ÆTIOLOGY.—Perforation of the lung may arise in many ways. Its causes may be classified under the three following headings:—

1. *Penetrating wounds*; for example, gunshot wound, punctured wound, or laceration by a broken rib.

2. *Diseases affecting the pleural cavity or neighbouring organs*; such as empyema, hepatic abscess or hydatid, or suppuration of the bronchial glands.

3. *Disease affecting the lung itself*; for instance, phthisis, emphysema, gangrene, hydatids, or cancer.

Of all the causes of perforation of the lung, phthisis is infinitely the most common. It is the rule in phthisis for pleuritic adhesions to form *pari passu* with the pulmonary lesion, and these adhesions are usually very firm and difficult to break down. In neither respect, however, does this rule always hold good. In some rare cases in the earliest stage of the disease a small tubercular nodule situated immediately under the pleura softens, and the pleura gives way. Again, at any stage of the disease an outlying tubercular mass, situated below the point to which the pleural adhesions have extended, may soften and rupture into the pleural cavity.

In the more acute pneumonic varieties of phthisis there is often a singular indisposition to the formation of pleural adhesions. The pulmonary pleura in such cases becomes covered with a thin, smooth, translucent layer of lymph, shining through which can be seen at several points opaque yellow spots. These spots are found to correspond with underlying masses of softened cheesy material, by which the pleura has been undermined and deprived of its vascular supply. Pneumothorax has its most frequent origin in rupture of the pleura at one of these yellow points.

Finally, sinuses are sometimes found leading from old cavities within the lung to the pleural surface. Occasionally these sinuses, the pleura being adherent, penetrate through the thoracic wall and point externally. In other cases, of which the writer has seen two examples, they may open into the opposite pleural cavity.

ANATOMICAL CHARACTERS.—The affected lung is in all cases collapsed, and in cases of old standing may be so completely so, and covered by such thick layers of lymph, as to be found only with difficulty. The opening may have closed. It is sometimes difficult to discern. It may consist of a small slit, communicating with a cavity by a slanting sinus, so as to form a complete valve; or it may be of considerable size, and communicate widely with a cavity or bronchus. All degrees of patency between these two extremes occur. The position of the opening is very variable; it is most commonly situated somewhere on the lateral or convex side of the lung. The rupture is almost always into the pleural cavity on the same side. It may, however, take place into the opposite pleural cavity, through the mediastinal fold of pleura. The pleura is inflamed, and covered with lymph; and its cavity contains air, and a greater or less quantity of purulent fluid. The heart is displaced, unless in some rare case it be held by a strong adhesion. Some years ago the writer tested the degree of air-pressure present in ten cases of pneumothorax by means of a water-pressure gauge. In two cases it was *nil*; in one case it was equal to 1·25 inch; in two cases 2 inches; in one case 3·75 inches; in two cases 4 inches; in one case 5·3 inches; and in a double case it equalled 3·5 inches in one pleura, and 2·7 in the other. The gas effused approximates in composition to that of expired air, containing from 8 to 16 per cent. of carbonic acid. Sometimes sulphuretted hydrogen also is found in fœtid cases.

SYMPTOMS AND SIGNS.—The symptoms and signs of perforation of the pleura are those of pneumothorax and of hydro-pneumothorax. At the moment of attack sudden acute pain is felt in the chest, at the seat of rupture, and is immediately followed by great dyspnœa and shock. In a well-marked case the expression of face is peculiarly agonized and terror-stricken; the extremities are cold; damp sweats break out; the pulse is quick and small; and the respirations are exceedingly rapid. The position of the patient is that of orthopnœa, with an inclination forwards, and to the sound side; it is, however, frequently changed in the endeavour to gain breath. The voice is feeble and whispering. The urgency of the shock and dyspnœa depends upon the amount of useful lung suddenly disabled. If the patient survive the attack, after two or three days fever of a hectic character, with sweats, supervenes. In some cases, however, the symptoms of pneumothorax come on very insidiously.

Physical signs.—The physical signs are very characteristic. There is enlargement of the side affected, and effacement or bulging of the intercostal spaces. The heart is displaced towards the sound side. The percussion-note is hyper-resonant or tympanitic over the side affected, except where (at the apex) the lung may perhaps be still adherent; and on auscultation either no respiration at all is audible, or amphoric breathing of a peculiar character may be heard at one or more points, sometimes accompanied with the characteristic metallic tinkle. A peculiar metallic echo is heard if the patient coughs. If, whilst the ear is applied, a coin placed on the diseased side is struck with another coin, a characteristic bell-note is heard. The vocal fremitus is diminished or lost. At a later stage, when more or less effusion has taken place, the signs of hydro-pneumothorax present themselves, namely, dulness below and hyper-resonance above—in varying proportions and shifting in relative position with the posture of the patient. If the amount of fluid be moderate, a splash or succussion-sound may be elicited. This sound may be audible to the ear applied to the chest, or to bystanders. If the fluid effusion be considerable, intercostal fluctuation may be felt; and this fluctuation gives to the finger, on percussion at the level of junction of air and fluid, a peculiar sensation of thrill. The position usually assumed by the patient now is with the head raised, and leaning towards the diseased side.

Diagnosis.—The diagnosis of perforation of the lung is to be made from other diseases; and also with respect to the probable nature of the opening, and the degree of pressure present. If the three essential signs of pneumothorax be remembered, namely, displacement of heart, tympanitic percussion-note, and either absence of respiration or amphoric breathing, there can scarcely be any difficulty in making the diagnosis. It cannot be confounded with a bilateral disease like emphysema. The shifting resonance and dulness, the succussion-splash, with perhaps metallic tinkle and amphoric breath-sonnd, are signs abundantly sufficient to distinguish hydro-pneumothorax from ordinary empyema. Respecting the nature of the opening —whether valvular or free, careful auscultation will usually gain the desired information. If amphoric breathing be well-marked, it may be assumed that the opening is a free and tolerably direct one; if, on the other hand, no respiratory sound be audible, the communication with the pleura is indirect and more or less completely valvular. In the latter case the pressure-symptoms become more urgent.

Prognosis.—Of course the prognosis in every case of tubercular pneumothorax is necessarily very grave, but by no means equally grave in all cases. The following considerations will guide to a correct prognosis. (*a*) *Nature of opening.* If the communication with the pleura be valvular, signified by the entire absence of breath-sound, and the increasing urgency of dyspnœa, the patient will die in a few hours, unless relieved by paracentesis. (*b*) *State of the opposite lung.* If the effusion of air have occurred on the side least affected by previous disease, the case is correspondingly hopeless. If, on the other hand, we know that the lung now collapsed was previously much diseased, and if the other lung be but little affected, the duration of life may not be greatly shortened by the accident. Life is then gradually extinguished by hectic fever, and progressive disease in the opposite lung. It is by no means impossible, and probably happens more frequently than is supposed, that the opening in the pleura may close, the air become absorbed, and the case converted into one of simple empyema. In pneumothorax arising from accidental wound or injury to the lung, the prognosis depends upon the visceral injury. The air in the pleura is absorbed with considerable readiness.

Treatment.—In all cases in which death is threatened by asphyxia, in consequence of air accumulating in the pleura, paracentesis with a fine trochar must be performed. This will in such cases give great relief, and may be repeated if necessary. There is a tendency for an opening at first completely valvular to become at a later period more patent or possibly to close, so that it is better to operate when necessary with a fine trochar than to make a permanent opening. Rest to the affected side should be secured, as far as possible, by the application of a broad piece of strapping extending round the side to beyond the middle line in front and behind. The shock and dyspnœa are best treated by opium in repeated small doses. Stimulants may also be necessary, but opium is far more useful.

R. Douglas Powell.

LUNG, Rupture of.—Rupture of the lung is an extremely rare occurrence. Cases of so-called rupture of the lung from external violence are, for the most part, really produced by perforation or laceration of the pleura by a fractured rib. It is said that rupture of the lung may occur in whooping-cough.

LUNGS, Syphilitic Disease of.—There is still much uncertainty as to the effects which syphilis may produce in connection with the lungs, but there can be no doubt that it does sometimes originate specific lesions in these organs, though much less frequently than in most of the other viscera. They are generally only met with in advanced cases of acquired syphilis, when the signs of the disease are markedly developed in other parts. Occasionally the lungs are involved in congenital syphilis. The presence of a tubercular or scrofulous diathesis has been supposed to predispose to the implication of the lungs in syphilitic disease.

Anatomical Characters.—Gummata constitute the most certain and unquestionable lesions of a syphilitic nature in the lungs, but they are rare. When present, they vary in number from one to many. In the latter case they are disseminated, but are stated to have a predilection for the deeper parts of the organs. In size these growths usually vary from a pea to a walnut, but may reach the dimensions of a large egg. They are generally well-defined, rounded in shape, and often surrounded with a fibrous capsule. In their early condition gummata in the lungs appear on section greyish or brownish-red, homogeneous, firm, and dryish in consistence. Subsequently they tend to degenerate, becoming more or less caseous, yellow, and less consistent; and they may even break down in the centre, so as to form cavities. The structure of these gummata is found on microscopical examination to be made up of imperfect fibres, abortive nuclei, and a few fibre-cells, infiltrating the pulmonary tissues, and thickening the alveoli. Afterwards these are mixed with granular matter and other products of degeneration and disintegration.

There has been much discussion regarding the relation of syphilis to another form of lesion affecting the lung-tissues, namely, a variety of chronic interstitial pneumonia. There seems every reason to believe that this morbid condition is in some instances due to syphilis. The result is a fibroid infiltration of the pulmonary tissue, which in its general and microscopic characters cannot be distinguished from a similar condition due to interstitial pneumonia from other causes, but the new tissue is said to be more vascular in its early stages. The affected parts are much indurated; and any bronchi which are implicated tend to become more or less dilated. The morbid condition may be distributed in various parts of the lungs, but appears to have a preference for their bases and the vicinity of their roots. It frequently originates at the surface, and penetrates thence into the interior of the lungs in the form of fibrous bands, the pleura being generally thickened or adherent, and superficial puckerings and depressions being visible. In other instances the new growth commences around gummata; or from a chronic contracting peri-bronchitis, associated with ulcerative inflammation (Pye-Smith). Dr. Green states that it originates mainly around the small interlobular blood-vessels. Syphilitic fibroid infiltration has no tendency to caseation; but it may become the seat of ulceration or gangrene.

In connection with congenital syphilis, a peculiar condition has been described as affecting the lungs in new-born or very young infants, under various names, such as syphilitic pneumonia, white hepatization, and epithelioma of the lungs. It assumes a more or less diffuse or infiltrated arrangement, but is of variable extent, and may involve one or both organs. One lung may be affected throughout, while the other is quite free from disease. The more obvious characters are as follows:—The pleura is usually unaffected. The lung is enlarged, and may be in a state of full expansion, so that its surface is marked by the ribs; it feels remarkably heavy; and at the seat of the disease is dense, firm, hard, and usually resistant, not breaking down under pressure. On section it presents a white or yellowish-white colour, being more or less bloodless; is uniform and smooth; and little or no fluid can be expressed or scraped from the cut surface. Careful examination reveals minute bands of fibrous tissue running in all directions. Microscopically the change seems to consist mainly in thickening of the alveolar walls and minute bronchi, due to an imperfectly fibrillated and nucleated tissue, which undergoes degenerative changes. Most observers further describe an increase in the epithelial cells, which fill the air-vesicles and minute air-tubes, but Wagner denies this. The vessels also become thickened and ultimately obliterated.

It may be remarked that the bronchial tubes or their divisions may be affected with syphilitic disease, their submucous tissue, or occasionally their deeper structures, becoming infiltrated with a fibro-nuclear growth. Ulceration may take place, followed by cicatrization, and leading to thickening of their walls, and narrowing or even complete closure of their channel.

Symptoms.—In the present state of knowledge it is impossible to write with anything like definiteness respecting the clinical history of syphilitic disease of the lungs. As a matter of fact, in the majority of cases the lesions have only been discovered after death, no symptoms having occurred during life pointing to the lungs; or, these having been obscured by symptoms affecting other parts. In a case of recognised constitutional syphilis, attention should be paid to the lungs as well as to other organs, and it would be advisable to examine them from time to time, as physical signs might occur without any obvious symptoms to attract the patient's attention. If pulmonary symptoms should arise in a person undoubtedly syphilitic, or who had had syphilis, the possibility of the lungs being affected should specially be borne in mind. Among these symptoms hæmoptysis at an early period is said to be important. Physical examination might possibly reveal the presence of gummata, as evidenced by localised dulness, bronchial breathing, increased vocal fremitus and resonance, and other signs of consolidation. The most significant signs, however, are those indicating marked induration of the lung from fibroid infiltration, especially if unilateral, and confined to the base or middle portion of the organ. In course of time signs of cavities might become evident, due to breaking-down of gummata, or to dilated bronchi. The general symptoms are those of constitutional syphilis, combined with those of phthisis. There is but little or no pyrexia accompanying the pulmonary lesions; and the progress of the case is essentially chronic. The effects of treatment may be of peculiar significance in the diagnosis of syphilitic disease of the lungs. If such symptoms and physical signs connected with these organs as have been indicated above should disappear under the use of anti-syphilitic remedies, a diagnosis of this disease might fairly be made. Indeed some observers think that they frequently discover and cure it, but this is somewhat doubtful.

Treatment.—If syphilitic disease of the lungs be recognised or suspected, the appropriate treatment in most cases is to administer iodide of potassium freely and continuously. In some cases a mercurial course of treatment answers best; or perchloride of mercury might be combined with the iodide. It may be necessary to employ internal remedies or local applications for the relief of pulmonary symptoms. Cod-liver oil and tonics may be given with advantage for the amelioration of the general condition, in cases where such medicines are needed.

Frederick T. Roberts.

LUNGS, Tuberculosis of.—Tubercle is the most important morbid growth affecting the lung, but it is by no means a settled point what should be included under this term. Many pathologists only recognise as tubercle the so-called grey granulations; others regard the various masses and infiltrations noticed in cases of phthisis as of this nature, and they look upon tubercle in these organs as divisible into grey and yellow varieties, and arranged either in granules or as an infiltration. It is unnecessary in this place to discuss this subject further, as it is considered fully in other appropriate articles. *See* Phthisis; and Tuberculosis.

Frederick T. Roberts.

LUPUS ERYTHEMATOSUS (*lupus*, a wolf, or a rodent disease; and *erythematosus*, related to erythema).—Synon.: *Seborrhœa congestiva*.

Definition.—A chronic hyperæmia of the skin, attended by a new cell-growth, followed by interstitial absorption, and ending in scar.

Ætiology.—Women are more liable to lupus erythematosus than men, in the proportion of 8 or 10 to 1. It is rare before puberty, and most often begins between the ages of 20 and 30 years; but no age of adult life up to 60 or 70 is exempt. Weakly persons are thought by some to be most liable, but it may attack perfectly healthy people—at any rate there is no intimate connection with any other special disease. This affection is not hereditary. It attacks all classes of society.

Anatomical Characters.—The capillaries of the cutis are dilated, and a small-celled new-growth develops in it, close under the epidermis, around the orifices of the sebaceous and hair-follicles and the sweat-ducts. There is an increased secretion of sebum; and crusts of epidermis and fatty matter form. The terminal scar is due to destruction of normal tissue by the new-growth; partial fatty degeneration and absorption of the latter; and conversion of the remainder into permanent connective-tissue.

Symptoms.—Lupus erythematosus most often attacks the face. Small patches of well-defined crimson or purplish redness form on the skin of the cheeks or nose, and remain for a long period unaltered; they then become covered in parts with thin, firmly adherent, dirty-looking crusts, which if removed are found to send processes into the dilated mouths of the sebaceous glands. In the final stage, the redness gives place to a very superficial whitish scar. Confluence of several small patches gives rise to irregular patterns. When both cheeks are attacked at once, the patches tend to unite across the nose in the shape of a bat's wing or butterfly. The scalp often suffers, and there is permanent loss of hair. Other seats of lupus erythematosus are the ears, eyelids, lips, and backs of the hands; but it may exceptionally occur on the arms and legs, on the trunk, and on several parts at one time. There is no pain, or ulceration, but sometimes slight itching. Exposure to cold winds or to great heat aggravates the disease. In Germany an acute form has been observed, in which the eruption quickly covers a large part of the body; is attended with fever and prostration; and may end in death. The writer has seen such a case.

Complications. — Recurrent erysipelas has been noticed more often in lupus erythematosus than in lupus vulgaris. These two forms of lupus may occur in the same individual.

Diagnosis.—This disease is to be diagnosed from lupus vulgaris, by its commencement after puberty; by its very superficial character; and by the sebaceous crusts. From eczema, which it sometimes resembles at first sight, lupus erythematosus may be distinguished by the history, chronicity, trifling itching, and the presence of scars. For its diagnosis from acne rosacea *see* Acne.

Prognosis.—This disease is very chronic, and may last for years. Permanent cure is very doubtful, on account of the tendency to relapse. Except in the acute form, which is rare, there is no danger to life.

Treatment. — In the treatment of lupus erythematosus the first indication is to rectify any derangement of the general health. There is no specific internal remedy. Arsenic and mercury are not indicated; milk and cod-liver oil improve the nutrition. Externally, mild caustics suit best. Emplastrum hydrargyri should always be tried, spread thickly on linen, with enough oleum terebinthinæ to make it soft, and applied every night for a long period. The liniment or tincture of iodine can be painted on until slight inflammation is set up, and repeated after an interval; or spirit of soap (℞ saponis mollis ʒj, spiritûs vini ℥ss–ʒj) may be rubbed in in the same way, and let dry on. Stronger caustics, such as the solution of caustic potash, *require great caution in their use* (*see* Lupus Vulgaris). Some cases do best with soothing remedies—such as unguentum zinci benzoati, or a lead lotion (℞ liquoris plumbi subacetatis ℥j, glycerini, ℥ij) applied warm after the crusts are removed; and the latter are always of service in the intervals between the caustics.

Edward I. Sparks.

LUPUS VULGARIS (*lupus*, a wolf, or a rodent disease; and *vulgaris*, common).—Synon.: Fr. *Scrofulide maligne*; *Dartre rongeante*; Ger. *Lupus*; *Fressende Flechte*.

Definition.—A very chronic non-contagious disease of the skin and mucous membranes; chiefly due to an infiltration of small round cells into their substance; attended either with epidermic exfoliation, interstitial absorption, or destructive ulceration.

Ætiology.—The ætiology of lupus vulgaris is unknown. Some cases occur in scrofulous persons with enlarged or suppurating lymphatic glands, diseases of the bones and joints, &c., or in the children of consumptive parents; but in the larger number lupus affects perfectly healthy people. Most cases begin very early in life, from the second or third year up to puberty. The ulcerative form—*lupus exedens*—may begin still later, but it is very rare for it to do so after the thirtieth year. Women are somewhat more liable to lupus than men, and country people than townspeople. It is in no way due to syphilis, either hereditary or acquired; and instances in which two members of the same family are attacked are rare.

Anatomical Characters.—The cutis in lupus is infiltrated with vast numbers of small round cells of about 0·004 mm. in diameter, which encroach on and gradually destroy its proper tissues. The new-growth has a certain resemblance to granulation-tissue (Virchow). It is highly vascular, and contains new-formed capillary vessels. Nodules have been described, disseminated through the cutis, each consisting of one or more central multinuclear giant-cells, surrounded by bands of smaller cells which shade off into the granulation-tissue. These nodules exactly resemble grey tubercle (Friedländer). Some authorities regard these giant-cells as retrograde products, due to central fusion of the endothelial cells of sweat-ducts, blood-vessels, and lymphatics, with persistence of their nuclei (Lang). The epidermis covering the lupus-tissue is thickened; the lower cells of the rete mucosum are fattily degenerated, and contain reddish pigment. Lupus-tissue is very persistent. It may either undergo fatty degeneration and subsequent absorption, without lesion of the epidermis; or else the latter breaks down too, and ulceration is the result.

Symptoms.—Lupus usually begins as one or more small, smooth, reddish-brown, or reddish-yellow blotches, from the size of a pin's head to a split pea, which may be level with the skin, or else raised in the form of small tubercles. Several of these are generally aggregated into a patch, and a number of them may coalesce, so as to cover extensive surfaces of skin; but this is the exception rather than the rule. Any change that occurs is always slow, and a patch the size of a shilling or a florin may take years to form. In the non-ulcerative variety, thin, epidermic scales are continually thrown off from the surface of the tubercles—*lupus exfoliativus.* After a while, interstitial absorption of the lupus-cells begins in the older tubercles, and a bluish-white papery scar is left. In other cases the tubercles soften, ulcerate, and become covered with greenish-yellow adherent scabs, beneath which the ulcer extends. The surrounding parts are swollen, and the edge of the ulcer is pinkish. Removal of the scab exposes a loss of substance, with sharp-cut edges, and a granulating base covered with purulent secretion. The ulceration may attack structures deeper than the skin, and destroy cartilage, fibrous tissues, muscle, and even bone. The mucous membranes are not often primarily affected by lupus, though it often extends to them from the skin; instances are, however, recorded in which the larynx has been attacked, causing ulceration, partial destruction of the epiglottis, and warty outgrowths on the posterior wall.

Lupus may occur on any part of the body or limbs, but it has a special preference for the skin of the face. The non-ulcerative form chiefly selects the cheeks, and afterwards, in order of frequency, the nose, ears, legs, arms, and trunk. The ulcerative form — *lupus exedens* — begins almost exclusively on the nose, attacking chiefly its anterior portion, either the tip or the edges of the alæ. Sometimes it begins within the nostril. Unless proper treatment is at hand the nose may be entirely destroyed, and severe inroads made into the tissues of the cheeks, lips, and other neighbouring parts.

Complications and Sequelæ.—Lupus may co-exist with enlarged and suppurating glands in the neck and elsewhere; with various scrofulous affections; with phthisis; and with chronic Bright's disease. Great deformity may result from the contraction of the scars which it leaves, for example, ectropion, stricture of the nares, and distortion of the mouth. About a dozen cases have been recorded in which epithelioma developed on a patch of lupus of many years' standing, or on a lupus scar. We may regard such cases as arising from the stimulus of the proliferative processes in the cutis on the neighbouring epithelium.

Diagnosis.—The duration and position of lupus vulgaris, and the absence of thick scaliness and itching, will generally render it easy to distinguish this disease from circumscribed forms of psoriasis and eczema; and its commencement in early life will clearly separate it from epithelial cancer and rodent ulcer. It is with syphilis that it is most apt to be confounded, and the diagnosis between lupus exedens on the nose, and an ulcerating syphilide, is sometimes extremely difficult, or at first sight impossible. In these cases, after carefully considering the history, we must examine other parts of the body for traces of syphilis, and an inspection of the mouth and pharynx will often materially assist us; and lastly, the greater chronicity and slower extension of lupus, as well as its resistance to specific treatment, will generally lead to a correct opinion. Indolence is a character of special value in deciding between lupus and syphilis, particularly as affecting the mucous membranes. Syphilis has also more tendency to suppuration than lupus.

Prognosis.—Lupus is never fatal *per se*, but it can never be looked on in a favourable light, owing to its tendency to relapse under treatment, and its invariable termination in a contracting cicatrix.

Treatment—*Internal.*—Internal treatment is only of use in lupus vulgaris where the patient's general health is bad, or where well-marked symptoms of scrofula are present. In these cases great benefit may be derived from tonics, especially the iodide of iron, and from cod-liver oil in as large doses as can be tolerated. Nutritious food should be freely given; and the patient should take plenty of outdoor exercise in a bracing climate.

External.—The real cure for all forms of lupus must always consist in the destruction of the new tissue forming it, by caustic agents of various strengths. A number of such remedies have been proposed, but the successful application of each seems often to depend more on individual experience of its use, than on the superiority of any one caustic over the rest. The caustics most generally used are caustic potash, nitrate of silver, and acid nitrate of mercury. Equal parts of caustic potash and distilled water may be applied with a tiny piece of sponge, so as to limit the action as much as possible. The pain which follows is not of long duration—a point of much importance where a caustic must be repeatedly used. Solid nitrate of silver should be bored freely into all ulcerated parts or soft tubercles. The lupus-tissue offers but slight resistance to it, whereas it will not penetrate or injure healthy parts. Acid nitrate of mercury may be painted on with a glass brush. The crusts which form after any of these agents, fall off in ten days or a fortnight, and it is not advisable to repeat the application at shorter intervals. As a rule no dressing except zinc ointment is required. Some authorities prefer the actual or else the galvanic cautery, but both these measures have the disadvantage of disfiguring the parts, so that it is difficult to determine when healthy tissues are reached. Others advise multiple scarification, with one or more fine-bladed knives, so as to obliterate blood-vessels, and produce absorption by starving the lupus tissue and exciting inflammation

(Volkmann, Veiel). For a more detailed description of the mechanical methods of treatment, including that by 'scraping,' *see* APPENDIX. In the treatment of the superficial patches of lupus non-exedens, the repeated application of mercurial plaster during several months has sometimes been followed by absorption of the growth. Pyrogallic acid ointment (1 to 10) has been used by Hebra and others with much success. In other cases painting with tincture or liniment of iodine, and coating with gutta-percha foil, produces slow improvement; and where no ulceration exists, demanding active interference, these milder remedies deserve a trial. *See* APPENDIX. EDWARD I. SPARKS.

LYMPH (*νύμφη*, a nymph, water).—Physiologically, lymph signifies the fluid which circulates in the lymphatic system. Pathologically, the term is applied to the coagulable exudation which escapes from the vessels in inflammation. The name 'vaccine lymph,' or 'lymph,' is also given to the fluid contained in the vaccine-vesicle. *See* INFLAMMATION; and VACCINIA.

LYMPHADENITIS (*lympha*, lymph, and *adenitis*, inflammation of a gland).—Inflammation of lymphatic glands. *See* LYMPHATIC SYSTEM, Diseases of.

LYMPHADENOMA.—SYNON.: Hodgkin's Disease; *Anæmia Lymphatica* (Wilks); Fr. *Adénie* (Trousseau); *Lymphadénie* (Ranvier); Ger. *Pseudoleukämie* (Wunderlich).

DEFINITION.—A disease characterised by more or less widely-spread enlargement of the lymphatic glands, accompanied frequently by enlargement of the spleen, and by progressive anæmia.

HISTORY.—Cases of coincident enlargement of the lymphatic glands and spleen were noted by Malpighi (1669) and Morgagni (1752). The nature of the glandular change was first carefully described by Craigie, (1828); and the general clinical history of the affection was pointed out by Hodgkin (1832), and by Wilks (1856). The most important subsequent observations are those of Virchow (1864), Wilks (1865), Trousseau (1865), Wunderlich (1858 and 1866), and Murchison (1870).

NATURE.—The enlargement of the lymphatic glands, which consists at first of mere hyperplasia, and subsequently of fibroid induration, varies much in its extent. A few glands only may suffer, or every gland in the body may be enlarged. The former cases have the characters of a local growth; the latter is distinctly a general disease, for which the term *lymphadenosis* seems the most exact. The glands vary in consistence: when soft there may a considerable excess of leucocytes in the blood; when hard there may be simple anæmia. This difference does not afford sufficient ground for separation. The enlargement of the spleen is usually due to disseminated growths, arising in the Malpighian bodies: sometimes there is also hyperplasia of the splenic pulp, as in splenic leucocythæmia.

ÆTIOLOGY.—In two-thirds of the cases of lymphadenoma, no cause can be traced, and the ascertainable antecedents of the disease, in most of the remaining cases, evidently constitute only a small part of the influences to which it is due. Hereditary transmission has not been distinctly proved. The disease is three times as frequent in males as in females. It is met with at all ages, but is most frequent in early and late adult life. It occurs, but is not specially frequent, in children under ten years, and, having regard to the numbers living, it is least frequent between the ages of forty and fifty years. Intemperance, mental depression, insufficient food, and over-exertion have been noted, in rare cases, as antecedents. Exposure to cold, in several instances, has appeared to be the exciting cause of the affection. It is doubtful whether the disease has any relation to constitutional syphilis. In several cases the symptoms have first appeared after child-birth. Various febrile affections have, in a few instances, preceded the affection. The exciting cause which has been noted most frequently is some local irritation, as of a decayed tooth, discharge from the ear, sore-throat, inflammation of the lachrymal sac, or eczema. In these cases the glands nearest the source of irritation first enlarged, and then more distant ones became affected.

ANATOMICAL CHARACTERS.—The several groups of glands are affected in the following order of frequency, beginning with those most commonly diseased: cervical, axillary, inguinal, retro-peritoneal, bronchial, mediastinal, mesenteric. Subsidiary adjacent glands are often enlarged together with the chief groups, and nodular growths, similar to enlarged glands, arise in the course of the lymphatics in places in which the existence of glands is not usually recognised, so that continuous chains of nodules connect the various groups. The size attained by the glands in lymphadenoma varies from that of a bean to that of a hen's egg. At first the individual glands are separate and movable one on another. Ultimately they often unite to form a conglomerate mass, in consequence, in most cases, of the perforation of the capsules of the glands by growth, which may also invade adjacent parts. The cervical glands are usually enlarged in both the anterior and posterior triangle; and the submaxillary glands may encircle the neck beneath the lower jaw. They may press on the trachea or larynx, displace the latter, compress the internal jugular vein, and cause paralysis of the recurrent laryngeal nerve. The occipital glands are usually also enlarged. The axillary glands often form a mass of very large size, and prolongations may extend beneath the pectoral muscle. The glands in the anterior mediastinum frequently suffer, and the growth may extend to adjacent structures, such as the pericardium, which may be perforated. The thymus may be involved, secondarily or primarily, or may escape. The bronchial glands are diseased more frequently than the cardiac glands, and the trachea and bronchi may be pressed upon, or the lung invaded. The retro-peritoneal glands often form a mass of large size, which may surround and compress the solar plexus, causing symptoms similar to those of Addison's disease. Enlargement of the mesenteric glands is neither common nor considerable. The inguinal group is frequently diseased, and the femoral vessels and crural nerves may be thereby compressed. The consistence of the enlarged glands may be either soft or very hard. Usually, the longer the enlargement has existed, the firmer are the glands. Their section is more uniform than in health. The colour is yellowish or whitish-grey. In the firmer glands dense tracts of fibrous tissue are seen to pass in different directions. Rarely the follicles have a different appearance, being opaque and yellowish from fatty degeneration, whilst the septa are white and conspicuous, from fibroid thickening. Caseation is, however, rare, and when it occurs is commonly confined to one or two glands. When caseation is general, the cases are of a form intermediate between lymphadenoma and scrofula. The softer glands yield a juice on scraping; the firmer glands yield no juice. In the former, the only histological change is an enormous increase in the cellular elements—the lymph-corpuscles of the reticulum; but the relations of the septa and follicles often remain normal. Sometimes the cell-growth invades the septa, which become split up and disappear; and it may even, in a similar manner, perforate the capsule. The firmer glands present much fibrous tissue, which may be confined to the septa, or invade also the delicate network in the substance of the gland; and then the cells gradually disappear, and the whole substance of the gland may be transformed into a fibrous mass. The tracts of fibrous tissue may have under the microscope a peculiar vitreous aspect, especially around the arteries.

The spleen is diseased in at least four-fifths of the cases, usually in consequence of disseminated growths, often irregular in shape, arising from the Malpighian corpuscles, yellowish or greyish white, rarely caseating, and usually corresponding in consistence, and resembling in structure, the glands in the same case. The splenic pulp may be normal in quantity, or may be compressed and atrophied. In some cases it is also increased in quantity, and this increase may even be the sole change. In such cases the morbid changes of lymphadenoma and splenic leucocythæmia coexist, and there is often a much greater increase in the white corpuscles of the blood, than when the spleen is the seat of simple growths. The size attained, in the cases of nodular growths, is not great, the weight being from ten to thirty ounces. When the splenic pulp is increased, the size attained is rather greater. In the latter case the enlargement is uniform, while it may be irregular when there are growths. The medulla of bones has been found, in rare cases, to present a change similar to that met with in splenic leucocythæmia and pernicious anæmia. Collections of adenoid tissue elsewhere often undergo changes similar to that of the lymphatic glands. The tonsils, the mucous membrane of the pharynx, the œsophagus, the stomach, and the large and small intestines, may all be the seat of growths, originating in the follicular glands, and sometimes ulcerating. The liver is often the seat of scattered lymphoid growths, usually minute, varying in size from a small pea to a pin's-head. They occupy the interlobular spaces. Rarely larger nodular growths are found. In other cases the liver is simply congested. Similar minute growths are often found in the kidneys, chiefly in the cortex; and these organs may also be the seat of parenchymatous degeneration. The peritoneum may be inflamed over enlarged glands, or may be the seat of growths. Growths have also been found in the testicles; and frequently in the lungs, where they may break down and form cavities.

Symptoms.—The most important symptoms of lymphadenoma are due to the altered blood-state, and to the enlarged glands. The latter cause the earliest symptoms, and the cervical glands are commonly the first to enlarge. When the internal glands are primarily affected, pain and pressure-signs may precede other symptoms. Occasionally the signs of anæmia precede those of the local change; and, in rare instances, irregular febrile disturbance may occur before the glandular enlargement. The affected glands are smooth, and present, at first, a peculiar mobility, which may disappear when they become adherent, and constitute an irregular lobular tumour of some size. They are usually painless, except during periods of rapid growth. A diminution in size has been observed before death. The enlargement of the cervical glands may cause the neck to equal, or even exceed, the head in circumference. The pressure on the veins may cause symptoms of passive cerebral congestion. The larynx may be displaced; and the movements of the lower jaw may be interfered with. Pressure on the trachea, by the glands in the neck and in the posterior mediastinum, may cause dyspnœa and even death by suffocation. That on the pharynx and œsophagus may obstruct deglutition, and cause death by starvation. The enlargement of the axillary and inguinal glands may interfere with the movement of the limbs, and impede the circulation. Various and serious pressure-effects result from the enlargement of the thoracic and abdominal glands, obstruction in veins, pressure on nerves, &c. The enlargement of the spleen can usually readily be felt, but does not commonly give rise to symptoms. Anæmia is one of the conspicuous symptoms, and may precede, or succeed, obtrusive affection of the glands. The red corpuscles may be reduced to fifty, thirty, and even twenty-five per cent. of the normal. In most cases there is no marked excess of white corpuscles, but occasionally they are much more numerous than normal. In almost all cases in which their excess is comparable to that met with in splenic leucocythæmia, the splenic pulp is increased in quantity, and the lesions of splenic leucocythæmia and of lymphadenoma are conjoined. The liver may be enlarged from the disseminated growths, and from congestion. Jaundice only occurs from the pressure of enlarged portal glands upon the bile-ducts. Ascites may be due to similar pressure, or to the blood-state, being then part of general dropsy. The function of the kidneys is rarely affected. Stomatitis, sometimes ulcerating, results from the lymphoid growth in the mucous membrane; and a similar change in the stomach causes interference with digestion and vomiting—symptoms which are increased by the anæmia. Slight dyspnœa results from the blood-state, while intense difficulty of breathing, and even actual suffocation, may occur from the pressure of enlarged glands on the trachea or bronchi. The functions of the nervous system are variously deranged by the ill-nourished blood. Towards the end there may be convulsions, delirium, and coma. Pyrexia is a frequent, but not invariable symptom. It is almost always present in early life, much less common at advanced ages. The temperature may be considerably raised, even when the glandular enlargement is slight; the elevation varies from two to six degrees, and may be continuous, or with daily remissions, or periods of considerable elevation may alternate with periods in which it is only slightly raised.

Complications.—The pressure-effects of the enlarged glands, already mentioned, are sometimes so considerable as to give rise to complications, as thrombosis in vessels, pleural and pericardial effusions, and bronzing of the skin from disease of the solar plexus. Intercurrent affections, occasionally met with, are Bright's disease, pneumonia, fatty degeneration of the heart and liver, erysipelas, pemphigus, boils, and other effects.

Course and Duration.—The disease may remain local for a long time, even years, affecting one group of glands only, and subsequently slowly becoming general. When the general enlargement of glands is established, the disease rarely lasts more than two years. It usually terminates fatally by asthenia; but not rarely by some secondary effect of the morbid process, as asphyxia, starvation, diarrhœa; or by a complication, especially by pneumonia.

Pathology.—The changes in the glands in lymphadenoma resemble, in the early stage, those which result from simple irritation; and, as has been seen, the first enlargement often appears to be excited by local irritation. Clinically, however, the disease has a semi-malignant aspect. Dr. Wilks therefore assigned to it a position between cancer and tubercle. Its history suggests that it is due to both constitutional and local causes, and that the extent of these two elements varies in different cases. The constitutional predisposition apparently affects chiefly the lymphatic structures. The assumption of such a predisposition is necessary to explain the general affection of the glands which characterises some cases in the beginning, and also the persistence of the affection when it begins locally, as well as its subsequent extension. In the latter case, however, a process of secondary infection may be at work, the lymphatic tissues, already predisposed, becoming affected by the circulation in the blood of a *materies morbi* derived from the structures first diseased. Some cases present characters intermediate between lymphadenoma and scrofula—the low tissue-vitality of the latter leading to wide fatty degeneration and caseation of the new growth, instead of its fibroid transformation. The existence of an excess of white corpuscles in the blood does not present valid ground for separating certain cases from the rest, and calling them 'lymphatic leucocythæmia.' Most of such cases are, as has been said, forms of mixed disease. In simple lymphadenosis the Malpighian follicles of the spleen are diseased, and when there is a considerable excess of leucocytes in the blood, the splenic pulp is usually also increased in quantity. The anatomical lesions of splenic leucocythæmia and lymphadenosis are conjoined, and to the increase in the pulp the leucocytal excess is due. Occasionally, however, when the diseased glands are soft, lymphoid corpuscles, changed in character, pass from them into the blood, and persist there, leading to an excess of the pale cells. When the glands are hard, the production of lymphoid cells, and their passage into the blood, seem interfered with, and thus simple anæmia results.

Diagnosis.—Local glandular growths cannot be sharply separated from cases of generalised lymphadenoma, although they may be clinically distinguished. Generalisation may ultimately occur, even though one group of glands has alone been diseased for many years. In splenic leucocythæmia the glands are only affected late in the disease, after considerable enlargement of the spleen has existed alone for a long time. When the spleen presents great enlargement, and the glands are affected early, the case is usually of the mixed form above described, both splenic pulp and follicles being diseased. In scrofulous enlargement of the glands, the disease is commonly confined to a single group of glands which have been subjected to local irritation; some of the glands often soften and suppurate; the affection occurs chiefly in early life; and the other constitutional signs of scrofula are present. Cancer of the glands differs widely in its microscopical characters from lymphadenoma, but clinically the distinction from a local lymphoma may be difficult, and turns chiefly on the slow extension of cancer to neighbouring glands, and in its subsequent localisation in organs rather than in lymphatic structures.

Prognosis.—When the disease is widely spread, or the local growths considerable in size, a fatal termination is almost certain. The duration, however, in each case, varies much. The younger the patient, the better the preceding health, the longer is the duration of the disease. The consistence of the glands has little prognostic value. The softer they are, the more rapid is the course of the disease; but, on the other hand, if it is influenced by remedial agents, the soft glands can be restored to a better functional condition than the hard. The prognosis is worse the more profound the anæmia. Elevation of temperature as a rule indicates a rapid course, but to this there are some striking exceptions, as in one case under the writer's care, in which the glandular enlargement continued slight, although the temperature for twelve months was always above the normal.

Treatment.—The possibly infecting influence of the primary glandular enlargements has led to their extirpation. Where other glands, or the spleen, has been enlarged, the operation has done no good; and, in such cases, surgical interference is only justified by impending death from the local pressure. But where the affection has been confined to one group of glands, the progress of the disease has been retarded by their removal, and in some cases, the malady has even been cured. The degree of anæmia is of great importance as influencing the prospect of benefit, and even of survival from the operation, and the actual proportion of corpuscles should, in all cases, be estimated by the hæmacytometer. An operation should never be performed if the proportion of red corpuscles is less than 60 per cent. of the normal. A slight excess of white corpuscles does not militate against the success of an operation. Other methods of local treatment have been employed, with some benefit, especially rubbing and shampooing, the alternate application of heat and cold, compression, and blistering. Galvanopuncture is useless. Various substances have been injected into the glands—iodine, nitrate of silver, carbolic acid, arsenic. The last has alone appeared useful (Winiwarter), but it was, in all cases, given internally at the same time. Of internal remedies arsenic is incomparably the most potent. It should be pushed to the largest doses the patient can bear, as ♏xv. of liquor arsenicalis three times daily. It often causes some pain in the glands, followed by their diminution in size, and even, in a few recorded cases, by their complete disappearance. Although such a favourable result has not come under the writer's personal observation, he has seen a marked diminution obtained in the size of glands which were before steadily enlarging, a diminution which has been maintained for years. Phosphorus has been given in the disease (first by Verneuil), but it is far less useful than arsenic. Iodine and iodide of potassium are of little service. Cod-liver oil is useful when there is any indication of a scrofulous diathesis. Mercury and carbolic acid have been given internally without success. Iron, useless alone, has sometimes appeared to do good when given in conjunction with other remedies. Change of air, general tonics, and careful diet are often of considerable service, especially when employed along with other measures. W. R. GOWERS.

LYMPHANGEITIS (*νύμφη*, water, or lymph, and *ἀγγεῖον*, a vessel).—Inflammation of lymphatic vessels. *See* LYMPHATIC SYSTEM, Diseases of.

LYMPHANGIECTASIS (*lympha*, lymph, and *angiectasis*, vascular dilatation).—Lymphatic varix, or varicose dilatation of lymphatic vessels. *See* LYMPHATIC SYSTEM, Diseases of.

LYMPHATIC SYSTEM, Diseases of.—SYNON.: Fr. *Maladies du Système Lymphatique*; Ger. *Krankheiten des Lymphsystems.*

There is no essential difference between the lymphatic and lacteal systems, which together constitute the absorbent system. In this article attention will be briefly directed to those diseases of the lymphatic vessels and glands which are more or less of a local nature; and what is stated with regard to the former will apply generally to the lacteals, but attention will be directed to any points connected with these vessels calling for special notice. Some of the affections involving these structures are considered in separate articles, and need, therefore, merely be mentioned here; while the mesenteric glands are discussed independently (*see* MESENTERIC GLANDS, Diseases of). It may be remarked that recent pathological investigations point to the existence of important relations between the absorbent system and certain diseases, namely, some of those belonging to the zymotic class, and those depending upon septic conditions, such as plague, typhus and typhoid fever, diphtheria, erysipelas, glanders, malignant pustule, snake-bite, dissection or post-mortem wounds, and certain forms of serous inflammation, such as puerperal peritonitis. Moreover, the lymphatic vessels seem to be materially affected in some skin-diseases, such as erythema and elephantiasis; while there are structures which consist mainly of lymphatic follicles, and their diseases principally affect these follicles. The absorbent system is also concerned in an important degree in conveying morbid products from one part of the body to another, such as cancerous elements, tubercle, or the syphilitic poison, and thus of disseminating these diseases through the system. These points are more fully dwelt upon in their appropriate articles, and now the individual diseases of the lymphatic system will be discussed in their appropriate order.

1. **Acute Inflammation.**—According to the structures involved, acute inflammation, connected with the lymphatic system, presents three varieties, namely:—(*a*) where the vessels are alone affected—*lymphangeitis* or *angeioleucitis*; (*b*) where the condition is limited to the glands—*adenitis*; or (*c*) where both vessels and glands are involved. It will be convenient to consider these varieties together. As a rule the disease is localized, but under certain circumstances the lymphatic system is more or less widely implicated, especially if the inflammation is of a septic character. It may be set up and extend with great rapidity.

ÆTIOLOGY AND PATHOLOGY.—The causes of acute inflammation of the lymphatic vessels or glands may be thus indicated:—1. *Traumatic*, including such injuries as wounds, contusions, or a severe strain. 2. *Irritation from without.* Strong heat, as that of the sun, may set up inflammation of the superficial lymphatics. Pressure or friction may also produce this effect upon the vessels or glands. It is not an uncommon practice to excite inflammation artificially in the glands, for the cure of certain of their diseases, by injecting irritants into their substance. 3. *Irritation from within.* This may be due to inflammation in the vicinity, suppuration, ulceration, diseases of joints or bones, and other causes. In medical practice the implication of the glands under the jaw, in cases of diphtheria and scarlatina, is a familiar illustration of this class of cases; or the inflammation of the glands behind the ear in cases of impetigo of the head. It may also be noticed here that the lymphatic vessels are more or less involved in phlegmasia dolens. 4. *Specific irritations.* These deserve separate recognition, and include syphilis, gonorrhœa, and various septic poisons, which frequently affect the lymphatic structures. Inflammation of the absorbent glands is also an important feature in plague, glanders, and other diseases.

With regard to the modes in which the inflammation is set up, this may happen in several ways. In the first place, the cause may act directly upon the lymphatic vessels or glands, as in the case of injury. Secondly, these structures may be involved by extension from neighbouring parts. Glands are frequently affected in this way; and lymphatic vessels may be involved by continuous extension of irritation from inflamed organs, serous membranes, or other structures with which they are connected. Thirdly, the cause of the inflammation is often more or less remote from the situation in which it appears, especially in the case of the glands. This may arise from the condition passing continuously along the vessels from some seat of irritation to the glands in their course; or morbid products may be carried by the current of lymph to the glands, the vessels themselves being unaffected, when the inflammation thus set up is said to be *sympathetic*. In other instances pus has been found within the lymphatic vessels, having made its way from some seat of inflammation. It may also be mentioned that lymphatic inflammation may originate a similar condition in other structures, such as the joints, and this may be of a purulent character.

Inflammation is much more readily excited in the lymphatic structures in some persons than in others, and especially in those who are of a strumous habit. The glands are more liable to be affected in the early periods of life. A low state of the general health may predispose to inflammation of these structures from slight causes. Glands which are chronically enlarged, as the result of inflammation, are very liable to become the seat of acute inflammation from slight causes.

ANATOMICAL CHARACTERS.—Inflammation affecting the lymphatic vessels presents two forms, but they may be met with together. When the minute capillary network is involved, the condition is termed *reticular lymphangeitis*; the skin and its capillaries are generally affected at the same time, so that there is more or less diffused redness, but it may present a reticulated arrangement. *Tubular lymphangeitis* signifies that the main vessels are implicated. They are visible on the surface as red lines, straight or wavy, passing to the glands. They become dilated, and their walls thickened. Their internal coat is opaque and uneven, and the endothelium often disappears. Coagulation of the lymph within the vessels takes place, closing up their channel. The coagulum may become organised, so that they are permanently obliterated; or it may soften and even suppurate at the centre, and the products may enter into the general circulation, and thus cause septicæmia or pyæmia. The inflammation is liable to extend to the surrounding cellular tissue, leading to exudation, hyperplasia of cells, and consequent swelling and thickening.

Inflammation of lymphatic glands is characterised in the early stage by swelling, congestion, and increased firmness. The lymph accumulates, exudation takes place, and abundant cells are present. The inflammatory process may soon subside, terminating in resolution. In many cases, however, suppuration ensues, especially in certain forms of inflammation, this commencing in the centre of the glands, the cavities of which become more or less speedily filled with pus. The inflammation spreads to the surrounding cellular tissue, and, an abscess being formed, the pus makes its way to the surface. If the glands are internal, they may burst there, and lead to serious consequences; or by merely setting up irritation in adjacent structures, they may produce similar results. Sometimes the glands remain permanently enlarged and indurated, especially after repeated attacks of inflammation; and they may become adherent to the parts around. A single gland may be inflamed, but it is common for a cluster or a chain of glands to be involved. In some cases the inflammation assumes a more or less sub-acute character, and the progress of events is slower.

SYMPTOMS.—These are *local* and *general*. The *local* phenomena consist of subjective sensations, and objective signs. Pain is felt at the seat of inflammation, which may be very severe, often accompanied with a sense of heat or burning, and stiffness or tension. There is usually marked tenderness, and this may be present when little or no spontaneous pain is complained of, while it is often remarkably limited to the line of an affected lymphatic vessel. Movement also increases the pain. The subjective sensations are more severe as a rule when the glands are involved. When suppuration takes place, the pain tends to assume a shooting and throbbing character. As regards objective signs, inflamed lymphatic vessels, if superficial, are usually visible as red lines, either straight or wavy, running in the direction of the glands; or there may be separate red patches. Should they be deeply situated, however, the vessels cannot be seen. The larger trunks may be felt by the fingers, being cord-like, firm, and knotted. The surrounding tissues are seen and felt to be more or less swollen and indurated. If the circulation of the lymph is much interfered with, a limb may be considerably enlarged, and presents a feeling of firmness and solidity, owing to the occurrence of lymphatic œdema.

When the lymphatic glands become inflamed, their enlargement can be detected, and the surrounding tissues may also be swollen. At first they feel firm, but if suppuration takes place they become more and more soft, and at last present a sensation of fluctuation. The overlying skin is markedly red, and there is often subcutaneous œdema. Suppurative inflammation of lymphatic glands constitutes the condition known as 'bubo.' If not opened artificially, the abscess ultimately bursts externally, but it may burrow considerably before doing so, and the opening is often imperfect. *See* BUBO.

The *general* symptoms accompanying inflammation of the lymphatic structures vary in their intensity in different cases, according to its severity, extent, and results. In the slighter cases there is no obvious constitutional disturbance. As a rule, however, more or less fever, with its accompanying symptoms, sets in, preceded often by shivering or even distinct rigors. If suppuration occurs the rigors may be repeated; the pyrexia increases; and more or less wasting follows, if there should be prolonged discharge of pus. Where the inflammation is of a septic character from the first, or when septic matters are conveyed into the circulation, the general symptoms are exceedingly grave, being similar to those indicative of septicæmia from other causes, such as repeated rigors, high and erratic fever, great weakness and prostration, low nervous symptoms, weak and rapid cardiac action and pulse, and other typhoid phenomena. The termination is then usually fatal.

TREATMENT.—In the management of any acute inflammation affecting the lymphatic vessels or glands, the first indication is to get rid of its cause, if this be practicable. In the next place rest is of essential importance, and the affected part should be so placed as to avoid all pressure or tension. As regards *local* treatment, the application of heat and moisture, by means of fomentations and poultices, usually answers best. To these anodynes may be added, if necessary, especially belladonna; and the latter may be often applied with advantage in the form of extract, mixed with glycerine. It is not uncommonly advisable to take away blood locally from the neighbourhood of inflamed glands, by means of leeches. Some authorities maintain that suppuration may sometimes be prevented by counter-irritation around the glands, effected by applying blistering-fluid or strong iodine. If suppuration take place, the progress of the pus towards the surface must be encouraged by the usual means, and the abscess opened at the appropriate time. Should *general* treatment be required, at first it is usually necessary to keep the patient on low diet, to open the bowels well, and perhaps to administer some simple saline mixture. When suppuration occurs, a more or less supporting tonic and stimulant treatment is called for. In septic cases the free use of alcoholic stimulants, with the administration of full doses of quinine or salicine, constitutes the appropriate treatment.

2. **Chronic Inflammation.**—It is only the lymphatic glands which can be said to be liable to this affection—*chronic adenitis.* They may remain in a condition of chronic inflammation after one or more acute or sub-acute attacks; or this is set up as a chronic affection from some continued or repeated irritation. Formerly a low form of chronic inflammation was regarded as the primary lesion in scrofulous or tubercular glands, and some pathologists still hold this view. The affected glands are enlarged and firm, and usually somewhat painful and tender. These changes may be due partly to a hyperplasia of the gland-structures, partly to an exudation into their midst. Frequently they continue in this condition for a long time, without undergoing any obvious change, but they are liable to acute exacerbations from slight causes. They may ultimately become the seat of caseous degeneration, or of suppuration, even though there is no evident scrofulous diathesis. The circulation of the lymph through the involved glands is prevented to a greater or less degree. Usually there is no constitutional disturbance, unless a considerable number of glands are implicated, or they degenerate or suppurate.

TREATMENT.—It is not desirable to allow chronic adenitis to continue, as unpleasant or even serious consequences may ensue, and therefore it should be subjected to proper treatment without delay. Any source of irritation must be removed at the outset. Gentle friction over the enlarged glands, with some simple oleaginous or greasy material, may be effectual in reducing them, or it may be necessary to rub in weak iodine ointment, or to paint the surface with tincture of iodine. Counter-irritation by blisters may be sometimes useful. Internally cod-liver oil and quinine are frequently of much value; preparations of iron are also often very serviceable, especially the syrup of the iodide.

3. **Scrofulous or Tubercular Disease.**—The morbid condition of the lymphatic glands thus named may be conveniently discussed here, as the ultimate effects produced are very similar to those which result from chronic inflammation in certain cases. This affection, however, is supposed to be one of the manifestations of a particular diathesis—the *scrofulous* or *tubercular*—in which the absorbent glands are very prone to become the seat of certain changes of a destructive character. It will be discussed at greater length in other articles, and here it will suffice to offer a few general remarks on the subject.

ÆTIOLOGY.—Scrofulous disease of the glands often occurs in those who present obvious characteristics of the diathesis; but this is by no means always the case, for the subjects of the glandular affection may be apparently strong and healthy. Children and young persons are by far most frequently affected. The glandular change may originally be set up by some irritation, which seems to give it a start, but in many instances there is no such obvious cause, and it appears to commence spontaneously. Once an absorbent gland becomes the seat of scrofulous changes, others in connection with it, or even at a distance, are very liable to become secondarily implicated.

ANATOMICAL CHARACTERS.—Scrofulous disease may involve the lacteal as well as the lymphatic glands, and of the latter those within the body may be affected, as well as those which are external. This disease of the lacteal glands is separately discussed (*see* MESENTERIC GLANDS, Diseases of); and also that of certain lymphatic glands within the chest (*see* BRONCHIAL GLANDS, Diseases of). Of the external glands, those in the neck and under the jaw are most commonly involved. The changes always go through a more or less chronic course. At first the glands become enlarged and firm, and, according to most observers, this seems to be merely due to a hyperplasia of the lymphatic elements. These, however, possess but a very low degree of vitality, and have a marked tendency to degenerate and disintegrate, so that the tissues become destroyed. Ordinarily caseation takes place, the substance of the glands becoming yellow and softened; then a slow process of unhealthy suppuration generally ensues, leading to the formation of chronic abscesses. The skin over them presents a congested appearance, and is often undermined for some distance, the subcutaneous tissues being involved in the suppurative process. If the abscesses are not properly opened, they are liable to cause much destruction of the skin, and to leave unhealthy sinuses and ulcers when they burst of their own accord. If they subsequently heal, this is often attended by extensive scarring, and the scars are permanent, but become less marked in course of time. In some cases the glands do not suppurate, but after caseation they become calcified and inert; it appears that this result may take place even after the formation of pus, which then becomes inspissated, and mixed up with calcareous matter.

SYMPTOMS.—In the case of the external glands, with which we are now concerned, the changes above described can be observed clinically. They are attended with little or no pain, but there is usually more or less tenderness. Constitutional symptoms are usually prominent, when the glands become to any extent the seat of scrofulous disease. There may be the symptoms of the diathesis; but the glandular affection itself also tends to produce wasting, anæmia, general weakness, and more or less pyrexia, which, if there should be abundant suppuration, is apt to assume a hectic type. If the glandular disease is limited, however, the system may suffer but little or not at all; and even after it has been extensive and severe, so as to lower the patient very much, recovery may take place under appropriate treatment, the patient ultimately becoming strong and robust. When the internal glands are affected, they may give rise to symptoms from their mere mechanical presence, such as those indicative of pressure or irritation; and if destructive changes occur in them, very serious results are liable to be produced. The general symptoms are also usually more marked in these cases, and may become extreme in degree. It must be remarked that it is highly probable that phthisis may be set up by an infective process, in connection with suppurating or caseous scrofulous glands.

TREATMENT.—*General* treatment is of essential consequence in the treatment of scrofulous disease of glands. The patient should be placed under the most satisfactory sanitary conditions that can be obtained; but in many cases this is a very difficult matter, and it is of great importance, if possible, to remove from their unhealthy and often wretched homes those suffering from this affection, and to treat them in suitable sanatoriums or hospitals. They should be as much as possible in the open air, and a change of air will often prove of decided benefit to those suffering from scrofulous glands. Residence at the seaside, with sea-bathing, is also of much service, or a sea voyage may be desirable. The digestive functions require careful attention and regulation; and the food must be nutritious, including abundance of good milk, fresh eggs, and such articles of diet. As regards medicines, those which are usually indicated are cod-liver oil, quinine, and preparations of iron, especially the syrup of the iodide, steel-wine, or Parrish's syrup. Where there is much suppuration, marked benefit has been found to result from the administration of minute doses of sulphide of calcium, and from chloride of calcium.

Local treatment is usually called for. In the early stages attempts may be made to cause absorption of the enlarged glands, but these must be cautiously conducted. Gentle friction, the application of preparations containing iodine or certain iodides, and the use of poultices or fomentation of sea-weeds, are the measures usually adopted. In some cases it certainly seems the best plan of treatment to try to encourage suppuration in glands which are in a torpid state, and which cannot be absorbed. For this purpose they have been injected with irritants. Suppuration and its consequences must be treated on ordinary principles; but it should be remarked that abscesses should not be allowed to burst of their own accord, but need surgical interference, as otherwise they may lead to much destruction of the skin and subcutaneous tissues.

4. **Hypertrophy and Atrophy of Glands.** The lymphatic glands become *hypertrophied* under different circumstances. In some cases there is a mere local hypertrophy, which shows no tendency to progress towards other parts, and which may be due to some obvious irritation, or independent of any known cause. As has been already pointed out, hypertrophy is the early condition of scrofulous glands. This morbid change is most important, however, in connection with the disease termed *lymphadenoma*, or *Hodgkin's disease*, in which there is a progressive enlargement of the lymphatic glands; and with one form of *leucocythæmia*. These affections are discussed in separate articles. Without entering upon any lengthy description, therefore, it will suffice to remark that in these affections the enlargement varies much in degree and extent in different cases; that it is due simply to an increase of the normal lymphatic structures; and that the glands usually show no tendency towards any degenerative or destructive change. Clinically they are recognised by their obvious physical characters when superficial; or by physical signs when situated in internal cavities. As a rule they are painless; but may give rise to various symptoms by their mechanical pressure, irritation, or destructive effects. In many cases more or less severe general symptoms are present. *See* LEUCOCYTHÆMIA; and LYMPHADENOMA.

Atrophy of lymphatic glands may occur after inflammation; as a senile change; after the removal of a limb, or its long-continued want of use; or from other causes. No definite effects can be referred to this condition, but if there should be extensive glandular atrophy it might obviously interfere with the due nutrition of the blood and general system.

5. **Morbid Formations and Deposits in Glands.**—Under this heading the following may be considered:—

a. Cancer.—The various forms of malignant growth frequently involve lymphatic glands. In most cases the disease is secondary to cancer in some neighbouring part, and the glands are very prone to become involved, owing to the cancer-elements being directly conveyed to them by the lymphatics. This is well exemplified by the implication of the axillary glands when the breast is the seat of cancer. Not uncommonly, however, the formation is primary in the glands, and then involves other structures by direct extension or convection. All forms of malignant disease are met with, but the encephaloid variety is most common. When secondary, however, it generally approximates in characters to the primary formation, and hence may be of a scirrhous or melanotic nature. It may also be mentioned here that secondary sarcoma occurs in the lymphatic glands. The growth may attain a considerable size, and it is more or less nodulated. The consistence will depend on the variety of the cancer; often it is soft, and a milky juice escapes on pressure. If cancerous glands are external, they can be recognised on examination, and are usually painful and tender.

When situated internally they give rise to physical signs of their presence, either in the chest or the abdomen; and to more or less pressure-symptoms; which may be combined with the constitutional symptoms of malignant disease. It may be very difficult to distinguish clinically between cancerous glands and lymphadenomatous growths situated internally.

b. Albuminoid disease.—The glands are liable to be involved in conditions which give rise to albuminoid degeneration. On section they present the peculiar waxy, pale, translucent, homogeneous appearance characteristic of tissues which are the seat of this change. The glands may be enlarged; but when they attain a considerable size, this is partly due to hypertrophy. In other cases they are small and firm. This condition may give rise to symptoms by pressure, as sometimes happens in the case of albuminoid glands in the portal fissure, which may cause ascites or jaundice.

c. Pigmentation.—The bronchial glands may be the seat of a deposit of black particles in cases where the lungs are thus affected, as in miners, colliers, &c. They are enlarged to some extent, and black; and a black liquid escapes on pressure. This condition does not give rise to any obvious symptoms. More or less pigmentation of these glands is often observed with advancing age.

d. Syphilitic growths.—The glands in the groin are affected from the irritation of the primary syphilitic sore, and others are often involved in connection with its secondary and tertiary effects; but no doubt they are also liable to become the seat of special syphilitic formations.

e. Tubercle.—The condition of glands usually termed 'tuberculous' has been already considered, but sometimes distinct grey granulations are found in connection with acute tuberculosis. They originate in the follicles of the glands.

TREATMENT.—Practically the treatment of the morbid formations in glands just considered, if any be called for, consists in measures directed against the constitutional condition of which they are a manifestation. In the case of cancer, operative interference may be demanded. Symptoms, especially those resulting from pressure, may also require special treatment.

6. **Chronic Changes affecting Lymphatics.**—The lymphatic vessels are subject to two principal classes of chronic changes, namely (*a*) *Dilatation* and *hypertrophy*: and (*b*) *Obstruction.*

a. Dilatation and hypertrophy—Lymphangiectasis.—Leaving out of consideration the thoracic duct and receptaculum chyli, the lymphatics, either superficial or deep, and also the lacteals, may become more or less dilated and hypertrophied. Even the vessels of internal mucous or serous membranes may be thus affected. In most cases the larger trunks are implicated, but the capillary plexuses are sometimes chiefly or alone involved. With regard to the causes of this condition, it is often congenital, and has then been attributed to a want of specialisation in the lymphatic system of certain parts. In other cases it is evidently due to some obstruction to the circulation of the lymph, and consequent enlargement of the vessels behind the impediment. Such obstruction may be seated in the glands or vessels, and in the latter case may be due to internal plugging or to external pressure. In some instances the enlargement of the lymphatics partakes of the character of a primary hypertrophy, either alone, or along with other tissues, as in connection with elephantiasis and other growths, of which enlarged lymphatics constitute an important element. Dilatation has been also attributed to a supposed paralysis of the muscular coat of the lymphatic vessels. Lymphangiectasis is most common in warm and moist climates.

There are various forms which enlarged lymphatics assume. Thus, there may be simply a localised dilatation of the capillaries, constituting a visible freely-anastomosing reticulum or network. More commonly the trunks are enlarged, assuming a tubular, fusiform, varicose, saccular, or cirsoid form. Or a distinct growth may be produced, which has been specially termed *lymphangiectasis*, and has been divided by Wagner into three varieties—(i.) *simple*; (ii.) *cavernous*; (iii.) *cystoid*—names which sufficiently indicate their several peculiarities. The walls of the vessels are often more or less thickened from hypertrophy. Dilated lymphatics are liable ultimately to give way, with consequent escape of the lymph.

Clinically the conditions now under consideration are visible when superficial, or when occurring on a surface which can be inspected. The appearances will differ according to the particular morbid change present. There may be a distinct tumour; or the enlarged lymphatics may only form one element in certain growths. Cystic formations originating in the lymphatic system are said to be most common in connection with the upper lip, tongue, and neck. It is beyond the province of this article to describe these conditions in any detail. Enlargement of the superficial lymphatics is chiefly observed on the inner side of the thigh, the sides of the abdomen, and the scrotum and penis; they appear in the form of vesicles like grains of sago, grouped regularly or irregularly. Sometimes only ampullæ are formed, which are generally soft and painless. These conditions have been mistaken for hernia, abscess, scrofulous glands, and other diseases. Should the dilated lymphatics rupture subcutaneously, vesicles containing a clear or milky fluid appear. They may rupture on the surface of the skin, the lymph being discharged externally, which is an important element in the diagnosis of doubtful cases. When dilated absorbents are situated internally, they cannot be recognised unless they should happen to rupture, with the escape of their contents by some outlet. This applies mainly to the lacteals, the contents of which may pass out with the stools, and to the urinary mucous membrane, it being supposed by some pathologists that the condition termed *chyluria* is merely due to the rupture of dilated lymphatic vessels in this membrane.

b. Obstruction.—As in the case of dilatation, the capillary plexuses or larger lymphatics may be obstructed. This may arise chiefly from plugging of their channels by coagulated lymph; inflammation of the vessels; pressure by enlarged glands, aneurisms, or other tumours, or merely as a result of inflammation of the cellular tissue around the vessels. It may be remarked here that lymphatic tissues, similar to those observed in the glands, sometimes form here and there in the course of the lymphatics in cases of lymphadenoma. The lymphatics of the urinary mucous membrane are also supposed by some pathologists to become the seat of aggregation of the animal parasites named *filariæ*, and they consider that this is the cause of chyluria.

The effects liable to be produced by obstruction of lymphatic vessels are swelling, from so-called lymphatic œdema; and dilatation of the vessels behind the obstruction, which may lead to their rupture. It is by these effects alone that this condition can be recognised clinically.

Treatment.—But little can be done for the chronic changes now under consideration affecting lymphatic vessels. Proper bandaging, or the use of some elastic support, may be of use in treating dilated vessels, if they happen to be conveniently situated. Friction and kneading may assist in removing lymphatic œdema due to obstruction. Growths come under the treatment of the surgeon, and do not call for any special remark here. Frederick T. Roberts.

LYMPHATIC TEMPERAMENT. *See* Temperament.

LYMPHOMA.—A synonym for lymphadenoma. *See* Lymphadenoma.

LYMPHORRHAGIA or **LYMPHORRHŒA** (*lympha*, lymph, from νύμφη, water; and ῥήγνυμι, I burst forth, or ῥέω, I flow).

Definition.—These terms literally signify a flow of lymph, but they are used to indicate an abnormal discharge from any part of the absorbent system, whether it be of lymph or of chyle.

Ætiology and Pathology.—Lymphorrhagia may take place from the lymphatic capillaries or trunks; from the lacteals; from the absorbent glands; or from the receptaculum chyli or thoracic duct. Cases in which this condition occurs are usually divided into *traumatic* and *idiopathic*, according to their apparent causation. In the former the cause is a wound, which generally affects either the thoracic duct, the larger lymphatic trunks, or the glands. A discharge of lymph has in rare instances followed even a slight wound, particularly in the neighbourhood of joints, and this was attributed by the late Mr. Messenger Bradley to a constitutional defect—a *lymphorrhagic diathesis*, corresponding to the hæmorrhagic diathesis. *Idiopathic* lymphorrhœa is almost always the result of dilatation of a vessel or vessels, which ultimately rupture. They are often greatly distended before they give way. Allusion may again be made here to the supposed relation of chyluria to the presence of *filariæ* in the lymphatic vessels of the urinary organs, these parasites causing them to rupture, and the lymph consequently being discharged with the urine.

Symptoms and Effects.—Should an escape of lymph take place upon any part of the surface of the body, it differs much in its quantity and characters in different cases. It may be less than an ounce, or amount to five and even ten pounds within the twenty-four hours; while in the same case its quantity is liable to variation from time to time, and the flow has even been known to assume a periodic character, increasing during the period of digestion. In traumatic cases the discharge either presents the ordinary appearance of lymph, being clear and limpid, or it is mixed more or less with blood or with inflammatory products. When rupture takes place spontaneously after dilatation of the vessels, the fluid is more like chyle, being more or less milky and white, from the presence of particles of fat, but its characters are liable to alter from time to time. It contains a variable quantity of fibrinogenous elements, and is proportionately disposed to coagulate spontaneously. Internal lymphorrhagia causes different results. In the case of the intestines and urinary organs, the fluid is discharged with the fæces and urine respectively, in the former case being supposed to give rise to fatty stools, and in the latter to chyluria. The late Mr. Bradley attributed some cases of effusion into serous cavities, such as certain forms of hydrocele, hydrocephalus, pleuritic effusion, and ascites, to a lymphorrhagia into the respective cavities; and the writer has met with a case of ascites which seemed to support this view. Fatal peritonitis has resulted from the entrance of chyle into the peritoneum, owing to the rupture of a dilated receptaculum chyli. The escape of lymph or chyle out of the system tends to affect the general health, and if it is in large amount, this is likely to lead to marked emaciation, debility, and anæmia.

Treatment.—In external lymphorrhagia all that can be done is to check the flow of lymph by pressure of bandages, and the application of astringents. In cases where it takes place into internal passages, tincture of iron in full doses may be of service. The general condition must be attended to, and improved by nutrients and tonics, if required.

Frederick T. Roberts.

LYPEMANIA (λύπη, grief, and μανία, madness).—The name applied by Esquirol to the form of insanity characterised by mental depression, usually called melancholia. *See* Melancholia.

LYSIS (λύω, I dissolve).—This word had formerly various significations, but is now generally applied to the *gradual* decline of any disease or pathological process, especially fever. *See* Fever.

M

MACULÆ (*macula*, a spot or stain).—Synon.: Fr. *Macules*; Ger. *Flecke.*

Description.—Willan's definition of macula is 'a permanent discoloration of some portion of the skin;' and that author adopted the term as the title of his eighth order of cutaneous affections, including sunburn, nævus, and spilus. The term macula is likewise applied to a hyperæmic state of the skin, which may be simply chronic without being permanent, such as those which have received the name of *maculæ syphiliticæ*. Maculæ, therefore, may be merely pigmentary, and located in the rete mucosum alone; or they may be hæmostatic or hæmorrhagic, and be seated in the derma and subcutaneous tissues. Sunburn, freckles, liver-spot, bronzed and melasmic spots, and the stains left on the skin after the dispersion of certain cutaneous eruptions, such as lepra vulgaris, acne, lichen planus, syphilis, and elephantiasis, are examples of pigmentary maculæ, whilst leucosmic spots and blotches represent an absence of pigment. The maculæ resulting from a permanent hyperæmia of the blood-vessels of the skin, such as flat vascular nævi and the claret-stain nævus, are hæmostatic and disappear under pressure; whilst the hæmorrhagic maculæ are represented by the escape of the red corpuscles of the blood from the vessels, and their diffusion in the connective tissues, such as occurs in purpura and in bruises.

Treatment.—The therapeutics of maculæ will be found treated of under the heads of pigmentary affections of the skin, and of the respective diseases with which they are associated.

Erasmus Wilson.

MADEIRA; North Atlantic Ocean.—Moist, mild, equable, relaxing climate. Mean temperature in winter, 60·6° Fahr. Prevailing wind N.E. *See* Climate, Treatment of Disease by.

MADNESS. *See* Insanity.

MADURA-FOOT.—A synonym for fungus-foot of India. *See* Fungus-Disease of India.

MAGGOTS.—A popular term for the parasitic larvæ of various insects, including bots. *See* Œstrus.

MAGNETISM, ANIMAL.—This name was formerly applied to the imaginary new force or principle, supposed to be akin to magnetism, and to be in operation when individuals were 'mesmerised.' This hypothetical new force was thought to be called into play by the mesmeriser; and it was deemed to be by virtue of its influence that the will, thoughts, and actions of the 'medium,' or person mesmerised, are capable of being influenced in the so-called mesmeric trance or sleep. This view as to the nature of the causal conditions is now regarded as altogether erroneous, although certain remarkable effects appear to have been produced on many persons by so-called 'mesmeric passes,' or other means, owing to the induction in such persons, under physiological conditions, of some at present imperfectly understood state or modification of cerebral activity (*see* Mesmerism). This state is now generally spoken of as the 'hypnotic condition,' 'hypnotic sleep,' or 'hypnotism'; or more rarely as 'induced somnambulism.' On the other hand, when such a state is induced, as a therapeutic means or agency, it has been spoken of as 'Braidism.' *See* Braidism.

H. Charlton Bastian.

MALACOSIS (μαλακὸς, soft).—A term for the morbid softening of structures. *See* Softening.

MALACOSTEON (μαλακὸς, soft, and ὀστέον, a bone).—A peculiar disease of bone, characterised by softening. *See* Mollities Ossium.

MALAGA, in South of Spain.—Dry, mild, bracing, equable climate. Mean temperature in winter, 55° Fahr. Winds: N.W. (*Terral*), dry and dusty; E. (*Levante*), cold and damp. Drawbacks: bad drainage and cookery. *See* Climate, Treatment of Disease by.

MALAISE (Fr.)—Synon.: Indisposition; Ger. *Missbefinden.*—In cases of simple digestive derangement, in ague, and in the stage of invasion of many acute diseases, the patient very commonly first becomes aware that his health is disturbed by a feeling of general illness, which is known as malaise.

Description.—Under the circumstances just mentioned, the ordinarily unconscious feeling of being well, or *bien-être*, which accompanies perfect health, is replaced by a painful and depressing feeling, which the patient probably cannot describe otherwise than as a sense of being weak, languid, listless, and disinclined to bodily or mental exertion. Malaise is commonly associated with bodily debility, chilliness or actual rigors, moderate pyrexia, general pains or aches, giddiness, headache, and anorexia. In the course of the more serious diseases in which it occurs, malaise either passes off or soon gives place to more urgent symptoms—such as depression, apathy, delirium, or stupor; but in other instances it persists, and constitutes the chief subjective phenomenon of the disease, as in some cases of typhoid fever.

Treatment.—The treatment of malaise will depend upon the nature of the cause of the feelings just described, and should be directed to its removal or remedy. J. Mitchell Bruce.

MALARIA (Ital.).—Synon.: Marsh Miasm.; Fr. *Mauvais Air*; *Intoxication des Marais*; *Intoxication Tellurique*; Ger. *Malaria.*

Definition.—An earthborn poison, generated in soils the energies of which are not expended in the growth and sustenance of healthy vegetation. By almost universal consent this poison is the cause of all the types of intermittent and remittent fevers, commonly called *malarial*, and of the degeneration of the blood and tissues resulting from long residence in places where this poison is generated.

The Italian word *malaria* is now employed to convey the meaning expressed in the above definition. It is certainly preferable to the term *marsh miasm*, which implies that marshes are the sole source of the poison. M. Léon Colin, Professor of Military Medicine in the Val-de-Grace, who has written an instructive work on malarial fevers, does not use the term malaria to distinguish the agent that causes them; he prefers the term telluric poison, *intoxication tellurique*, proceeding from the energy of the soil, when that energy is not absorbed by its natural consumers, crops or plants—in a word, healthy vegetation. This telluric influence or poison is, however, after all, a malaria, a bad or poisonous air under another name.

Essential Nature.—Chemists have not been able to demonstrate the presence of a malaria—a fever-generating agent—in the air of marshes, any more than they have been able so to do in other places where the same fevers prevail. Much light has, however, been thrown upon the intimate nature of the malarial poison, by the researches of Professors Tommasi Crudeli, of Rome, and Klebs, of Prague, who made the physical cause or poison to which malarial fevers are due the subject of careful investigation in the *Agro Romano*, in the spring season of 1879. They examined minutely the lower strata of the atmosphere of the district in question, as well as its soil and stagnant waters; and in the two former they discovered 'a microscopic fungus, consisting of numerous movable shining spores, of a longish oval shape, and nine *micromillimètres* in diameter. This fungus was afterwards artificially generated in various kinds of soil; the fluid matter thus obtained was filtered, and repeatedly washed; and the residuum left after filtration was introduced under the skin of healthy dogs. The same thing was done with the microscopical particles obtained by washing large quantities of the surface soil. All the animals experimented upon had the fever, with the regular typical course, showing free intervals, lasting various lengths of time up to sixty hours, and an increase of the temperature of the blood during the shivering fits up to nearly 42° C.; the normal temperature in healthy dogs being from 38° to 39° centigrade. The animals affected by intermittent fever showed precisely the same acute enlargement of the spleen as human patients who had caught the disease in the usual way; and in the spleens of these animals a large quantity of the characteristic form of fungus was present.' Tommasi Crudeli and Klebs have given to this organism the name of *Bacillus malariæ*.

Doctors Marchiafava and Valenti, of Rome, affirm that they have detected the *Bacillus malariæ* in human patients, in a more advanced stage than in the animals operated upon by Crudeli and Klebs. Dr. Crudeli still more recently states, as the result of further pathological investigations, that the bacilli may always be found in the blood during the period of invasion of the fever; but that during the acme they disappear, and spores only can be discovered. The bacilli have been found chiefly in the spleen of the human subject; and in the marrow of bones in animals experimented on. The bacillus has not yet been found in Bengal. According to the researches of Laveran, extended and corrected by Richard, the blood in malarial fever contains, during the accession, spherical organisms, developed in connexion with the red corpuscles, and furnished with filaments; also certain curved and pointed bodies, which are only infected and deformed corpuscles. The pigment granules of malarial blood are produced in the red corpuscles during the growth of the organisms. *Lancet*, 1882, vol. i. p. 993. Should future investigations by independent observers in other malarial regions confirm these conclusions, it would be difficult to overrate their importance.

Genetic Relations.—When we consider that in many regions of the globe two-thirds of the mortality is caused by the fevers, and their sequels, to which this poison gives rise, we can understand why all that relates to malaria is important to the statesman, the soldier, the sanitarian, and the physician. 'Fevers,' says Dr. Cornish, the Sanitary Commissioner of Madras, 'one year with another destroy twice as many people in India as small-pox, cholera, and all other epidemic causes put together.' Dr. Parkes has well said 'that when a climate is called "unhealthy," it is simply meant that it is malarious.' This remark is especially true of tropical climates. Malaria has generally been said to be the product of heat, moisture, and vegetable decomposition. The terms *marsh miasm*, and *paludal fevers*, long employed to distinguish the poison and the fevers to which it gives rise, mark the almost universal belief that the air of marshes alone is endowed with the power of generating them. That low, moist, and warm localities are generally noted as malarious is indisputable. Marshes are not, as a rule, dangerous when abundantly covered with water; it is when the water level is lowered, and the saturated soil is exposed to the drying influence of a high temperature and the direct rays of the sun, that this poison is evolved in abundance. The production of malaria on a great scale in this way was seen in the district of Burdwan, in Bengal. The soil is alluvial, but dry; and, until within the last few years, Burdwan was more salubrious than the central or eastern districts of the Lower Gangetic delta. The drainage of the district became obstructed by the silting up of its natural and artificial outlets, the result being a waterlogged condition of the soil, the development of malaria, and an alarming increase in the death-rate.

Malaria is, however, generated under conditions apparently widely different from the above. When the British Army under Wellington was operating in Estremadura, the country was so arid and dry for want of rain, that the rivers and small streams were reduced to mere lines of widely detached pools; yet it was assailed by a remittent fever of such destructive malignity 'that,' says Ferguson, who records the fact, 'the enemy and all Europe believed that the British host was extirpated.' A fever of like malignity scourged the same army in the bare open country by which Ciudad Rodrigo is approached from the side of Portugal, at a time when, says the same author, 'the vegetation was so burned up that the whole country resembled a brick-ground.' It must, however, be kept in mind that both districts are in the rainy season flooded with water, at which time they are healthy, until the drying process begins under the action of a powerful sun.

Malaria is notoriously rife in soils the upper strata of which are rich in organic matter, and are from any cause left to nature and the influence of the sun. The Roman Campagna[1] is a well-known example of this kind. M. Léon Colin has explored this tract of country in search of the commonly recognised sources of malaria, and reports it everywhere dry and free from stagnant water. But the cultivating hand of man has long been withdrawn from this once fertile region, and the energies of its rich soil, instead of being directed to food-producing ends, are wholly given up to the development of malaria, for which it is notorious.

It is well known that so-called malarial fevers prevail in some of the most sterile regions of the earth. Here, it is often said, 'there is no organic matter, no vegetative energy running waste, on which to fall back for an explanation.' Yet many of those desert places, to all appearance under the curse of perpetual barrenness, do contain organic matter, and are in reality so full of vegetative energy, that water only is wanted to fit them for the productive labour of the husbandman. There are millions of acres in India, now supplying abundant harvests, which, if water was withdrawn, and the cultivating hand of man withheld, would quickly relapse into deserts fruitful only in malaria.

We need not go to tropical countries in search of examples of this kind: our own country can furnish them in abundance. So late as the reign of the sister of Elizabeth, 'to whose name a horrible epithet adheres,' large tracts of country from political causes fell out of cereal cultivation, and forthwith malarial fevers became epidemic, attended with a heavy mortality.

The disturbance of soil that has long been fallow is often followed, both in hot and temperate climates, by the evolution of malaria. A familiar example was the prevalence of intermittent fever in Paris during the construction of the Canal St. Martin; also during the excavations for the fortifications of the same city, in the reign of Louis Philippe; and on a larger scale in different parts of France when the railways were in process of construction.

Malaria is freely generated at the bases of mountain ranges in tropical climates. The strip of land extending along the base of the Himalaya, called the *terrai*, is a notable example of this kind. The soil of this region is immensely rich, well supplied with water, and covered with dense forests, which with the vast mountain range makes free perflation of air impossible. At particular seasons of the year it is almost certain death to enter this region.

Some rocks in a state of disintegration, when freely exposed to the drying action of the sun and air, are in tropical countries often highly malarious, and give rise to severe forms of fever. The example most familiar to the writer from personal knowledge is the island of Hong-Kong. The soil, according to Dr. Parkes, contains only about 2 per cent. of organic matter; but like all granitic rocks it is highly absorbent of water; and Friedell, quoted by the same authority, affirms that it is permeated by fungi. The writer was encamped on this island before it was ceded to the British Government. At this time the soil was but little disturbed, and the troops did not suffer. But when excavations were made at a subsequent time, for the construction of the city of Victoria, on the side of the island facing the harbour, a fatal form of remittent fever appeared, which caused great mortality among both the civil and the military population.

Parkes (*Practical Hygiene*) thus sums up his account of the soils with the largest organic emanations: '1. Alluvial soils, old estuaries, deltas. Peaty soils are much less malarious. Marshes overflowed regularly by the sea are often healthy, while the occasional admixture of salt water increases the emanations. 2. Sands, if there is an impermiable clay or marly subsoil. Old watercourses. 3. The lower parts of the chalk, where there is a subsoil of gault or clay. 4. Weathered granitic or trap rocks, if vegetable matter has become intermixed; such soils absorb both heat and water. 5. Rich vegetable soils at the foot of hills.'

When malarial fevers appear in ships returning from unhealthy climates, the explanation is to be looked for under one or other of the following causes:—(*a*) the sufferers may have had their systems charged with malaria before embarkation, as is constantly seen in the case of invalids returning from India; (*b*) they may have used water on board drawn from a malarious locality; (*c*) the source of the malaria may be in the ship, from decayed vegetable matter mingling with the bilge water, in ships under a bad sanitary *régime*;[1] or (*d*) it may be derived from malarious mud, as in the case of H.M. ship 'Powerful,' returning from India, when a severe outbreak of fever was traced to this cause. There is, however, reason to believe that when fever has been observed to follow the consumption of unwholesome water at sea, it has sometimes been not malarial but enteric, from the unsuspected presence in it of the specific germs of that disease.

Instances are also recorded, in which symptoms having a periodic character, and yielding to the treatment which is effective in malarial diseases, have resulted from exposure to decaying vegetable matter, a connection of which with a special marsh poison could not well be traced.

Attributes.—Malaria, however generated, possesses certain properties well known to those who live in malarial localities. Temperature exercises great influence over its development and activity; many places can be visited with impunity in winter which are dangerous in summer and autumn. Wenzel made observations on the effect of temperature in the development of malaria during the construction of the fortified port of Jahde; he observed that the increase of attacks of malarial fever was coincident with a rise in the temperature. In the charts constructed by him to illustrate the point, a constant precedence of the temperature curve by twenty or twenty-five days of the sickness curve of attacks is to be seen; so that in a temperate climate like that of Jahde, three weeks of increased temperature appeared to be necessary for the genesis of the malarial poison, and the outbreak of sickness. When in any year the medium summer temperature did not reach 12° R. (59° F.) the sickness remained at its minimum.

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[1] Every sanitarian must wish success to the gigantic schemes suggested by Garibaldi to make Rome fit in a sanitary point of view for the capital of Italy, and to purify the pestilential Agro Romano. In the present state of matters Rome is unsuitable for a capital, except for reasons purely sentimental.

[1] The writer is indebted to the late Dr. Mansfield, R.N., for an instructive example of a fatal form of yellow malarial fever on board H.M. ship 'Egmont,' long used as a storeship at Rio. The ship was found to be in a state of decay; the timbers were permeated by fungi of a white or cream colour, giving off a sickening and offensive odour.

Malaria drifts along plains to a considerable distance from its source, when aided by winds sufficiently strong to propel, but not to dispel it. Under the influence of currents of heated air it can ascend, in dangerous concentration, far above its source, and buildings elevated some hundreds of feet above a malarious plain are often more under its influence than those on the plain itself. When favoured by ravines and currents of heated air, it can scale mountains to a height which appears to differ in different climates, varying from four or five hundred to two or three thousand feet. It is unsafe to place human habitations on the edge of such ravines on mountain tracts generally considered above 'fever-range.' A belt of forest interposed between any malarial place and human habitations affords considerable protection, and a sheet of water similarly placed exercises an absorbing power—facts long familiar to sanitarians. Soils protected from the sun's rays by forest trees are generally healthy; but when exposed to the sun after the forests have been cleared away, malaria is evolved until the land is brought under cultivation.[1]

Pathological Relations.—The physician can demonstrate the existence of malaria by the best of all tests, namely, its pathological action. This action has been recognised for ages in the property it possesses of producing a class of fevers distinct from all others in their symptoms and sequels, to which the name of *malarial* or *paroxysmal* has been given; the latter term from the almost clock-like regularity of the periods of apyrexia and recurrence. Pathologists have also recognised its power of impressing on other disorders, in a lesser degree, the same stamp of periodicity, and its more insidious but not less dangerous endowment of inducing that 'slow blight of the constitutional powers' to which the term *malarial cachexia* is now applied. The most striking features of this condition are easily recognised. The sufferers appear much older than they are; the skin assumes a brownish yellow tint, of various shades, according to the natural complexion of the person and length of residence in an unhealthy climate. They become anæmic, with an immense increase in the white corpuscles of the blood. The rapidity with which this anæmia is developed is surprising. Professor Kelsch has shown by carefully conducted observations made by Malassez's method, that in twenty-four hours a man affected with intermittent fever lost more than a million of globules per millimètre cube. This condition of the blood often gives rise to murmurs, not confined to the cardiac region, but heard also in the large vessels, misleading unwary observers into a false diagnosis of organic disease. Persons whose blood is thus so affected are prone to attacks of a fatal form of pneumonia, if exposed to cold when not protected by sufficiently warm clothing. Their digestive and heat-generating powers are impaired, and they are liable to diarrhœa from slight causes, often of an intractable kind. The liver is generally enlarged, but the most characteristic lesion is enlargement of the spleen, which often attains such a size as to occupy a large part of the abdominal cavity. There is in the pathological museum at Netley a preparation of the section of a spleen taken from the body of a small drummer boy, who had been under the care of the writer. This lad had spent some years of his brief life in the Peshawur Valley. The weight of the spleen was 10 lbs. 15 oz., that of the liver 9 lbs. 10 ozs. The condition was alike in both organs, an immense development of connective tissue having taken place. These two organs made up one quarter of the total body-weight of the boy. Both spleen and liver, and sometimes even the brain and spinal cord, are deeply pigmented. The urine is sometimes albuminous, with œdema of the lower extremities—symptoms suggestive of Bright's disease, leading to a grave prognosis, often ill-founded, as the above symptoms usually disappear under good climatic and therapeutic means.

Neuralgic affections, varied and numerous, are common sequels of malarial poisoning; 'brow ache' is a familiar example. To the above may be added palpitation of the heart, rheumatic pains in limbs and joints, and amenorrhœa; and if, as often happens, scurvy be engrafted on the malarial cachexia, such of the above affections as may be present are at once seriously aggravated.

Tropical dysentery prevails in its worst forms in malarial localities; the same is true of suppurative inflammation of the liver. It seems probable that when malaria acts as a predisposing cause of dysentery, it is taken into the system through the medium of water. It is a significant fact, elsewhere insisted on by the writer, that exactly in proportion as we have banished malaria from the soil of the British Islands, so has dysentery disappeared as an endemic disease.

The late Dr. Cutchliffe, of the Bengal army, noticed that in some very malarious districts in the Bengal Presidency, large numbers of males were impotent, the women proving fruitful with males from other non-malarious regions. In such localities, also, the children of those affected are often born, not only with the external signs of the malarial cachexia, but also with the visceral changes and pigmented organs described above.

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[1] A popular belief has arisen that the blue gum tree of Australia, Eucalyptus Globulus, is particularly efficacious in this way. This tree is now popularly known as the 'fever tree,' and is being extensively planted for protective purposes in the malarious parts of Italy. Its supposed virtues are said to be due to the camphoracious constitution of the leaves of this noble, gigantic, and rapidly-growing tree. It is a notable fact that the extensive pasture lands of Australia are very free from malaria, and the fact is there attributed to the existence of vast forests of the blue gum tree.

All the species of eucalyptus grow with amazing rapidity; wherever they are planted they are great consumers of moisture, and thus exercise a drying influence on the subsoil, which must have a considerable effect on the climate where they exist in large numbers.

Since we cannot yet affirm that the essential nature of the malarial poison has been discovered, we may notice two other theories that have been advanced. It need only be said of the few who maintain that the grave pathological changes attributed to malaria are all explicable either on the hypothesis of 'chill,' according to Dr. Oldham, or 'certain electrical conditions,' according to Dr. Munro, that they have a difficult thesis to support. If 'chill' will account for the loss of 10,000 men at Walcheren, for the frightful disaster of a like kind at Carthagena, for the terrible visitation of paroxysmal fevers in the Mauritius, and countless examples of the same kind, and for the yearly loss of life in India from fevers—the country in which Dr. Oldham serves, why, seeing that mankind are exposed to 'chill' everywhere, are not such fevers with their sequels universal in their prevalence, instead of being confined to places under one or other of the conditions described in this article? Why, above all, in a country like Great Britain, where vast multitudes of the population are hourly exposed to every variety of atmospheric change, have paroxysmal fevers, once endemic there, disappeared, save in such exceptional places as are still under one or other of the conditions described above? No satisfactory answer has been given to this question. As for the 'electrical conditions' of the other hypothesis, when its author can explain what these conditions are, and why they no longer exist in the British Islands, or do not produce their usual effects, we shall be prepared to discuss their value from a pathological point of view.

W. C. Maclean.

MALARIAL.—Pertaining to or connected with malaria; for example, *malarial fever*, *malarial region*, *malarial poison*. *See* Malaria.

MALFORMATIONS (*male*, amiss, and *formo*, I fashion).—Synon.: Fr. *Malformations*; Ger. *Missbildungen*.

Definition.—Deviations from the normal standard, in the size, form, number, or situation of any part or organ of the body.

Varieties and Ætiology.—The malformations of the human body may be conveniently considered under two distinct heads, namely—(A) *Acquired* malformations, more commonly called *deformities*; and (B) *Congenital* malformations.

A. *Acquired Deformities.*—Acquired deformities may be the result of disease, affecting, for instance, the spine, which may become curved, or the joints, or the tendons. Similarly, the bones may be the seat of deformity, as in rickets, mollities ossium, or osteitis. Certain injuries and accidents, such as burns, scalds, fractures, and dislocations, lead also to a great number and variety of deformities. Various habits, customs, and occupations, by giving rise to pressure on certain parts of the body, by altering the amount of blood circulating through them, or by interfering with their due innervation, bring about changes in the relative size and shape of the bony or soft textures, and so lead to malformations. It is thus that the brow is flattened by certain tribes of American Indians; the waist deformed, and the corresponding viscera compressed and dislocated, by means of the tight-lacing practised by more civilized peoples; and the feet distorted by many nations, especially the Chinese. Not only is such a striking example as the common depression of the lower part of the sternum in shoemakers a deformity, but the huge development of certain groups of muscles at the expense of others induced by some occupations, must be looked upon in the same light, for these, too, are deviations from the normal outline of the human figure. Besides these cases, which may be termed primary malformations, many others of a secondary character, that is, dependent on some antecedent change or lesion, are frequently seen. These may occur in organs correlated in growth, as the absence of hair on the face and pubes, and the increase of subcutaneous fat, if from any cause the testicles waste, or if they are removed before puberty. Absence of, or disease in, any part which causes the disuse of other parts, also induces a secondary deformity, as the atrophy and degeneration of a group of muscles, or of a limb, when the nervous supply is in any way interrupted either at the centre or the periphery. The brief reference which has been made to these acquired malformations will suffice, and this article will be devoted to a consideration of the large class of congenital deformities, and of these to such only as are of a general character. Special malformations of organs will be noticed with the diseases of those organs, such as the brain, heart, and liver. Deformities of the chest, which are a subject of the greatest interest to the practitioner, are also separately discussed. *See* Deformities of the Chest.

B. *Congenital Malformations.*—Since the appearance of the classic work of Isid. Geoffroy St. Hilaire, congenital malformations have been grouped and classified, and their causes determined with such approximate accuracy, that, in place of the superstitious beliefs and incredible absurdities which formerly prevailed, a distinct branch of pathological anatomy has been established, namely, that of Teratology. Instead of considering a monstrosity as a presage of some misfortune, a proof of divine vengeance, an effect of witchcraft, the result of intercourse with the lower animals, with demons, or even with women during menstruation or pregnancy, we now trace it either to a malformation of the original germ, or to some cause interfering with its development, and inducing either an excess or a deficiency of parts or organs. Starting from the normal standard, we find varieties in development of all kinds in two complete series, namely, an ascending series, from a mere supernumerary digit to double or even triple monsters; and a descending series, from the mere default of a digit or organ, or the union of digits, to monsters with scarcely a trace of human structure, forming an almost shapeless mass. Besides these, we may have excess or defect in the size and development of various organs and parts, or of the body *en masse*, leading to the formation of giants and of dwarfs. In other cases, development and size are normal, but the viscera are transposed, and this, too, may be either general or partial. From the moment of fecundation the ovum is exposed to various influences, which may alter its normal development; and it depends on whether it is subjected to these at an early or a late stage, as to whether complex or simple anomalies result.

1. **Malformations by Excess.**—Reference will first be made to the formation of monsters by excess. Two ova may be formed in one Graafian vesicle, for double-yelked eggs are well known; but there is no evidence to show that these would form a double monster. Indeed, Professor Allen Thomson found on incubating a dozen of such eggs, that not one produced a double embryo; whilst Wolff observed two completely separate fœtuses developed upon a single yelk. The arrival of two impregnated ova in the uterus at the same time will probably give rise, not to double monsters, but to twins, and their fusion seems almost impossible. We are thus led to the opinion that monsters by excess depend on an error of development taking place in a single germ; and this idea is more readily tenable since Allen Thomson has shown that, in birds, two primitive grooves may be formed on one yelk and in one *area germinativa*, for in this way the most complete cases of double monstrosity can be explained. In confirmation of this theory, the researches of Lereboullet may be quoted. This observer has seen, instead of the single budding of the blastoderma, which is ordinarily developed into the embryo of the fish, two or even three buds marked off; and these, during the process of development would meet at some point, and in this manner produce parts of distinct embryos where they are separate, whilst a corresponding region of a single organism only would be formed at the point of junction. According to the mode and extent of the junction of the blastodermic buds, the monsters would vary; and so would be derived all the different varieties, from a duplicity of the face or head, the upper or lower extremities, to such extreme cases as the Hungarian sisters, and the Siamese twins, who were joined by the xiphoid cartilage only, and the twin negresses (Millie and Christine) who are united by their lower lumbar vertebræ, sacrum and coccyx. In these cases all the viscera are not completely isolated and double, for in the Siamese twins three peritoneal prolongations were found in the connecting band, and there was a vascular communication between their two livers. In the case of Millie and Christine, there is a single anus and a single vulva, but two hymens, two clitorides, and very probably two vaginæ and uteri. The Hungarian sisters, Helen and Judith, had but one vaginal orifice, although the upper part of that organ was divided into two, and the two intestines met in a single anus, placed between the four thighs. The Bohemian sisters Rosalie and Josepha, more recently exhibited, in whom there is a junction of the posterior wall of the pelvis, present apparently a single urethra and a single anus, but a double vagina. Still more curious are the monstrosities which are only united by their vertex, as the cephalopages, where the two fœtuses are placed end to end; and the metopages, where they are placed parallel, face to face, and sternum to sternum. In one of these cases, two normal brains, completely separated by their membranes, were found on dissection. These compound monsters always have a single chorion, a single amnion, and a single placenta, though the umbilical cord may be double. They are always of the same sex, and their capability of living depends on their having an almost completely double organisation, or on one individual being reduced to such a state of atrophy as to be a mere appendage to the other, who is almost normal in other respects. The condition of the brain and of the heart are the most important factors with regard to their viability. They have never transmitted their peculiarities to their offspring.

2. **Parasitic Monsters.**—The parasitic family of monsters are characterised by a more or less rudimentary individual being implanted on, and growing at the expense of, another who is fully formed. This parasite may either exist as a supernumerary head, or limbs, or may be almost complete; it may grow from the head, maxillæ, or lower part of the trunk; and when the genitals exist, it is found to be of the same sex as the chief individual. Some of these cases attain to adult life, and if they have any children, these are well-formed. From such instances the transition is easy to those monsters in which the parasite is either included under the skin, or even, during the approximation of the visceral laminæ, becomes implanted inside the abdominal cavity, as is well seen in a specimen in the Hunterian Museum of the College of Surgeons. In these an arm, a leg, or a hand may be found; fragments of bone are common; and even nervous, muscular, or glandular structures may occur. A fibrous capsule is formed around these vestiges, and if they are sufficiently nourished from without, they may live a kind of vegetative life; but more frequently they degenerate or decompose by contact with the air, and so cause the death of their host.

3. **Malformations by Deficiency.**—In the case of monstrosities by deficiency, we again have every grade, from those almost without human form, to the simplest malformation due to a non-development or defective union of some parts of the embryo. The acardiac monsters are always products of a twin conception; and the amount of their development depends on the period of its arrest, and on the degree of anastomosis between their umbilical vessels and those of the normal fœtus. Slighter malformations are caused by physical or mechanical influences acting on a single individual, or by some pathological lesion. Panum and Dareste, by experiments on this subject, have shown that different degrees of heat, and mechanical shocks always lead to some malformation, and that the same agency always produces the same malformation. Lesions of the amnion and placenta, and twisting of the funis around the fœtus, are fertile causes of deformity. On dissection a large number of deviations are found to be dependent on inflammatory processes, causing morbid adhesions and serous effusions. These interfere with nutrition, and so lead to an arrest of development. Again, as in after-life so in the embryo, a primary lesion may induce a secondary one, as when club-feet are caused by a defect in the nervous centres. In the production of malformations, causes of a general nature affecting the parents must not be left out of consideration; for syphilis, chronic alcoholism,

and hereditary influences are undoubtedly very potent factors. The writer attaches but very little importance to Demeaux's suggestion—unsupported as it is by any valid evidence—that copulation in a state of drunkenness may engender malformations; but he is inclined to give more credit to maternal impressions during pregnancy as an agent in some of these cases. Many examples which are ascribed to such influences are undoubtedly due to other causes; but the numerous well-attested instances in physiological treatises, which prove the effects of both prolonged, and sudden, but intense, emotion on the process of secretion, must make one pause before dogmatically asserting that the nutrition and development of the embryo cannot be interfered with in a similar manner.

4. **Transpositions.**—Transposition may affect the entire organism in some of the lower classes of animals, as in certain fishes and molluscs, but in man this is limited to the thoracic and abdominal viscera. The organs normally situated on the right side are placed on the left, and *vice versâ*; whilst those which occupy the median plane are so rotated that the parts which should be found on one side of the mesial line are displaced to the other. Such transposition varies in degree in different cases, sometimes affecting all the viscera, at other times merely one or two organs. The more general cases are stated by Dareste to be due to the embryo-heart taking a turn in its early development to the left instead of to the right, which is its normal change. He has artificially produced similar deformities by incubating eggs placed obliquely, so as to subject their extremities to unequal degrees of heat, and cause an excess of development on one side. Bischoff, however, attributes them to an alteration in the normal position of the umbilical vesicle and allantois, so that the former turns to the left and the latter to the right, and suggests that this might possibly influence the site of the internal organs.

A variety of malformations, such as hare-lip, cleft palate, imperforate anus or vagina, club-foot, and webbed fingers, are subjects which belong to surgery, and do not require further notice here.

TREATMENT.—Many malformations, especially such as belong to the class of acquired deformities, admit of benefit by treatment, but as such treatment is of a purely surgical kind, it does not require to be discussed in the present work.

JOHN CURNOW.

MALIGNANT CHOLERA. A synonym for Asiatic cholera. *See* CHOLERA.

MALIGNANT DISEASES.—This term is applied to certain diseases or types of a disease which tend towards a fatal issue. First, it is applied to such diseases as cancer, which essentially lead to the destruction of life; and secondly, to certain varieties of fevers and other acute affections, such as typhoid fever, scarlet fever, smallpox, and cholera, which present peculiarly grave and aggravated symptoms, and generally end in death. *See* CANCER; SMALLPOX; &c.

MALIGNANT PUSTULE. *See* PUSTULE, MALIGNANT.

MALINGERING.—Malingering, in the sense of an elaborate and carefully-planned attempt to deceive the medical man, is not very frequently met with in private practice; and although the simulation of various morbid conditions is a common complication of hysteria, the consideration of this branch of the subject will find its more natural place under the heading of FEIGNED DISEASES. The army or prison surgeon, however, must be on his guard against imposture, and must exercise all his diagnostic skill. For his guidance many elaborate works have been written, and much information collected regarding the nefarious way in which soldiers have often outwitted their medical attendants. In our own country, under the present conditions of voluntary service, the men seldom attempt to do more than plead the excuse of some slight and temporary ailment to obtain remission from guards or drills. Headaches, rheumatism, colic, diarrhœa, and other affections of a more or less 'subjective' order, are naturally difficult of detection; but the surgeon learns gradually by experience, and seldom fails to acquire a pretty shrewd knowledge of the habitual schemer's somewhat narrow range of imposture; and hence it is that, with all its faults, the regimental system of military practice has always worked well, and enabled a sharp look-out to be kept on the troublesome malingerer, whose ingenuity is so unprofitably expended on attempts to shirk his own duties at the expense of his more industrious comrades. Occasionally, however, when the soldier urgently wishes his discharge, he is induced to lay his plans with greater decision, and to resort either to mutilation or to the imitation of chronic disease, and in Continental armies instances of this sort are comparatively common. To avoid the grievous burden of conscription, an infinite variety of artifices have been employed with greater or less success, and the ample literature of the subject bears amusing record to the ingenuity with which these inventions have been carried out. In dealing, however, with the minor degrees of malingering met with at home, we must be very careful not to be over-suspicious, and not to do injustice to a real sufferer whose symptoms seem somewhat vague and incomprehensible. Numerous cases are on record in which the mystery surrounding a fixed and obstinate pain in the back has been cleared up by the rupture of an abdominal aneurism; and Dr. Spry records, in the nineteenth volume of the *Pathological Society's Transactions*, a most instructive case in point. A typically healthy trooper of the Second Life Guards presented himself at hospital, complaining of very uncomfortable sensations in the œsophagus and stomach, following the swallowing of a bone. Some suspicion of malingering was entertained at the time; but Dr. Spry, impressed by a certain anxiety of aspect, retained the man under treatment, and three days later death suddenly ensued, and the *post-mortem* examination revealed perforation of the aorta, caused by a small spiculum of beef-bone. Facts like this are abundantly suggestive of caution, and of the happy medium between excessive sharpness and undue credulity, which a wide and intelligently used experience can alone confer. Far better is it for us to be deceived twenty times, than for unjust suspicion to be directed to the victim of some painful and depressing disease, whose only fault may consist in his inability to supply a sufficiently clear and convincing scheme of sufferings which may be only too real.

Robert Farquharson.

MALPOSITION OF ORGANS. *See* Organs, Displacement of.

MALTA.—Warm, rather moist, and very variable winter climate. *See* Climate, Treatment of Disease by.

MAMMARY GLAND, Diseases of. *See* Breast, Diseases of.

MANIA (*μανία*, fury, madness).—Synon.: Fr. *Manie suraiguë ; Dèlire aiguë ; Fureur* ; Ger. *Tobsucht ; Wuth.*

Under the term mania, very distinct disorders or degrees of disorder have been described, which we shall speak of as *Acute Delirious Mania ; Acute Mania*; and *Mania.*

I. Acute Delirious Mania.—Acute delirious mania, or maniacal delirium—whichever we prefer to call it—is something quite distinct from that ordinarily known as acute mania. The symptoms are much graver, the course is briefer and more defined, and the treatment of the one would be quite inappropriate to the other. An outburst of delirious mania may take place after very few and very short premonitory symptoms. Quite suddenly, after a few days or even hours, the patient will display the most violent excitement, which may as suddenly subside, or run a well-marked course of a few weeks; and if it does not terminate fatally will gradually decline, recovery usually taking place. Such an attack may have its origin in some sudden mental shock, as the death of a friend, a violent quarrel, a disappointment or suddenly announced misfortune; or it may arise in the course or decline of an acute disease, as pneumonia or measles. It may also come on during rheumatism; or after great fatigue, an epileptic seizure, or child-birth.

We cannot tell at first whether the attack will be transient or prolonged. We may try to cut it short by a brisk purgative, and by such medicines as chloral and bromide of potassium, and these not unfrequently answer the purpose. Sleep is procured, and perfect recovery may take place in a few days. There are patients whose organisation is so unstable that it is thrown off its balance by a cause perhaps trifling, but which produces a tremendous nerve-discharge, a complete disturbance of the whole mental functions. But so transient may this be, that one sleep restores the normal equilibrium, and the patient is cured. This condition in females is often called hysterical—hysterical mania. There is no special connection between it and the uterine functions, and it is better to retain the name hysterical mania for a variety to which it may be more appropriately given.

The delirium, however, does not always terminate quickly. If sleep becomes less and less, the mind more and more confused, and quiet and lucid intervals rarer and rarer, we may be sure that the attack will be serious and prolonged, and that careful and efficient nursing for some time will be necessary. Where a quiet and airy room can be provided, and where a patient's means are sufficient to allow him an adequate staff of attendants, an asylum is not indispensable. He will not require to take exercise in a garden; he will not be dangerous, as some are, to himself or others, though he may be violent and excited. He may be noisy, and therefore may not be able to remain unless the house is detached. The room should be lofty and cool, the windows protected and darkened; all furniture must be removed, and the bed made on mattresses placed on the floor, for he will not lie on a bedstead, and attempts to keep him there will end in bruises or more serious injury. Clothes will be torn off; but if the weather is very hot, as is so often the case during these attacks, this will be of little consequence. If it is cold, a strong suit laced up the back may be put on, and underneath it the requisite body-clothes; or a blanket may be placed round the patient, and fastened up the back.

These patients are in incessant motion, singing, shouting, and talking in a string of incoherent utterances, often repeating the same sentence again and again, or a snatch of a song or text, or a rhyme of their own composition. As a rule they are not violent, and do not attack those about them, though they may resist that which is done for them. They may be hilarious and full of glee and mischief, which is a good sign; or terror-stricken, with visions of horrible objects, which is unfavourable. They are wet and dirty; and the urine will be high-coloured, and often retained for a long period. We shall derive valuable information if we are able to take the temperature, but often that is a difficult task. A high temperature is a bad sign; and so is a rapid pulse, if it continues persistently when the patient has not been using violent exertion for some time. The tongue will often become thickly coated, dry, and brown. If it does not, but remains moist and comparatively clean, this is of good omen.

Prognosis.—The prognosis in these cases is upon the whole favourable. The terminations are almost always either recovery or death. The patients are mostly young persons, who recover unless weakened by previous attacks, other disease, or child-birth. Many of the fatal cases, in the writer's experience, have been complicated by tuberculosis.

Treatment.—Sleep in such attacks is generally absent, sometimes for many days. Women can last longer without sleep than men, and die much less frequently in acute delirium. If sleep does not come the patient dies, and our great effort must be to promote sleep by various methods. The first question will be whether we are to give drugs to accomplish this; and if so, what drugs? Opium must not be given; it will not procure sleep, whether given by the mouth or subcutaneously. It may produce a slight narcotism for half-an-hour or so, and if we increase the dose, will cause narcotic poisoning and death; but in the height of the attack it will not procure sleep. Chloral we may try in combination with bromide of potassium, giving half-drachm doses of each, and watching the effect. In all but the most acute cases, sleep of longer or shorter duration will be caused by these drugs; and although it may be short, it may be sufficient to save the patient's life, and enable him to battle successfully with the disorder. In the writer's experience, many more of these acutely delirious patients died before the introduction of chloral than have done since. Yet it must not be given in enormous or repeated doses, and a considerable interval should elapse between them. It may be administered easily in stout or ale, and often in wine.

Next to sleep, the most important matter is food. To enable the sufferer to withstand the exhaustion, which is the cause of death when a case ends fatally, he must be fed frequently and liberally. These patients rarely refuse food, but require careful coaxing and feeding; and a skilful attendant will give something every two or three hours—minced meat and vegetables, or bread and milk, beef-tea, eggs, and the like. Brandy often produces great excitement at the onset and height of an attack, and stout or ale is more suitable, and more likely to bring about sleep. We may give also plenty of lemonade, barley-water, and such drinks, if there be great heat and thirst.

Although this unconscious or semi-conscious delirium may continue for many days, yet in almost every case the violence and excitement are paroxysmal, with intervals of comparative calm, even if there be no sleep. Judicious attendants will avail themselves of these quiet intervals to administer food, and to keep the patient in the recumbent posture, thus ensuring rest, instead of letting him be continually on his legs wandering about the room, and so exhausting his strength. And when held down in this way, with cold cloths applied to the head, or his face fanned by the nurse, he is not unlikely to drop off to sleep.

Can sleep be procured by other means? The French have advocated prolonged hot baths, but they are attended with considerable danger. We may try a bath of half-an-hour at 90° or 92°, allowing it to become cooler, but it is of no use attempting this unless the patient submits to it without a desperate struggle. Cold to the head may be applied, because it is soothing and grateful to the sufferer, though it is a question whether the circulation in the brain is much affected thereby.

The bowels may be kept open by a few grains of calomel administered in the food, or half-a-grain of podophyllin. Active purgation is inadmissible except at the very outset, and enemata cannot easily be given in the violent stages. It is somewhat the fashion to apply blisters to the nape or calves. This is most inadvisable, for such parts may become very sore, owing to the restlessness of the patient, and thus deprive him of sleep. Neither is it necessary to cut all the hair off, which in the case of a lady may be a very grievous matter. If very long, it may be shortened without being cut close to the head.

II. **Acute Mania.**—Quite different from the unconscious raving of maniacal delirium is the conscious but violent excitement to which we give the name of *acute mania*. The former is a disorder dangerous to life, running a rapid course to death or amendment in a week or two. The latter may go on for weeks or months with little danger to life, but with excitement so troublesome that the sufferers require the restraint and discipline of an asylum. Though most insane, full of delusions and insane habits of every kind, they know what they are about, and are all the more mischievous in consequence. They can take every advantage of an opportunity, and know how to exasperate those about them. They generally eat well, and sleep indifferently, but sufficiently to support life; and their bodily health often remains wonderfully good considering what they go through. They will destroy clothes, windows, bedding, and deny or justify all they have done. The termination is not usually fatal, unless the health gives way through some other disease. The patients generally recover gradually, or sink into chronic mania or dementia.

Prognosis.—The prognosis in cases of acute mania will depend upon circumstances. (1) The number and duration of the attacks are important. In a first attack the prognosis is favourable. If recent, we may have hopes, even if there have been preceding attacks of a like character. (2) If the patient is not of advanced age or of broken health, the prognosis is favourable. (3) If the mania consists of violent, turbulent conduct rather than of fixed delusions, as is frequently the case, there is more hope. If the patient hears voices, the prognosis is bad. If there are delusions which impel him to refuse food, and he does so persistently and violently, it may be difficult to give sufficient nourishment, and he may sink from exhaustion, or become a chronic maniac.

Treatment.—Patients suffering from this form of mania do not require, like the last, to be kept in one room; on the contrary, they should take plenty of exercise in the open air. This will promote sleep more than drugs, though we may give an occasional dose of chloral, or bromide of potassium, or the latter with chloral or with Indian hemp. Such medicines, however, should be given only to procure sleep, not to allay excitement. Plenty of food is required, for the waste is great.

Such patients are not to be cured or even kept without discipline and moral treatment; and great tact, firmness, and patience are required for their management. They may be very dangerous and spiteful, will know how to provoke attendants, and how to take them unawares if off their guard. Such moral treatment will be far more efficacious than drugs, but it can only be carried out in an asylum. Patients in this condition, if kept in private houses, must be rendered quiet by drugs; but there is great fear lest by this the disease, instead of being cured, may be converted into a chronic and incurable mania.

III. **Mania.**—A great variety of cases are grouped under this name, arising from various causes, but alike in the fact that they are marked by excitement rather than depression, by exaltation or wrath, but not by gloom. Excitement, and noisy and irrational conduct, characterise some, but most patients present delusions coinciding with their temper and bodily condition. Almost always this form of insanity is marked by delusions, if it lasts long enough; but sometimes a short burst of excitement—a transitory mania—may pass away without the stage of delusion being reached.

The diagnosis of an ordinary case of mania is not difficult. The prognosis must depend on the cause; the age of the patient; the character of the delusions, if there be any; the occurrence or non-occurrence of previous attacks; and their history. Attacks of mania are frequently recurrent, and may recur again and again through a long life; recovery may take place on each occasion, or the disorder may at last turn into chronic mania or dementia. The period of excitement in many cases is followed by one of depression, and these may alternate with great regularity for twenty or thirty years; and even when the patient is sunk into hopeless dementia, the period of excitement may occur as regularly as before the mental powers had given way.

Treatment.—Of the treatment of these cases little can be said. The majority will need the care of an asylum, at any rate during the excited stage. The intervening or rational period will often be prolonged by removal from the asylum, and when this is the case there is frequently less reluctance to return to it when the necessity arises, and instances are not uncommon of patients themselves seeking its shelter.

G. F. Blandford.

MANIPULATION (*manus*, the hand).—A mode of investigating and also of treating diseases by the use of the hands. *See* Physical Examination; Friction; and Shampooing.

MARASMUS (μαραίνω, I grow lean).—A synonym for general wasting. *See* Atrophy, General.

MARIENBAD, in Bohemia.—Alkaline sulphated waters. *See* Mineral Waters.

MARSH FEVER.—A synonym for intermittent fever. *See* Intermittent Fever.

MASKED. A synonym for larvated. *See* Larvated.

MASSAGE (French).—A synonym for shampooing. *See* Shampooing.

MASTALGIA
MASTODYNIA } (μαστὸς, the breast, and ἄλγος, or ὀδύνη, pain).—Pain in the mammary gland. *See* Breast, Diseases of.

MASTICATION, Disorders of.—In the mouth the food is submitted to the action of the jaws, carrying the teeth; is moved about by the tongue; and is kept between the teeth by the lips, cheeks, and tongue. The muscles which perform the complicated and nicely-adjusted movements of mastication, are supplied by the trifacial, facial, and hypoglossal nerves—that is, the v., vii., and xii. pairs of cranial nerves respectively. These movements are essentially voluntary, the stimuli which determine them being central in origin, and passing to the muscles by the above-mentioned nerves; but at the same time, the mere contact of the buccal mucous membrane with food, aids in determining the movements, its impressions travelling to the brain by the fifth pair of nerves.

Mastication is liable to be disordered from various causes.

1. *Muscular Paralysis.*—Imperfect performance of mastication is frequently the result of cerebral lesions, such as hæmorrhage or tumours. Dependent on the seat and extent of these will be the extent of the paralysis, which may vary from an impaired movement of one cheek, thus permitting the food to collect between it and the gum, to an absolute loss of power of swallowing. Sometimes the purely reflex portion of this act may be retained, mastication being impossible; or it may be that the tongue alone is affected, from injury to the nucleus of origin of the hypoglossal nerve. In those cases where the trifacial alone is affected, mastication is rendered difficult, by the absence of the contact-sensations which aid in determining normal movements.

There are several special forms of paralysis in which these movements are affected, either alone or in common with other muscles of the body.

(*a*) *Labio-glosso-laryngeal paralysis*, due to certain morbid conditions of the medulla, affecting the glosso-pharyngeal, hypoglossal, and spinal accessory nerves, is especially characterised by the impairment of mastication and deglutition, which progresses from a mere escape of saliva, due to paralysis of the orbicularis oris, to absolute inability to perform either act. Of the masticatory muscles, it is those of the tongue and cheek which are mainly affected, the elevators and depressors of the jaw usually escaping. The patient thrusts his food to the very back of the mouth; and even then, when in the grasp of the constrictors of the pharynx, it is swallowed with difficulty; often being ejected through the nose, or getting into the trachea through the imperfectly closed glottis. As the disease progresses to its invariably fatal end, the palsy increases in completeness.

(*b*) The loss of power in the muscles of mastication and deglutition, so frequently associated with *diphtheria*, is doubtless dependent on some central changes, since it is only one of the many forms of paralysis that may complicate this disease. At the same time it has been in part ascribed to degeneration of the muscular tissue.

2. *Muscular Spasm.*—Trismus, or tonic spasm of the muscles of mastication supplied by the motor branch of the fifth nerve, is rarely unilateral. The jaws are usually completely locked, and incapable of separation, thus rendering mastication impossible. The trismus may be a part of a general condition of tetanus, or may be the sole indication of spasm; and in the latter case is usually reflex in origin, being determined by such causes as dental irritation, or facial neuralgia, or, more rarely, by distant wounds or intestinal worms.

Irregular clonic spasms of the muscles of the jaws, such as are frequently seen in epilepsy and hysteria, and are evidenced by chattering and grinding of the teeth, will offer some difficulty to the proper performance of mastication.

Spasm, whether tonic or clonic, when limited to the facial muscles supplied by the seventh pair, will interfere but slightly with mastication. By preventing the action of the lips and cheeks, the food will not be so easily kept between the teeth, and the saliva will dribble from the unclosed mouth. Nor are the impulsive spasmodic movements of the tongue, as seen in chorea, important as impairing the proper mastication and swallowing of the food.

3. *Affections of the Temporo-maxillary Articulation.*—Chronic arthritis may lead to such serious disorganisation of the joint as to impair its movements, anchylosis occasionally occurring.

4. *Tumours.*—Enlargements of the salivary or lymphatic glands, tumours of the thyroid body, epulis, and new growths of the tongue, may interfere with mastication.

5. *Morbid Conditions of the Mouth.*—Inflammation of the mouth or tongue, and disorders of the teeth, render mastication difficult.

The several subjects here referred to are treated of under separate headings.

Effects.—Portions of food imperfectly masticated may produce suffocation, by blocking up the entrance of the glottis, or lodging in the gullet. Imperfectly masticated food, when swallowed, is a well-recognised cause of dyspepsia and its many inconveniences.

Treatment.—The treatment of disorders of mastication naturally consists in the removal of their cause, when possible. The reader is referred to the articles in which the several conditions are fully discussed. W. H. Allchin.

MASTURBATION (*manus*, the hand, and *stupro*, I ravish).—Synon.: Fr. *Masturbation*; Ger. *Selbstbefleckung*.

Definition.—The production of the sexual orgasm by unnatural means.

Ætiology.—This practice is found to occur under a variety of circumstances. First, in very young children, local irritation, situated beneath the prepuce in males, or within the vulva in females, leads to manipulation of the parts, and to consequent pleasurable excitement, which is constantly renewed, with an entire unconsciousness of the meaning of the practice. As an instance, not long since the writer was consulted by a mother about the extreme delicacy of her boy, then little over four years of age. No tangible disease being evident, the little fellow was stripped, with the view to a more complete examination. Whilst this was being made, the child was seen to rub his penis with the hand in the most careless manner, causing thereby an erection—an observation which explained the cause of the ill-health.

The second class includes cases which are of a very different character. The individuals in this class have reached or are near the age of puberty, and have either accidentally learned, or been taught, this pernicious habit. *Pruritus vulvæ*, due to diabetes or other causes, may, for instance, lead to it in the female. A third class of cases may be mentioned, in which the practice has a central origin, in certain forms of brain-disease or cerebral deficiency, as is seen in some forms of insanity and in idiocy.

In the last two classes of cases it may be said that there is often more or less perversion or loss of the higher moral feelings, if not entire degradation of the moral sense.

Effects and Symptoms.—There is no doubt that the excitement incident to the habitual and frequent indulgence in the unnatural practice of masturbation leads to the most serious constitutional effects. These effects are more especially manifested in the nervous system, the functions of which are perverted. The mental faculties become more or less affected; and often great despondency, loss of memory, irritability, prostration of strength, headache, and neuralgic pains ensue. Anæmia occurs, and the functions of the heart and other organs of circulation are disturbed. Digestion is disordered. There is general loss of health and strength; and chronic hypochondriacal invalidism, if not worse, is set up. In certain cases the urinary organs are affected; and the writer has observed in several instances the presence of albumin in the urine, which would seem to be the result of some reflex action on the nerves and vessels of the kidney. The effects on the male genital organs themselves are marked. There is extreme irritability of the neck of the bladder and adjoining parts, accompanied by discharge of mucus and of prostatic secretion, often mistaken for semen. At the same time seminal emissions are prone to occur on the least sexual excitement, either by day or during sleep; and in extreme cases there is impotence. In the female the natural feelings are often lost.

Diagnosis.—In many cases of masturbation in young men the diagnosis is sufficiently easy; for such persons, alarmed by reading the advertisements and books written specially to excite feelings of shame and fear, and to bring the subjects of them within the nets spread abroad by quacks, are sufficiently ready to declare the cause of their distress. In other cases, in which the practice is concealed from fear of the consequences, or from innocent unconsciousness of its nature—and this is more especially the case in females, the diagnosis is often very difficult. When, however, the symptoms just described are present, in the absence of any cause to account for them, the practitioner may entertain a reasonable suspicion of the existence of this habit, although it may be difficult in many cases to carry his impression beyond the suspicion.

Treatment.—In the first class of cases above mentioned—that is, in very young persons, in whom some local irritation exists—the source of this irritation must be found and removed. Sometimes it may be an elongated prepuce, with irritating matter beneath it; in such cases circumcision may be required. In females cleanliness and simple lotions may suffice; or irritation caused by the wandering of thread-worms or otherwise may require to be treated. In these cases attention to the general health, to the state of the digestion, to the urinary secretion, and to the bowels should not be neglected. Diabetes must be searched for, and treated if present. Extreme watchfulness by the nurse is necessary, and at night it may be even necessary to secure the hands by muffling or tying them behind the back.

In young adults the moral sense must be

acted upon. It has been suggested, by way of prevention, that judicious and kind advice may with advantage be given before even a knowledge of the habit is acquired, whilst too much vigilance cannot be exercised by those who direct and assist in the management of schools.

In the actual treatment of the disease, that is, the effects established by masturbation, it is of the highest importance to improve the health, both mentally and bodily. Early rising and healthful exercise, with careful diet, and travel, if practicable, should be recommended. Remedies directed to the treatment of symptoms connected with the nervous, circulatory, and digestive systems will be required. Of course the habit must be entirely surrendered, and all thoughts of a loose or libidinous character must be avoided. The bromides, especially the bromides of potassium and ammonium, are very useful for lessening sexual excitability; and in the case of females, these may be more especially needed at the close of or just after the catamenial periods. In certain cases where these remedies, together with steel, and other appropriate drugs, have failed to diminish the frequency of the seminal emissions which are common in males, caustics may be applied to the neck of the bladder. *See* SPERMATORRHŒA.

MAW-WORMS.—A synonym for thread-worms. *See* THREAD-WORMS.

MEASLE.—In helminthology this term is frequently employed as a synonym of *cysticercus.* Thus, we have pork, beef, and mutton measles, each entozoon being a distinct form of bladder-worm, and therefore, at the same time, the larval representative of an equally distinct species of tape-worm. The human measle is a variety only of the pork measle, both forms constituting what is sometimes called the scolex-condition of the *Tænia solium.* Most kinds of flesh ordinarily consumed as food are liable to become 'measled,' but no such parasites have hitherto been detected in the muscles of the horse. This fact supplies an argument in favour of hippophagy. For detailed information respecting all the known forms of human and animal measles and bladder-worms the reader is referred to Dr. R. Moniez' *Essai Monographique sur les Cysticerques,* forming the first part of the third volume of the *Travaux de l'Institut Zoologique de Lille,* 1880. *See* BLADDER-WORMS; and CYSTICERCUS. T. S. COBBOLD.

MEASLES.—SYNON.: *Morbilli*; *Rubeola*; Fr. *Rougeole*; Ger. *Masern.*

DEFINITION.—An infectious specific fever; with an eruption, on the fourth day after catarrhal symptoms, of a deep-red spotted rash; this is at first slightly raised, and is distributed in crescentic groups, which soon extend over all parts of the surface; it persists as a general mottling after the subsidence of the fever, and where intense may cause a fine desquamation. The disease prevails as an epidemic; and it very rarely, if ever, attacks the same person more than once.

ÆTIOLOGY.—Contagion is the cause of measles wherever it is now met with. In large towns, where sources of infection always exist, epidemics recur about every four years, chiefly among children, as fresh series of the susceptible become exposed. Few adults suffer; most of them having been attacked in childhood. Among scattered populations long periods may elapse without infection reaching them; when it does, neither age nor sex influences directly either the liability to attacks, or their severity.

The essential characters of the disease are everywhere the same. The fatality is increased by extremes of heat in hot countries and seasons, and by extremes of cold in cold climates; by malarial soil, vitiated air, or crowded dwellings; by defective diet; and by scurvy.

The annual mortality from measles in London is nearly five per ten thousand. The deaths from measles are about one per cent. of all deaths in England and Wales, and nearly two per cent. in large towns; this is higher during epidemics, but has not reached much beyond 2·7 in London. The proportion of deaths to attacks varies from twenty to thirty per cent. in crowded wards, to one or two per cent. in healthy houses; the mortality of ten or twelve per cent. is a common estimate.

The contagium of measles, except in the catarrhal stage, is not far diffusible in the air, but clings to surfaces, and may so be carried from place to place. Children with full eruption have been brought into a house among others, and nursed in a room apart, without any extension of the disease even to the most susceptible. When young infants are said to escape infection, it is where the family is small, and they are less exposed. Among young children the deaths are in equal proportion to the numbers of the two sexes living. With us more than half of the whole number of deaths from measles are of children under two years of age; the proportion thence progressively diminishes. This differs from what is observed in scarlet fever and diphtheria; moreover, the proportionate fatality of these latter diseases in the two sexes is greater for girls.

Measles in a school or family is sure to spread; the catarrhal stage, infectious throughout, is mistaken for a common cold, and no timely separation is attempted. The cough is an important means of conveying infection at this time. The period of incubation is ten to twelve days, rarely a day or two more. During the latent stage of this long incubation, those who have been exposed to infection are thought to have escaped, and are sent to begin the same round elsewhere. The disease may be conveyed by *fomites.* Infection begins before the rash appears, and the contagium may be given off by the third day, most probably during the greater part of the incubation-period. The contagium principle developed only in the bodies of the sick, is found during the height of the disease in the tissues, the secretions, the blood, and the breath. Inoculation at this stage either with the blood or serum, by Home, Cullen, and others, reproduced measles without modification; the primary fever then appearing on the seventh day, and the eruption on the ninth and tenth. Mayr, of Leipzig, twice conveyed the disease by means of nasal mucus. Catarrh began on the eighth and ninth days; rash on the tenth and eleventh. After an attack of measles personal infection is probably over by the end of a month; it may persist longer, or be conveyed somehow by convalescents for another month. How long infection may cling to articles of clothing, or linger in closed rooms, is uncertain. After two years of age the mortality is not greater in proportion to the number of attacks than at other periods of life; and there is some advantage in contracting this disease at a time when careful nursing and individual attention can be secured. Those who escape measles during childhood are very likely to be seized on taking their part in mixed communities.

Pathology.—Measles is the type of a zymotic disease. An organised ferment, *bacterium* or *torula*, in a suitable medium, at first increases slowly, with barely noticeable changes; then comes a more violent disturbance; after which the zymotic organism ceases to develop, and the medium can no more sustain a similar action. After experimental zymosis the fluid medium clears, and the organisms accumulate at some part of the containing vessel. Several years ago Dr. Ransome, of Manchester, obtained particles from the breath of two persons suffering from measles. Drs. Braidwood and Vacher have since confirmed this observation. Glycerine, on which children with measles respired during any of the eruptive days, exhibited numerous highly refractile bodies, larger than those seen in vaccine-lymph; others were elongated, with sharp-cut ends, sparkling and colourless; they were most abundant in the two days of greatest eruption; they were not found in the breath during health, nor in the course of scarlet fever and typhus. After death from measles, on the eighth day, they were found in the true skin in groups below the rete mucosum, by the lymph-spaces and sweat-ducts, but not deeper than the level of these glands; sparkling, spindle-shaped, rod-like, or canoe-shaped bodies were also seen, which did not take the carmine tinge. These bodies were not seen in the lymph-spaces, nor in the sweat-ducts and glands, nor in the hair-follicles. In the lung both forms were found in some exudation filling the alveoli. The spherical forms have a dark, smooth outline, and do not readily take the carmine stain. Near these were rod-like, fusiform, or ovate bodies, slightly tinged with carmine. These are quite distinguishable from the particles seen in other forms of pneumonia. With a high power, similar sparkling, staff-shaped bodies were seen scattered round the bile-ducts. None were found in the kidneys, spleen, or mesenteric glands.

In the blood some increase of white and a great decrease of red corpuscles occur during the fever. Numerous moving microzymes have been seen during the eruption, decreasing rapidly, and disappearing in three weeks; but temporarily reappearing with any febrile disturbance.

Anatomical Characters.—The mucous membrane of the larynx and trachea is always red in measles, often with punctiform congeries of vessels; and not unfrequently thin films of lymph are found loosely adherent. The bronchi are congested, sometimes with exudation on the lining membrane, more frequently covered with muco-pus, or plugged with catarrhal mucus; capillary bronchitis with broncho-pneumonia is frequent. Lobules of the lung are often collapsed or inflamed; the pneumonic exudation, whether the result of occluded bronchioles, or of direct congestion, fills or breaks down the alveoli, and invades the parenchyma. Lobar pneumonia, if extending to the surface, is accompanied by pleurisy, often limited to the part of the lung affected. Fluid may be found effused into the pleura or pericardium, without any traces of inflammation. Petechiæ are often found on the pleural surfaces. Any inflammatory signs, either cardiac or articular, in the serous membranes are so rare as to be quite exceptional. Dark, soft coagula are found in the right side of the heart, in the venæ cavæ, and in the cranial venous sinuses. The meninges are congested; there is injection and hyperæmia of the brain-substance, and increased fluid in the ventricles and subarachnoid space; more rarely recent lymph is seen on the surface of the hemispheres; deposits at the base belong to later consequences of the disease. Congestion of the digestive tract is most marked near the ileum and colon; externally the distended veins of the submucous coat are seen; internally there is deep redness of the surface, the solitary glands are distended and elevated, the agminated to a less degree, but there is little or no enlargement of the mesenteric glands; the follicles of Lieberkühn and the tubular glands of the large intestine are more distinct than usual; a chronic ileo-colitis may result. The liver is mottled; both the portal and hepatic veins are full; and the lobules are ill-defined and granular in appearance, with fatty particles interspersed. The bronchial glands are often enlarged, and sometimes softened; suppuration from them extended up behind the œsophagus in one instance. The lymphatic glands of the neck are always congested and enlarged, and often those elsewhere, as in the axilla or groin. The spleen is swollen and friable, or very little altered. The kidneys show no distinctive changes; they are hyperæmic in the earlier stages of the disease, and the tubules may then be full of epithelium and cell-débris; the degree of after-congestion depends much on the degree of pulmonary obstruction, or on early exposure to cold or fatigue; no albumen or casts of renal tubes are found in the urine, unless a secondary nephritis have been thus occasioned.

Symptoms.—The symptoms of measles seldom occur until eight days after exposure to infection. They may begin suddenly, with high fever, aching pains, and vomiting, the initial fever subsiding next day, but not completely, when there may be little feeling of illness, but some signs of coryza, cough and sneezing, with enlargement of the lymphatic glands in the neck. On the third day the coryza is more marked, the cough often very troublesome, and the fever increased. Some few spots of eruption are now visible on the forehead and sides of the face. The conjunctivæ are injected, the tonsils full and smooth, the soft palate mottled, the tongue furred, the pulse quickened. On the fourth day the eruption appears more fully, with rapid pulse and sudden elevation of temperature, often to 104° by night, with delirium. On the fifth day, with full rash, there is marked alleviation of all the symptoms: the cough is quiet; the pulse is less full and frequent; the tongue cleans; and the temperature, already fallen by 3° or even 4°, often reaches the normal by the sixth day, leaving the skin still deeply stained by the fading rash, and the patient weak. During the next week or ten days there is a tendency, not only to depression, but to sudden rises of temperature, with various complications that retard or endanger convalescence. We notice three stages:—the *ingress*; the *eruption*; and the *decline*.

The ingress.—The ingress of measles is not always with marked initial fever. Coryza and spots of the rash may be observed before illness is complained of, though some elevation of temperature can be traced by the thermometer for three days before the full eruption. This febrile movement has been preceded in some cases, where thermometric observations were made throughout the period of incubation, by a well-marked depression of short duration. Before this, fatigue, headache, vertigo, chorea, and other irregular symptoms may occur. Often some slight disturbances of health, and even cough, have been observed all through the incubation-period; sometimes an intercurrent disease has delayed the regular march of the invasion to seven or eight days, or the latent stage has been prolonged to ten or twelve days; more frequently this is reduced to three days, and even these days may be febrile from a concurrent influenza or herpetic catarrh. The eruptive fever always occupies four days. As this approaches the crisis, many symptoms are aggravated. Incessant cough occurs, often in children with croup of the catarrhal kind; bronchial irritation with *râles* and rhonchal fremitus, or possibly submucous rhonchus, may be heard at the pulmonary bases; the respirations, hurried and shallow, are 30 to 40 in the minute; the pulse is quickened to 130 or 140. Both the respiration and the pulse, especially the former, are more accelerated in young children; and with them convulsions may at this period retard the eruption or prove fatal. Death before the rash is thrown out, though rare, has also happened in adults. The urine is scanty, yellow or dark-coloured, and deposits lithates; in extreme cases it has been suppressed. Abdominal pain or diarrhœa may occur, and the latter may become a serious symptom. Thirst is great; the lips are dry; the tongue is moist, with red papillæ showing through a thick white fur; the palate and fauces are red, from many punctiform congeries of vessels; the deep injection and swelling of the pharynx may extend to the Eustachian orifices, and cause deafness; deglutition is painful, and sometimes difficult, from the imperfect closing of the turgid epiglottis, as well as from fulness of the tonsils. With these throat-symptoms the gland at the angle of the jaw is somewhat enlarged and tender; but there is not much swelling or œdema of the overlying integument. The lymphatic glands of the neck are palpably enlarged before there is much or any rash on the skin, those of the axilla and groin afterwards. Epistaxis is not rare. The eyelids are swollen, the conjunctiva being inflamed and purulent; there is intolerance of light; there is fear of the eye being permanently injured. The nocturnal delirium and most of the other symptoms abate when the eruption is complete.

The rash.—The rash first shows itself in distinct, red, and nearly circular spots, much scattered; fresh spots soon show in the clear skin. They begin as red points, which are raised, and feel rough or 'shotty,' especially on the face, and early in the eruption; they then form crescentic groups, which coalesce into patches of irregular outline on the body. The face, disfigured by the swelling, is first covered; then the neck and chest. The rash is also well-marked in the scapular region, extending to the rest of the trunk and to the extremities on the second day, becoming more sparse as it descends. A peculiar and offensive odour from the sick is recognisable during the whole eruptive period. The rash declines in the order of its invasion. Within twenty-four hours the swelling of the face subsides; the red spots, no longer raised, become pale under pressure, and leave a yellowish discolouration, or on the shoulders marks of a dusky red. Considerable irritation attends the rash, continuing with it to the third day or longer. At this time fine desquamation is noticed on the face; small scales of cuticle are detached from the top of the enlarged papillæ, so that most of the surface is furfuraceous; this disappears with the irritation by the second week, or may persist a week longer; it does not occur when the eruption has been slight, hardly ever on the fingers and feet, and never in large shreds. A coppery, mottled discolouration remains on the more vascular parts of the skin, or where the rash has been most marked, for eight or ten days, and sometimes continues visible three weeks from the commencement of the illness. The eruption may begin on other parts of the body than the face, as at the seat of any injury to the skin. The disease may run its course safely with very little, possibly without any eruption. An imperfectly developed dusky or livid rash is met with in severe cases. With serious lung-complication a full rash may recede. Petechial specks may accompany a moderate eruption, or hæmorrhagic spots complicate the irregular forms. Some of the earlier spots may not only be raised and acuminate, but minutely vesicular at their apices. In the dark races the eruption is yellowish, raised above, but somewhat lighter in colour than the surrounding integument; in the mulatto it varies from a yellowish to a dusky brown; but all other signs of the eruptive period are well marked.

The decline. Complications and sequelæ.—The pulmonary lesions of the febrile stage, capillary bronchitis or broncho-pneumonia, may delay defervescence, or rapidly prove fatal. With moderate lung-mischief the fall of temperature following the rash is often very marked, and, with extreme depression further congestion of the lung will occur. The liability to depression of temperature which follows many acute fevers, is specially marked in this one, and requires to be guarded against. A tendency to sudden elevations of temperature is also noticeable for ten or twelve days after the eruptive fever subsides; rarely this has been accompanied by a recrudescence and reappearance of the rash, sometimes by no definite changes, possibly by some that are obscure, of the nervous centres. The common accidents of this period are—first, a return of cough in children; this may be croupy, beginning the very day of the first decline of temperature. The temperature again rises suddenly, perhaps to 103°, with greatly excited pulse and respiration. Next day there is tracheal rhonchus, but no increased size of the cervical glands. The cough then becomes looser, and thin shreds of false membrane are expelled. This form of membranous croup is as common from three to six days after the rash, as catarrhal croup is the day before the rash. It rarely attacks more than one child in a family; this is sometimes the same child who had laryngeal symptoms in the catarrhal period. In some epidemics laryngitis and subsequent hoarseness have often followed. More frequently a return of cough indicates the commencement of bronchitis or of broncho-pneumonia. In the latter a sharp elevation of the temperature of no long duration occurs. Lobar pneumonia, less frequent, maintains a higher range of temperature; it may be mistaken for meningitis. Pleurisy, except in connection with lobar pneumonia, is rare. Otitis may cause a high temperature of short duration. Three or four such interruptions may happen in a single convalescence. Serious complications, not attended with much temperature-disturbance, are found in diarrhœa, dysentery, and passive hæmorrhages. Enteritis, with diarrhœa and dysentery, is as fatal and frequent a complication of this disease in hot climates as are pulmonary affections with us. In convalescence, after a critical increase of urine, the kidneys act more freely; if during pulmonary obstruction the chlorides were diminished, they now reappear, the excretion of urea is increased, and uric acid may be eliminated in excess. Albuminuria, unless determined by extreme neglect and exposure, is not a consequence of measles.

Impairment of health results as often from this as from other specific fevers. Nerve-waste may lead to imbecility and dementia. Acute tuberculosis is started, or tubercular deposits begin after measles. The strumous diathesis is evoked, and may set up a troublesome ophthalmia, with danger to the cornea; or a fatal ulcerative stomatitis. Abrasions of the nares or lips may persist or extend, eczema or ecthyma appear, and glandular enlargements increase or become chronic. Even in the robust acute pulmonary disease is readily induced by exposure or want of care during convalescence; a liability to this, to pustular eruptions, and to irregular febrile disturbance, may persist for three weeks. It has happened that some nervous disorders, such as chorea or mania, have been arrested during an attack of measles, even with permanent benefit. Measles not infrequently co-exists with mumps and with whooping-cough, more rarely with varicella and vaccinia. Either of these, taken with measles, is delayed or interrupted, resuming its course when the eruption of measles is over. Whooping-cough, established beforehand, is temporarily interrupted by an attack of measles. Scarlet fever may complicate measles, also erysipelas; or measles may be contracted in the course of typhoid fever. Diphtheria is not so frequent a complication of measles as it is of scarlet fever. After any of these diseases the liability to suffer infection from the others seems to be increased. The exemption from a second attack of measles is not universal, but the exceptions to the rule are so few as to be rarely observed. In two instances observed by the writer, at intervals of fifteen and twenty-five years respectively from the primary attack, the rash was preceded by the usual catarrhal fever, and was but slightly, if at all, modified. Out of numberless mistaken cases, no other has come under his notice. An allied form of rubeola (*sine catarrho*), essentially distinct, is commonly mistaken for measles; hence the belief in second measles.

Diagnosis.—The first spots of measles, if scattered, raised, and hard, may be mistaken for those of small-pox; or the small-pox eruption may begin with some measles-like roseola. The temperature curve for the two diseases is similar. In the small-pox curve a sudden rise begins only two days before the eruption, whilst in measles there is a gradual rise for three or four days; this in small-pox is evidenced by a history of sudden and severe illness only on the day but one before the eruption, whilst in measles there is no such symptom on that day, the illness dating from a day or two earlier, usually with distinctive catarrhal symptoms.

The declining rash of measles leaves a mottling of the skin, not unlike the mulberry eruption of typhus; the latter seldom appears before the fifth day of the disease, the fever continuing high for several days after. In measles, at this stage of the rash, the fever has already begun to decline, the temperature falling suddenly, often to below the normal. The rash of *rubeola sine catarrho*, *Rötheln*, or *rubella*, closely resembles the eruption of measles; the spots, brighter in colour and even more discrete, are preceded by only one day of headache or slight sore-throat. The incubation-period generally is longer than in measles. In scarlet fever the ingress is sudden; there is the characteristic sore-throat; and there is the early appearance on many parts of the body of the finely diffused, comparatively smooth, bright scarlet redness of the rash. The incubation-period has been short. In erysipelas the redness appears at one part only, and extends from that, whether it be the face or other parts of the body. Roseola from irritating articles of food has very little fever, and no enlargement of the cervical glands, otherwise it might look like measles. Urticaria and erythema, with differing aspect, cause but slight thermometric disturbance.

Prognosis.—This is mostly favourable in measles; the tendency of the febrile action is to recovery. Favourable progress may be endangered by—1. The bad health of the sufferer. 2. Want of care. 3. Insanitary surroundings. Under either of these conditions the simplest kind of measles in a healthy subject may give rise to the worst forms of the disease. Morbilli *mitiores* and *graviores* are not essentially distinct. High fever with the eruption is not in itself unfavourable; at this time a temperature of 105° in children, and 104° in adults, or half a degree beyond, is safely reached; with precautions at its sudden decline, the progress afterwards is most satisfactory. High temperature during the after-course is a sign of greater import; it guides to various complications, and subsides as they are relieved; occurring irregularly it is a cause for anxiety; if steadily maintained, or recurring regularly at short intervals, with wasting as a result, there is little hope of recovery, and none if acute tuberculosis of lung or of brain is evidenced. The latter danger makes convulsions of worse augury in the decline than during the ingress of measles in young children; convulsions, taking the place of delirium in older persons, cease after the eruption. Recession of the rash is not alarming when the attack is slight, or the temperature is low at the crisis; when there is pulmonary or other local congestion, and at the same time sudden depression, it becomes an additional sign of danger. A dark rash, interspersed with fine red specks, may occur early in cases of moderate severity; a dusky or livid colour subsequently marks cases of considerable intensity; petechial or hæmorrhagic blotches at this time are of grave import, as indicative of scorbutus, which state ranks next to impaired nutrition in infants, as the most unfavourable concomitant of measles. Black or hæmorrhagic measles, without scorbutus, is more rare than is hæmorrhagic or black small-pox. Some dangerous hæmorrhages may follow measles where no scorbutic condition exists. Among insanitary conditions, though the presence of sewer-gas has in isolated instances determined a fatal result, the most disastrous is overcrowding. The great mortality from measles is due to lung-disease, not at the height of the fever, but in the second week; the frequency and severity of pulmonary complications being less a direct effect of low temperature than of tainted air in which the poor are pent up for the sake of warmth. During the ingress of measles exposure to cold may occasion a highly dangerous suffocative catarrh, with capillary bronchitis; after or during the rash a chill is as likely to conduce to serious diarrhœa as to pulmonary congestion, especially in hot weather. Equally depressing in their effects, these are direct results of the disease independently of weather or season. Measles contracted during acute or prolonged illness is a grave addition to the danger. In the puerperal state infinitely less mischief is produced by this disease than by scarlet fever; delivery has been hastened without mischance, or abortion has resulted, not without risk of fatal results; there are times when young married women who have not had measles should keep from risk of infection. It would seem that the child can go through the disease *in utero*, with after-immunity. There is an instance on record of a mother with measles giving birth to a child 'full of measles,' both doing well; others of infants having the rash three, five, and eight days after birth, when the mother was herself ill. Infants escape measles while suckling, insomuch as they are less exposed to infection; they suffer no less severely than others. In adolescence a body-heat of 107° has been safely passed, during the decline of measles, with no marked complication. In children of all ages a warning is given of some danger closely following the eruption, when the normal fall of temperature at the crisis is delayed or prevented. In advanced convalescence sudden rise of temperature, with delirium, often marks an attack of pneumonia; this, if of limited extent, may be hoped to end favourably in a week by resolution, without much cough, but with steady high temperature till near the end.

Treatment.—Rest, pure air, equable warmth, diluents, and nourishment, are the chief requisites in the treatment of measles.

All risks from exposure or fatigue should be avoided while the disease may be only latent. The first catarrhal signs demand confinement to the room; the initial fever, rest in bed. The usual meals, moderate in quantity, can be taken; if not, milk, broth, or meat-jelly will be required. Extra liquids, as barley-water, lemonade, or even cold water, and small pieces of ice, are pleasant and necessary. Simple salines, as potash in the lemonade, or citrate of ammonia, are useful; dilute acetate of ammonia, coloured with syrupus croci, is an old and good form; to this a few drops of ipecacuanha wine may be added, but neither expectorants nor diaphoretics have any influence on the cough until after the eruption. The bowels must be gently regulated; a furred tongue is not a reason for giving purgative medicine. No diminution of the expected critical fever, if this were desirable, will be brought about by the action of emetics and aperients; where either of such evacuations have troubled the ingress, the eruption is delayed with no after-benefit. The free use of cold, so speedy and potent an antipyretic in scarlet and other fevers, is not required in the early stages of measles, and would be injurious until after the eruption is out. In the fever of measles a certain progressive rise of temperature is necessary to its favourable termination; where this is interrupted, as by debility or chill, sometimes by convulsions in infants, the warm bath is to be used. At this stage of the disease wine is rarely necessary; it may be required after epistaxis or for sudden depression, where food has not been taken. The room should be kept quiet, and perhaps dark, so that sleep may be favoured. Tepid sponging of the surface, part at a time, relieves the feeling of heat and tension; irritation is soothed by applying cold cream to the face, and carbolated oil to the body, or by rubbing with suet in some places. The bed-clothes should not be too heavy. An attendant may be required during the night. Good ventilation admits fresh air without draught or chill to the patient. A spray of ozonised water or aromatic vinegar freshens the air of the room. In this way, with previous good health, the danger of pulmonary complications is lessened. When several cases have to be treated in a ward, each patient should have a space screened off from draughts, and kept sweet. Directly the rash is out, the fever falls, the tongue cleans, the appetite returns, and the patient seems cheerful and well; ordinary food can again be taken, sleep returns, and no alcoholic stimulant is required. On the other hand, with dislike of food, languor, or restlessness at nights, stimulants should be given, before the dry tongue, small and rapid pulse, receding rash, or signs of pulmonary congestion, render free and frequent stimulation indispensable. There is, perhaps, no condition where wine produces such marked and immediate benefit as in the depression following upon the crisis of measles; it seems to give life, certainly it is a direct means of saving it, enabling such nourishment to be taken as will soon supply altogether the needed support. Sedatives are not often required; a small dose of Dover's powder moderates any tendency to diarrhœa; this is always to be guarded against, and never provoked. Where, without complication, the febrile crisis is delayed, a dose of quinine with Dover's powder at night has been useful. After the crisis cold bathing, with great precaution, aids sleep, and gives tone to the cutaneous, bronchial, and pulmonary circulations; cold affusions may be necessary for hyperpyrexia at a later stage, when, if head-symptoms threaten, ice should be applied to the head. Croupy symptoms and bronchial catarrh in children after the eruption, are to be treated on general principles, as described in the articles having reference to these diseases. Diarrhœa at the close of measles may take the place of pneumonic symptoms, and need not be suddenly checked. Rest in bed, carefully regulated diet, and stimulants, with opiate epithems, or an opiate enema, will generally relieve. The mineral acids, with or without a bitter, aid digestion, and can either be given very dilute as a drink at any time, or in a definite dose with food. For the irregular febrile disturbance noticed in the weakly, they are useful adjuncts to the quinine or cod-liver oil that are then essential. Some local troubles must be treated; earache needs a dose of croton-chloral, or a warm poultice with a little opium in the ear gives relief; otorrhœa requires tepid syringing; for ophthalmia, lead lotion, and the topical use of belladonna or atropia if there be photophobia, are necessary; the swollen eyelids should be raised to see that no injury to the eye occurs while other severe symptoms may be attracting most attention. Ulcers in the mouth or elsewhere may have to be touched with nitrate of silver or boracic acid, where astringent washes are ineffective. After-treatment is always important and necessary. For the anæmia which attends convalescence some form of iron is to be taken with meals two or three times a day. Cod-liver oil should be given an hour after meals, at least twice a day, to the strumous or delicate. Often the mineral acids with a bitter are of service, especially when the rash has been livid or petechial. The clothing should be warm, with flannel next the skin. Cold bathing rapidly performed, or with salt-water, is to be recommended; and when the weather is fine the patient should go out of doors once or twice a day, avoiding chill or fatigue. Children are the better for an afternoon sleep; adults should avoid full work, or exposure at night, for one or two months after measles. Convalescents should have a change of room in the second week of the illness; means should then be taken to purify and disinfect the sick chamber, as by burning sulphur or the bisulphide of carbon in it before the cleaning; this does not interfere with other rooms in the house to which convalescents are removed. Change of air or place is not so necessary as is often supposed. Home is the best place for cure, not only until all danger of infection is passed, but that the dangers of convalescence and the possible development of any constitutional defect may be watched, and receive the earliest and best attention.

William Squire.

MEASUREMENT.—A method of physical examination, in which tape-measures and other instruments are used to ascertain accurately the shape, dimensions, and movements of different parts of the body. *See* Physical Examination.

MEDIASTINUM, Diseases of.—Synon.: Fr. *Maladies du Médiastin*; Ger. *Krankheiten des Mediastinum.*—The principal morbid conditions which occur in connection with that region of the chest which is known as the mediastinum, are (1) aneurism of the thoracic aorta; (2) inflammation of the tissues or textures within the cavity; and (3) new growths involving the same space. Of these conditions, aortic aneurism is by far the most common; but it possesses so many special features that it will be described separately in this work (*see* Aorta, Diseases of; and Thoracic Aneurism). The remaining pathological conditions involving the mediastinum will be discussed in the following pages.

1. Mediastinum, Inflammation of.—Synon.: Mediastinitis; Fr. *Médiastinite*; Ger. *Mediastinitis.*

Definition.—This term has been employed by writers to denote inflammation of the serous surface of the duplicature of the pleura separating the pleural from the mediastinal cavity, and also inflammation originating in the cellular tissue or other textures of the mediastinal space. In the former sense mediastinitis is but a variety of pleurisy, which, though it may be characterised by special symptoms, must be very difficult, if not impossible, to diagnose during life. We confine our attention here to inflammation and its results in the mediastinal cavity.

Ætiology and Anatomical Characters.—There are very few trustworthy observations on record of simple acute inflammation of the mediastinum, terminating either in resolution or in effusion of plastic lymph. An example of the latter detailed by Wildemann is probably unique. In this instance the anterior mediastinum was filled with layers of solid exudation; the pericardium inflamed; and its cavity distended by six ounces of pus. The mediastinal effusion appeared to have been occasioned by long-continued pressure on the sternal region. On the other hand, we have numerous examples recorded, in which mediastinal abscesses have resulted both from primary or idiopathic, and from secondary or symptomatic inflammation. Primary abscess, though rare, is occasionally met with, produced either by local injury or simply cold. Gunther (in *Oesterreich. Zeitschr. f. prak. Heilk.* 1859,) and others have recorded cases of mediastinal abscess originating simply in cold. It may, however, be suspected that some forgotten physical injury had in some of these cases been received, as in the only case of the kind that has fallen under the writer's notice. Dr. Goodhart, in the *Pathological Transactions*, vol. xxviii., records a case of acute mediastinal abscess, resulting apparently from injury produced by the sticking of a piece of meat in the œsophagus. But by far the most frequent cause is suppuration of the lymphatic glands in scrofulous subjects, as in a remarkable instance recorded by Dr. Bristowe, in the *Pathological Transactions*, vol. ix. p. 46. Secondary or symptomatic abscesses, in the form of purulent *depôts*, are not infrequently met with in the anterior mediastinum, either in connection with operations, such as tracheotomy, or as the result of general pyæmia.

Symptoms.—The only instance of primary abscess of the anterior mediastinum that has fallen under the writer's observation presented the following symptoms:—A middle-aged lady, previously in good health, fell on going up-stairs and struck the sternum against the stone edge of the stairs. A few weeks afterwards she complained of uneasiness about the chest, and of pains in the left shoulder and about the scapula and neck. They were not severe, and had more the character of neuralgia or rheumatism than of anything more serious. After a time there was some general derangement of the health, attended by dyspeptic symptoms, a certain degree of febrile disturbance, some dyspnœa, and inability to lie down except in certain positions. Two months after the accident, which had been forgotten, there was a distinct prominence over the upper part of the sternum of an oval shape, and rather less in circumference than the palm of the hand, not red, but tender on pressure, and to which was referred a sense of uneasiness and pressure. The aspect of the patient was indicative of some anxiety, but not distress. The breathing was quiet; the pulse was quickened; but there was little or no febrile heat. There was some cough, attended by mucous expectoration sometimes streaked with blood. She complained of soreness and irritation of the larynx and fauces. The action and situation of the heart were normal. There was dulness on percussion over the whole of the prominence of the sternum, and nowhere else throughout the chest, but neither pulsation nor fluctuation could be detected in the tumour. There was no physical evidence of pressure either on the trachea or bronchi, although the patient admitted a feeling of weight or pressure, as well as of dull uneasiness; but there had been no sense of throbbing. There was no enlargement of the jugulars or superficial veins, nor any tumefaction of the base of the neck. Careful physical examination of the whole chest revealed nothing beyond a few loose mucous *râles*. Local sedative applications and the use of bromide of potassium gave some relief to the pain and local tenderness, but the cough and laryngeal irritation continued. After a few days about a teaspoonful of bright fluid blood was coughed up, and the day following a little more, without effort. The next day there was suddenly brought up from two to three ounces of purulent matter, followed by a sense of great relief. A microscopical examination of this matter revealed nothing more than pus and mucus mixed with an unusually large number of squamous epithelial cells, but not a trace of elastic tissue, or anything to indicate disorganising changes in the lung. The purulent expectoration continued, but in steadily decreasing amount, for about five weeks, the sternal swelling subsiding *pari passu*. Ultimately the sternal region was of normal aspect, and the general health was completely restored, though for some time there was occasional slight oppression of the breathing.

The above example has been recited because the symptoms correspond very closely with those which have generally characterised such cases. In some instances, however, there has been more distinct evidence of phlegmon, and a greater amount of febrile disturbance and distress. Unless the abscess be large, or associated with glandular or other organic disease, symptoms of compression, either of the bronchi or large vessels, are not usually observed. But in the latter case there may be not only symptoms of venous and bronchial obstruction, but even serious laryngeal symptoms and paroxysms of severe dyspnœa. The abscess may open either into the trachea, bronchi, or pleural cavity, if no external outlet is obtained. Spontaneous external opening is said to occur most frequently on a level with the second rib, to the left of the sternum.

Prognosis.—The prognosis of mediastinal inflammation should, in view of its possible terminations, be guarded.

Treatment.—Unless the acute symptoms of phlegmonous inflammation should be well marked, but little can be done in the way of treatment, beyond allaying pain, and the use of local soothing applications. Strict rest should be enjoined, and an external opening should be made for the outlet of matter, so soon as distinct indications are presented of its presence. It should also be borne in mind that the inflammatory action is liable to spread, and to involve either the lungs or the pericardium.

2. **Mediastinum, Morbid Growths connected with.**—By far the larger proportion of intrathoracic growths originate in the mediastinum, and for the most part in the lymphatic glands. Others, which may commence in the lungs or pleura, involve, sooner or later, the mediastinal spaces. In treating, therefore, of mediastinal tumours, from a clinical point of view, it is of less importance to determine their precise origin than to ascertain the general character of the growth, its modes of development, and the effects likely to be produced on the surrounding textures. It is manifest, however, that the particular site of the growth must exercise an important influence, both on the early symptoms, and the subsequent features of the case. It is necessary, therefore, to remember, when forming a diagnosis in cases necessarily very obscure in their early stages, how very various are the situations and relations of the growths. Thus either functional derangements of the heart, neuralgic pains of the muscles, dysphagia, spasmodic affections of the larynx, bronchial irritation, or limited pleuritic symptoms, may be the earliest indications.

Varieties and Symptoms.—Almost every form of morbid growth has been met with in the mediastina: cancer in all its varieties; sarcomatous, osteosarcomatous, enchondromatous, and fibrous tumours; lymphadenoma; and lardaceous, steatomatous, and tubercular masses. The progress and duration of the disease will differ materially, according to the natural history of these several formations. The growth of some is much more rapid than that of others. By some the adjacent textures are much more readily invaded than by others. Constitutional symptoms and impairment of the general health are much more pronounced in some than in others. Apart, therefore, from the special features given to each case by the particular locality of the disease, there will be very great differences in its general aspect and progress. And were it only in reference to prognosis, irrespective of treatment, it would be very desirable to determine the nature as well as the existence of the growth. This, unfortunately, in many instances, cannot be done; but in others we may form an opinion with considerable confidence. The development of the malignant growths is generally much more rapid than that of the more innocent, and the duration much shorter. It is seldom that the duration of an intra-thoracic growth of a malignant character extends beyond a year. Those having the character of lymphadenoma or lymphosarcoma are sometimes of much longer duration. These in a large proportion of cases commence in the lymphatic glands of the posterior mediastinum, or in the anterior mediastinum, from, as some believe, remains of the thymus gland. They sometimes attain to an enormous size, and may ultimately involve all the structures within the thorax, including the heart and pericardium. In other instances, commencing probably in the connective tissue, the disease spreads along the roots of the lungs and sides of the bronchi, extensively involving the adjacent tissues and the lungs themselves, without, for a long time, giving rise to any considerable tumour. In other cases several distinct tumours are developed at some distance apart. The period at which pleuritic effusion, or œdema of the external parts occurs, also varies greatly. Thus, too, it happens that alterations in the external form of the chest are early manifest in some cases, and not till later in others. In some instances these alterations of form are limited, in others they implicate the whole of one side, or even the whole contour of the thorax. In not a few instances, whilst the growth is still of limited extent, and confined to the posterior mediastinum, the symptoms so closely resemble those of aneurism as to make the diagnosis extremely difficult and uncertain. The more prominent symptoms are indeed in some instances, and for a long time, mainly cardiac. In the most malignant types of disease, and where, as in far the greater number of instances is the case, the lymphatic glands of the thorax have become implicated by extension of disease from other organs, the local thoracic symptoms are from the first associated with those general symptoms which are characteristic of malignant disease, and pass under the term of cancerous cachexia. Sarcomatous tumours, on the other hand, attain a considerable size without constitutional symptoms of any special character. As a rule it may be said that all intra-thoracic growths tend to develop inwards rather than outwards; and thus often overlap the lungs and heart, pass along the great vessels and nerves, and press on those parts that offer least resistance. It is only in very rare instances that the chest-walls become eroded by the outward pressure of the tumour, as in so many cases of aneurism. This is the more remarkable because in many instances the presence of the growth is distinctly indicated by external tumour, arising from outward pressure of portions of the chest-walls. This is of course especially the case when the growth is in immediate proximity to the walls of the chest. In the case of large tumours the external form of the chest may be rendered unsymmetrical by displacement of the heart, and downward pressure on the diaphragm and liver. There is, however, another and very distinct mode by which the symmetry of the chest is affected, and that is by collapse of the lung and sinking of the chest-wall, in consequence of the pressure exercised on the root of the lung, by the progressive advance of the tumour. The effect of this is sometimes rendered still more apparent by the corresponding expansion of the opposite lung, either from congestion or induced emphysema. The deformity of the chest attains its maximum in many cases by the outgrowth of tumours above the clavicle and along the neck. It may be well, however, at the risk of some repetition, to classify, under different heads, the most characteristic of the multifarious phenomena that have been observed in connection with the different varieties of mediastinal growths.

Derangements of the circulation.—Derangements of the circulation, which are necessarily induced, in all cases, to a greater or less degree, give rise to phenomena which are of special diagnostic importance in mediastinal tumours. The return of blood through the vena cava superior and its affluents is early impeded, more or less, in the majority of cases, and sometimes to such an extent as to give a special aspect to the case. It is not, however, simply by pressure on the venous trunks that the indications of pulmonary congestion, œdema, and cyanosis are induced. In many cases the veins themselves, although seldom the arteries, are involved in the cancerous disease; and when this is not the case, there is often a special tendency to thrombosis and obliteration both of the large veins and of their radicles. Cancerous deposit has, in some cases, been traced into the jugular and subclavian veins, entirely occluding them; in other cases these vessels have been enormously distended. Thus we have in many instances great tumefaction of the face, neck, and upper extremities, from œdema and general serous infiltration. In like manner the circulation through certain portions of the lungs may give rise either to hæmorrhage in the form of hæmoptysis, or to sanguineous effusion into the pleura, or to large apoplectic clots, that is, infarcts. In this latter way the physical signs of consolidation are sometimes suddenly induced, or increased; and after death the pleural cavity has been found occupied by large protuberances from the pleura, consisting simply of blood-tumours, due to extravasation into the pulmonary tissues. Although the arteries are much less liable to become implicated in cancerous disease than the veins, they are subject, like all the other contents of the thorax, to pressure. The force of the current of blood through them may thus be diminished, and there may be a marked difference in the radial and carotid arteries of the two sides, just as there is in aneurism of the aorta. It is needless to say that the symptoms arising from mechanical influences acting on the heart must be very various. This organ may either be dragged from its natural situation, or surrounded, more or less completely, by the advancing disease, and its situation and action concealed from all observation; or its very substance may become involved in the spread of the disease, and the pericardium may be largely distended by serous and bloody effusion. Apart from those disturbances of the heart's action arising from interrupted circulation through the lungs, its innervation may be seriously affected, as will be subsequently noted. And it is evident that the sounds, rhythm, and impulse will be affected in more ways than one; even when neither the valvular apparatus nor any other structure is the actual seat of disease. In the malignant forms of disease the muscular power of the heart is generally impaired, and there is a consequent tendency to palpitation and faintness, often associated with nausea and vomiting. Such symptoms have been observed in rare cases, where the heart has become implicated by disease extending from the mamma through the thoracic walls.

Febrile symptoms.—Mediastinal tumours are not as a rule characterised by febrile disturbance, at any period of their course. Several examples of tumours having the character of lymphadenoma have, however, exhibited striking exceptions to this rule. The writer has recorded a remarkable instance, and others have been recorded by the late Dr. Murchison and Dr. Church, in which there was persistent elevation of temperature, and rapidity of pulse and respiration, but with daily alternations of rise and fall. And in these instances it is remarkable that the pyrexia declined with the advance of the disease to its fatal termination. Intercurrent inflammatory affections, whether of the pulmonary tissue or of the pleura, may in any case occasion corresponding symptoms of fever. These, however, are seldom very pronounced.

Disturbances of innervation.—Disturbances of innervation occur at all stages, and in connection with every variety of growth. They vary, however, greatly in their character and severity. Although pain may be said to be present in most instances, it is often, all through the case, by no means a prominent symptom. The patient's distress, often very great, is more frequently due to dyspnœa and interrupted circulation, than to direct implication of the nerves. Nevertheless neuralgic pains are among the most frequent of the early subjective symptoms, and are sometimes severe in the later stages. When from the situation of the growth the recurrent laryngeal nerve is early implicated, we sometimes get paralysis of the vocal cords and aphonia, at other times spasmodic paroxysms of dyspnœa, and urgent laryngeal symptoms. In rare cases cancerous disease of the posterior mediastinum has invaded the spine, and given rise to paralysis of the limbs and trunk. The cough, which is generally due to more or less bronchial irritation and secretion, sometimes arises from purely nervous reflex irritation, and may occur in paroxysms like those of whooping cough. The innervation of the heart may be so disturbed as to occasion symptoms of angina, as well as various irregularities of action and tendency to fainting. The immediate cause of death is not infrequently to be attributed to sudden interruption of the heart's action.

Respiratory phenomena.—The respiratory phenomena, although presenting the utmost diversities, have nevertheless certain special characteristics. When the patient is at rest, there is often nothing to denote any impediment to the respiratory function—no quickened movement, no alteration of aspect, no expression of anxiety; but on the least exertion, dyspnœa is at once manifested. Mere change of position may induce a paroxysm of dyspnœa. With advancing disease implicating at length the contents of the thorax to a great extent, there may be no corresponding increase of dyspnœa, especially if the progress be slow. In other cases, with physical signs of a very questionable and limited character, there may be great distress in breathing. Absence of apparent dyspnœa is sometimes the more remarkable from the manifestly diminished movement of the chest-walls, or even complete immobility perhaps of one side. Nor in many cases does the dyspnœa correspond with the evidence of pressure, and the absence of respiratory sounds on auscultation. The want of correspondence between the physical signs and the functional symptoms is indeed often most striking. In one case there will be persistent difficulty of breathing, amounting to orthopnœa of the most urgent character, in another merely a little quickened respiration—lividity and turgescence of features in one case, in another an anæmic aspect.

Physical signs.—So long as a mediastinal tumour remains of but small size, it will, of course, not be recognisable by external physical signs, except such as are due to mechanical derangements of the circulation, generally denoted by enlargement of the external superficial veins. Comparatively small tumours will, however, sometimes manifest themselves by circumscribed alterations in the external aspect of the chest. This of course will depend much on the site of the tumour. Tumours of the anterior mediastinum may very early manifest themselves, by throwing forward the sternum and the sternal attachments of one or more of the ribs, and ultimately rendering the two sides of the chest asymmetrical. It is in these cases, when, with the growth of the tumour, the heart and aorta become overlapped and pressed on, that we have evidence of pulsation and vibration, simulating closely the signs of aneurism, and sometimes attended by a cardiac bruit. In other cases the growth, extending upwards, shows itself by tumefaction and swelling above the sternum and clavicles, being then often attended by signs of pressure on the trachea or bronchi. When the posterior mediastinum is the chief seat of disease, this may attain to very considerable development before any very decided alteration is seen in the form of the chest, unless one or other pleura have become distended by fluid effusion. The diagnosis of these latter cases often presents the utmost difficulty, the physical signs being simply those of pleuritic effusion, and the symptoms such only as may be fairly referred to the mechanical effects of fluid pressure. When the tumour is of any considerable size, the motions of those parts of the chest-walls which are in immediate proximity to the growth are almost always impeded, and there is evidence of diminished expansion. This is also the case when the pleura is occupied by secondary growths, when there may be obliteration of the intercostal spaces, as in pleurisy. But as collapse of the lung sometimes takes place with little or no pleuritic effusion, there may be falling in of one side of the chest, appreciable by the eye, as well as by measurement. As, however, the tumour usually extends more to one side than the other, the measurements of the two sides will generally differ, from this cause alone. By percussion and palpation the ordinary signs of solidification will of course be detected, whenever the tumour approaches the chest-walls and attains to any size, or whenever any considerable portion of the lung has been rendered solid, either by invasion of the growth, by pneumonic consolidation, or by hæmoptic engorgement. Signs of displacement are often manifest comparatively early, and later on may be of the most unmistakable character. The heart may be dragged away from its natural situation in various directions; the diaphragm thrust down; the lower ribs thrown out; and the deformity of the anterior part of the chest, and the physical signs on auscultation and percussion, may be greatly modified, by distension of the pericardium from effusion. It will at once, therefore, be seen that the cardiac signs will be of very variable and diverse character—so much so that any detailed description would be of little practical use. It should also always be remembered, that the lung undergoes very various and opposite changes as the result simply of pressure on the bronchi, and interruption to the entrance and egress of air from the air-cells. Thus in the early stages there may be more or less of emphysema, and corresponding physical signs on the affected side; and in more advanced cases a certain amount of emphysema of the opposite side. As the bronchi become occluded, we have at first the stethoscopic signs of accumulation of secretion, soon to be followed by signs of consolidation and absence of respiration, when the lung is undergoing those destructive changes by which it becomes converted into a solid mass broken up by irregular abscesses or pockets of pus, produced in part by actual pulmonary disintegration, and partly by dilatation of the bronchi. In the latter condition there may be enlargement of the lung and distension of the side, rather than collapse. Hyper-resonance from emphysema, followed by signs of consolidation and absence of all respiratory phenomena, associated with or preceded by other indications of pressure, would be tolerably decisive of the existence of a mediastinal tumour, but whether aneurismal or some form of malignant disease might still be a question.

Diagnosis.—From the preceding remarks it will be evident that there are no symptoms or physical signs, nor any precise order of phenomena, that can be said to be peculiar to, or diagnostic of, an intra-thoracic growth. No two cases will be found to be precisely alike. Nevertheless, the want of correspondence with the ordinary forms of thoracic disease; the very general presence of signs of pressure and mechanical derangement; and the varying aspects of these signs are, in the majority of cases, when considered in conjunction with the history of the case, sufficient to lead, if not to a positive, at least to a probable diagnosis. In the early stages of a mediastinal tumour, when the growth is still small, it will be easily seen, if we reflect on the anatomical relations of the mediastinum, that an accurate diagnosis must often be impossible. And even when formidable symptoms arise from the peculiar relations of a small growth, it must often be extremely difficult to avoid error. Both retro- and antero-sternal nodes will sometimes closely resemble both aneurism on the one side, and mediastinal tumours on the other. For further remarks on the physical diagnosis, the reader is referred to the articles Lungs, Malignant Disease of; Mediastinum, Inflammation of; and Thoracic Aneurism.

Treatment.—There is but little that can be said as to the treatment of mediastinal tumours, except as regards the palliation of urgent symptoms, or the relief of some of the chief secondary effects of the original diseases. All forms of intra-thoracic growths of a malignant character are steadily progressive to their fatal termination. Some of the less malignant in character—for example, lymphadenomatous tumours—may last a long time, and appear for a while to be stationary, and unattended by any serious impairment of the general health. Even these, however, are exceptional cases. Bodily rest, freedom from causes of moral disturbance, maintenance of the general nutrition, change of air, and every available hygienic means, are essential in all cases. Chalybeates and other tonics may be of more or less service. Special symptoms often admit of considerable relief; for instance, local pains by external soothing applications, or counter-irritants, such as sinapisms and small blisters. The latter are often of signal benefit. Pain, sleeplessness, and harassing unrelieving cough may all be alleviated by opium and other narcotics, such as chloral or bromide of potassium, and sometimes by minute doses of antimony. For the distressing paroxysmal attacks of dyspnœa and laryngeal spasm, opium and its preparations require to be given with caution; but chlorodyne, Hoffman's ether, and the inhalation of chloroform are often useful. The distress arising from dyspnœa and inability to lie down will often tax the resources of the physician to the utmost, depending as they do on a variety of complex causes. When they appear to be mainly referrible to accumulation of fluid in the pleura, paracentesis must be resorted to, and will often be followed by great temporary relief. At one time the writer was averse to this procedure, but further experience has led him to believe that it is productive of little if any mischief, and that life may sometimes be much prolonged by even repeated evacuation of the pleural effusion. In proportion as symptoms of pleurisy, bronchitis, or pneumonia predominate, they must be met by the ordinary therapeutic resources. It remains to be seen whether our further knowledge of the natural history of lymphadenoma may advance our therapeutic resources. Certainly the slower progress of such cases affords more time for the trial of iodine, chalybeates, or other constitutional remedies. It should ever be borne in mind that severe attacks of dyspnœa, with stridulous breathing and other indications of intra-thoracic pressure, may all be due to nerve-irritation alone, and often be greatly alleviated by small doses of morphia combined with antispasmodics.

J. Risdon Bennett.

MEDIATE (*medius*, a means).—A term applied to auscultation and percussion, when some medium is interposed between the surface of the body of the patient and the ear or finger of the physician, such as the stethoscope in the one case, or a pleximeter in the other. *See* Physical Examination.

MEDITERRANEAN, The.—Moderately dry and warm, and very sunny winter climate. *See* Algiers; Cannes; Hyères; Nice; Mentone; Malaga; San Remo, &c.; and Climate, Treatment of Disease by.

MEDULLA OBLONGATA, Lesions of. Synon.: Fr. *Maladies de la Moelle allongée*; Ger. *Krankheiten des verlängerten Marks.*

Introduction.—The pathology of the medulla oblongata is more than usually complex. Not merely is it liable to injuries, and diseases such as hæmorrhages, softenings—necrobiotic and inflammatory, tumours, &c., having their primary seat here, as in other nerve-centres; but also, and more frequently, the medulla is implicated in diseases of the pons and cerebellum, and affected indirectly by intracranial diseases in general. Being the connecting link between the brain and spinal cord, it is subject to ascending or descending degenerative processes, secondary to lesions in the cerebral or spinal sensory and motor tracts. Further, it is the seat of a special form of degeneration, characterised by a very definite group of symptoms, differentiated under the term bulbar or labio-glosso-laryngeal paralysis.

With the indirect affections of the medulla oblongata, in connection with the various forms of intracranial disease, degenerations of the sensory or motor tracts secondary to cerebral or spinal disease, or the pathology and symptomatology of bulbar paralysis, this article does not profess to deal, as these subjects will be found fully discussed under other headings. Attention will be directed mainly to the data which serve to establish, so far as this is possible, the regional diagnosis of medullary lesions.

Summary of Pathological Conditions.—*Traumatic lesions.*—Injuries of the medulla oblongata are not uncommon in consequence of fracture or dislocation of the atlas and axis, as in falls, hanging, twisting of the neck, or as the result of diseased vertebræ. In such cases death is instantaneous, owing to the sudden cessation of the circulation and respiration, from lesion of the centres of these vital functions, which are situated in the medulla (Flourens' *nœud vital*).

To commotion or contusion, with punctiform extravasations in the medullary centres (Duret, *Sur les Traumatismes Cérébraux*, 1878), is also to be attributed sudden death from blows on the head. Not unfrequently lesions of the fourth ventricle, the result of cranial injuries, not proving fatal, give rise to diabetes mellitus or insipidus, along with other symptoms indicative of chronic lesion of the pons or medulla.

Effusions of blood into the fourth ventricle, whether arising from the medulla itself, the pons, or the cerebellum, or gaining access from the lateral ventricles by the aqueduct of Sylvius, are, as a rule, suddenly fatal from paralysis of the circulation and respiration. Death may occur with or without convulsions.

Tumours.—Tumours implicating the medulla oblongata may have their seat primarily in the medulla; but more commonly the tumours are situated at the base of the skull, in the cerebellum or pons, and invade the medulla in their growth. Apart from the general symptoms of cerebral tumour—headache, sickness, optic neuritis, &c., the special indications of implication of the medulla oblongata are one or more of the symptoms mentioned below. Here also, however, some remarkable cases have been put on record, in which, notwithstanding the existence of tumours actually in the substance of the medulla itself, the symptoms during life have presented nothing striking or characteristic. (See a case by Dr. Wilks, *Diseases of the Nervous System*, 1878.)

Hæmorrhage.—Hæmorrhage into the substance of the medulla oblongata, and limited to this, is comparatively rare. More commonly the pons and medulla are affected together. Hæmorrhages here of any extent are very rapidly fatal. In some cases death is instantaneous. In others a few hours may elapse, death occurring in profound coma with stertorous respiration, and occasionally convulsions. Whether the hæmorrhage is primarily in the medulla or in the pons cannot be diagnosed with certainty. The other causes of sudden death, such as affections of the heart, must be excluded before hæmorrhage into the medulla can be diagnosed, and this is in many circumstances obviously impossible.

Hæmorrhage into the medulla oblongata is usually fatal, and rarely gives rise to chronic stationary lesions. These are usually the result of thrombosis or embolism, or, more rarely, acute myelitis.

Thrombosis.—Thrombosis of the vertebral arteries is the most common origin of softening limited to the medulla oblongata. The onset is frequently sudden, as in hæmorrhage, but the course is more slow. The more chronic nature of the affection is an important diagnostic feature of softening. The symptoms of softening of the medulla thus arising are in many respects like those of progressive bulbar paralysis, but there are also important differences. They are sometimes generalised under the head of 'acute' or 'apoplectiform' bulbar paralysis, in contradistinction to the classic form of this affection described by Duchenne. *See* Labio-Glosso-Laryngeal Paralysis.

Localising Phenomena.—The symptoms met with in the affection just named are the most reliable clinical data on which to found a regional diagnosis of lesions of the medulla oblongata. The characteristic symptoms are a conjoint affection of the extremities and one or more of the bulbar cranial nerves, with impairment of speech and deglutition, and cardiorespiratory disturbances. Sometimes all four extremities are paretic or paralysed; sometimes the lower extremities alone; and occasionally the paralysis is of the hemiplegic order.

If the paralysis affects only the extremities, without implication of the bulbar nerves, as sometimes occurs, a diagnosis of the medullary seat of the lesion cannot be made with certainty. Anæsthesia has not been recorded, but occasionally paræsthesiæ have been observed. Ataxic affections of the extremities have also been met with by Leyden and Prévost.

Of the cranial nerves the hypoglossal is most commonly involved. The symptoms are impaired mobility of the tongue, with more or less pronounced dysarthria. This is not absolutely characteristic of bulbar disease, however, as a similar affection of the hypoglossal may occur in disease of the pons. The tongue and speech are rarely, if ever, so affected as in the classic or progressive bulbar paralysis, nor has the atrophy of the muscles of the tongue, with altered electrical reactions, been noted.

Of more importance as a diagnostic mark is dysphagia, or paralysis of deglutition. This, in the absence of general cerebral symptoms, points to affection of the medulla. Paralysis of the soft palate, on one or both sides, is also a frequent, if not constant, symptom. Occasionally also aphonia occurs, and, taken with the other symptoms, points conclusively to affection of the medulla oblongata.

Irregularity of the heart; acceleration or retardation of the pulse; and sighing and laboured respiration, often amounting to orthopnœa, in the absence of general cerebral symptoms, are also important indications of disease of the medulla oblongata. Among other symptoms have been noted coughing, and vomiting, explicable by affection of the respiratory centres. Trismus has been mentioned by Joffroy as a characteristic symptom of acute bulbar paralysis, but Nothnagel, on good grounds, disputes the accuracy of this statement.

Albuminuria and glycosuria have also been observed in connection with bulbar lesions, the latter more particularly after injuries affecting the floor of the fourth ventricle; but the occurrence of these symptoms in connection with acute bulbar paralysis requires further investigation, as they cannot as yet be regarded as constant.

An affection simulating disease of the medulla oblongata results from bilateral lesion of the anterior third of the internal capsule (Lépine), or of the cortex in the region of the lower extremity of the ascending frontal and posterior extremity of the third frontal convolution (Barlow). Such a bilateral lesion causes paralysis of articulation, and also true aphasia if the lesion is cortical, along with a greater or less degree of double hemiplegia. The diagnosis must depend on the truly volitional character of the paralysis in such cases, the reflex mechanism of deglutition being unimpaired. There will also be absence of affection of sensibility and of trophic degeneration of the muscles, and absence also of disturbances of the cardiac and respiratory rhythm. Defective comprehension of speech, and obvious aphasia—the movements of articulation not being absolutely paralysed, and also agraphia—the hand not being completely powerless—will differentiate cerebral from bulbar paralysis.

D. Ferrier.

MEDULLA OF BONES, Diseases of.—Synon.: Fr. *Maladies de la Moelle des Os*; Ger. *Krankheiten des Knochenmarks.*—The morbid conditions of the medulla of bones are most conveniently described under the head of the several diseases of which they almost invariably form but a part. Thus, injuries, acute and chronic inflammation or osteomyelitis, and the majority of new growths involving the marrow, affect the bone as a whole, and are accordingly discussed in the article upon these subjects (*see* Bone, Diseases of). Myeloid tumour, which is peculiarly connected with the medulla, is also described and figured in the article on Tumours.

The medulla of bones is also the seat of important pathological changes in several chronic constitutional diseases. For instance, it is affected in some cases of leucocythæmia, and of lymphadenoma; in mollities ossium; and in rickets. The reader is referred to the description of the anatomical characters of these conditions in the articles bearing their several names.

MEDULLA SPINALIS, Diseases of. *See* Spinal Cord, Diseases of.

MEDULLARY CANCER.—A synonym for encephaloid cancer. *See* Cancer.

MEGRIM.—Synon.: Migraine; Sick Headache; Nervous Headache; Hemicrania; Fr. *Migraine*; Ger. *Migräne.*

Definition.—Headache of a periodical character; generally ushered in by some premonitory symptoms; more or less unilateral; and frequently associated with nausea and bilious vomiting.

Ætiology.—The chief predisposing causes of attacks of migraine are hereditary tendency; anæmia; a general want of tone in the system; and the nervous temperament. Among the exciting causes may be included all those of a depressing or exhausting nature, whether physical or mental, such as prolonged mental work, mental excitement, grief, anxiety, bodily fatigue, late hours, sexual excesses, breathing the impure air of a crowded room, and improper food.

Symptoms.—This complaint seems to have two more or less well-defined stages, the headache being preceded for a variable period by certain disorders of sensation. In some persons the malady stops short here, and is not followed by headache; in others the headache appears to be developed without any premonitory symptoms, until careful inquiry reveals the contrary. The two stages therefore are, first, the stage of disordered sensation; second, the stage of headache, with other symptoms.

The most striking of the disordered sensations is a transient disturbance of vision which sometimes takes place. It commences with a wavy glimmering near the outside corner of the field of vision, and spreads all over the visual area with a zigzag outline, in a straight-lined angular pattern, and with or without lines of colour between the darker lines. Or it may commence by the appearance of a blind spot close to the centre of vision, which soon begins to spread, showing a serrated margin, and presenting a tremor or wavy glimmering in its interior.

This condition is often associated with a feeling of chilliness, coldness of the hands and feet, or other symptoms; it may last from five to thirty minutes or longer, and then be succeeded by the stage of headache.

On the other hand, the headache may be, and in many individuals always is, developed without the ocular disturbance, but other sensations are substituted for it. The patient has a feeling of chilliness, and the feet are cold. There is mental depression, with a dread of impending evil; the patient is restless and uneasy; 'cannot quite tell,' as he says, 'what he would be at;' and has what is expressively called 'the fidgets.' This condition may continue half an hour or more, and then the slight boring piercing pain is felt in the head, with which the aching begins; and the disorder runs its course, as will be presently described. In other cases, this feeling of depression or uneasiness lasts for several hours, the patient goes to bed, and in the early morning wakes with the headache fully developed.

The headache, when preceded by ocular disturbance, shows itself as follows:—When the vibratory movement is at its height, a little aching is felt in the head, on the side *opposite* to that on which the glimmering first appeared: it is slight at first, but gradually increases in intensity. Some persons have said that the sensation was as though a point in the temple were being bored with a gimlet, and the gimlet slowly increasing in size. The pain gradually spreads from this point, which may be covered with the finger, and pressure upon which affords relief, first over one side of the head; and then, but not always, it extends to the other. As the headache increases, the ocular disturbance declines; nausea is felt, which increases with the headache; retching and vomiting occur, the latter sometimes, though rarely, giving relief; the head throbs; the slightest movement increases the pain, and any attempt to move from the recumbent posture increases the gastric uneasiness; the mouth feels clammy; the eyeballs ache, and are tender on pressure, one more so than the other; the pupils are rather contracted, and generally unequally so; and the patient lies apparently more dead than alive, his face pale, and the head hot. After a varying number of hours he is somewhat relieved by troubled sleep; he wakes up next morning free perhaps from headache; but he is listless; his brain is weary; and he feels as if he had undergone a hard mental struggle. There may be now an interval of a few days, weeks, or years, before the disorder again shows itself.

The headache varies much in character, degree, and duration. In some persons the pain is not localised in any particular spot, but seems generally diffused over the head; others have not noticed that there is more pain on one side of the head than the other, or that the aching radiates from one painful spot, until their attention has been directed to the fact, and then they distinctly recognise it; others, again, have neither vomiting nor nausea; and lastly, the duration of the headache may be very short, or not extend over more than two or three hours, or this symptom may be entirely absent. The disorder may even stop short at the vibratory stage, the vision be restored, and no further inconvenience felt.

In a certain proportion of cases during the vibratory stage a tingling is felt in some portion of the body—the part is 'asleep.' Sometimes it is felt in one arm or in the side of the tongue, or on the side of the face, and it is on the same side as that on which the glimmering in the eye begins. Sometimes the hearing, speech, or memory is affected.

The age at which the attacks generally commence is from twelve to twenty-five. Females are more liable to them than males. After a certain period, with advancing age the attacks, as a rule, are less easily developed, and become much less frequent. They cease generally after fifty or sixty, and in women not uncommonly at the change of life.

PATHOLOGY.—Considerable diversity of opinion exists as to the nature of megrim. Formerly it was regarded as being dependent upon gastric or hepatic derangement, a view, however, which now finds few supporters. Some pathologists hold it to be a form of neuralgia; but though it has a great resemblance to neuralgia, it 'causes much greater disturbance of the sensorium, it spreads much more generally over the head, and is not unfrequently accompanied with nausea and vomiting. After the attack there may be an intermission of weeks or months, and the attack itself runs a more uniform or continuous course' (Lebert). The view which the writer has advanced is that the affection is to be referred to the sympathetic nervous system. If by fatigue, anxiety, or other depressing cause, the general tone of the body be lowered, and with it the regulating or inhibitory power of the cerebro-spinal over the sympathetic nervous system impaired, then uncontrolled action or excitement of one or more portions of the latter takes place, causing contraction of the blood-vessels under the influence of the affected portions, and so producing the disorders of sensation which precede the headache; this excitement is followed by exhaustion or paralysis of the sympathetic, and is associated (just as would be the case after section of the nerve) with dilatation of the vessels, and with headache. Dr. Edward Liveing, in his classical and exhaustive work on megrim, combats this view, and maintains that the phenomena are those of 'a nerve-storm traversing more or less of the sensory tract from the optic thalami to the ganglia of the vagus, or else radiating in the same tract from a focus in the neighbourhood of the quadrigaminal bodies.'

TREATMENT.—By careful management very great relief can be afforded to the sufferers from this malady, not only by diminishing the intensity of the attacks, but also by considerably lengthening the intervals between them. We may consider separately the remedial measures to be employed (1) during the intervals between the attacks; (2) during the premonitory stage or stage of disordered sensation; and (3) during the stage of headache.

1. *During the intervals between the attacks.*—It is to the treatment during this period that the greatest consideration must be given. The cause, if possible, must be discovered, and in a

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very large majority of cases, careful inquiry will reveal the fact that a distinct cause does exist. Overwork, prolonged anxiety, over-fatigue, disappointed hopes or affections, sexual irregularities, and impoverished nutrition of the body, are among the chief causes; and while these are in operation medicine will prove of little avail. Remove the cause, and then endeavour to brace up the bodily and nervous systems. The chief remedies for this purpose are the vegetable bitters, iron, strychnine, and cod-liver oil. But the success following their use very much depends upon the way in which they are administered. For a day or two after a headache the stomach and bowels may possibly be disordered, and not in a fit state to tolerate iron or cod-liver oil. This condition must be corrected, and for this purpose the simple vegetable bitters, such as gentian with small doses of henbane and some aromatic, may be of service; and if necessary one or two grains of blue pill, with four or five of compound rhubarb pill, may be given at night, but strong purgation must be avoided. Iron may then be given, either in the form of the ammonio-citrate alone, or combined with two or three grains of iodide of potassium; and according to circumstances fifteen or twenty minims of tincture of henbane, or twenty or thirty minims of aromatic spirit of ammonia, may be added to each dose. Or the iron may be given in the form of the mistura ferri composita of the Pharmacopœia; the mixture answering better, however, in some cases without the myrrh. Strychnine is, in the writer's opinion, a very important remedial agent in many forms of this disorder, and may be given with the remedies previously mentioned in the form of liquor strychniæ or tinctura nucis vomicæ, or may be combined with infusion of quassia or calumba. Where iron is contra-indicated from any cause, or when it is not readily borne, the administration of nux vomica with quassia has seemed to act beneficially. In females with a distinct hysterical temperament nux vomica does not answer so well, and better results will be obtained by giving the vegetable bitters with ten-grain doses of bromide of potassium, and fifteen or twenty of tincture of henbane, twice or three times a day. As a rule, however, the bromide is of more use administered during the headache than in the intervals. Cod-liver oil often acts beneficially, especially when there is much nervous exhaustion. It may be given once a day immediately after breakfast, beginning with a small teaspoonful, and gradually increasing the quantity to a tablespoonful, but not beyond, unless in exceptional cases. If the bowels are constipated, five grains or so of the socotrine aloes pill may be given at night; or if the constipation be habitual, five grains of the aloes-and-iron pill, given twice a day before meals, will generally induce greater regularity in the action of the bowels.

Other remedies have been recommended, and are sometimes of service, especially arsenic and quinine.

In persons of feeble bodily power, rest is of the greatest importance, and it is often advisable that such patients should remain in bed at least twelve hours out of the twenty-four, and take their breakfast an hour and a half or two hours before rising in the morning. Whenever the headaches recur frequently, this rule should be enforced. In many cases a tumblerful of new milk, to which two teaspoonfuls of brandy, rum, or whisky have been added, may be taken with advantage before breakfast, directly on waking in the morning.

The diet should be liberal; the food plain and easily digestible; and two or three glasses of wine, beer, or porter per diem, may generally be taken with benefit. The more exercise the patient can take in the open air, without fatigue, the better.

2. *During the premonitory stage, or stage of disturbed sensation.*—In the forms attended by disturbance of vision, the longer this lasts the greater will be the headache, and we must endeavour therefore to shorten this stage as much as possible. Directly the glimmering appears the patient should lie down, with the head low; and if the glimmering be on the right or left of the field of vision, he should lie on the *opposite* side. Let him take at once some alcoholic stimulant, a full-sized glass of sherry, a large tablespoonful of brandy diluted, or a glass of champagne. If alcoholic stimulants be objected to, or if it be not advisable to recommend them, then a teaspoonful of sal volatile in water may be prescribed instead. If the patient be chilly, or his feet cold, the couch should be drawn near the fire, and a hot bottle applied to the feet. By these means the heart is enabled to drive the blood with greater force to the brain, and the duration of the vibratory movement is thereby materially lessened. After the glimmering has passed off, the patient should lie still for a time, so that it may not return. This injunction will only be necessary when the headache is slight; if it be severe, attended with much nausea or vomiting, the patient will be little disposed, or little able, to leave the recumbent position.

If, instead of the disturbance of vision preceding the headache, there be a feeling of depression or irritability, fidgets, and similar phenomena, the administration of such cerebro-spinal stimulants as henbane, valerian, assafœtida, spirit of chloroform, or ether, will often cut short the attack. Fifteen or twenty drops of the tincture of henbane, with the same quantity of spirit of chloroform, will soothe the nervous irritability in the slighter forms, and may be repeated in three or four hours if necessary. If there be great mental depression, then valerian or assafœtida should be tried. Half a drachm to a drachm of the ammoniated tincture of valerian, or the same quantity of the fetid spirit of ammonia may be given. As a rule, in such cases as these, alcoholic stimulants are not advisable at this stage. A small quantity will cause flushing, heaviness, and slight confusion of thought, without relieving the depression; and though the severe headache may be averted, alcoholic stimulants do not answer so well as the remedies previously mentioned.

3. *During the stage of headache.*—If the headache be slight, and the patient soon able to sit up, there is little to be done. A cup of coffee or tea, cheerful conversation, a walk, drive, or ride, may often help to remove the pain. If, however, the symptoms be severe, then the adminis-

tration of further remedies is called for. The patient should keep perfectly still and quiet, with the room darkened; for every sound or sight causes pain, and the slightest movement is sufficient to produce gastric uneasiness. Sometimes free evacuation of the contents of the stomach, especially if it contain undigested food, is followed by relief; but, as a rule, it is better to try to relieve and check the vomiting. Iced soda-water, with or without two or three drops of dilute hydrocyanic acid or spirit of chloroform; cold tea; or the effervescing citrate of potash with hydrocyanic acid, may often afford marked relief. The headache may be lessened by applying cloths dipped in cold water or evaporating lotions to the head. If the extremities be cold, and the headache severe, a warm stimulating foot-bath can be tried, so soon as the nausea will allow the patient to sit up. If the attacks occur in the early part of the day, as soon as the pain has subsided it is generally better for the patient to sit up or move about, or even to take exercise in the open air. During the attack the appetite is diminished, the idea even of taking food provoking disgust. Still, after the nausea has passed away, a plate of soup, or some easily digested food, will often have a good effect in equalising the cerebral circulation, and in relieving the headache. If the headache be severe, bromide of potassium is a remedy which will often prove of great service. It may be given in doses of fifteen or twenty grains, with fifteen or twenty minims of tincture of henbane, and to these may be added thirty or forty minims of the aromatic spirit of ammonia, in some cases with advantage. If necessary, the dose may be repeated after an interval of two hours or so. In other cases chloride of ammonium in doses of fifteen grains produces marked relief, and may be sometimes advantageously combined with spirit of chloroform and compound tincture of lavender. Guarana powder is a remedy which is used, often with happy results. The sick-headaches which it seems to relieve are those in which distinct premonitory symptoms usher in the attack, and particularly those preceded by disturbance of vision. It may be given in such cases in doses of fifteen grains, with the same quantity of sugar, and repeated in from half an hour to two hours. In those individuals, however, in whom the headache is developed suddenly, where the attacks come on without any or with very indefinite premonitory symptoms, guarana appears to have little effect.

As a rule, the use of purgatives in this stage is decidedly objectionable, but occasionally a saline purgative at the commencement of an attack is indicated, and is of service.

P. W. Latham.

MELÆNA (μέλας, black).—Synon.: *Dysenteria splenica*; Fr. *Méléna*; Ger. *Schwarze Ruhr*.

This term is used to denote black tar-like evacuations that are passed from the bowel. The colour and appearance are due to *altered* blood, and the expression is not properly applicable to simple hæmorrhage from the alimentary canal, when blood of a normal appearance is voided.

In order that the blood should have undergone the change which produces the characteristic evacuations, it must have been effused high up in the canal, and in some quantity. When hæmorrhage takes place in the lower part of the small intestine, or in the colon or rectum, the blood is passed in a scarcely altered state, or at most renders the fæces dark, without producing the black, viscid motions now referred to.

Blood that is passed into the stomach, from any cause, is subjected to the action of the gastric juice, and undergoes a partial digestion. The acid of the secretion converts the hæmoglobin into hæmatin, a blackish-brown substance, and the exposure of this to the sulphuretted hydrogen produced in the lower part of the intestine converts the iron it contains into a black sulphide. The tar-like consistency is due to the serum, digested clot, and mucus; and the discharged material is usually free from remains of food, being simply altered blood. When the hæmorrhage takes place into the upper part of the intestine, the change is not so completely effected. In place of being submitted to prolonged action of an acid secretion, with considerable power of digesting, the blood is acted upon by alkaline secretions, the efficacy of which is less, unless the ingesta have been previously affected by the gastric juice. The result is that, although the blood is to a great extent altered, and the same black sulphide of iron is formed, it becomes more or less mixed with the contents of the tube, and is not voided in lumpy clots, but almost uniformly incorporated with the fæces, which may be solid, semi-solid, or fluid. The fæces may be blackened by iron, bismuth, and other agents, taken as drugs, but they do not produce the viscid matter like semi-digested blood.

Melæna is the mere expression of a condition brought about by many causes, and these have to be sought for and treated. *See* Fæces, Examination of; Hæmatemesis; Intestines, Hæmorrhage from; and Stools.

W. H. Allchin.

MELANÆMIA (μελας, black, and αἷμα, the blood).—A morbid condition of the blood, in which it contains black and brown pigment-particles. *See* Blood, Morbid Conditions of.

MELANCHOLIA (μέλας, black; and χολή, bile).—Synon.: Fr. *Lypémanie*; *Mélancolie*; Ger. *Schwermuth*; *Melancholie*.—This name is now usually applied to a form of insanity characterised by great mental depression, but formerly it was used by writers to denote *partial* insanity, or monomania. The sufferer in this disorder feels his whole existence, mental and bodily, overwhelmed and oppressed by gloom, anxiety, and foreboding. At first it may be only a feeling which takes no definite shape, and there may be no delusions. Sometimes, though rarely, there are none throughout; the morbid feeling constitutes the disorder, which in this form has been called *simple* melancholia. Its access is almost always gradual, and though we may attribute it to grief, overwork, or worry, it often happens that no mental or moral cause can be found, and we are obliged to set it down to inherited predisposition, to some debilitating illness, to declining strength, or to advancing age. Some are aware that there is no real ground for their sorrow and sadness, and are able to look on it as an illness; others feel that there must be some real cause for their despondency, that something terrible is impending, though they know not what. The majority can argue and converse rationally on subjects unconnected with their feeling of misery.

The bodily health, even if at first it appears good, soon participates in the disturbance. The digestion is disordered, the urine loaded with lithates, the skin dry, the bowels are constipated, the pulse is slow rather than quick, the conjunctiva dull and yellow. The patient will complain of various uneasy feelings in the præcordial or epigastric region, and this, with the state of the excretions, will confirm the notion, so prevalent amongst many, that the whole mischief is in the liver. Such simple depression may continue for a longer or shorter space of time. It may pass away suddenly or gradually, or the individual will grow worse in one of two ways. The depression becomes greater, and delusions of various kinds present themselves; or it is replaced by the excitement of mania.

Melancholia with delusions is far more common than *simple melancholia*, and is that which most frequently we are called upon to treat. The patient feels utterly changed, and attributes it to various causes, and deduces various results from it. He has all manner of diseases—syphilis, leprosy, lice; his stomach is gone, and therefore he cannot eat. He cannot attend to business, and therefore is ruined. He is so wretched that he must have committed sins unpardonable in this world or the next. The bodily symptoms, like the mental, are aggravated. Sleep is absent or scanty, and there is rapid wasting. The bowels are loaded, and resist strong purgatives; the tongue is white and furred; the breath offensive. The patients are for the most part elderly; climacteric insanity is almost always melancholia. Of 338 melancholic patients admitted into St. Luke's Hospital only 9 were below the age of twenty.

It cannot be too strongly impressed upon medical men that all melancholic patients, even those whose disorder seems simple and slight, are, especially in the early stage, very apt to commit suicide. We read accounts almost daily in the newspapers of suicides committed by this class of persons, and most lamentable they are, for it is a class which above all others is amenable to treatment.

An asylum is not absolutely requisite for such, if their means allow of proper companions, house, and exercise. They must not be left alone by night or day; must not be left to attendants only; and must have some amusement or diversion. If all this cannot be provided, to an asylum they must go; for if they are resolutely and constantly bent on suicide, it is most difficult to guard against it in an ordinary house.

Whether they are sent to an asylum or not, it is found to be almost invariably necessary to remove them from home. We may think the case a slight one, and may hope that amusement and cessation from work, with medical treatment and good living, will remove the depression. Again and again we are disappointed. The sight of home and home scenes, of family and friends, and the contrast between past happiness and present gloom, perpetuate the melancholy and prevent its dispersion. After valuable time is lost, we are compelled to send away the patient to an asylum or quasi-asylum.

PROGNOSIS.—The prognosis in cases of melancholia is favourable, and patients get well in great numbers, even at an advanced age. It is also important to remember that recovery may take place from this form of insanity after considerable periods of time. The writer has in the second volume of the *St. George's Hospital Reports* recorded three cases of melancholia in which recovery took place after five, six, and seven years' residence in an asylum; and he has since treated a lady who recovered from a most suicidal attack of the disorder after nine years. In dealing with property it is often necessary to consider the question of probable recovery, and it is well to keep in view the chance of it here, although in perhaps every other form of insanity recovery after such periods would be out of the question.

TREATMENT.—On examination of a melancholic patient, it is generally found that there has been a considerable loss of flesh. This may be due to the mental care and sorrow, but it is often caused by an insufficient quantity of food, which has been scanty, either because all appetite has been lost owing to the prevailing wretchedness, or because, from various delusions, there has been an unwillingness to take food. Moreover, there is almost always considerable disorder of the digestive apparatus, the result and not the cause of the depressed nervous condition. The first thing to be done is to correct this disorder; and then to restore the defective nutrition of the brain.

One symptom is obstinate constipation. It may be necessary in the first instance to relieve the loaded and obstructed bowel by means of turpentine enemata; after which it will be of advantage to give a daily dinner pill of the extracts of aloes and nux vomica, or a daily teaspoonful of castor-oil, following it up if necessary by an enema, but ensuring an action every, or every other day, and so habituating the bowels to act. Many of these patients, especially women, will be found to be persons who have been accustomed to go for long periods without the bowels acting, or who never had relief with out medicine. Food must be given to melancholic patients in large quantities. It constantly happens that it is withheld from them under the impression that their malady is essentially dyspepsia, and that the stomach must not be called upon for much exertion. Many, as has been said, refuse it for one reason or other. In either case the melancholia increases, and the patient gets thinner and weaker. Food must be given with no sparing hand, not merely beef-tea and invalid diet, but solid food, bread, meat, and eggs, with a liberal allowance of wine or malt liquor. Some may require forcible feeding, and this can hardly be carried out except in an asylum, but many by coaxing or threats will take what is given to them with a spoon, and they must be fed frequently till they will take the meals of their own accord. Under this augmented diet the tongue will become clean, the bowels will act without physic, and the patient's appearance will soon testify to the efficacy of the treatment.

Sleep, though not entirely absent here, will be in defect. To procure it opium has been long looked upon as of the greatest value. In melancholia, of all the various forms of insanity, this drug is most useful, and its benefit consists not merely in the procuring of sleep, but in alleviating the feeling of wretchedness. It may be given either by the mouth or by subcutaneous injection. It is of importance that we do not give a preparation which shall cause sickness or constipation: the ordinary preparations of morphia, the acetate and hydrochlorate, are apt to do this if given in full doses, and it is better to substitute the liquor morphiæ bimeconatis, Dover's powder, Battley's solution, or solid opium, if we can be sure that pills will be swallowed. Chloral will procure sleep here as in other cases, and may be combined with opium to bring about more speedy action of the latter, but chloral has not such a lasting influence on the malady; when its sleep-producing effect has passed away, the patient does not feel any benefit from the medicine. When the secretions have been corrected, and digestion is re-established, tonics may be useful, especially the preparations of iron.

G. F. Blandford.

MELANCHOLIA, Varieties of.—1. Melancholia, Acute.—Although the prognosis in simple melancholia, and that which may be called sub-acute, is so favourable, there is an advanced stage which truly merits the name of *acute*, and generally terminates fatally. The patients are not silent, gloomy, and depressed, but panic-stricken; and in violent frenzy and terror they try to escape from those about them, to tear off their clothes, gouge out their eyes, and injure themselves in every way. They will not lie on a bed unless forced to do so, but will prefer the floor, or incessantly pace the room. Food they resist with all their power, thinking that it is poisoned, or that they will be punished for taking it. Such patients must be fed by force, and fed early, but it often happens that our feeding here is of no avail, and they sink from the exhaustion of this acute disorder. For it is constantly found in those who are already broken and debilitated in health, and it is but the last stage of a series of disorders. The incessant agitation, violence, and sleeplessness produce rapid wasting and sinking; the food administered is not assimilated, and fails to restore the wasted force. This form runs a rapid course, in contradistinction to the last, which is tedious, but nevertheless tends to recovery in the majority of cases. We may administer opium here with or without chloral; other drugs are of little use. Cod-liver oil may be added to the food. Warmth and stimulants are demanded; and clothes must be kept on by means of a strong suit which cannot be removed by the patient.

2. **Mélancolie avec Stupeur** (Fr.) Synon.: Ger. *Schwermuth mit Stumpfsinn.*—A more extreme form of melancholia is thus named, where the patient sits or stands, speechless and motionless, and requires to be fed, washed, and dressed. Though such a one will not speak or do anything for himself, he may be watching every opportunity of committing suicide, and refuse food with the same motive. The vital powers in these persons are greatly depressed, and they require much food and stimulant. This form has been confounded by some with that variety of insanity termed acute dementia (*see* Dementia); but the latter occurs only in young people, whereas melancholia as a rule does not; and the early symptoms are quite different, acute dementia coming on rapidly, and without the depression and gloomy delusions which mark the other complaint.

G. F. Blandford.

MELANOMA (μέλας, black).—Any morbid growth in which the presence of black pigment is a leading character. *See* Tumours.

MELANOPATHIA (μέλας, black, and πάθος, a disease).—An excess of black pigment in the skin, due to abnormal function of the rete mucosum. Melanopathia is rarely general, more frequently partial. In certain instances, as in the 'bronzed skin' of Addison's disease, it is associated with anæmia. *See* Pigmentary Skin-Diseases.

MELANOSIS (μέλας, black).—According to the present doctrines of pathology, melanosis signifies the condition of system associated with the presence of pigmented tumours. *See* Cancer; and Tumours.

MELASMA (μέλας, black).—A term usually applied to excess of pigment in the skin, from abnormal function of the rete mucosum. *See* Pigmentary Skin-Diseases.

MELLITURIA (μέλι, honey, and οὖρον, urine).—A synonym for saccharine urine. *See* Diabetes.

MEMBRANA TYMPANI, Diseases of. *See* Ear, Diseases of.

MEMBRANES OF BRAIN AND CORD, Diseases of. *See* Meninges, Diseases of.

MEMORY, Defects of.—There are so many different kinds of memory, and so many different degrees of excellence of each variety in different individuals in health, that it is not always easy to say in regard to any particular person how far his memory is defective. In other cases the degree of impairment is so great as to make its existence perfectly obvious. Between such extremes, all intermediate grades of defect may at times be met with. The nature and causes of the various defects of memory cannot possibly be set forth without giving some account of the different physiological processes involved in its exercise; and also of the several fundamental modes in which this is brought about.

The Component Processes in Memory.—What is commonly known as 'memory' is dependent upon two kinds of processes. The *first* of these is a vital, molecular, or organic process of some kind, taking place in various parts of the brain simultaneously, on the occurrence of some 'perceptive act' or thought-process. In a healthy and properly-nourished brain certain neural processes, in different regions of the organ, are supposed to coincide with each act of perception and apprehension. Similarly, in 'ideation' or reflection, molecular processes of a closely-related kind are presumed to take place, partly in the areas of the brain concerned with perceptions and partly in other regions, and these several changes have the same kind of relation to our thoughts that the others have to our perceptions; in each case they, in fact, constitute the organic basis of the respective processes. These initial organic changes of all kinds were referred to by Laycock, and comprised under the name 'synesis.' The first essential, therefore, for the exercise of memory is that these synetic processes should have been properly accomplished. If they have been imperfectly performed, memory will be either defective or non-existent.

Yet these processes constitute the foundations for memory, rather than memory itself.

Memory essentially consists in a repetition or weak revival of such molecular movements and processes in nerve-tissues, and of the conscious states associated with them. They are similar in kind, and take place in all such parts of the brain as were concerned with the original conscious realisation of the objects, relations, or processes which now recur as 'remembered' impressions or thoughts. This, therefore, is the *second* of the processes above referred to, as essential to the exercise of memory.

MODES OF EXERCISE OF MEMORY.—The repetition or weak revival of foregone processes, and of their associated conscious states, is brought about in three modes fairly distinct from one another. The first mode of exercise of memory (*a*) is found in acts of perception, when, on the presentation of some object to the sense of sight, hearing, touch, smell, or taste, or to any two of them, the remaining qualities of this object become nascent or revived in memory, so that the object itself is perceived or recognised as being of such and such a nature.

This kind of process is only impaired where the nutrition of the brain as a whole is gravely interfered with. Special parts of such a process are, however, not unfrequently interfered with by local brain-disease, as when, for instance, the sight of a written or printed word does not rouse its appropriate related memories; or when a spoken word remains unrealised or unapprehended, because its mere sound does not excite all the memories which should cluster round it; in the one case we have what has been rather inappropriately termed 'word-blindness,' and in the other 'word-deafness.' The one set of persons exhibiting such defects may be perfectly well able to recognise natural objects or persons by sight; just as the others may be able to appreciate different kinds of natural sounds, or differences in emotional intonations of the voice, although particular words may not call to their mind any distinct apprehension of the thing, idea, or relation which they are usually employed to designate.

The second, or most common mode in which memory is exercised is (*b*) during the ordinary course of thought, when by natural processes of 'association' the ideas of objects, of persons, of events, and of their relations one with another and with ideas, recur to consciousness, with or without a simultaneous full realisation of the words suitable for the expression of all these phases of our thoughts—according as we are merely thinking to ourselves, or as we at the same time give expression to our thoughts whilst conversing with another person. These, together with the kinds of exercise first referred to, constitute by far the most frequent modes in which memory is called into play. It here manifests itself in a purely automatic manner, without sense of effort on our part (other than that which is concerned with the direction of our thoughts), owing to the fact that present cerebral activities tend to recur in the manner and order which have been most frequently repeated in the race and in the individual—such manner and order necessarily varying according to the particular direction and nature of their or his education, natural or acquired. The study of this order corresponds with the study of the order of mental phenomena, and has resulted in the establishment of certain so-called 'laws of association.'

The process by which language incorporates itself with all our perceptions and thoughts is not different from that which associates perceptions and thoughts among themselves. It is, however, a more special association; and consequently a weak or failing memory—whether resulting from old age, brain-shock, or malnutrition—is peculiarly apt to show itself in this direction, and that more especially by an inability to revive the cerebral processes connected with the names of persons, places, or things (*see* APHASIA). But this kind of defect has to be distinguished from the inability to utter or to write words which are nevertheless remembered, that is, where the cerebral processes associated with the word as a mental symbol may be revived, in the main, in some portions of the brain concerned with the reception of auditory impressions, though incitations may not be able to pass over from these centres so as to revive nerve-processes in other centres of the motor type, by which the word is either spoken or written, according as the one or other effect is desired (*see* APHASIA). The loss of verbal memory is in these latter cases not so real as it seems to be, and such defects may, moreover, be induced by quite limited cerebral lesions.

In the third mode of exercise of memory (*c*) there is no longer the easy flowing mechanical revival of foregone processes, together with the simultaneous recurrence of copies of foregone phases of consciousness, which should characterise the modes of exercise above alluded to. Now there is a delay in the process of automatic revival; a vague sense of effort intervenes at some stage of the thought-processes, similar to that of which we are conscious when we attempt to 'guide our thoughts' into particular channels; we strive 'by way of association' to find some new molecular channel by means of which the cerebral processes concerned with the forgotten name, event, idea, or relation, may be roused anew, in order that we may 'recollect,' or recall by voluntary effort, what may be needful for the continued expression of our thoughts.

This latter process of 'recollection' is, therefore, that which is rendered necessary by the first stage of faultiness of memory, a condition which may obviously be brought about in altogether different modes, to some of which we are now about to refer.

Ætiology of Defective Memory.—It seems clear, on the one hand, that for memory to be good (*a*) the preliminary process of synesis must have been well accomplished. Yet this first and essential condition may be defective from various causes. (1) The original plasticity or receptive potency of the nerve-tissue may have been inferior from birth; or it may have been temporarily lowered by conditions of mal-nutrition, such as are not unfrequently met with in persons who have suffered from severe fevers or from other exhausting diseases. On the other hand, the potency of the nerve-tissue may be good, and yet the processes of synesis may have been badly effected, owing (2) to the individual's lack of attention at the time when what is now to be remembered originally engaged his consciousness; for no truth is more obvious in regard to memory than that of its dependence upon the degree of attention bestowed upon the original impressions or ideas. Those which have been vividly attended to at the time, from whatever cause, tend to become indelibly 'stamped upon the memory,' and all the more so because such impressions or ideas are prone to be often thought of, and thereby strengthened by each revival of the cerebral process; whilst those that have slightly engaged our attention are apt not to be revived, and to be after a time effaced, though it is in this respect especially that so much of individual difference is met with. Greatly diminished power of attention is, moreover, commonly met with in exhausting diseases, and in multitudinous brain-affections.

But, on the other hand, however well the process of synesis may have been accomplished originally, this will be altogether unavailing if (*b*) the avenues are damaged or impaired by which associated processes transmit their stimuli. The automatic excitation of memory is then hindered. Thus, to take only one example, if certain commissural connections be severed between what we may term the visual and the auditory word-centres, a person may be able to read so as to understand the words which he sees, and yet not be able to pronounce one of them, because the associational stimulus cannot pass to the corresponding part of the auditory word-centre, so as to rouse this particular memory or idea of the word, from the molecular processes concerned with which the motor stimuli issue for its pronunciation. (See *Brain as an Organ of Mind*, p. 640.)

Again, however well the process of synesis may have been originally performed, if (*c*) the whole nutrition of the brain becomes lowered by exhausting disease or old age, failure of memory may present itself because attention cannot be adequately roused, and the cerebral processes generally are too feeble to propagate themselves, as they would have done formerly, into the various collateral channels or molecular paths, so as to rouse the activity of all such previously associated brain-regions as are necessary for the full realisation of the thoughts of the moment.

From what has been already said, it will be seen that defects of memory may result from very various causes, acting as an impediment to one or other of the successive processes upon which memory depends—namely, either (*a*) from synetic defects; (*b*) from associational defects; or (*c*) from expressional defects.

Pathology.—In all those cases in which we may presume that synesis is impaired, we may expect also to find evidence of a greatly weakened power of attention, and there may in addition be an impaired perceptive power. Such defects are mostly dependent upon general causes, affecting the nutrition of the brain as a whole. A condition of this kind may be only temporary, and then, whilst recent events are speedily forgotten, it may happen that the memory of old impressions remains fairly good, or may even be marvellously intensified, so that long-forgotten occurrences or knowledge become revived. At other times the patient's mind may for a time be reduced to a perfect blank, old and recent knowledge, familiar and unfamiliar, is alike blotted out; though after a time recovery of memory may take place, either slowly or with comparative suddenness. In cases of epileptic mania, and in many instances of brain-shock from blows upon the head, the patient may lose all memory of immediately preceding events.

Where the secondary process of revival is that which is interfered with, the loss of memory is generally most manifest in regard to words. The processes of association by which these are recalled to memory, are either impaired or disturbed, so that we get one or other variety of amnesia induced, either of the paralytic, or of the incoördinate type (*see* Aphasia). Such defects are, in the opinion of the writer, specially prone to be induced by lesions of the convolutions contiguous to the posterior extremity of the Sylvian fissure. (See *Brain as an Organ of Mind*, pp. 682–7.)

Where there is mere loss of power to express thoughts, the loss of memory is often more apparent than real, and is due to a mere paralysis affecting speech and writing as motor acts (*see* Aphasia). And these conditions, either singly or in combination, are also apt to be induced by lesions in the third left frontal convolution, or of regions between this gyrus and those bordering upon the posterior extremity of the Sylvian fissure.

Treatment.—The treatment of these various defects of memory, so far as they are amenable to therapeutic influence, naturally resolves itself into the treatment of the various general or local morbid conditions upon which they depend. In some cases we can do little or nothing; but in other instances much good may be effected under the influence of a tonic and restorative regimen, aided by stimulant, sedative, or hypnotic remedies.

H. Charlton Bastian.

MENIDROSIS (*μὴν*, a month, and *ἱδρῶς*, sweat).—A term applied to vicarious menstruation by the skin. *See* Perspiration, Disorders of.

MENIÈRE'S DISEASE. *See* Vertigo.

MENINGES, Diseases of.—The treatment of this subject is naturally divisible into two main heads. We have to consider (1) the morbid conditions resulting from disease of the Cerebral Meninges; (2) those of the Spinal Meninges. Though most frequently affected separately, still it happens on some occasions that these two main divisions of the membranes surrounding the great nerve-centres are simultaneously diseased. This is the case, for instance, in *Epidemic Cerebro-Spinal Meningitis*, an important general disease, which is considered in a separate article (*see* EPIDEMIC CEREBRO-SPINAL MENINGITIS). A similar diffusion of inflammation also occurs, but more rarely, in cases of *Sporadic Cerebro-Spinal Meningitis*, which may be sometimes 'simple,' and sometimes of the 'tubercular' order. In the articles that follow, the several diseases of the Cerebral Meninges and of the Spinal Meninges will be separately discussed.

MENINGES, CEREBRAL, Diseases of.—SYNON.: Fr. *Maladies des Meninges Cérébrales*; Ger. *Krankheiten der Hirnhäute.*—The following morbid conditions, and varieties of such conditions, have to be considered under this heading:—

1. *Inflammation*—of several varieties.
2. *Hæmorrhage into.*
3. *Hæmatoma of.*
4. *New growths* and *Adventitious products.*—Under this head are included, besides the different kind of tumours originating in the meninges, other bodies of quasi-accidental origin, which may be met with in the cavity of the arachnoid, in the meshes of the pia mater, or in connection with the vessels of these parts.
5. *Malformations. See* BRAIN, Malformations of.

Inflammation of the cerebral meninges occurs from various causes, and also affects various parts of the membranes, so that the subjoined varieties of the disease will have to be separately considered:—

a. Simple Meningitis { α. Idiopathic.
β. Traumatic.

b. Tubercular Meningitis.

The simple meningitis of traumatic origin occurs under three pretty distinct forms, according as it affects the dura mater—*Pachymeningitis*; the surfaces of the arachnoid—*Arachnitis*; or the meshes of the pia mater beneath this membrane—*Leptomeningitis.* Both the *idiopathic simple meningitis* and *tubercular meningitis* are forms of leptomeningitis. All are acute diseases.

Concerning *chronic meningitis* we have more of pathological than of clinical knowledge, though even as regards the former side we are bound to say that much of the thickening and opacity of the arachnoid, formerly regarded as due to 'chronic inflammation,' is rather a mere result of degenerative overgrowth—partly brought about as an appenage of advancing age, and partly as a consequence of frequent or long-continued congestions. Still, such conditions may at times be coupled with more distinctive evidences of actual chronic inflammation, for example, in some cases of chronic mania, and also in general paralysis of the insane.

Good reasons, moreover, exist for believing in the frequent clinical existence of local chronic inflammation of the meninges, as evidenced by the presence more especially of localised pain and of tenderness on slight percussion, coupled with other head-symptoms. Fortunately for the patient, however, we have often no opportunity of verifying this diagnosis, because such a condition is of itself not likely to lead to fatal results. It may follow a blow; it may occur as one of the consequences of constitutional syphilis, or it may manifest itself independently of either of these causes. Chronic syphilitic meningitis is the best known of these varieties. Its associated morbid conditions are, however, most closely related to another set of changes, which will be described, and in which we have to do with new growths or 'gummata.'

Two other varieties of meningitis are occasionally met with as rare events; first, an inflammation limited to the envelopes of the cerebellum, or extending from it only to the pons varolii; and, secondly, an inflammatory condition of the lining membrane of the lateral, and perhaps the third ventricles. The natural history of these states is at present so little known as not to admit of systematic treatment. Their ætiology and symptomatology have still to be established. H. CHARLTON BASTIAN.

MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.—SYNON.: Simple Idiopathic Cerebral Leptomeningitis; *Leptomeningitis infantum* (in part). Fr. *Méningite Simple*; Ger. *Acute Hirnhautentzündung.*

DEFINITION.—A simple non-tubercular inflammation of the cerebral pia mater, which may be either limited to the convexity, general, or confined to the base of the brain. It is associated with very variable symptoms in different cases; and is probably caused in many different ways.

ÆTIOLOGY AND PATHOLOGY.—Our knowledge of the ætiology and pathology of acute idiopathic cerebral meningitis is only vague and indefinite, so that little but unconnected statements or mere suggestions can be here set down.

It appears that sex exercises an influence in the production of idiopathic meningitis, and that the disease occurs much more frequently in males than in females. In regard to age, it is met with almost as frequently in individuals from ten to twenty as in those below the tenth year. In individuals over twenty the disease is much more rare.

Meningitis is apt to occur during, or as a sequence of, some acute febrile disease, such as measles, scarlet fever, small-pox, and rheumatic fever. It may complicate erysipelas of the head and face; or may occur in the course of pneumonia or pleuro-pneumonia. Sometimes it is met with in miserably cachectic subjects, who have not previously been suffering from any acute disease. It has been known to follow prolonged exposure to the sun; to ensue after the occurrence of severe moral perturbations; and likewise to follow a shock or blow, even when this has not been complicated with an external wound, or with a fracture of one of the bones of the skull.

But how do these various predisposing or exciting causes operate, so as actually to bring about the inflammation of the meninges, with which we are now concerned? Here some hints only can be offered by way of explanation. In part the problem does not differ from that as to the actual cause of inflammation in other internal parts of the body. Setting aside traumatic influences, or the sudden operation of excessive heat or excessive cold, how does inflammation start from mere altered nutritive processes? It is difficult to believe in a primary alteration in the mode of activity of cell-elements originating of and by itself, independently of altered nervous or of altered vascular conditions within the texture. Again, altered nervous influence (whether vaso-motor or other) *may* be a real factor in the initiation of a meningitis, even though we know nothing of it as a fact, and consequently can say nothing as to the kind or cause of altered nervous influence which might be operative. We are thrown back, therefore, necessarily upon a consideration of those altered influences that may arise in or upon the side of the vascular system, for the elucidation of the other probable cause or starting-point of the inflammation with which we may have to deal.

We shall do well to bear in mind, also, that in certain states of the system, or in certain constitutions, conditions exist (partly febrile, partly cachectic, and partly of the nature of blood-poisoning) which are inimical to the localisation of an inflammatory process (howsoever initiated), and just as favourable to its extension, especially in a tissue like that of the pia mater. And in just such conditions of the system we should also find that some simple accident on the side of the vascular system, such as the rupture of some vessel or vessels and the occurrence of a slight hæmorrhage into the tissue, or the occlusion of one or more vessels either by embolism or thrombosis (events which might not on other occasions lead to the setting up of anything like inflammation), may, under the particular constitutional conditions existing in the patient, be capable of exciting an inflammatory process.

1. In the acute diseases, or during convalescence from them, as well as in extremely cachectic subjects, altered blood-states sometimes exist favourable to the occurrence of thrombosis; and this may occur either in one of the veins returning blood to the longitudinal sinus, or in the sinus itself. The condition of the sinuses should therefore be always investigated in cases of meningitis. In many instances hæmorrhages have been found beneath the arachnoid in meningitis, and these may, like the meningitis itself, have been immediately consequent upon thrombosis in the longitudinal sinus, although this, the primary process, has escaped observation.

2. In erysipelas of the head and face, as a cause, we have the type of a mode of origin of meningitis such as may occur also in other cases—for example, in some of those instances where, in the course of rheumatic fever symptoms of meningitis (other than those which are occasioned by hyperpyrexia) set in with great severity, and cause the death of the patient just as rapidly as when they supervene in the course of erysipelas of the head and face. In both these cases no products of inflammation may be met with in the membranes *post mortem*, but only a very minute injection of the pia mater in all regions basal, as well as lateral, or vertical. The tendency here, therefore, is to set up a *general* meningitis, just as in the previous category of causes the tendency would be to the establishment of a meningitis affecting the convexity. On microscopical examination, in one such case, the writer found the minute vessels blocked with concretions of an albuminoid or fibrinous nature, which seem to have separated from the blood. (See *Path. Trans.* vol. xx. p. 8.)

It is difficult to say in what acute conditions some such cause as this may not have been operative in setting up the inflammation, where meningitis occurs in the absence of other easily recognisable causes.

3. Multiple embolisms of the vessels of the pia mater in certain cases of endocarditis are another possible initiating cause of idiopathic meningitis—which, moreover, seemed almost certainly to have been the actual cause, in a case that came under the writer's observation a few years ago.

4. Meningitis may take its origin in a slight lacerating lesion of the surface of the brain or of its membranes, with or without notable extravasation of blood, as a result of a fall or blow, even in cases where there is no fracture of the skull or external wound.

5. In other cases, also, a meningitis really secondary may appear to be primary and idiopathic, as when (*a*) it extends from some focus of syphilitic disease of the meninges, or (*b*) when it occurs as a sequence of some unrecognised chronic inflammation involving the middle ear and portions of the temporal bone.

ANATOMICAL CHARACTERS.—Simple idiopathic inflammation of the cerebral meninges is a condition which varies much in severity in different cases. In its earliest or initial stage, nothing more than a minute and more or less uniform injection of small vessels and capillaries in certain regions of the cortex may be met with. But later on, definite products of inflammation are to be seen; these are for the most part situated beneath the arachnoid, in the meshes of the pia mater. They consist, according to the stage of the morbid process, either of a gelatinous white or yellow lymph-like matter, of actual pus, or of more coherent yellow lymph, in the form of membranous layers. In regard to the area involved considerable differences also exist. The inflammation—(1) may be limited to the convexity and to the lateral regions of both hemispheres; (2) it may be general, that is, involve the parts above-mentioned, and also the base; or (3) it may be limited to the basal regions of the brain. In both the latter cases the ventricles are apt to contain fluid, and the central parts of the brain to be softened, as they are in tubercular meningitis, which also affects the base in a special manner.

Of these varieties as to seat, the first, in which the convexity is involved, is decidedly the most typical, and in this respect simple idiopathic meningitis contrasts in a salient manner with tubercular meningitis, in which the tendency is no less marked to implicate the base of the brain. In the second variety, the inflammation beginning above probably extends to the base by mere continuity, in cases where the condition of the patient, or the intensity of the inflammatory process itself, favours its spread from the original site; or, in certain cases, the inflammation may be from the first general in seat. In regard to the third variety.

much doubt may be said to exist. It is by no means clearly established that a simple idiopathic inflammation ever begins to manifest itself at the base, and there only—though no good reason can be assigned why such a distribution should not occasionally exist, except that experience shows it to be at least very rare. If, moreover, such an inflammation be not of unsuspected traumatic origin, there are still two other modes of accounting for its existence, which should be excluded before regarding it as an idiopathic cerebral meningitis of unusual site. Thus, it may be an extension upwards from the spinal meninges of an inflammation beginning there—a case, in fact, of cerebro-spinal meningitis, either sporadic or epidemic. Or, on the other hand, it may be one of those cases of tubercular meningitis where the general disease manifests itself on the side of the brain first, and in which the patient dies before the local process is at all fully developed. In such a case the inflammation may be really of the tubercular variety, and yet to superficial observation not recognisable as such. Although not likely to occur often when the autopsy is made by a competent observer, the case may be otherwise, and either of such misapprehensions as to the real nature of the affection is more especially apt to occur where the head only is examined.

In all these cases, too, the inflammation may be limited to the meninges themselves, or the surface of the brain may also be manifestly involved in the inflammatory process, so that we then have to do with a *meningo-cerebritis* of varying seat and extent.

Symptoms.—In no disease is the symptomatology more various than it is in acute meningitis—a fact partly due to the varying intensity of the inflammatory process, partly dependent upon the process being localised or more general, and partly according as there is or is not the co-existence of dropsy of the ventricles with inflammation of their walls. Sometimes the disease is almost latent, accompanied only with slight symptoms, merging into stupor and coma a day or two before death. Or the symptoms may be marked and quite tragic in their severity; ushered in either by frightful pains in the head, by well-marked delirium, or by convulsions; subsiding eventually into a condition of stupor or coma; and followed by death within eight or ten days, though this may be delayed till the expiration of three weeks or a month. Recovery, which sometimes occurs, must be regarded as a rare event.

Inasmuch as it is not practicable, within the limits of this article, to give a detailed account of the various groupings of symptoms that may be met with in different cases, we must confine ourselves to an enumeration of the symptoms themselves, most apt to occur—(1) in the early stages of the disease, and (2) in its later phases.

1. Cephalalgia of an intense character, either general, or localised in some particular region or regions of the head, may be complained of again and again where the patient is old enough, or, if he be too young, is indicated by cries, by application of the hands to the head, or by other signs. Sometimes, however, this symptom may be almost absent, or it may come on at a later date. Delirium, occasionally furious, at other times more quiet and of a simply loquacious type, is another symptom; or extreme restlessness. Mere insomnia, too, sometimes exists from the commencement; whilst at other times a semi-comatose condition, gradually deepening into actual coma, may exist from the first, especially in children, or it may succeed a transitory delirious condition. Nausea and vomiting, and also convulsions, either local or general, may be met with in the early stages of the disease, and sometimes as initial symptoms. With them will go general pyrexia and sometimes rigors; also heat of head, rapid pulse, a furred and often thickly-coated tongue, constipation, perhaps some intolerance of light and of loud sounds, together with an easily obtainable *tâche cérébrale*.

2. As later symptoms we may have localised convulsions, or spasms, often of the tonic order, affecting perhaps the head and neck, which are frequently drawn backwards, or one or both arms; or a condition of trismus may exist. The eyes, too, are sometimes drawn upwards. The pupils may be at first contracted, or if not, they may be of medium size, unequal and insensitive; whilst later on they are most frequently widely dilated and insensitive. The conjunctivæ are often injected. Paralysis of one arm, or sometimes of an arm and a leg, may occur. The sensibility of the skin may be either exalted or deadened. The abdomen is often hollow and boat-shaped. The tongue becomes thickly coated, or dry and brown. Difficulty of deglutition is frequently well marked towards the end; and there is incontinence of fæces and urine as soon as the stupor becomes marked. Sometimes the pulse is unnaturally slow and infrequent from the first: at other times, and especially towards the end, it is very frequent and irregular. The respiration, too, becomes much disturbed, being often sighing and of very irregular rhythm, tending to become stertorous at last. The temperature is frequently high, but pursues a markedly irregular course. Remissions of the pyrexial condition may take place from time to time. The skin is generally hot and dry, though occasionally there may be copious sweats. Stupor and coma almost invariably occur at the last, if not present at an earlier stage.

Prognosis.—A large number of deaths take place within the first week of acute meningitis; a much smaller number survive till the end of the second week; fewer still reach the end of the third; and only a very few survive to the fourth week. It is difficult to say what the percentage of recoveries may be; but probably less than ten would survive out of a hundred cases of acute idiopathic cerebral meningitis.

Diagnosis.—The diagnosis of idiopathic meningitis involves considerations very similar to those arising in the diagnosis of tubercular meningitis, and need not therefore now be discussed. *See* Meninges, Cerebral, Inflammation of, Tubercular.

The diagnosis of simple from tubercular meningitis must oftentimes be a matter of extreme difficulty. Whether the condition of the blood, as recognised by the aid of the microscope is the same in simple meningitis as it is in tubercular meningitis the writer is unable to say. Should it not be so, some help might be obtained in this direction. The conditions under which the disease seems to develop may throw some light upon the problem. In regard to special symptoms, the possible range is so great in each variety, that it becomes difficult to fix upon any that are positively distinctive of one or of the other. Delirium is, however, rarely so violent in tubercular as it may be in simple meningitis. Retraction of the head is also not so frequent in the tubercular variety. On the other hand the temperature much more frequently rises over 101° Fh. in simple than it does in tubercular meningitis. Finally, it must be borne in mind that the former is an extremely rare disease, the latter unfortunately only too common; and that whilst in tubercular meningitis the two sexes fall victims with about equal frequency, in the simple variety, two out of three are likely to be males.

TREATMENT.—In the early stages of acute simple meningitis aperients may be freely administered. A leech or two might be applied to the temples, in cases where pain is greatly complained of; or under the same conditions the head may be shaved and an ice-bag applied, should it not be deemed useless on account of the extreme restlessness of the patient. The writer believes that little or nothing is to be expected from drug treatment towards the cure of this disease, although some alleviation of the more distressing symptoms may at times be brought about by special attention to them. The patient requires to be carefully fed, and assiduously nursed and kept quiet throughout, in the hope that the end may be favourable.

H. CHARLTON BASTIAN.

MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.—Several distinct forms of meningitis, of traumatic origin, have to be carefully distinguished from each other. We have a meningitis in which the outer surface of the dura mater is the part chiefly affected—*Pachymeningitis*; one in which the cavity of the arachnoid is the seat of the effusion—*Arachnitis*; and one in which both these escape, and the subarachnoid spaces, or, it may be, the structure of the pia mater, is primarily involved—*Leptomeningitis* or *Subarachnoid Meningitis*. For the most part, it is possible to distinguish these forms at the bedside, as well as in the post-mortem room. Sometimes the case is of a mixed form; especially is it not uncommon for an inflammation which had begun between dura mater and bone to extend through the fibrous membrane, and involve the arachnoid beneath it; but it is still a remarkable fact in pathology that very frequently the delicate arachnoid suffices to restrict an extensive inflammatory process to one or the other side of it.

Of the inflammation between the dura mater and bone it is possibly true that it occurs only in association with disease of the bone. If there be any exceptions to this latter statement they occur probably in connection with syphilis. Occasionally cases are met with in which the arachnoid cavity itself contains puro-lymph, the surface of one hemisphere, for instance, being covered, and yet there is no history of injury or of prior inflammation of the scalp or bone. Such cases are, however, rare, and their possible causes need further investigation.

In a general way, children may be deemed more liable to meningitis after injuries than adults, and in them not very unfrequently severe and fatal complications ensue after injuries not attended by fracture.

1. **Pachymeningitis.**—Inflammation of the meninges secondary to inflammation of the bone is one of the commonest of the dangers which attach to injuries to the head. The bone is contused, and in most cases there is some stripping off of the pericranium.

SYMPTOMS.—For a week or ten days the patient does well; and then he begins perhaps to complain of headache, feels chilly and uncomfortable, and cannot eat. These symptoms increase, and drowsiness and semi-stupor may come on. If the ophthalmoscope be used, very possibly at this stage the discs may be found hazy and swollen; and this may occur without any evident defect of sight, or with but little. If the trephine be now used, the bone will be found discoloured, its diploe greenish, and beneath it a collection of pus. The pus is rarely in large quantity, and is usually discoloured, whilst all around the collection of fluid there is much coherent and sticky lymph, which loosens the membrane from the bone. It is very rare to find a large abscess, such as those described in the celebrated cases given by Pott. Usually the termination of such cases is that the substance of the dura mater inflames; that the arachnoid is implicated; and that a layer of puro-lymph lines that membrane, and coats the hemisphere. With this state special symptoms are associated, the most noteworthy being hemiplegia of the opposite side. Very commonly, however, another event cuts short the case. In mentioning the early symptoms nothing has been said as to rigors, nor do they, as a rule, occur, unless the complication just hinted at is developed. That complication is pyæmia. This pyæmia has no essential connection with the meningitis. It depends upon the inflammation of bone, which is the common cause of both, and which may be the parent of either singly, or of the two as twins. With the gangrenous osteitis occurs gangrenous phlebitis of the veins of the diploe; from these the process extends to the proximal sinus of the brain (more commonly the superior longitudinal); infective emboli of decomposing material gain access to the circulation; and all the well-known phenomena of pyæmia follow. It is most important to distinguish the symptoms which belong to the pyæmia, if we would rightly estimate those due to the meningitis, for very frequently they are met with together. Especially must we remember that a severe rigor probably denotes pyæmia; and that, if it be repeated, the diagnosis of this affection is almost certain. It is the almost constant complication with phlebitic pyæmia, which so almost invariably disappoints the surgeon of any benefit from the use of the trephine in this group of cases. If pyæmia does not occur, then probably arachnitis is there, and thus it comes to pass that a recovery after secondary trephining is almost unknown.

TREATMENT.—But little is to be done as

regards treatment for this form of osteitic meningitis; the main thing is to adopt measures for its prevention. The careful management of the wound, either by Lister's plan or by the constant use of the lead and spirit lotion, and the exemption of the patient from all risk of contagion, are the matters which will chiefly claim attention. In cases of depressed compound fracture without symptoms, one of the objects of primary trephining is to prevent meningitis, by removing displaced fragments, and by affording free exit for secretions.

2. **Arachnitis.**—The form of meningitis to which the term arachnitis is applicable is a frequent consequence both of inflammation of contused bone and of wounds of the membranes. Enough has already been said as to the circumstances under which it occurs after contusions of bone, and we have chiefly now to examine its pathology and special symptoms.

Anatomical Characters.—In the *post-mortem* room arachnitis may be easily distinguished from inflammation in the subarachnoid spaces, and the distinction ought always to be carefully made. In arachnitis the puro-lymph covers the cerebral convolutions in an even layer, and does not dip into the sulci, to which, indeed, it has no access; whereas when the spaces are affected, the sulci are filled, and the convexities of the convolutions remain free. In the latter none of the effusion can be peeled or sponged away, nor does any adhere to the parietal arachnoid. In true arachnitis both the parietal and visceral layers are smeared over.

Symptoms.—Many cases of compound fracture of the skull, with laceration of the dura mater, afford us good opportunities for the study of acute traumatic arachnitis; but, unfortunately, in many of these cases the brain-substance is also punctured, and it becomes at least possible that the condition described as diffuse encephalitis may be present, and may complicate the symptoms. We are helped, however, as regards the avoidance of fallacious inferences by the other set of arachnitis cases, in which the arachnitis is secondary to osteitis, in which, there having been no injury to the brain, there is no probability of encephalitis. Speaking, then, from the result of observation of both classes, it may be stated that whenever evidences of arachnitis are found widely spread over a whole hemisphere, there has been during life hemiplegia of the opposite limbs. Exceptions, apparent or real, occur to this, but they are rare, and probably most of them are apparent and not real. The risk of error lies in the case in which, in a patient who is very ill, hemiplegia, which supervened gradually during the last day or two of life, may have been overlooked. The hemiplegia is rarely complete, and unless the limbs be carefully tested at each visit, both patient and surgeon may be unaware of its presence. Its degree is proportionate to the extent of the arachnitis; and if the latter pass under the falx and involve the opposite hemisphere also, there may be general weakness of all the limbs, which may again to some extent mask the hemiplegia. It is almost certain that the hemiplegia has little or nothing to do with pressure from effused fluid, for the latter is rarely in large quantity. Its immediate cause is, indeed, not very obvious, but as the grey matter of the cortex is almost always discoloured, and changed from a pink tint to a greenish-slate hue, it may be conjectured that this in some way has to do with the symptoms. The other symptoms which attend acute diffuse arachnitis are—wandering delirium, rarely violent; increased temperature; incontinence of urine and fæces (part of the hemiplegia); and occasionally unilateral sweating. It should be remarked that the hemiplegia involves both sensation and motion. As, however, it is incomplete, the defect in sensation is almost certain to escape notice. Patients who are obliged to admit that they cannot move their limbs forcibly, will deny that there is any defect in feeling, and it is often impossible to confute them. In well-pronounced cases, however, sensation always fails as well as motion.

Treatment.—It is doubtful whether recovery ever takes place after this form of arachnitis has become well established; and here, again, we have to think rather of prevention than of cure. Cold to the head—spirit lotions being the most convenient form—and very early and efficient resort to mercury, are the chief measures where the dura mater is known to have been lacerated. Strong spirit lotions should be used from the first, and mercury also given. It is too late to commence the exhibition of mercury after the symptoms of arachnitis have set in. Amongst the measures of treatment of more doubtful value are aconite, in small doses frequently repeated, leeches, blisters, and fomentations. If blisters are used, they should be applied to the neck, or back, or shoulder.

3. **Leptomeningitis.**—This form of traumatic meningitis, which occurs in the subarachnoid spaces, is an exceedingly interesting malady.

Ætiology.—Leptomeningitis may be encountered after any form of injury to the skull involving laceration or puncture of the visceral arachnoid, but its most typical illustrations are witnessed after fracture through the petrous portion of the temporal bone. This fracture, although usually counting as a simple one, is in reality compound, in that it opens up access to an air-containing cavity. It is possible that air may reach the injured bone either through the external ear or the Eustachian tube.

It is a matter of some interest to determine whether arachnitis of these spaces often, if ever, results from severe concussion without any fracture, or after simple fracture without any possibility of admission of air. It is impossible, however, to speak clearly on this point.

Anatomical Characters.—Results which are scarcely ever witnessed after simple fractures in other regions of the skull may occur here, a fact which can only be explained on the supposition that we have to encounter the risks incident to compound lesions. Amongst the results referred to is the frequent development, some days after the accident, of inflammation in the large subarachnoid spaces at the base of the brain. It is probable that the inflammatory process travels along the course of the nerve-trunks (seventh nerve), and thus gains access to the spaces. Affecting first the parts adjacent to the roots of the nerves, the inflammation may spread downwards on the medulla and cord, or upwards through the posterior fissures into the ventricles, or over the surface of the hemispheres. Usually it is almost confined to the base of the brain and medulla oblongata. These parts are coated with serous lymph, which invests them closely and adheres to all the nerve-roots passing from them. The layers of arachnoid which cover in and confine the exudation remain quite transparent, and show no traces of lymph on their inner surface. It is only when these layers are cut or torn that access to the inflammatory effusion is gained. In performing the autopsy it is needful to use care lest this laceration be made by accident, and the characteristic appearance somewhat spoiled.

Symptoms.—Patients suffering from this form of basal subarachnoid inflammation may become delirious and die very quickly in the first access of the morbid action; but, on the other hand, and more usually, they may live for several days, or a week or two, and show only comparatively mild symptoms. Absolute sleeplessness, with occasional wandering, but without any degree of paralysis, was the most prominent symptom in one very well-marked case. It is probable, though not as yet established, that optic neuritis often attends this form of meningitis. Its peculiarities as regards increase of temperature have not as yet been ascertained. That the subarachnoid spaces are affected may be plausibly suspected whenever, after supposed injury to the base of the skull, vague cerebral symptoms, unattended by definite paralysis, supervene; and if there have been bleeding from the ear and deafness, with facial paralysis in the first instance—a triad pathognomonic of fractured petrous bone—then this is the form of meningitis certain to follow, if any.

Prognosis.—As regards recovery from traumatic meningitis of the base, what has been said on the difficulties in forming a confident opinion as to its presence will sufficiently explain the impossibility, in any given case in which recovery has resulted, of feeling sure that the inflammation in question had really existed. Many patients, however, recover more or less, often perfectly, after prolonged and severe symptoms following fractured base. Some of these are doubtless recoveries from severe contusion, but others, especially those in which serous fluid has drained away from the ear, may be plausibly conjectured to be recoveries from meningitis of the base.

Treatment.—The measures of treatment likely to conduce to recovery in such cases are the same as those for other forms of meningitis. Mercury to ptyalism is the chief agent, and so impressed has the writer for long been as to the danger of the malady, and the value and harmlessness of the drug, that he has been in the habit of giving it from the first in all cases in which fracture of the petrous bone has been diagnosed. Jonathan Hutchinson.

MENINGES, CEREBRAL, Inflammation of, Tubercular.—Synon.: Granular Meningitis; Acute Hydrocephalus; *Hydrocephalus internus*; Brain Fever (in part); Tubercular Leptomeningitis; Fr. *Fièvre cérébrale; Méningite granuleuse; Méningite tuberculeuse*; Ger. *Tuberculöse Hirnhautentzündung.*

Definition.—An acute and extremely fatal febrile disease, with a predominance of head-symptoms; terminating in stupor and coma, with or without convulsions; and characterised after death by a 'granular' meningitis affecting the pia mater at the base of the brain, with the frequent accompaniment of dropsy of the lateral ventricles, and softening of the parts around them. The inflammation of the membranes at the base of the brain is often found to be associated with a spinal meningitis.

Tubercular meningitis is not an independent affection; it constitutes one important phase of a many-sided general disease commonly known as Acute Tuberculosis, and marked anatomically by the presence of 'grey granulations' within the thorax and abdomen, as well as in the membranes of the brain. In certain rare cases death takes place from granular meningitis, before the anatomical marks of the general disease have had time to develop within the chest or abdomen. More frequently, however, the manifestations of the general disease are already well developed in one or other, or in both, of these situations, at the time that they reveal themselves also on the side of the brain. In the latter, and by far the most common class of cases, the symptoms met with will be in part those of the general affection, and in part (but in a predominant degree) those due to that implication of the brain and its membranes with which we are now specially concerned. *See* Tuberculosis, Acute.

Ætiology.—The ætiology of tubercular meningitis of course resolves itself into the ætiology of the general disease, acute tuberculosis, of which it forms part.

This affection is one which occurs with special frequency in young children, between two and six years old, though it is also met with in infants, in older children, in young adults, and even in persons beyond middle age. In adults it is most apt to manifest itself as an occasional complication in the course of chronic phthisis. In children a proclivity to the disease seems often to be inherited, so that two or more in the same family may be carried off by it. But in what proportion of cases any such proclivity exists can scarcely be said to be known.

The central brain-changes—namely, the dropsy and the central softening—are not, in the opinion of the writer, necessary accompaniments of tubercular meningitis, although they most frequently coexist—just as they are also most frequently concomitants of simple or non-tubercular meningitis when it affects the base of the brain. These central brain-changes were, however, the part of the disease that first attracted the attention of physicians, so that the affection with which we are now concerned was known as *Acute Hydrocephalus* long before the more modern designations of *Granular* or *Tubercular Meningitis* came into use.

Anatomical Characters.—When the calvaria is removed the dura mater is found to be tightly stretched over the brain. On stripping back this membrane, the arachnoid presents a dull appearance, and it is slightly sticky when touched. The convolutions of the vertex and lateral regions of the brain are seen to be more or less flattened from pressure, and the sulci are correspondingly indistinct. No lymph may be seen; or at most a small quantity, in the lower parietal regions along some of the branches of the middle cerebral arteries. When the brain is removed, however, and its under surface is examined, a more or less opaque white or a yellowish lymph-like matter may be seen (beneath the arachnoid, in the meshes of the pia mater) extending from the optic commissure backwards over the central portions of the base and onwards over the pons. In certain cases lymph and evidences of recent inflammation are found round the medulla, and even along the whole length of the spinal cord. More or less lymph also extends on each side into the sylvian fissures. A minute inspection will likewise show that the tip of the temporo-sphenoidal lobe, and the orbital surface of the frontal lobe, are flecked with a number of translucent granulations, as though the parts had been sprinkled with fine sand; and on opening up the Sylvian fissure on each side, similar granulations, with others more opaque and of larger size, may be seen amongst the lymph in this situation. Translucent granulations also sometimes exist, scattered more sparingly over the lateral aspects of the hemispheres, especially along the sides of the vessels.

Examination with the microscope shows that the granulations are composed of overgrowths of tissue-elements immediately surrounding the smaller vessels, and within their perivascular sheaths. In these situations the tissue overgrowths may cause a local bulging of the sheath, either all round, or merely on one side of the vessel; and when such growths become opaque from incipient fatty degeneration, they are then more easily visible as minute white specks. A close examination of the prolongations of the pia mater dipping between the convolutions, with the aid of lens or microscope, will often show minute granulations not otherwise recognisable—and that, too, in many regions of the brain. And in cases of incipient tubercular meningitis, where the amount of lymph about the base is extremely slight, the lens or microscope may show the presence of granulations, not otherwise recognisable, in and around the lower part of the Sylvian fissures—that is in the regions where they are most prone first to manifest themselves.

The pia mater is generally unduly adherent to the surface of the convolutions, so that it can only be removed in small shreds, and then not without tearing the superficial grey matter. This condition of things is the very opposite of what may be met with in some cases of simple meningitis affecting the vertex, in which the thickened pia mater, with all its prolongations, may sometimes be easily stripped off from the greater portion of a hemisphere in one piece.

The substance of the brain is commonly much more vascular than natural. The lateral ventricles are usually moderately dilated, containing from 2 to 4 or 6 ounces of not very clear serum. The veins on their surface are then engorged, and the fornix and other adjacent parts may be more or less softened, or actually diffluent. Microscopical examination of such softened tissue will reveal the presence of an abundance of granulation-corpuscles; and its specific gravity, if estimated, will be found to be diminished—both these characteristics being marks of a pathological softening which has occurred during life, and not of a softening due to mere *post-mortem* maceration. Some have erroneously supposed that such mere maceration would be adequate to produce the softening.

Sometimes the above-described changes are more fully developed in one than in the other hemisphere; and occasionally also in some parts of the brain small nodular growths of a 'tubercular' nature may be met with, varying in size from a small pea to an almond. These growths are most apt to occur in the substance of some of the cerebral convolutions, or near the surface of the cerebellum, or even, as the writer has seen, within the substance of the corpus striatum. In many such cases the small nodular tumours will be found to be in intimate relations with the vessels of the part, and, in fact, to be composed of a mere aggregate of the smaller 'granulations' more or less fused into a single mass.

PATHOLOGY.—The granulations begin to appear first in the meninges of the base under those influences, whatever they may be, that lead to the development of similar grey granulations in other organs of the body. These primary changes excite a common inflammation of the membranes around, and thus entail the production of the lymph, which covers the base of the brain, and extends on either side into the Sylvian fissures. Why the grey granulations should tend to develop first, and specially about the vessels at the base of the brain, cannot at present be explained.

This inflammation of the basal meninges also extends, by direct continuity of tissue, over and around the cerebral peduncles to the velum interpositum, and to the connective tissue at the upper and anterior extremity of the middle lobe of the cerebellum. In one or other, and often in both, situations the tissues are thickened by lymph. The writer has seen the velum interpositum thick and leather-like in consistence, and the venæ magnæ Galeni which run through it blocked by thrombosis; and this he believes to be an occasional cause of the central softening and dropsy, previously referred to as component parts of the disease (see *Edinburgh Medical Journal*, April 1867). In other cases, where no such thickening or thrombosis is to be detected, there is great swelling of the connective tissue, from development of lymph, opposite the termination of these great veins which return the blood from the surface of the ventricles and from the central parts of the brain—at the point, that is, where the veins of Galen empty themselves into the straight sinus.

In this way the very common association of the central ventricular changes with the basal meningitis may be accounted for, and also the occasional absence of such changes, in instances where the inflammation, apt to be set up through mere continuity of tissue, does not attain sufficient proportions to interfere with the return of blood, either through the veins of Galen, or from them into the straight sinus. It is of course possible that the central softening may also be favoured by an independent affection of the small vessels situated in the walls of the ventricles, and a development of granulations around them—though this has not hitherto been recognised. It is, however, well known that thrombosis is extremely apt to occur in those minute vessels in various parts of the brain which are enveloped by granulations—a fact that goes far to account for the extreme gravity of the symptoms in many cases of tubercular meningitis, in which naked-eye changes appear to be slight and altogether disproportionate in amount.

SYMPTOMS.—The symptoms presented in different cases of tubercular meningitis often vary very widely from one another, although amongst them all there is an underlying bond of similarity. The variation may be easily understood from a consideration of the fact that such symptoms form part of those pertaining to a febrile affection characterised by other local manifestations, of varying importance in different cases; and also from the fact of the differences constantly met with in the relative and absolute development of the different kinds of changes encountered within the cranium itself in this disease—especially in regard to the amount of ventricular effusion and central softening existing in conjunction with the meningeal inflammation, which itself varies much in intensity and in regard to the area involved in different cases.

It is, therefore, usual and most convenient to enumerate the possible signs and symptoms of this disease as they occur in three stages—artificial and often ill-marked from one another as they are—namely, (1) those of the *invasion stage*; (2) those of the *developed disease*; and (3) those of its *closing phases*.

(1) *Stage of Invasion.*—Amongst the initial symptoms of tubercular meningitis may be mentioned obstinate and recurrent vomiting, often associated with constipation; coming on frequently after a period of previous malaise; and associated with fretfulness, slight wasting, indisposition to play, and disturbed sleep. Soon after, or simultaneously, there may be more or less marked indications of cephalalgia. Young children who cannot speak are fretful and constantly cry; they often also put their hands to their head. Such children start and cry out in their sleep. The temperature may be as yet scarcely, if at all elevated; or there may be rigors from time to time, with temporary feverishness, recurring daily about the same hour. The child often cries out when touched, and a more or less general exalted sensibility to painful impressions seems to exist.

(2) *Developed Disease.*—In the second stage any feverishness that may have existed often abates. There may be less restlessness, so that the child even sleeps more than natural. The pupils are often insensitive to light, and unequal. There is frequently also some slight or perhaps marked strabismus. The pulse is apt to be much less frequent than natural (56–70 per minute perhaps), and decidedly irregular. The hypersensitiveness of skin may have disappeared, but a peculiar vaso-motor irritability exists, so that when the nail of the fore-finger is drawn once across the skin of the abdomen or other part, a deep red linear mark comes out slowly, and persists a long time. This so-called 'tache cérébrale,' whilst also met with in other affections, is, as Trousseau rightly enough insists, rarely absent in tubercular meningitis. Frequent plaintive cries may be uttered, though the child is generally more quiet and drowsy; it is apathetic also in regard to food, not asking or crying for it, but still taking it, perhaps well, whenever it is administered. Convulsions may occur during this stage, or weakness of one or more limbs may be noticed, especially where larger tubercular nodules occur in one or other portion of the brain-substance. Sometimes, too, the paralysis is of a shifting and transitory nature, varying in degree or even in situation in the course of a few days.

(3) *Closing Phases.*—In the closing stages of the disease the drowsiness may gradually deepen into stupor or actual coma; though in conditions short of the latter, the child may still more or less frequently utter plaintive cries. The pulse, instead of being less frequent than natural, now becomes preternaturally frequent; whilst the respiration often assumes a slow, sighing, and markedly irregular type. The face, frequently pale and clammy, flushes at times. The head is hot, and the temperature generally raised, though often not more than to 100°, and rarely beyond 102°, until quite to the close of the disease. The fontanelle is raised, and there may be unnatural pulsation. The eyes, when examined with the ophthalmoscope, may show evidences of grey granulations in the choroid. The pupils may be unequal, but are generally dilated and insensitive. In one remarkable case the writer has seen a rhythmical contraction and dilatation go on, especially on exposing them to light. In this stage, when the patient is sufficiently conscious, it may be found that sight is notably impaired or almost lost.

The patient may take the food which is given, up to the last; though at other times there seems to be an actual inability to swallow it, even when it is placed in the mouth, owing to paralysis of the muscles of the tongue and pharynx. The abdomen is often boat-shaped and retracted; and an obstinate constipation still continues. Even in this last stage of the disease a temporary and delusive lull may take place; the child may seem to revive a little, but only too soon to lapse again into a state as bad as or even worse than before. Frequent and long-continued convulsive seizures are especially apt to occur during this stage of the disease; and death may take place during or immediately after one of these attacks. At other times the end is brought about more gradually, through progressing failure in the heart's action, combined with disturbance of respiration. In the latter class of cases the temperature may gradually fall, during the last few hours before death takes place, to several degrees below the normal; though in other cases of tubercular meningitis there is a slow and steady rise of temperature up to 105°, or even 106°, before the patient expires.

DIAGNOSIS.—In the early stages the diagnosis of tubercular meningitis may present extreme difficulties. We must wait, before expressing a definite opinion in one of these doubtful cases, till the patient has been seen and examined two or three times. The premonitory symptoms and those of the first stage are often far from distinctive. They may, it is true, represent the beginning of tubercular meningitis, but, on the other hand, they may also represent something less serious—for instance, a mere failure of health from various causes, complicated by some gastro-intestinal irritation, or perhaps the commencing outbreak of some one or other of the specific fevers. Details as to the child's condition during the last two or three weeks, comprising the order of evolution of the several symptoms, may, however, throw some light upon the real nature of the case at an early stage of the disease.

A contributory cause of the difficulties besetting the early diagnosis of tubercular meningitis is to be found in the fact that acute tuberculosis is itself extremely difficult to recognise. We cannot, therefore, readily fall back upon a diagnosis of the general condition in order to strengthen our diagnosis of tubercular meningitis. As a matter of fact it is just the reverse. Of all the local manifestations of this disease, those within the head produce by far the most definite set of symptoms; so that we can always most safely infer the probable existence of acute tuberculosis with grey granulations throughout the body, from the presence of the developed symptoms of tubercular meningitis. The symptoms produced by grey granulations within the thorax or within the abdomen, are far less distinctive or, in fact, not distinctive at all. The existence of a particular habit or build of body in all cases of acute tuberculosis to any appreciable extent, or certainly to such an extent as to make it possible to use the recognition of it as an aid to diagnosis in a case otherwise obscure, is very improbable. Our notions as to the existence and nature of a tubercular habit of body need revision; it must not thoughtlessly be confounded with the mere phthisical habit of body; and it seems probable, from more than one point of view, that acute tuberculosis is a quasi-accidental disease, occurring at times in individuals of any build of body whatsoever—with no more limitations, that is, than may exist in regard to the incidence upon persons of different bodily types of one of the common acute specific diseases.

The symptoms of the established disease are therefore alone distinctive, to any really trustworthy extent, of the existence of tubercular meningitis, and through it of the presence of its general underlying condition. We may have our suspicions before, but these can only transform themselves into certainties as the disease actually develops, and as it passes, moreover, into the incurable stage.

At this phasis of the disease the alternative conditions to be thought of are in the main these—typhoid fever on the one hand, or else some form of intracranial disease other than tubercular meningitis. Here, as in almost all cases of brain-disease, we have to look not to any one or two signs or symptoms which can be regarded as pathognomonic, but rather to the sum total of symptoms, and to the way in which they are grouped. With the possible existence of some or all of the premonitory and initial symptoms already enumerated, if the patient becomes more somnolent; if the pulse falls much below par in frequency, and is at the same time irregular; if with a condition of fever still existing, the child does not constantly crave for drink; and especially if there is also the combination of obstinate constipation and a retracted abdomen, together with an irregular and suspirious form of respiration we may feel more and more certain that we have not to do with even one of the most anomalous forms of typhoid fever associated with head-symptoms—or, indeed, with any form of intracranial disease other than tubercular meningitis. An examination of the temperature chart may considerably aid us in the same direction, and so also may a microscopical examination of the blood.

Some years ago, the writer made observations upon this latter point, tending to show that in tubercular meningitis there are, in a large proportion of the cases, distinctive alterations in the blood—as drawn by a needle-prick from the tip of the fore-finger and examined at once upon an ordinary microscope-slide—capable of affording very material aid in the diagnosis of tubercular meningitis from typhoid fever, as well as from other brain-affections (such as a new-growth implicating the pons and contiguous parts, thrombosis in some of the cranial sinuses, or perhaps one of the simple forms of meningitis). The characters of the blood met with in tubercular meningitis are these:—The white corpuscles are decidedly more numerous than natural, and speedily (that is, within ten to fifteen minutes after the blood has been drawn) show signs of great amœboid activity, by the development of vacuoles within them, and of numerous projections from their outer surface; groups of protoplasmic particles of various sizes are also to be seen interspersed amongst the blood-corpuscles, as well as here and there a small pigment-granule or an irregular block of pigment of reddish or reddish-black colour. The red corpuscles usually run together into irregular masses, rather than into definite rouleaux, though they present no very distinctive changes. This increase in number with exalted amœboid activity of white corpuscles, in conjunction with the other blood-characters above-mentioned, are not met with in typhoid fever, or in the great majority, at least, of other cerebral affections.

For the diagnosis of tubercular from the simple form of meningitis, *see* MENINGES, CEREBRAL, Inflammation of, Simple Idiopathic.

PROGNOSIS.—Death is well-nigh certain within three weeks, or at most a month, from the date of the invasion-symptoms of tubercular meningitis. When the disease has arrived at a stage permitting of pretty certain diagnosis, hope rather than rational expectation may still hold out a chance of recovery. Although instances of this have occurred, they are of extreme rarity. If the course of the disease is to be modified by treatment, it must be during those early stages when we are capable of forming only a provisional or tentative diagnosis. In these stages, however, the writer—and many good observers share this opinion—is inclined to think that under judicious treatment the development of the disease may be arrested. Still this view may, quite possibly, be an erroneous one. Proof of such a position, or of its opposite, is, from the nature of the case, impossible.

TREATMENT.—From what has just been said, it will be seen that anything like curative treatment must be directed to the early or premonitory symptoms of the disease. Here the writer thinks he has seen decidedly good results from one to six grains of iodide of potassium, according to the age of the child, administered three times a day, with small doses of cod-liver oil; at the same time attending to the state of the bowels, and giving suitable doses of bromide of potassium at night, till the restless condition with disturbed sleep has passed away.

When the disease is further advanced, we may perhaps be able to diminish pain by the application of cold to the head; but we only aggravate the sufferings of the patient by the use of blisters, tartar emetic ointment, or other irritating applications. Bromide of potassium may do something to keep convulsions in check, though at other times it seems to be quite powerless. Chloral is probably a dangerous drug for a patient, the action of whose heart is already so seriously interfered with; though chloroform inhalations may be had recourse to in an extreme case, where persistent convulsions cannot otherwise be checked. Beyond this, the child needs the most careful nursing, and to be well supported with strong beef-tea and milk, and occasionally with stimulants, so long as it is capable of taking food, whilst attention is paid to the bowels. In this way, if the patient's case is to prove one of those rare and exceptional instances in which recovery is possible, we, at all events do nothing to thwart the course of natural processes which have a chance, however small, of terminating in recovery.

H. CHARLTON BASTIAN.

MENINGES, CEREBRAL, Hæmorrhage into.—SYNON.: Fr. *Apoplexie meningée*; *Hémorrhagie méningée*; Ger. *Hirnhautblutungen.*

DEFINITION.—Effusion of blood in one or other of the following situations:—(1) Between the bone and the dura mater; (2) Between the dura mater and the arachnoid (into the so-called 'arachnoid sac'); or (3) beneath the arachnoid and into the meshes of the pia mater.

ÆTIOLOGY.—The first of these varieties of meningeal hæmorrhage has an almost exclusively traumatic origin; being a result of falls or blows which occasion the rupture of one of the meningeal arteries, lying between the bone and the dura mater. Still, caries of the bone may in very rare cases lead to such a hæmorrhage, by causing erosion of one of the meningeal arteries.

The other two varieties are not so distinctly separated from one another, since a hæmorrhage occurring in the pia mater, if large, is very apt to break through the arachnoid, and thus lead to effusion of blood into the 'arachnoid sac'; and this whether the primary effusion has been the result of a traumatic injury, or is a sequela of some general or local disease. Effusion into the arachnoid may also occur as a result of rupture of some vessel on the inner surface of the dura mater; this being probably a rare consequence of injury, though it is a frequent result of disease in this situation (*pachymeningitis interna*).

Effusions of blood are occasionally found beneath the arachnoid which have not originated there, but which have come to the surface, by laceration of brain-substance, from some intracerebral hæmorrhage; or they may have been caused by intraventricular hæmorrhages, finding their way into the fourth ventricle, and thence into the sub-arachnoid tissue.

In very young children, whose vessels are presumably healthy, bleeding into the arachnoid may occur from any unusual amount of strain. This occasionally takes place at the time of birth, especially during prolonged labours. Indeed, according to Cruveilhier, arachnoid hæmorrhage is the cause of the death of about one-third of those infants who die almost immediately after birth. A little later on in life, a similar accident may occur during paroxysms of whooping-cough, or during other spasmodic respiratory conditions, in which the return of venous blood from the head is impeded. Later still, an arachnoid hæmorrhage not unfrequently follows a fall or blow upon the head, or it may result from the rupture of an aneurism on one of the larger vessels about the base of the brain—especially the basilar or one of the middle cerebrals. Small subarachoid hæmorrhages, often multiple, are not unfrequently produced by the occurrence of thrombosis in the longitudinal sinus. They may also occur in persons suffering from scurvy or leucocythemia. Lastly, they may be met with as one out of the many forms of lesion occurring in men suffering from general paralysis of the insane.

Meningeal hæmorrhages are decidedly more common in males than in females—in the proportion of about three to one. They do not, like cerebral hæmorrhages, occur with progressive frequency as age advances, but are much more uniformly distributed through the different decades of life.

ANATOMICAL CHARACTERS.—When death takes place soon after blood has been effused into the arachnoid, as well as in the other situations, it is found in an easily recognisable condition. This is by no means the case, however, after the lapse of months or years; then, in the case of small hæmorrhages, we may meet with mere yellowish or rust-coloured stains; whilst where they have been of larger size, we may meet with decolorised cyst-like bodies, either free or adherent—or else there may be decolorised membranous masses, adhering mostly to the parietal arachnoid. Where the size of the clot has been large, the surface of the brain is more or less pressed upon, so that some atrophy of its substance follows. Many of these latter points are well exemplified in a case recorded by Dr. Quain in the *Path. Trans.*, vol. vi. page 8.

Sometimes the layers of altered blood are neither adherent to the arachnoid, nor do they lie free on its surface; they may be attached to the surface of the dura mater, or lie between new growths arising from its inner layers, and thus produce a condition which often goes by the name of *hæmatoma*. Prolonged discussions have taken place on the question whether these changes are results of a primary hæmorrhage, or whether we have not rather to do with a *pachymeningitis interna hæmorrhagica*, where an inflammation is the first event, during which effusion of blood takes place into the innermost layers of the altered and inflamed membrane. *See* MENINGES, CEREBRAL, Hæmatoma of.

SYMPTOMS.—The symptoms attendant upon meningeal hæmorrhage will necessarily vary a great deal in severity, according to the amount and suddenness of the effusion. These symptoms are, moreover, in the great majority of the traumatic cases obscured by those depending upon the mere shock and concussion of the brain, which the original accident or blow occasions.

Where subarachnoid hæmorrhages occur in the course of thrombosis of the longitudinal sinus, no distinctive symptoms are as a rule produced; and those of the primary affection are themselves only too variable, and difficult of recognition. Again, where subarachnoid hæmorrhages occur in the course of purpura, leukæmia, or allied affections, the amount of blood effused is usually too small to produce definite or recognisable symptoms. At most, the abrupt onset of pain in the head, vertigo, or mental confusion, may give rise to a suspicion that such an event has occurred.

Where a large hæmorrhage takes place beneath and into the arachnoid sac, over one hemisphere, or over both, either as the result of a fall or blow, or from the bursting of an aneurism on one of the large arteries at the base of the brain, a profound coma is produced which may prove rapidly fatal—that is, in the course of a few minutes or a few hours. Where the amount of blood effused is less, and where it is poured out more gradually at first, there may be premonitory symptoms, in the form of sudden headache, vertigo, mental confusion, vomiting, or convulsions, rapidly followed by unconsciousness. At first there is generally complete relaxation of all the limbs; but later—after some hours or days—the weakness may be distinctly unilateral, that is, of hemiplegic type—though sometimes with very slight implication of the face. There may also be twitchings or rigidity of the limbs on one or both sides. On recovery of consciousness there may be no distinct loss of sensibility, only numbness, in the limbs; and the paralysis may after a time grow less up to a certain point, or gradually disappear.

DIAGNOSIS.—In many of the slighter forms of hæmorrhage into the cerebral meninges diagnosis is, for the reasons specified, almost impossible.

In the more severe cases a sudden apoplectic attack is produced, agreeing very closely with that occasioned by some of the most serious forms of intra-cerebral hæmorrhage. Causal conditions, especially when they have been traumatic, together with the possible youth of the patient, may in some cases help us to diagnose a large arachnoid hæmorrhage, from a copious bleeding into the lateral ventricles, or from a sudden hæmorrhage into the middle of the pons Varolii; though it should be borne in mind that in the former of these two conditions the pupils are almost always widely dilated, whilst in the latter they are as constantly contracted and insensitive, whereas they are likely, so far as the writer's observations have gone, to be in a more intermediate condition in arachnoid hæmorrhage.

PROGNOSIS.—In the case of arachnoid hæmorrhages, whether large or of only moderate volume, should the patient survive the first effects of the effusion, and, it may be, of the injury which caused it, danger to life is no longer to be feared. The only question, then, is as to the amount of paralysis, mental impairment, or of irritability with cephalalgia, which may remain; or whether or not a tendency to convulsions may be set up, as a consequence of the original injury and lesion.

TREATMENT.—The treatment of a case of meningeal hæmorrhage does not differ from that appropriate for cerebral hæmorrhage. Perfect rest in the recumbent position, with the head slightly raised, is essential. Cold to the head may be conjoined with hot applications and mustard plasters to the lower extremities. For other indications and details of treatment we must be guided by the varying conditions of the patient. During convalescence in the more favourable cases we must pay great attention to the general health of the patient, and above all protect him from overwork or excitement of any kind. H. CHARLTON BASTIAN.

MENINGES, CEREBRAL, Hæmatoma of.—SYNON.: *Pachymeningitis interna hæmorrhagica*; Fr. *Pachyméningite*; Ger. *Pachymeningitis.*

DEFINITION.—Inflammation of the inner surface of the dura mater, attended with the formation of a membranous vascular tissue, into which hæmorrhage takes place.

ÆTIOLOGY.—This affection is met with at all ages, but is most common in advanced life and early childhood. Males are said to suffer more frequently than females. It is rarely primary; most of the recorded cases have followed, at some interval, an injury, or occurred in the subjects of insanity, or chronic alcoholism. Other cases have appeared consequent on acute rheumatism and other pyrexial affections, especially pneumonia and small-pox.

ANATOMICAL CHARACTERS.—According to Virchow, in the early stage, before hæmorrhage has taken place, a delicate reticulated membrane exists on the inner surface of the dura mater in one or many layers—even twenty. It varies in consistence according to its age. The colour is usually reddish, from the number of new-formed vessels; but it is often rust-coloured from degenerated blood extravasated in minute quantity. The position of the membrane is always over the convexity, commonly near the middle line; and it is often symmetrical on the two sides. In the second stage, that of hæmorrhage, blood in considerable quantity is effused between the layers in one or several places, and may extend as far as the limits of the false membrane, thus constituting one or more simple or loculated cysts. These cysts are, of course, adherent externally to the dura mater, and internally rest on the arachnoid membrane and convolutions, which they compress and even depress. Their contents are blood—liquid, coagulated, or in every stage of degeneration. Ultimately only coloured serosity may remain. The thin delicate wall of the cyst was formerly regarded as organised fibrin from a blood-clot, or as the separated parietal layer of the arachnoid; and some pathologists are still of opinion that the hæmorrhage precedes the formation of the membrane. *See* MENINGES, CEREBRAL, Hæmorrhage into.

SYMPTOMS.—Two periods may often be recognised, corresponding to the anatomical stages of hæmatoma of the dura mater just described. In the first, circumscribed headache is the chief symptom, often felt at the vertex. It may be associated with giddiness, uncertainty of movement, lowered mental power, and contraction of pupils. In children, in whom the whole disease commonly lasts only a few days, there is often fever. In adults this stage may last for weeks or months. The second stage, that of blood-effusion, is attended by an increase of the mental dulness to distinct somnolence, at first intermitting, but deepening to actual coma with a rapidity that depends on the rapidity of effusion. The pupils continue contracted, but that on the side of the mischief may become the smaller. Hemiplegic paralysis or contraction may occur when the hæmatoma is unilateral. In children convulsions are common. The duration of this stage in the adult may be weeks or months; and death occurs in coma. In children it usually lasts only a few days.

DIAGNOSIS.—The diagnosis of hæmatoma of the dura mater is often difficult, and depends on the slow onset of coma, after a period of headache, without symptoms to indicate a localised lesion of the brain. In the child the disease may be mistaken for tubercular meningitis, but the course of infantile hæmatoma is usually more rapid, vomiting is rare, and muscular contractions and convulsions are common.

PROGNOSIS.—The prognosis is very unfavourable, but not absolutely fatal in the adult; in several cases in which the symptoms of hæmatoma have been present, recovery has taken place. In children there is little hope.

TREATMENT.—In the child one or two leeches may be applied behind the ears: and cold to the head, and counter-irritation to the skin of the neck and limbs, are likely to be useful.

In the adult, if by rest, cold to the head, and counter-irritation the effusion can be arrested, absorption of the blood will slowly take place; and this may be furthered by moderate purgation, by diuresis, as well as, perhaps, by the administration of iodide of potassium.

W. R. GOWERS.

MENINGES, CEREBRAL, New Growths and Adventitious Products in.—The clinical aspects of the several pathological conditions composing the set of changes included under these heads, are comparatively meagre and ill-defined, as compared with what we know of them pathologically. For this various reasons exist, some of which will be presently indicated.

ANATOMICAL CHARACTERS.—In the present article it will suffice to enumerate the new growths and adventitious products met with in the cerebral meninges, referring to special articles on the several bodies for a fuller description of them.

SYMPTOMS AND DIAGNOSIS.—Intracranial new growths or adventitious products are, as a class, accompanied by the most diverse sets of symptoms. The new growths or products vary in different cases within very wide limits, from the point of view of the suddenness of their onset or increase, as well as of their actual bulk or number, and also as regards the particular intracranial region or regions which they implicate. We may therefore in some measure understand what happens, that some growths or products may be unaccompanied by appreciable symptoms during life; that others may be associated only with vague symptoms of a general order, denoting the existence of some kind of intracranial mischief; whilst, on the other hand, some may be associated with such comparatively definite groups of symptoms as to make it reasonably easy to arrive at a pretty certain diagnosis, both as to the situation and as to the nature of the intracranial growth or morbid product.

But, it may be said, why use the broader term 'intracranial' when we are here only concerned with morbid conditions of the meninges? This brings us to the second of the reasons above referred to, namely, that it is often, and, for the most part, impossible to distinguish clinically between mere meningeal new growths or products, and those which arise from or within some portions of the encephalon. The reasons for our impotency in this direction are also not difficult to find. First, we may cite the general one, of the frequent vagueness or even absence of any appreciable symptoms attendant upon intracranial growths or products; and, secondly, the more special reason, that growths starting from the meninges will often press upon and implicate the surface of the brain in different regions, in much the same manner as if they sprang from the surface of the brain itself in such regions. And, thirdly, there is the further consideration that intracranial growths or products are frequently multiple in the same individual, and then may partly spring from the meninges, and partly in the substance of the brain itself.

For these various reasons it happens that if the diagnosis of a purely meningeal new growth or adventitious product could ever be arrived at, it would be effected through the medium of a previous pathological diagnosis. But how limited are the possibilities in this direction may be gathered from the following considerations. Certain personal or family characteristics presented by a patient may make it highly probable that syphilitic intracranial disease, or that scrofulous intracranial growths exist. Still more rarely the signs and symptoms may indicate that cancerous intracranial growths, or that growths similar to some multiple tumours already existing in other parts of the body, may be the causes also of co-existing head-symptoms. Yet these are almost the only cases in which it may be possible for us to arrive at anything like a positive diagnosis as to the nature of a supposed intracranial growth or product. And of these the first only, namely, syphilitic disease, could with any degree of certainty be diagnosed as a change limited to the meninges; the others would be just as likely to take origin within the cerebral substance as from the meninges.

For these reasons no good purpose would be attained by entering at length into the groups of symptoms that may be produced by meningeal growths or adventitious products. They are apt closely to resemble some of those co-existing with growths within the brain, which have been already considered. *See* BRAIN, Tumours and New Growths of.

A. New Growths.—(*a*) *Syphilitic growths or thickenings of the meninges.*—These products are met with principally in the form of yellowish lymph-like masses, connecting the dura mater to the arachnoid, and this with the pia mater to the surface of the cerebral hemispheres in some region (often the parietal), of irregular area and variable extent. This yellow 'gummatous' material probably takes its origin, for the most part, in or on the surface of the dura mater, while it may extend inwardly so as to infiltrate or press upon the surface of the brain, and also outwardly, so as to cause erosion of the cranial bones. The membranes around may be thickened, or more or less obviously inflamed. This form of disease does not occur in congenital syphilis; when it exists, therefore, it is invariably met with in persons beyond the age of puberty. Similar growths taking origin completely within the brain-substance are extremely rare.

(*b*) *Scrofulous tumours.*—These are often spoken of as 'tubercular' growths. They, unlike the last, are much more frequently met with in children than in adults, and especially in young children between the ages of two and seven years. They are yellowish nodular masses, varying in size from a small pea to a walnut. Whilst some of them may obviously spring from the pia mater, others (and this much more frequently) are met with within the substance of some portion of the cerebrum or cerebellum. As in the last case, these growths are presumed to be in the main dependent upon the existence of a special constitutional state—one which carries with it proclivities to certain kinds of tissue over-growth.

(*c*) *Cancer.*—Cancer not unfrequently affects the dura mater, whence it may extend outwards or inwards, and thus implicate other parts secondarily—either eroding and perforating the bone, or greatly depressing the surface of the brain as it grows inwards. Although more frequent in the second half of life, meningeal cancer may occur also in youth, or even in childhood.

(*d*) *Other growths.*—Other growths of less frequent occurrence, and therefore of less importance, also start from the meninges. We may have the following:—*Sarcomata; Fibromata; Fibro-enchondromata; Steatomatous or cholesteatomatous growths;* and *Structureless or wax-like tumours,* having the so-called 'amyloid' reaction. Such tumours as these may give rise to more or less definite head-symptoms during life. They spring, for the most part, from the dura mater rather than from the arachnoid.

Other smaller, and mostly rare, growths may be met with quite unexpectedly after death, because of their occurrence in the form of flat plates, which do not interfere by pressure or otherwise with the subjacent cerebral substance, and therefore give rise to no obvious symptoms. They are:—*Osteomata,* which occur either in the falx, in the walls of the lateral sinuses, or much more rarely in the substance of the arachnoid, in the form of osseous plaques; and *Calcareous depositions* (belonging, perhaps, more strictly to the next than to this section) which vary in size from a mustard seed to a small nut, and which may be found in or beneath the arachnoid, or also on the inner surface of the dura mater. Sometimes a number of such minute concretions may be met with in connection with the pia mater or arachnoid (especially when these membranes are thickened or otherwise diseased), in the form of minute granules closely resembling the so-called 'brain sand,' each of which may present traces of several concentric layers.

B. Adventitious Products.—(*a*) *Parasites.* These may be of two kinds, both of them being larval states of tape-worms.

Cysticerci are larval conditions of *Tænia solium,* having the form of small bladders, which vary in size from that of a pea to a horse-bean. They often exist in large numbers in the meninges, and within the brain of the same individual, and are very rarely solitary. As many as 100 may be found within the cranium; and when they are thus numerous many of them will almost certainly be met with in the pia mater, merely pressing upon and slightly indenting the surface of the convolutions, though others will be situated within the substance of both cerebral and cerebellar convolutions. They are not confined to persons of any age or either sex, though they occur rather more frequently in those representing the second than the first half of life. Infection is brought about by the eating of raw, or insufficiently cooked 'measly' pork. *See* CYSTICERCUS.

Hydatids are larval forms of *Tænia echinococcus,* a very small four-jointed tape-worm commonly infesting the alimentary canal of the dog. The hydatids met with in the brain are always barren cysts (acephalocysts), and the outer enclosing membrane is generally very thin. They are usually solitary; may vary in size from that of a marble up to a large orange; are rare even in the brain-substance, and still more rare in the pia mater. Sometimes two, three, or more hydatid cysts exist within the cranium of the same individual, but they are then usually of small size. Davaine refers to an instance in which many hydatids were found in the meninges and at the surface of the brain, as well as within its substance. Out of twenty-four recorded cases, in which the age was stated, the writer has found that no less than eighteen of them were persons between the ages of ten and thirty years, three of the remainder being above and three below these extremes. Infection may well be brought about by means of the dog's tongue, which is at times only too quickly transferred from parts liable to be contaminated by ova of its own tape-worms, to the hands or even the lips of his master or mistress. Besides this more direct method, the ova of the Tænia echinococcus voided by the dog may be blown about, or otherwise get by accidental means into water or food taken by man. *See* HYDATIDS.

(*b*) *Aneurisms.*—These, situated either on one of the vessels composing the circle of Willis, or on some one or more of its primary branches, may vary in size from a small pea to that of a walnut. Those of larger size, which are usually single, may give rise to distinct head-symptoms; but at other times, and especially when the aneurism is very small, there may have been no reason to suspect its existence, or that of any other intracranial disease, till, perhaps, the rupture of such an aneurism may lead to the supervention of serious symptoms, speedily terminating in death. These aneurisms may occur, possibly as a sequence of a previous embolism (Church), even in early youth as in adult age.

(*c*) *Thrombi in the cerebral sinuses.*—The process of thrombosis is known principally as it occurs in three of the sinuses contained within the cerebral meninges, namely, in the longitudinal sinus, or in one or other of the two lateral sinuses.

(1) The formation of a thrombus in the *longitudinal* sinus is usually a *primary* phenomenon, dependent in the main upon the operation of general causes, such as some alteration in the quality of the blood, combined with slow, feeble, and irregular action of the heart. The operation of these causes has, however, been known to have been favoured in certain cases by local conditions, such as the great development of Pacchionian bodies, and their projection into the sinus—an event most likely to occur in elderly persons. Thrombosis of the longitudinal sinus may, however, be met with also in the early as well as in the middle periods of life. The original thrombus frequently prolongs itself through the straight sinus to the 'torcular Herophili,' and thence on either side into the lateral sinuses. And in this latter class of cases ventricular effusions and superficial cerebral softenings are apt to be associated with the thrombosis. The softenings are of a peculiar and characteristic kind, consisting generally of a number of small red patches, occupying principally the grey matter on each side of the upper surface of the brain. Occasionally softening of a portion of brain of considerable extent has been produced. Besides the ventricular effusion, there may also be an excess of serum beneath the arachnoid, or more rarely small effusions of blood in these situations, together with minute patches of hæmorrhage in the convolutional grey matter, such as have been described by Cruveilhier under the name of *apoplexie capillaire.* The actual combination of these conditions will depend upon the seat of the obstruction, the rapidity with which it is brought about, and the existence or not of marked pathological conditions of the vessels generally. The variation in the symptomatology of this affection in different cases is, therefore, also extreme; the symptoms are sometimes of an excessively grave order, and sometimes almost *nil.* Strange as it may seem, Dr. Gee says:—'I have known a decolorised softening thrombus to occupy the whole bore of the upper longitudinal sinus, to be attended by large sub-arachnoid hæmorrhages, and to have caused no symptoms during life.'

(2) Just as frequent, however, as the event above referred to, is the formation of a thrombus in one or other of the *lateral* sinuses; only then the process is almost invariably *secondary* to inflammation of the scalp or cranial bones, whether induced by traumatic conditions or by disease. Caries of the cranial bones is the principal predisposing condition; indeed, in three-fourths of the recorded cases the temporal bone was the part affected, and that as a result of internal otitis. In these cases there is often evidence of a more or less circumscribed inflammation of the meninges, but cerebral softenings and subarachnoid extravasations of blood rarely occur. This, according to Von Dusch, is explicable by the fact that in these cases the thrombosis starts from the veins in communication with the inflamed spot, and reaches the lateral sinus only after the collateral circulation has had time to establish itself; instead of forming primarily in the sinus, and before a collateral circulation has been set up.

(*d*) *Serum.*—This fluid may be met with in excess in two situations. It occurs (1) *beneath* the arachnoid, in cases in which one or both cerebral hemispheres have become wasted or atrophied. After fifty or sixty years of age, therefore, it is common to find an excess of subarachnoid serum. This fluid transudes from the vessels as pressure outside them diminishes, owing to brain-atrophy. It is absurd to suppose that it has any other, or at least any important, pathological significance. To speak, as some do, of 'serous apoplexy' as a cause of death, when no very obvious reason can by such persons be assigned for it, is a mischievous assumption of knowledge where a confession of ignorance would be better. But serum is sometimes found in excess (2) *within* the cavity of the arachnoid, when it constitutes the condition occasionally spoken of as 'external hydrocephalus.' It seems probable that the majority of such cases are instances in which the fluid of an ordinary internal hydrocephalus has, at some period before or after death, in part escaped from the ventricles into the cavity of the arachnoid (*see* HYDROCEPHALUS, Chronic). Still, there may be a narrow margin of cases not capable of being thus accounted for, in which the cause of the presence of fluid in this situation is very uncertain, when it is not, as it may be sometimes, an appanage of meningeal inflammation.

PROGNOSIS.—Some of the smaller and more slowly growing tumours may give rise to no symptoms during life, and may not appreciably tend to shorten its duration. The accumulation of serum beneath the arachnoid is, moreover, only a non-disturbing effect of other causes.

The case is, however, of much graver import where we have to do with syphilitic, scrofulous, cancerous, or other growths having a tendency to more or less rapid increase; also where the patient is suffering from the existence of intracranial cysticerci or hydatids, or from the occurrence of thrombosis in the longitudinal or lateral sinuses. In all such instances we may, for the most part, look for a steady increase in the gravity of the patient's symptoms, and, except in the case of the first kind of growth under the influence of proper treatment, for death at no very distant date.

TREATMENT.—Drug treatment can be looked forward to as curative, or nearly so, in only one of these various maladies, namely, in that of syphilitic origin—hence the great importance of a correct diagnosis where this condition is present. In a large number of cases, symptoms of the gravest character, associated, it may be, with paralysis, stupor, severe convulsions, excruciating cephalalgia, and even incipient insanity, one or more, or all, will, when really of syphilitic origin, yield in a truly marvellous manner to the continued and steady use of iodide of potassium in doses of eight grains, gradually raised to twenty or thirty grains, three times a day, especially when given in combination with $\frac{1}{32}$ to $\frac{1}{16}$ of a grain of bichloride of mercury.

Cod-liver oil, with vinum ferri or the syrupus ferri phosphatis, together with good food, quietude, and fresh air, may also do something to retard or even stop the growth of scrofulous tumours in sickly children.

Beyond this, in the class of cases which we have just been considering, medicinal treatment can be merely palliative. We must strive to relieve headache and secure better sleep; to mitigate the severity of convulsive attacks; or, if possible, to lessen the marked tendency to vomiting which may exist. Mental dulness and stupor, in such cases, are mostly beyond the reach of relief from therapeutics; though restlessness and irritability may perhaps be mitigated, by the administration of remedies suitable for the relief of pain, and for the encouragement of sleep.

H. Charlton Bastian.

MENINGES, SPINAL, Diseases of.—In this place we shall have to consider the following conditions:—

1. *Inflammation* of several varieties.
2. *Hæmorrhage into.*
3. *New growths* and *Adventitious Products.*
4. *Malformations.* *See* Spina Bifida.

Inflammation affects the spinal meninges in several different forms, though they are divisible into two main categories. Thus we may have:—(*a*) *Inflammation* of the spinal meninges of *traumatic* or *secondary* origin; and affecting either the dura mater (spinal pachymeningitis); or the arachnoid membrane (spinal arachnitis). (*b*) *Inflammation* of the spinal meninges of a *simple idiopathic*, or of a *tubercular* nature, and both of them affecting the pia mater (spinal leptomeningitis).

These different forms of spinal meningitis, whether existing alone or in association with a similar inflammation of the cerebral meninges, occur as acute diseases. Occasionally, where such diseases do not terminate fatally, they may lapse into a sub-acute or chronic condition, and thus persist for a considerable time. In association with new growths or with adventitious products in the meninges there may also arise a sub-acute or chronic localised inflammation of these membranes; but of chronic spinal meningitis beginning idiopathically as such, and pursuing a course chronic from the first, our knowledge is at present extremely slight. Chronic thickenings of the spinal membranes are, it is true, met with from time to time *post mortem*, which are by some deemed to have had an inflammatory origin independently of any acute attack. But as in other situations, so here considerable thickenings of these serous membranes may be met with as a result of degenerative rather than of inflammatory changes; and such conditions may give rise to no very appreciable symptoms during life till, as a sequence of their thickening and undue adhesion to the surface of the spinal cord, a superficial or annular form of sclerosis becomes established in this organ, either limited in site or irregularly developed in different regions.

1. Meninges, Spinal, Inflammation of, Traumatic and Secondary.—Ætiology.—In the case of the cerebral meninges, inflammation as a result of traumatic injuries is more common than as a phenomenon secondary to disease of the bone or of the scalp. The proportional frequency of these modes of causation is, however, somewhat reversed in the case of the spinal meninges; partly because the head is more liable than the spine to suffer from direct injuries, and partly because disease of the spine and of adjacent parts occurs with considerable frequency in such a manner as to be capable of exciting a secondary inflammation of the spinal meninges. Among the various efficient *traumatic* influences may be mentioned fractures and dislocations of the vertebræ, and stabs or other penetrating wounds implicating the contents of the spinal canal; whilst among the most frequent morbid conditions, in the course of which there may be a *secondary* development of spinal meningitis, we must cite the following:—caries of the vertebræ, deep sloughing bed-sores in the sacral region; cancer of the vertebræ; and inflammation of some part of the thoracic or abdominal parietes contiguous to the spinal column, and capable of spreading to the spinal canal from within.

Anatomical Characters.—In all these cases the signs and products of inflammation may be found in one or other, or in both, of two situations; that is, either implicating the dura mater, principally on its external surface, when we have the condition commonly known as *spinal pachymeningitis*; or affecting the surface of the arachnoid so as to produce a *spinal arachnitis*. Thus the same kind of limitation in the distribution of the inflammation is apt to occur when it starts under the influence of such causes, as is found to obtain in regard to the traumatic or secondary inflammations of the cerebral meninges. Perhaps there is in the case of inflammation of the spinal membranes, however, a rather more distinct tendency for such inflammations to spread, so as to involve the subjacent pia mater, than is the case in the parallel inflammations of the cerebral meninges.

In *spinal pachymeningitis* the dura mater itself is thickened and more vascular than natural, this being seen more especially on its outer surface; and both it and the surrounding connective tissue are covered or infiltrated either with yellowish lymph-like matter, or with actual pus. The internal surface of the dura mater may also be more or less covered with inflammatory products. The nerve-roots passing through the membrane are likewise generally affected by the inflammatory process, and they may show signs of compression or even of atrophy. Such inflammation may be either limited to the region of two or three vertebræ, or it may affect more or less the whole length of the spinal membranes.

Another more idiopathic and also more chronic form of spinal pachymeningitis has of late been observed by Charcot and others, affecting principally the inner layers of the dura mater in the cervical region. In this condition, which is described by the author above named as *pachyméningite cervicale hypertrophique*, there seems to be a considerable hyperplasia of tissue-elements in the inner layers of the dura mater, which is apt to develop into an overgrowth of almost cicatricial hardness, often made up of concentric laminæ. These are frequently adherent to the arachnoid and to the pia mater, which also become more or less thickened. In these latter cases especially, not only are the spinal nerve-roots greatly damaged, but the spinal cord is itself more or less compressed and softened, so that distinct paralytic symptoms, with muscular atrophy, are apt to be produced.

Where *spinal arachnitis* is superadded, or when it exists alone, we find that pus or lymph is situated on the outer surface of the visceral arachnoid, and also to a less extent on that lining the dura mater. The combination of the two conditions is rather more frequent than the existence of arachnitis alone, and it is important to remember that these forms of inflammation are very rarely, if ever, primary and idiopathic, with the exception of the more chronic variety described by Charcot, but that they occur as consequences of injury or of certain forms of disease adjacent to the spinal canal.

Symptoms, Prognosis, and Treatment.—As the nerve-roots are affected in these forms of inflammation, as well as in the idiopathic meningitis which implicates the pia mater (*Spinal leptomeningitis*), and as the symptoms of both sets of affections are in great part dependent upon this, and are therefore in many respects similar (and by no means always capable of being accurately discriminated from one another), it would serve no useful purpose to dwell upon the symptomatology and treatment of spinal pachymeningitis and arachnitis alone. The reader is, therefore, referred to the corresponding sections in the next article.

1a. Meninges, Spinal, Inflammation of, Simple Idiopathic and Tubercular.—Synon.: *Simple and Tubercular Spinal Leptomeningitis.*

Simple spinal meningitis of idiopathic origin, and tubercular spinal meningitis, are affections so closely related to one another, both in their clinical and pathological aspects, that no advantage whatsoever would be derived from considering them separately. In each case we have to do with an inflammation involving the spinal pia mater, so that the products of inflammation are situated beneath the arachnoid membrane. In order to distinguish these from other forms of meningitis, such as pachymeningitis and arachnitis, it is desirable that we should use some special term, such as *leptomeningitis*, which has of late been employed as a distinctive appellation for an inflammation affecting the pia mater, whether cerebral or spinal.

In regard to the extent or area of this kind of inflammation, it must be said that the tubercular variety always involves the presence of a similar inflammation at the base of the brain, though the contrary position is not true—that is to say, the tubercular inflammation may exist at the base of the brain alone, without involving the spinal meninges. Of the non-tubercular forms of spinal leptomeningitis, there are two varieties, and of these one form always involves the membranes at the base of the brain and the spinal meninges simultaneously. This is the 'epidemic cerebro-spinal meningitis,' which is described in a separate article (*see* Epidemic Cerebro-Spinal Meningitis). The other form may or may not simultaneously involve the membranes at the base of the brain, so that we have in these cases either a 'simple sporadic cerebro-spinal meningitis,' or a 'simple spinal meningitis.'

Whenever the inflammation has a 'cerebro-spinal' distribution, no confusion is involved by retaining the use of the simpler term meningitis, as it is generally understood that forms of inflammation having such a distribution involve the pia mater especially. But in place of the name spinal meningitis, if we mean to imply that the inflammation affects the same tissue, it is best to use the more special and distinctive term 'spinal leptomeningitis.'

From what has been said above, it will be understood that the symptoms resulting from meningitis involving the base of the brain alone, or together with serous effusion and softening of the walls of the ventricles (which, as we have seen, so frequently co-exists with inflammation of the membranes in this situation), have been principally studied in the purely cerebral forms of tubercular meningitis. On the other hand, the symptoms resulting from spinal leptomeningitis are best studied in the simple forms of this disease. It will also be evident that the simple and the tubercular forms of cerebro-spinal meningitis are likely to agree to some extent in their symptomatology with that of the disease known as 'epidemic cerebro-spinal meningitis.'

Ætiology.—This disease is most prone to occur in children and in young persons; and is more frequent in males than in females. Persons who are badly fed, and live under very unfavourable sanitary conditions, are more liable to be attacked than those who are healthy and surrounded by opposite conditions.

For the tubercular form the exciting causes are all such influences or conditions, whatever they may be, which determine the outbreak of acute tuberculosis. The affection of the spinal meninges may be either an extension of the inflammation originally existing at the base of the brain alone, or it may be another independent manifestation of the general disease developing within the spinal canal simultaneously with the cerebral meningitis. *See* Meninges, Cerebral, Tubercular Inflammation of.

For the simple or non-tubercular form, the exciting causes are various, but the best established of them would seem to be these:—exposure to cold, or cold and wet, in various forms; certain acute diseases, or the period of convalescence therefrom; concussion of the spine, as from falling down stairs, or in other ways; wounds affecting the spinal cord or its membranes, as in stabs of various kinds; or fracture and dislocation of the vertebræ.

The last modes of causation mentioned are similar to those which obtain for spinal pachymeningitis and arachnitis. For, although these latter conditions may be excited alone under such traumatic influences, they may also in certain cases, and especially arachnitis, be excited in association with a spinal leptomeningitis. Precisely the same kind of thing has also to be said in regard to the occasional action of other causes, such as caries of the vertebræ, deep-sloughing bed-sores in cases of paraplegia, or other instances of inflammatory processes contiguous to the spinal canal. Any of these latter conditions may also set up a leptomeningitis, in association with one of the other forms of meningeal inflammation.

A spinal leptomeningitis may spread so as to implicate the base of the brain; or a cerebral basal leptomeningitis may subsequently implicate the spinal membranes; or, lastly, the inflammation may appear in both regions simultaneously, and thus be from the first cerebro-spinal in seat. The writer has of late seen several cases of the tubercular variety belonging apparently to this latter category; but until the spinal canal has been regularly opened for some time in autopsies of persons dying from this disease, we shall be unable to say what is the exact numerical proportion of such cases as compared with those which are simply cerebral in type. The medulla may be comparatively free from lymph, and yet an inflammation of the spinal meninges may be well-marked. There must, therefore, be a routine opening of the spinal canal for the decision of this question, and not a mere casual inspection of its upper extremity through the foramen magnum.

Anatomical Characters.—According to the stage of the disease at which death takes place, we may meet with the inflammatory process in one or other of three different stages:—(1) that of greatly increased vascularity of the spinal pia mater; (2) one in which, in addition to the increased vascularity, gelatinous serum, lymph, or pus exists in the meshes of the pia mater, and often more marked in amount along the posterior columns. This latter is the condition commonly met with; but in rare cases, where patients have survived an acute attack, we may find (3) certain residuary chronic changes in the form of thickenings, opacities, and undue adhesions of the pia and arachnoid to the spinal cord, which perhaps may itself show a more or less marked condition of peripheral sclerosis.

In the tubercular variety we frequently have to do with a mere gelatinous serum, or thin greenish-yellow lymph (similar to that met with at the base of the brain) rather than with actual pus in the meshes of the pia mater. Careful scrutiny of the vessels in the anterior fissure and in other parts may also show the characteristic 'granulations,' in the form of opalescent, whitish, or yellowish-white specks.

In both forms of the disease the *nerve-roots* are implicated in various ways. They are usually involved in the inflammatory process, and may be much pressed upon by lymph and other hyperplasic products. The nutrition of the cord itself is probably profoundly altered, owing to the existence of an inflammatory process affecting the network of vessels from which its blood-supply is derived; and, moreover, the organic continuity existing between the pia mater and the off-shoots of connective tissue which extend into it on all sides, around the blood-vessels that penetrate its substance, makes it only natural to suppose that the inflammatory process would more or less invade the substance of the cord itself. And this, as the observations of F. Schultze have shown (*Berlin. Klin. Wochenschrift*, 1876, No. 1), actually does occur. But further researches are needed in this direction, in order that we may know the frequency with which grave changes of this kind are produced.

Symptoms.—General listlessness and a sense of chilliness have been noticed as premonitory symptoms in some cases of spinal meningitis. At other times the disease has been observed to commence with a more marked feeling of chilliness, accompanied or quickly followed by some febrile elevation of temperature, together with a full, rapid pulse. Soon there supervenes a deep-seated, boring pain in the back, varying in situation according to the degree of intensity of the inflammatory process at different levels. Pains also extend round the body in girdle fashion, and likewise into the limbs. Whilst the pains in the back are more or less continuous, though greatly aggravated by all attempts at movement, those felt in the limbs and trunk may be only experienced when attempts to move are made. Movement excites the dorsal pain far more than pressure upon the vertebral spines, or light tapping over the same region.

Rigidity of the spine, from muscular spasms, either localised or general, and also rigidity of the limbs, or even of special muscles, may coexist with the pains in the back and limbs. There is often an exaltation of reflex movements in the early stages of the disease, though this condition is nothing like so well marked as it is in tetanus.

At the same time marked hyperæsthesia of the skin exists over considerable regions of the trunk and extremities. The patient cannot bear to be touched, however lightly; and still less can he endure to be moved. He is irritable or plaintive if these proceedings be attempted. Owing to the varying nature and extent of the spasms, and the different amount of pain endured, the position assumed by the patient is very various in different cases.

Difficulty in defæcation and in micturition often exists, especially in the early stages of the disease, and this is supposed to be due to a spasmodic condition of the sphincters. The respiration and the heart's action are principally interfered with in cases where the cervical meninges are gravely involved.

The temperature seems to pursue a somewhat irregular course, but concerning this further information is needed. It may be only slightly above the normal; and may not rise much beyond 102°, even in fatal cases, till near the end. Then it may rise considerably in the course of a few hours; whilst in other cases it may at this same period become depressed below the normal.

In the later stages of the disease some amount of paresis, or actual paralysis, may be noted in one or more limbs; the pains on movement and the skin-hyperæsthesia become less, or may indeed be intermixed with tracts in which actual anæsthesia exists. The bladder may at last be paralysed; and respiration may be most gravely interfered with, so that disturbance of this function, as well as of the heart's action, may be the actual cause of death.

These symptoms are, in all probability, as Erb maintains, due in very great part to the inflammatory and other changes by which the anterior and posterior nerve-roots are implicated. Others may be due to extensions of the inflammatory process to the substance of the spinal cord, thus leaving a somewhat uncertain minority of symptoms to be accounted for by the mere implication of the pia mater itself.

The grouping of symptoms is apt to vary much in different cases, according as there is or is not the coexistence of a cerebral meningitis; or, in the absence of this complication, according as the inflammation is more or less localised in different regions of the cord, or general in its distribution. Much will depend also upon the severity of the process, and upon the extent to which the substance of the spinal cord becomes involved in the course of the disease.

Diagnosis.—Fever; pains in the back and limbs, greatly aggravated by movement; together with stiffness of the neck, trunk, or limbs; local muscular spasms; hyperæsthesia of the skin; retention of fæces and urine; dyspnœa; with a tendency in the later stages to the supervention of paresis, or actual paralysis of limbs—these are the symptoms, the combination of which to a marked extent becomes almost typical of spinal meningitis.

Its complication with a basal cerebral meningitis is, amongst other signs, chiefly indicated by the occurrence of vomiting, headache, slight delirium or stupor, paralysis of ocular muscles, difficulty in deglutition, loss of speech, or convulsions. The presence of many of such symptoms may, from their great importance, tend to dwarf or obscure those due to the inflammation of the spinal meninges alone; on the other hand, if they are absent we may feel assured that the inflammation has not also attacked the base of the brain.

The fact that a meningitis is spinal in seat, and unaccompanied with cerebral symptoms, is of itself exceedingly good evidence to prove that it is not the tubercular form of the affection.

To settle the question, which membranes of the cord are inflamed in any given case, we must be guided much by what we can learn concerning the causal conditions and the distribution of the inflammation, rather than by any at present known differences in the grouping of symptoms. Thus inflammations of idiopathic origin, or those which are cerebro-spinal in seat, will almost invariably be found to be instances of leptomeningitis; whilst those set up as a result of caries of the vertebræ, or as a sequence of a sloughing sacral bed-sore, are certainly much more prone to take the form of pachymeningitis, or of this in combination with arachnitis.

In reference to the diagnosis of spinal meningitis from other affections, it may be said that a very slight amount of attention to the nature of the pains and attendant conditions, will suffice to avoid the mistake of supposing them to be rheumatic in nature. And, similarly, the absence of trismus in the early stages, and of any extremely well-marked exaltation of reflex excitability, together with the presence of severe pains in the back and limbs, will be negative and positive characters sufficient for distinguishing spinal meningitis from tetanus.

Another disease with which spinal meningitis is liable to be confounded, is acute softening of the spinal cord. But the distinction should be easy in the early stages; and the history of the course of the affection will guide us later on, when symptoms of actual paralysis may have become developed. Still, in certain cases, a spinal meningitis may entail a softening of the cord to a marked extent, and then the symptoms of the primary affection will gradually be merged in those of the other which it induces.

A very rare condition, once met with by the present writer, is, he thinks, almost impossible to be diagnosed from spinal meningitis—that is, where a sarcomatous or carcinomatous new growth springs up rapidly throughout the spinal pia mater in the situation usually occupied by lymph or pus, especially when, as in the instance referred to, the disease seems to be the direct sequence of a fall from a height or over a flight of steps, and death takes place within a period of six or eight weeks (see *Lancet*, vol. i. 1880, p. 988).

Prognosis.—The prognosis of spinal meningitis depends a good deal upon the nature of the primary or causal conditions; upon the question whether the disease shows a tendency to extend to the cerebral meninges; upon the severity with which it implicates the cervical region of the cord; and also to some extent upon the age and general state of health of the person attacked.

It is a disease which proves fatal in the course of a few weeks in a very large percentage of cases; complete recovery is certainly a rare exception; but late and partial recovery—that is, after the disease has lasted long, and with the remainder of some amount of muscular atrophy or incurable paralysis—is a little more frequent. In such cases the disease after a time lapses into a chronic condition, and the patient very gradually recovers, except, perhaps, for such incurable sequelæ as are above mentioned. But even in these cases tending towards recovery, a relapse is most easily brought about, owing to the recommencement of the disease in an acute form.

Where spinal meningitis supervenes upon a sloughing bed-sore existing in a case of paraplegia, the end is usually not far distant. The gravity of any case of spinal meningitis is also always greatly enhanced when the disease spreads to the cerebral meninges. And, so far as the spinal meninges themselves are concerned, any great intensity of the inflammatory process in the cervical region, is always of the gravest import, because of the liability to secondary implication of the cord itself in these regions, either structurally or functionally and the

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bringing about from this cause of serious interference with the functions of respiration and circulation. A continuously rising temperature in such a case—to 105° and onwards—is also of fatal import.

TREATMENT.—The severity of the disease is apt to prompt to the use of active measures of questionable utility; amongst these may be cited free local blood-letting, the free application of ice to the spine, and active purgation. It is difficult, too, to say on what principle it is thought absolutely necessary to apply cold when we have to do with an inflammation within the spinal canal or within the cranium, whilst we almost always apply heat externally in the case of an inflamed pleura, an inflamed peritoneum, or even to an inflamed skin-tract. Probably the application of ice in such cases tends to alleviate pain, so that where this is great its use may bring much relief to present suffering, when hot applications would only aggravate it. But were it not for the fact that in meningeal inflammation (whether spinal or cerebral) increased fulness of vessels around sensitive organs shut in by unyielding walls, almost necessarily leads to aggravation of pain, the application of heat would probably be more beneficial than that of cold, so far as the possible resolution of the inflammatory condition itself is concerned.

The patient should certainly be kept in a cool, quiet room, and lying either on his side, or, if possible, on his face on a comfortable bed. He should be well supplied with spoon diet of the most nourishing description, together with eggs and a moderate amount of stimulants, according to the indications presented by his symptoms and general condition.

Blisters may be applied along each side of the spine alternately, or the same regions may be painted with liquor iodi. Pain should also be eased by opium or morphia; in fact, an opiate treatment may be resorted to in a large proportion of the cases. When opium and morphia do not agree, or are not admissible, Indian hemp would be worthy of trial as a mere anodyne; or we must fall back upon bromide of potassium and chloral, though the latter must be used with great caution where the heart's action is slow, irregular, and seriously interfered with. Belladonna and ergot have also been recommended, on somewhat doubtful grounds, as anti-inflammatory remedies.

We ought, in fact, to endeavour to combat the most urgent symptoms as much as possible, even if we cannot, by counter-irritants and by the judicious use of drugs, modify the course of the inflammation. Also by suitable feeding and judicious nursing we should endeavour to tide the patient through the disease. And if, happily, the activity of the inflammatory process subsides, the most unremitting attention will still be required to protect the patient against a relapse. Should his condition otherwise admit of it, the absorption of inflammatory products would, in this stage, be likely to be promoted by the use of a small dose of bichloride of mercury (such as one-sixteenth of a grain for an adult), in combination with increasing doses of iodide of potassium. At the same time, every effort must be made to restore the patient's general health, and to combat the emaciation which the disease itself usually involves.

2. Meninges, Spinal, Hæmorrhage int or upon.—SYNON.: *Hæmatorrachis*; Meningea Apoplexy (Spinal).

Effusions of blood upon, between or beneat the spinal meninges are altogether rare events contrasting notably in this respect with the comparative frequency of parallel conditions on th side of the cerebral meninges.

ÆTIOLOGY.—Among the causes of meningea hæmorrhages, stabs, blows, or falls will hold a first rank. After these causes we should hav to cite impediments to the circulation of blood occasioned by various respiratory or muscula spasms, occurring either in the course of whooping-cough, or during some more than usuall violent convulsive attack, epileptic, tetanic, or other. The lifting of heavy weights, or other great voluntary muscular exertions, may likewise at times prove causes of spinal meningeal hæmorrhage. Occasionally, however, it occurs independently of any such, or of other readily assignable causes.

ANATOMICAL CHARACTERS.—Fluid blood or blood-clots may exist in relation with the spinal meninges in three different situations.

The most frequent site of such hæmorrhage is (1) outside the dura mater, between it and the vertebral arches. Here large clots are sometimes found, wholly, or more frequently in part, surrounding the dura mater in the region in which the hæmorrhage has occurred. Where the effusion is large, the cord itself may be distinctly compressed, but even smaller effusions may produce some amount of compression of nerve-roots. A clot in this situation, as in other sites, will, of course, become much modified in appearance with age.

Clots and more or less fluid blood may also, but more rarely, be met with (2) inside the dura mater, within the so-called arachnoid sac. This occurs perhaps most frequently as a mere sequence of a similar hæmorrhage taking place in the cerebral meninges, the blood simply gravitating into the spinal canal. Sometimes, however, especially in cases of spinal pachymeningitis, blood is actually effused in this situation—and that where the internal surface of the dura mater is much more vascular than natural. The opening of a thoracic or abdominal aneurism may also occasionally take place into the spinal canal, and thus produce sudden and grave compression of the spinal cord.

Much smaller extravasations of blood are also met with (3) beneath the arachnoid and within the meshes of the pia mater, over areas perhaps small in extent longitudinally, but more or less embracing the cord in one or more regions. The cord or nerve-roots may, however, be decidedly compressed by such hæmorrhages, even when they are small in amount, owing to the space into which the effusion takes place being comparatively shallow.

SYMPTOMS.—The symptoms of these affections are in a large proportion of the cases vague and ill-defined. They may be much obscured by the causal conditions. In other cases they will vary in distinctness according to the amount and abruptness of the hæmorrhage.

As a rule, the onset of symptoms is sudden. Pain in the region of the spine, in which the hæmorrhage exists, or radiating thence along the nerves emanating from this region, may be the first symptom. More rarely, muscular twitchings or spasms may exist, either alone or with pains. These symptoms, dependent upon irritation and compression of sensory and motor nerve-roots, are at other times almost wholly absent. There may then be as abiding symptoms mere numbness or tingling in the parts affected, together with a sense of weight and paresis in the limbs. Actual paralysis is rare; and even when it is present, the rectum and bladder mostly escape.

Where pain exists, there is often stiffness of the spine; and these both together greatly interfere with movement. Febrile reaction is usually absent or very slight. The severity of the symptoms may abate after a day or two, leaving only more or less paresis. In the case of large hæmorrhages, however, with extensive compression of the spinal cord, death may be rapid, occurring in the course of some hours or of a day or two.

The symptoms will vary as the effused blood presses upon the cord in the cervical, the dorsal, or the lumbar region. Where the effusion is in the cervical region in a traumatic case, in which there is obvious head-injury with a condition of stupor, it is almost certain not to be diagnosed. The patient is not sensible enough to complain of pain; and the irregular respiration and small disordered pulse, with slight tremor or rigidity of one or both upper extremities, may with more probability be ascribed to multiple head-lesions—as actually happened in a case which recently came under the writer's notice.

Diagnosis.—It may be impossible to diagnose hæmorrhage into the spinal meninges in cases where it occurs as a concomitant of other grave diseases—such as tetanus, eclampsia, or cerebral hæmorrhage; and also in cases where it merely complicates a traumatic injury of the spinal cord itself. In other cases, the presence of certain causal conditions, together with the abrupt commencement of spinal symptoms in such combinations as have been above referred to, is sufficient to enable us to diagnose it from hæmorrhage into the substance of the cord, as well as from meningitis, or acute softening (*see* Spinal Cord, Diseases of). The gradual onset of the symptoms arising from tumours of the spinal cord, or of the spinal meninges, make it more easy to separate these affections from meningeal hæmorrhages.

Prognosis.—Meningeal hæmorrhages are as a class decidedly less grave than meningeal tumours. They are unlike the latter, moreover, inasmuch as the worst symptoms attendant upon them are produced at once, instead of being only very slowly evolved; so that after a short time, unless the blood effused happen to have produced a certain amount of compression of the spinal cord, the symptoms gradually diminish in severity. Large extra-meningeal hæmorrhages, compressing the cervical region of the cord, are by far the most serious forms of this affection.

Treatment.—In the treatment of spinal meningeal hæmorrhage the patient must, of course, be kept perfectly quiet and in the recumbent position. Spoon diet should be administered for a few days; and vascular sedatives, such as aconite, may be given with advantage. Some recommend active purgation, and the abstraction of blood from the neighbourhood of the spinal column by cupping or leeches. These measures, however, are of questionable utility, and the former especially might easily do positive harm.

3. Meninges, Spinal, New Growths and Adventitious Products of.—This subject requires no very lengthy discussion. As was said in regard to such growths and products springing from or connected with the cerebral meninges, the symptoms to which they give rise are in the main referable to irritation and pressure upon adjacent portions of the nerve-centres or upon certain nerve-roots. The symptoms, therefore, of meningeal growths or adventitious products are almost, if not quite, indistinguishable from those produced by similar bodies in the spinal cord.

The sections on special symptoms and diagnosis which might otherwise have appeared here may be suppressed; and the reader be referred for their equivalents to what he will find under the head of Spinal Cord, Tumours of.

We shall now merely give a few details concerning the ætiology, nature, and precise sites of the various new growths and adventitious products that may be met with in connection with the spinal meninges, and shall supplement these details with some few general remarks bearing upon the prognosis and treatment of such affections.

Ætiology.—In accounting for certain tumours, such as those of a syphilitic, of a scrofulous, or of a cancerous type, we may fall back upon the existence of a general 'predisposition'; though what determines the appearance of such tumours in this or that particular situation generally remains as much a matter of uncertainty as when the growths are solitary or of non-diathetic origin. Amongst such determining or exciting causes only one of those usually cited seems to be of real potency, namely, the occurrence of blows or injuries of various kinds. These certainly appear at times to be—in the spinal meninges as in other situations — the immediately exciting causes of certain new growths.

Parasites, such as cysticerci and hydatids, gain entry to the system in the way mentioned in the articles on these subjects; but something so indefinite or accidental as to be spoken of by us as 'chance,' will determine their appearance in this or that particular tissue or organ.

A. New Growths.—(*a*) *Cancer.*—Cancer occurs most frequently in the spinal meninges, not as a primary affection, but by extending to them from a previous cancerous growth in one of the adjacent vertebræ. The space within the spinal canal being very limited, such a tumour soon begins to press injuriously upon nerve-roots and upon the cord itself. In rare cases, however, a cancerous new growth may start from the spinal dura mater.

(*b*) *Scrofulous growths.*—These masses are met with principally in cases of scrofulous disease of the spinal column, and especially where angular curvature is produced, though they are not confined to these more severe forms of vertebral caries. Caseating growths are in such cases apt to extend from the vertebræ, so as to infiltrate the dura mater, and then produce fungating excrescences on its inner surface. Small isolated scrofulous tumours, the so-called 'tubercular' growths, may also be met with, though more rarely than in the cerebrum, springing from the spinal pia mater, and more or less imbedding themselves in the substance of the spinal cord.

(c) *Syphilomata.*—Syphilitic growths are also decidedly less frequent in connection with the spinal than with the cerebral meninges. Small tumours may, however, spring either from the dura mater or from the arachnoid and pia mater. Or, instead of well-defined tumours, there may be thickenings of the membranes in some part of their extent, and adhesions between one another and the surface of the cord, by means of opaque, yellowish-white, gummatous growths.

(d) *Sarcomata.*—Sarcomatous tumours of all kinds may be met with in connection with the spinal meninges, springing occasionally from the dura mater, but more commonly from the arachnoid and pia mater. Instead of being distinctly circumscribed, such growths may exist in the form of diffuse infiltrations, invading the pia mater all round the cord for a variable extent. In one remarkable case the writer met with a growth of this kind involving the pia mater throughout the whole length of the spinal cord, which was most developed on its lateral and posterior aspects. Here in some places the layer of new growth was about one-third of an inch in depth, and the cord was notably compressed in its postero-lateral aspects (*Lancet*, June 26, 1880, p. 988).

(e) *Myxomata.*—Myxomata are met with in the form of small circumscribed tumours, springing mostly from the pia mater. The writer has seen one about the size of a very large almond situated on, and greatly compressing, the posterior columns of the cord. Its presence was associated with very obscure and ill-defined symptoms during life.

(f) *Tubercle.*—Tubercles in the form of 'grey granulations' have already been referred to in the description of Spinal Leptomeningitis.

(g) *Fibromata*, (h) *Lipomata*, and (i) *Enchondromata.*—These various kinds of new-growth have been met with occasionally, but principally in connection with the outer aspect of the dura mater.

(k) *Osteomata.*—These formations are here of no clinical significance, though they are much more common in persons of all ages on the spinal than on the cerebral meninges. They are apt to occur in the form of small bony plates scattered over the surface of the arachnoid. Sometimes a limited 'ossification' of the dura mater is also met with.

B. **Adventitious Products.**—*Parasites* The same two kinds of parasites may be found in connection with the spinal meninges as we have already had to refer to in connection with those of the cerebrum—namely, the small and often numerous *cysticerci*, as well as the more solitary and larger *hydatids*. The latter may be found within the dura mater, but they have been met with much more frequently outside this membrane, often forming large tumours contiguous to the spinal canal. These are the only adventitious products of any importance which occur in, or in relation with, the spinal meninges.

PROGNOSIS.—As a class these affections are grave, tending to produce, with some exceptions, various irregular forms of paralysis, and ultimately death, though this latter may take place only after the expiration of two, three, or more years. The symptoms produced by tumours and parasites, as a rule, go on increasing in severity; and the gravity of the prognosis will depend much upon their rapidity of growth, as evidenced by the increase of signs of severe compression of the cord or of its nerve-roots, in connexion with the state of other organs. The supervention of obstinate bed-sores, and paralysis with inflammation of the bladder, may at last greatly hasten the fatal termination.

TREATMENT.—In the treatment of tumours or parasites within the spinal canal, our efforts must be in the main directed to restoring or improving the general health of the patient, and to combating the more urgent symptoms that may arise—such as pain, spasms, paralysis, sleeplessness, bed-sores, and cystitis. Where, however, we have to deal with growths of syphilitic origin, we can attack the disease itself by means of drugs. Under the influence of small doses of mercury and increasing doses of iodide of potassium, the patient's condition may often be marvellously improved, though the relief is perhaps not so striking as in cases where syphilis affects the cerebral meninges, because in this latter disease the symptoms are more varied in nature, and more dependent upon added functional complications.

H. CHARLTON BASTIAN.

MENINGOCELE.—*See* BRAIN, Malformations of; and SKULL, Diseases of.

MENINGO-CEREBRITIS.—A name given to a pathological condition in which inflammation of the pia mater extends in some regions of the cerebrum so as to implicate the subjacent cortical substance. The fact of such an extension is much less capable of being diagnosed during life than of being discovered after death, but it may then be recognised by the existence of superficial softening of the brain-substance, together with a more or less marked increase of vascularity. This condition probably always exists to a certain extent in meningitis, and might reveal itself on careful microscopical examination—although the inflammatory changes may not have advanced far enough to produce an easily appreciable amount of softening.

MENINGO-MYELITIS is a term used to indicate a condition in which inflammation of the spinal meninges has extended to the surface of the spinal cord. The evidence of such an extension has usually been supposed to depend upon the existence of an appreciable amount of superficial softening. But minor changes of an inflammatory type, capable of recognition by the microscope, may also here exist with frequency, as F. Schultze has shown, although they may fall short of entailing actual softening.

MENOPAUSE (μηνὲς, the menses, and παῦσις, a cessation).—The natural cessation of the menstrual flow, or 'change of life' in the female. *See* Change of Life.

MENORRHAGIA (μὴν, a month, and ῥήγνυμι, I burst forth).—Over-abundant menstruation, whether due to excessive quantity, or to undue frequency. *See* Menses or Menstruation, Disorders of.

MENSES or MENSTRUATION, Disorders of.—Synon.: Fr. *Troubles de la Menstruation*; Ger. *Störungen des Monatsflusses*; *Störungen der Menstruation.*

Menstruation is the periodic discharge of a sanguineous fluid from the female generative organs. The discharge continues each time for from three to eight days. It varies in quantity in different subjects. The estimation of this is surrounded by great difficulties; usually, however, the quantity is from four to six or eight ounces. It takes place monthly; that is, a period of twenty-eight days intervenes from the appearance of one flow to the appearance of the next following. In many cases, however, this interval is less than twenty-eight, and may be as short as twenty-one days; on the other hand, it may be prolonged to thirty-one days, and the function be still performed normally. The discharge does not appear during childhood or old age. It usually appears for the first time between the twelfth and fifteenth years, and for the last time between the forty-third and forty-eighth; but it may appear as early as the ninth, and continue to appear regularly afterwards up to the fifty-third or fifty-fifth year. The function is suspended during pregnancy, and, as a rule, during lactation. The source of the discharge is the body of the uterus. It is not due to a congestion or an erection of that organ, as has been supposed, but to the degeneration, disintegration, and removal of the so-called mucous membrane of the uterus—the decidua menstrualis. In consequence of this degeneration and disintegration, the vessels on the inner surface of the uterus are opened, and hæmorrhage follows. The ultimate cause of the discharge is said to be the separation of ova; such, however, is not the case in every instance, for menstruation may take place without the discharge of an ovum, and, on the other hand, ova may be separated from the ovary without the occurrence of menstruation. It can hardly be doubted, however, that the function is in some manner dependent on the ovaries, for when the latter have been removed menstruation ceases.

The fluid is not in all cases sanguineous; indeed its bloody character may be regarded as accidental, though present in the infinite majority of cases. It may, however, be easily understood that the disintegration and removal of the 'decidua menstrualis,' which is the essential factor in menstruation, may be effected without the occurrence of hæmorrhage, and there is reason to believe that in so-called 'white menstruation' such is the case.

For the due performance of the function two conditions are essential, namely, sound general health, and normally developed organs of generation. Disorders of the menstrual process may be brought about by very many conditions. These disorders are generally divided into:—

I. **Amenorrhœa**, where the discharge is absent, or deficient in quantity.

II. **Dysmenorrhœa**, where the function is performed with difficulty and pain.

III. **Menorrhagia**, where the discharge is profuse.

I. **Amenorrhœa.**—Synon.: Fr. *Aménorrhée*; Ger. *Amenorrhoë.*

Ætiology and Symptoms.—Amenorrhœa is dependent either on *general* states; or on *local* pathological conditions—that is, on lesions of the uterus and ovaries.

1. All conditions or influences which tend to deteriorate the blood, or which act unfavourably on nutrition, may be causes of amenorrhœa. The most common of these is the demand made on the system in the development of the aptitude for conception, the growth and separation of ova, and the performance of the menstrual function. At this time the breasts develop, the ovaries and uterus enlarge, the pelvis grows, and the whole form becomes altered. Many women who during childhood have enjoyed apparently perfect health, as they approach puberty become gradually or suddenly anæmic or chlorotic, without any assignable cause other than the demand made on nutrition by the process of development through which they at the time pass. Nutrition becomes impaired, tastes perverted, pains of a neuralgic character are felt in various parts of the body, the menstrual discharge does not appear, or it may appear once scantily, and then at irregular intervals, or it may disappear for months or even years. All the symptoms of anæmia are present, and the patient is languid, listless, lacks energy, and is in more or less constant suffering. The above may take place in cases where the surroundings may be favourable to healthy development. Hygienic conditions, however, play a most important part in the proper development of the female functions, and when the surroundings are unfavourable, evil is sure to follow. Want of food, or improper food, want of fresh air, impure air, want of exercise, foul gases, malaria, are prolific causes of failure or imperfection in the growth and development of the young girl, and are common causes of amenorrhœa. Disease also is a by no means infrequent cause of the condition under consideration, as phthisis, Bright's disease, diseases of the liver, stomach, and nervous system. Emotion, fright, or grief, change of air and food (as when girls go from the country to London), and cold, may arrest or suspend the monthly discharge.

2. But amenorrhœa may be due to local conditions. These are absence or disease of the ovaries, of the uterus, or of both; and imperfect development of one or both organs.

In cases where the ovaries are absent, the change in form, from girl to woman, which takes place at puberty, does not occur. The girl grows but does not develop. A masculine appearance supervenes, the breasts remain small, the pelvis narrow, the voice becomes manly and harsh, a beard may grow on the face, sexual passion is absent, and the health remains good.

When the uterus alone is wanting, there may be no indication of the condition in the state of the general health or development, and local examination is necessary in order to detect the circumstance. In these cases the vagina terminates in a *cul de sac*, and the uterus cannot be felt on examination. On introducing a finger into the rectum and a sound into the bladder, it is found that the two organs are in contact, and that there is no uterus between them. There are, however, as a rule, one or two small fibrous masses representing the uterus.

Certain diseases, as scrofulous abscess and atrophy, which involve the whole substance of the ovaries, and also atrophy of the womb, may cause amenorrhœa.

Amenorrhœa from retention.—In these cases the sanguineous discharge is separated, but does not appear externally, owing to atresia of the genital canal. The closure may occur at any point between the os uteri and the vaginal orifice. A membrane may close the os tincæ; the hymen may be imperforate; the vagina may be absent, or its walls may be adherent at any part of its course, or along the whole of it. The occlusion may be congenital, or may arise from inflammation during childhood, or after severe labours. In these cases the menstrual molimina are periodically present, but the catamenia do not appear. The molimina increase in severity from month to month; the patient has pain in the back, a sense of weight in the pelvis, and becomes pale and sallow; the abdomen after a time begins to enlarge, and continues to increase. On examination a tumour having the shape of the enlarged uterus may be felt rising from the pelvis. It is smooth, elastic, and dull on percussion. If the condition be not discovered, the distension of the uterus may go on to rupture, or its contents may pass along the Fallopian tubes into the abdomen, causing peritonitis and death.

Diagnosis.—Whenever a patient suffers from amenorrhœa, pregnancy must be thought of. If this state can be excluded, the general condition must be investigated. Anæmia and its causes should be sought for. The chest, heart, and urine must be examined. If there be no general condition to account for the amenorrhœa, the practitioner must see whether the breasts and pelvis are developed, and examine the vulva and vagina for obstruction, if there be any suspicion of such a condition. Finally it may be necessary to examine the uterus and ovaries.

Treatment.—The treatment of the first form of amenorrhœa is the treatment of the general state. If there be want of constitutional vigour, change of air, exercise in the open air, mental occupation, but not severe, and nourishing diet should be advised. The stomach and bowels must be attended to; and gentle aperients and salines given if the tongue be foul; then vegetable tonics, iron, iodine, or other appropriate remedies. No efforts should be made to act especially upon the uterus, and this is particularly binding when the amenorrhœa is dependent on phthisis, Bright's disease, or such-like conditions.

The second form is often incurable. In those cases where the uterus and ovaries are absent, nothing can be done. If the uterus be present, but imperfectly developed, means should be used to promote its growth. With this view stem pessaries, galvanic pessaries, and irritants have been advised. Galvanism will probably prove a useful agent in these cases. It should be tried first externally, one pole being applied to the spine and one over the uterus and ovaries. Should this fail, one pole should be applied to the uterus direct, and the other above the pubes, and to the ovarian regions. These means, which are not free from danger, should, however, never be tried where the amenorrhœa is not associated with suffering of some kind. Indeed, amenorrhœa in many instances requires no treatment at all.

In cases of retention from atresia of the genital canal, an outlet must be made for the flow. If the hymen be imperforate it should be divided, and the fluid allowed to run out. In cases of absence of the vagina, a canal has in some instances been successfully made. In atresia of the os uteri the offending structure should be divided by the trochar or knife. These operations are accompanied by a considerable amount of danger. Patients not infrequently die after them from peritonitis or shock. It should not be forgotten, however, that it is imperative to remove the menstrual fluid retained, for unless this be accomplished death is inevitable.

II. **Dysmenorrhœa.**—Synon.: Fr. *Dysménorrhée*; Ger. *Dysmenorrhoë*.

In dysmenorrhœa, menstruation is accompanied by pain. In some women the menstrual function is performed without pain or discomfort of any kind; as a rule, however, they suffer more or less from backache, headache, languor, and lassitude during the catamenial flow. When the dull aching amounts to sharp pain, the function is performed abnormally, and the woman is said to suffer from dysmenorrhœa.

Ætiology and Symptoms.—This symptom has been referred to five different conditions, upon one or more of which it is supposed to depend, and hence there are five kinds of dysmenorrhœa recognised, namely:—

1. *Mechanical* or *obstructive*.
2. *Congestive* or *inflammatory*.
3. *Neuralgic*, *sympathetic*, or *spasmodic*.
4. *Membranous*.
5. *Ovarian*.

1. *Mechanical dysmenorrhœa.*—Mechanical dysmenorrhœa is doubtless the most common of the above forms. Indeed, it has been said that dysmenorrhœa cannot exist without obstruction to the flow of blood from the uterus. Opinions, however, differ greatly with regard to the seat of obstruction. It may exist in the vagina or in the uterus. Dr. Robert Barnes believes it to be usually situated at the os tincæ, and to be frequently accompanied by conical cervix. Dr. Marion Sims thinks its most frequent seat is the os internum uteri. Dr. Graily Hewitt refers the obstruction to flexion of the uterus in the great majority of cases. That the outer orifice of the uterus is occasionally so small as to cause ob-

struction to the catamenial flow has been proved beyond question, but there is no evidence of the great frequency of this condition. Still less evidence is found of the existence of obstruction at the inner orifice. Flexions of the uterus need be acute to present obstruction to the flow; in such cases, at the point of flexion the canal of the uterus is flattened, and its walls are not easily separated. Retroflexion is a more frequent cause of dysmenorrhœa than antiflexion, because, as a rule, the angle of flexion is more acute in the former than in the latter. It should, however, be borne in mind that a very fine channel, even a pinhole os, may suffice to permit a fatal hæmorrhage, and it is probable that a very narrow canal would prove capable of the painless passage through it of the menstrual discharge when the latter is in a healthy state—that is, when it contains neither clots of blood nor fragments of membrane. There are reasons for believing that in the great majority of cases of painful menstruation, the cause of the obstruction does not lie in the genital passage, but in the menstrual fluid itself, because the latter, instead of being a homogeneous mixture of blood, mucus, and the molecularly disintegrated decidua, contains small fragments of the inner surface of the uterus, clots, and masses of viscid mucus; and that while the orifices of the uterus would easily permit the passage of healthy menses, they do not suffice for the painless expulsion of such particles as have been enumerated.

This form of dysmenorrhœa is very common. It is frequently accompanied by inflammation or congestion of the body of the uterus, as well as by inflammation and abrasion of the lining membrane of the cervix. That these complications contribute to enhance the pain caused by the obstruction present during menstruation cannot be doubted. At the same time it should be borne in mind that the complications are probably secondary. Indeed, primary inflammation of the unimpregnated uterus is of infinite rarity; it depends on the obstruction which had been at work for years before the inflammation set in.

The symptom of this variety is pain of varying intensity; in some cases it is of a very severe character. It begins in the pelvis, and radiates to the groin, sacrum, and thighs. It is often said to be all round the pelvis or lower part of the trunk. It may come on a little before, with, or a little after the appearance of the discharge, and may cease with or soon after the same; or it may continue more or less severe, but always paroxysmal, until the end of the flow. There is often tenderness of the skin of the hypogastrium and groins; vomiting, hiccough, headache, hysteria, and even delirium may be present. The flow may be scanty or profuse, and in the former case it is often followed by an abundant yellow discharge for a few days. There may be leucorrhœa throughout the inter-menstrual interval. Micturition is often painful.

2. *Congestive or inflammatory.*—This name has been given to those cases of painful menstruation in which the uterus is enlarged, and heavier than natural. It is met with in the married and in the single; but it is probable that it never occurs as a primary affection, but is the result of obstruction, abortion, or labour. The symptoms are those of mechanical dysmenorrhœa. The state of enlargement can be diagnosed by digital examination only.

3. *Neuralgic.*—This variety at one time included a very large number of the cases of painful menstruation which came under notice; but since more efficient means have been employed for learning the condition of the uterus, the number of cases referred to this category has greatly diminished. At present it is limited to the cases of young girls, in whom it is not desirable to make a vaginal examination; and to those cases in which no pelvic lesion can be found to account for the suffering. It cannot be said that neuralgia of the uterus never exists; at the same time it is of such rarity that it should be diagnosed with the greatest hesitation.

The symptoms are similar to those of the obstructive variety.

4. *Membranous.*—In this form a membranous sac, having the shape of the cavity of the body of the uterus, is expelled with the catamenia. The sac has three orifices, corresponding to the orifices of the Fallopian tubes, and the inner orifice of the neck of the uterus. It has an internal smooth, punctated, and an external flocculent surface. Occasionally during expulsion the sac is turned inside out. It may be passed with every, or with every other, menstruation, or only occasionally. Instead of being passed in the form of a complete sac, the membrane may be broken up, and expelled as shreds of various sizes. Microscopic examination shows that the membrane possesses a structure identical with the lining of the body of the uterus. It contains glands and blood-vessels, and is, in fact, the decidua. It has been said that it is always the result of conception, but ample evidence has been published to refute this statement. As a rule the uterus is enlarged; this, however, is not always the case. The enlargement is probably a condition secondary to the dysmenorrhœa, or to previous gestation. There is commonly tenderness of the pelvic tissues around the uterus, probably of the peritoneum; ovaritis is frequently present. All these conditions are probably secondary.

Displacement of the uterus is also not an uncommon complication—an anteflexion or retroflexion: an affection of another mucous membrane may also co-exist.

The symptoms are usually very severe, the pain being most intense, of a bearing-down character, and often compared to labour-pains. It reaches its acme just before the membrane is expelled. If the membrane be passed in fragments, the pain recurs with the passage of each. The pain accompanying the expulsion may be slight, or even absent. In the latter case the uterus is large, and the os patulous. The passage of the membrane takes place often on the third day of menstruation, but may occur later; frequently shreds are passed from the first or second day at intervals to the end of the flow. With the expulsion of the membrane, there is generally a gush of blood, after which the flow proceeds normally. The catamenial discharge may be normal in amount, considerably increased, or even scanty.

The pathology of this affection is unknown. It has been said to be the result of conception. Cases of abortion may probably have been mistaken for this affection, but that it occurs independently of sexual connection is amply proved. It has also been said that it is due to inflammation; that the membrane expelled is an inflammatory exudation. The evidence in favour of this view is very scanty. Inflammation or congestion of the uterus is frequently met with in cases of membranous dysmenorrhœa, but not always. Indeed, cases of this affection occur in which no trace of inflammation of the uterus could be found either before or after death. More recently it has been stated that it is due to amyloid degeneration of the lining membrane of the uterus. If this be the fact in some cases, it certainly is not in all. It is more probably due to malnutrition, which in some cases has existed *ab initio.* It has been met with also in gouty and rheumatic subjects, but what relation it holds to these diatheses is unknown.

5. *Ovarian.*—This does not deserve the name of dysmenorrhœa, for it is not due to menstruation—that is, to the discharge of the sanguineous fluid from the uterus—but to the growth and rupture of the Graafian follicles. The Graafian follicles develop gradually, and take a long time to arrive at maturity. It is not a sudden process. It is, however, towards the end of their growth, as they approach the time of rupture, that they become painful. They usually burst some time before the appearance of the menstrual flow, but this may happen during the catamenia, or after their cessation. The pain usually comes on before the catamenia, a few days or a week, and may cease with the appearance of the menses, or several days before that event. The suffering may, however, come on at any time during the flow or during the interval. It is situated usually in the left ovarian region, for the left ovary is more frequently affected than the right. The pain extends down the thighs, and to the sacro-iliac joint of the same side. Not infrequently the corresponding kidney is tender. Pain may occur in the left and right side at alternate periods, or a period may pass without pain. Vomiting and hysteria are often present. There is superficial and deep tenderness over the painful part. Patients often say that they have a swelling in the side, and on examination a diffused fulness is found in the ovarian region, which is tympanitic, and due evidently to local distension of the intestine by gas. Examination *per vaginam* and *per rectum* will often detect a small tumour, tender, movable in the early periods, later on fixed, on the side affected, and a little behind the uterus. Pressure on the tumour calls forth severe pain and a feeling of sickness. Later on the uterus becomes less movable, and drawn to the affected side. This is doubtless due to contraction of inflammatory products, and not to distension of the broad ligaments, for it occurs in long standing cases only. Micturition is frequent and painful.

The pathological lesion is inflammation of the Graafian follicles, of the stroma, or surfaces of the ovary, extending to the neighbouring tissues. This, again, is rarely primary. In women who have had children, it is often due to parturition and abortion. In the unmarried it is the result of long-standing dysmenorrhœa. In the latter cases true dysmenorrhœa is always primary, and ovaritis secondary. It may, however, be the result of exposure to cold during menstruation.

Many diseases of the uterus, as fibroid tumours, polypi, cancer, &c., cause dysmenorrhœa.

TREATMENT.—Dysmenorrhœa is often very obstinate under treatment, and its course is very protracted. In many cases much may be done by attention to the general health, and to the stomach, liver, and bowels.

During an attack rest in bed should be enjoined, and hot baths, anodynes—opium, morphia, chloral, or chloroform—be administered for the relief of the pain. Saline aperients, iron, arsenic, and bismuth, are of service during the intervals. If there be a gouty or rheumatic tendency, this must be treated. But recourse must be had in the great majority of cases to local treatment, and the plan adopted will depend much on the view taken, not of the individual case, but of dysmenorrhœa generally. Should displacement be found, it should be corrected. Frequently, however, when this has been accomplished, the suffering continues. Clots are commonly found in the discharge, and the cervical canal is not capacious enough to permit their passage. In these cases the channel must be enlarged. This may be done in several ways:—

1. By graduated bougies, similar to those in use for dilating stricture of the urethra. One or more of them are passed at intervals of several days, until the necessary dilatation has been accomplished.

2. A dilator, such as Priestley's or Ellinger's, may be introduced into the uterus, and the orifices forcibly and suddenly dilated.

3. Tents of compressed sponge, or of *laminaria digitata*, may be passed into the canal, and allowed to remain there for six or ten hours, until it has been well dilated.

These means, however, are unsatisfactory, for the orifices regain their original state—the dilatation is not permanent. To obviate this contraction, recourse has been had to incision of the supposed contracted part. The best method is that first proposed by Dr. Marion Sims, that is, the division of the external orifice by scissors, and of the internal, if necessary, by means of a blunt pointed knife. The operation is performed as follows:—

The patient is placed on a table on the left side, with the knees drawn up. Sims's duck-bill speculum is introduced, so as to bring the cervix uteri to view. It is then given to an assistant to maintain it in position. The cervix is fixed by a sharp hook, and the lips of the uterus divided laterally by scissors. Sims's knife is then introduced through the inner orifice, and as it is withdrawn is made to incise the *os internum* as well as the angle of the wound made by the scissors near the same orifice; the knife is again introduced, and the opposite side incised in a similar manner. Marion Sims recommends incision of the inner and outer orifices; Dr. Robert Barnes the outer orifice only. When the cutting is completed, a strip of lint, moistened in a solution of perchloride of iron in glycerine, should be introduced into the wound, and a plug of lint into the vagina, and the patient put to bed. The hæmorrhage accompanying the operation is usually slight; sometimes, however, it is profuse, but it can generally be controlled by pressure made against the cervix fixed by a sharp hook, by means of sponge probangs. Rest in bed for one week should be enjoined. The vaginal plug should be renewed every day until the third or fourth day, when the intra-cervical dressing may be removed. The sound should then be introduced daily, to prevent union of the edges of the wound, or an intra-uterine stem may be worn with a similar object. Instruments called hysterotomes have been invented for incising the orifices of the uterus. They are single or double-bladed. The blade or blades are concealed in a sheath during their introduction into the uterus; when this has been done, the blade or blades are made to spring out and incise the cervix as the instrument is withdrawn. The operation is better performed by knife or scissors.

III. **Menorrhagia, and Metrorrhagia.**—Synon.: Vulg. Flooding; Fr. *Ménorrhagie*; *Métrorrhagie*; Ger. *Mutterblutfluss.*

The former term is used to denote profuse menstruation; the latter, hæmorrhage from the uterus at any other time than the catamenial epoch. The two symptoms are frequently met with. Menorrhagia often exists alone. When metrorrhagia is present during menstrual life, the catamenia are, as a rule, also profuse. These hæmorrhages may be called forth by many lesions. Indeed, they may accompany the majority of the pathological conditions to which the pelvic organs are liable. They may also arise from general states—as scurvy, the hæmorrhagic diathesis, Bright's disease, phthisis, cirrhosis of the liver, and the acute specific diseases. The most common cases are, however, met with in the form of distinct alterations of structure in the pelvic organs, as sub-involution of the uterus, polypus, fibroid tumour, cancer, displacements, retained portions of placenta, moles—fleshy or vesicular, fungous degeneration of the mucous membrane of the uterus, mucous polypi, ulcerations of the cervix, hæmatocele, inversion of the uterus, and congestion of the uterus, due to obstruction to the circulation through the heart and lungs or liver.

Profuse hæmorrhages of an irregular character occur also in young girls before the advent of regular menstruation. This form of uterine hæmorrhage is not common, but it is sometimes of very serious import, for occasionally it has proved fatal. More frequent is the occurrence of irregular bleeding from the uterus during the menopause. The causes of these climacteric hæmorrhages are really not known. They have been said to be due to congestion, but on insufficient evidence.

Treatment.—The treatment of hæmorrhage from the uterus resolves itself into the immediate treatment of the attack, and the treatment of the condition leading to it. The treatment of the attack, or the means of arresting the bleeding, consists in great part in securing absolute rest. The patient should remain in bed in the recumbent position, and avoid all exertion mental and physical. At the same time, internal remedies which tend to check hæmorrhage should be given. Of these, those most commonly used are ergot of rye, gallic acid, the mineral acids, and acetate of lead. Mineral acids, in combination with sulphate of magnesia or soda, often act well. Should acetate of lead be administered, the patient should be carefully watched, as some persons are very sensitive to the action of the drug, and manifest symptoms of acute lead-poisoning after the administration of a small quantity of it. Should these means fail, recourse should be had to plugging the vagina or uterus. The vagina is plugged in the following manner:—The patient is placed on her left side and a speculum is introduced, and the canal is firmly packed with pledgets of cotton-wool or strips of lint, tied on a string for convenience of removal. This will arrest the hæmorrhage for a time, but it can only prove a temporary expedient. The plug is liable to become extremely offensive, from decomposition of blood and of the secretions in the vagina, and should consequently be changed every eight or twelve hours. A more efficient means of arresting hæmorrhage is plugging the uterus itself. This is done by means of tents of sponge or laminaria, and with a twofold object. The first object is the immediate arrest of the bleeding; but the chief object usually is to dilate the canal of the uterus so as to permit its exploration by the finger, and the discovery of the cause of the bleeding. This means will not only check the bleeding temporarily, but will in many cases effect a permanent cure. To facilitate the introduction of a tent a Sims's speculum should be used, and the cervix of the uterus should be fixed by a sharp hook. In many cases, however, tents will not be necessary. The hæmorrhage will be controlled by the other means enumerated, or the cause of the hæmorrhage will be made out without the use of tents. In all cases, however, in which the hæmorrhage is uncontrollable, or so profuse as to threaten life, or in which the cause of the bleeding is obscure, tents should be had recourse to, both to check the flow and complete the diagnosis. When the cause has been discovered, it should, if possible, be removed.

But even after the uterine canal has been dilated no definite cause may be found for the bleeding. In these cases, styptics, or even caustics, may be applied to the inner surface of the organ. Those chiefly used are nitric acid, chromic acid, carbolic acid, a solution of iodine, or a solution of perchloride of iron. These are best applied through a uterine speculum of platinum or vulcanite, on a probe of similar material. While using these means it should be borne in mind that internal uterine medication is not free from grave danger.

The remainder of the treatment of menorrhagia consists in attention to the general state.

MENSURATION (*mensura*, a measure).—A synonym for measurement. *See* Measurement; and Physical Examination.

MENTAGRA (*mentum*, the chin, and ἄγρα, an attack).—A name for affections of the chin, more general than *sycosis*, and therefore sometimes convenient. *See* SKIN, Diseases of; and SYCOSIS.

MENTAGROPHYTON (*mentagra*, and φυτόν, a plant).—The fungus-plant of mentagra, in reality a trichophyton, discovered by Gruby in the hair-follicles and hair in sycosis. *See* EPIPHYTIC SKIN-DISEASES; SYCOSIS; and TINEA.

MENTAL DISORDERS. *See* INSANITY.

MENTIGO. *See* MENTAGRA.

MENTONE, on extreme east of French Riviera.—Moderately warm, bracing, sheltered, and dry winter climate. Mean temperature in winter, 48° Fahr. Winds: E. SE., and NW. Soil, sandstone. *See* CLIMATE, Treatment of Disease by.

MERCURY, Diseases arising from.—SYNON.: Fr. *Hydrargyrie*; *Intoxication mercurielle*; Ger. *Quecksilbervergiftung*.

Though considerable discrepancies of opinion have existed as to the poisonous or innocent properties of the metal mercury itself when swallowed, there can be no doubt as to the poisonous character of its soluble and volatile compounds, nor even as to the insidious nature of the vapours of metallic mercury. Metallic mercury has occasionally been administered in enormous quantities without producing any decided physiological effects; whilst in other instances, salivation and other specific effects have resulted. These differences are doubtless due to the fact, that in those cases where effects have resulted from the administration, oxidation and solution of a portion of the metal had taken place.

Mercurial poisoning may be either (A) acute, or (B) chronic; the former resulting from the administration of one or several large doses at short intervals, the latter form of mercurialism arising from the repeated exhibition of small doses of the less active preparations of the metal. There is also a peculiar form of mercurialism, which is the effect of the inhalation of the vapours, either of the metal or of its volatile compounds, and is characterised by paralysis.

A. Acute mercurial poisoning.—DESCRIPTION.—The effects produced by a considerable dose, say a drachm, of one of the more soluble compounds of mercury, such as corrosive sublimate, or the nitrate, are those of a corrosive and irritant poison. The effects are immediate. In the act of swallowing an intense burning sensation is experienced in the mouth and throat, followed by excruciating pain in the stomach, and extending to the abdomen. The local effects of the poison are frequently visible, as a whitening of the tongue and fauces. There is vomiting, tenesmus, and purging, often of a bloody character. Colic and great tenderness and swelling of the abdomen, are also symptomatic. Not unfrequently there is suppression of the urine. The gustatory sensation is perverted; there is dryness of the mouth; and a brassy or metallic taste is generally experienced after the first local corrosive action of the poison has somewhat abated. The countenance is anxious; the skin is pale, cold, and clammy; and the pulse is small, weak, and rapid. Salivation may supervene, accompanied by fœtor of the breath. Should recovery not take place, death may occur within a few hours, or may be delayed for one or more days; or the patient may more rarely succumb to some of the ordinary sequelæ of corrosive poisoning. When death supervenes speedily after the administration of the poison, the fatal result is usually due to collapse.

Most of the effects of acute mercurial poisoning may result from the application of a concentrated solution of corrosive sublimate to the unbroken skin.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances seen after acute mercurial poisoning are inflammation, and even erosion of the mucous membrane of the stomach, and extravasation of blood beneath this membrane. Ulceration is rare. The intestinal tract also exhibits signs of extensive inflammation, and this has been noticed especially in the large intestine. The rectum is usually much inflamed, and its surface covered with shreds of bloody mucus. A peculiar slaty appearance of the mucous membrane of the stomach and intestines, where not highly inflamed, has been thought to be characteristic of corrosive sublimate poisoning.

DIAGNOSIS.—Though the symptoms of poisoning by corrosive sublimate, and other corrosive preparations of mercury, greatly resemble those produced by arsenic, the diagnosis is generally not difficult. The effects following almost immediately on administration, the metallic taste in the mouth, and the greater frequency of bloody stools in mercurial poisoning, serve to differentiate between the poisons. Where doubt exists, an analysis of the secretions may be made; arsenic is most readily detected in the urine, and mercury in the saliva. The existence of salivation and fœtor of the breath—though not always present—may also be valuable aids in completing the diagnosis.

TREATMENT.—In acute poisoning by corrosive sublimate, the best antidote is albumen, or the albuminoids in any soluble form. The white of one or more eggs should be beaten up with water, and swallowed as quickly as possible. Failing an egg, flour made into a thin paste may be administered. Albumen combines directly with corrosive sublimate to form an insoluble compound. On account of the powerful local action of the poison on the stomach, the use of the stomach-pump is not advisable; but if the vomiting be not free, emetics of as simple character as possible may be administered. The rest of the treatment consists in alleviating pain by means of opiates, and the general treatment applicable for irritant poisons. Thirst must be alleviated by demulcent drinks. For this purpose milk, mixed with once or twice its bulk of lime-water, is excellent; the casein of the milk and the lime both tending to render the mercury insoluble, and so to act as antidotes.

B. Chronic mercurial poisoning. SYNON.: Mercurialism.

DESCRIPTION.—The repeated ingestion of small doses of the more soluble and active preparations of mercury, such as the bichloride and the bicyanide, may give rise to chronic symptoms; but these more frequently result from the administration of one or more doses of the more insoluble preparations of the metal, such as calomel or the oxides. When chronic symptoms follow the administration of one dose of a mercurial preparation, this is not altogether due to the peculiar idiosyncrasy of the patient, but is attributable in no small degree to the slowness with which mercury is eliminated from the system. There appears also to be a remarkable difference, not altogether dependent upon their differing solubilities, between *mercuric* or persalts, and *mercurous* or proto-salts, in respect to their toxic properties. Mercuric compounds are greatly more potent than mercurous salts. By far the most common result of the continued administration of mercury compounds is salivation. This consists in a profuse discharge from the salivary glands; swelling and tenderness of the gums; and fœtor of the breath. In children, and more rarely in adults, salivation may pass into sloughing and gangrene of the cheeks; and a fatal result may ensue. Other symptoms are nausea, colicky pains, depression, and those nervous symptoms to which the term 'mercurial palsy' has been applied; but this last group of symptoms, which is most commonly met with after inhalation of the vapours of mercury, must be described more in detail.

Mercurial Paralysis.—Workers in mercury, such as water-gilders, looking-glass makers, and the makers of barometers and thermometers, are apt to suffer from a peculiar form of shaking palsy, known either as 'the trembles,' mercurial tremors or metallic tremors, and *tremblement métallique* by the French. This disease affects those who handle the oxides of the metal, but more frequently those who are exposed to mercurial fumes. Mercury exhibits a small vapour-tension, and consequently is vapourisable at all ordinary temperatures, but the tension of its vapour below 60° Fahr. is very small. The metallic tremors may come on suddenly or gradually, and they may be unaccompanied with salivation. The upper limbs are first affected, and then by degrees the whole muscular system. The patient is affected with tremors when an endeavour is made to exert the muscles, so that he is unable to guide, for instance, a glass of water steadily to the lips; he cannot put his feet steadily to the ground; and when he tries to walk he breaks into a dancing trot. The muscles of mastication and deglutition are affected in advanced cases. Delirium, mania, and idiocy have occasionally followed the continued inhalation of mercury fumes.

Diagnosis.—The diagnosis of mercurial tremors is usually not difficult. It must be admitted, however, that in some cases the tremors produced by mercury are in no way distinguishable from those due to the now well-recognised disease known as disseminated, multiple, or insular sclerosis. The former are less readily confounded with ordinary shaking palsy (paralysis agitans) and the convulsive movements of chorea. The history of exposure to mercury will seldom be absent. In paralysis agitans the tremors occur when the patient is at rest; and the peculiar forward gait, as if the patient were endeavouring to pass from a walking to a running pace, is characteristic. The metallic tremors come on only when the muscles are exerted, and usually they entirely cease when the patient is lying at rest, or is asleep. The same may be said of the tremors of disseminated sclerosis; but here we have the peculiar consensual rotation of the eyes known as nystagmus. In paralysis agitans, when told to raise the affected hand, or to protrude the tongue, the patient performs both actions steadily. In mercurial tremors, and in disseminated sclerosis, the case is different—the tongue when voluntarily protruded is tremulous, and the patient cannot raise his hand when requested to do so, without shaking. In both mercurial tremors and the tremors of insular sclerosis, the muscular agitation ceases for the most part during sleep. In one form of metallic tremors the movements approach in character the convulsive movements of chorea.

Treatment.—In chronic mercurial poisoning, it is obvious that the patient must at once be removed from the further influence of the metal. Masks worn over the mouth are not of much use. In mercurial tremors cessation from working with the metal, and mild tonics of iron, usually suffice for the speedy restoration to health; but the shaking occasionally persists throughout life. For salivation and the more formidable gangrene of the mouth, besides cessation of the administration of the metal, and the exhibition of tonics, iodide of potassium may be given. Astringent gargles and active local treatment may perhaps be necessary.

Thomas Stevenson.

MESENTERIC GLANDS, Diseases of. Of the lacteal glands, which lie in the folds of the peritoneum connected with the intestines, the mesenteric—which are connected with the small intestines—may be ranked as the most important, and what is described with regard to these will apply to the rest of the lacteal glands. They are all really of the same nature as the lymphatic glands, and are subject to similar diseases. The statements made, therefore, with reference to these structures, will also apply in the main to the lacteal glands (*see* Lymphatic System, Diseases of); but the latter are likewise liable to certain special morbid changes, whilst these changes present some peculiarities as regards their effects and symptoms. Thus, when the lacteal glands are diseased, the general nutrition tends to be markedly impaired, owing to the interference with the transmission and due elaboration of the chyle, and if they are extensively involved the entire system suffers gravely. Owing to their situation and anatomical relations, these glands, in certain forms of disease, may originate secondary effects of considerable importance. For instance, peritonitis may be excited by their irritation or rupture; or by their pressure on vessels or other structures, ascites and other conditions more or less serious may result. The enlarged mesenteric glands may be felt, in certain diseases, through the abdominal walls. With these preliminary remarks, the particular diseases of the mesenteric glands will now be considered, so far as they may require special comment.

1. Acute Congestion and Inflammation. The lacteal glands are very liable to become more or less congested or inflamed in connection with any inflammatory condition affecting the intestinal canal. The situation and number of glands implicated will correspond mainly with the portion of bowel involved. They become enlarged, but the changes are seldom such as to give rise to any evident symptoms, and they subside as the cause of the irritation ceases to operate. In rare instances the inflammatory process may go on to suppuration, and then there is great danger of serious consequences; in one case which came under the writer's notice, fatal peritonitis appeared to have been set up by the irritation of a suppurating mesenteric gland.

Attention may be directed here to the changes which occur in the lacteal glands in certain special acute diseases, namely, typhoid fever and dysentery. In typhoid fever the mesenteric glands are usually involved, corresponding with the part of the small bowel affected in this disease; but if the colon is implicated the mesocolic glands also suffer. The changes in the glands cannot be looked upon as merely secondary to intestinal irritation, for they commence from the outset, and go on simultaneously with the progress of the intestinal lesions. The glands become enlarged, from a hyperplasia of their lymphatic elements, and this enlargement increases until from about the tenth to the fourteenth day of the disease. They are of a red or purplish colour, and moderately firm. On section small, opaque, pale-yellow, friable collections are sometimes seen. As a rule the glands subsequently become gradually softer, and diminish in size, resuming in favourable cases their normal condition; not uncommonly, however, they become more or less shrivelled and contracted, tough and pale, or of a grey or bluish colour, and they may even calcify. In exceptional instances the glands rapidly soften in their interior, a purulent fluid being formed, mingled with sloughs; and very rarely they have ruptured into the peritoneum, thus setting up fatal peritonitis. It cannot be demonstrated how far the implication of the absorbent glands accounts for the symptoms of typhoid fever, but it is highly probable that they have more or less influence over them.

Dysentery is another special disease in which the lacteal glands are involved, but the changes here seem to be merely the effects of irritation from the intestinal lesion. The mesocolic glands are mainly affected, but if the disease implicates the small intestines, the mesenteric also suffer. They become enlarged, red, and softened; and if the dysentery assumes a chronic form, the glands are also permanently changed.

2. Scrofulous or Tubercular Disease.—*Tabes mesenterica.*—The nature of this affection has been already discussed in relation to the absorbent glands generally (*see* LYMPHATIC SYSTEM, Diseases of), and it will suffice to indicate here the special points which require to be noticed in connection with the lacteal glands. Scrofulous or tuberculous disease of the mesenteric glands constitutes a most important disease in children and young persons. It may exist independently, but is usually associated with so-called tubercular ulceration of the intestines, to which it is then probably secondary. It is not improbable that the mesenteric disease may be primarily set up as the result of mere long-continued chronic intestinal catarrh. The patient may be evidently scrofulous or tubercular, but this is by no means constant, and there may be no signs whatever of any such diathesis. The disease may also be accompanied with pulmonary phthisis, although this is comparatively rare in children, and the lung-affection is almost always secondary. In adults, on the other hand, tuberculous disease of the lacteal glands, when it does occur, is in the large majority of cases a complication of pulmonary phthisis, intestinal ulceration being present at the same time.

The changes in the glands are similar to those characteristic of the scrofulous process in the lymphatic glands, namely, a hyperplasia of the cellular structures, of low vitality, followed by caseation, and ultimately by calcification, if the case last sufficiently long; and it is usual in fatal cases to find these conditions more or less combined in different glands. Should recovery take place, all the involved glands may be converted into inert, chalky masses, in which condition they remain permanently. A case came under the writer's notice some years ago, in which the patient having died from an independent acute illness, the mesenteric glands were found to be universally calcified, this being associated with scarring of the external glands, and other signs of past scrofulous disease, from which the patient had quite recovered; the condition of the glands was unattended with any symptoms whatever. The individual glands in mesenteric disease may attain a considerable size, and when they are agglomerated a distinct tumour is formed.

SYMPTOMS.—It is frequently impossible to recognise definitely the symptoms, either local or general, due to scrofulous disease of the mesenteric glands, as they are combined with, and masked by those resulting from intestinal ulceration and catarrh, or from the implication of other structures. The digestive organs are usually disordered, and, even if there should not be intestinal ulceration, children who suffer from mesenteric disease are very liable to enteric catarrh. Hence diarrhœa, with unhealthy stools, is a common symptom, and it is often difficult to check, or it returns from very slight causes. In other cases the bowels are constipated. Scrofulous mesenteric glands do not seem to be painful in themselves, but colicky pains in connection with the bowels are of frequent occurrence, and the diseases of the glands may have some influence in exciting these. The abdomen is almost always distended and prominent, owing to the accumulation of flatus, and it may be distinctly tympanitic. Hence, even when the glands are much enlarged, it is often impossible to feel them, but they may sometimes be made out by deep pressure with the fingers over the abdomen. In some instances the abdomen is retracted, and then the glands may be more readily felt. They may produce symptoms by their mechanical effects, and the writer has met with a case in which extreme ascites was probably due to tubercular mesenteric disease. By irritation of the peritoneum, or, in very rare instances, by the glands bursting into its cavity, peritonitis may be set up. The general symptoms are usually very prominent, as evidenced by wasting, which may reach extreme emaciation, anæmia, debility, and pyrexia, marked hectic fever ultimately supervening in some cases. How far, however, the mesenteric lesion originates these symptoms is a matter of doubt and dispute, but it is highly probable that it is in some measure accountable for them. Cases in which mesenteric glands are the seat of scrofulous disease differ much in their severity, and it may be quite impossible to make any positive diagnosis. A large number of cases prove fatal, but it must be remembered that even after severe symptoms recovery may take place, the glands becoming calcareous and harmless. When the glandular affection is secondary to pulmonary phthisis, it helps to hasten the fatal termination.

TREATMENT.—This mainly consists in the treatment required for scrofulous disease in general, such as the administration of cod-liver oil, preparations of iron, quinine, and other tonics; favourable hygienic conditions and surroundings; change of air, especially to the country or to the sea-side; and other appropriate measures. The diet needs particularly careful attention. It should be nutritious and digestible, but has often to be modified so as to render it suitable for the condition of the alimentary canal. Remedies directed to the improvement of the state of this canal, or to the relief of symptoms connected with it, are also often required. No local application can possibly have any effect upon scrofulous mesenteric glands; but symptoms might be benefited by friction with some liniment, the application of a flannel bandage, or the use of dry heat, fomentations, or poultices in connection with the abdomen, should occasion call for them. Any secondary morbid conditions which may arise must be attended to. In the case already alluded to, paracentesis was urgently demanded, on account of extreme ascites; the fluid re-accumulated almost to the same amount, but it afterwards gradually disappeared entirely by absorption, and the patient recovered.

3. **Hypertrophy.**—It will merely be needful to remark under this head that the lacteal glands are liable to be more or less hypertrophied in cases of lymphadenoma, and in the form of leucocythæmia attended with glandular enlargement. The writer has met with instances where the growth was very considerable. They might possibly be detected during life by physical examination, or they might cause symptoms by their mechanical effects; but, as a rule, their existence is only ascertained at the *post-mortem* examination.

4. **Atrophy and Degeneration.**—The mesenteric glands atrophy in old age, and they may also become wasted and withered after previous disease, such as typhoid fever. The caseous and calcareous changes which they undergo in connection with scrofulous disease have been already indicated. It may happen that atrophic or degenerative changes in these glands affect the general condition; but it is certain that they may be extensively calcified, and yet the patient remain apparently in excellent health.

5. **Morbid Formations.**—The mesenteric glands may be the seat of *albuminoid* disease. It is said that they can then be felt through the abdominal walls, firm, distinct, and easily moveable; but this is by no means always the case. *Cancer* is chiefly met with as a secondary deposit, the lacteal glands being particularly liable to become affected if the intestine is the seat of malignant disease, and the localisation being determined by that of the intestinal lesion. It may occur, however, as a primary affection. The cancer is usually of the softer variety, but it will depend to some extent on the nature of any primary deposit. A considerable tumour may be formed, firm and nodulated; or the glands may remain separate. Physical examination often reveals the presence of the disease; and this, together with localised pain, and symptoms due to pressure, should any such be present, as well as signs of the cancerous cachexia, or of the implication of other organs, especially the intestines, constitute the clinical phenomena associated with malignant disease of the lacteal glands. No treatment can be of any service. FREDERICK T. ROBERTS.

MESENTERY, Diseases of. *See* PERITONEUM, Diseases of.

MESMERISM.—DEFINITION.—The name of the process by which, rather more than a century ago, Anthony Mesmer, the deluded (or at all events the deluding) promulgator of the doctrine of 'animal magnetism,' induced the so-called mesmeric trance or sleep. *See* MAGNETISM, ANIMAL.

This mesmeric trance is identical with the condition now known as 'induced somnambulism,' or still more commonly as 'hypnotism' or the 'hypnotic state.' The condition itself is one which presents to the observer many highly interesting phenomena, and it, together with the means of inducing it, were first investigated in a full and scientific manner by James Braid of Manchester (1843).

In this place it is not intended to speak of the subject from its old point of view. The reader who desires to gain some notion of the errors, deceptions, and vain pretensions with which the whole subject was enveloped by those who have been content to style themselves 'mesmerists,' may with advantage consult the article on 'Mesmérisme,' by Deschambre (*Dict. Ency. des Sc. Méd.*, tome vii.), at the close of which they will also find a valuable bibliography. Here the proceedings of Mesmer and his followers in France are fully exposed.

As a sort of transition between this old state of things, with its erroneous theory and vain pretensions, and the scientific standpoint taken by Braid in regard to the more correct limitation of the phenomena observable and their altogether intrinsic mode of production, came the observations of Elliotson in London, as conducted in the years 1837–38, when he sought to inform himself and others as to the phenomena and curative virtues of mesmerism. He encountered a storm of opposition, principally on account of his mode of dealing with the subject. He was unquestionably honest and enthusiastic in his search for what he believed to be truth; but he unfortunately did not, as Braid by his keener insight was enabled to do, reject and otherwise explain the so-called phenomena of clairvoyance, of transposition of the senses, and of prediction or prophecy. It is to be regretted, however, that Braid did not also reject all the so-called phenomena of phreno-hypnotism.

An independent practical study of the subject and of its therapeutic applications was shortly after the date of Braid's labours commenced by Esdaile in India (1846), as well as by J. K. Mitchell in the United States. They have more recently been succeeded by other investigators, amongst whom may be mentioned Girard Teulon and Demarquay (1860); Ch. Richet (1875); Charcot (1878); and also Weinhold, Beard, Preyer, Berger, Grützner, and Heidenhain (1880).

The induction of the hypnotic state or sleep has hitherto been possible in only a certain, but variable percentage of the persons with whom trial has been made, though a successful result has been much more frequent with women than with men. According to Richet, however, the operator should not be discouraged by the failure of his first attempts with the same person; as persons may succumb on the fourth or fifth trial, and subsequently prove thoroughly good subjects for experimentation. Persons who have once been hypnotised can in general be again brought with comparative ease into the same condition, and the facility of hypnotising such persons goes on increasing after each operation, owing to the existence of a predisposing mental state. A condition of excited expectancy is indeed a decidedly favouring mental state, though one which is not essential, since, according to Braid, Heidenhain, and others, even male adults who have heard nothing on the subject, and do not know for what purpose they are being experimented with, can often be hypnotised.

In persons who are favourably disposed for passing into the hypnotic state, the condition is easily induced by weak, long-continued, and uniform stimulation, either of the nerves of sight, of touch, or of hearing. This state is, on the contrary, almost always easily capable of being abruptly terminated by some strong or suddenly varying stimulation of the same nerves.

Many of the lower animals, such as frogs and fowls, can be thrown into an extremely similar condition as a result of certain sudden and powerful sensorial impressions. Preyer distinguishes the state into which they are thrown by a different name, namely, 'cataplexy,' because the mode, or physiological process, by which it is induced, seems to be different from that by which hypnotism is caused.

The hypnotic state or sleep is one which varies much in intensity in different persons, or in the same person at different times. The principal phenomena that are exhibited or which can be detected in hypnotized persons are the following:—(1) Imitation movements; (2) Exaltations of special sense; (3) Illusions and hallucinations; (4) Analgesia, general or unilateral, or even a condition of hemianæsthesia, general and special; (5) Increased reflex irritability and tonic spasms of the voluntary muscles; and (6) Other miscellaneous phenomena, such as spasm of the accommodation apparatus in the eye, dilatation of the pupils, increased rapidity of respiration and of the pulse, together with profuse perspiration.

A discussion of the mode of production of these several phenomena, or of the nature of the hypnotic condition itself, would lead us into details too purely physiological for our present purpose—suffice it to say that the hypnotic state, in one or other of its stages, seems to be akin to that met with in some sleeping persons, as well as to the states known as somnambulism and catalepsy, and that its physiological cause is presumed by Heidenhain to be some inhibitory arrest of activity of the ganglion-cells of the cerebral cortex, or, as the writer would rather put it, of certain tracts of these ganglion-cells. (See *Animal Magnetism: Physiological Observations*, by R. Heidenhain, 1880.)

The scientific study of the phenomena presented by hypnotized persons is unquestionably of great interest and importance, from the point of view of the higher cerebral physiology. But whether the systematic induction of such a state can ever be used as a legitimate or potent means for curing disease, or even for the alleviation of certain distressing symptoms, must be left for the future to decide. The good use to which it was put by Esdaile in India, as a means of inducing insensibility during surgical operations before the general introduction of chloroform, ought, however, never to be forgotten. (See his *Mesmerism in India, and its Practical Application in Surgery and Medicine.*) The whole subject is one of great interest for the practitioner of medicine, now that the absurd theories have been got rid of. We must be careful, however, to pursue the study of the condition itself in a strictly scientific manner, and watch lest the too-ready adoption of hypnosis or Braidism as a curative agent may do harm rather than good—and that not to the patient only, but also to the practitioner. The statements of the results obtained by Braid (see his *Neurypnology*, 1843) are little less than marvellous; and there can be no doubt that the therapeutic uses of hypnotism ought to receive a new and thorough investigation by some instructed and well-trained observers. The pitfalls besetting such an investigation are by no means few; but, on the other hand, the gains to the science of medicine and to therapeutics might be great. *See* BRAIDISM.

H. CHARLTON BASTIAN.

MESOLOGY (*μέσος*, a medium; and *λόγος*, a discourse).

This term, recently introduced by Bertillon, conveniently expresses the investigation of the mutual relationships existing between living beings and their surroundings.

The physiological life of any organism may be regarded as the resultant on the part of the tissues of two sets of influences—intrinsic or hereditary, and extrinsic. To the former are due those structural, and consequently functional characteristics, which are common to ancestors and progeny alike, whilst the fluctuating nature of the environment determines those variations which distinguish different species. Within certain assumed limits these stimuli are regarded as normal, and the resulting manifestations of the tissues are said to be healthy; whilst disturbances in either of these groups of influences constitute the causes of disease—that is, abnormal function dependent on abnormal structure, which in its turn has been brought about by a change in the usual conditions under which it exists.

Mesology, therefore, may be looked upon in a restricted sense as a branch of ætiology, dealing, as it does, with such factors as temperature, atmosphere, climate, locality, food, clothing, and the more subtle agencies of habit, profession, domesticity, mental states of depression, excitement, or irritation; in short, with any and every circumstance, whether material or psychical, which acts upon the body. W. H. ALLCHIN.

METALLIC.—A peculiar quality of sound, which the name suggests, either elicited by percussion or heard on auscultation, especially in connection with certain adventitious sounds in pulmonary cavities. *See* PHYSICAL EXAMINATION.

METAMORPHOSIS (*μετὰ*, a particle signifying change, and *μορφόω*, I form).—In a pathological sense this word signifies a form of degeneration, in which one tissue or substance becomes chemically changed into another, as for example, albuminous structures into fat. *See* DEGENERATION.

METASTASIS }
METASTATIC } (*μεθίστημι*, I change place).—These terms are supposed to imply the translation of a disease from one part of the body to another, such as seems to occur occasionally in gout, rheumatism, mumps, and certain affections of the skin and mucous membranes. Modern pathology, whilst admitting the existence of the phenomena to which the term metastasis has been applied, refuses to accept as satisfactory the explanation of the fact implied in the term.

METEORISM (*μετεωρίζω*, I raise up).—A synonym for tympanites. *See* TYMPANITES.

METRALGIA (*μητρα*, the womb, and *ἄλγος*, pain).—Pain in the womb. *See* WOMB, Diseases of.

METRITIS (*μήτρα*, the womb).—Inflammation of the womb. *See* WOMB, Diseases of.

MIASM (*μιαίνω*, I pollute).—This term has been used very vaguely in reference to poisonous emanations generally, but its application ought to be limited to the malarial poison. *See* MALARIA.

MICROCOCCI (*μικρὸς*, little; and *κόκκος*, a berry).—SYNON.: Spherical or sphæro-bacteria; globular bacteria; *Microsporon* (Klebs); *Monas crepusculum*; Ger. *Kugel-bacterien*.

Some of these names are also used by different authors in a wider sense; and some, such as *microsporon*, have only been applied to certain species.

DEFINITION.—Bacteria, of spherical or ovoid form, which multiply like other bacteria by transverse fission into double forms, chains, or clumps, or into large globular masses (zooglœa), in which the individual elements are densely packed, with very little intercellular substance. They do not grow into rods or filaments, thus being distinguished from bacteria proper and bacilli; and they have, according to Cohn, no power of independent locomotive movement, differing in this respect from common bacteria, which have usually alternate stages of rest and motion. The other essential generic characters are those of bacteria in general. *See* BACTERIA.

DESCRIPTION AND PHYSICAL CHARACTERS.—Micrococci are of extreme minuteness, rarely exceeding $\frac{1}{25000}$ of an inch in diameter, and often being much smaller than this. As seen with the microscope, they appear as minute highly-refractile dots; and, if suspended in fluid, are in active Brownian movement. When single, they are with difficulty to be distinguished from minute oil-globules or granules of protoplasm, but they are usually found in pairs or rows, and are then more easily recognised. As they multiply by transverse fission with extraordinary rapidity, they are usually seen in this dumb-bell shape, and moving to and fro, when in active growth. If growing more slowly in a quiescent medium, they form chains, composed of six, eight, or more members linked together. And, lastly, under favourable conditions, they grow into rounded masses consisting of an agglomeration of an infinite number of individuals, united by an intercellular substance, the so-called *zooglœa* (fig. 27, *d*). The various groupings thus produced have been described under various names: *dumb-bell* or *double* form, when two individual elements are incompletely separated (Fig. 27, *a*); *chain* form (*Kettenform*), *rosary* form (*Rosenkranzform*), *torula* form, *leptothrix*. *mycothrix*, *streptococcus*, and various other names, when in rows which are straight, bent, or curved (Fig. 27, *c*). Usually, before complete separation of any two elements takes place, the fission process has commenced in these individuals, and thus a chain of four is produced, if, as is usual, the fission is transverse; when, more rarely, it is longitudinal, a group of four—'*sarcina-form*'—is produced (Fig. 27, *b*). These names are unscientific, and should be discarded, for they indicate no real difference in nature but merely an accidental grouping.

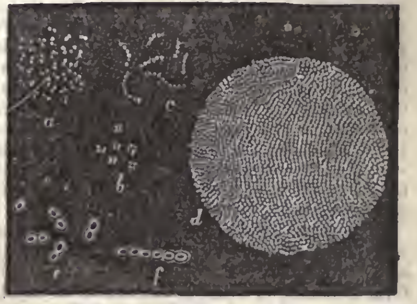

FIG. 27. *a*. Single and double micrococci; *b*. groups of four, 'sarcina' form; *c*. chains; *d*. zooglœa; *e*. single and double micrococci, more highly magnified, showing process of division; *f*. a chain, more highly magnified.

When diffused in a clear fluid, micrococci cause an opalescence. If, however, they are in zooglœa masses, they appear to the naked eye as opaque, white dots, which may be as large as a pin's-head or more; or they may be tinged by colouring matters absorbed from the surrounding medium.

Micrococci consist of protoplasm, which, like that of other bacteria, is highly refractile, resists the action of alkalies and dilute acids, and is strongly coloured by various reagents. The protoplasm is believed to consist of an outer envelope and cell-contents. When in zoogloea masses, micrococci are united by a small quantity of intercellular substance, which may, perhaps, be produced by solution of their outer envelope. The zoogloea appears under the microscope as dense granular masses, with a finely but uniformly punctated surface.

Life-history.—Micrococci have been supposed by some to originate spontaneously by the disintegration of organised albuminous bodies; but this mode of production is denied by other observers. In their free growth they require the presence of a pabulum containing nitrogen- and carbon-compounds, and water, together with a small quantity of free oxygen; but most micrococci, if not all, grow freely in fluids from which the free access of air is excluded, and hence they belong to Pasteur's class of *anærobiæ.* The growth of micrococci is largely influenced by temperature, but the degree of heat most favourable to their germination probably varies with the different species.

Micrococci are very tenacious of life, resisting the action of heat to a remarkable degree. The exact death-point has not been accurately determined. They appear also to resist the so-called antiseptics' much more than other bacteria.

The relation of micrococci to ordinary rod-shaped bacteria has been a matter of dispute. It is now known that rod-bacteria, when cultivated, may produce spores, which can divide and sub-divide again, and which, in their physical characters, are undistinguishable from micrococci. So, also, bacilli produce spores, which may subdivide, but again germinating reproduce the bacillus filaments. The question has therefore been raised, whether these micrococci are not the spores of bacteria, which have assumed an abortive stable form, and do not usually produce rod-bacteria. It has indeed been stated that bacteria have been seen to divide into micrococci. But the numerous experiments and observations made with the object of reproducing bacteria from micrococci have hitherto failed.

Classification.—Thus far micrococci have been treated as a class; it must now be stated that various sub-genera and species have been described.

Micrococci have been divided by Cohn into three sub-orders, namely—(1) *chromogenic,* those which produce in their growth soluble or insoluble colouring matters; (2) *zymogenic,* those concerned in special forms of fermentation; and (3) *pathogenic,* or those associated with disease, 'ferments of contagion.' It is the *pathogenic* alone that need here be considered.

Pathological Relations in General.—Micrococci, like other bacteria, play a certain part in putrefactive and fermentative processes, in which they are constantly present; and probably they are also in some way concerned in certain of the processes of disease in animal and vegetable organisms. Although the exact part which bacteria play must be allowed to be doubtful, there can hardly be a question of their importance in relation to some of these processes. In face of the various opinions now entertained on the subject, it can only be stated here that some believe them to be the active agents of these processes, and as a consequence that the bacterium which produces each process, whether fermentative or morbific, is specific in its nature; whilst others believe that these processes arise independently, that the bacteria are merely concomitants, and that the varieties in mode of growth and in outward form are merely the results of the various conditions under which they grow. But there is much evidence, both from the study of processes of fermentation, and of the diseases of vegetables and animals, to show that the various forms of micrococci, as of other bacteria, are more or less specific, or at least have acquired specific properties and powers.

Micrococci have been alleged to be concerned in the production of a large number of diseases, mainly those known as septic and contagious. Of the septic diseases, pyæmia, septicæmia, and puerperal fever, and of the contagious specific diseases, diphtheria, erysipelas, gonorrhœa, and vaccinia, are those in which micrococci are asserted to play an important part. There can be no doubt that they are frequently, if not constantly, present in the tissues or fluids of the body, or in the inflammatory products, in some of these diseases, but their significance is a matter of dispute (*see* Bacteria). It may be observed that the question of their action in pyæmia and septicæmia is a very different one from that of their relation to the specific diseases, such as vaccinia, and these two classes of disease may therefore be considered separately.

Special pathology in relation to blood-poisoning.—With regard to the septic diseases, especially pyæmia, the evidence of the action of micrococci is partly derived from general consideration, partly from anatomical observation, and partly from experiments on the lower animals.

Micrococci are known to be present in nearly all decomposing animal fluids, and, on the other hand, the experiments of Lister and others tend to show that if precautions are taken to exclude bacteria, especially micrococci and bacterium termo, putrescence does not occur. Micrococci are hence regarded as the ferments of putrefaction, or, rather, of one form of putrefaction. The evidence that pyæmia is produced by the inoculation of some putrescent animal matter is very strong; and the exclusion of the ferment of putrefaction has apparently the same effect. Micrococci are also found in the pus or serum of nearly all active poisoned wounds, commonly so called, such as 'necrotic warts,' whitlows, &c., and frequently in the pus of acute abscesses, (Birch-Hirschfeld, Alex. Ogston, and others); and there is much evidence to show that the infective property of the pus of abscesses is dependent on, or co-existent with, their presence, inoculation with fresh pus containing them producing suppuration, but in their absence no such effect being observed. When artificially cultivated in nutrient fluids this property of causing suppuration may be lost, especially if there is free access of air; but A. Ogston has succeeded in cultivating them in eggs, excluding the air, and in thus multiplying micrococci which retain their power of causing suppuration. This is also in accordance with numerous experiments, which have proved that decomposed blood, containing abundant micrococci, may be inoculated with impunity, showing that either only *certain kinds* of micrococci have phlogogenic or septic properties, or that certain conditions of growth are necessary to confer or maintain those properties.

Anatomical observations on pyæmia, both in man and in the lower animals, have shown that micrococci are almost constantly present in the affected parts. The first observations on this point are probably due to Klebs, who described the *microsporon septicum* as found in pyæmia, and cultivated it outside the body. Many observers have since confirmed his results, with some variations in detail. Zooglœa masses of micrococci are found in the capillaries, and capillary arterioles and venules, the latter especially, of various organs—the lung, kidney, heart, liver, and thymus in particular. Moreover, their presence in these viscera usually coincides with the presence of abscesses in course of formation in these situations. They are also found in the submucous tissues, and the serous cavities, lymphatic glands, &c. In pyæmia in the lower animals, micrococci are often found in large numbers in the blood. Nor is it only in pyæmia, commonly so-called, that this constant presence of micrococci is observed; in many other allied diseases associated with blood-poisoning similar observations have been made. Thus, in puerperal fever (Heiberg), hospital gangrene, ulcerative endocarditis, diphtheritic endocarditis (Weigert), &c., they have been found, both in the primary lesion and in the secondary abscesses. As to their mode of action, apart from the general results of putrid fermentation, micrococci appear in some cases to produce local effects, such as dilatation of the walls of vessels, or thrombosis by their action on leucocytes, and local irritation and its consequences. Moreover, it would appear from the researches of Koch, who produced various forms of blood-poisoning and gangrene in rodents, that micrococci may have different actions in different forms of these diseases, and that in their physical characters and grouping, as well as in their local action, these micrococci may show differences sufficient to constitute distinct species, each having a specific action, and producing a special form of disease, whether pyæmia, septicæmia, or gangrene. By many other observers, however, the specific distinctness of these different forms is altogether denied. For fuller details the writings of Hiller, Klebs, Billroth, Pasteur, Lister, Burdon-Sanderson, Watson-Cheyne, and many others, may be consulted.

Against these observations the objection has been raised that micrococci are capable of development in the body in lowered conditions of vitality, or even of spontaneous generation from disintegrating albuminous substances, both after death and during life when death is approaching; and that they are merely evidence of a change allied to decomposition *intra vitam*. That the healthy organism has a great power of resisting their entrance, and of destroying them when artificially introduced, must be considered an established fact; but there are so many channels by which they may enter if the power of resistance is lowered, that a spontaneous generation must not be assumed too readily to explain their presence. Experiments made by feeding animals with phosphorus, and thus lowering their vitality, clearly show that micrococci do appear in the blood under these conditions. Many experiments have been made to determine whether micrococci and bacteria exist normally in the blood and tissues, held in check only by the vitality of the organism, so that after death they germinate. Recent experiments, notably those of Billroth, Tiegel, Burdon-Sanderson, Chiene and Ewart, Nencki and Giacosa, and Watson-Cheyne, have led to very different results, partly due to differences in method; but the question must be considered to be at present undecided.

Special pathology in relation to specific contagious diseases.—The subject of the relation of micrococci to specific contagious diseases, such as diphtheria and vaccinia, is too wide for complete discussion here. By some each of these diseases is believed to be dependent on the action of a particular specific micrococcus constituting its contagium and virus; and by the multiplication of these micrococci, and the pathological changes consequent thereon, the disease is supposed to be produced and propagated. Of the 'pathogenic' micrococci which have been described, the most important are the *micrococcus diphtheriticus* and *micrococcus vaccinæ*. The micrococcus of diphtheria has been described by Eberth, Nassilloff, Weigert, and others, and they have insisted on its constancy and importance. On the other hand many good observers have failed to find it in well-marked cases; and it must be allowed that micrococci are most abundant in the tonsils and pharynx and other parts most prone to sloughing, and are far less constant in the larynx and trachea. Their presence in decomposing false membranes is probably of no significance. The *micrococcus vaccinæ* of Cohn, Burdon-Sanderson, and others has no doubt a real existence—that is, micrococci are commonly found in vaccine lymph; but the experimental evidence that they constitute the contagium is negative.

It appears unnecessary to refer in detail to many other supposed pathogenic micrococci which have been described in relation to small-pox, horse-pox, glanders, gonorrhœa, and other affections, for the evidence upon which their existence is asserted is, to say the least, extremely imperfect. All that can safely be affirmed is that micrococci are to be found in great abundance in the pathological excretions and secretions of certain contagious diseases, especially when, as in diphtheria, these have a tendency to become putrid; and that they are usually also present in the active virus of inoculable diseases, for example, vaccinia; but whether they constitute the actual contagium, or by their action produce a local condition which is favourable to the absorption and activity of the virus, is at present uncertain.

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MICROSCOPE in MEDICINE.—The exact position of the microscope in medicine has, like most other instruments of research, not been always clearly recognised. Over-estimated in its value by the enthusiast, it has suffered from an undue exaggeration as to its capabilities, second only to that unfair depreciation put forward by ignorance of its use. Whilst perhaps representatives of both views may be found at the present day, the time has come, after nearly half a century of experience, to define with moderation the limits of its application.

It must at the outset be recognised that the microscope is but an aid to one of our senses. It merely extends our means of observation, of seeing what is. The range of our vision being limited, this optical arrangement permits a wider field, a greater depth of perception. Of itself the microscope allows the hitherto hidden, only because too minute, to be seen, whilst it discloses nothing that does not already exist; it renders, in short, the eye for the time being and in one direction more perfect.

The formation of a diagnosis, which may be regarded as the first aim of practical medicine, is the result of a judgment founded upon observation of the case, guided by experience and with due regard to external circumstances. Any agent that may extend the means of observation, or render such more accurate, is obviously a great gain; and on this ground the microscope ranks with the stethoscope, the thermometer, and the probe, which permit a wider application of the senses of hearing and touch. But whilst perhaps it may be conceded that the microscope for daily practice is not of such necessity as either of those instruments, it has a further and greater claim on the consideration of the medical man, for what it has done and is doing in laying the foundation of the science on which his practice depends.

That which characterises the theories of pathology at the present day, and which markedly distinguishes them from any and all hitherto taught, is the recognition of the association and dependence of function upon structure, with the subsequent corollary that disease is but altered function due to altered structure. Whilst the knowledge of the structure of the body—anatomy—was, previous to the present century, of the grossest character, the theories of disease were limited only by fancy and empiricism. But as the great truth which established the connection of physiology, and hence of pathology, with anatomy came more and more to be recognised, the principles of morbid action, the explanation of symptoms, and the suggestion of rational treatment followed on truly scientific grounds. It was in establishing, and is now in maintaining and following this truth, that the microscope ranks highest among our instruments of research.

The Instrument.—In face of the many and excellent instruments that are offered, it would be invidious to recommend any particular one; but the following remarks are intended to be a guide as to the kind of microscope that is sufficient for the ordinary requirements of the practitioner, it being assumed that the optical principles of a compound microscope are understood.

Obviously the first point to keep in view is the *magnifying power*, inasmuch as it is to bring within the range of vision invisible objects that the instrument is valuable. For all ordinary practical purposes a power that will magnify 300 to 400 diameters is sufficient; higher degrees require specially skilled manipulation, and are out of the category of present consideration. But at the same time it is almost an essential that a much lower power be available, such as one of 60 diameters, in order that a more general view may be had of the object under examination, since it is thus that an idea may be obtained of the plan and arrangement of the object, the details of which are resolved by the higher power. Scarcely secondary in consideration is the 'defining power,' by which 'a clear and distinct image of all well-marked features of an object, especially of its boundaries,' is obtained (Carpenter). Subordinate to these qualifications, but yet of great importance, are 'flatness of field,' 'achromatism,' 'penetration,' and 'sufficient light.' Excellence in these various points is to be aimed at in the selection of a glass. The whole field of vision should be flat, that is, the circumference and the centre should be in focus at the same time; and the margins of the object viewed should not be fringed with coloured bands. Errors in these directions, known as spherical and chromatic aberrations, are corrected by the employment of 'combinations' of lenses, of varying degrees of convexity, and manufactured of different kinds of glass. It is clearly of great importance to have the field well illuminated, or that there be as much light as possible, but it is equally obvious that this necessarily varies with the focal length of the object-glass—the higher the power the less the light that can be admitted. Still, however, a considerable difference exists in respect to the illumination among glasses of the same magnifying power, and it is highly desirable to keep this point in view in choosing an objective. Certain aids to this end are given by reflectors, achromatic condensers, &c. With the degree of 'illuminating power' of the glass must be considered its 'penetrating power or focal depth, by which the observer is enabled to *look into* the structure of objects' (Carpenter). The latter quality is of the utmost importance in the microscope of the medical practitioner and histologist, as by it a knowledge is afforded of the relative disposition of the constituent parts of the object under investigation. All these properties are closely associated with what is known as the 'angular aperture' of the objective, that is, 'the angle formed between the most external rays that can penetrate the entire system of lenses of an objective, from a luminous point placed in the focus.' Now the degree of angular aperture will depend on the distance of the object, when in focus, from the front lens of the objective, and the size of the 'actual aperture,' or width of the front lens of the combination. The illumination of the object must be directly proportionate to the latter, since upon the actual size of the lens must depend the amount of light admitted; but since the circumferential and central rays tend to come to a focus at different points, to the manifest detriment of the distinctness of the image, the defining power of the glass will be improved as the outside rays are cut off by diminishing the field, or, in other words, by diminishing the amount of light. Within certain limits, therefore, the definition improves in inverse proportion to the illumination, always assuming a complete correction of chromatic and spherical aberration. Now the 'penetrating power,' within certain limits, varies in inverse proportion to the extent of angle of aperture of the objective, which, as already said, in part depends on the size of the actual aperture. Hence also the penetration up to a certain point improves in inverse proportion to the illumination. Since it is impossible to reconcile these very opposite qualities, the observer must be prepared to lose somewhat in light what he gains in distinctness and depth of his image; and, as a rule, the angular aperture of the ¼ should not exceed 75°, nor of the ⅕th or ⅛th, 90°. The so-called 'resolving power' of a glass, 'by which closely-approximated markings may be distinguished,' is of but little value to the medical practitioner.

Keeping in mind these points, it is possible to obtain a microscope for a very moderate cost (£6 to £7), which shall fulfil all the ordinary requirements of the medical man. The stand should be small and perfectly steady, on the tripod or horseshoe (Hartnack) model. The stage should be tolerably large (a common fault is its small size), and its aperture of moderate size and provided with a wheel of diaphragms; whilst the addition of an achromatic condenser is most desirable. The mirror itself should be double, concave on one side and flat on the other, attached to the body by a jointed arm, and not too small—another fault in cheap instruments. The body of the microscope should be so attached to the stand as to permit of inclination to any angle between the vertical and horizontal positions, and should be provided with a 'draw tube.' In order that the tube carrying the optical arrangements, eye-piece and objective, may be brought into proper position to focus the object, it is usually provided with 'coarse' and 'fine' adjustments, though these are not always both present in the cheaper instruments, and are really not absolutely necessary for the powers here recommended, being moreover worse than useless unless they are exceedingly well made, which adds considerably to the expense, whilst a little practice will render the observer independent of them; if one only be available, the finer should be preferred. Lastly with respect to the glasses, a great diversity of opinion exists, very much determined by what the individual is accustomed to; familiarity with a special instrument and its parts going a great way to ensure success in its employment. Whilst probably the very best glasses, and those of the highest power (1-25th and 1-50th inch) are made in England, excellent objectives are made in Germany and France, are amply sufficient for medical practice, and give a nearly equivalent result at a much lower cost. The cheapest English glasses should certainly be avoided. For a low power a 1-inch or ⅔-inch is sufficient, and anything lower is of little use; whilst for a high power opinions differ in regard to a ⅕, ⅙, or ⅛ (or the foreign equivalents), depending much on the quality and maker of the glass. The writer believes that for all ordinary purposes the English ¼-inch is sufficient, if used with a No. 2 or B eye-piece, giving a magnifying power of about 320 diameters, whilst it has the great advantage of permitting considerable illumination, the want of which is especially felt by the occasional observer, whilst to one more familiar with the instrument the loss of light is but little felt, as magnifying power and definition are increased.

For testing the optical properties of the glasses, nothing is better than a drop of fresh blood and a piece of muscular fibre; and both the A and B eye-pieces should be tried with each objective.

Drawing.—It is frequently necessary that an accurate drawing should be made of the object seen, and this may be done by means of the camera lucida prism, attached to the eye-piece of the microscope, which is then placed horizontally. The rays of light proceeding from the object along the tube to the eye-piece are then projected downwards by the prism, on to the paper beneath, forming an image which may be traced over. An arrangement with a piece of neutral tint glass is supplied, which answers all the purposes of a camera lucida, and is much cheaper Considerable practice is, however, needed in the use of these instruments.

Measuring.—For purposes of measuring microscopical objects various forms of micrometers are employed. One kind fits into the eye-piece; and another consists of a ruled glass slip, a drawing of the lines on which is made by the aid of the camera lucida with each objective—such drawing being afterwards used as a measure to be applied to the outlines previously made by the prism.

Binocular Microscope.—The binocular arrangement of the microscope, though undoubtedly possessing great advantages as regards penetrating power, is not of such value for ordinary clinical purposes; and, necessitating as it does the very best construction, is only applicable to the larger and more expensive instruments. A very convenient accessory when well made is the 'nose-piece,' which carries the two objectives, and thereby saves much trouble. For powers higher than the ¼, it is not satisfactory with the smaller microscopes.

Apparatus and Reagents.—Bearing in mind that it is for the clinical use of the instrument, rather than as a means of histological research, that the microscope is here considered, the actual reagents and apparatus required are very few. The following are requisites:—A pair of small curved scissors; a pair of fine pointed forceps; a few sharp needles, mounted in handles, those with cutting edge being preferable; slides and cover-glasses, which latter cannot be too thin; several camel's-hair brushes; one or two glass rods; and pipettes. Except for the examination of tumours and new growths, which may require hardening and staining, the medical man chiefly wants a microscope to ascertain the nature of various secretions and discharges, which are mostly of a fluid nature, and do not require the addition of any medium; but should any such be needed, it is desirable that it should be inert, and as nearly as possible of the

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density of the blood-serum with which the tissues are normally moistened. For that purpose a 3 or 4 per cent. solution of chloride of sodium, or a 3 per cent. solution of glycerine in distilled water, to which a few crystals of carbolic acid have been added to prevent the growth of fungi, is most convenient. For hardening portions of tissue to allow of cutting sections, solutions of chromic acid (½ to 1 per cent.); of bichromate of potash of the same strength; of chromic acid and spirit (½ per cent. to 90 per cent.), distilled water to 100; and Müller's fluid—a solution of bichromate of potash (2½), sulphate of soda (1), distilled water (to 100); are the most effective, and are easily made. It is necessary to remember that a very considerable quantity of such fluid is required, and that it requires renewing daily for the first three days. For a piece of tissue of the size of a filbert, at least four ounces of either of the above is requisite. Under favourable circumstances the hardening is complete in 14 to 21 days. By means of the freezing microtome perfectly fresh tissue may be cut and examined.

Among the very many methods recommended for hardening and staining portions of tissue, the following is given as an extremely ready and, on the whole, easy plan. Small pieces of the substance, of about the size of a large pea, are placed in spirit for at least twelve hours to get rid of the water; they are then transferred to a solution of magenta in oil of cloves, to stain. The time required for staining varies with the tissue, the size of the piece, and the strength of the solution; but usually twenty-four hours is sufficient. The pieces are then removed to a bottle containing melted cocoa-butter, and kept there for twelve hours. The heat of the chimney-piece suffices to keep the butter melted. One of the portions is now put on the end of a small cork, to which it becomes attached by the setting of the cocoa-butter in about a couple of hours, and may then be cut with a razor, wetted with spirit in the ordinary way. The sections are floated on to a slide, the superfluous spirit removed by blotting-paper; and a drop of oil of cloves let fall on the specimen; which is covered with a covering-glass, and finally gently warmed for a minute over a spirit-lamp to dissolve out the butter. Such a specimen may be preserved by the addition of a little chloroform-balsam to the edge of the cover-glass.

Clinical Uses.—The microscope may be applied to the investigation of the various discharges and secretions from the body, with the result of obtaining information, which though often of but imperfect value, may on other occasions be of the most positive and precise character, determining a diagnosis which without it would be uncertain.

(A) **Urine.**—It may be taken as a fundamental principle that perfectly healthy, fresh urine should have no visible deposits. A small quantity of flocculent mucus, entangling a few epithelial cells, is, however, of such frequent occurrence and of such trifling importance as practically to come within the limits of health. More than that is abnormal, and such deposits demand investigation. It may be that they are only the result of changes in the urine after it is passed, or, on the contrary, they may have been voided as such. Occasionally absolutely clear-looking urine may contain tube-casts, which the microscope only can detect.

It is important, therefore, to know the age of any sample of urine that is examined, and when possible, a portion of the whole twenty-four hours' quantity should be taken. Where this cannot be done, what is passed in the morning on rising should be chosen, since it is in such a specimen that certain matters are most likely to be present. Frequently an examination for several successive days may be necessary, for there are some conditions of kidney-disease in which but very few casts are passed, and would most probably escape one examination of a haphazard specimen. The urine should be collected in conical glasses, holding about four ounces, which must be scrupulously clean, and, if in frequent use, are best kept in a closed vessel of water, since thereby dust is prevented from accumulating at the bottom; and it is well to pour a little strong nitric acid into such glasses occasionally, to effectually remove all dust and deposits, subsequently, of course, thoroughly washing them in cold water. The urine should be allowed to stand six or eight hours at least, and be covered by a plate of glass or a paper cap, to prevent the entrance of dust. With a clean glass pipette a few drops of the lowest portion of the fluid may be removed. A collecting-glass has been recently invented whereby the lower strata of urine may be drawn off from the bottom by a tap; but a pipette answers all ordinary purposes. It is convenient to have the glass slide to which the drops are transferred provided with a cell, made by a very thin circle of gold size, since not infrequently large casts are crushed by the pressure of the cover-glass. The cell also answers the purpose of confining the fluid, any excess of which can be removed with blotting paper. Such an arrangement is not suitable when it is required to add any reagents to the specimen.

A preliminary examination with the lower power is occasionally desirable, but it is with the higher power that a knowledge of the nature of any deposit that may be present is obtained. The following objects may occur, the clinical significance of which is treated of elsewhere:—

1. *Adventitious matter, dust, &c.*—Even with the greatest care in collecting and preparation, foreign bodies are extremely apt to be met with, the commonest of which are hairs, wool, cotton and flax fibres, minute particles of wood, starch-granules, sand, and oil-globules. Besides these, a number of extraneous substances may occur, such as sputum and fæces, the source of which is obvious, whilst occasionally substances are purposely added to deceive the observer. It is absolutely essential that an acquaintance with the microscopic appearance of all such objects be possessed by the medical man.

2. *Mucus.*—This material presents itself as finely granular streaks and smears of every variety of size and shape, often mistaken for casts, and occasionally simulated by scratches on the slide or cover-glass.

3. *Epithelial cells.*—These may be derived from all parts of the urinary tract; and they include glandular spheroidal or polyhedral cells,

from the kidney, especially the convoluted tubules; columnar cells from the ureter and the greater portion of the urethra; and flattened tesselated scales from the pelvis of the kidneys, and the orifice of the urethra. Very large cells of the same variety come from the vagina. The vesical epithelium is very variable in appearance, but is generally either flattened or pyriform, of large size, and not always to be distinguished from the scales from other parts.

4. *Spermatozoa.* — Spermatozoa occasionally occur in the urine, without being of serious importance. Their characteristic appearance is not easily recognised under a magnifying power of less than 300 diameters.

5. *Blood.*—Blood-corpuscles in the urine differ considerably from their normal biconcave disc shape, and usually shrink into irregularly-shaped particles, but they may swell up and become globular in appearance, these changes being due to alterations in the density of the fluid. Under such circumstances the corpuscles are not very easy of detection, and if but very few in number, may not always be recognised with certainty, especially as there are many other objects, such as spores of fungi, which closely resemble them. If the blood be present in moderate quantity, it gives a characteristic colour to the urine, which suggests the presence of corpuscles. The discs more rapidly disappear in alkaline than acid urine, remaining in the latter for a considerable time.

6. *Leucocytes.*—Bodies identical with white blood-corpuscles are sometimes seen entangled in the shreds of mucus (mucous corpuscles), or may be derived from the epithelial surface; and, if present in large amount, constitute pus-corpuscles, originating from pyelitis, cystitis, urethritis, leucorrhœa, rupture of an abscess into the urinary tract, and other conditions.

7. *Portions of new growths.*—Cells, fibres, and other elements, from cancerous and other neoplasms of the urinary organs or adjacent structures, such as the uterus and the rectum, may be detected in the urine; but it is very seldom that the diagnosis of the existence of these new growths rests upon their recognition under such circumstances.

8. *Renal tube-casts.*—The appearances, nature, and origin of these bodies have been fully treated of in the article CASTS.

9. *Living organisms.*—The urine after standing, at the onset of the alkaline fermentation, contains bacteria and vibriones, with their characteristic vibrating movements; sometimes, also, various forms of torula and even sarcinæ, the former often in association with diabetes in acid urine (*Torula cerevisiæ; Penicillium glaucum*). Certain entozoa are found in the urine, the most important of which is the *Bilharzia hæmotobia*, a trematode worm, which causes a peculiar form of endemic hæmaturia. The ova are about $\frac{1}{170}$th inch in length, of oval form, and terminating in a spine: empty egg-shells and flask-shaped ciliated embryos are present in large quantities in the urine of patients suffering from this affection, together with blood and pus. Hooklets and fragments of *echinococci* from rupture of hydatid cysts into the urinary passages may sometimes be detected in the urine.

10. *Fat.*—In the condition known as chyluria, large quantities of fat in a state of fine molecules and minute globules, with a few leucocytes and red blood-corpuscles, are seen by the aid of the microscope.

11. *Salts.*—(*a*) *Amorphous.*—During the so-called 'acid fermentation,' which takes place within a few hours after the passage of normal urine, *urates of soda, potash*, and *ammonia*, and occasionally of *lime* and *magnesia*, are thrown down as a granular amorphous deposit of a brick-dust appearance; and later, during the 'alkaline fermentation,' *phosphate of lime* is precipitated in a similar condition, but of a white colour. Microscopic examination is useless to distinguish such substances, which require treatment with heat or reagents for their detection.

(*β*) *Crystalline.*—*Uric acid*, which in excess forms the cayenne-pepper-like grains, or gravel, is multiform in its microscopic appearances, presenting as it does typically six-sided plates, and four-sided rhombs, but often ovoid, barrel- or comb-shaped. Owing, to the affinity of the urinary pigments for uric acid and its salts, such crystals are usually slightly tinted—straw colour to pale brown; and they are very frequently aggregated into masses, and of the greatest diversity in size.

Oxalate of lime, found in both acid and alkaline urine, especially after the ingestion of rhubarb, tomatoes, and certain other articles of food, occurs as octahedra, or more rarely as very perfect dumb-bells, the former being composed of two four-sided pyramids placed base to base, appearing when seen in the short diameter as a square marked by two bright cross lines.

Triple or *ammonio-magnesian phosphates* are deposited in alkaline urine as triangular prisms with bevelled ends, and differing in length; when very short simulating the oxalate of lime octahedra. Stellate crystals of the same substance have been seen.

Phosphate of lime, though usually amorphous, occurs sometimes as crystals arranged in very characteristic rosettes.

Carbonate of lime, of very rare occurrence, appears as small spheres.

Leucin occurs as yellowish, highly refracting spheres, almost like oil-globules, and as needle-like scales. *Tyrosin* assumes the form of tufts of very fine needles. *Cystin* appears as regular hexagonal tablets of various size, frequently laid one on the other. *Hæmatin*, derived from the blood-pigment, has been found in minute acicular crystals in the urine of cases of hæmatinuria.

For the simple detection of most of the above-mentioned objects no reagents are necessary, the urine itself being sufficient; but the more transparent bodies, such as casts and epithelial cells, are often rendered easier of detection by slightly tinting the field with a drop of magenta solution or tincture of iodine. The crystalline deposits may be preserved by mounting in Canada balsam, subsequent to washing in spirit and turpentine; but attempts to keep for any time casts, or epithelium, are usually very unsatisfactory, though occasionally successful in very weak glycerine solution.

(B) **Fæces.**—It is not often that the matters passed by the bowel are submitted to microscopic examination—not so often perhaps as they should be. The greater part of the motions appears to consist microscopically of amorphous granular flakes of no special character; these are for the most part the degenerated dead epithelial cells shed from the mucous membrane.

Amongst the distinctly recognisable normal objects are starch-granules, oil-globules, shreds and fibres of vegetable tissue, and also of yellow elastic tissue, and not infrequently leucin, tyrosin, and cholesterine crystals. Various fungi, blood- and pus-corpuscles, crystals of triple phosphates, and ova of entozoa, are among the most important abnormal objects that may be met with.

To investigate these it is merely sufficient to flatten out, by means of slight pressure on the cover-glass, a small portion of the motion, in a drop of dilute glycerine. Both powers should be employed, since many of the fragments are easily recognised when magnified sixty or eighty diameters.

(C) **Vomit.**—This should be examined as soon as possible after expulsion, and the liability to the presence of all kinds of extraneous matter should be borne in mind. Small portions may be spread out in dilute glycerine; or it may be necessary to shake up the matter with distilled water, and take up a few drops of the mixture with a pipette.

It is impossible to give any accurate description of the appearances of the various kinds of partially digested food; but besides the characteristic starch-granules and the gastric epithelial cells, there are certain bodies which it is often of importance to be able to recognise, such as torulæ and sarcinæ, blood-corpuscles, and cancer-cells.

(D) **Sputum.**—In the examination of the expectoration the microscope is often of great value, as thereby the exact nature of the condition of the lungs may be declared. Small shreds of the sputum should be separated and spread out on the slide, and covered at once; sometimes a drop of dilute glycerine is required. It is obvious that the expectoration is liable to contain all kinds of objects that have not come from the lungs—fragments of food, epithelial scales from the tongue and mouth, hairs, &c.—but, excluding all such bodies, the sputum consists of a menstruum of viscid mucus, which is hardly recognisable under the microscope, except as a very finely granular film, entangled in which are innumerable air-bubbles of all sizes, with a few leucocytes (mucous corpuscles), and occasionally a few ciliated epithelium-cells from the air-passages. If a drop of acetic acid be floated in beneath the cover-glass, the mucus assumes a finely striated appearance, and the nuclei of the cells are rendered very distinct. With all degrees of catarrh and inflammation of the mucous tract the number of leucocytes becomes more and more abundant, with occasional red blood-corpuscles and oil-globules, the latter often aggregated into spheroidal masses. Black particles, due to inhaled soot, or coal or metallic dust, or else derived from the pigment of the lung-tissue, are present in varying amounts. When the lung is actually breaking down, fragments of pulmonic tissue may be readily recognised under the microscope by the characteristic elastic fibres, which are rendered especially distinct by the addition of acetic acid, or by previously boiling the sputum with solution of caustic soda (20 grains to the ounce), which clears up other matter, leaving the elastic tissue untouched. Vegetable fibres derived from the food, and which also resist the action of the alkali, must not be mistaken for the lung-tissue.

Among other objects which an examination of the sputum may reveal are crystals of cholesterine from caseous matter, blood-crystals, portions of new growths, as cancer-cells, bacilli, and hooklets of echinococcus.

(E) **Blood.**—By an examination of a drop of blood under the high power, the relative and actual numbers of the red and white corpuscles, their character, and the presence of abnormal objects, may be ascertained. The method of estimating the number of corpuscles is fully detailed under the heading HÆMACYTOMETER. The recognition of leucocythæmia to a great extent depends upon the microscope, by which the excess of white corpuscles is at once manifested.

The red corpuscles are apt to undergo alteration in shape, such as shrinking, or crenation, but it is not always easy to determine how far such may be the result of the preparation of the specimen.

Living organisms are occasionally found in the blood—*bacillus, spirilla*, &c.—associated with certain septic states, such as malignant pustule and relapsing fever. For their detection a higher power is needed, and no satisfactory investigation of such bodies can be made without a power of 700 diameters. A small nematoid worm, the *Filaria sanguinis-hominis*, about $\frac{1}{75}$ inch long and $\frac{1}{3000}$-inch broad, has also been found in the blood. *See* FILARIA SANGUINIS-HOMINIS.

To examine the blood it is sufficient to prick the finger, apply with the small forceps a clean, dry cover-glass to the wound, and gently place it on the slide, interposing a hair at the edge to prevent the corpuscles from being crushed. It is necessary to have enough blood to form a complete film, as otherwise it dries very quickly and alters in appearance, whilst if there be sufficient, the edge alone will dry, and prevent the central part from evaporating.

(F) **Milk.**—A drop of milk placed on a slide and covered with a thin glass, discloses on examination fatty granules and globules of all sizes, with sharply-defined outlines, and kept separate from one another by being surrounded by invisible films of transparent casein. In the milk secreted immediately after delivery will be seen colostrum corpuscles.

(G) **Morbid Discharges.**—The microscope is frequently of value in examining discharges from surfaces—for instance, in leucorrhœa; or from abscesses which may have burst. In the latter cases, besides the pus-cells, fragments of tissue may be seen, indicating the situation of the abscess; or the existence of a new growth may be manifested by the escape of small portions in the discharge.

(H) **Contents of Cysts.**—These are for the most part fluid or gelatinous, and leave very little for microscopic examination. Exception must be made to the echinococcus hooklets of hydatid cysts, the fatty matter of sebaceous cysts, and cholesterine crystals, so commonly met with in ovarian, and indeed in all forms of cysts.

(I) **New Growths.**—The microscopical characters of tumours are fully described under the heads of CANCER and TUMOURS.

(K) **Adulterations of Food, Drugs, &c.**—By means of the microscope many impurities and adulterations may be discovered, which would otherwise remain unrecognised. The following substances which are extensively used—namely, starch of various kinds, improperly added to cocoa and mustard; leaves of willow or plum, substituted for tea; chicory, a root of a species of dandelion, mixed with coffee; sand with sugar; red lead with cayenne pepper; and many pigments—indigo, venetian red, umber, turmeric; as well as different salts, sulphate and carbonate of lime—are at once detected under the microscope, and many of them in this way only.

(L) **Medico-Legal Inquiries.** — Stains of blood, semen, &c., on clothing. The spots should be moistened with a few drops of distilled water, or, better still, a ½ per cent. solution of chloride of sodium, and scraped with a sharp knife; and the fluid then transferred to a glass slide, and examined in the usual manner. The microscopical characters of spermatozoa and blood have been already referred to.

(Consult *The Microscope*, by Dr. Carpenter; *How to work with the Microscope*, and *The Microscope in Clinical Medicine*, by Dr. Beale; *Practical Histology*, by Professor Rutherford; and *A Course of Practical Histology*, by Professor Schäfer.)

DESCRIPTION OF FIGURES.

Fig. 28.—Red blood-corpuscles—human; × 350.
a. Normal, singly and in rouleaux. *b.* Shrunk from treatment with concentrated fluid. *c.* Distended and globular from absorption of water. It is in this condition that the red corpuscles are most apt to appear when mixed with various fluids of the body.

Fig. 29.—Scaly epithelial cells from mouth, vagina, &c. × 200.

Fig. 30.—Leucocytes. Pus, mucous or white blood-corpuscles. × 350.
a. Normal. *b.* After treatment with acetic acid; nuclei very apparent. *c.* Distended and rendered transparent by water.

Fig. 31.—Ciliated epithelial cells from air-passages. × 200.

Fig. 32.—Cotton fibres, showing characteristic twist. × 100.

Fig. 33.—Milk showing colostrum corpuscles and oil-globules, the latter very variable in size, and with a sharply defined outline. × 200.

Fig. 34.—Particles of vomited matter. × 250.
a. Starch granules, showing characteristic concentric lines. *b.* Fragments of partially digested muscular fibre.

Fig. 35.—Epithelium from urinary tracts. × 200.
a. From renal tubules; glandular. *b.* From ureter and urethra; columnar. *c.* Vesical.

Fig. 36.—Spermatozoa; human. × 350.

Fig. 37.—Fragments of hair. × 100.
a. Cortex. *b.* Epidermis. *c.* Medulla.

Fig. 38.—Sarcina ventriculi. × 250.

Fig. 39.—Hooklets of Echinococcus. × 250.

Fig. 40.—From phthisical sputum, showing elastic fibres of lung-tissue and leucocytes. × 350.

Fig 41.—Hæmin crystals from old blood-clot. × 250.

Fig. 42.—Cubes of chloride of sodium. × 200.

Fig. 43.—Leucin. × 120.

Fig. 44.—Tyrosin. × 120.

Fig. 45.—Uric acid, various forms. × 120.

Fig. 46.—Cholesterin plates. × 120.

Fig. 47.—Cystin. × 120.

Fig. 48.—Oxalate of lime; dumb-bells and octahedra. × 120.

Fig. 49.—Triple or ammoniaco-magnesian phosphate. × 120.

Fig. 50.—Torula cerevisiæ; yeast fungus. × 350.

Fig. 51.—Sputum of early pneumonia, showing red blood-corpuscles and leucocytes. × 300.

Fig. 52.—Shreds of elastic tissue in sputum of phthisis × 300.

Fig. 53.—Oïdium albicans; thrush. × 300.

Fig. 54.—Penicillium glaucum. × 300.

W. H. ALLCHIN.

MICROSPORON (*μικρὸς*, small, and *σπόρος*, a spore).—The fungus-plant of phytosis or tinea versicolor; also named epidermophyton. *See* EPIPHYTIC SKIN-DISEASES; and SKIN, Diseases of.

MICTURITION, Disorders of.—Under this term will be considered those conditions which interfere with the normal performance of micturition, regarded as a physical act. Thus suppression of urine is not included in this category, for in the state so described, the urine is not secreted by the kidney, and the absence of the secretion is not due to any physical cause in the bladder or urethra. The following will be treated of as disorders of micturition:—

1. *Irritability of the bladder in the adult.*
2. *Diminished size of stream.*
3. *Retention of urine, partial* and *complete.*
4. *Urine passing by an abnormal channel.*
5. *Incontinence and overflow of urine in the adult.*
6. *Incontinence of urine in the child.*

1. *Irritability of the bladder.*—This term is never to be employed as defining any morbid condition of the bladder, since it is too vague to denote anything else than a symptom, of which the practitioner has to discover the cause. It is commonly used in widely differing senses, and conveys therefore no definite meaning to the hearer. As denoting a symptom, it may be held to imply the simple fact of unduly frequent micturition, and should never be used, either in writing or otherwise, in any other sense. Whenever, therefore, this phenomenon is present, instead of regarding it as due to 'irritability of the bladder' as so frequently happens, the problem to be solved is what is the cause of that irritability? In all maladies of the bladder, and in most that affect the kidney also, unnaturally frequent micturition is present. It may vary in degree, and exist alone as a single symptom; or it may, as is much more usually the case, be accompanied by other symptoms, which aid the diagnosis. Thus it is present in all the inflammatory conditions of the bladder, and whenever foreign bodies or tumours exist there. Also when the bladder is full, and either habitually does not empty itself, or when absolute retention is present, in either case the wants to pass water are frequent and pressing. It is often present in stricture of the urethra, and in inflammations of that passage; also in chronic pyelitis, simple or calculous, in chronic nephritis, in Bright's disease, and in diabetes, as a result of the increased quantity of urine. It is present likewise during hysterical states, and under emotional excitements in many persons of either sex; and whenever the watery ele-

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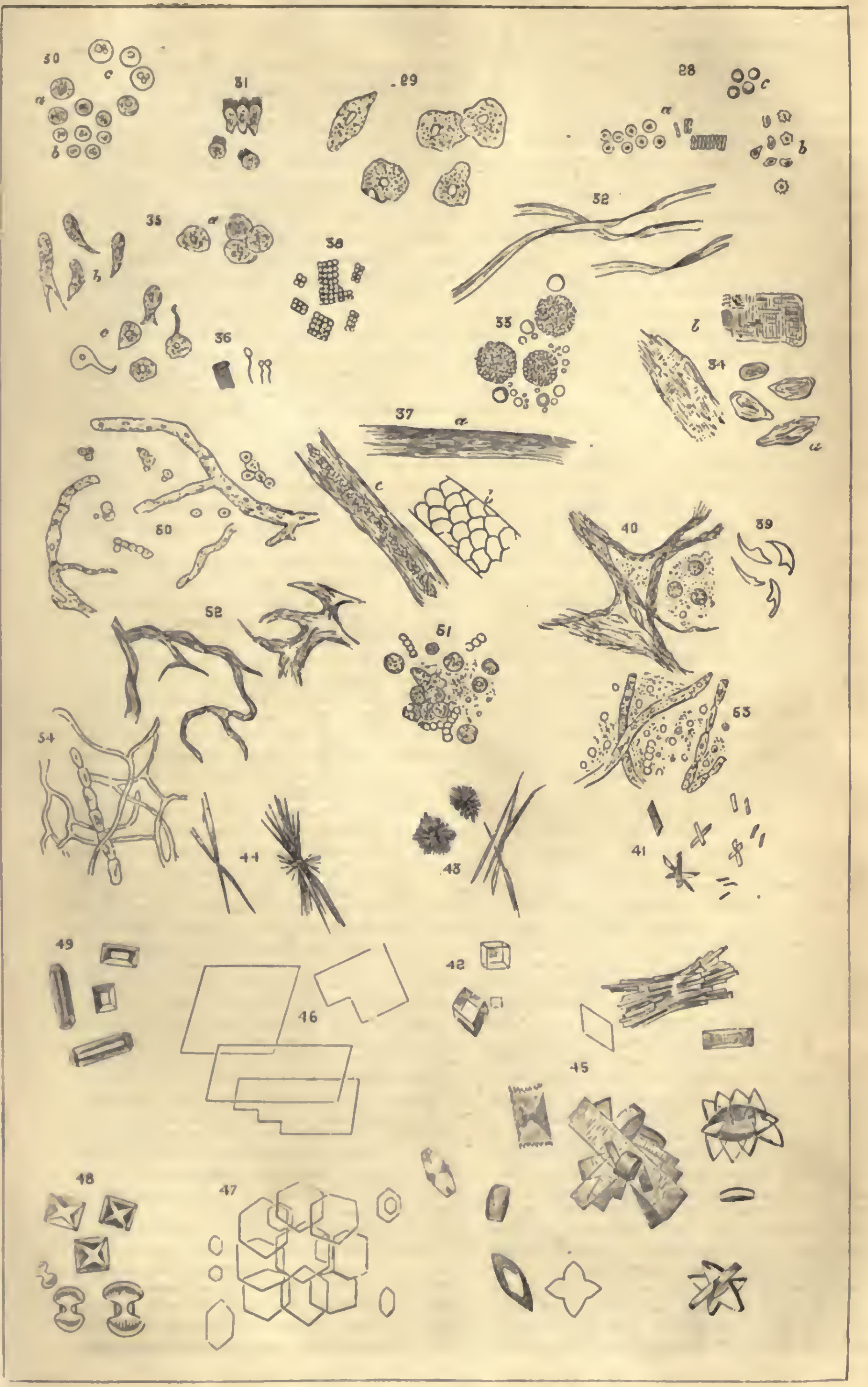

Drawings Illustrating Common Objects seen with the Microscope in Medicine.

ments of the urine are rapidly and abundantly secreted.

2. *Diminished size of stream.*—This may occur either with or without organic obstruction in the passage. It is always present, of course, in congenital narrowing of the prepuce or of the external meatus; in organic stricture of the urethra; and mostly in enlarged prostate. It may be occasioned by inflammation of the urethra and prostate; and by impaired power in the bladder to expel its contents, from partial paralysis, atony, or other cause. Occasionally the channel is narrowed by irregular actions of the surrounding muscles, and thus 'spasmodic stricture' (not a good term) is spoken of as producing a diminution of the stream.

3. *Retention of urine.*—Retention of urine, partial or complete, is not to be confounded with 'suppression,' the latter being of course defective action of the secreting organ, so that no urine is produced, and the bladder remains empty. Retention is the product in almost all cases of mechanical obstruction, such as enlarged prostate from hypertrophy, tumour, or inflammation, or stricture of the urethra. Impacted calculus is sometimes the cause; sometimes also, but most rarely, the spasmodic action referred to above.

Treatment.—As the cause is a purely mechanical one in the great majority of instances, the remedy which should be applied is also a mechanical one, namely, a catheter of appropriate size and kind. The instrument, however, is not always at hand, and medicinal agents are valuable until it can be obtained. At the head of these no doubt is opium, which allays involuntary straining, and sometimes thus enables the patient to relieve himself by the natural method, at all events to some extent. It should be given in full doses, for the purpose either of relieving the patient's suffering and anxiety, or of acting favourably on the function; and the error in practice which has been most common is to give doses of 10 to 15 minims of laudanum or liquor opii, when 30 to 40 or more were necessary, and would have been highly useful. Of course the form of opiate may be varied, according to the habits of the patient or the views of the attendant. Simple opium is merely mentioned here as the type. Local bathing, as hot as it can be borne, is also a valuable adjunct. Diuretics, often given, are for the most part injurious; that is to say, when the cause is a mechanical one; the same must be said, in such circumstances, of the tincture of the perchloride of iron, once in some repute in retention of urine. As a general principle also, it is not to be forgotten that purgation commonly promotes the expulsive action of the bladder, often materially so, and tends to afford relief.

4. *Urine passing by abnormal passages.*—The urine may escape by abnormal channels, such as fistulæ. This condition is necessarily named as one of the 'disorders of micturition,' but its nature and treatment bring it solely under the hands of the surgeon.

5. *Incontinence and overflow of urine in the adult.*—The conditions so denoted are among those disorders of micturition which it is most important to understand. Nothing is commoner than to find a man, probably in advanced years, passing urine with increased frequency, even sometimes passing it without his will or knowledge, during sleep; and it is unfortunately not uncommon also, that he is told that this is a common weakness among elderly men, inseparable from the fact of age, and either not amenable to treatment, or not worthy of serious notice. Many a life has been endangered most certainly, and some even lost by such counsel. This condition is often loosely spoken of as 'incontinence' of urine; of which, however, it is not only not an example, but on the contrary indicates a condition of a precisely opposite character. The confounding of these opposite states is a matter of extreme importance. What does produce frequent micturition and so-called incontinence, is a bladder unable to empty itself, consequently always partially if not completely filled, from which the surplus must be either frequently discharged, or runs off 'incontinently.' The important point, then, is never to lose sight of the fact that frequent micturition, and above all urine involuntarily passed by elderly men, in nineteen cases out of twenty indicates retention (requiring the catheter), and not incontinence.

True incontinence, which means inability to retain, on the part of the bladder, is a very rare occurrence, and is present almost invariably only in cases of disease in the nervous centres producing paralysis in other parts of the body, as well as the bladder. When the bladder-symptoms alone are present, and no signs of paralysis elsewhere exist, it may be held as almost absolutely certain that the bladder itself is not paralysed. It may be over-distended with fluid from enlarged prostate; or its coats may be thinned and atonied, and so unable to contract on their contents; but there is no true paralysis of the bladder (commonly as that term is often employed) without central lesions of the kind above referred to, and affecting other functions also besides that of micturition.

Treatment.—In these partial retentions of urine, producing its overflow and involuntary discharge, the remedy is the catheter, and the case is mainly surgical. There are some instances in which restoration of the power of the bladder may be attempted by medicinal agents, such as strychnia, iron, and electricity, but their effect is little or none, apart from the habitual emptying of the organ by artificial means. In some cases perhaps they may be advantageously associated with the surgical treatment.

6. *Juvenile incontinence.*—A brief sketch of this common and well-known affection is all that our limits will admit. Nevertheless it is one relative to which much might be written, without exhausting a subject the pathology of which has wide and manifold relations.

In the earliest periods of childhood an undue frequency of passing water is often to be observed among individuals of both sexes, more commonly in boys than in girls. As age advances the infirmity usually lessens, and then disappears; whilst in exceptional instances it continues, without change, to puberty, and even for some years after that period has arrived. But the peculiarity of the case is that the urine is passed unconsciously during sleep, and this forms the most serious symptom. In spite of all precautions a quantity of urine is discharged every night during deep sleep, an occurrence of which the child is quite unaware, and which as he advances in age he is wholly unable to control, however strong may be his disposition to do so. On the bladder becoming distended reflex action of the vesical muscular coats takes place, and the contents are discharged. The flow of urine is determined, as it would appear, not by inability on the part of the bladder to retain a small quantity of urine, but by its undue excitability or readiness to contract, so that the act of micturition can be exerted while the will is in abeyance through sleep. There appears to be something analogous between this condition and that which determines in after-life seminal emissions under similar circumstances. In a few instances, certain aberrations from a good standard of health seem to favour the production of these phenomena, especially sources of irritation in the rectum, which produce activity in that muscular apparatus, involving also the kindred muscles of the bladder, which are so closely associated. Thus the presence of ascarides or other foreign agents may suffice to occasion expulsive action in the bladder. During the period of infancy and early childhood the nervous system is highly impressionable, and the habit in question being accidentally set up, its persistence may result solely from repetition through the force of custom, long after the original cause has disappeared.

Sometimes slight malformations of the male organ favour the occurrence of incontinence; such as a narrow meatus, or a long prepuce which is never retracted, and is consequently in an unhealthy state.

Precocious development and extreme activity of the mental faculties, producing disturbed sleep, seem to favour the occurrence of incontinence. On the other hand, it is sometimes associated with a morbid deficiency of intelligence.

Treatment.—The treatment ordinarily necessary may be to some extent inferred, when examination of the patient has determined the presence or absence of the conditions named. This done, the next indication is to subdue the activity of the expulsive function of the bladder by some agent which possesses that power. The most powerful for this purpose is undoubtedly belladonna; one of the most notable qualities of this drug is its temporary influence to produce a paralysed condition of the vesical muscles. Thus, if administered to an adult whose powers of expelling urine are feeble, such, for example, as are commonly met with in advancing years, complete retention of urine is often produced. Of this the writer has seen many marked illustrations. Now, as has already been observed, in not a few of the cases of so-called 'juvenile incontinence,' its existence is due solely to persisting habit after the original occasion of it has long ceased; and these are certainly and rapidly cured by administering the agent in question. We have only to induce a partial paralysis of the bladder for a week or two, or for a few weeks at most, and by this means not only to destroy the old habit, but to develop a new one, namely, a habit of retention, and the annoyance disappears entirely and for ever. On meeting, therefore, with a case, whether in childhood or youth, the first indication is to correct any manifest deviation from the ordinary standard of general health; and secondly, to administer belladonna persistently. Small doses, suited to the age of the patient, suffice at first, and may be given every afternoon and evening only—say from eight to fifteen minims of the tincture on each occasion during the first week. In the second week of treatment, the dose may be augmented one half; and in the third week the original dose is doubled; meantime some improvement will almost certainly now be manifest. Since the ability to bear belladonna increases rapidly as the system becomes habituated to it, a large dose may be given during another term of three successive weeks, by which time the involuntary discharge of urine probably ceases. After this the dose may be gradually diminished, and at a rate more rapid than it was augmented: the habit of retention has probably been formed by this time, and when cessation from medicine takes place, no recurrence of the symptoms will be observed. Such is the writer's experience in a considerable proportion of the cases which have fallen in his way. But it must be confessed that a troublesome minority is met with in which the belladonna has had little or no useful influence. It generally exerts some, however, and it is worth while to be careful that the drug has been well prepared. Thus the writer has been successful with the belladonna of one chemist after failure with that of another. Now, in regard of these obstinate and exceptional cases, what remains to be done? It may be assumed that an exhaustive observation has been made of all the functions, especially of those which perform digestion, and that it is unnecessary to insist further on this score, or to suggest the numerous details which such consideration gives rise to. All this done, there still remain modes of treatment of a local character, which ultimately almost always prove successful in these cases. These do not include blisters on the sacrum; apparatus to prevent the patient lying on his back, when asleep; arrangements to arouse him during the night once or twice to pass water voluntarily, and such measures—all of which are palliative means, and do little towards a radical cure, and which constituted the chief agencies employed some years ago.

Superior to all these in the writer's hands has been the application of a solution of nitrate of silver to the urethra, whether in the male or female. Even the use of a flexible bougie, small of course for children, passed daily, and removed in the course of a minute or so, is sometimes successful. But if this fails, the injection by means of a sufficiently long tube of the solution named to the prostatic portion of the urethra and neck of the bladder, is a remedy of no mean value. For young women up to the age of eighteen or twenty in whom this unfortunate infirmity still exists, the writer has found it almost, if not invariably, successful. It should be applied immediately after the bladder is emptied, in quantity, say, of a drachm, and of a minimum strength of ten grains to the ounce, up to treble that strength if necessary for subsequent applications. Enough should be employed to produce decided smarting, which shall continue for a day or two. A week or two should be permitted to elapse between each application.

It would not be right to omit the mention of other remedies besides belladonna, which may be used either alone or in combination with it. Such are the tincture of the perchloride of iron; strychnia; tincture of cantharides; and bromide of potassium. The latter, given at night only, has sometimes a manifestly beneficial effect.

Henry Thompson.

MIGRAINE.—A synonym for megrim. *See* Megrim.

MIGRATION OF CORPUSCLES.—The escape of blood-corpuscles through the walls of minute vessels, and their passage into the surrounding tissues. The process is chiefly seen in inflammation. *See* Inflammation.

MILIARIA (*milium*, a grain).—Synon.: *Sudatoria* (*sudamina*); Fr. *Miliaire*; Ger. *Friesel*.

Definition.—A vesicular eruption of the skin, generally associated with profuse sweating, and sometimes with pyrexia.

Description.—The proximate cause of miliaria is reduction of the vitality of the skin, under the influence of extreme heat and sweating. The vesicles have the bulk of millet-seeds; are developed close to the pores of the skin; are generally discrete; and are dispersed irregularly over the surface. They are thin, and contain at first a pellucid serum, which by magnifying the hyperæmic base on which they are developed, gives them a red appearance—*miliaria rubra*; in a more advanced stage the serum becomes milky and opaque, and then the eruption is called *miliaria alba*. When left to themselves the vesicles subside and dry up into an extremely thin scale.

Treatment.—The treatment of miliaria consists in subduing whatever feverish symptoms may be present; in lightening the clothing and coverings; in the use of tepid baths and tepid sponging; and after the bath, dusting the skin with some absorbent powder, such as fuller's earth. Sponging with lime-water is also useful; and the use of a lotion in which oxide of zinc is suspended in lime-water, in the proportion of two scruples to an ounce. This should be painted on the affected parts of the skin, and allowed to dessicate thereon.

Erasmus Wilson.

MILIARY ANEURISMS.—Minute dilatations in connection with the small blood-vessels; especially met with in the brain. *See* Brain, Vessels of, Diseases of.

MILIARY FEVER.—A febrile condition attended with the eruption of miliaria. *See* Miliaria.

MILIARY TUBERCLES.—True tubercles, which appear in the form of minute granulations. *See* Tubercle.

MILIUM (Latin).—A term suggestive of small size and roundness, resembling a millet-seed; a synonym of grutum. *See* Grutum.

MILK FEVER.—Synon.: Ephemeral Fever; Fr. *Fièvre laiteuse*; Ger. *Milchfieber*.

Definition.—A certain amount of constitutional disturbance, accompanying the flow of milk to the breasts, on the second or third day following delivery.

Ætiology.—This condition appears to affect chiefly those who are in a feeble state, from want of nourishment, loss of blood, or other cause; or to occur when the child has not been put to the breasts sufficiently early to free the milk-tubes.

Symptoms.—The symptoms of milk-fever are sometimes slight, and pass off very quickly, in which case the term 'ephemeral' is appropriate; but not infrequently the fever runs high, the temperature reaching beyond 102° Fahr., and the pulse beating 140 in the minute, from which state recovery is less rapid. The patient is generally seized suddenly with severe rigors; her teeth chatter, there is a sensation of cold water running down her spine, and she calls for blankets and hot-water bottles. At this time the breasts are swollen and sensitive. This chill soon gives way to a hot stage, which may last from two to twelve hours; the head aches fearfully; there is pain in the limbs, restlessness, a dry tongue, thirst, and sometimes delirium. The breasts now become hard and knotty, and very painful when touched. Then follows the sweating stage, from which great relief is experienced; as a rule the breasts become softer, and milk commences to flow from the nipples; the temperature falls; and all the symptoms abate. Sometimes, however, the breasts remain hard, and an abscess forms in one of them, in which case the temperature still remains high, though the other feverish symptoms subside.

Treatment.—During the cold stage the desire of the patient for hot-water bottles and blankets should be gratified; and care should be taken not to diminish the amount of clothing too rapidly during the hot stage. The bowels should be evacuated. A diaphoretic mixture should be administered; and the child should be put to the breasts as soon as the sweating stage sets in.

Clement Godson.

MILPHOSIS (*μίλφωσις*, falling off of the hair).—Synon.: *Milkosis*.—Falling off of hair, especially of the eyebrows; an obsolete term.

MIMOSIS (*μιμέομαι*, I imitate).—A term applied to the phenomena of a disease, which resemble or imitate those of another disease.

MIND, **Disorders of.** *See* Idiocy; and Insanity.

MINERAL WATERS.—Definition.—Mineral waters is the name given to those waters which, on account of the different saline or gaseous substances which they hold in solution, or of their elevated temperature, are used in the treatment of disease, either internally or in the various forms of baths.

The science that treats of the effects of mineral waters and baths on a great number of chronic maladies is called *balneotherapeutics*. In a wider sense this branch of medicine comprises also the use of sea-baths and of common water, but these subjects are treated in separate articles. *See* Hydrotherapeutics; and Sea Air.

Courses of mineral waters and baths are to be regarded as methods of treatment analogous to courses of other remedies, but they are much more complicated, not only because many of the mineral waters are in themselves compound remedies, containing several active substances in combination, but also because in most courses of waters or baths the invalid is influenced by several other powerful agents, such as travelling, change of social conditions, of occupation, scene, and diet, change of climate, and increased exercise. Each of these influences has in itself a powerful action, and to their combination we must often ascribe a great part of the curative effects of balneotherapeutic courses; they ought therefore to be carefully considered in every individual case as part of the plan prescribed. We are unable in this article fully to discuss these important concomitant influences, but may refer for their critical estimation to Dr. Braun's treatise *On the curative effects of Baths and Waters* (Smith, Elder, and Co. 1875), and other works.

As most chronic diseases are treated by other remedies as well as by balneotherapeutic courses, the physician must in every case consider whether and when mineral waters are to be used, either instead of other remedies, or in combination, or in alternation with them.

GENERAL COMPOSITION AND CLASSIFICATION.—The principal constituents of mineral waters are:—water, soda, magnesia, lime, and iron; combined with hydrochloric, sulphuric, carbonic and hydro-sulphuric acids, the two latter existing also in some waters 'free,' that is, uncombined with bases. Nitrogen and oxygen are likewise present in most mineral waters in various proportions; and in some there are also silica, arsenic, bromine, iodine, lithia, manganese, potash, organic matters, and several other substances in small quantities.

The substances dissolved in mineral waters are derived from the surface soil and the rocky strata through which the water deposited from the atmosphere passes. The dissolving power of this water is much increased by the gases which it absorbs, especially carbonic acid and oxygen. The constitution of mineral waters, therefore, varies according to the nature of the strata through which they have passed.

The different mineral waters may be grouped in various ways, as, for instance, according to their chemical constituents, their temperature, their geological origin or geographical distribution, or their physiological or therapeutical actions.

The *chemical* classification, imperfect though it is, offers the advantage, that it directs the attention at once to the most important constituents of the water. Some of the classes, however, are not named according to the substances contained in them in the *largest quantity*, but according to those considered most *potent*; such as the iron and sulphur waters. Another difficulty in the classification is, that some mineral waters contain several active substances in sufficiently large proportions to allow of their being placed in different classes; and, again, that some springs are so deficient in active principles as to render it doubtful where to place them. Of these latter, some appear to owe their virtues to the water alone, and its temperature, aided by the climate in which they are situated. Beginning with the latter as the most simple, we may group the mineral waters in the following principal classes:—

I. **Simple thermal waters.**
II. **Common salt or muriated saline waters.**
III. **Alkaline waters.**
IV. **Sulphated saline waters.**
V. **Iron or chalybeate waters.**
VI. **Sulphur waters.**
VII. **Earthy and calcareous waters.**

Some of the waters are chiefly used for bathing, others more for drinking, the majority for both purposes. In the consideration of the uses of the different spas, it is important to distinguish between the effects produced by the baths, and those caused by the internal use of the waters; and in larger works the plan followed by Dr. Braun, namely, to devote one section to 'bathing' and another to 'drinking courses of mineral waters,' offers advantages to the student; but in an article like the present it would be inconvenient, as frequent repetitions would be necessary.

The term 'baths' comprises not only the ordinary tub bath, but also swimming baths, or piscines; partial baths for the feet, the hands, and other parts; douches of great variety; vapour baths; and mineral mud baths. At many places also inhalations of vapour and pulverised spray form part of the treatment.

We will now give a short account of the different classes.

I. Simple thermal waters.—The simple thermal waters are characterised by poverty in solid and gaseous substances, and hence low specific gravity; by perfect transparency; by great softness; and by elevated temperature—varying in the different spas from about 80° to over 150° Fahr. Some of them contain nitrogen in larger proportions than the gases of waters usually do, others oxygen. They are often called *indifferent* waters, on account of the absence of special mineralization; and also *wild baths* (*Wildbäder*), on account of their being usually situated in wild mountainous regions.

ACTION.—The water of this class of spas when taken internally probably acts only as ordinary very pure warm water. By the drinking of warm as well as of cold water, the stomach is washed out; the secretion of bile, saliva, pancreatic juice, urine, etc. is increased; the tissue-change is augmented, and the removal of effete matters from the tissues and blood promoted; and by the acceleration of the retrogressive tissue-change, the progressive tissue-change becomes facilitated. As differences between warm water and cold water, we may mention that the latter acts more as a local excitant on the stomach, while the former is more easily absorbed, and makes less demands on the powers of the constitution, by not causing any expenditure of heat.

The simple thermal waters are much more used for *bathing* than for drinking courses; and the baths, as such, have probably the effects of ordinary warm baths, varying according to the temperature of the baths, and the time spent in them.

As the *fundamental effects of warm baths*, which effects form part of the action of all kinds of warm baths, simple as well as mineralised, we may regard:—

(1.) That they soften and purify the skin more rapidly than cold baths, and prepare it for perspiration.

(2.) That they equalise and diminish the loss of heat, and, according to the temperature of the bath, lessen and prevent it altogether; and that in the hot bath, heat is even added to the body.

(3.) That the circulation in the skin is accelerated.

(4.) That the organic functions and the tissue-change are slightly stimulated, or rather facilitated, without any strong reaction on the part of the organism.

(5.) That the nervous system and muscular irritability are calmed.

(6.) That the absorption of exudations is promoted.

These effects, as already mentioned, vary considerably with the degree of heat. In the *tepid bath* (from 80° to 95° Fahr.) the central nervous system and the action of the heart are but slightly influenced; in the *warm* bath (from 96° to 102° or 103°) the heart's action is quickened, but the respiration is generally but slightly affected; in the *hot bath* (from 103° to 110° F.) the central nervous system becomes much more excited; not only is the heart's action further accelerated, but the respiration becomes rapid, and sometimes irregular; and the hyperæmia of the skin leads to perspiration on removal from the bath.

Baths of a temperature above 110° are scarcely ever used, and only for a very few minutes. The effects vary also considerably, according to the duration of the immersion.

USES.—The *drinking courses* of these waters may assist in the treatment of irritable forms of affections of the throat, stomach, and intestines, with spasmodic cough, cardialgia, constipation from sluggish secretion of bile and intestinal juices; and by increasing the tissue-change, they are useful in chronic rheumatism and gout.

One of the main uses of the simple thermal baths is to allay over-excitability and hypersensibility of the nervous system in its various spheres; thus they often act beneficially in cases of neuralgia, hyperæsthesia, painful menstruation, and hysterical tendency. Their reputation in painful wounds and cicatrices is historical. In these cases, as well as in chronic rheumatism in its various forms, and sciatica, the hotter are more useful than the tepid baths. In some forms of paralysis and loss of muscular power depending on peripheral changes, such as exudations on nerve-sheaths, good effects are produced; but if they are caused by changes in the centres of the nervous system, not much is to be expected. In gout the internal use of other mineral waters is generally required, but as second courses the simple thermal waters are often useful; and in many delicate gouty persons the balneotherapeutic treatment ought to be restricted to courses of tepid baths, aided by climate and diet. Most of these conditions can be also treated with other waters.

ENUMERATION, AND SELECTION.—The choice of a simple thermal spa is to be guided, not by the name of the disease alone, but also by the state of constitution, and many concomitant circumstances. The simple thermal waters deserve, *cæteris paribus*, the preference, when gentle management is required—when it is desirable to make as slight demands as possible on the powers of the constitution. Their action is in this respect greatly assisted by the mountainous climate enjoyed by the majority of these baths. The selection of a special spa in a given case depends on the nature of the case in the widest sense; on the degree of elevation which is desirable; on the means of treatment obtainable and customary at the different spas, including the most important agent—the spa physician; on the accommodation, the food, manner of living, and social conditions; on the distance and means of reaching the spa; and on many other circumstances. Information on these subjects can only be obtained by the study of larger works (*see* the English edition of Braun's Work on Baths, pp. 123 to 192), and by personal visits. We can give here only the names of the principal spas of this class arranged according to their elevation:—

Name.	Country.	Elevation (approximative). Feet.	Temperature of springs. Fahrenheit.
Panticosa	Spain (Pyrenees)	5000	77°-92°
Leukerbad (Loeche les Bains)	Switzerland	4600	102°-122°
Bormio	Italy	4300	90°-104°
Gastein	Austrian Alps	3300	95°-114·8°
Pfäffers	Switzerland	2115	100·4°
Johannisbad	Bohemia	2000	86°
Bagnères de Bigorre	France (Pyrenees)	1850	90°-95°
Ragatz	Switzerland	1570	96°
Badenweiler	Baden	1425	86°-90·5°
Landeck	Silesia (Prussia)	1400	66°-84·2°
Wildbad	Wurtemberg	1323	95°-98·6°
Plombières	France	1310	66°-156°
Luxeuil	France	1300	65°-163°
Neuhaus	Styria (Austria)	1200	95°
Liebenzell	Wurtemberg	1113	72°-82°
Warmbrunn	Silesia (Prussia	1100	96·8°-104°
Buxton	England	1000 (nearly)	82°
Schlangenbad	Nassau (Prussia)	900	81·5°-86°
Néris	France	800	114°-125°
Römerbad and Tüffer	Styria (Austria)	700-800	93°-100°
Teplitz	Bohemia	650	95°-120°
Lucca	Italy	500	100°-129°
Bath	England	100	100°-120°

Many other slightly mineralised warm waters, whose principal action is to be referred to water and heat, might be mentioned here, while several of the places contained in the list, as Leukerbad, Bormio, Bagnères de Bigorre, and Bath, might find places in other divisions.

The very hot Algerian baths, Hammam-Meskoutin, Biskra, and Hammam R'Irha, the last beautifully situated some sixty miles from Algiers, belong likewise to this class.

Allied in their action, though more powerful in their demands on the system, and in their effects, are the natural hot vapour baths in the large cave of Monsummano in Upper Italy, and in the smaller excavation in the rocks of Battaglia in the Euganean mountains.

II. Common salt or muriated saline waters.—Composition.—Common salt or chloride of sodium is the principal solid constituent of the waters of this class; but this substance is contained also in many other mineral waters, especially in some alkaline, in some sulphur, and some Glauber's salt waters, and has a considerable share in the effects of these waters.

Action.—In order to appreciate the action of the common salt waters, we must bear in mind that common salt forms part of all the tissues and juices of the body; that it acts as a solvent in the stomach, promoting digestion; that it is essential to the formation as well as the disintegration of cells and tissues; that it stimulates not only the retrogressive, but also the progressive tissue-change or nutrition of the body; and that it is a great agent in the endosmotic qualities of the blood and in the processes of secretion and absorption. Chloride of sodium stimulates the secreting apparatus of the stomach and intestines, and hence the action of the bowels, and the circulation of the portal system, and indirectly the general circulation. It quickens the tissue-change, and through this, as well as the increased circulation, promotes absorption of pathological products, without lowering the organism. In larger doses, however, beyond about five drachms per diem, irritation of the mucous membrane of the stomach and intestines may be produced. The action of the common salt waters is modified by their accompanying properties, especially by the carbonic acid contained in them, by their temperature, and by the degree of their concentration.

The *carbonic acid* in this and other classes of waters quiets the sensitive nerves of the stomach; stimulates the secretion and peristaltic action of the stomach and bowels; and indirectly increases the secretion of the kidneys. In large quantities, however, if not rapidly ejected by eructation, it may produce, by being absorbed, poisonous effects on the blood and nervous system. The presence of carbonic acid in salt waters increases the effects of chloride of sodium on the stomach and intestines, and by accelerating the passage of the waters from the stomach into the intestinal canal, promotes the action of the bowels.

Elevation of the temperature of the water produces more rapid absorption, and thus diminishes the local, and increases the more distant and constitutional effects.

Concentration increases the local stimulation.

As to the action of these waters in the form of *baths*, the chloride of sodium and other chlorides (though any absorption through the skin of these and other salts contained in mineral waters is doubtful or, at all events, forms only a small part of their therapeutic effects) stimulate the cutaneous ends of the nerves and the capillaries, and promote through this the nutrition and tone of the skin, and indirectly the tissue-change, an action which is heightened by the presence of carbonic acid, as witnessed at the gaseous saline baths of Rehme and Nauheim.

Uses.—Salt waters and salt baths are useful in weakness of the skin; in tendency to rheumatic fever or bronchitis; in retarded convalescence from acute and chronic illness; in enlargements of joints from preceding inflammation; in scrofulous complaints; in many forms of anæmia and chlorosis—especially those where iron alone is not borne; in numerous cases of Indian cachexia; and in cases of sluggish circulation in the portal system, which leads to innumerable varieties of digestive troubles, to congestion of the liver, and of the pelvic organs in women, and to piles.

Enumeration, and Selection. — The same classes of cases, as far as the name goes, are treated also by alkaline and sulphated waters. The individual conditions must guide the practitioner in deciding for either the one or the other kind of waters, and for the special spa, according to the strength of the springs, the amount of carbonic acid, and concomitant conditions. Spare and pale persons, we may mention, mostly bear the common salt waters better than strongly alkaline and sulphated waters. Common salt waters are to be found in almost all countries; we can only give the most important or best known. In *England*:—Droitwich —perhaps the strongest of all brines, with good arrangements—Nantwich, Middlewich, Woodhall, and Harrogate; Leamington and Cheltenham contain likewise much common salt, in addition to sulphate of soda. In *Germany*:—Kissingen, Homburg, Rehme-Oeynhausen, Nauheim, Kreuznach, Soden, Pyrmont (which contains salt as well as iron springs), Wiesbaden, Hall in Austria, Hall in the Tyrol, Hall in Wurtemberg, Reichenhall, Ischl, Kreuth, Dürkheim, Salzungen, Canstatt, Cronthal, Baden-Baden, and several others. In *France*:—Bourbonne-les-Bains, Lamotte-les-Bains, Balaruc, Salins. In *Italy*:—Ischia, Castellamare, Monte Cattini, La Porretta. In *Switzerland*:—Bex.

III. Alkaline Waters.—Composition.—The alkaline waters contain *carbonate of soda* as a prominent constituent; they are also more or less rich in *carbonic acid*; and some are distinguished by so large a proportion of *chloride of sodium* as to warrant a sub-division into—(1) *simple alkaline waters*; and (2) *muriated alkaline waters.*

Action.—In considering the dietetic and medicinal value of these waters, we must bear in mind that soda in combination with carbonic acid is a most important constituent of the human body. Oxidation and tissue-change seem to be greatly influenced by the presence of soda; various proteinaceous bodies seem to be kept in solution by it; it has a considerable share in the secretion of saliva and bile, and in the digestive processes; and, according to Liebig, it acts as a vehicle for the carbonic acid from the blood to the lungs.

Carbonate of soda may be considered as an antacid, as a diuretic, as a promoter of tissue-change, and as a solvent. The beneficial effects of alkalis are in general produced only by a systematic use of *small* doses; whilst *large* quantities cause, by their excessive solvent effect, emaciation, and, by their depressing influence on the heart's action, diminish the tissue-change. The action of soda differs in this respect from that of chloride of sodium, which even in considerable doses increases the tissue-change, and does not so easily exercise an emaciating effect.

Uses.—The conditions in which alkaline waters are mostly employed are certain forms of dyspepsia, with undue acidity of the stomach; congestive conditions of the liver from sluggish portal circulation; tendency to gallstones; diabetes; uric acid diathesis, and its results—gravel and lithiasis; some forms of gout; and especially chronic catarrhal affections of the mucous membranes of the respiratory, digestive, and genital organs.

Enumeration, and Selection.—Where it is necessary to improve the state of the blood, or to avoid emaciation, the muriated alkaline are preferable to the simple alkaline waters.

1. The principal spas with *simple alkaline waters* are:—*a. Hot*:—Vichy, Neuenahr, Mont Dore, Chaudes Aigues, and Neris, the three last being feebly mineralised; *b. Cold*:—Apollinaris, Vals, Salzbrunn, le Boulou, Evian, Bilin, Fachingen, Geilnau, Wilhelmsquelle, Taunus, Giesshübel, Soulzmatt, and Marcolo.

2. The chief *muriated alkaline waters* are—(*a*) Ems, Royat, and La Bourboule, which represent the *hot* springs; whilst (*b*) Luhatschowitz, Selters, Gleichenberg, Roisdorf, Rosbach, Vic-sur-Cère, and Toennistein are *cold*.

We ought to remark that several of the waters in this class, especially la Bourboule and Mont Dore, contain *arsenic* in appreciable quantities.

IV. Sulphated waters.—Composition.—We include under this term those springs which are characterised by a preponderating amount of the sulphates of soda or magnesia, or both sulphates together. They may be subdivided into (1) *simple sulphated waters* or *bitter waters*; and (2) *alkaline sulphated waters*, which latter contain also carbonate of soda and chloride of sodium.

Action.—The *bitter salts* can scarcely be said to be constituents of the organism; they seem to act by stimulating, and in larger doses irritating the mucous membrane of the stomach and alimentary canal, causing thin watery secretion, and in large doses diarrhœa. Sulphate of soda is less irritating than sulphate of magnesia. The peristaltic action of the bowels is likewise increased by them. Their continued employment is apt to cause emaciation. By the presence of carbonate of soda and chloride of sodium, the action of the bitter salts is modified.

Uses.—The bitter waters are useful in habits of constipation with sluggish portal circulation, in hæmorrhoidal tendencies, in congestion and enlargement of the liver and spleen, in some forms of dyspepsia, in gallstones and allied affections, in gouty conditions, lithiasis, and diabetes; and, *cæteris paribus*, have in stout and in so-called plethoric persons, the preference over the muriated saline waters.

Enumeration, and Selection.—Where prolonged courses are required the weaker sulphated waters, and especially the alkaline sulphated waters, are to be preferred; whilst the stronger bitter waters, are more frequently selected for occasional purging doses. 1. The principal *simple sulphated* or *bitter waters* are:—Galthof, Pullna, Saidschutz, Sedlitz, Birmensdorf, Ivanda, Hunyadi Jànos and other springs near Ofen, Epsom, Aranjuez, Friedrichshall, and Mergentheim, the two latter being also rich in chlorides. Weaker springs of a similar nature are at Leamington and Cheltenham—both with a large amount of common salt, at Scarborough, and at the Purton Spa. 2. The principal *alkaline sulphated waters* are Carlsbad, Marienbad, Tarasp-Schuls, Franzensbad, Elster, and Bertrich. The constitution and the action of the waters of Carlsbad and Bertrich are modified by their thermal nature.

V. Iron or chalybeate waters.—Composition.—Iron is contained in the majority of mineral waters; but we regard as iron waters only those where the quantity of iron is, in proportion to the other constituents, so far predominant as to give a therapeutic character to the springs.

Action.—The formation of blood-globules, the contractility of the blood-vessels, the oxidation and the production of heat, and the general nutrition of tissues seem to be favoured by the use of iron waters. A small quantity only of iron seems to be absorbed by the stomach, none through the skin; the action of chalybeate baths seemingly being due to the influence of the water and carbonic acid only.

Uses.—The conditions most benefited by chalybeate waters are the various forms of anæmia, or poverty of blood and particularly of red corpuscles, especially when caused by actual loss of blood, suppuration, or previous acute or chronic disease. The liver and digestive organs, however, must be in healthy working order, whilst in cases of anæmia accompanied by congestion of the liver and spleen, chalybeates alone are rarely useful, but must be preceded or modified in their action by the use of saline waters; and this is often the case not only in anæmia of Indian and malarious cachexia, but also in chlorosis. Neuralgia, sterility and impotency, and general debility are often benefited through improvement of the general health. Those iron waters are most useful which contain the iron in the form of the bicarbonate of the protoxide, kept in solution by free carbonic acid.

Enumeration, and Selection.—Iron springs are (1) *comparatively pure*, that is containing only a few grains of other substances in 16 ounces of water:—Schwalbach, Spa, Brückenau, Schandau, Liebwerda, Flinsberg, Freienwalde, Recoaro, Koenigswarth, Liebenstein, Altwasser, Alexisbad, Muskau, Tunbridge Wells, and one spring at Harrogate: (2) *compound iron springs*, that is, which contain, in addition to iron and carbonic acid, a moderate quantity of other salts, especially the carbonates of soda, lime, and magnesia, the sulphates of soda, magnesia, and lime, and common salt:—Aratapak, Orezza, Pyrmont, Driburg, Rippoldsau, Griesbach, Antogast, Petersthal, Bocklet, St. Moritz, Reinerz, Godesberg, Cudowa, Imnau, and Santa Catarina.

VI. Sulphur waters.—Composition.—Amongst sulphur waters we class those springs which contain either sulphuret of hydrogen, or the sulphuret of sodium, calcium, potassium, or magnesium, in an appreciable and constant proportion. They are partly thermal, partly cold; and some of them, especially Aix-la-Chapelle, Uriage, and Baden in Switzerland, contain a considerable proportion of common salt and other solids, which are to be taken into consideration in the appreciation of their effects.

Action.—It is difficult to describe the physiological effects of the sulphur waters, as far as they depend on such minute quantities of sulphur as are contained in them. Sulphur water baths seem to act in the same manner as simple baths. If the waters are taken internally, some sulphuretted hydrogen is probably absorbed, entering the circulation through the portal vein. The pure sulphur waters exercise a constipating rather than an aperient effect. The fæces become mostly blackened from sulphuret of iron. The protracted use of these waters is apt to lead to a certain degree of anæmia, possibly from the action of the sulphur on the iron of the blood-globules.

Uses.—Sulphur waters are mostly used in combined bathing and drinking courses, as also by inhalation, in cases of metallic poisoning; in congestion of the liver; piles; bronchial, laryngeal and pharyngeal catarrh; in early chronic phthisis; in numerous cutaneous affections, especially the herpetic dyscrasia of the French; in rheumatism and gout; and in constitutional syphilis.

Enumeration, and Selection. — The best known *thermal sulphur waters* are: — Eaux Bonnes, Eaux Chaudes, Cauterets, Saint Sauveur, Barèges, Bagnères de Luchon, Ax, Escaldes, Le Vernet, Amélie-les-Bains, Uriage, Allevard, Aix-les-Bains, Aix-la-Chapelle, Baden in Austria, Baden in Switzerland, Lavey, Schinznach, Battaglia and Abano in the Enganean Mountains; Panticosa; Mehadia, and other springs in Hungary; and Helouan or Helwan, near Cairo. *Cold sulphur springs* are:—Eilsen, Nenndorf, Langenbrücken, Weilbach, Meinberg, Reutlingen, Enghien, Challes, Stachelberg, Heustrich, Gurnigel, some Harrogate springs, Llandrindod and Builth in Wales, Moffat and Strathpeffer in Scotland, and Lisdunvarna in Ireland.

VII. **Earthy and calcareous waters.**—Composition.—As *earthy* and *calcareous waters* we designate those springs in which the earthy substances, especially carbonate and sulphate of lime and carbonate of magnesia, form the prominent constituents.

Action.—In the shape of baths, the earthy waters act almost in the same way as ordinary water baths. Internally taken, the carbonate of lime exercises an antacid and a soothing effect on the mucous membrane of the stomach and intestines, and together with the sulphate of lime is slightly astringent and constipating. If lime is absorbed, it may possibly assist in the formation of cells and of bone, and may exercise also a soothing effect on other mucous membranes; this point, however, can scarcely be regarded as settled.

Uses.—These waters, according to their composition, are useful in digestive troubles with tendency to acidity, diarrhœa, and undue irritability of the mucous membrane. They are employed also in osteomalacia, rhachitis, and tuberculosis; and further, in some skin-diseases, especially in eczema and psoriasis, where, however, the long continuation of the warm bath, that is the soaking of the skin, is of more importance than the nature of the solid constituents contained in the water. Some of these waters possess a great reputation in chronic catarrh of the bladder, and in tendency to gravel and stone; but probably the large quantity of water consumed, as for instance, at Contrexeville, and the consequent dilution of the urine and the washing out of renal tubules, are here to be regarded as the principal causes of the useful effect. The best known earthy or calcareous waters are:—Wildungen, Lippspringe, with the Inselbad, Weissenburg, Contrexeville, Bagnère-de-Bigorre, St. Arnaud, and Cransac; and amongst the table waters:—Couzan, St. Galmier, and the Taunus water.

Many of the waters mentioned in other classes might also be mentioned here, such as Bormio, Leuk, Bath, and Lucca, named under the simple thermal waters; and Baden in Austria, Baden in Switzerland, Schinznach, Battaglia, Abano, and others enumerated under the sulphur waters.

On prescribing mineral waters and baths. In every case we must first settle the question whether the treatment by mineral waters and baths offers advantages over ordinary treatment. If the question is answered in the affirmative, we have to consider not only the nature of the disease, but quite as much the nature of the individual in whom it occurs; the amount of vital forces in general; the power of reaction; the state of the different organs; and whether they can assist in relieving the diseased part of the organism, or whether they are unable to respond to any unusual demand made on them. Thus we shall be enabled to decide whether stronger therapeutic influences can be employed; whether longer and rougher journeys are permitted, and colder climates and seasons; or whether delicate treatment is essential, comprising the simple thermal baths, summer temperature, mountain climates of moderate elevation, and easy journeys. The baths and waters are not to be selected according to the chemical constitution of their springs alone, but the means and appliances in use, and the accustomed methods of treatment at certain places, the qualities of the local physician, the accommodation, the food, the cooking, and the social conditions, the facility of reaching a place, the climate and other elements of 'change,' are each and every one to be taken into consideration. It must be evident already from these remarks, that the same morbid affection can occasionally be treated with advantage by different classes of mineral waters and at different spas, and that apparently widely different diseases may be benefited by the same spa; not only because many mineral waters are composed of different active elements, but also because the internal and external administration of the same water may be so much varied as to produce a great variety of effects. In many instances the disease itself cannot be directly attacked, but our efforts must be directed towards improving the general constitution, and through this influencing the diseased portion of the organism.

We cannot do more here than give some hints regarding the groups of diseased conditions in which mineral waters may be prescribed.

1. *Anæmia.*—In cases of anæmia it is essential to consider whether the condition is caused, first, by direct loss of blood and its component parts; secondly, indirectly by acute or chronic disease,

sleeplessness, neuralgia, and inability to take up food; thirdly, by congestion of the pelvic organs, with loss of blood and albuminous juices; or, lastly, by lymphatic diseases, or visceral affections resulting from warm climates. The more the first cause preponderates, the more we may expect from the direct use of iron; and we have then to consider whether pharmaceutical preparations, or iron waters with or without change of climate, with or without baths, are to be preferred, or whether iron springs are to be recommended. In the indirect forms of anæmia the mildest thermal treatment, with mountainous climates of moderate elevation, or the latter alone, are often the only beneficial courses in delicate constitutions; whilst in others somewhat less feeble according to individual conditions, common salt waters and baths with or without iron, or the gaseous tepid salt baths of Nauheim and Rehme, or the much stronger influences of sea air and of sea baths, are useful. In the third group the common salt waters with a certain amount of iron, and occasionally the sulphated saline waters, must generally precede every other attempt at strengthening; for the acceleration of the portal circulation, the regular emptying of the different branches of the portal vein, and the increased tissue-change are essential to the improvement of the nutrition and sanguification; and only after such a preliminary course the purer iron waters and the higher alpine air are likely to become useful.

2. *Sluggish portal circulation.*—A sluggish condition of the portal system forms a frequent complication, not only of anæmia, but of a great many ailments of the different systems of the body; and is often only a part of a general want of tone in the organic muscular fibre, especially of the right ventricle and of the whole venous system. It is difficult to find a name for these, by no means, rare constitutional defects, which form the main characteristics of what the old German physicians called 'abdominal plethora.' If we only know what we mean by the terms, we may call these conditions *portal venosity* and *general venosity* according to the extent of the defect. They form the principal complications and in many cases the main cause of the most varied digestive troubles, as acidity, sickness, flatulency, constipation, and intestinal catarrh. They are also at the root of congestion of the hæmorrhoidal vessels and piles, of varicosity of the legs, of congestion of the womb and ovaries and menstrual anomalies, of congestion of the liver and imperfect secretion of bile, and of chronic bronchial catarrh, with dilatation and imperfect contraction of the right ventricle. Gravel and gout are likewise often associated with sluggish portal circulation. In the treatment of these very numerous complaints, widely different though they appear to be, we have therefore always to ask in how far they are complicated by portal venosity, and in how far diet, regimen, pharmaceutical and balneotherapeutic treatment directed against this venosity may relieve the special case before us. If this portal venosity occur in *lean* and *delicate* persons, the common salt-waters as Kissingen, Homburg, Soden, &c., which increase the tissue-change without impairing the nutrition, internally and in the form of baths, or the simple thermal baths in sub-alpine situations, assisted by the internal use of salt waters, are often useful. If the individual be *stout* and inclined to costiveness, the sulphated saline waters with soda and common salt, such as Carlsbad, Marienbad, Franzensbad, Elster, and Tarasp, are the most effective; while again in others of this class the simple alkaline waters, such as Vichy, are preferable. In all these cases, however, the treatment by waters and baths ought to be assisted by regulation of diet and exercise.

3. *Gravel.*—Gravel, especially uric acid gravel, is usually complicated with portal venosity, and is to be treated accordingly. As a symptomatic treatment, the alkaline mineral waters have a more lasting effect than the administration of pharmaceutical preparations; but more effective are alkaline waters containing sulphates, and especially the less concentrated and hot springs of Carlsbad. Most useful of all, especially for home treatment, are the waters of Luhatschowitz, with their peculiar combination of carbonates and chlorides.

4. *Gout.*—Gout is likewise often complicated with and aggravated by portal venosity, and we must always endeavour to facilitate the removal of the products of the retrogressive tissue-change; but gout occurs in the most widely different constitutions. If gout and its allied forms be met with in so-called strong constitutions, with a good primary digestion, ability to sustain a long morning fast, accompanied perhaps by a tendency to stoutness, and an acid urine of tolerably high specific gravity, becoming iridescent with nitric acid, the alkaline sulphated waters of Carlsbad, and sometimes those of Marienbad, Franzensbad, Elster, and Tarasp are most useful, though they cannot altogether remove the gouty disposition. If the time be short, and a long rest after the course not permitted, the simple alkaline waters of Vichy may be selected, and in more delicate constitutions the muriated alkaline waters of Royat, Ems, or Baden-Baden. In lean and decrepit gouty patients the common salt-waters of Homburg, Kissingen, Harrogate and Leamington, the arsenical salt-waters of La Bourboule, the waters of Wiesbaden, the muriated sulphur waters of Aix-la-Chapelle, or, again, weak muriated alkaline waters like Baden-Baden, deserve a trial. In many delicate persons the simple thermal waters of Buxton, Schlangenbad, Wildbad, Ragatz, Gastein, and Bath, and the sulphur waters of Aix-les-Bains and Bagnères-de-Luchon, offer great advantages; but numerous cases may be regarded as quite intractable by baths, waters, and medicines, and in these diet and climate are the only means of management.

5. *Chronic Rheumatism.*—In chronic rheumatism, associated with exudation round the joints, the hot thermal treatment, either at the hotter simple thermal spas, as Bath, Teplitz, the Euganean baths, or the natural vapour baths of the cave of Monsummano, at the weaker hot salt-waters of Wiesbaden and Baden-Baden, or at the thermal sulphur waters, such as Aix-la-Chapelle, Aix-les-Bains, Barèges, Bagnères-de-Luchon, Eaux Chaudes, &c., are the most useful; or in more delicate cases, the gaseous thermal salt

waters of Rehme and Nauheim. In the muscular varieties, with stiffness, the hotter waters, assisted by douches and shampooing, are specially indicated. In many instances, however, the cause of constantly recurring rheumatism is weakness of the skin, and here the tonic forms of the cold water-cure and sea-baths promise more permanent good than hot baths.

It is impossible, in a short treatise, to enter into all the morbid conditions suitable for balneotherapeutic treatment; but the preceding remarks may show that the physician, in prescribing waters, ought to base his advice on the teachings of physiology, pathology, climatology, and general therapeutics, in the widest sense.

We might be expected to give a few hints on diet, during mineral-water courses, but no general rules can be laid down. Every individual requires rules for his own case, and rules which may be necessary during the use of muriatic saline, or sulphated saline waters, are not necessary in other courses—for instance, of simple thermal or of iron waters.

The bath physician ought to guide every invalid, according to his or her individual condition, as well with regard to diet, as to the internal or external use of waters, and with regard to exercise and other hygienic and therapeutic aids. The result of a course of waters often depends entirely on this guidance. It is important, therefore, to supply the bath physician with a statement as to the ailments and the constitution of the invalid.

Length of Treatment.—It is a general belief that three or four weeks is the term for a course of waters or baths; but it is impossible to fix a definite time. As courses of iodide of potassium, of iron, of quinine, or of mercury must be of different duration in different individuals, exactly so we find it with mineral waters; and as two or three courses of a remedy may have to be taken in the same year, so it is often desirable to give two or three courses of Vichy, of Carlsbad, or of Spa waters, in one year, though not all of them need be taken at the spring. In many cases preparatory courses are advisable, climatic, medicinal, and balneotherapeutic, and in as large a number secondary courses. Most invalids would do well not to return immediately after a course of baths to their usual abodes and accustomed ways of living. In many instances, however, it is imperatively necessary to abstain from work, and to keep to a simple diet for about a month or more after the course of waters, and this is especially the case with the more powerful waters like Carlsbad and Marienbad.

Season.—As to the period of the year, there is no time when the different waters might not be drunk, if it were necessary. Most spas are open only from May till October, some longer, some only from June till September; but some few localities are partially open also during winter, especially Aix-la-Chapelle, Aix-les-Bains, Baden-Baden, and Wiesbaden. Many waters can be taken at home, and at any time of the year; but the elements of change are wanting, and the strict adherence to regimen and diet is often difficult. During the summer months the demands on the human body are diminished, by the external warmth and the greater equability of the meteorological influences; nature is more exhilarating, and invites to outdoor life and exercise, without much risk of chills and their consequences; and delicate persons, therefore, ought to select the summer months for courses at the spas. The later parts of the spring and the autumn, however, offer advantages to the more robust, who at those times find the baths and the hotels less crowded, and who can then receive more attention from the bath physician. And, besides, those who are unable to bear heat have in the earlier and later parts of the season the benefit of cooler air, which is to the average visitor a real advantage at some of the hotter localities, like Aix-les-Bains, Aix-la-Chapelle, Ems, Creuznach, Soden, Baden-Baden, and Ragatz.

Hermann Weber.

MISCARRIAGE.—Synon.: Abortion; Fr. *Avortement*; *Fausse Couche*; Ger. *Fehlgeburt*.

Definition.—Miscarriage is the interruption of gestation before the fœtus has become viable.

Frequency.—The relative frequency of miscarriages, of premature labours (between the seventh and ninth months), and of full-time births, cannot be very closely estimated. Early abortions are often unnoticed or forgotten. The statement of Dr. Whitehead is very striking, that of sixty-four women who had lived in wedlock till the ménopause, there were only eight who had not at some time had a miscarriage. His statistics show that the period at which abortions most frequently occur is about the third month.

Ætiology.—The causes of abortion may be found either:—(1) on the part of the ovum or fœtus; or (2) on the part of the mother.

1. *Fœtal.*—The causes of miscarriage on the part of the ovum are:—(*a*) all the diseases of the fœtus itself which compromise its life, such as acute fevers and chronic diseases—chiefly of syphilitic origin; and (*b*) many of the morbid changes in the fœtal appendages. Of the latter the most noteworthy are, first, diseases of the chorion, the more familiar of which is the hydatidiform degeneration; secondly, abnormal conditions of the umbilical cord, such as excessive torsion with constriction of the vessels, convolutions of it simultaneously round the neck and lower extremities, and the formation of tight knots upon it; and thirdly, abnormal relations and morbid conditions of the placenta. Where the placental area, for example, is of too limited extent, the ovum easily becomes detached from the uterus; where it is too large, extravasations of blood easily take place in the lobules. When the placenta is planted low down in the cavity of the uterus, it is liable to partial detachments; and thus in a great many cases abortion takes place at an early stage in patients who would have been subject to the greater dangers of unavoidable hæmorrhage, had the pregnancy gone on towards the usual term. Again, the morbid processes which occur in the placenta, inflammatory, degenerative, or apoplectic, whether due to a syphilitic taint, or to other causes, lead to death of the embryo or fœtus, and thus in many instances to the early casting of the ovum. It is worth while to note that death of the embryo, and morbid changes in its appen-

dages, do not necessarily at once cause abortion. Three or four weeks usually elapse after the death of the fœtus ere its expulsion is effected; the decidual membrane having in the interval undergone retrogressive changes. It is only when such an extravasation of blood takes place as leads to sudden distension of the uterus, or when the membranes burst and such escape of liquor amnii occurs as leads to its sudden collapse, that the organ is stimulated to the immediate evacuation of its contents. Hence, while the ultimate cause of abortion is often enough traceable to the ovum, the immediate occasion is more frequently due to some maternal condition.

2. *Maternal.*—The causes of miscarriage on the part of the mother are either (*a*) *general*; or (*b*) *local.* (*a*) Amongst the *general* or constitutional conditions that favour the occurrence of abortion we note, first, all the causes that lead to depression of a woman's health. Abortions are frequent, for instance, in times of famine; amongst women who yield themselves to excesses; in anæmic women; and in those tainted with the syphilitic poison. Often enough, especially in the last class, the cause of the abortion can be traced to some morbid change in the maternal portion of the placenta; but sometimes it seems to be due simply to the impure or impoverished condition of the patient's blood. Secondly, fevers, such as the zymotic fevers, and acute inflammations, more particularly of important viscera, such as pneumonia, occurring in gravid women, very frequently become complicated by abortion. Thirdly, shock may bring on miscarriage, whether operating simply through the nervous system, of which we meet occasional examples; or, as is more frequently the case, by producing a more direct physical impression upon the uterus, as in cases where the patient leaps or steps suddenly down from a height, lifts a weight, stretches her arms above the head, or is exposed to any sudden jar or more protracted jolting. Though many cases of abortion are attributed to such a cause, it is always to be borne in mind that in some of these, at least, that supposed cause would not have led to the disaster unless there had already existed a predisposition in some morbid condition of the uterus or its contents.

Amongst (*b*) the *local* causes we find, first, and most frequently, diseased conditions of the deciduæ. Commonly in these cases the patient had previously been the subject of chronic endometritis; though occasionally cases are met with where there have been no marked symptoms previously, and the degenerative process may affect either the vera or reflexa or serotina, separately or simultaneously. Second in frequency under this head we have the abortions due to displacements of the uterus, these being commonly either descents or retroversions. Thirdly, neoplasms of the uterus, such as cancers or fibroid tumours, sometimes permit the occurrence of conception, but prevent gestation running to its natural term. Fourthly, the presence of tumours in the neighbouring organs, or inflammatory adhesions among them, may prevent the uterus from attaining its full growth, and compel it to early evacuation of its contents.

Symptoms and Diagnosis.—In dealing with a case of suspected miscarriage, we have to determine first that the patient is pregnant. This we do by a careful inquiry into the patient's history, and a complete physical diagnosis. Supposing that, by the usual investigation into the signs and symptoms of pregnancy, we are satisfied that gestation had begun, we have next to ascertain whether miscarriage is only threatening to come on, has fairly set in, or has already been completed.

The symptom that, in the great run of cases, first attracts attention, which usually goes on till the process is completed, and which continues for some hours or days subsequently, is hæmorrhage. The amount of blood lost varies indefinitely; and so does the manner of its escape. In certain cases the onset of pelvic pains, with the regular intermissions that betray their origin in the muscular contractions of the uterine walls, alarms the patient and attracts her attention before any escape of blood has taken place. These cases are exceptional. Usually the hæmorrhage precedes—and it may be for days or weeks—the expulsive action of the uterus. The cases, however, are rare unless they be instances of very early abortion, where the process is completed without the accession of appreciably painful contractions. Occasionally there occur discharges of liquor amnii or other watery fluid, or of fragments of the degenerated membranes, or of the disintegrated fœtus.

These symptoms call for physical exploration of the uterus. If we find the uterus gravid, with the os undilated and the cervical canal above it unexpanded, the hæmorrhage being slight and the pains controllable, we regard and treat the case as one simply of threatened abortion. But if the pains are persistent, if the os uteri opens to admit the finger, or the canal of the cervix above it is becoming expanded; still more, if the uterine contents are being pressed down within reach of the exploring finger, we have to do with an actual abortion which it is useless to seek to avert. The treatment of actual abortion is often enough called for, even with quiescent uterus and closed canals, when the hæmorrhage is profuse.

In trying to determine whether the miscarriage is completed, we have first to examine the mole or mass that has been expelled. This consists sometimes of the ovum alone; of the ovum and decidua reflexa; or of the ovum with all the uterine deciduæ. Where the uterine contents escape in broken-down fragments, and cannot be satisfactorily pieced together, it becomes necessary to examine the uterus, and even to explore the interior of that organ with the finger; and in these and other cases where the diagnosis is doubtful, it may be requisite sometimes to dilate the cervix with a carbolized sponge-tent, in order to get full access to the uterine cavity.

Treatment.—The treatment of miscarriage varies according as we have to do with a case of (1) threatening abortion; or (2) abortion in actual progress.

Treatment of threatening abortion.—The treatment in a case where abortion is merely threatening is largely expectant. The patient is put to bed and kept at rest in the recumbent position.

All exercise or excitement, physical or psychical, must be forbidden. A light, non-stimulating diet, with fluids for the most part cold, is to be enjoined; and any tendency either to constipation or to diarrhœa is to be combated. Where the hæmorrhage is continuous and the uterus atonic or flaccid, small doses of ergot—twenty drops, every six or eight hours, of the extractum ergotæ liquidum—are useful. Dilute sulphuric acid or gallic acid, either alone or in combination with digitalis, may be administered. Where there are occasional pains accompanying the discharge, the best effects are obtained from the administration of opiates, which may be prescribed in the form of the acetate of lead and opium pill. Where the pains constitute the more urgent symptom, and the hæmorrhage is less, it may be well to check the uterine action at once by the use of an anæsthetic followed by opiates, or the administration of a dose of chloral; and the astringent may then be dispensed with. The opiates in such cases are best administered hypodermically or *per rectum*.

Treatment of actual abortion.—Where the stage of expectancy is clearly over, and the patency of the os internum, the persistence of the pains, or the profusion of the hæmorrhage, calls for active interference, there are two main indications to be fulfilled, namely, to restrain the hæmorrhage; and to ensure the complete evacuation of the uterus.

To restrain the hæmorrhage we compel the uterus to more energetic contraction, first, by the administration of large repeated doses of ergot. A drachm of the liquid extract may be given every three or four hours; but the effect of the drug can be most speedily and safely ensured by the hypodermic injection of ergotin—according to some such a formula as this:—℞ Ergotin. ʒij; chloral hydratis, ʒss; Aquæ destillatæ, ʒvi—16 drops to be injected into the gluteal muscle. The dialysed solution of ergotin is said to produce less irritation. Secondly, the genital canal must be plugged. Where we have no other means at command of checking the discharge, a carefully applied vaginal tampon may be trusted; or the vaginal plug may be used where the hæmorrhage is going on, but there is still some hope that the abortion may be arrested. Where the indication is more urgent, the introduction of a sponge-tent into the cervical canal is very much more satisfactory, and in every way more efficacious. It arrests the hæmorrhage immediately and inevitably; it excites the uterus to more energetic action; and it at the same time expands the cervical canal in all its length.

The complete evacuation of the uterus may take place by the unaided efforts of its muscular walls. On visiting a patient in the morning, who had a sponge tent passed into the cervix uteri, and a hypodermic injection of ergotin over night, we may find sponge and ovum and all expelled. Where the ovum is still *in utero*, if it be loose and the cervix dilated, compression of the uterus from above the pubes may suffice to make it expel its contents. Usually, however, it becomes necessary to get at the interior of the uterine cavity with a finger or fingers passed through the vaginal canal. In most cases it greatly facilitates the operation to anæsthetize the patient, and in some cases the previous administration of chloroform is absolutely necessary. To render the uterus accessible to the exploring fingers, it must either be pushed down from above or dragged down from below. The patient lying unconscious on her back, the fundus uteri may be depressed by the left hand pushed firmly and steadily down through the pelvic brim. The depression may be effected by an assistant, but never so satisfactorily as by the operator himself. Not less than two fingers of the right hand should be used for the internal manipulation; the middle finger being folded in the fornix vaginæ, whilst the index passes through the os to the fundus uteri, and sweeps round the entire ovum, detaching it at any adherent points. Sometimes the middle finger more conveniently enters the uterine cavity; and in most cases of miscarriage in the fourth month, the whole hand, except the thumb, may require to be passed into the vagina, and two or more fingers into the uterine cavity. Even where the vaginal orifice is not at first very wide, if the hand be carefully warmed and soaped, and the interstices of the fingers filled up on their palmar aspect with a quantity of half-melted soap, sufficient dilatation is speedily effected. Occasionally the smaller left hand may be employed for internal manipulation, while the stronger right is engaged in making the external pressure on the fundus uteri. Access to the interior of the uterus may in most cases be gained more easily by dragging the uterus down from below. One or other of the lips of the uterus—usually the anterior—is seized with a vulsellum, double or triple pronged, and slightly curved. One of the blades grasps the vaginal aspect of the front lip of the cervix as high up as the roof of the vagina, the other at a corresponding level within the cervical canal. The uterus is capable of being drawn far down without any injury to its ligaments, or any laceration by the bite of the vulsellum. It may be pulled down with the right hand and kept fixed by it, whilst the fingers of the left pass into the cavity, and explore and evacuate it. Or the vulsellum may be held in the left hand, or given to an assistant, to keep the uterus depressed, whilst the more familiar right-hand fingers do the intra-uterine work. The finger or fingers that have detached the ovum commonly succeed in extracting it, aided sometimes by pressure with the other hand from without. If not, there is no objection to laying hold of the loosened body with a pair of long dressing forceps, or a Lyon's or polypus forceps, and so withdrawing it; but no such instrument, even though it bear the name of abortion-forceps, ought to be trusted to for the detachment of a retained ovum or fragment of adherent placenta. The separation should always be effected by the direct action of the living finger.

After-treatment.—The uterus having been completely emptied, the patient should be kept at absolute rest in bed, and subjected to the same treatment as an ordinary puerperal female.

Alexander Russell Simpson.

MITRAL VALVE AND ORIFICE. Diseases of. *See* Heart, Valves of, Diseases of.

MODIFIED.—A term applied to a disease, or to any of the phenomena of a disease, such as an eruption, when, as the result of a recognised cause, they present unusual characters, or run an unusual course. Thus, small-pox is modified by vaccination. *See* SMALL-POX.

MOFFAT, in Scotland.—Sulphur and also chalybeate waters. *See* MINERAL WATERS.

MOGIGRAPHIA (*μόγις*, with difficulty, and *γράφω*, I write).—A synonym for writer's cramp. *See* WRITER'S CRAMP.

MOLE.—MOLAR PREGNANCY.—The moles that are met with in obstetrical practice may be conveniently divided into two classes, (A) the *false*; and (B) the *true* moles. The false moles may be briefly dismissed, but it is desirable that they should be discussed, in order to clear the ground for the consideration of the more important variety.

A. **False moles.**—False moles are not the result of conception. Substances discharged from the virgin passages are occasionally so called; for example, shreds of vaginal mucous membrane, which the microscope should recognise. There is more difficulty, however, with the membranes of membranous dysmenorrhœa, where the discharged tissues may be mistaken for true decidual membranes. The circumstances attending each case must be nicely weighed, such as the history of previous attacks, the absence of the signs or symptoms of pregnancy, and so on. Again, if the discharged membrane happen to be complete, the two openings of the Fallopian tubes and that of the cervix will be found, a condition which does not obtain in true deciduæ. Microscopical examination will also aid in the diagnosis, by proving the presence or absence of structures belonging to the fecundated ovum. Blood-clots, variously altered, may also be discharged by the non-pregnant, and give rise to doubt and difficulty; especially those partially decolourised clots, which consist mainly of fibrin, the serum and red blood-corpuscles having to a great extent escaped. The blood is probably hyperinotic in these cases. Careful examination is necessary to determine the true nature of the expelled product. Nothing should be pronounced to be a true mole which does not present structures known to occur only in the fecundated ovum. Polypi and small fibroid tumours, or portions of large ones, are not difficult of recognition by naked-eye and microscopical examination.

B. **True moles.**—True moles are always the result of impregnation. The embryo may speedily disappear in the early stages, and then we meet only with the membranes or appendages; these, however, are characteristic.

Two chief varieties of true mole are at present recognised, namely, (1) the *fleshy*; and (2) the *vesicular* or *hydatidiform* mole.

1. *Fleshy mole.*—ÆTIOLOGY AND PATHOLOGY. Extravasation of blood between the maternal and fœtal structures of the fecundated ovum, or into the tissues of the latter, appears to be the active agent in the production of the fleshy mole; though it is difficult to determine the agencies whereby this condition is brought about. A diseased state of the deciduæ may doubtless result when pregnancy supervenes upon chronic endo-metritis; or effusion of blood into the maternal structures may occur from cardiac disease. Again, syphilitic and other blood-dyscrasiæ appear to exert an influence; and perhaps the same may be said of acute specific diseases when they fail to excite abortion. It seems probable that degeneration of the embryonic appendages takes place as the initial lesion in some cases, it may be from syphilis. The pathology of the subject is still, however, shrouded in considerable obscurity.

DESCRIPTION.—Whatever may be the exciting causes, when once blood has been effused into or between the fœtal and maternal structures, the vitality of the embryo is speedily compromised. The common result of this is abortion; but when the whole ovum is not thrown off, growth may take place in the remaining tissues, while the effused blood becomes organised and gives bulk to the mole. Not unfrequently a considerable effusion of blood takes place immediately beneath the amnion, encroaching greatly upon, and sometimes rupturing, the amnionic sac. The inner aspect of this cavity then presents an irregularly nodular appearance, and is of deep, almost black, colour. When the nodules are incised they are seen to be composed of firm blood-clot. If not immediately thrown off, growth may continue in the tissues, and a bulky, fleshy mole may result. The connection between the ovum and the womb being most intimate at the placental site, changes go on most actively at that spot; and when blood is largely effused here it constitutes what is called 'apoplexy of the ovum.' Examination of carneous moles seems to show that, under certain circumstances, the decidua vera is the chief seat of degenerative changes; but it appears that in all cases chorion villi may be found, though much altered by the presence of fatty and molecular matter.

The growth of fleshy moles may be rapid, but ordinarily it is not excessively so: such, at least, is the experience of the writer. Fatty degeneration may be extremely marked, and in rare cases calcareous degeneration may be met with, forming what the Germans call the *Steinmole*; but it must never be forgotten that similar degeneration of other uterine bodies may occur, for example, of fibroids, so that calcareous bodies are not to be looked upon as true moles unless other clear evidence exists of conception having taken place. Blood-polypi are occasionally met with, arising after miscarriage or delivery at full term, in which, organisation having taken place, and communication being established between the clot and the uterus, degenerative changes go on to the extent of calcification, whereby a so-called *Steinmole* may be produced.

2. *Vesicular mole.*—The vesicular, hydatid, or hydatidiform is the better understood, if not more important, variety of true mole.

DESCRIPTION.—It is necessary to state at the outset that the name 'hydatid' mole is erroneous and misleading. There are no true hydatids or echinococci in it. The physical arrangement of the vesicles is different. True hydatids are closed sacs, contained one within another, while the vesicular mole is formed by saccules growing from one another. It was formerly supposed that they grew from a common stalk, and they were likened to a bunch of grapes or currants; but, for the reason given above, that simile was imperfect. The vesicles vary in size from a chestnut to a pin's head, or less; usually they are about the size of small currants; and as a few may from time to time escape, accompanied by more or less sanguineous discharge, Gooch's simile of 'white currants floating in red-currant juice' is a very apt one.

All authorities agree that the vesicles grow from the chorionic villi. There is no new formation, but excessive and erratic development. Mettenheimer, Paget, Barnes, Virchow, and others concur in this view. Whether the change is the cause or consequence of the death of the embryo is unsettled. Leishman points out that the period within which degeneration of the chorionic villi may originate does not extend probably beyond the tenth week, that being the period of greatest activity in the growth and multiplication of the villi. Later on, when blood-vessels have occupied the bulk of the villi, this kind of degeneration seems incapable of formation. The probabilities, therefore, are in favour of the formation taking place in the first chorion, or vitelline membrane. In reference to this portion of the subject it may be well to remark that recurrence of vesicular growths has occasionally, though rarely, been met with after apparent removal of vesicular moles from the uterus. Probably some portion escaped detection in those cases, and growth went on therein. Dr. McClintock mentioned this many years ago, and several cases are on record.

The connection between the vesicular mole and the uterus may be extremely intimate, some vesicles penetrating the uterine wall even to the peritoneum. Barnes states this, and Schroeder refers to a case by Volkmann and one by Jarotsky and Waldeyer, in which it occurred. The occasional recurrence of this variety of mole may be explained by portions imbedded in the uterine wall escaping removal, or resisting expulsion. The penetration of the uterine parietes may also favour rupture of the organ during the expulsion of a vesicular mole, as in a case recorded by the late Dr. Tyler-Smith.

The vesicular mole belongs to the class of pathological products known as myxomata. According to Gscheidlen the cyst-fluid contains albumen, mucin, phosphates, and other inorganic salts, leucin and tyrosin in small quantities, but no trace of fibrinogenous substance, paralbumen, or sugar.

An analogous degeneration of the placenta has been described by Virchow and Hildebrandt as 'fibrous myxoma' of the placenta. Schroeder quotes cases of 'diffuse myxoma' of the placenta, by Breslau and Eberth, and Spaeth and Wedl. A case of myxoma, or hyperplasia of the chorionic villi, is related by Dr. Sinclair in vol. i. of the *Publications of the Massachusetts Medical Society*.

SYMPTOMS.—The symptoms of vesicular molar pregnancy are at first usually those of ordinary pregnancy, but patients often complain of malaise. The bulk of the uterus increases with great and disproportionate rapidity. There is a tendency to the loss of the ovoid form, and the assumption of the globular or more transversely wide shape. Generally there is early evidence of the presence of some derangement, by the appearance of watery and sanguineous discharge. When vesicles come away the diagnosis is clear; but in their absence the practitioner may be puzzled. In other cases there may be high temperature, quick pulse, an icteric tint of skin, and a dry or glazed tongue.

Physical examination often yields important information. Palpation may give, as Leishman remarks, a significant sensation of bogginess, with absence of the irregular fœtal hardness. Hardening under manipulation is very significant of the uterine nature of the tumour. On vaginal examination a doughy sensation may be experienced in the lower segment of the uterus. Should the os be open, vesicles may be felt. To the touch they somewhat resemble recent blood-clots. In all suspicious cases discharged materials should be carefully examined.

TREATMENT.—The treatment of all these cases of mole pregnancy consists in the complete removal, whenever practicable, of all the diseased tissues. Dilatation of the uterus may be necessary for this purpose, either by the finger or by means of tents, or Barnes's bags; and ergot and other oxytocics may be called for to aid in the expulsion of the offending product in some cases.

The diseased tissues should, if possible, be completely removed. Portions may be retained, after the bulk has been removed or expelled, and give rise to grave and exhausting discharges, or to recurrence, as has been mentioned above. It is important to remember, in this connection, that twin pregnancies may occur in which vesicular degeneration affects the membranes of but one ovum. It is well, therefore, to bear in mind the possibility of this; and that the sound ovum may proceed to full development. This state of things is said to have occurred on the occasion of the birth of the celebrated anatomist Beclard.

ALFRED WILTSHIRE.

MOLE, in Skin-Diseases (A.S. *mâl*).—A term applied to certain permanent out-growths of the skin. They are usually congenital, and are termed *nævi* or 'mother-marks.' When covered with hair they are called 'hairy moles,' or *nævi pilosi*; and when of a dark colour, 'pigmentary moles,' *nævi pigmentosi*. Another synonym of the pigmentary mole is *spilus*.

TREATMENT.—The most convenient mode of treatment of all these kinds of mole is the careful application of a strong solution of potassa fusa, two parts to one of water. They are thereby converted, in the course of a few minutes, into a transparent gelatinous mass, which dries up into a black scab; and they are rarely reproduced when removed in this manner.

ERASMUS WILSON.

MOLIMEN (*molior*, I move or stir).—An impulse or effort. The word is chiefly used in connection with menstruation, to indicate the effort which appears to be made by the system to perform this function. *See* MENSES, OR MENSTRUATION, Disorders of.

MOLLITIES OSSIUM (Lat.).—Synon.: *Osteomalacia*; *Malacosteon*; Fr. *Ramollissement des Os*; Ger. *Knochenerweichung*.

Definition.—A condition in which the bones of the skeleton become by degrees decalcified, so that they can no longer sustain the weight of the body, but bend or break on slight provocation.

Mollities ossium has been called an excentric atrophy; but the minute changes which occur are not those of atrophy, but rather of active decalcification of the bone.

Ætiology and Pathology.—The causes of mollities ossium are unknown. It affects the female sex almost exclusively; only occurs in adults, and during the period of child-bearing. There is some intimate connection between the outbreak of mollities ossium and the gravid state; and repeated pregnancies appear to predispose to its occurrence. It also, but very rarely, is observed in the male sex. The disease seems to occur in the lower classes of the people, who are exposed to hardship and have inadequate food. In certain localities it would seem to be endemic. It has been ascribed to changes in the nutrition of the bone; to a process akin to chronic osteitis, or osteomyelitis; and to the action of an excess of lactic acid in the blood. This acid is said to have been found in the bones and urine of persons affected by the disease.

Anatomical Characters.—The bone in mollities ossium becomes gradually decalcified, the change spreading from within outwards, until a mere shell of external compact tissue is left, but this cortical layer never wholly disappears. The medullary cavity enlarges in all directions, occupying the epiphysis, and invading the cortical substance, until the interior becomes a gelatiniform mass, enclosed in a periosteal shell. The bone can be cut into layers with a knife, or indented with the pressure of the finger.

In the stage of acute progress the medulla is very vascular, the vessels are enlarged, and here and there extravasations of blood occur. The medullary spaces are filled with nucleated marrow-corpuscles; the trabeculæ give way; the osseous particles disappear; the fat-cells diminish, and gradually disappear; and finally the whole interior is filled with a pale or yellowish gelatinous substance, resembling the vitreous body. In extreme cases the external covering may be solely the fibrous periosteum, with a few plates of bone in its interior.

Symptoms.—One of the earliest symptoms of mollities ossium is aching rheumatoid pains in the affected bones, generally aggravated at night. The vertebral column, the ribs, and the pelvis are the parts first affected; and in these serious deformity shortly becomes manifest. The weight of the body causes extreme lateral and angular curvatures. The ribs are bent and broken; one series of fractures taking place in the axillary line, usually directed inwards, is produced by external pressure; whilst a second and third row of fractures take place by more indirect force—the one near the head of the ribs, the other outside the sternum. The arms often lie in a trough-shaped hollow on the sides of the body. The sternum gives way in several places, and is displaced forwards.

Through the weight of the body acting from above, the promontory of the sacrum is projected forwards, whilst the lateral pressure of the head of the femur, against the acetabulum, causes the transverse diameter of the pelvic outlet to diminish. It thus assumes a trifoliate shape, the pubic symphysis often projecting forwards at right angles to its normal position, with its two horizontal rami in contact. The floor of one acetabulum may even touch the other. The bones of the extremities suffer from multiple fractures and bending from the most trifling causes; and these are very imperfectly repaired in the later stages of the disease, although in the earlier they unite readily by bony callus. As the disease progresses, the body becomes more and more misshapen; the patient more perfectly helpless and bedridden; and death usually ensues from exhaustion, after a more or less protracted interval, or the sufferer is carried off by intercurrent disease. Female subjects frequently die in consequence of severe instrumental interference required during pregnancy. There is no constitutional cachexia.

Diagnosis.—The diagnosis of mollities ossium is at first very obscure. The pains resemble those of rheumatism. The character of the deformity will, however, settle any doubts. The disease should not be confounded with rickets, which is a disease of infancy or childhood, due to delayed ossification, and producing prominent curvatures of the shafts of the bone, and enlargements near the epiphyses, very distinct in type from the infractions and extravagant distortions of the osteomalacic skeleton. Nor does mollities resemble the fatty atrophy of bones due to senile changes, in which condition, though fracture be common, there is no general deformity involving different parts of the skeleton.

Prognosis.—The prognosis in most cases is unfavourable. In some well-marked cases of softening, the bones appear to have afterwards recovered their normal consistence, but this is very unusual.

Treatment.—No remedial measures, as yet discovered, have either arrested the progress of mollities ossium or promoted its cure. Women affected in this way should be restrained, if possible, from further childbearing, not only to avert increase of the disease, but to avoid the dangers attending childbirth in cases of deformed pelvis. Otherwise, an ample supply of nourishing food, rest in the recumbent position, and abundance of fresh air, are, combined with iron and quinine internally, the principal means of treatment at our disposal.

William Mac Cormac.

MOLLUSCUM (*mollis*, soft).—Definition.—A term applied to soft tumours of the skin.

Structurally, molluscum is an overgrowth of the connective tissue, and therefore a fibroma; hence it is named by Virchow *fibroma molluscum*. But there is another tumour of small size, rarely larger than a pea, which has been described as an overgrowth of the sebaceous glands, but recently as a specific degeneration of the cells of the rete Malpighii. In England observation proves the contagiousness of this affection—*molluscum contagiosum*.

Description.—Pathologically the fibromatous molluscum is an hypertrophy of the connective tissue of the superficial stratum of the integument, infiltrated with serum, which renders the tumour more or less œdematous, and gives it its character of softness. It may range in size from that of a millet-seed to that of an orange or large melon. Occasionally even, as in a remarkable case illustrated by Virchow, small mollusca were protruded from the surface of one of very large size. The molluscum will also vary in density, in proportion to the firmness or relaxation of the connective tissue, and the quantity of fluid contained within its meshes.

Sometimes the molluscous growth is not restricted to the form of a tumour, but occupies a large extent of the integument, such as the whole circumference of a limb, and gives rise to immense folds and lobes which overhang each other in festoons, suggesting the term 'dermatolysis,' applied to this variety by Alibert. At other times the tumour grows in length, expanding as it proceeds, until, issuing from a narrow base, it develops into a mass resembling distended intestines.

The blood-vessels of molluscous tumours are always large, particularly the veins; but in the exaggerated forms of the disease the latter are prodigious in size, and may be seen through the skin twining around the base of the lobes.

Treatment.—The treatment of molluscum consists in the removal of the tumour. When the latter is of small size this may be accomplished with the scissors, but when it assumes the gigantic proportions already mentioned the operation is a serious one. Mr. Pollock, in a case of this kind, secured the large vessels by means of a ligature before proceeding to the employment of the knife. To treat *molluscum contagiosum* we must slightly enlarge the opening with a lancet, and press out its contents. The capsule then contracts or dies.

Erasmus Wilson.

MONOMANIA.—Synon.: Fr. *Monomanie*; Ger. *Wahnsinn*.—This term is falling into disuse on account of its vagueness, and because it has been employed by various writers to denote different kinds of insanity. Some have used it to denote an insanity which is indicated by some one particular delusion, the mind remaining clear on every other point. Others mean by it an insanity without delusion, an *affective* or *impulsive* insanity, the essence of which is the absence of delusion, and the so-called integrity of the intellectual portion of the mind. Esquirol thought it a disorder of the faculties limited to a few subjects, with excitement, and gay and expensive passion; while according to others, melancholia without delusion would be an instance of affective monomania. We may take it, however, that all authors are agreed in using the term monomania to indicate a partial insanity, which enables the patient to converse and act rationally to a considerable degree, and therefore renders his responsibility a matter of question. Such cases form the grounds of forensic contests, whether criminal or civil; but it is better to affix to them some more precise term, and to indicate symptomatologically and pathologically the exact nature of the mental and bodily condition of the alleged lunatic.

G. F. Blandford.

MONSUMMANA, Cave of; in Upper Italy.—Natural vapour baths. *See* Mineral Waters.

MONT DORE, in France.—Simple thermal water, containing arsenic and soda. *See* Mineral Waters.

MONTPELLIER, in South of France.—Variable, fairly warm, winter climate. High winds from N.E. and N.W. *See* Climate, Treatment of Disease by.

MORAL INSANITY. *See* Insanity, Varieties of.

MORBID (*morbus*, a disease).—This word merely signifies *diseased*, and is used, in its several applications, as a technical or scientific term, in contradistinction to the term *healthy*. Among the most common examples of these applications may be mentioned *morbid anatomy* and *histology*, which imply the anatomy and histology of diseased conditions; *morbid sensations* or *feelings*, as distinguished from healthy sensations, whether connected with either of the ordinary senses, or with some particular organ, such as appetite; *morbid actions*; *morbid secretions* or *discharges*; and *morbid growths*. The word is employed in a somewhat special sense, in relation to individuals who are mentally low in spirits and despondent, without any obvious cause to account for this condition; such individuals are often spoken of as being in a *morbid state*.

MORBIDITY (*morbus*, a disease).—This term, which is of recent introduction, is employed to denote the amount of illness existing in a given community; and, as 'mortality' expresses the death-rate, so 'morbidity' indicates the sick-rate, whether the diseases be fatal or not.

Since health is an extremely ill-defined state, marked out by no absolute boundaries, and since many people suffer from diseases that are concealed intentionally or through ignorance, it becomes a matter of considerable difficulty to express with certainty the amount of illness that may exist at any time. Some information may, however, be obtained from the records of sick-clubs and benefit societies, on which statistics may be based of the average time their subscribers are ill during the year, in relation to employment, age, locality, and other circumstances.

By an investigation of this subject the rates of mortality come to possess an extended significance, for they thus indicate not merely the proportion between the living and the dead, but between the latter and the two classes of the living, namely, the healthy and the diseased; and, as a branch of State medicine, must doubtless come to take a prominent place. As further knowledge provides accurate facts and figures, the subject will have a distinct practical bearing, in estimating the value of men for work, if the average liability to disease and the total amount of illness an individual may expect to suffer be known; while it is reasonable to believe that as the 'aptitudes to disease' are further conditioned, the means for prevention may be extended.

W. H. Allchin.

MORBIFIC (*morbus*, disease, and *facio*, I make).—This word is properly applied to any

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cause that produces a disease. Such a cause is often spoken of as a *morbific agent.*

MORBILLI (dim. of *morbus*, a disease).—A synonym for measles. *See* Measles.

MORBUS.—This is the Latin word for *disease.* Formerly it was frequently employed, but is not much in vogue at the present day. When applied to particular diseases, it is associated with some qualifying adjective or noun, indicating the nature or seat of such disease, some peculiarity by which it is characterised, or the name of some renowned authority upon it. It would not serve any useful purpose to give a list of the diseases with which the word is connected, and it will suffice to cite, as examples, some of its more common applications, such as *morbus cordis*, disease of the heart; *morbus coxæ* or *coxarius*, disease of the hip-joint; *morbus cerealis*, ergotism; *morbus Brightii*, Bright's disease; *morbus cæruleus*, blue disease.

MOROCCO, in North Africa.—Warm, healthy winter climate. Tangiers is exposed to cold, damp S.W. winds in autumn and spring, and to E. winds. Living superior to Malaga. *See* Climate, Treatment of Disease by.

MORPHIA, Poisoning by. *See* Opium, Poisoning by.

MORPHŒA (*morphœa*, a blotch).—This word has been used at various times as a synonym of lepra alphoides or alphos, and leuce, and is allied in meaning with vitiligo. More recently it has served to distinguish a circumscribed form of scleroderma. Four varieties of morphœa have been recognised—namely, *morphœa alba*, *nigra*, *tuberosa*, and *atrophica*; but a better knowledge of the pathology of the disease will probably merge the whole of these varieties in scleroderma. *See* Scleroderma. Erasmus Wilson.

MORTALITY.—Synon.: Rate of Mortality; Death-rate; Fr. *Mortalité*; Ger. *Sterblichkeit.*

Definition.—The proportion of persons dying to those surviving under given circumstances; or, more usually, the proportion borne by the persons who die to the whole number of those subjected to the given circumstances.

Thus we may have to do with the annual mortality of the population of a country, a district, or a city; or of a body of men similarly circumstanced, as of clergymen or of lead-miners; or of bodies of men otherwise alike, but subjected to different conditions of climate, &c., as the British army; or of the population, or any section of the population, at special ages, as of infants in factory towns.

Or we may be concerned with the proportions of deaths to survivors, or to the whole number of entrants, during and after exposure to a special cause or causes of death, operating either speedily or during a protracted period. Hereunder come, for example, the mortality sustained by the population of Rio Janeiro, or New Orleans, during an epidemic of yellow fever; or that suffered by a number of persons in passing through an attack of enteric fever or pneumonia.

Estimation of Mortality.—The annual mortality of a population is reckoned, not on the numbers in existence at the beginning of a year, but on the average number in existence on the several days of the year, or, what is nearly the same thing, on the mean population of the year. The necessity of this becomes evident, when we consider that in our own country the large towns are mostly increasing at a very rapid rate, while some agricultural parishes and unprosperous places actually decline in population. In the towns, therefore, the death-rate, if reckoned on the last census, or even on the number believed or estimated to exist at the beginning of the given year, would come out higher than it ought to be, while in declining parishes it would be somewhat too low. Similarly the annual mortality of bodies of troops is calculated on the mean strength.

Two formulæ are in use for specifying death-rates. In the first the proportion of deaths is taken as unity: thus, the mortality in England and Wales in 1878 would be stated as 1 in 46. In the second, which is more convenient and is now generally employed, the number of lives at risk is taken as 100 or 1,000: thus the mortality of 1878 would come out 21·7. Either formula is convertible into the other by simple division: thus 1,000 ÷ 46 = 21·7; and 1,000 ÷ 21·7 = 46.

The death-rates of large civilised countries, in which registration is strictly carried out, give a pretty fair representation of the viability of the population. So much may be said for England, Wales, and Scotland, and for most of the European States, but not, unfortunately, for Ireland, where the weakness of the registration laws makes the record defective.

Mortality of Nations.—The following are the death-rates per 1,000 of most of the principal States of Europe:—

	In years.	Per 1000 living.
Norway	1846–55	17·9
Sweden	1869–78	18·9
Denmark	"	19·2
England and Wales	"	21·8
Scotland	"	22·1
Belgium	"	22·6
Switzerland	1870–78	23·5
France	1869–78	24·3
Or excluding two years of war	. . . .	22·5
Netherlands	1869–78	24·4
German Empire	1872–78	27·2
Italy	1869–78	29·5
Spain	1861–70	29·7
Austria	1869–73	31·1
Hungary	1868–77	39·6
Or excluding two cholera years	. . . .	36·1

The death-rate of Russia, except in the extreme north, is high. It was stated at 35·9 in 1842. That of Portugal the writer has not been able to obtain. Those of Turkey, of Ireland, and of Greece are unknown. In many of the British colonies it is lower than even in Norway. Thus the average mortality during the ten years, 1866–75, was in [1]

Victoria, 15·8
New South Wales, 15·3
Queensland, 17·7
South Australia, 15·3
Tasmania, 14·8
New Zealand, 12·4

Mortality of Cities.—The mortality of cities is in this country almost invariably higher than that of the open country. But this rule does not apply to all other countries; the exceptions occur mostly where endemic fevers are prevalent in the country. Thus the mortality rate in 1878 was in London, 23·5; in Edinburgh, 22·[illegible], and in Dublin, 29·6; and in 20 other large towns in the United Kingdom it varied between 19· in Portsmouth, and 29·4 in Liverpool; while in 50 towns of the second class the extremes were 16·2 at Dover, and 18·1 at Rochester; 30·4 at Blackburn, and 30·8 at Preston; the average of the 23 towns being 24·4 per 1,000, and of the 50 towns 23·. In the same year the rural districts and small towns of England yielded an average rate of 19· only. There are a considerable number of districts, almost all rural, which year after year fall below 17; and 17 was accordingly fixed upon by the late registrar-general for England as a kind of standard to be aimed at by sanitarians. And there are districts in England, and entire small counties in Scotland, where the rate occasionally falls below even 15.

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[1] Hayter, *Australian Statistics.*

The following table exhibits the death-rates experienced in 1878 in a number of foreign and colonial cities:—

Calcutta	37·7	Paris	24·6
Madras	48·8	Brussels	28·0
Bombay	41·8	Amsterdam	24·4
New York	24·8	Rotterdam	27·3
Brooklyn	20·1	The Hague	26·4
Philadelphia	18·0	Copenhagen	22·0
Montreal	30·9	Stockholm	22·4
Alexandria	45·4	Christiania	18·5
Melbourne, 1873 and 1875	22·8	St. Petersburg	47·1
Rome (1878)	29·8	Berlin	29·9
Naples	33·1	Hamburg	26·9
Turin	31·1	Dresden	24·7
Venice	28·7	Munich	34·6
Trieste	36·2	Breslau	29·9
Geneva	23·6	Vienna	29·6
		Budapest	40·3

Analysis of Results.—These tables awaken, by the enormous differences between the several cities and countries, a curiosity respecting the causes of such differences, which, however, the figures themselves go far towards satisfying. It is at once evident that, whatever may be the case in the open country, cities suffer to a considerable extent in the ratio of their ignorance and neglect of sanitary laws, and of the poverty and squalor, or barbarism of their populations. Mark, for example, the contrast between Philadelphia and St. Petersburg! Cities having a steadily warm climate, or a climate of extremes, are more unhealthy than those which enjoy a temperate one. By this consideration, combined with that of their superior civilisation, may be explained the favourable position of the cities of Western as compared with those of Eastern Europe. The short, hot summers are very fatal in the latter region, and even in Southern Germany and at Stockholm; while in Western Europe generally, and especially in Scotland, winter and spring are the deadly seasons. It is noteworthy that in most of the large cities of Italy the short, sharp, and changeable winter is not less deadly than the hot summer and malarious autumn; in fact good winter climates for *poitrinaires* are exceptional even in Italy.

In Great Britain the influence of climate *per se* on the annual mortality of the several cities and districts is not very great; and its effects are obscured by those of other agencies. But if we confine our attention to the rural districts, where the disturbing factors are less important, we shall find that the rates of mortality are on the whole slightly more favourable in the north than in the south. Of all the counties in Great Britain Orkney-and-Shetland stands best, with an annual mortality, on an average of 10 years,[1] of 15·13; and Shetland, the more northern division, stands better than Orkney. Great Britain is, therefore, no exception to the rule that in Europe mortality decreases from south to north. This is in no way inconsistent with the fact that throughout Great Britain winter is the deadly season, and cold is more fatal than heat, thoracic than abdominal diseases.

Influence of Seasons.—The following were the death-rates of the four seasons in England and Wales, in 1868–77:—

	Winter.	Spring.	Summer.	Autumn.	Year.
In the chief towns	25·8	22·5	23·1	24·2	23·7
In the small towns and rural districts	21·7	19·3	17·2	18·5	19·0

In Scotland the seasonal mortality, owing, doubtless, to the less intensity of the summer heat, follows pretty nearly the order of the English small towns and rural districts. Thus, in 1878: winter, 25·2; spring, 23·2; summer, 19·8; autumn, 20·4; year, 22·3.

It would seem, however, that in London, in the early part of the seventeenth century, when the death-rate, owing to the closeness and filthiness of the city, was fearfully high, the maximum was attained in summer, the figures standing as follows in 1606–10, during which years the plague was absent. Average mortality per cent.:—winter (J. F. M.), 1·4; spring, 1·5; summer, 2·7; autumn, 2·0:—total, 7·0.

Influence of Density of Population.—In accordance with a principle already laid down, that in communities sufficiently advanced to furnish mortality statistics, the death-rate diminishes with the progress of civilisation, the mortality of London has since the seventeeth century gradually and greatly diminished. At the beginning of this nineteenth century it had sunk to 29, in 1840–49 it was 25·3, and in 1870–78 only 23.

The death-rate is also diminishing in France, Belgium, the Netherlands, Sweden, and Germany, in all of which countries the population is believed to be advancing in comfort and general well-being, but in southern and eastern Europe, where comparatively little advance has taken place in these respects, no such diminution can be demonstrated.

Nor, though evident in London and in several other great towns, can a diminution of the death-rate be positively affirmed of Great Britain generally. In Scotland, indeed, there was a decided increase from 1855 until 1876, when a decline, which may prove transient only, set in. And in England no improvement could be shown for many years before 1871, since which date there has been an almost unbroken succession of years of low mortality, concurring with a generally low temperature and excessive fall of rain.

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[1] 1866–75.

The great antagonistic influence in Great Britain may be found in Dr. Farr's principle, 'That mortality increases with density of population.' And 'urbanisation' advances so rapidly in Great Britain, that all the efforts and devices of sanitary and medical science are scarcely able to do more than neutralise its evil effects.

Sources of Fallacy.—It may be as well to advert to some of the principal sources of fallacy, which hamper us in appreciating national and local death-rates. One of these is the varying number of births. This ranges in the Continental States of Europe from about 40 in Germany and Austria, and even more in Russia and Hungary, down to 25 in France; and in Britain from 48 or 50 in some coal and iron districts, down to 22 in the county of Sutherland. The late Dr. Letheby maintained that a high birth-rate was a direct cause of a high death-rate, owing to the great mortality among infants. This was an error; the two often concur, but the former is not a cause of the latter, unless where the infants perish in enormous proportion. The usual result in this country of a large and especially of an increasing birth-rate, is to augment in the community the proportion of children beyond infancy, and of young persons, who ordinarily suffer a very low death-rate as compared with old or even middle-aged persons. The favourable rates prevailing among these young persons overpowering the unfavourable ones of the infants, and of the comparatively small number of old people, the apparent death-rate is actually diminished, instead of being increased as Letheby supposed. And this points to the true reason why the death-rate of France is higher than that of England, whereas the expectation of life in the two countries is about the same at most ages, the birth-rate of France being exceedingly low (Bertillon). *The lower the average age of the population the lower the death-rate.*

A considerable amount of emigration or immigration affects the death-rate in proportion to the average age of the migrants. Thus the mortality of most great and growing towns would stand worse than it does, were it not for the large numbers of young and healthy persons from the country who settle in them. Watering-places and residential towns appear somewhat healthier than they really are, by reason of the numbers of young domestic servants who form a large portion of their population. But it is in our colonies that the effect of migration on the death-rate can best be studied. The unexampled death-rate of New Zealand, quoted above, is the result of two kinds of causes, one set of which we may call real, the other factitious or apparent. The former are the cool, equable climate, and the orderly and prosperous condition of the population; the latter are the constant stream of mostly youthful immigrants, and the very high birth-rate.

Influence of Age and Sex.—The influence of age and of sex on the mortality in England and Wales may be best shown in a tabular form.

Mortality per 1,000 at twelve groups of ages in males and females in the 41 years 1838–78 :—

	All Ages	0–	5–	10–	15–	20–	25–
Males	23·3	71	8	4	6	8	9
Females	21·2	62	8	4	7	8	9
		35–	45–	55–	65–	75–	85–
Males	23·3	13	18	32	67	147	311
Females	21·2	12	15	28	59	134	287

The superiority of the women is here well-marked, except during childhood and the years of early married life and much child-bearing.

Influence of Race.—The influence of race is usually difficult to separate from that of habits of life. In Europe the Jews offer the most notable example. It may be sufficient to quote from Oesterlen Neufville's statistics of Frankfort-on-the-Maine, who found that there the average age of Christians at death was 36·9 years, but that of Jews was 48·7; and from Hoffman, the death-rate of the Jews of Prussia, which was only 21·6 per 1,000, against 29·6 among the Christians.

Influence of Station and Occupation.—The influence of station and occupation on mortality is very great. The subject has been carefully handled by Dr. Farr in the Supplement to the Registrar-General for England's thirty-fifth Report. Briefly, it may be said that of all trades or professions that can be isolated, clergymen, barristers, farmers, agricultural labourers, gamekeepers, grocers, seem to stand best in this respect. Booksellers, paper-makers, wheelwrights, and carpenters also suffer but a small mortality. Schoolmasters and teachers go on well up to fifty-five. Solicitors, domestic servants, watchmakers, shoemakers, blacksmiths, range not far from the average rates; so do bakers (though such is not the current opinion), and the whole tribe of weavers. The workers in iron, as a rule, experience but a low mortality in early life, but a high one as they grow older; the same may be said of millers, and, somewhat strangely, and no doubt for very different reasons, of Roman Catholic priests. Tailors begin very ill, and end fairly. Medical men, alas! perish frequently in early life, and only attain a respectable position after fifty-five. Chemists, too, and veterinary surgeons, come out badly. The figures for drapers much resemble those for medical men. Those for miners, naturally enough, are not much different from those for iron-workers, though a little worse. Tobacconists, as might be expected, suffer very heavily until middle life. Printers, bookbinders, clerks, commercial travellers, glass manufacturers, dock labourers, porters, railway employés, butchers, fishmongers, coachmen, draymen, grooms, all suffer a very high mortality. And the very worst positions are occupied by the dealers in alcohol and in lead (the painters), and by the potters.

These facts are of considerable practical interest in relation to questions of life insurance.

Mortality of Diseases.—Some acquaintance with the mortality of diseases, and the extent to which it is influenced by age, sex, climate, season, &c., is also of great value for prognosis.

Information on this subject will be found under the heads of the several diseases; moreover the limits of this article are not sufficient to admit of much discussion of the subject.

A few facts respecting the acute infectious diseases will, however, be of interest—

1. *Typhoid Fever.*—The average death-rate of enteric fever was put by Murchison, in accordance with British, French, and German hospital statistics, at 17·4 per cent. There is a good deal of ground for putting the average mortality of children and youths at 11 or 12, but it is probable that only the worst cases occurring in children find their way to hospitals. Over fifty years of age somewhere near one-half usually die (Liebermeister).

2. *Typhus.*—In typhus the mortality varies extremely in different epidemics, sometimes rising above the average of enteric fever, more often, perhaps, falling below it. In Ireland it is usually low, averaging perhaps 9 or 10 per cent., or less. The mortality of children from this disease is much lower than from enteric fever (Murchison, Lebert, &c.). The number of deaths ascribed to typhus (that is continued fever, including enteric) in the register, is, however, largest in proportion to the living under five years; is low from 10 to 15, and again from 25 to 35; and then increases gradually up to extreme old age. One cannot help suspecting that other febrile affections of children are confounded with typhus and enteric fevers.

3. *Measles.*—The mortality from epidemics of this disease is often as low as 2 or 3 per cent., but it has been known to rise to 30 per cent. under unfavourable circumstances, as where children, or even adults, are crowded together in a hospital. Among 'virgin' communities (as in well-known epidemics in Iceland, Färoe, Madagascar, Fiji) the mortality is sometimes frightfully large. It is comparatively small in summer; and decidedly small among the comfortable classes, owing doubtless to the exercise of greater care. It is beyond comparison greatest in the second year of life, and by the tenth has become quite trifling; but adults *may* die of measles.

4. *Scarlatina.*—There is a prodigious difference in the deadliness of different epidemics of this disease, even in the same locality. In Southern Europe it is comparatively a mild disease; in Britain it is most severe; yet even here eighty successive cases may occur without a death. But a mortality under 10 per cent. may be considered moderate (Thomas, in *Ziemssen*); it is often much higher. It is at its maximum from the second to the fourth year, but continues very deadly up to ten or twelve; by fifteen it has almost reached a minimum, but, unlike measles, continues to be somewhat formidable throughout life, especially to parturient women. Season and station in life make little difference in its deadliness.

5. *Smallpox.*—Smallpox did and does, in unvaccinated communities, where it has long been at home, destroy somewhere about 10 per cent. of the population; and of persons unprotected by vaccination, who are attacked, 40 per cent. often perish. Among 'virgin' communities it is still more deadly. Age makes comparatively little difference in its fatality.

6. *Whooping cough.*—The death-rate of this disease is very large in the first year of life, declining afterwards like that of measles, but rather more rapidly, and becoming quite insignificant before the tenth year. Whooping-cough is more fatal in winter than in summer, in towns than in the country, among the poor than among the rich; but these differences, except the first, are not very well-marked. JOHN BEDDOE.

MORTIFICATION (*mors*, death, and *facio*, I make).—A popular name for gangrene. *See* GANGRENE.

MOTILITY, Disorders of.—The power of executing movements of the different parts, or of the body as a whole, may be interfered with in various ways; and as such disabilities are generally partial, the particular movements that happen to be implicated will also differ amongst themselves in different cases.

The disorders of movement to be referred to in this place are principally those in which muscles of one of the limbs, or of other external parts of the body are concerned — though disorders of the same kind, and also of different degrees, are likewise frequent, in which we may find perverted movements of viscera and their ducts, as well as of blood-vessels: in other words, portions of the involuntary muscular system are apt to have their functional activity deranged, after some of the same modes as portions of the voluntary muscular system.

In such cases, almost without exception—and to whichever class the defects may belong—the disordered motility is due primarily to some defective or abnormal action of the nerve-centres or of the nerves in relation with the muscles implicated, rather than to any primitive disease of the muscles themselves.

CLASSIFICATION.—Disorders of motility are divisible into three primary classes, according as they show themselves (A) in response to voluntary incitations; (B) in response to mere 'reflex' impressions; or (C) spontaneously. The particular muscles implicated (or the mode of distribution of the various defects) will necessarily differ much according to the extent and situation of the disease in the nerve-centres or in the nerve-trunks to which the defects are due. In some cases particular defects of motility can be confidently referred to disease of the brain, and even of particular parts thereof; in others they may be referred to disease of the spinal cord in particular regions; or, in other cases still, they may be as clearly due to some altered condition of nerve-roots or of nerve-trunks in their continuity.

A. Disorders of voluntary movements. Under this head are to be included different varieties of disordered movement, thus divisible:—

1. *Diminution of motor power.*—This varies much in degree in different cases. There may be mere weakness (paresis) or actual loss of power (paralysis) of one or more limbs, or of particular sets of muscles. The type of the paralysis will vary according to the seat and extent of the lesion; thus it may be due to a cerebral lesion, and be of the hemiplegic type (*see* HEMIPLEGIA); or it may be due to a spinal lesion, and be of the paraplegic type (*see* PARA-

PLEGIA); or the loss of power may be owing to disease or injury of some nerve-trunk, and then be of the type of a peripheral paralysis, such as we get in facial palsy.

2. *Imperfect coördination of movements.*—Here the several muscles concerned with the production of a given movement act without the relative subordination and gradation of force needful for its proper execution. Some muscles contract too powerfully and others not enough, or some contract too quickly and others too slowly, with the effect of producing a spasmodic or otherwise disordered movement—one by which the end desired is not readily attained. The condition thus produced is known as '*ataxia*,' of which there are two principal varieties—one caused by disease of the posterior columns of the spinal cord (*see* LOCOMOTOR ATAXY); and the other by disease of the cerebellum (*see* CEREBELLUM, Lesions of). Ataxia is, in fact, a condition for the most part caused by the defects described in the previous category, together with that to be mentioned in the next, the two states co-existing (in different proportions in different cases) among muscles called into simultaneous or successive activity for the execution of various complex movements. A kind of ataxy may indeed be induced by mere paresis in some muscles of a physiological group, that is of some muscles whose business it is habitually to act in combination with others.

3. *Spasmodic action of certain muscles.*—On volitional incitations reaching the spinal cord in certain states of disease, some of the muscles whose contraction is to be brought about are thrown into a condition of over-action or tonic spasm, whereby the performance of the movement is greatly interfered with. In such cases there is almost always in addition increased reflex excitability, so that it is in some cases difficult to say how much of the spasm is primarily due to the volitional incitation, and how much to reflex spasms—caused by cutaneous impressions consequent upon the commencing movement. These conditions are especially met with in cases where portions of the cord are cut off from the so-called 'inhibiting' influence of the brain, at the same time that there is hyperæmia, with increased excitability of the then active regions of spinal grey matter. This state of things is particularly frequent in 'primary sclerosis of the lateral columns.' On the other hand, the initiation of voluntary movements may, in other cases, give rise to clonic spasms in the parts moved, especially in certain cases of disseminated or insular sclerosis. *See* SPINAL CORD, Diseases of.

4. *Tremors, shakings, or choreic movements.*—Tremors (fine or coarse) and shakings are really clonic spasms of limited range; and all gradations may at times be met with between these several types of disordered movement. Such morbid movements of one or other grade, even if they exist more or less continuously, are usually increased by volitional incitations. This is the case, for instance, in paralysis agitans; in the trembling from mercurial poisoning or from chronic alcoholism, as well as in that from senile changes; in the shakings met with in disseminated sclerosis; and also in the more irregular movements, often of wider range, met with in chorea. *See* CHOREA; SPINAL CORD, Diseases of; and TREMOR.

B. Disorders of reflex motility.—The conditions on which disordered movements, due to increase of reflex excitability, depend, have been above referred to. The withdrawal of brain-influence from, and the increased hyperæmia of certain tracts of spinal grey matter, seem to be the main causes, and these are met with principally in certain forms of paraplegia, and in spasmodic spinal paralysis, or primary sclerosis of the lateral columns. The mere weakening of cerebral influence will, however, lead to an increased manifestation of reflex movements, as may be seen in certain nervous or delicate persons, in infants, or in young children.

Two forms of reflex actions have to be discriminated, namely, those excited by cutaneous impressions—skin reflexes; and those induced by taps or slight blows upon tendons—tendon reflexes. Both forms are often unduly exalted in the same person, though sometimes the skin reflexes may be normal, whilst the tendon reflexes are greatly exaggerated.

Reflex movements of both kinds may be diminished, either (1) from disease of afferent nerve-roots outside or within the cord, as in locomotor ataxy; (2) from destructive disease of the grey matter of the cord, as in many cases of severe paraplegia; or (3) from disease of the motor roots or nerves supplying particular groups of muscles.

An increase or a diminution of reflex excitability is frequently met with, and is often of much importance, in connection with one or other of the viscera, such as the heart, the stomach, the bladder, or the intestines. This undue nervous excitability may be depend upon morbid conditions, partly of the medulla or spinal cord, and partly of portions of the sympathetic system.

As possible conditions of much importance in the ætiology of many nervous affections we may here also mention disordered activity of certain vaso-motor centres, which, either immediately or remotely, influence the calibre of the blood-vessels supplying certain portions of the brain or cord. In this manner there may be induced either spasm of their vessels, with greatly lowered blood-supply; or paralysis of vessels, with consequent hyperæmia in such nerve-centres. These conditions would correspond with the death-like pallors or the flushings occasionally observable in the face, or other tracts of skin. The doubt exists, however, as to how long such mere reflex pallors or flushings may persist in nerve-centres, that is, when they are simply due to functional defects. Are they always merely transient phenomena, or may they persist for days or even weeks, as some have supposed?

C. Spontaneous movements.—The movements which are manifested 'spontaneously' are various in nature or degree, though they are of kinds similar to those that may be excited by voluntary incitations. We need only enumerate these different varieties here, and briefly indicate either the diseases in which they are encountered, or the conditions on which they depend. (*a*) *Tremors*, such as present themselves in paralysis agitans, or mercurial poisoning; (*b*) *twitchings*, or *startings*, occurring in one or more limbs, either upper or lower, in some cases of cerebral and of spinal disease; the more irregular but less spasmodic movements, known as (*c*) *choreic*, occurring principally in the disease from which they derive their name (being sometimes indefinite, and at others distinctly co-ordinated); (*d*) *spasms*, which may be either co-ordinated, as in some cases of chorea; clonic, as in epilepsy, eclampsia, and other allied affections; or tonic, as in tetany, tetanus, strychnia-poisoning, and certain spinal affections, as well as in some cerebral diseases.

Conditions of *rigidity* and *contraction*, due to a more or less permanent tonic spasm, are scarcely to be described under the head of spontaneous movements, since in such conditions, although there is powerful muscular contraction, there is no actual movement; and, similarly, the spontaneous *flickerings* of muscular fibres, seen in so many cases of progressive muscular atrophy, deserve to be mentioned here, even though no movements are produced, owing to the small number of muscular fibres involved at any one time. The flickerings themselves are really clonic spasms, involving a few fibres simultaneously.

Treatment.—The treatment of these different nervous conditions will be considered fully under the various special articles to which reference has been made.

H. Charlton Bastian.

MOUTH, Diseases of.—The principal diseases of the mouth may be thus enumerated in the following order:—1. Inflammation and its results; 2. Epulis; 3. Gumboil; 4. Ranula; 5. Salivary calculus; and 6. Salivary fistula. Diseases of the tongue and of the teeth are treated of in other articles

1. **Inflammation.**—Synon.: Stomatitis; Fr. *Stomatite*; Ger. *Mundschleimhautentzündung*.—Inflammation of the mouth is fully described under the heading Stomatitis. *See* also Aphthæ; and Cancrum Oris.

2. **Epulis.** — Synon.: Fr. *Épulide*; Ger. *Epulis*.

Description.—Epulis is the name given to a tumour which springs from the alveolar processes and from the periosteum covering them. It is more often seen in connection with the inferior than with the superior maxilla. It forms a smooth, rounded, or lobulated tumour, covered with the mucous membrane of the gum. It is firm or semi-elastic to the touch. As it grows, it loosens and displaces the teeth. Its intimate structure varies considerably. Sometimes it is a simple fibrous tumour; sometimes a round-celled sarcoma; sometimes a myeloid. At first it is benign; but if it be allowed to remain, it is apt to ulcerate, and exhibits something of a malignant aspect and character.

Treatment.—The tumour should be removed, and the portion of the alveolar process from which it springs should be taken away. Unless this be done, the growth is almost certain to return.

3. **Gumboil.**—Synon.: *Parulis*; Fr. *Parulie*; Ger. *Zahnfleischgeschwür*.

Description.—A gumboil is a circumscribed inflammation of the mucous membrane, or of the periosteum covering the alveolar processes. It is usually caused by the irritation of a decayed tooth. In a severe case the swelling, pain, and discomfort are great; and the constitutional symptoms often run high. When suppuration takes place the boil generally breaks, and a speedy cure is obtained. If, however, the pus cannot find a ready exit, it may burrow, giving rise to necrosis of the subjacent bone, or it may form sinuses in various directions—for instance, on the cheek.

Treatment.—The cheek should be poulticed, and the old-fashioned fig poultice is often applied to the gum with advantage. The mouth is to be frequently rinsed with hot water. The diet should consist entirely of fluids. An aperient should be given at the outset, and subsequently a suitable stimulant, such as ammonia and bark. As soon as pus can be detected, the gum should be lanced. When the acute inflammation has subsided, the source of irritation should be removed.

4. **Ranula.**—Synon.: Fr. *Grenouillette*; Ger. *Ranula; Fröschleingeschwulst.*

Definition.—Cystic formations in the mucous membrane beneath the tongue, which take their origin sometimes in the ducts of the sublingual or sub-maxillary glands, sometimes in the areolar spaces, and possibly also in the bursa between the genio-hyo-glossi muscles.

A. *Internal Ranula.*—Description.—The majority of cases of ranula are unconnected with the salivary glands; and, in many instances, a probe may be passed along the ducts, or the saliva may be noticed flowing from them, while the ranula remains unaltered.

Other cases belong to that simple variety which depends merely upon an accumulation of the normal secretions in a natural cavity, such as a duct, which has become temporarily obstructed. Such obstruction may arise from local inflammation, from inspissation of the normal fluid, or from the impaction of a salivary calculus, as will be subsequently described.

Treatment.—The majority of cysts in this situation lie just beneath the mucous membrane. They are, moreover, always small at their commencement, so that if the attention of the surgeon is called to them early, they can generally be cured by taking up a piece of the cyst-wall, and cutting it off with scissors; or a seton may be passed through the tumour and knotted, when the cyst will gradually contract.

B. *External Ranula.* — Description. — These are larger tumours, which lie between the tongue and the jaw, and become prominent at the upper part of the neck. Though the term *ranula* is applied to them, they are of a different character, and analogous to the sebaceous tumours which are so frequently met with in the skin, containing, like them, a thick, gritty substance of a fawn colour, often very offensive. This material is made up chiefly of epithelium, plates of cholesterine, and oil.

Sometimes these enlargements advance very slowly; but in other instances their progress is extraordinarily rapid, and then the disease is called *acute ranula*.

Treatment.—The cure of cases of this class is more difficult and tedious. The cyst should be freely opened from the mouth; the contents scooped out; and the cavity filled with lint. Sometimes it is desirable to make a counter-opening in the neck, and to treat the disease as an ordinary abscess. Passing a seton may be useful. To dissect the cyst out is an unnecessary proceeding, and not always free from danger.

5. **Salivary Calculus.**—Synon.: Fr. *Calcul salivaire*; Ger. *Speichelstein*.

Description.—Concretions, composed chiefly of phosphate of lime, are not very uncommon in the ducts of the parotid, sub-maxillary, and sublingual glands. These calculi may vary in size from a pin's head to a filbert, or even larger. Not unfrequently they form around some small foreign body, such as a seed or a morsel of woody fibre, which has made its way into the duct. Occasionally they occupy the substance of the gland, but more often they are found in the duct. Here they may simply obstruct the outlet, and give rise to an accumulation of the secretion, forming a ranula, and inconveniencing the patient by forcing the tongue upward and backward; or they may cause a local inflammation which terminates in an abscess.

Treatment.—If a concretion can be felt, either with a finger or with a probe, an incision should be made and the calculus removed. If there is local inflammation, it should be fomented or poulticed; and, if an abscess forms, it should be opened and then treated in the same way.

6. **Salivary fistula.**—Synon.: Fr. *Fistule salivaire*; Ger. *Speichelfistel*.

Description.—Occasionally the duct of the parotid gland (Steno's duct) is wounded or involved in an ulceration, or an abscess forms in its track and bursts externally. In such cases a salivary fistula is likely to be the result. The secretion from the parotid, instead of making its way into the mouth, dribbles over the cheek.

Treatment.—The treatment of salivary fistula consists, first, in establishing an opening into the mouth by means of a few threads of silk, a wire, or a piece of catgut, passed from without inwards, brought out at the mouth, and the ends tied together. The next point is to close the skin of the cheek over the fistulous opening. This may be done by touching the edges with the actual cautery, so as to make them contract; by paring the edges, and bringing them accurately together; or by dissecting the skin around the wound, sliding it along so as to cover the opening, and securing it with stitches. But the cure of salivary fistula—a purely surgical proceeding—is always difficult, and a more or less depressed scar is sure to remain.

W. Fairlie Clarke.

MOVABLE KIDNEY. *See* Kidneys, Diseases of.

MOVEMENT, Therapeutical Uses of.—Synon.: Movement Cure; Kinesitherapeutics; Fr. *Gymnastique Suédoise*; Ger. *Kinesitherapie*.

Description.—The method of treatment of disease by movement appears to have been first designed by Ling, a member of the Royal Swedish Academy, about the beginning of the present century. The movements employed are said to be of three classes, namely: 1. *Active movements*, executed by the patient himself, or by the patient aided by an assistant; 2. *Passive movements*, performed by the assistant on the patient; and 3. *Acts of resistance to movements*, whether executed by the assistant against the patient, or by the patient against the assistant.

Uses.—The several classes of movements, for which mechanical arrangements are also contrived, when scientifically employed, are used in the treatment of paralysis, curvatures of the spine or limbs, and injuries and diseases of the joints. Movements of the nature of friction or shampooing are also employed in the treatment of certain diseases of internal organs, and will be found described elsewhere in this work. *See* Friction; and Shampooing.

MOXÆ (Eastern).—A term for a form of counter-irritation, which consists in producing an eschar by burning certain materials upon the skin of a part. Moxæ were originally prepared in Eastern countries from the leaves of the artemisia; but when used in this country, cotton-wool and other substances are employed. *See* Counter-Irritation.

MUCOID DEGENERATION.—A form of degeneration, which is associated with the production of a mucus-like substance. *See* Degeneration.

MUCOUS MEMBRANES, Diseases of. This class of membranes, which line organs and passages communicating with the exterior of the body, though presenting modifications as to their minute structure in different parts of the body, exhibit a general resemblance in their construction, and consist essentially of sub-mucous tissue; a basement-membrane; epithelium of various kinds covering the free surface; and numerous glands or follicles, differing in their characters in different tracts. They are highly vascular as a rule; and many of them are richly provided with absorbent vessels. It is only intended in this article to treat briefly, from a general point of view, the morbid conditions to which mucous structures as a class are liable. Those connected with the several mucous tracts are discussed under their appropriate headings.

1. **Injury.**—Most of the mucous surfaces are exposed to injury from various causes. This may come from without, the cause being either mechanical, chemical, or excessive heat. As illustrations may be mentioned injury to the mucous lining of the alimentary canal or air-passages by foreign bodies; corrosion from swallowing strong acids; and burning or scalding of the mouth or of parts lower down, in consequence of inhaling a hot blast or swallowing boiling water. In other cases the injury may originate within the body, as by calculi passing along tubes or lodged in cavities; hardened fæces in the intestines; parasites; or the rupture of enlarged veins, aneurisms, or abscesses opening into mucous cavities.

The effects of an injury to a mucous surface differ much in their nature and extent, according to its cause. Thus there may be a mere contusion; a superficial erosion or abrasion; a more or less extensive wound or rupture, other structures being then also involved; a burn or scald; or actual destruction by corrosives. More

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or less inflammation follows injury to a mucous surface. Subsequently ulcers may be produced, which by their cicatrization may give rise to constriction or actual obliteration of tubes, and other untoward consequences.

2. **Hyperæmia and Anæmia.**—The mucous membranes are very prone to become the seat of congestion, either active, mechanical, or passive. *Active congestion* may be a part of a physiological process, as is seen in the gastric mucous membrane during the process of digestion. Any slight irritation may also cause it, and it is scarcely practicable to indicate a distinct line of demarcation between this condition and inflammation, of which active congestion constitutes the earliest stage. It is characterised by bright redness, new vessels frequently coming to view; and at first by a tendency to dryness of the affected membrane, which may be followed by excessive and altered secretion. *Mechanical congestion* is often an important morbid condition in connection with mucous structures, giving rise to troublesome symptoms. For instance, in cases of cardiac disease obstructing the pulmonary circulation, the mucous lining of the air-passages becomes more or less congested permanently; and if the general venous circulation becomes overloaded from a similar cause, other mucous tracts suffer, especially that of the alimentary canal. This tract is also directly involved in cases of portal obstruction. Particular portions of a mucous membrane might become the seat of mechanical congestion, if some local vein should become obstructed from any cause. The effects of this condition are in the first instance to make the colour deeper, with a more or less venous hue; and at last the small veins may be evidently dilated and varicose. The secretion becomes modified in quantity and quality, and in time a permanent discharge is likely to be established, consisting of an unhealthy, thick, and tenacious mucus; while the proper secretion of special glands, such as the gastric juice, is interfered with. In some instances mechanical congestion gives rise to an abundant flow of a watery mucus. The membrane itself is also liable to become altered, being swollen at first; and ultimately it may become permanently thickened and firmer than normal, owing to increase of connective tissue, while its own special structures degenerate. *Passive hyperæmia* may follow inflammation of a mucous membrane; or it occurs in persons of relaxed and feeble habit; or follows undue use of a part covered with a mucous membrane, as in the case of the throat.

Anæmia in connection with a mucous membrane is important only when this is a part of general anæmia from any cause. Those mucous surfaces which are visible, such as the conjunctivæ or the lining of the mouth and lips, give the most striking evidence of this condition, as indicated by their pallor or even bloodlessness. An anæmic condition of the alimentary canal interferes in an important degree with the functions of its mucous membrane, and with the formation of the secretions which it normally produces.

3. **Inflammation.**—Various forms and degrees of inflammation are of very common occurrence in connection with mucous membranes, and a large number of cases in ordinary practice belong to this class. Without entering into any description, it will suffice to state here that the inflammation may be acute, sub-acute, or chronic; and either catarrhal, croupous, or diphtheritic in character (*see* INFLAMMATION). Different tracts of membrane present different degrees of liability to these several forms of inflammation; and the catarrhal form not only has various grades of intensity, with corresponding variety in its products, which may become muco-purulent or actually purulent, but these products also differ in their nature in connection with different membranes of the mucous class. Further, inflammation from special causes, such as gonorrhœa, is characterised by running a definite course, and forming special products. When the inflammation is of a severe type, it may end in more or less destruction of the mucous tissues, as indicated by erosions, ulcerations, or even gangrene. Where the submucous tissue is loose, œdema is liable to occur. From this cause, as well as from thickening of the mucous membrane itself, or from a croupous or other deposit on its surface, narrowing or even actual closure of any tube or passage lined by such a membrane is apt to be produced. Inflammation may also give rise to sub-mucous suppuration. When the inflammation is chronic, permanent changes are set up in mucous tissues, the normal elements being altered or entirely removed, and a fibroid material being formed in course of time, so that the membrane is rendered permanently thickened and tough. The cause of inflammation of a mucous membrane may be *local*, including injury, mechanical or chemical irritation, or that resulting from undue heat or cold, morbid products or growths; or *general*, such as chilling of the body from 'a cold,' blood-poisoning in connection with fevers and other conditions; or the inflammation may be a part of some specific disease—for instance, diphtheria or gonorrhœa. Some mucous tracts are particularly liable to be affected under certain predisposing conditions, and at certain periods of life. Thus, bronchitis is very common in children and old persons; while the former are exceedingly subject to catarrh of the alimentary mucous lining.

4. **Ulceration.**—Ulcers are of common occurrence on mucous surfaces. They usually result from injury or inflammation, or are the termination of certain special morbid processes, as in the case of typhoid fever, syphilis, tubercular disease, cancer, dysentery, or diphtheria. Ulceration may depend upon destruction of the tissues by parasitic growths, as in some cases of thrush. Some pathologists believe that ulceration of a mucous membrane occasionally arises from plugging of arteries, and consequent death of a limited portion of this membrane, which separates, leaving an ulcer. In the case of the stomach it has also been supposed that under certain circumstances the gastric juice may so act upon the mucous lining as to destroy it. A peculiar form of ulcer is sometimes observed in the duodenum after severe burns. Ulceration often begins in connection with the glandular structures; this may be due in the first instance to mere blocking up of their orifices, leading to accumulation of their products and subsequent inflammation;

but certain special morbid processes commence in these structures. Inflammation may cause ulceration, either by directly destroying the membrane rapidly or gradually, or by setting up sub-mucous suppuration. Mucous ulcers differ much in their seat, extent, depth, shape, and other characters, according to their cause. The simple forms are either mere erosions, or of the catarrhal or follicular varieties; and in each of the special diseases already mentioned the ulcers present peculiar characters. Occasionally they assume a gangrenous appearance. If they extend deeply, they involve other tissues besides those of the mucous membrane, and may thus lead to perforation of cavities or tubes, and other untoward consequences. Cicatrization often takes place, and this may lead to permanent contraction, stricture, or even complete closure of channels lined by mucous membranes, with more or less thickening and induration. Ulceration frequently destroys the glandular structures, which are not afterwards renewed.

5. **Gangrene.**—Occasionally the tissues forming mucous membrane mortify, as the result either of severe injury, corrosion, inflammation, or vascular obstruction. The gangrene is of the moist kind, and the dead tissues may separate in a mass or in shreds. Consequently an ulcer is left; or actual perforation of a tube or hollow organ may take place.

6. **Nutritive Changes.**—*Hypertrophy* of mucous tissues is sometimes seen, but this may appear to be the case when it is not really so, the membrane being thickened and firm, owing to a chronic inflammation, and the formation of fibrous tissue. *Atrophy* is not uncommon, especially of certain of the elements of mucous membranes, such as the glands or epithelium. *Degeneration* is also often observed, affecting these and other structures. This degeneration may be of a senile character; or of a special kind, such as albuminoid or mucous degeneration. Not uncommonly mucous tissues are relaxed and deficient in tone, their nutrition being impaired.

7. **Deposits and New Growths.**—The chief new formations observed in connection with mucous membranes are polypi, villous growths, epithelioma, and tubercle. Syphilitic gummata may involve these membranes. Cysts also occasionally form, originating from the glands or epithelial structures. It may be mentioned here that certain animal or vegetable parasites are often associated with mucous membranes.

8. **Special Diseases.**—It will suffice to remark under this head that in certain diseases mucous membranes are particularly affected, such as typhoid fever, diphtheria, and dysentery.

SYMPTOMS.—The symptoms which may arise in connection with one or other of the diseases affecting mucous membranes just indicated, are of the following nature:—

1. *Morbid sensations*, usually of a more or less painful character, are often experienced. These will vary in degree and kind, not only with the nature of the disease, but also with the particular mucous surface which is involved, some being much more sensitive than others. Painful sensations are chiefly met with in connection with injury, inflammation, or ulceration, and they will be localised in accordance with the seat and extent of the mischief. As a general rule it may be stated that the sensation is one of burning, rawness, or soreness; and it is usually much increased by any irritation of the affected part, to which mucous membranes, from their situation, are specially exposed. Sometimes the morbid sensation consists in a feeling of tickling, itching, or undue irritability and sensibility to sensory impressions. It must be borne in mind that serious lesions of mucous surfaces, which, as a rule, cause marked painful sensations, may exist without any such effects.

2. *Hæmorrhage* from mucous surfaces is of common occurrence, the amount of blood lost varying from a mere trace to a quantity sufficient to cause death. The bleeding may apparently take place quite spontaneously, and without any evident cause, as in some cases of epistaxis; or it may be associated with congestion, injury, inflammation, ulceration, gangrene, new growths, or other conditions.

3. *Morbid products* are very frequently formed on mucous surfaces, or the normal secretions are modified in quantity or quality. Thus, the mucus may be deficient or excessive; and either thin and watery, unduly thick and adhesive, modified in its reaction, or otherwise altered. A free serous flow may take place from a mucous membrane, as the result of congestion or catarrh. Muco-purulent matter, actual pus, and croupous or diphtheritic substance, are among the chief morbid products formed in connection with mucous surfaces. Not only do these materials reveal their presence by being discharged externally in various ways, but they may themselves cause other symptoms, by affecting substances with which they come into contact. For instance, in the alimentary canal unhealthy mucous secretions often lead to fermentation and decomposition of food, with their consequences; and similar effects are produced on the urine by morbid materials formed in the bladder. Some products are also in themselves irritating, and affect injuriously the surfaces over which they pass, causing pain, or setting up secondary inflammation. Gangrenous tissues may also be discharged.

4. *Expulsive actions* of different kinds are often excited by morbid conditions connected with mucous surfaces lining passages and organs. These may be illustrated by sneezing, coughing, vomiting, undue action of the bowels, and frequent micturition. They may result merely from excessive sensibility of the membrane; or from the presence of blood, or of the morbid materials already mentioned.

5. The *special functions* of certain mucous membranes are very liable to be interfered with when they are affected in various ways, especially in consequence of changes in the epithelium and glandular structures. This may be best illustrated by the alimentary canal, where dyspeptic symptoms often arise from changes of this character, the secretions necessary for the process of digestion not being properly formed; and absorption by the intestinal wall is also liable to be interfered with.

6. *Obstruction* or *contraction* of tubes or orifices lined by mucous membranes may arise from inflammatory or hypertrophic thickening, submucous œdema or suppuration, thick secre-

tion, cicatrization of ulcers, or some forms of new growth. The consequent symptoms are similar to those from other forms of obstruction, such as dysphagia when the œsophagus is affected, dilatation of the stomach from obstruction of the pylorus, retention of urine when the urethra is involved, or some form of dyspnœa when the air-tubes are obstructed.

7. *Physical examination*, particularly by *inspection*, at once reveals the condition of mucous surfaces which are visible. This may be aided by instruments in the examination of parts which are situated more internally. Special modes of examination give us important information as to the diseases of certain mucous membranes, such as that lining the air-tubes.

8. *General symptoms.*—Diseases of mucous membranes are often accompanied with symptoms affecting the general system. The most obvious of these are fever and wasting, which may arise from various causes. Pyrexia is not as a rule high in inflammation of mucous surfaces. It must be remembered that certain affections of this class of membranes are but manifestations of some general or constitutional disease, which presents its own symptoms.

TREATMENT.—The general principles or indications in the treatment of diseases of mucous membranes may be summed up as follows:—1. To relieve pain and other sensations by appropriate means. 2. To check hæmorrhages, if they are in such amount as to need interference. 3. To subdue inflammatory action. 4. To brace up and give tone to relaxed tissues. 5. To influence secretions and morbid products, increasing or diminishing the former, checking or modifying discharges, and endeavouring to affect special materials, such as diphtheritic deposits. 6. To allay undue excitability, causing violent actions; or to aid such actions as may be necessary to expel excessive secretions or morbid products; or in other ways to prevent their accumulation. 7. To supply the place of, and prevent the symptoms resulting from the want of secretions necessary for special purposes, which are formed by certain mucous surfaces, such as the gastric juice. 8. To treat particular morbid conditions, such as ulcers, gangrene, new growths, or constriction, with the view of curing them. 9. To treat general symptoms.

Local applications; or such remedies as when administered internally come into contact with the affected surface, are of much value in the treatment of diseased mucous membranes. These may be anodyne, sedative, stimulating, astringent, demulcent, or of other kinds, according to the action required; and they are often advantageously applied in special ways. Operative procedures are not unfrequently required. *General* treatment is often of the greatest service in the management of diseases of mucous membranes, and this may be the only indication needing attention. Moreover, it must be borne in mind that there are certain diseases in which the morbid condition of the mucous membrane is but a part of the general malady, and calls for no special treatment.

FREDERICK T. ROBERTS.

MUCOUS RÂLE.—An adventitious sound heard on auscultating the chest in certain forms of disease, and due to the passage of air through viscid fluid in the bronchi. *See* PHYSICAL EXAMINATION.

MUCOUS SECRETION, Disorders of. *See* MUCOUS MEMBRANES, Diseases of; and SECRETIONS, Disorders of.

MUCOUS TUBERCLES.—SYNON.: Condylomata; Fr. *Plaques muqueuses.*

DEFINITION.—Flattened raised patches upon the soft skin and mucous surfaces of syphilitic persons. *See* CONDYLOMA.

ÆTIOLOGY.—Mucous tubercles are a certain evidence of syphilitic contamination, and belong to what are commonly known as the secondary manifestations; they may appear very early in that stage of the disease, or amongst the later symptoms. They are often present in hereditary syphilis. Mucous tubercles are much more frequent in women than in men; in fact they are sometimes the only symptom of the constitutional taint in females.

Experimental inoculation of the discharge from these tubercles shows that it is capable of producing a hard chancre at the point of insertion, followed by general syphilis; and from clinical observation it would appear that these lesions are highly contagious, and a fertile source for spreading disease.

DESCRIPTION.—Mucous tubercles consist of a circumscribed hypertrophy of the skin and cuticle. They appear as flat, elevated patches, of a round or oval shape, with a broad base, of a reddish colour, and generally covered by a thin grey pellicle. When in close proximity they coalesce, and form a dense tuberculated mass of irregular shape and size, which is generally fissured, ulcerated, and encrusted with dried secretion from the neighbouring skin. As a rule they are not painful, but when irritated they become very sensitive. When situated upon a mucous membrane they are less raised, patchy in appearance, and whitish in colour. This is especially the case in the throat, where they have been termed *plaques opalines.* At other times they may form superficial ulcerations with inflamed margins.

The favourite locality of mucous tubercles is the genital organs, the anus, and the moist skin adjoining; but they are not frequent on the penis. They may also be found at the umbilicus, axillæ, auditory meatus, alæ of the nose, on the lips and nipples, and between the toes. The mucous membranes usually affected are those of the mouth, tongue, and throat; and occasionally they are seen in the vagina or on the os uteri. Want of cleanliness favours their development, as does irritation from any cause; and in stout persons they may be met with in unusual situations, where folds of skin meet, and perspiration collects.

In young children, the subjects of inherited syphilis, mucous tubercles are generally found at or about the anus or organs of generation; but when the disease has been communicated, the mouth and fauces are more usually affected.

TREATMENT.—The local treatment of syphilitic condylomata is cleanliness, with some mercurial or astringent application; and if the patches be small and few in number, this will generally be sufficient. If the tubercles be large, indurated, and ulcerated, or if they be very chronic, with little disposition to subside under the above treatment, an occasional pencilling with nitrate of silver or tincture of iodine may hasten their removal. General mercurial treatment must be combined with the local remedies. Attention must of course be given to the general health.

George G. Gascoyen.

MULTILOCULAR (*multi*, many, and *loculi*, small spaces).—A term applied to cysts and other forms of growths, and to pulmonary cavities, when they consist of many small spaces or loculi. *See* Cysts.

MUMPS.—Synon.: Parotitis; *Cynanche Parotidea*; Fr. *Oreillon*; Ger. *Mumps*.

Definition.—An acute, febrile, infectious disease; attended with swelling of the salivary glands, mostly of the parotids; and ending in resolution.

Ætiology.—This is an affection more commonly seen in young persons—boys, growing girls, and young men; but it may occur in adults of either sex who are much with the sick, and have not had the complaint before. Mumps rarely attacks the same person twice. It occurs as an epidemic in large institutions, such as schools and barracks. It is conveyed from person to person by contagion—that is, by infecting particles reproduced in the course of the disease, and given off by the sick, possibly even before the glands are affected, certainly for two or three weeks afterwards. It has an incubation-period of from eight days to three weeks.

Some hygienic defects may favour the spread of mumps. Whether it prevails more at one season than another is uncertain.

Anatomical Characters.—Not many, probably no cases of idiopathic parotitis afford the pathologist an opportunity of making a *post-mortem* examination into the nature of the affection. But arguing from analogy, some maintain that here, as in the more frequently fatal symptomatic parotitis, the inflammation has its starting-point in the gland-tissue proper, or in a catarrh of its duct. Others again assert, and this has long been the prevalent opinion, that the interstitial and the connective tissue around the gland are the seat of the mischief. The affection is probably both parenchymatous and interstitial. But wherever the inflammation has its origin, certain it is that the interstitial and cellular tissue around the gland are the parts which give most evidence of the existence of the disease. They become hyperæmic, infiltrated with serous fluid, and consequently much swollen. And this œdematous state passes to structures beyond those pertaining directly to the parotid gland. Seldom does there appear to be any fibrinous exudation poured out; and still less frequently do the tissues exhibit any tendency to break down and to suppurate. The swelling completely disappears about three days after the fever. On the subsidence of the local lesion a so-called metastasis to the testicle and other glandular and fibrous structures is not rare. Alterations in the kidney and atrophy of the testicles have followed; nor have the investments of the nerves, or the surfaces of the heart, always escaped.

Symptoms and Diagnosis.—Some general symptoms always precede the local manifestations of mumps; they may be so slight as almost to escape notice; or fatigue in the day, restlessness at night, chilliness, or vomiting may mark the ingress. These initial symptoms do not occur until a week after exposure to infection, and may not be followed at once by the local signs. Mostly, after a week of malaise, or only a look of illness, the onset of mumps is sudden, with chill, rarely rigor, sometimes vomiting, and well-marked fever; often only a few hours before pain and swelling begin in the parotid or sub-maxillary glands.

One restless night follows, either from pain, or from fever, or both. Sometimes the pain is severe, and the temperature only elevated by one degree; sometimes the fever is more evident. It generally reaches 100° or 101°, and frequently rises to 103° or 104°; at this point it is not long maintained, but subsides as the local lesion is established, falling to the normal, or even below it, on the third or fourth day of the disease. The temperature may be low while the swelling is still marked and painful; and in some cases appetite returns before eating is easy. This happens when the patient is kept at rest in bed. Without such precaution sudden and great elevations of temperature occur at the end of the first week, either without serious local mischief, or with orchitis, deafness, tinnitus of one ear, and albuminuria, not always transient; rheumatism, and heart-affections, leaving traces both of pericardial and of endocardial inflammation, may also occur.

From face-ache and enlarged lymphatic glands, the sudden sensation of pain or stiffness in the parotid or submaxillary gland, following on the general symptoms, and absence of any such local trouble as usually affects the lymphatics, together with the history of a possible infection, will generally suffice for the diagnosis of mumps. Further evidence is obtained on examining the spot, where, besides the swelling being at first deeply seated, some degree of swelling of the parts surrounding the gland exists near the lobe of the ear, which very soon thereafter increases to such an extent as to involve more or less the whole of one side of the face, and passes down on to the neck. Coincidently with the appearance of this enlargement, the pyrexia declines in some cases; while in others some days elapse before the subsidence of the fever. Pain is now complained of, and the patient can no longer open his mouth to the usual extent. Yawning excites severe pain; in fact, it can hardly be effected. The yawn is aborted. So with mastication and speaking—they are greatly impaired, and the sufferer prefers to starve and to remain silent rather than endure the pain involved in the effort to perform either act. The saliva is either largely increased, going the length of salivation, or much diminished in quantity. If pressure be made over the swelling, the patient quickly indicates the unpleasantness and the pain of the proceeding; and the sensation afforded by manipulation is that of an elastic tumour, with a slightly softer feeling in the centre. The skin over the swelling may be slightly reddened; often there is no deviation from the normal colour. In many cases these symptoms are not nearly so severe, and the disproportion between the amount of distortion of the countenance and the actual suffering is sufficiently astonishing, as well to the patient as to the sympathising friends. Most frequently the affection is limited to one side of the face; but as the swelling of the one side subsides, the other seems to take it up, and it runs through the same series of events, with, possibly, an interval of a few days between them. Rarely are the two sides simultaneously affected; but in such a case the uneasiness, pain, and discomfort are of course greatly increased. After the continuance of these symptoms for about six or eight days, they begin to abate, the œdema lessens, the pain is lost, the stiffness and tension disappear, and in a few days later the face acquires its usual appearance. Occasionally there is left, for some time after this, a certain degree of hardness in the neighbourhood of the parotid, which gives no uneasiness, and can rarely be mistaken for tumour. In like manner the history of the case will disclose the nature of other local pains, or of orchitis.

Not uncommonly, especially in young subjects, a 'metastasis' takes place from the parotid gland to the testicle in boys, and to the mammæ or ovary in girls. When this occurs, and it may happen at any period of the disease, an exacerbation of the fever takes place, and at the same time pain in the inguinal region is complained of. An examination of the parts reveals the fact that there is swelling of the testicle, an orchitis, as well as an accompanying œdema of the scrotum. In the case of the girl the vulva becomes the seat of the œdema, and on pressure over the region of the ovary pain is elicited. The metastasis may take place before the inflammation of the parotid has entirely subsided; and when the orchitis abates, the parotid may again take on the inflammatory condition. Inflammation of the coverings of the brain is to be feared on sudden subsidence of the inflammation of the parotid, if no orchitis follows the disappearance of the original affection.

Prognosis.—This is almost invariably favourable in mumps, unless in the very weakly and in the tuberculous, or in the rare event of meningitis being developed. It may be said to be always a disease of a comparatively trivial nature, producing considerable pain and much discomfort, but not endangering the life of the sufferer. In very exceptional instances the inflammation of the parotid terminates in abscess. The indications of such an untoward result are increased pain in the centre of the swelling, hardness, and dark red appearance of the skin over the spot. In time the abscess discharges outwardly, or into the external auditory meatus. Atrophy of the testis sometimes follows 'metastatic' orchitis.

Treatment.—It may not, in every case, and at all seasons, be necessary to confine a patient suffering from mumps to his bed. But little treatment, beyond rest and care for the week or ten days this disease lasts, is required; still it is more prudent for the first few days to enjoin rest in bed. This is particularly necessary if the patient be young. In every case going out into the open air should be forbidden, and the patient recommended to keep as much as possible to one room. Rise of temperature means increased waste, and this is cancelled by rest. The bowels may require relief, as constipation keeps up disturbance of the temperature. All active evacuants should be avoided. It may be well to give some simple saline, as potash with lemon juice, and diluents during the first few days; ice is always grateful. A dose of chloral may be required at night (a grain for each year of the patient's age in children) if there be any restlessness.

As to local treatment, not much is required, unless the pain be unusually severe. It will be sufficient in most cases to protect the part from the air by means of a light handkerchief. Should more active interference be called for, some anodyne may be used, or soothing embrocation, such as the soap and opium liniment, belladonna liniment, or external warmth; discretion in the use of these may safely enough be left in the hands of the patient himself, if of mature years. If there be the slightest tendency to suppuration, indicated by increase of fever and tenderness over the gland, with redness of the overlying skin, poultices must be had recourse to, and so soon as distinct fluctuation is discovered the abscess must be opened, otherwise the gland-tissue becomes still further disorganised, the lobules become softened and break down, and the gland is permanently destroyed. The application of leeches is useless in reducing the inflammation, or in staying the formation of the abscess. They may be of service in lessening the pain of metastatic orchitis or ovaritis; but these are well treated by the same gentle means employed in the case of the parotid itself. It is almost universally recommended in the case of a metastasis to try to induce a return of the inflammation to its original source, by the application of irritants to the parotid, such as a mustard poultice. This seems unnecessary in the majority of instances, as the inflammation is of such a mild type; besides it implies a belief in the dictum that this is a true metastasis, and not merely another manifestation of the same morbid condition which originally gave rise to the parotitis. Tepid sponging is of use during the course of the disease, and a warm bath, or a pediluvium, may be required when metastasis threatens. Sometimes wine or brandy is required.

Considerable anæmia and much debility may persist even when mumps has been mild in its course, especially in the weakly or unhealthy, so that tonics, with iron and cod-liver oil, may have to be continued for some time.

C. Muirhead.

MURMUR.—This term, as used in auscultation, was originally applied to the natural sounds heard over the lungs in respiration; but its employment has since been extended to include a great variety of auscultatory sounds connected with the heart, the blood-vessels, the placenta, &c. *See* Physical Examination.

MUSCÆ VOLITANTES (*musca*, a fly; *volitans*, floating about).—This name is given to the semi-translucent threads, spots, circles, and filaments that may be seen, subjectively, to float and glide about over the field of vision. They form the spectrum of the vitreous humour, and may be seen by every eye. They are stirred up and brought into view whenever the eye is suddenly moved; and when the eye is fixed they continue to float about for a time, then gradually subside, and seem to sink down below and away from the axis of vision. True *muscæ volitantes* have no pathological significance, and are not visible objectively. They are, however, not unfrequently associated with some error of refraction, or with disturbed states of cerebral circulation. *See* VISION, Disorders of.

MUSCLES, Diseases of.—SYNON.: Fr. *Maladies des Muscles*; Ger. *Krankheiten der Muskel.*

In describing the diseases of the muscular tissue attention will be confined to the voluntary muscles, excluding diseases of the muscular substance of the heart, which are treated of elsewhere. Many of the morbid states of the voluntary muscles come properly under the consideration of the surgeon, and others of them will be more suitably treated of in special articles on the various diseases of the nervous system with which they are associated. There still remain, however, some special diseases of muscles to be described.

1. **Acute Inflammation.**—SYNON.: Myositis.—Ordinary inflammation of muscle, leading to exudation and suppuration, arises chiefly as a result of injury, rupture of a muscle, or extension of inflammation from neighbouring diseased bones. Inflammation sometimes, however, arises spontaneously, particularly in the tongue, diaphragm, and psoas muscle; in the latter situation forming one variety of psoas abscess. The symptoms are pain, tenderness, and swelling, corresponding to the seat of the inflammation. Exudation of serum and of lymph takes place, and subsequently an abscess may form; occasionally the process goes on to gangrene.

Secondary inflammations and formations of pus are of more frequent occurrence than simple inflammation and abscess. They arise in the course of the various forms of pyæmia. The presence of such secondary abscesses in muscles is especially characteristic of glanders and farcy, where inflammatory infiltrations of various sizes appear in many of the muscles, especially those of the arm. Disintegration takes place in their centre, and a collection of puriform fluid results.

2. **Chronic Indurating Inflammation.**—In this form of inflammation there is proliferation of cells in the interstitial tissue, causing the muscle to become hard and painful. The whole muscle may be attacked, or the process may be limited to one or more portions. Infants are often attacked by chronic inflammation of the sterno-mastoid muscle. The whole muscle becomes hard and painful, but rarely suppurates. The disease usually yields to soothing external applications; but if it be of syphilitic origin, the use of internal antisyphilitic remedies may be required. In adults chronic indurative myositis of a syphilitic character may occur in the sterno-mastoid, the various muscles of the leg and arm, the temporal and masseter muscles, the tongue, and other parts. The disease may appear either as a diffuse inflammation, with the usual signs of pain on movement, tenderness, and some swelling, or sometimes a series of beaded swellings; or as a circumscribed inflammation, with an abundant infiltration of nucleated cells. If the inflammation does not soon subside, the cellular exudation becomes organised into contracting fibrous tissue, and the compressed muscular fibres atrophy. In diffused myositis permanent contraction of the muscle may result from this cause; in circumscribed syphilitic myositis a fibrous tumour in the interior of the muscle may result; sometimes a gummy tumour is formed. Syphilitic tumours thus formed in muscle bear a great resemblance to malignant tumours. Indeed it is often found that the only means of distinguishing the two clinically is by the effect of iodide of potassium in causing the disappearance of the former.

3. **Rheumatic Inflammation.**—The morbid changes in this form of inflammation rarely pass beyond the stage of congestion and serous exudation, though occasionally proliferation of the interstitial tissue may occur, and callosities may be formed. *See* RHEUMATISM, MUSCULAR.

4. **Hæmorrhage.**—Hæmorrhage takes place in muscle not only from injury, but frequently in the course of typhus and typhoid fevers and pyæmia.

5. **Rupture.**—Rupture of muscle is a subject which falls more properly into the domain of the surgeon, but the accident occurs also in circumstances which may bring it under the notice of the physician. Violent contraction of a muscle, without external injury, may lead to partial rupture of its fibres, for example the gastrocnemius. The violent spasms of tetanus occasionally cause complete rupture of a muscle, particularly of the muscles of the back, the rectus femoris, and the psoas. Rupture of muscles has been known to occur in the delirium of fever; and may be the cause of abscess forming in muscle, as described above.

TREATMENT.—The treatment of ruptured muscle consists mainly in rest; in the support of the muscle by uniform bandaging; and in suitable applications, should the formation of abscess occur.

6. **Lesions of Sensibility.**—*a. Myalgia.*—This term was given by the late Dr. Inman to a painful condition of the muscles arising in those who are in feeble health. The pain is similar to that which is present in a muscle after long-continued and fatiguing exertion—for example, in the limbs after a long walk, or in the diaphragm and intercostals after violent laughing. In persons who are debilitated, pain may arise in the muscles after very slight exertion, and this constitutes myalgia. It is often accompanied by cramps at intervals. The pain is most commonly felt at the tendinous insertion of the muscle. The abdominal muscles are frequently the seat of myalgia, such as the costal origin of the external oblique—causing, according to some authorities, that pain in the side which is so common in women—and the pubic insertion of the recti. The muscles of the back, and especially the trapezius, also suffer; the muscles of the limbs much less frequently.

When situated in the trunk, myalgia is often mistaken for some congestive or inflammatory condition of the liver, spleen, or other viscus lying beneath. The pains of myalgia are distinguished by their hot and burning character. They are increased by exercise of the affected muscle, and disappear when it is relaxed or artificially supported. However severe the pain may be, the pulse remains unaffected; but it is usually uniformly weak and fast.

The muscles or their fibrous connexions are also the seat of pain in the condition known as muscular rheumatism.

Treatment.—The muscles should have rest and support by bandaging. Tonic treatment is required. Dr. Inman especially recommended cod-liver oil and tincture of perchloride of iron. Friction and counter-irritation do little good. Exercise is of no use, unless combined with fresh air and good diet.

b. Muscular anæsthesia.—This term is given by Dr. Russell Reynolds to a group of symptoms occasionally met with, and believed by him to be caused by loss of the 'muscular sense.' See Muscular Sense, Disorders of.

7. Atrophy and Degenerations.—*a. Simple atrophy.*—Simple atrophy of the substance of muscular fibres arises either from general defective nutrition, during the course of wasting diseases, such as phthisis, in cachectic conditions, or after severe fevers; or as a local condition from disuse of the muscle. The muscles become pale and flabby. The ultimate fibres are reduced in volume, but preserve their anatomical characters, still showing the longitudinal and transverse striation. The atrophy is sometimes so advanced in parts, that the muscular substance of the fibre entirely disappears, and nothing is left but the sheath of the sarcolemma, which appears in the form of fibrous bands between the remaining muscular fibres.

As a local condition, atrophy is most frequently seen in muscles in the neighbourhood of a diseased joint, or in a paralysed limb. In these cases the atrophy is usually combined with more or less interstitial deposit of fat between the ultimate fibres, constituting *fatty growth* on or *infiltration* of muscle. Occasionally the amount of fat is so great as to cause an actual increase in bulk of the muscle, so that it appears hypertrophied. The atrophic and other changes arising in paralysed muscles are considered in their appropriate articles. Fatty infiltration of muscles may also arise as a primary condition, when there is an excess of fat in the blood, and atrophy of the muscular substance results from it.

b. Fatty degeneration.—Here the fat is deposited, not between the ultimate fibres, as in fatty infiltration of muscle, but in their interior. Rows of minute granules appear in the longitudinal striæ, and gradually increase until the whole breadth of the fibre is occupied by them, and nothing is left but the sarcolemma. When the degeneration reaches this extent, it is of course irrecoverable. Muscles affected by this change become very soft and friable. This degeneration is met with much oftener in the heart than in voluntary muscles. It is sometimes associated with atrophy of the fibres in the muscles of limbs attacked by certain forms of paralysis. It is met with also in fever and phosphorus-poisoning, granular degeneration being the first stage. *See* Fatty Degeneration.

c. Granular degeneration.—Granular degeneration of muscles occurs in fevers and acute diseases. The ultimate fibres become swollen and opaque, being filled with fine granules. These clear up on the addition of acetic acid; this test distinguishing granular from fatty degeneration. The muscles which are affected by it are soft and friable and easily rupture. The fibres no doubt ultimately recover their natural appearances; but if the disease be severe and long-continued, granular degeneration advances to fatty degeneration, as is seen in cases of phosphorus-poisoning.

d. Waxy degeneration; *Vitreous degeneration*; *Myositis typhosa.*—This degeneration, which was discovered by Zenker, is believed to be partly a *post-mortem* change. The affected fibres swell and lose their striation; and become of a homogeneous translucent aspect. After a time transverse fractures appear in each fibre, dividing it into a series of short cylinders. The nuclei of the sarcolemma also multiply. The change does not attack all the muscular fibres of a part uniformly; for healthy and degenerated fibres are seen side by side. It is observed chiefly in typhoid fever, cholera, and other acute febrile diseases, being often associated with the granular degeneration. It usually attacks the adductor muscles of the thigh, the abdominal and pectoral muscles, and the diaphragm; appearing in patches of one or more square inches, which gradually become softened and pulpy, and resemble a muscular abscess (Wilks and Moxon). *See* Degeneration.

e. Fibroid degeneration.—Fibroid degeneration of muscle has already been referred to as a result of myositis. Chronic or repeated inflammation, of a rheumatic or syphilitic character, leads to the formation of fibrous tissue in muscle, and the muscle becomes of a tough whitish character.

f. Ossification. — Ossification of muscle is a rare result of chronic inflammation or irritation. It is observed to occur in muscles which are subject to pressure, as the deltoid in soldiers, and the adductors in riders. In a few cases ossification of a considerable number of the muscles has taken place.

8. Tumours.—Besides the syphilitic, fibrous, and gummatous tumours already referred to, muscle is subject to growths of a sarcomatous and cancerous nature. Fatty, cartilaginous, vascular, and other tumours, are also met with in this tissue, but rarely.

9. Parasitic Affections.—The chief disease of muscles belonging to this group is that due to the presence of *trichinæ* (*see* Trichinosis). The *cysticercus cellulosæ* is also sometimes found in muscles. *See* also Pelodera.

Alexander Davidson.

MUSCULAR ATROPHY, PROGRESSIVE. *See* Progressive Muscular Atrophy

MUSCULAR HYPERTROPHY. — An increase in muscular tissue, affecting either the voluntary muscles, or the muscular tissue of special organs, such as the heart, the intestine, or the bladder. True muscular hypertrophy must not be confounded with an increase in the volume of muscular structures from hyperplasia of the connective-tissue elements. *See* HYPERTROPHY; and PSEUDO-HYPERTROPHIC PARALYSIS.

MUSCULAR RHEUMATISM.—A form of rheumatism affecting the muscles. *See* RHEUMATISM, Muscular.

MUSCULAR SENSE, Disorders of.—By the term 'muscular sense' is meant the sensation by which we are aware of the degree of force exerted by contracting muscles. By it we become conscious of the resistance to contraction, that is, the tension of the fibres, rather than of the contraction itself. This sense must be distinguished from the 'common sensibility' which muscles possess, and by which we feel—(1) pain on firm pressure; and (2) pain on tetanic contraction, whether spontaneous ('cramp'), or excited by faradisation, independently of the excitation of cutaneous nerves, as when the skin is insensitive or absent. It must also be distinguished from (3) the sense of muscular fatigue. The muscular sense proper has been referred to a sensation in the joints, skin, and other parts, of the position of the limb, but it may be unimpaired when this sensation is lost (*see* KINÆSTHESIS). It has been thought to be merely the consciousness of the degree of the out-going motor-impulse, but it may be lost when motor power is normal, as in a case under the observation of the writer, in which the muscular sense was suddenly lost in one arm, although the power was unimpaired. A poker did not seem heavier than a feather. The sensibility probably depends upon afferent fibres, which have been found by Tschirjow to terminate between the fibrillæ. They apparently course with the motor fibres in the mixed nerves, but pass to the spinal cord in the posterior roots. From the fact that the common and special sensibility of muscles may be lost in different degrees, it has been conjectured that in the cord the paths are not quite the same.

Hyperæsthesia.—Increase of the common sensibility of muscles is not unusual, but very little is known of that of the muscular sense. The sensation of restlessness, impelling movement, has been attributed to it, but without sufficient reason. An increase of the muscular sense has also been supposed to exist in writer's cramp and chorea (Eulenberg).

Anæsthesia.—Diminution of common sensation in muscles is frequent, with or without loss of voluntary power. Diminution of the special sensibility, *muscular anæsthesia*, or *muscular analgesia*, is occasionally observed, commonly in consequence of central disease, especially of the spinal cord, and is usually associated with a diminution of other forms of sensibility. The diseases in which muscular anæsthesia is commonly observed are locomotor ataxy and hysteria. In the former it is common, but not invariable, and bears no necessary relation to the change in cutaneous sensibility.

SYMPTOMS.—In muscular anæsthesia the patient is unaware of the degree of force exerted by the contracting muscles, and is dependent for his knowledge of the position of his limb, and of its movements mainly upon cutaneous impressions. Ignorance of the degree of contraction interferes with muscular coördination, by rendering this dependent on cutaneous and ocular perceptions. When these are perfect, the amount of incoördination may be slight. The condition of the muscular sense is ascertained by observing the accuracy of movement with and without closure of the eyes, and especially by ascertaining the sensitiveness to movement against resistance so applied as to affect the cutaneous nerves as little as possible. The best method for this purpose is to suspend a weight, in a bag or cloth, to the limb, and observe (*a*) the minimum which can be recognised; and (*b*) the least increase in a greater weight which can be distinctly perceived. The sensibility of the two limbs may be conveniently compared. In each of these points the muscular sense may present a deviation from the normal, and the change in the two is not always proportioned. The minimum recognisable, and the minimum difference recognisable, vary in different parts. The latter amounts in the case of the arm in health to a difference of $\frac{1}{40}$th in a weight of three or four pounds. Balls of similar size and appearance, but of different weights, have been employed for the same purpose.

TREATMENT.—Muscular anæsthesia usually occurs as part of a wider affection, as in hysteria and ataxy, and rarely requires special treatment. Sudden local loss of muscular sense commonly depends on an acute, localised change in the cord, and requires rest and counter-irritation. In one case under the writer's care, such a condition in the arm rapidly passed away under this treatment. Faradisation of the muscles has been suggested, and may in some cases be useful.

W. R. GOWERS.

MUSCULAR SPASM. *See* SPASM.

MUSCULAR TIC.—A synonym for facial spasm. *See* FACIAL SPASM.

MUSCULAR TREMORS. *See* TREMORS.

MUSHROOMS, Poisoning by.—SYNON.: Fr. *Empoisonnement par les Champignons*; Ger. *Pilzvergiftung*.

Poisoning by mushrooms is by no means a common occurrence. Great discrepancy of opinion has existed as to the poisonous or harmless nature of some species of fungi. We are, now, however, increasing our hitherto limited knowledge of the various species and varieties of mushrooms; and within the last dozen years the researches of Schmiedeberg, Poppe, and others, have thrown great light upon the active principle of at least one mushroom—the fly-fungus. The varied toxic symptoms produced by the ingestion of mushrooms become more easily explicable when we bear in mind that only a few fungi are apparently poisonous under all conditions. They are *Amanita muscaria*, the fly-fungus, which grows not very plentifully in this country; *Russula integra* seu *emetica* (*Agaricus integer* seu *emeticus*), also not very common; *Boletus luridus* (*B. perniciosus*, *B. bovinus*); and *Amanita phalloides* (*A. bulbosa*, *A. venenosa*, *A. viridis*), to which belong the varieties termed *Agaricus citrinus* and *Agaricus virescens*. Other fungi are poisonous only under special conditions, among which may be named idiosyncrasy, and the susceptibility of young children to the toxic effects of mushrooms. The delicious edible morel even has been known to produce fatal results. It must not be forgotten that gastro-intestinal catarrh of a severe character may result from the ingestion of a large quantity of ill-cooked indigestible fungus-tissue; that the highly nitrogenous tissue of fungi is peculiarly prone to rapid decomposition; and that fungi as a class absorb excretory animal matters, perhaps unchanged. These circumstances may serve to explain some of the apparent anomalies connected with mushroom-poisoning. Some kinds of poisonous mushrooms have their active principle either dissipated or destroyed by the prolonged heat employed in thorough cooking.

Anatomical Characters.—Evidence of gastro-intestinal catarrh, more prominent in the stomach than in the intestines; signs of cardiac paralysis, or of asphyxia; occasionally fatty degeneration of the liver and other viscera; and minute sub-serous extravasations of blood, have all been noted after death from mushroom-poisoning.

Symptoms.—The symptoms of mushroom poisoning are of a twofold character: gastro-intestinal irritation, and a so-called narcosis. After partaking of a meal of poisonous mushrooms, colic sets in, followed by nausea and repeated vomiting, and diarrhœa eventually supervenes. The onset of symptoms does not as a rule manifest itself till after the lapse of some hours, six or eight or more, after partaking of the fungi. But this period is liable to great variation, and may be much shorter. Fragments of the fungi may be recognised in the fæces; and, indeed, were it not for this, and the history of the case, a diagnosis from violent ordinary gastro-intestinal catarrh would often be impossible. In severe and fatal cases the stools of the patient may become rice-watery in character; the patient becomes algid, collapsed, and cyanosed, with muscular contractions; and in children convulsions are not rarely met with. The sufferer eventually becomes somnolent and falls into a state of sopor; but this is perhaps not due to a true narcosis, but to the drain of fluid from the system, and carbonic acid poisoning.

When the *amanita muscaria* has been taken, cerebral symptoms are more prominent. The patient appears to be in a state of inebriation; and there frequently appears to be a tendency to dash the head against a wall or other solid object. These symptoms, are, however, not exclusively met with in muscarine poisoning, but may be observed when other fungi have been eaten.

Diagnosis.—The history of the case, and the detection of particles of the fungi in the fæces, are usually sufficient; but in the absence of these a diagnosis from natural disease is perhaps impossible. It has been proposed to test for the presence of muscarine, the active alkaloid of the fly-fungus, by applying a drop of the concentrated or unconcentrated urine to the heart of a frog. Muscarine causes the heart of the animal to stop in the state of diastole.

Prognosis.—The patient cannot be considered safe for at least three days, unless the more prominent symptoms have been markedly alleviated. Death may occur at any period between six and seventy-two hours. Recovery is frequent.

Treatment.—In poisoning by mushrooms emetics should be promptly administered, to evacuate the stomach, and those which are not of a depressing nature should be selected. The stomach-pump is perhaps of little service, seeing how persistently the particles of fungi adhere to the walls of the gastro-intestinal canal. Oleaginous purgatives, as, for example, a spoonful of castor oil in olive oil, may be advantageously administered. Fortunately the action of *muscarine*, which Schmiedeberg and Poppe have isolated as the active alkaloid of *amanita muscarina*, and which is probably identical with *bulbosine*, stated by Letellier and Speneux to be the active principle of *amanita phalloides*, is pretty well known. *Amanitine*, an alkaloid, is said to be an active principle in certain fungi, and is perhaps closely allied to muscarine. Atropine appears to be a direct antidote to muscarine; and digitalis appears to be so in a lesser degree. Atropine should therefore be given in small doses in cases of poisoning by *amanita muscarina*; and failing this some preparation of digitalis. Should atropine be administered it would be well to avoid the use of opium; but if atropine be not administered the exhaustive diarrhœa may have to be combated by the use of opiates combined with astringents.

Thomas Stevenson.

MYALGIA (*μῦs*, a muscle, and *ἄλγοs*, pain). A name for pain in a muscle. *See* Muscles, Diseases of; and Rheumatism. Muscular.

MYCETOMA (*μύκηs*, a mushroom).—A synonym for fungus-foot of India. *See* Fungus-Disease of India.

MYCODERMA (*μύκηs*, a mushroom, and *δέρμα*, the skin).—Vegetable organisms associated with certain diseases of the skin. *See* Epiphytic Skin-diseases; and Tinea.

MYDRIASIS (*μυδρίᾱσιs*).—This word was used by Galen and other writers to signify an undue enlargement of the pupil; but by Aretæus (*περὶ χρονίων παθῶν*, I. 7) to mean a shrinking or contraction of the pupil. Aretæus employs the word *πλᾰτῡκορία* (ibid.) to express dilatation of the pupil. The word is now invariably used to mean a preternatural dilatation, and sluggishness or immobility of the pupil. It is the opposite of myosis. *See* Pupil, Disorders of.

MYELITIS (*μυελὸs*, marrow).—Inflammation of the spinal cord. A term that has been much abused, and which is still wrongly applied to many mere degenerative softenings of this organ. *See* Spinal Cord, Diseases of.

MYELOID }
MYELOMA } (*μυελὸs*, the marrow).—A form of sarcoma, characterised by the presence of giant or myeloid cells. *See* Tumours.

MYOCARDITIS (*μῦs*, a muscle, and *καρδία*, the heart).—Inflammation of the walls of the heart. *See* Heart, Inflammation of.

MYOPIA (*μύωψ*; from *μύω*, I close or blink, and *ὤψ*, the eye).—That form of *ametropia*, or error of refraction, in which, owing to a high refractive index of the dioptric media, or excessive convexity of the refracting surfaces, or abnormal elongation of the antero-posterior axis of the eyeball, parallel rays of light converge to a focus in front of the retina, and form, therefore, circles of diffusion upon the retina. It is the opposite of hypermetropia (*see* HYPERMETROPIA), and is sometimes called *brachymetropia* (*βρᾰχύς*, short; *μέτρον*, a measure; and *ὤψ*, the eye), or *hypometropia* (*ὑπομετρος*, below the measure). *See* VISION, Disorders of.

MYOSIS (*μύω*, I shut).—A preternatural contraction and sluggishness or immobility of the pupil. The opposite of mydriasis. *See* PUPIL, Disorders of.

MYOSITIS (*μῦς*, a muscle).—Inflammation of a muscle. *See* MUSCLES, Diseases of.

MYXŒDEMA (*μύξα*, mucus, and *οἴδημα*, a swelling).

DEFINITION.—A name given by the writer of this article to a progressive disease, in which the tissues of the body are invaded by a jelly-like mucus-yielding dropsy, unaccompanied by albuminuria or other signs of primary affection of the kidneys.

ÆTIOLOGY.—Beyond the almost invariable association of this disease with the period of adult life in women, no indications of its mode of causation have been recognised. In the fifteen or sixteen cases so far fully recorded, alcoholism, syphilis, and fevers, are, as causes, excluded by the history. More married than single women are affected. Pregnancy has in one or two cases been followed by the first appearance of the change.

ANATOMICAL CHARACTERS.—Hitherto only two bodies of persons dying from this disease have been examined. The results were identical in these two. A remarkable overgrowth, associated with a sort of retrograde degeneration, of connective tissue was found in all parts of the body. The fibrillar element of ordinary connective tissue was everywhere increased, and its elements unnaturally defined; the corpuscular elements were enlarged and multiplied; the interstitial cement enormously augmented. In normal tissue this latter element yields some mucin. The skin in myxœdema yields many hundreds of times as much mucin as ordinary or anasarcous skin.

To such amplification and mucous infiltration the skin owes its swelling, its translucency, and its defect of secretion. The same sort of interstitial expansion is found in the mucous membranes, in glands of all kinds, in muscles, and in the central ganglia of the nervous system, subjecting the proper structural elements of each tissue to destructive pressure. It is most developed of all, perhaps, in the outer coat of arteries. The diminution of the thyroid is associated with an almost complete annihilation of the proper gland-structure by this stuff; and the late occurrence of albuminuria marks the advanced progress of its inroads on the Malpighian bodies and tubules. Whether the mental failure of the last stage be due to the operation of similar changes in the brain, is not a matter upon which a decision is at present possible. There appears to be a general increase of neuroglia, and a very considerable development of the connective tissue around all the vessels. On the other hand, the appearances seen in sections of the central ganglia are not those of disseminated sclerosis.

SYMPTOMS.—The subjects of myxœdema are, some doubtful cases excepted, always adult females, who present a very characteristic physiognomy. The face is swollen in every feature, so as to suggest the existence of renal disease. But while the negative results of a complete examination dispel this idea, the distribution and quality of the swelling are different from what is observed in common dropsy. The swollen skin is singularly waxy-looking and anæmic; and the swelling affects dependent and non-dependent features equally. Thus the upper and lower eyelids, and the upper and lower lips are uniformly enlarged; the alæ nasi are thickened and broadened; the ridges of expression are blurred and coarsened, or the lines obliterated. The œdema is resilient; does not pit on pressure; and shows, as the foregoing statement indicates, no tendency to shift by gravitation. The cheeks are overspread with a dull pink flush, abruptly limited towards the orbits, and standing in vivid contrast with the anæmic skin around.

The conditions observed in the face prevail throughout the body. The skin is everywhere thickened, translucent, dry, and rough to the touch; perspiration being infrequent or absent. The hands, in particular, lose all shapeliness and expression, and have received from Sir William Gull the appropriate epithet, 'spade-like.' All visible and tangible mucous membrane is similarly amplified. Late in the disease ordinary anasarca is often added to the mucoid œdema.

Two other noteworthy phenomena are met with in the external examination of the body; first, a diminution, sometimes almost a disappearance, of the thyroid body; and secondly, a correlated tumefaction, with marked resilience of the skin, in the lower triangle of the neck, above the clavicle.

An affection of the nervous system as well marked as that of the skin, belongs to myxœdema. In the earlier stages an ever-increasing hebetude involves sensation, voluntary movement, and intellect; in the later, aberration of mind often supervenes. The face wears a fixed, heavy, and withal most sad expression; the speech is slow and laboured, though not slurred or slovenly; the voice monotonous, like that of an automaton, and leathery in tone. Sensation is slow, but finally sure. The movements of the limbs are slow and languid; the maintenance of fixed attitudes requires much effort; and sudden falls are not infrequent. It appears as if the muscles were toneless and excessively relaxed during rest, so that a considerable initial contraction is necessary before they bear on their attachments; and as if the muscular sense were also torpid. The result is that while there is neither jerking nor tremor of the legs in walking, the balance of the body is painfully maintained, as the weight is thrown on each leg in succession; and a quiver often runs through the body at the moment of raising one foot from the ground and balancing the body on the other. This tardiness of coördination is altogether different from the vague staggerings and jerks of locomotor ataxy, and from the rhythmical tremors of disseminated sclerosis. And it must be remembered that there is no real loss of muscular power, no wasting of muscles, and no loss of sensation. Laxity of muscles at rest gives rise to drooping of the head on the chest in some cases; in others it has led to fracture of the patella, by allowing, first, a yielding of the extensors of the leg, and then a sudden arrest of the consequent fall.

In the operations of the intellect, thought and volition are again slow. All the patients observed have complained of being unable to perform any of the daily actions of life with their natural expedition. Yet all that they actually do is well done, and they are acutely conscious of their shortcoming in activity. In conversation ideas come deliberately, and are tardily expressed. To write a letter occupies an hour where it would before have taken ten minutes. Yet the language is correct, and the caligraphy unchanged. There is, in fact, an unwieldy state of mind as of body. The difficulty of collecting thoughts gives an early impression of loss of memory. This, in fact, occurs late in the disease, when other aberrations are developed.

Two affections of the special senses apparently related with changes of the periphery are often noticed—one a persistent unpleasant taste, sometimes of bitterness, sometimes of sweetness, &c.; the other a persistent unpleasant smell. Otherwise the special senses show no defect save tardiness. The hair is often scanty, and the teeth decay early—conditions no doubt related with the changes in the skin and mucous membrane.

The heat of the body is almost always lower than normal, ranging between 98° and 94° Fahr., or even less. Most patients complain of constant chilliness, without appearing to estimate at all readily changes of external temperature. The viscera give no signs of organic affection in the beginning of the disease. The urine is usually increased in quantity; lowered in specific gravity; and contains no albumin, sugar, or casts. The uterine functions go on as in health. As the affection advances various indications of damage to viscera are declared, and the urine is generally albuminous in the last stage. Then also, together with all the indications of great general debility, the mind often becomes unhinged. Lethargic good temper is exchanged for moroseness, fretfulness, irritability; delusions or hallucinations often follow; and there is a speedy lapse into coma. Death comes either by coma, or with the signs of uræmic poisoning, or by inanition.

Prognosis.—The progress of the disease is not readily affected by any remedy. The prognosis is altogether unfavourable; the duration of observed cases has been from six years upwards.

Treatment.—Something may be done by keeping the patient carefully sheltered from the cold; something by tonics; something by good food. Though these will not cure they will at least help the patient to bear her sufferings better. Of late the writer has found in two cases benefit from the use of vapour baths. In three others under the prolonged use of jaborandi the signs of myxœdema have almost disappeared. Ten to sixty minims of the fluid extract may be given four times daily. Nitro-glycerine has benefited one case. Dr. Andrew Clark regards the disease as fairly curable by careful diet, iron, arsenic, baths, and assiduous frictions.[1]

William M. Ord.

N

NÆVUS. *See* Tumours.

NAILS, Diseases of.—Synon.: Fr. *Maladies des Ongles*; Ger. *Krankheiten der Nägel.*

Onychopathic or ungual affections admit of a division into—(A.) Diseases of the *nail proper*; and (B.) Diseases of the *soft parts in immediate relation* with the nail.

Under the former head may be considered alterations of colour, texture, figure, and development; and under the latter, affections of the walls of the nails and inflammation.

Ætiology.—The nails, in consequence of their position, are more than usually liable to injury from undue pressure, from blows, and from foreign bodies forced beneath them, such as splinters of wood, pins, and nails. The great vascularity and sensitiveness of the tip of the fingers and toes, and the close adhesion of the bed of the nail to the deeper structures, are at the same time predisposing causes, and causes of greater intensity of result. Syphilis, struma, eczema, psoriasis, and gout are also causes of onychia and paronychia.

A. Diseases of the Nail Proper.—1. *Colour.* In colour, the nails, which are naturally clear and translucent, may be brownish or greyish, and dirty in appearance; or they may be opaque in round and circumscribed white spots, or in patches of greater extent. The small, white opaque spots are termed *flores unguium* or *mendacia*, but when of greater extent and producing a more general whiteness, *selene unguium.* The transparency of the nails admits of stains in the derma being visible through them, and these are not to be confounded with discolouration of the nail itself. Stains of this kind result from the development of psoriasis or of syphilis beneath the nail, as also the diffusion of pus and blood, the latter constituting *ecchymoma unguium.*

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[1] Since the above was written, many cases of this disease have been described by observers in England and France, but the condition appears to be rare in Germany. These additions to our knowledge make it evident that more men are affected than the earlier observations indicated. Several cases of a typical kind in which males were the subjects have been fully described; and Dr. Andrew Clark has stated that in his experience males have been the more frequent sufferers, namely, in about the proportion of seven to three females. Recent observations again bring out more strongly the fact that the central organs of the nervous system are affected, in many cases to a large extent, by the destructive increase of the connective tissue element. Marked bulbar paralysis has been observed in two cases. Dr. Mahomed has argued strongly in favour of the identity of myxœdema with Bright's disease.

2. *Texture.*—In texture the nail-substance may be hard or soft, thick or thin, brittle or flexible, uneven and rough, or fibrous. *Thick* nail may be the simple consequence of more active production of nail-substance, and in this respect may be contrasted with the thin nail; or it may result from interference of growth in length, which enforces the apposition of lamina after lamina to its under surface, until a thick horizontal mass is formed, or, if it be lifted from its bed, those elongated, horny, and twisted cylinders which resemble horns rather than nails. A third kind of thickening of the nail results from the formation in excessive quantity of a coarse, lamellated cell-substance on the bed of the nail, which lifts the horny plate into an oblique and almost perpendicular position, and gives it the appearance of a claw. This state of the nail is termed *gryphosis* or *onychogryphosis*, and is often the first stage of the horn-like nail.

Hardness of texture of the nail may retain its quality of toughness, but is more frequently associated with brittleness to a greater or less extent. In the latter state there may be several longitudinal cracks or fissures in the nail, sinking as deeply as the vascular corium, and the longitudinal fragments may themselves be transversely fissured and broken.

Softness of the nail is accompanied with flexibility; and the degree of the latter quality will be governed by the degree of density of the horny plate. In some instances the covering of the matrix and bed of the nail more nearly resembles epidermis than horn, and may be taken to represent an absence of the nail, or *alopecia ungualis.* Usually smooth and polished on its surface, the nail may be *rough*, sometimes apparently fibrous, sometimes crossed by shallow grooves or deep fissures, and sometimes fretted or eroded as if it were worm-eaten. These various appearances have suggested the terms *fissura* and *tinea unguium*, as likewise, *scabrities*, *defœdatio*, and *degeneratio*.

3. *Growth.*—The condition of the nails has relation to the state of the system generally, as it is well known that they undergo an impairment of growth during illnesses which affect the nutritive function of the organism. In the case of the nail this is exhibited by a deficient formation of horny matter, which results in the production of a groove across the nail; and it has been shown by Dr. Wilks and Dr. Beau, that if the rate of growth of the nails be ascertained, the period and duration of the illness may be determined by the position and breadth of the groove.

4. *Figure.*—Aberrations of figure of the nails are exemplified in the broad, thin, curved nail which is met with on the club-shaped fingers of struma, and which has received the name of *unguis aduncus*; in the longitudinally contracted and prominent nail termed keel-shaped, *arctura unguis* or *gryphosis*; and in the depressed, or dish-shaped nail, which looks as if it were tied down in the centre and forced upwards at the circumference.

5. *Development.* — Errors of development of the nail, giving rise to supernumerary nails, are almost entirely restricted to the bifid or double nail, which is associated with a broadening and tendency to bifurcation of the last phalanx.

6. *Parasitic Affections.* *See* TINEA.

B. **Disorders of the Connected Soft Parts.**—Disorders of the soft parts connected with the nail, assume the forms of errors of growth, and inflammation.

1. *Errors of Growth.*—The epidermis which borders the posterior wall of the nail, and is normally adherent to its surface, is apt to be drawn forward with the growth of the nail, and become stretched over its surface as a thin film, which has been likened to a wing, and has received the name of *pterygium unguis.* At other times this border of cuticle splits up into narrow shreds, some of which separate from the nail and curve backwards. In their abnormal position they are liable to become torn; and when the tear, as is usually the case, extends to the corium, there is bleeding and pain, and sometimes inflammation. This is the affection which is known by the term *agnail*, derived from the ancient Saxon word, *ange*, signifying 'angry.'

2. *Onychia.*—Inflammation of the end of the finger, involving the soft parts surrounding and beneath the nail, is termed *onychia*; but when the inflammation is limited to one or other of the walls of the nails, the case is one of *paronychia*.

Onychia presents the ordinary characters of inflammation, modified by extent and degree; by the anatomical construction of the part; and especially by the constitution of the patient. Hence we distinguish a *common*, a *strumous*, and a *syphilitic* onychia; the first probably issuing in suppuration with loss of the nail, the second in prolonged ulceration with fungous vegetation, and the third in deep ulceration. Common onychia is intensely painful, and more rapid in its course than the specific kinds. Sometimes the inflammation is so severe as to destroy the vitality of the bone. The strumous and syphilitic forms of onychia are sometimes associated with much swelling and congestion of the finger-end; and have probably been described as *onychia maligna*.

3. *Paronychia.*—Paronychia, or inflammation of the walls of the nails, sometimes presents itself in an acute form, as in the painful abscess termed *panaris* or whitlow; sometimes as a chronic inflammation of one of the lateral walls of the nail due to pressure against the border of the nail, termed *ingrowing nail*; and sometimes as a chronic thickening of the posterior wall, which, becoming everted and prominent, is termed *ficus ungualis.*

TREATMENT.—A prophylactic of the slighter forms of disorder of the nails, is the bestowal of some care and attention on their culture, to prevent them from growing too long; to prevent the epidermis growing forward on the back of the nail; and at the same time to avoid the loosening of this fold and pressing it back too forcibly.

Onychia and paronychia must be managed according to the general principles of treatment of inflammation. If the cause be obvious, such as the presence of a foreign body or an ingrowing nail, these irritants must be removed. In acute idiopathic onychia, position, pressure, and cold applications are appropriate to its primary stage; and water-dressing or poultice if the pain should be severe. Where the issue is by abscess, as in whitlow, the first appearance of the pale disk which represents pus should be looked for, and a puncture made to give it exit; whilst chronic inflammation and ulceration are to be treated with stimulant applications, the former with linimentum iodi, the latter with the compound tincture of benzoin and unguentum resinæ; possibly with lunar caustic.

Where an ingrowing nail keeps up a paronychial inflammation, the body of the nail should be thinned by scraping to diminish the force of pressure; and by a little manœuvring, a director may be introduced, beneath the border of the nail, and the edge cut away with a pair of scissors. A minute compress of cotton-wool should then be passed beneath the adjoining part of the nail, so as to direct the ingrowing point upwards and outwards. As a last resource, avulsion or some other surgical procedure may be found necessary.

Its appropriate treatment is removal of the diseased nail, and dressing with powdered nitrate of lead or a lotion of liquor arsenicalis.

Syphilitic, strumous, eczematous, leprous, and gouty onychia and paronychia, besides the ordinary treatment applicable to inflammation in general, will call for specific constitutional and local treatment, for example, iodide of potassium and blackwash for syphilis; cod-liver oil, iron tonics, and nitrate of silver for struma; arsenic for eczema and psoriasis; and colchicum, *inter alia*, for gout. ERASMUS WILSON.

NAPLES, in South Italy.—Changeable climate. Mean temperature, winter, 48° Fahr. Cold winds in spring. *See* CLIMATE, Treatment of Disease by.

NARCOSIS
NARCOTISM } (ναρκόω, I become torpid). A condition of profound insensibility, due to the introduction of certain poisons, or excessive doses of certain drugs, into the system, such as opium or alcohol; or to the retention there of certain excretory elements, as in uræmia. *See* CONSCIOUSNESS, Disorders of; and NARCOTICS.

NARCOTICS (ναρκόω, I become torpid).—SYNON.: Fr. *Narcotiques*; Ger. *Narcotische Mittel*.—DEFINITION.—Remedies which promote or artificially imitate the natural physiological processes of sleep; but which in large quantity produce complete insensibility.

ENUMERATION.—A convenient division of narcotics, in the limited sense of hypnotics, may be made into (1) *indirect* narcotics, which include many soothing and hygienic conditions, Anodynes, Conium, &c.; and (2), *direct* narcotics, of which Opium, Chloral-hydrate, Croton-chloral, Bromide of Potassium, Hyoscyamus, Stramonium, Belladonna, Hop, Indian hemp, Alcohol, Digitalis, and the Anæsthetic vapours are in most general use.

ACTION.—The *indirect* class of narcotics have no primary influence over the cerebral circulation, but act either by supplying warmth, quiet, and other tranquillising elements, or by removing some disturbing cause which renders sleep impossible. We know how powerfully sleep is under the influence of habit and regularity; how an excess of heat or cold, an inconveniently placed pillow, or a penetrating beam of morning light may often produce more or less restlessness; and the insomnia of feebleness or exhaustion may readily yield to a little nourishment, or to a well timed dose of alcohol. Rain, again, is in some individuals responsible for many a wakeful hour; and the evacuation of deep-seated pus, the extraction of an aching tooth, or a dose of quinine may sometimes prove as effectual an anodyne as the subcutaneous injection of morphia, or a moderate dose of opium, which stands as the type of this therapeutical group.

Conium may prove narcotic, by stilling the disorderly movements of chorea or of acute mania.

Direct narcotics, on the other hand, either produce some specific effect upon the cerebral grey matter, or have a very decided action on the blood-supply of the brain, and by constricting its vessels, produce that degree of anæmia which more or less suspends its functions, and causes sleep. In larger doses, however, an opposite effect results, and we then see the cerebral congestion, the livid face, and the gradually deepening coma, which too surely indicate the fatal termination of opium-poisoning.

USES.—Enough has been already said regarding the general principles on which we employ indirect narcotics; and the tact and ingenuity of the physician will often be severely taxed to discover the precise cause on which the want of sleep depends. When remedies, however, of the more domestic class have been exhausted, we must have recourse to drugs, and a brief *résumé* may now be given of the advantages and disadvantages of those remedial agents whose soporific qualities have been firmly established by experiment and experience.

Opium and morphia naturally stand first, and still hold their place as our most potent and reliable narcotics, all the more valuable because, almost alone in their class, they are also endowed with powerful anodyne action, in virtue of which they may relieve pain without causing sleep. Valuable as it is in all forms of insomnia, opium is especially indicated in typhus fever and other acute disorders, when delirium and prolonged wakefulness seem to endanger life. The principal drawback to opium is the digestive disturbance following its use, and the fact that as toleration is very rapidly established, gradually increasing doses are needed to check the counteracting influence of habit.

Chloral is less to be recommended in acute diseases, on account of its tendency to cause cardiac failure, but it is of essential service in simple insomnia, in chronic affections where the prolonged use of narcotics is required, and in delirium tremens. In prescribing it we must not forget its weakening action on the heart, and on the respiratory centre, or the petechial and other skin-eruptions which have been described as following its use.

Bromide of potassium is peculiarly well fitted to soothe the brain when rendered irritable by over-work, but we must remember that it is very uncertain as a narcotic, and is apt to produce an eruption, and an uncomfortable degree of muscular weakness. *See* BROMISM.

Digitalis is of use when flaccid vessels permit a free flow of blood to the brain, thus effectually preventing sleep when the patient occupies the recumbent posture, the tonic influence of the drug bracing up the arterial tissues, and enabling a due amount of cerebral anæmia to be obtained.

The other narcotics may be tried when the more potent remedies of the class fail or lose their power; and under certain circumstances a combination may succeed better than simplicity. Thus chloral and bromide of potassium are more valuable in acute mania when given together than alone; and opium and tartar-emetic are well known to form one of our most effectual means of dealing with some of those very intractable forms of sleeplessness which occur in the course of typhus. Robert Farquharson.

NATAL, in South Africa.—Warm, but healthy climate, with hot, wet summers, and dry, clear winters. High winds from S.E. and N.W. Soil, sandstone and granite. *See* Climate, Treatment of Disease by.

NAUHEIM, in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

NAUSEA (ναῦς, a ship, in relation to sea-sickness).—A feeling of sickness or inclination to vomit, generally accompanied by a sense of disgust or loathing, and sometimes by a feeling of great depression. *See* Sea-sickness; and Vomiting.

NAUSEANTS (ναῦς, a ship).—Definition. Agents which produce the condition of nausea.

Enumeration.—The principal nauseants are Warm water, Tartar-emetic, Ipecacuanha, Tobacco, Squill, and Apomorphia.

Action.—These substances produce irritation of the stomach, loss of appetite, general malaise, enfeebled circulation, muscular weakness, and frequently also salivation and sweating.

Uses.—Nauseants have been employed to diminish appetite, in the hope of causing absorption of fatty accumulations, or of pathological deposits. They are also used in producing relaxation of involuntary muscular fibre, and thus accelerating the passage of calculi through the bile-duct or the ureters. They were formerly used to produce relaxation of voluntary muscles, in order to facilitate the reduction of dislocations, or to subdue the paroxysms of delirium or mania. For such purposes, however, they are now replaced by anæsthetics or other sedative measures. They are still used to excite sweating. *See* Diaphoretics; and Emetics.

T. Lauder Brunton.

NEAR-SIGHTEDNESS. *See* Myopia; and Vision, Disorders of.

NECRO-BIOSIS (νεκρός, a dead body, and βίος, life).—Molecular death of a tissue without loss of continuity, especially seen in the various forms of atrophy and degeneration. *See* Atrophy; and Degeneration.

NECROPSY (νεκρός, a dead body; and σκοπέω, I inspect).—Synon.: Fr. *Nécropsie*; Ger. *Leichenschau*.

Definition.—The inspection of the body after death.

Method.—After making a complete external inspection of the body, and noticing the general appearance, *rigor mortis*, change of colour, whether partial or general, œdema, marks of injury, and other points, a *post-mortem* examination should begin with the head, or, if the spinal cord is to be examined, with the spine.

Head.—To open the head, make an incision down to the bone, across the vertex from the base of one mastoid process to the other, and reflect the scalp backwards and forwards; then divide the bone all round with the saw, beginning in front a little above the level of the superciliary ridge. The posterior half of this section should make an angle with the anterior half by being brought over the occipital bone, a little behind the apex of the lambdoidal suture. By this means the skull-cap will, when replaced, rest firmly in its position without slipping back and so causing disfigurement of the forehead. In cases of fracture of the skull the section should be completed with the saw, care being taken not to wound the dura mater. Under other circumstances the inner table may be conveniently divided with a chisel and mallet. The skull-cap must now be forcibly dragged off; if very adherent to the dura mater, a long flexible spatula may be introduced between them, and separation effected.

In young subjects, before the sutures and fontanelles are united, it is better to remove the dura mater and skull-cap together, by dividing the former with blunt-pointed scissors in a line with the section through the bone, and then cutting through the falx at its anterior and posterior attachments.

The longitudinal sinus may now be opened and examined. The dura mater should next be divided on each side with blunt-pointed scissors, or on the level of the section through the bone, and the two lateral flaps turned up; the falx should next be divided near its anterior attachment, and the whole membrane drawn backwards off the hemispheres. The brain must now be removed; a long narrow scalpel being used to cut through the nerves and vessels, whilst the tentorium is most safely divided with blunt-pointed scissors. The spinal cord should be cut as low as possible. Any fluid present at the base of the skull should be drawn off with a syringe and measured.

Brain.—After examining the pia mater, it should be entirely stripped off, and the surface of the brain examined. It should then be placed on its base, and, if very soft, supported by a towel wrapped round it. A horizontal incision should then be carried through each cerebral hemisphere, on a level with the upper surface of the corpus callosum, from within outwards, not quite reaching the surface, so as to leave the hemispheres still attached to the rest of the brain. These should be turned back, and numerous vertical incisions made in the upturned surface. Each lateral ventricle should then be opened by a vertical incision through its roof, and any fluid contents withdrawn by a syringe. The fornix should now be divided in front, and with the septum and corpus callosum turned backwards. The velum interpositum and choroid plexus being reflected in a similar manner, numerous longitudinal incisions should then be made in the corpora striata and thalami optici, and in the corpora quadrigemina. An incision should now be made through the superior vermiform process of the cerebellum, so as to lay open the fourth ventricle. The cerebellum may be examined by making parallel incisions on each side through its lobes, not quite detaching the sections. The brain may now be folded together again, and the under surface turned up and examined. Incisions should be made into the under surface of the cerebral lobes, and into the crura and pons; and the medulla divided transversely at different levels. Softened portions should be tested with a stream of water; and parts reserved for microscopical examination at once placed in a hardening solution, such as chromic acid 1 per cent.

A method of examining the cerebrum preferable to the above, when it is desired to determine accurately the exact seat of lesions, is the one recommended by Dr. Pitres.

The cerebral hemispheres having been separated and stripped of their pia mater, are divided into three portions by two transverse vertical incisions, the first passing about two inches in front of the fissure of Rolando, the second a little less than half an inch in front of the internal perpendicular fissure, the occipito-parietal fissure of Huxley, which divides the parietal from the occipital lobe of the cerebrum. The cerebrum will thus be divided into three portions, an anterior or prefrontal, a middle or fronto-parietal, and a posterior or occipital. The first and last portions correspond to the non-excitable parts of the cerebrum, lesions of which do not cause either motor or sensory disturbances. The middle region, on the contrary, comprises the corpus striatum and optic thalamus, and the cortical motor zone.

This central portion may be best examined by making four vertical sections by incisions parallel to the fissure of Rolando. The first, or pediculo-frontal section is made by an incision about three-quarters of an inch in front of the fissure of Rolando, dividing the second and third frontal convolutions close to their insertion into the ascending frontal convolution. This section will especially comprise the third frontal convolution. On its surface are seen sections of the three frontal convolutions, the anterior extremity of the island of Reil, the posterior extremity of the orbitar convolutions, the caudate and lenticular nuclei of the corpus striatum separated by the internal capsule.

The second, or frontal section, is made by an incision at the level of the ascending frontal convolution. Its surface displays a section of the ascending frontal convolution in all its extent, the convolutions of the sphenoidal lobe, the island of Reil, the external capsule and the claustrum, the caudate nucleus, the lenticular nucleus at its thickest part, and the optic thalamus.

The third, or parietal section, is made by an incision carried through the ascending parietal convolution. It much resembles the former, but the lenticular nucleus and the claustrum are divided where they are smaller.

The fourth, or pediculo-parietal section, is made by an incision about an inch behind the fissure of Rolando at the level of the foot of the parietal lobules, and passes through the posterior extremity of the optic thalamus. The lenticular ganglion is no longer visible; the corona radiata is divided in the region where lesions produce hemianæsthesia.

By means of these sections the exact relations of lesions of the cerebrum can be made out with much greater accuracy than by the ordinary methods of examination.

Base of Skull, Orbit, and Internal Ear.—The base of the skull and its sinuses may now be examined. In cases of fracture, the dura mater should be carefully stripped off, so as to expose the surface of the bone. The contents of the orbit may be examined by removing its roof. The tympanum can be opened by cutting through with a chisel the plate of bone forming its roof. This is situated on the anterior surface of the petrous bone, just in front of the eminence of the superior semicircular canal. To examine the internal ear the petrous bone must be removed. This is best done by two converging incisions made with a saw, and then separating its apex from the sphenoid and occipital bones with the chisel.

Spinal Cord.—To examine the spinal cord the body must be turned on its face, with the head hanging over the table, and a block placed under the chest. An incision must be made over the vertebral spines from the top of the sacrum to the occiput, and the vertebral arches laid bare. These are best divided with the rachitome, a double semi-circular saw, in the absence of which a short common saw may be used, or a chisel and mallet. The cord should be removed in its tube of dura mater, the latter being held by the forceps, and care taken not to bend the cord abruptly. The dura mater should then be slit open with blunt-pointed scissors along its anterior and posterior surfaces, and the cord examined, with as little handling as possible, by means of transverse sections made with a sharp scalpel. For microscopical examination the cord may be placed in spirit for about twenty-four hours; and then, after removal of its membranes, cut into lengths, and transferred to a one per cent. solution of chromic acid.

A method of opening the spinal canal from the front, preferable in many respects to the above, is practised at Vienna and many places on the Continent. The instruments used are a strong knife-shaped chisel, with a cutting beak, and a mallet. After the removal of the thoracic and abdominal viscera, the beak of the chisel is introduced into the lowest intervertebral foramen, and, by successive blows of the mallet, the pedicles of the vertebræ are cut through on each side and the canal exposed by removing the bodies. In this way great disfigurement of the body and soiling of the table and linen are avoided, and the spinal ganglia are more easily examined.

Thorax and Abdomen.—The thorax and abdomen should now be examined. It is better to lay the abdominal cavity fully open before removing the sternum. In cutting through the first rib, and disarticulating the clavicle, care should be taken not to wound the innominate vein.

By using cutting pliers, which should be directed so as to cut obliquely through the rib into the articulation, all danger is avoided.

If much ascites is present, the belly should be tapped before laying open the peritoneal cavity. So, if either pleura be full of fluid, which will be shown by its pouring out when the cartilages of the ribs are cut through, sufficient should be drawn off with a syringe to prevent any overflow when the sternum is removed.

The lungs should now be drawn out of the chest, adhesions separated, and their posterior surfaces examined. The contents of the mediastinum should next be inspected, and the pericardium opened. If the case be one of thoracic aneurism, mediastinal tumour, or malformation of the heart or great vessels, the heart and lungs should be removed together. Otherwise, the heart may be first removed and examined.

Heart.—The auricles should be laid freely open with a pair of scissors, by an incision joining the mouths of the great veins and carried to the extremity of the auricular appendage. The competency of the valves may then be tested. All clots must first be removed, the heart held in an upright position, and water poured into the aorta and pulmonary artery successively, the semilunar valves being held back with the handle of a scalpel to allow the ventricle to become filled; on looking into the auricles the competency of the auriculo-ventricular valves may be estimated. To test the semilunar valves an opening must be made into each ventricle; the pulmonary artery and aorta cut sufficiently short to enable the valves to be clearly seen; and then water poured into these two vessels successively, and the valves looked at from above. The right ventricle may now be opened. The left forefinger should be introduced through the pulmonary artery, and the anterior wall of the ventricle divided with blunt-pointed scissors into the artery, the point of the scissors being guided by the left forefinger to the junction of the valves. The pulmonary artery and aorta should then be separated as much as possible, and the left ventricle opened in a similar manner along its anterior wall, the left forefinger as before guiding the scissors to the point of junction of the semilunar valves. The incision must be carried close to the ventricular septum, and the septum between the aorta and pulmonary artery, but without cutting the latter. The most accurate way of measuring the capacity of the orifices is to pass through them graduated balls fixed on rods, in default of which the fingers may be used.

Lungs.—To remove the lungs, the trachea must be cut across at the root of the neck, and well drawn forwards by inserting the middle finger into the lower end, and the other fingers on each side behind the bifurcation, care being taken not to cut the œsophagus.

Larynx and Pharynx.—To remove the larynx and pharynx, the incision in the neck must be carried up to the chin; the floor of the mouth opened from below; the left forefinger introduced, and used to depress the tongue; a long narrow scalpel introduced above the finger, and carried along each side of the ramus of the jaw; the tongue then drawn down under the chin; and the soft palate and pharynx divided transversely. The pharynx and larynx should then be opened along their posterior walls.

Intestines.—In examining the abdomen it is most convenient to begin with the intestines. The large intestines should be divided between two ligatures below the sigmoid flexure, and drawn out, cutting the mesentery close to the bowel. This process should be continued till the duodenum is reached, when it may be again tied and cut. The intestine should be opened along the line of attachment of the mesentery.

Spleen.—The spleen may next be examined. It should be drawn forwards out of the abdomen, and the gastro-splenic omentum cut through.

Stomach.—The stomach should next be removed. A double ligature should be placed round the duodenum about two inches below the pylorus, and another one round the lower end of the œsophagus, and these tubes cut through, so as to remove the stomach without the escape of its contents. If required for chemical analysis, the contents should be emptied into a glass vessel, by removing the œsophageal ligature.

The usual practice is to lay open the stomach along its lesser curvature, from the œsophagus to the duodenum; but in many cases it is better to carry the incision along the greater curvature, for, as ulcers and cancers are more frequently situated near the lesser curvature, this incision is more likely to avoid cutting through them.

Unless required for chemical analysis, the mucous membrane may be washed by a gentle stream of water and then examined.

Pancreas.—After the removal of the stomach the pancreas may be conveniently examined. Before separating it from the duodenum the condition of its duct should be ascertained.

Liver.—In all cases of jaundice the liver and duodenum should be removed together, so as to obtain the bile-duct intact. In removing the liver care should be taken not to injure the right suprarenal capsule, which is in close contact and often adherent. In testing the perviousness of the bile-ducts it is better not to squeeze the gall-bladder, as this will often overcome an obstruction, but to open the duct with scissors, and observe the colour of the lining membrane below an obstruction. This will be found unstained by bile.

Supra-renal Capsules.—In cases of Addison's disease the supra-renal capsules should be removed, united with the semilunar ganglia and solar plexus.

Genito-urinary Organs.—In all cases of urinary obstruction the kidney, ureters, and bladder should be removed in connexion. The pelvic organs may be removed *en masse* by carrying a large knife all round the pelvic walls, and drawing the viscera upwards and backwards. As much of the urethra as may be required can be pulled back under the pubic arch. The urethra and bladder should be opened with scissors along their upper wall.

The uterus may be examined by introducing one blade of a pair of probe-pointed scissors through the os; making an incision through the anterior or posterior wall to the fundus; and carrying this on each side to the entrance of the Fallopian tubes.

The kidney may be bisected by an incision through it from the convex border to the hilus; the capsules should then be stripped off, their thickness and degree of adhesion being noticed, and the state of the surface of the kidney, both external and on section, carefully observed.

W. Cayley.

NECROSIS (*νεκρὸς*, a dead body).—The absolute death of a circumscribed portion of any tissue, but the phrase is usually associated with death of bone. *See* Bone, Diseases of.

NEOPLASMS (*νέος*, new, and *πλάσσω*, I mould).—A term for new growths. *See* Tumours.

NEPHRALGIA (*νεφρὸς*, the kidney, and *ἄλγος*, pain).—Definition.—An affection of the nerves of the kidney, unattended by any evident anatomical lesion; characterised by the occurrence of pain in the region of the kidney, sometimes periodic, often accompanying exhaustion, but without any morbid changes in the urine.

Ætiology.—Exhaustion, exposure to cold, malarious poison, and the nervous, rheumatic, or gouty constitutions, are to be ranked amongst the chief causes of nephralgia. It is probable that the pains in the kidney, due to the presence of calculi in its pelvis, are at times of a purely neuralgic character.

Symptoms.—Neuralgic pain in the region of the kidney is sometimes paroxysmal and very intense, at other times more continued and less severe. It is frequently periodic, and is apt to occur when the patient is exhausted, or in a state of nervous depression. It is unattended by any change in the quantity or appearance of the urine, and the pain does not tend to dart down in the direction of the ureter, while tender spots may generally be discovered in the neighbourhood of the spinal column.

Diagnosis.—The disease with which nephralgia is most apt to be confounded is renal calculus. The points upon which reliance is to be placed in making the diagnosis are the exact seat of the pain, and the direction in which it spreads; the presence or absence of tender spots in the lumbar region; and the condition of the urine. In renal calculus the urine is commonly bloody, and contains crystals or groups of crystals, or minute calculi, while in nephralgia it is natural.

Prognosis.—The prognosis of nephralgia is favourable.

Treatment.—The severity of the pain may be such as to demand subcutaneous injection of morphia. The most valuable remedy for cure is quinine, which may be given in doses of five, ten, or even twenty grains two or three times in the course of the day. Iron, arsenic, chloride of ammonium, acupuncture, or Corrigan's cautery may be employed in suitable cases, if the quinine fail.

T. Grainger Stewart.

NEPHRITIC COLIC (*νεφρὸς*, the kidney). A synonym for renal colic, an affection which is usually due to the presence or passage of a renal calculus. *See* Renal Calculus.

NEPHRITIS (*νεφρὸς*, the kidney).—A general term for inflammation of the kidney. *See* Bright's Disease; and Kidney, Diseases of.

NERVES, Diseases of.—Synon.: Fr. *Maladies des Nerfs*; Ger. *Nervenkrankheiten.*—Nerves, in their origin, course, and distribution, are connected with the several organs and tissues of the body, and are consequently affected in various ways when such parts are disordered or diseased. But, besides such *secondary* derangements, nerves are subject to many morbid conditions which affect them *primarily*. In the case of certain classes of nerves, connected with special functions, the effects produced by disease are at once so distinct and so important, that they require separate consideration. Such, for example, are the glosso-pharyngeal, hypoglossal, olfactory, optic, phrenic, pneumogastric, spinal-accessory, sixth and third cranial nerves, the morbid conditions of which will be found fully discussed under their respective headings. Again, certain forms of congestion or inflammation (whether occurring in the subjects of gout, rheumatism, malaria, plumbism, syphilis, or in other states), when they affect important nerves, cause symptoms of a character so marked, either in their progress or distribution or by their severity, as to deserve a special designation, and to demand separate description (*see* Intercostal Neuralgia; Neuritis; Sciatica; and Tic-Douloureux). In these and in other allied instances the prominent symptoms are referable to functional disturbances of the nerves. In another class of cases similar phenomena originate in interference with the general nutrition, in disease of the nervous centres, or by reflex action; and these phenomena will be found discussed in the articles upon Convulsions, Neuralgia, &c.

In this place there remain for special consideration the following subjects:—(1) the effects of *injuries* of nerves; (2) the most common morbid growths involving nerves, which are generally known as *neuromata*; and (3) the effect of cutting or stretching nerves regarded as a means of *treatment*.

1. Nerves, Injuries of.—Nerves may be divided accidentally either by tearing or cutting, or surgically during an operation, or for the relief of pain or resection of tumours. The nerves most frequently divided accidentally are those of the upper extremity, especially the ulnar as it passes behind the inner humeral condyle, or as it lies upon the anterior annular ligament. The median and musculo-spiral nerves are also not unfrequently divided by deep cuts, on the fleshy front of the upper fore-arm or wrist.

Sometimes, besides being wholly or partially divided, nerves may be bruised, or have imbedded in their substance particles of friable foreign bodies, such as glass or slate. Fractures of the humerus at the upper or lower third, are not uncommonly complicated by laceration of the musculo-spiral nerve, by the sharp edge of one of the fragments; for the nerve passes spirally round and in close contact with the bone, first on the inner, then on the hinder, and near the elbow at the outer aspect of the bone.

Symptoms.—The symptoms of the division of a nerve are loss of power in the muscles, and of sensation in the skin supplied by the offsets of the injured nerve, as, for example, the radial and posterior inter-osseous branches of the musculo-spiral. The complete or the partial division may be diagnosed by the more or less complete interruption of their functions.

Nerves unite, if the cut ends are placed in apposition, as readily as other structures; but it is usually some time before the sensory or motor functions are restored, and then only by slow degrees, the former usually taking place sooner. The recovery is sometimes delayed by displacement or error in the co-aptation of the cut fibrils, and then the brain seems to require some education and training to correct misplaced impressions, which, however, is in most cases accomplished ultimately more or less perfectly. When an important nerve, such as the great sciatic, is divided, the part of the limb supplied by it suffers in its nutrition, and is apt to become wasted, and if the patient be growing, to lag behind its fellow in development. Sometimes the muscles may become atrophied; and if the division is not united in due time, the fibres become subject to fatty degeneration, and may not afterwards regain their power. Other tissues besides the muscles may likewise become atrophied. Thus wasting or atrophy of the fingers may result from injury of the ulnar or median nerve. This has been thought to be in some degree due to the interruption of innervation in certain fibres, which are bound up in the spinal as well as in the sympathetic nervous systems, and which preside over and control the nutrition of the tissues, the so-called *trophic* nerves. The parts supplied by them seem to be more liable to the formation of sloughing sores, as is illustrated by the bed-sores which are apt to follow division of or pressure upon the spinal cord, or *cauda equina* in fractures of the spine. Severe contusions of nerves will sometimes so interrupt their functional power as to produce the results of complete division.

TREATMENT.—In the treatment of nerves accidentally divided all foreign bodies are, in the first place, to be carefully removed by sponge or forceps, with as little further injury to the nerve-tissue as possible; and the wound, if practicable, is to be treated antiseptically. Then the limb should be fixed upon splints in a position which will bring most easily and closely the cut ends of the divided nerve into apposition. Carbolised catgut ligature may be applied upon the nerve-sheath or closely adjacent textures, so as to hold the cut ends evenly together; or a thin wire may be applied to the neighbouring tissues, brought out at the surface, and secured over shot or buttons, and the wound treated in the ordinary way. If possible, none of the nerve-fibres should be cut away, although a slight trimming off of jagged ends may be advisable. Passive motion of the paralysed muscles should be employed, as soon as the wound is united; and afterwards weak faradization should be applied to the limb, to promote nutrition and stimulate nerve-currents.

2. Nerves, Tumours of.—SYNON.: *Neuromata.*

The tumours which affect nerve-structure, although no doubt varying in essential character, as they do in other parts of the body, have usually been grouped indiscriminately under this head. Surgically they may be classed thus:—(*a*) *constitutional*, which affect the whole of a particular group or groups of nerves, and are clearly constitutional in their origin; and (*b*) *traumatic*, such as form on the cut ends of nerves after amputation, or result from local injury of some kind.

(*a*) *Constitutional.*—Numerous cases of multiple neuromata are on record. In one case, recorded by R. W. Smith, upwards of 2,000 tumours were found. In most instances they are confined to one particular set of nerves and their branches. For instance, they have been found in the posterior tibial and plantar nerves, as in a case recorded by Van der Byl (*Pathological Society's Transactions*, vol. vi.), where the growth may have been round-celled sarcoma or cancer. In another remarkable case of multiple neuromata, recorded by Dr. Wilks (*op. cit.*, vol. x.), perhaps of syphilitic origin, a simple fibroid deposit was found within the neurilemma, causing in some places hardening and contraction, and in others neuromatous tumours. One of these had formed in the substance of the pneumogastric nerve, and was thought by Dr. Wilks to have caused the disease of the lung which proved fatal. In another case, recorded by Mr. F. Smith, multiple tumours affected the internal cutaneous and interosseous nerves of the arm, and the larger tumours were found to have undergone calcareous degeneration (*op. cit.* vol. xii.).

A single neuromatous tumour has been found on the auditory nerve, causing deafness (Toynbee, *op. cit.* vol. iv.), and on the musculo-spiral nerve in several recorded cases (*op. cit.* vol. viii.), by Nunn and Barber. In one of these cases acute sensibility and intense pain in the course of the distribution of the nerve were present. In the other case, no pain was felt unless the tumour was pressed. In a tumour upon the same nerve, recorded by Shillitoe (*op. cit.*, vol. x.), of the size of a billiard ball, a blood-cyst containing clot and serum was found in the interior, surrounded by fibro-cellular structure.

b. Traumatic.—Neuromatous tumours which form on the cut ends of nerves after amputation, are rounded or oval masses placed near, but not usually quite at, the extremity of the cut nerve. A small portion of the extreme end frequently forms a sort of tapering tail to the tumour, giving to it a resemblance to a turnip-radish. On section the tumour is found to consist of a fibroid substance, hard, resisting, and firm to the touch, with a somewhat glistening surface. Under the microscope there are seen the same general characters which are found in neuromata, namely, fibroid elongated or spindle cells within and around the neurilemma, pressing upon and displacing the nerve-tubules, which are seen convoluted, distorted, varicose, or lost entirely in the tumour-substance. Some few may be traced through the tumour itself into the tail-like termination, but this latter usually consists of fibrous tissue only. These tumours seem to occur more commonly after amputation of the upper than of the lower extremity. These neuromata are not uncommonly associated with pain, more or less acute at intervals. They may last a long time—in some cases during the whole of the life of the individual. Sometimes neuromata give rise to acute sensibility or tenderness of the stump, and more rarely to spasmodic twitchings of the muscles or even epileptiform convulsions.

TREATMENT.—Neuromata on the continuity of a nerve, if painful or situated so as to be easily accessible, and liable to injury, may be dissected out carefully and with antiseptic precautions. Sometimes it will be found that the tumour can be extirpated without taking away the entire section and continuity of the nerve, which when a large one (as for instance the great sciatic) it is important to preserve. In case this cannot be done, the whole section of the nerve-trunk may be taken away, and the smoothly cut ends brought together with fine catgut sutures put through the outer nerve-sheath only, the limb being placed in a position to relax the nerve and lessen tension to the utmost. This proceeding, as before remarked, has been successful in uniting the ends of nerves accidentally cut through.

In cases of neuromata in stumps the same treatment is sometimes available and effective. Opening the cicatrix and dissecting out the tumour or tumours may be all that is required. But in other instances the pain and tenderness are so diffused, and the growths so numerous, that re-amputation a few inches higher up, gives more complete and satisfactory results. Yet in some patients the tendency to the formation of these tumours is so great that they reappear, even after re-amputation, and the prognosis must always be guarded on this point.

3. Nerves, Surgical Division and Stretching of.

(*a*) *Nerve-section*. SYNON.: Neurotomy.—Surgical division of nerves has been employed for the cure of painful affections such as neuralgia, and for tetanus and other obstinate and sustained spasmodic movements. It has been usually performed subcutaneously, and most frequently in the case of the branches of the tri-facial nerve, at their exit from the bony foramina, such as the supra-orbital, the infra-orbital, and the mental branches. The division should be thoroughly and completely done. It has been found, however, that in a comparatively short space of time, the operation, though perfectly successful in removing the pain and sensation at the peripheral distribution of the nerve, is of no avail. The nerve, after simple subcutaneous division, unites in a few weeks or months; and first sensation and then pain recur in the part. In cases of intracranial disease the operation is of course useless. Efforts have been directed to prevent this union of the cut nerve, by taking away a considerable portion, so as absolutely to prevent contact of the ends; and the operation then must necessarily lose its subcutaneous character. When the nerve, as in those nerves above-named, spreads out to its distribution in all directions, it is difficult to secure this absolute removal, and a good deal of the adjacent soft parts must be excised to insure its being done thoroughly. In a case of obstinate neuralgia of the inferior dental nerve, the late Sir William Fergusson gouged away the outer wall of the mental foramen for the space of an inch, and dissected out the nerve from the canal to the same extent, with the effect of curing the disease.

In some neuralgic cases the cause of the pain lies within the cranium or brain itself, as above mentioned, and is of course not to be reached by surgical operation.

In traumatic tetanus division of the nerve going to the wounded part has been practised by Hilton (*Medical Times and Gazette*, vol. i. 1869), and by Sir Joseph Fayrer (*Rankin's Abstract*, 1863, vol. ii.), as well as by Nelaton and others. The results, however, do not seem to be as favourable as in the more recently introduced treatment of nerve-stretching, whilst the injury inflicted on the structures is certainly greater, and the disabling results are more apt to be permanent.

(*b*) *Nerve-stretching.*—This is one of the modern modes of the treatment of disease, which has so far achieved a certain amount of success. It has been practised in cases in which section of the nerve may be considered justifiable, such as continued and severe pain or spasm, acute or chronic, of the parts supplied by a nerve, which has resisted all milder treatment, and in locomotor ataxy. Cases of traumatic tetanus also claim a trial of this method of cure.

METHOD.—Nerve-stretching is effected by cutting down upon the nerve-trunk, detaching it from its connections for the space of a few inches, laying hold of it with the fingers, forcibly stretching the whole nerve from its origin to such an extent as to affect powerfully its functions, and then closing up the wound. In some instances a certain amount of loss of sensation or muscular power in parts to which the nerve is distributed is the immediate result, which, however, passes away after a certain interval, and the nerve-function becomes more or less completely restored.

APPLICATIONS.—A number of cases have been recorded within the last few years, in which nerve-stretching has been employed with considerable success. Thus in a case of spasm affecting the whole of the muscles of the left arm, with considerable anæsthesia, Nussbaum, of Munich, stretched the nerves of the arm in three places—namely, the ulnar nerve at the elbow; the median, musculo-spiral, and ulnar in the axilla; and the primary trunks of the three lower cervical nerves above the clavicle. The patient recovered in eleven weeks, with restoration of the healthy action of the muscles of the limb.

The late Mr. Callender has described the case of a man in whom re-amputation of the stump of the fore-arm for neuralgia had been performed, and which he operated on by stretching the median nerve for three-fourths of an inch. There was no return of the pain, and the nutrition of the stump and arm, which had wasted, was much improved. The writer lately cut down upon and stretched the external popliteal (peroneal) nerve, behind the biceps cruris tendon, in a case of painful spasm of the extensor and peroneal muscles, with a success which was permanent months afterwards. Still more recently Mr. Godlee has treated two cases of facial spasm of many years' standing, by stretching the *portio dura* at its exit from the stylo-mastoid foramen, one with complete success.

In cases of traumatic tetanus, the application of nerve-stretching seems sufficiently appropriate, and accordingly it has not failed to be tried. A striking case of this description is recorded in the *Centralblatt für Chirurgie*, Oct. 7, 1876, No. 10, by Vogt. In fifteen cases of tetanus collected by Johnstone of Kentucky, seven of which were operated on in late stages of disease, it is stated that there were five cases of recovery from this fatal disease—a much greater proportion than from any other method of treatment. The results in cases of nerve-stretching for traumatic tetanus, practised in London during the last few years, do not add to the favourable impression that the preceding cases were calculated to give as to the efficacy of this operation. It has been tried in various hospitals, lately in King's College Hospital, without success. In one case it seemed rather to hasten the fatal termination. And it can scarcely be said that the infliction of a further injury on the continuity of the nerves of the affected part, with a corresponding impression upon the nerve-centres, is, *à priori*, likely to cure the consequences of a primary injury, which has already so powerfully and fatally influenced the condition of these same nerve-centres.

Still more recently nerve-stretching has been practised upon the nerves of the limb for the relief of the pains of locomotor ataxy. The results, in some instances, appear to have been successful even beyond expectation; for not only have the pains been removed, but the disturbances of co-ordination have also been diminished, though to a limited extent.

PRINCIPLES.—A satisfactory explanation of the *modus operandi* of nerve-stretching is not easily given. Nussbaum suggested that the success may be owing to an alteration in the relations between the nerve-fibres, having the effect of improving their nutrition; whilst Callender attributed it to the consequent numbing of the nerve, that is, the temporary suspension of its functions, by interfering with the transit of painful and abnormal impressions, the nerve-centres having time to resume their normal control. With regard to this explanation it may be pointed out, however, that both motion and sensation are often uninterruptedly retained after the successful stretching of a large nerve.

In certain cases of rheumatic neuralgia it might be conjectured that a degree of contraction may follow a rheumatic or gouty deposit in the nerve-sheath, and thus affect the nerve-current in the central axis of the fibre; and that this may be drawn out, overcome, or broken by the nerve-stretching, the normal function of the nerve-tubule being thus restored temporarily or permanently. Whether a similar explanation will suffice for the recorded cases of cure of tetanus may be more than doubtful, and we must wait for further evidence of fact before we can explain the phenomena with any appearance of probability. Brown-Séquard has recommended exposure of the nerve, and washing it with ether, to effect the same end.

JOHN WOOD.

NERVI, in the Eastern Italian Riviera, Warm, moist, winter climate. *See* CLIMATE, Treatment of Disease by.

NERVOUS.—A term used variously in reference to persons, to temperaments, or to morbid conditions. A person is said to be nervous, or of a nervous *temperament*, who seems to present a special susceptibility to pain, or who exhibits an undue mobility, as it is termed, of the nervous system—that is to say, when the person starts or shakes on the occasion of abrupt or intense sensorial impressions, or when he exhibits a proneness to convulsions or manifests an exalted emotional susceptibility. An organisation of this kind characterises children rather than adults, and, amongst the latter, females more than males. Nevertheless, in persons of both sexes such a bodily disposition is frequently to be met with, varying not only in degree, but also in kind or type. As one of the most important of these varieties, we must include the as yet very imperfectly understood condition known as hysteria (*see* HYSTERIA). A nervous disposition may be either inherited, or acquired during the life of the individual, and it then ensues as a sequence of some severe illness, of some grave anxiety, or of some physical or moral shock.

In reference to *disease*, the term nervous is used with different significations in different cases. Sometimes it is used in more general terms to signify that the disease is one implicating the nervous system rather than any other part of the body. At other times the use of the term is very variable. Thus, by the term 'nervous aphonia' we imply that the voicelessness is due to some functional nervous inhibition, rather than to any distinct paralytic condition caused by structural disease; whilst, by the term 'nervous deafness,' we should imply that the deafness is due to disease, functional or organic, of the auditory nerve or its centres, rather than to an inflammatory or other affection of the middle ear.

H. CHARLTON BASTIAN.

NERVOUSNESS.—A term applied to the state of, or to the conditions manifested by, a person coming within the description of 'nervous' as above defined. *See* NERVOUS.

NERVOUS SYSTEM, Diseases of.—The complexity of the nervous system, its manifold functions, and its extensive distribution, render its diseases more varied than those of any other system of the body.

From the manner in which the nervous and vascular systems interlock, their diseases or pathological conditions are to some extent inseparably related to one another. The modes of interference with the functions of the vascular system through altered nervous action are comparatively few and simple. The heart may, under the influence of modified nervous stimulation depart from its customary order and rate of contraction, or in extreme cases cease to beat; the smaller arteries over a greater or less extent of the body may diminish in their calibre, or become dilated; but, save for such events as these and their direct consequences, the work of the vascular system is habitually carried on without variations impressed upon it by abnormal states of the nervous system.

On the other hand, the diseases of the nervous system which may be induced by altered quality of blood, or by alteration of function in the heart or some part of the vascular system, are numerous and varied. The functional activity of the system as a whole may be degraded, owing to the fact of its receiving an inadequate amount of blood from a feeble or slowly acting heart. Or the functions of a part of the system may be interfered with by an undue contraction or dilatation in its small arteries, or by an impediment to the outflow of blood, inducing a mechanical congestion. Again the complete or partial arrest of the blood-flow in the vessels of some important region (owing to thrombosis or embolism therein), or the rupture of one of the branches of such a vessel, with extravasation of blood into the organ,—either of these events may impair or destroy the functions of that particular part, even if it cause no more general disturbance of nerve-function. In short, both local perversions of function and structural changes in the nervous system, are far more frequently initiated by altered quality of blood, or unnatural phenomena in the vessels of the part, than by primary morbid changes in either of the other two components of nerve-tissue, namely, the nerve-elements themselves, or their interstitial connective tissue.

But, as already intimated, the number of different nervous diseases is referable principally to the great complexity of this system. It is now a familiar fact that the same kind of morbid change existing in different parts of the nervous system tends to give rise to wholly dissimilar groups of symptoms. Hence the importance, from a clinical point of view, of studying the varied functions and functional relationships of the several parts of the nervous system.

The most practical and useful classification of the principal component parts of the nervous system is as follows:—

1. THE CEREBRO-SPINAL DIVISION (or *Nervous system of animal life*).
    - *a.* The Encephalon.
    - *b.* The Spinal Cord.
    - *c.* The Encephalic and Spinal Nerves.
2. THE ORGANIC DIVISION (or *Nervous system of vegetative life*).
    - *a.* The Pneumogastric or Vagus Nerves.
    - *b.* The Great Sympathetic System (with which is included the 'Vaso-Motor' System of Nerves).

This classification, though in part natural, is also in other respects purely artificial. The cerebro-spinal and the organic nerve-centres are structurally continuous at many points. The vagus nerves, and the vaso-motor system of fibres in part, have an encephalic origin, though the latter are distributed almost throughout with the sympathetic system, of which it is often supposed to constitute the most important part. This sympathetic system is connected at intervals with the whole length of the cerebro-spinal system, from the lumbar enlargement to the base of the brain, chiefly by connecting filaments passing between it and the anterior spinal nerves. Some of these connecting filaments are afferent, others are efferent. The brain again is brought into immediate relation with the sympathetic system through the wide-spread filaments of the pneumogastric nerves, which mingle with almost all the visceral plexuses both of the thorax and of the abdomen. The spinal accessories seem to be the motor nerves through which the more direct impressions brought to the medulla by the pneumogastrics are reflected upon some of the viscera; and, similarly, the tranference of motor-stimuli direct from the spinal cord to the viscera, in response to afferent impressions conveyed to it by certain nerves of the sympathetic system, takes place through motor fibrils in the filaments connecting the anterior spinal nerves with this system. The sympathetic system also possesses its own intrinsic motor fibres and vaso-motor centres. Other intrinsic motor centres probably exist amongst the sympathetic ganglia, which, like those of the heart, may be capable of bringing about muscular contractions in the parts with which they are severally in relation.

The direct consequence of the close relationship between the viscera and the fibres of the pneumogastric and spinal accessory, as well as between the spinal motor nerves, and those emanating from the central connections of the vaso-motor system, is that we find lesions of some portions of the cerebro-spinal system frequently involving altered actions in parts under the immediate influence of the nervous system of organic life—as when diseases of the medulla and its neighbourhood disturb the action of the heart or the respiratory processes, when vomiting is produced by cerebral or spinal disease, when diabetes or polyuria are induced by irritations of the fourth ventricle. Such effects, again, are illustrated by the flow of tears under the influence of grief, by the arrest of the salivary secretion under the influence of fear, or by the occasional production of an increased flow of the same fluid at the thought of savoury food. Or, the action of the two nervous systems upon one another may take place in an opposite direction, as when in a neurotic subject an irritant in the intestine, or the passage of a renal calculus down the ureter, gives rise to convulsions; when forms of 'reflex' paralysis are produced; when the 'spirits' are depressed under the influence of visceral disease, sometimes to such an extent as to induce melancholia; or when, on the other hand, irritative states of the ovary lead to that form of insanity known as nymphomania.

Sympathetic disturbances are also apt to show themselves in the functions of certain parts comprised within the sphere of the cerebro-spinal system itself, when some other portion of it becomes the seat of disease, though the extent to which this occurs is still involved in much doubt. Brown-Séquard believed that hemiplegia itself is often induced by an 'inhibitory' influence, emanating from some morbid portion of the brain and acting upon certain motor-cells in the spinal cord. Similarly we find an irritation occurring in one portion of the organic nervous system entailing morbid manifestations in some other and perhaps distant part of this system, as when the early stage of pregnancy or when ovarian or uterine disease leads to vomiting; when certain irritations of the stomach excite the act of coughing; or when irritations of the bronchial mucous membrane lead to vomiting. Essentially similar phenomena are seen when suprarenal-capsular disease leads to sickness; or when a blow on the epigastrium, by conveying a shock to the semilunar ganglia, causes an arrest of respiration or of the heart's action. *See* SYMPATHETIC SYSTEM, Disorders of.

This tendency to the establishment of sympathetic or related disturbance of distant parts in local diseases of the nervous system, is one of the principal sources of the great complexity of diagnosis in these affections. Thus, though a lesion in the brain may give rise to a certain set of *direct* effects, the consequences of the same lesion may also, and mostly do, become multiplied by a reverberation of impressions throughout the nervous system. In this way what are called *indirect* effects are produced. Such indirect effects may show themselves either in the direction of arrest or of exaltation of function, and in the former case they are often said to be brought about by 'inhibition.'

The proportion between the direct and the indirect effects resulting from an injury to nervous tissue varies greatly in different cases, according to the seat, the extent, and the nature of the lesions, as well as according to the age, sex, and general health of the patients. Hence it often happens that the same kind of lesion seems at different times to give rise to a different set of clinical accompaniments.

In regard to *diseases of the organic nervous system* our knowledge is at present extremely defective. The recognition of the diseases of this system—that is, as diseases having such or such a pathological starting-point—is beset with peculiar difficulties. This is in part attributable to the free connections existing between the organic and the cerebro-spinal nervous system, and the consequent difficulty, so frequently arising, which opposes itself to our settlement of the question, as to whether any particular group of symptoms, possibly due to some primary disease of a portion of the organic nervous system, really owns such a cause, or whether it is rather due to some disordered condition of the cerebro-spinal centres, which induces indirect effects on the side of the nervous system of organic life. Then, again, in other cases, disease of some portion of the organic nervous system may really exist, which, by reason merely of our present defective physiological and pathological knowledge, remains unsuspected as a disease having that particular nature and origin.

The nature of the functions performed by the organic nervous system sufficiently explains this difficulty. In part it serves to link the functional activity of certain viscera with sensory impressions or motor acts referable to the cerebro-spinal system, as in the processes of ordinary or disturbed respiration, parturition, &c.; in part also it brings different organs into co-ordinated activity, as when the presence of food in the alimentary canal excites the simultaneous activity of the pancreas, the liver, and other glandular organs. And how well such functions as those last-named are performed we are often only able to estimate vaguely, if at all, since the actions of those portions of the nervous system on which they depend do not reveal themselves either by sensible impressions, or by movements of parts of which we are conscious.

Other functions of the 'sympathetic' nervous system, such as those which have to do with the maintenance and regulation of the functional activity of the blood-making or ductless glands, namely, the liver, the spleen, the supra-renal capsules, or the lymphatic glands, are even still further beyond the pale of recognisable phenomena. Yet disturbances of these purely organic functions may give rise to certain general affections, which we are unable to refer to morbid states or actions of this portion of the nervous system. Suprarenal-capsular disease, leucocythæmia, diabetes, chlorosis, various forms of anæmia and other conditions of general malnutrition, are instances of diseases possibly due to deficient or perverted action of some of these blood-making organs, immediately occasioned by morbid conditions of the sympathetic nerve-centres in relation therewith. And it may be fairly presumed that the functional activity of these organs is influenced by the nerves and nerve-centres with which they are in connection —just as that of ordinary secretory glands (such as the parotid and sub-maxillary) is known to be under the influence of the nerves with which they are supplied.

The true pathology of such general diseases as have been named, we may hope will be ultimately elucidated by the application of the same means as have led to our present knowledge concerning the symptomatology of local diseases in the cerebro-spinal portion of the nervous system. This means, therefore, would consist in a more searching and habitual examination of the several parts of the nervous system of organic life, so as to endeavour to connect morbid appearances in its several centres with appreciable pathological states of ductless and other organs, and the still further endeavour to colligate these morbid appearances with the respective states of health or symptoms exhibited by the patients during life. Slow and difficult as this method is, it is the only one (apart from the experimental method with lower animals, which is here available only to a very limited extent) that would appear to hold out any probability of ultimate success.

The obscurity prevailing in reference to diseases of the *cerebro-spinal nervous system*, is not to be compared in extent with that relating to the nervous system of organic life. The reason of this is obvious. Deviations from its proper functions come much more easily under the ken of the physician and of the patient; whilst, in addition, morbid changes in this part are a few degrees less difficult to detect, and as they are situated in parts which are also much more frequently scrutinised in the *post-mortem* room, such changes are in reality far more frequently recognized than when they occur in one or other of the more scattered centres of the nervous system of organic life.

For some general remarks on the diseases of the cerebro-spinal nervous system, the reader is referred to the articles, BRAIN, Diseases of; and SPINAL CORD, Diseases of.

ÆTIOLOGY AND PATHOLOGY.—The proper and well-balanced working of the nervous system, as a whole, depends upon the maintenance of the accustomed degree of excitability in its different nerve-centres; and the proper nutrition of such centres, upon which their normal molecular mobility depends, is certainly largely dependent upon their habitually receiving a supply of blood which is definite in amount, and uniform in quality. But the amount of blood going to any tissue or part is subject to the regulating influence of the local vaso-motor centre, with which the vaso-motor nerves supplying the blood-vessels in question are in relation. By the influence of other parts of the nervous system, or owing to the condition of these vaso-motor nerve-centres, the vessels dependent upon them may be either unduly contracted, or unduly dilated. Again, the proper quality of blood is subject to much alteration in different diseases; for instance, it may be thin and poor in anæmic states, it may contain poisonous ingredients in workers with lead and mercury, whilst it may contain varied noxious constituents in those suffering from grave renal disease, from septicæmia, and from the acute specific fevers. In this latter group there is, however, reason to believe that some of the abnormal nervous phenomena which are apt to manifest themselves may be due, not so much to the direct toxic influence of altered blood, as to the fact that in such states of the system the blood may be, at times, more prone than natural to coagulate in the minute vessels of the nervous system. Such undue proneness to coagulate sometimes depends upon the existence of an increased number of white blood-corpuscles, which, either from the state of the blood-plasma, or from the condition of the tissues outside, show a more than usual amœboid activity. Or an undue proneness of the blood to coagulate in some of the small vessels of the nervous system, during or after some of the acute specific diseases, may be due to an unnatural tendency of the fibrin to separate from such altered blood. The nutritive changes taking place in different tissues are chemical changes, differing from one another in exact nature, and therefore capable of reacting differently upon the blood circulating through such parts. These facts suffice to show how difficult it is to draw the line between what are probably mere toxic effects of an altered blood, and those which are due in the main to minute and almost inappreciable changes in the condition of the smaller blood-vessels of a nerve-centre.

But whenever variations take place in the nutritive condition of any centre, these variations are apt to involve not only an altered action in that particular part, but a perverted functional activity of other related parts. It often happens, therefore, that an exaltation or diminution of functional activity in some one part of the nervous system, causes a diminution, exaltation, or other perverted activity in distant parts of the system. Thus, owing to the many possible permutations and combinations, we may get the most varied grouping of abnormal phenomena traceable to altered actions in the nervous system, and having for a starting-point some perverted functioning of one or more nerve-centres. We have here the mode of production of what are commonly called *functional diseases*. Diseases of this type are specially apt to manifest themselves after some unusual strain has been thrown upon the nervous system, especially if the general health was at the same time lowered. The strain may have arisen from prolonged over-work and deficient sleep, or from some sudden mental shock, whether of joy or terror, but more especially the latter. At other times such functional diseases appear without any assignable cause, more especially in persons of a neurotic habit of body. Great differences exist amongst different individuals in this respect, that is, in their proclivity to diseases of the nervous system, though it is a matter of common observation that children and females are, as a rule, much more prone than men to become affected by nervous diseases of this type.

It is now a well-established fact that persons who are endowed with a neurotic habit of body, very frequently *transmit* a similar tendency to their children. It is not a tendency to any one particular disease, but a vulnerability of the nervous system as a whole which is transmitted, so that under the influence of even a comparatively slight strain, this weakness may manifest itself in one or other of various ways. It may reveal itself by mere general nervousness or tremors, by attacks of chorea, by epilepsy, or by one or other of the forms of insanity. When the neurotic habit of body exists to a well-marked extent—either in one or in both parents, different children may be affected in several of these modes; yet it is not necessarily so, for the inherent vigour of some of their progeny may cause such tendencies to be dwarfed and practically blotted out.

Other diseases of the nervous system are induced by definite and easily recognisable structural changes belonging to one or other of the following varieties. Rupture of blood-vessels often happens, causing *hæmorrhage* either into or upon the brain or spinal cord; though hæmorrhage into the latter organ is an extremely rare event. Or changes may occur in the vessels of some part of the nervous system, leading to their narrowing or actual occlusion by the combined influence of degenerations and thrombosis; or a similar result may be brought about by the lodgment of an embolus, and in each case the consequence, if the patient live long enough, is the establishment of a focus of *softening* in the brain or spinal cord. In addition to these changes we have others of an irritative or *inflammatory* nature. These may affect the surface of the brain, when they are associated with *simple* or with *tubercular meningitis*; or they may implicate some deeper portion of its substance, though unfortunately we are at present only very imperfectly able to separate these inflammatory affections from the more simple degenerative softenings, either at the bedside or in the *post-mortem* room. If, however, the inflammatory focus should subsequently become the seat of an *abscess*, the latter difficulty would disappear. In the nerve-trunks an inflammatory condition, affecting principally their connective-tissue envelopes, is not unfrequently met with, and goes by the name of *neuritis*. Again, *tumours* may be found, either arising in or pressing upon some portion of the nervous system. These may have been produced under the influence of scrofulosis or syphilis, or they may be cancerous, or wholly unrelated to any general diathetic state. *Acephalocysts* or *cysticerci* are also occasionally met with pressing upon the surface, or within the substance of the brain; or fluid may accumulate within the ventricles, as in *hydrocephalus*. But a far more frequent morbid condition consists of an overgrowth of the interstitial connective tissue, leading to the formation of patches or tracts of *sclerosis* in the brain and spinal cord. This change constitutes the basis of several well-recognised morbid conditions of a progressive type. Lastly we may have certain special forms of *atrophy* and *degeneration*, showing themselves more especially in the nerve-cells of various parts of the brain, spinal cord, or sympathetic ganglia.

Treatment.—For the treatment of nervous diseases we have at our disposal a number of invaluable remedies, whose action is more or less special. Thus, we have strychnine and bromide of potassium, possessing the opposite properties of increasing and diminishing the reflex excitability of the nervous system, in addition to other beneficial modes of action. We have chloral and morphia acting either directly or indirectly as hypnotics, and thus allowing the curative action of rest to come into play. We have opium and Indian hemp, subcutaneous injections of morphia, and the constant galvanic current as pain-subduers. We have drugs like ergot and nitrite of amyl, capable of influencing the calibre of the smaller arteries. We have in conium and chloroform most powerful agents for relaxing the whole muscular system. We have iodide of potassium, which in syphilis and other cachectic states of the system seems to act as a direct antidote for the dispersion of connective-tissue overgrowths. Whilst in the various forms of electricity we have special agents of the highest value, not only for mitigating pain, but for allaying spasm, for improving the nutrition of wasted muscles, and for facilitating the bringing of them again under the influence of the will in cases of paralysis.

The above are only some of the chief special remedies which we employ in the treatment of nervous diseases. We have, as more general remedies—so-called nervine tonics—the preparations of zinc, arsenic, iron, quinine, phosphorus, cod-liver oil, &c.; whilst we have also frequent occasion to call to our aid ordinary tonics, purgatives, emmenagogues, anthelmintics, and counter-irritants, together with cold or tepid douches and the shampooing of paralysed limbs.

The manifestations of nervous disease are immensely influenced by the general state of health of the patient, and this not only in so-called functional, but even in the gravest of structural diseases. There is indeed no class of affections in which more good may result from a minute regard to diet, exercise, amount and kind of labour, and that general attention to all hygienic details upon which those most skilled in the treatment of these diseases always largely rely. There are few chronic diseases of the nervous system, even of the most obstinate and progressive type, in which very much may not be done either to arrest or to stay their progress, by careful attention to such hygienic details, by the judicious administration of drugs, and by maintaining the general health of the patient at the highest possible standard.

H. Charlton Bastian.

NERVOUS TEMPERAMENT. *See* Temperament.

NETTLE RASH.—A popular synonym for urticaria. *See* Urticaria.

NEUCLEUS.—*See* Cell; and Appendix.

NEUENAHR, in Germany.—Thermal alkaline waters. *See* Mineral Waters.

NEURALGIA (*νεῦρον*, nerve, and *ἀλγέω*, I suffer pain).—Synon.: Fr. *Névralgie*; Ger. *Neuralgie*.—This is a term applied to a disease of the nervous sensory apparatus, marked by paroxysmal pain, which is for the most part unilateral, and in the course of nerves. In many cases no evidence of change in the periphery of the nerve is discoverable, and to these the term *neuralgic* is perhaps most properly applied; in others, however, there is reason to think that inflammation of the sheath of the nerve is at least the starting-point of the disorder. The diagnostic points are as yet not sufficiently certain for these cases of peri-neuritis to be absolutely separated from those of neuralgia, and they may so far be considered together. Relative constancy in the pain, with paresis and atrophy of muscles supplied by the affected nerve, and swelling of the nerve-trunk, point to peri-neuritis. *See* Neuritis.

Ætiology.—Neuralgia is prone to occur in families marked by neurosal tendencies, not necessarily of neuralgic character, but which display themselves in various phases of psychical disturbance, as insanity, hysteria, hypochondriasis, or in the shape of epilepsy and chorea. Rare before puberty, that crisis has a strong predisposing influence. In the middle period of life, though first attacks are not very common, revivals of old-standing disease are apt to occur, as a result apparently of the depression occasioned by the cares of life. Premature agedness (marked by atheromatous changes in the vessels, arcus senilis, permanent greyness of hair, bagging of the cheeks, pulmonary emphysema) conduces to severe and intractable neuralgias. Malaria is a potent cause. Anæmia and mal-nutrition generally, however brought about, play an important part. So also do sexual excesses, and perhaps likewise a state of celibacy. Pregnancy, over-lactation, and menorrhagia are each predisposing causes. The most frequent exciting causes are cold, especially damp cold; injury to the nerve by violence, or by the encroachment of morbid growths; syphilis; gout; and the presence of lead or mercury in the system. Irritation of peripheric organs may excite neuralgia in nerves nearly or remotely associated. So dental caries may induce supra-orbital neuralgia; uterine disease may excite neuralgia of distant nerve-trunks—as, for example, the occipital; and the presence of intestinal worms may explain the occurrence of neuralgia in parts quite unconnected with the bowels. Neuralgia is a common sequel of relapsing fever.

Anatomical Characters.—In neuralgia proper no definite lesions are discoverable — at least, none that are constant enough to deserve the place of necessary accompaniments or factors of the disease. As a result of neuritis or perineuritis the nerve-trunk is sometimes found swollen and hyperæmic; or, in a later stage, it may be atrophied and its fibres degenerated.

Symptoms. — After some little preceding numbness, cutaneous anæsthesia, or other abnormality of sensation, the import of which gets to be well understood by persons liable to neuralgia, the patient is seized with pain, which at first is not severe, and ceases quickly, but returns in a few seconds or minutes, lasting for a short time, and then remitting. These darts revive with shorter and shorter intervals, so that in a little time the pain appears to be almost continuous, or interrupted only by waves of intensity, and it will last for some seconds or more than a minute together. Then comes a respite, to be followed by recurrence, and these alternations may continue for a few minutes or as many hours. In attacks of long duration where no treatment is applied, the pains gradually get less acute, the intermissions longer, and the outbreak slides off into a confused feeling of discomfort and bruising about the seat of pain, coupled with a sense of exhaustion and desire for sleep. The character of the pain varies; it is described as darting like a knife or like lightning, crushing, hammering, boring, and sometimes burning. In neuralgia about the head the patient will often be seen to cringe and recede before the plunges of pain, as though he were receiving blows. When the pain is at its worst there is often a radiation of it to other nerves, and especially to those placed symmetrically with the one affected; but this secondary pain never attains anything like the severity of the original. Not always, but very commonly, certain definite points where pressure is exceedingly painful may be found by palpation. These, the '*points douloureux*' of Valleix, have a certain diagnostic importance. Rare in first attacks, they are much more common in patients who have been subject to recurrences during many years. There is always a nerve-branch under the skin at these points, and more often than not they correspond with the point of emergence of a nerve from a bony groove or opening, or its passage through a muscular aponeurosis. Pallor of the skin, followed by intense redness, horripilation, and other evidences of vaso-motor disturbance are common. In the case of nerves being attacked which preside over glands there is often increased secretion. The tactile sensibility of the skin is almost always diminished after a time in the neighbourhood of the affected nerve, though at first there is some hyperæsthesia.

Local Varieties.—The varieties of neuralgia are divided into two primary groups, namely, I. **Superficial**; and II. **Visceral.**

I. **Superficial.**—These include the following:—

(*a*) *Trigeminal neuralgia. See* Tic Douloureux.

(*b*) *Cervico-occipital neuralgia.*—The posterior branches of the first four pairs of spinal nerves may be affected, but it is that of the second, the great occipital, which is most important, from its size, and the frequency with which it is attacked. Shooting pains start from just below the occiput, and run over the back and top of the head, sometimes into the external meatus, and often to the front of the head and face. Giddiness, noise in the ears, and some confusion of ideas are often associated, and frequently cause cervico-occipital neuralgia to be mistaken for commencing organic disease of the brain. It may begin by such acute tenderness of the scalp as makes it an agony to brush the hair.

(*c*) *Cervico-brachial neuralgia.*—The nerves of the brachial plexus and the posterior branches of the four lower cervical nerves are here concerned. The pains affect the neck and shoulders, or shoot down the arm to the hand, in the course of one or more of the nerve-trunks. Painful points may be found in the axilla, over the upper part of the deltoid, at the bend of the elbow, three inches above it externally, in the groove between the inner condyle of the humerus and the olecranon, at the ulnar side of the annular ligament, and where the radial nerve becomes superficial. The ulnar nerve is that most often affected, but the neuralgia usually spreads to other trunks. This form of neuralgia is sometimes associated with the presence of carious teeth.

(*d*) *Dorso-intercostal neuralgia. See* Intercostal Neuralgia.

(*e*) *Lumbo-abdominal neuralgia.*—Here the superficial branches of the lumbar plexus to the abdominal walls are affected. It is less common than intercostal neuralgia, but resembles it generally. Tender points may be found close to the spine, at the middle of the crest of the ilium, in the hypogastric region, in the groin, and on the scrotum. The female sex is apt to be most affected.

(*f*) *Crural neuralgia.*—This variety is almost always met with as a complication of sciatica, being rare by itself. Pain occurs in the front of the thigh and knee, and inner surface of the leg and foot. The long saphenous branch of the anterior crural nerve is most commonly affected. This form of neuralgia is not unfrequent in hip-joint disease, where it is secondary to irritation of the branches of the obturator nerve supplying the joint.

(*g*) *Obturator neuralgia* affects the inner side of the thigh.

(*h*) *Femoro-popliteal neuralgia. See* Sciatica.

(*i*) *Coccydynia.*—Pain in the neighbourhood of the coccyx, more properly called *coccygodynia*, especially apt to occur in women, is sometimes, but by no means always, due to neuralgia of the coccygeal plexus. The pain is felt particularly in sitting, and shocks from rapid movement or jumping will cause great distress. So also sometimes the act of defæcation may be so painful as to suggest the presence of fissure of the anus. More often than not the affection follows an injury, especially a fall in the sitting position, and happens sometimes after difficult parturition.

II. **Visceral.**—(*a*) *Cardiac.*—A certain portion of the class of cases called angina pectoris depends upon cardiac neuralgia (*see* Angina Pectoris). There is sudden severe pain at the lower end of the sternum, darting to the back and down the left arm, or it may be diffused over the chest and affect both arms. The heart feels as though it were grasped, the face loses colour, the pulse becomes altered in character, there is cold sweating, and generally the aspect and feeling of approaching death. Such attacks may be confined to two or three repetitions, or there may be a constant tendency to their recurrence under circumstances of fatigue or strong emotion.

(*b*) *Uterine and ovarian neuralgia.*—Pain attendant upon menstruation, independent of any mechanical difficulty, is thus named. It may be excited by such sources of peripheral irritation as ascarides, leucorrhœa, renal calculus, prolapsus uteri, tumours, ulceration of the cervix, or impaction of fæces; or the sources may be in some distant part of the body. Ovarian neuralgia may be accompanied by congestion of the ovary.

(*c*) The *urethra*, *bladder*, *rectum*, *kidney*, and *testis* may each be affected by neuralgia. The latter may result from self-abuse, or be consequent upon renal concretion. *See* NEPHRALGIA.

(*d*) *Gastralgia.*—Abdominal neuralgia is characterised by intensity of colicky pain, occurring in paroxysms in circumstances differing from those which induce ordinary dyspepsia. There is nearly always a history of neuralgia in some other part of the body. Vomiting sometimes, and constipation invariably, accompanies the attacks. *See* GASTRALGIA.

COMPLICATIONS AND SEQUELÆ.—Neuralgia when it attacks mixed nerves may produce muscular powerlessness, which is not merely a shrinking from making muscular effort because of the pain attending it, but a temporary paralysis. Or there may be spasm of muscles. Long-continued neuralgia is attended by more or less atrophy of the muscles supplied by the affected nerves, which may be temporary, or, in cases where frequent recurrences of the attack take place, may be permanent. Certain forms of neuralgia, especially that of the first division of the fifth, intercostal, and sciatic are liable to be accompanied by a herpetic eruption (*see* HERPES). Anæsthesia of a portion of the skin will often persist, though the pain itself may be absent.

DIAGNOSIS.—It may be said perhaps that for pain to be strictly accounted *neuralgic* there should be no obvious cause for it, such as local inflammation, tumour, or injury: it should be intermittent, or at least liable to great exacerbations, and independent of movement or any external agency; it should take the course of one or more nerves; and there should be spots painful to pressure in some of the localities already indicated. Neuralgia is distinguished from myalgia by the latter involving the attachments of a muscle, not occurring in paroxysms, but dependent upon movement; from aneurism by careful physical examination, which is especially necessary when the pain is about the chest and loins. In chronic rheumatism the pain is diffused, influenced by movement, and it does not affect the district of a particular nerve. Acute rheumatism is accompanied by elevation of temperature, sweating and swelling of joints. The thermometer, and the known symptoms and signs of the several diseases, will also at once exclude pleurisy, pneumonia, and peritonitis. Syphilitic periostitis is evidenced by the sight and touch, as well as (if it occur early in the disease), by the presence of febrile movement. Where pain in the back is supposed to be of neuralgic origin it is important to exclude the presence of hernia. Examination should be made *per vaginam* to exclude flexions or tumours of the uterus, and *per anum* for the presence of abscess about the rectum or malignant disease. Organic disease of the brain must be excluded by the absence of local palsy, vomiting, intellectual disturbance, or optic neuritis. The pains of Bright's disease must be carefully excluded by search for albumen, signs of arterial thickening, and cardiac hypertrophy. Spinal irritation is accompanied by pains which, however, fail to mark the district of particular nerves, and are vague and shifting. There is hyperæsthesia of the skin over some of the vertebral spines. Locomotor ataxy is characterised by pains of lightning-like rapidity, and neuralgic in character; but they shift, are often accompanied by a staggering gait, sometimes by diplopia. Absence of the patellar tendon reflex (the quadriceps extensor muscle at the same time responding freely to faradization and blows) is a strong indication of locomotor ataxy. The pains of syphilis in its second stage may be distinguished by the presence of fever, usually also of a rash, and the fact that they affect many parts at once.

PROGNOSIS.—Youth, the absence of strongly-marked history of hereditary neurosis, the fact that neuralgia has followed exposures to unusual strain, severe weather, or passing defects of nutrition, and that its attacks are influenced readily by treatment, afford a favourable prognosis. The onset of the disease after middle life, and its concurrence with signs of arterial degeneration, are unfavourable as regards cure. Neuralgia of itself can scarcely be said to affect the duration of life. On the whole neuralgia of the fifth nerve is the most persistent.

TREATMENT.—In patients suffering from malnutrition the diet should be ample and nutritious, and should include a fair amount of the fatty element, in the form of cod-liver oil, butter, or cream. A little stimulant may sometimes be necessary, enough to promote primary digestion, but no attempt should be made to relieve pain by its direct agency. Rheumatism should be treated by salicylate of soda in 20-grain doses three or four times a day. Two or three grains of iodide of potassium with fifteen of carbonate of soda taken every four hours will often remove neuralgic pain connected with rheumatism. When malaria is suspected it is well to follow up this treatment by quinine in doses of from five to ten grains twice a day. A mercurial purgative may be usefully combined with a dose of quinine. If there be syphilis, iodide of potassium in 10-grain doses three times a day must be had recourse to; if gout, the acetic extract of colchicum may be given in one-grain doses twice daily, coupled with saline purgatives. Even where there is no history of malaria quinine will often be very useful, especially in neuralgia of the first division of the fifth (*see* TIC-DOULOUREUX). Phosphorus in its free state, in capsules containing $\frac{1}{30}$ gr. twice a day, after food, is sometimes of service. Or the hypophosphite of soda or potash may be given in doses of from five to ten grains. Phosphoric acid is not of value. The liquor potassæ arsenitis, in doses of ♏iij, increased cautiously to ♏vij, or ♏x, and the tincture of steel, in doses of ♏xxx, largely diluted with water, may sometimes be used with advantage; and the latter will occasionally succeed even when there are no ordinary signs of chlorosis. As anæmia may exist with a well-coloured face, the state of the gums and inner surface of the lower eyelid should be examined for undue pallor. Strychnia, in ♏iij to ♏v doses of the liquor three or four times daily, is especially useful in gastralgia, and belladonna, in $\frac{1}{4}$ gr. doses of the extract or ♏x doses of the tincture, in neuralgia of the pelvic viscera. Seclusion from irritation of various kinds—movement, cold, noise, dazzling light, worry—should be carefully maintained in cases of trigeminal neuralgia. All sources of peripheral irritation, of which decayed teeth, foreign bodies under the skin, intestinal worms, imperfectly-fitting boots are examples, should be carefully searched for, and where practicable removed. If lead be suspected the drinking water should be tested, and if the mineral be found iodide of potassium may be administered. Removal from imperfectly ventilated rooms, or from exposure to noxious gases, is essential. A warm, dry climate, such as Egypt or Algeria, will often cure when all other remedies have failed. For immediate relief morphia may be injected hypodermically, either near the seat of pain, or in an indifferent part of the body. It is best used pretty freely diluted, ♏iij of a solution of acetate of morphia, 1 to 30, being commenced with, and repeated, if necessary, when the pain returns. This dose may be gradually increased to one of ♏xv, but an effort should be made to do with as little as possible and to avoid narcotic effects. The following pill is often useful: ℞ Quiniæ gr. j, Ferri Tartarati gr. ij, Morphiæ Acetatis gr. $\frac{1}{12}$, repeated every hour or two when the onset is expected.

Next in value to morphia is the use of small blisters (size of a florin), applied in the neighbourhood of the principal focus of pain, one following another at intervals of two days, not on but near the already blistered surface. The continuous current, derived from so many cells of a battery as cause a characteristic feeling of burning, may be so applied that the affected nerve is as completely as possible included in the voltaic circuit. Sponges moistened with warm salt water should convey the current, and be kept firmly pressed upon the skin for about ten minutes; or, whilst one is still, the other may be slid along so as to linger in turn upon each focus of pain. To avoid shock the circuit should not be broken by the lifting of a sponge till the battery is 'let down' to zero. If relief be afforded the application may be repeated many times a day. No notice need be taken of the position of the poles (+ and −), the object of the proceeding being simply to alter the electric tension of the tissues which are made to form part of the circuit.

In rare instances, but especially in ovarian neuralgia, the hypodermic injection of atropine ($\frac{1}{120}$ gr. to $\frac{1}{60}$ gr. of the sulphate) may prove serviceable. Where there is great restlessness and irritability of the nervous system, bromide of potassium in 30-grain doses two or three times a day should be used. Relief, in slight cases of neuralgia, is obtained by applying to the skin such liniments as the following: ℞ Chloroformi ʒss, Tincturæ Opii ʒss, Linimentum Belladonnæ ad ℥iij.; or ℞ Spiritus Ammoniæ aromatici, Ætheris, Tincturæ Opii, Spiritus Vini rectificati āā ʒi. Aconite and veratria benumb the sensory nerves, but they are uncertain remedies and very apt to cause irritation.

In unusually severe cases, which have lasted over years, a portion of the nerve may be excised; or, what is better, the nerve, which has been exposed by an incision, may be lifted from its bed and so firmly pulled upon as to be stretched (*see* NERVES, Diseases of). Very satisfactory results have followed this procedure. In a case, treated by the writer, of terribly severe neuralgia of the first two divisions of the fifth nerve, the operation was performed on each division of the nerve in turn, with immediate and, as far as at present observed, permanent relief from pain. Some time after the cure of a neuralgia there may be threatenings of a revival (dull heaviness, with tenderness, of the part) following great fatigue or worry, but not immediately amounting to anything. Sleep is the best remedy for this condition, and this, if necessary, may be aided by giving ten grains of chloral hydrate.

Special reference must be made to the treatment of coccydynia. This consists in subcutaneous division of the muscles and fibrous structures attached to the coccyx with a tenotomy knife. In very troublesome cases the coccyx has been excised. The application of a leech or small flying blisters in the neighbourhood, will sometimes relieve. The bowels should be kept rather loose, and rest enjoined. In obstinate cases, where it seems probable that local irritation exists, the above-mentioned operation of Sir J. Simpson may be performed with advantage.

T. BUZZARD.

NEURITIS (*νεῦρον*, a nerve).—DEFINITION. Inflammation of a nerve.

ÆTIOLOGY.—This process occurs sometimes as an idiopathic change, whose origin is altogether obscure, as where it implicates some of the intercostal or other spinal nerves, and is then often associated with an eruption of *herpes zoster* in corresponding regions of the skin. At other times, as in some of the cases when it attacks the facial especially, or the sciatic nerve, neuritis seems to be set up as a result of local exposure to cold (*see* FACIAL NERVE, Paralysis of; and SCIATICA). Such forms of neuritis as these are commonly spoken of as 'rheumatic inflammations' of the respective nerves. Sometimes this appellation may be distinctly justified; but whether such changes have necessarily to do either with rheumatism or with a rheumatic predisposition—or, indeed, with gout—seems in many cases fully open to doubt. A process essentially similar does, however, unquestionably occur with especial frequency in connection with the roots of cranial or spinal nerves, in persons affected with syphilis.

At other times neuritis may be of traumatic origin, or it may spread along the nerves leading from some wound or sloughing sore. This latter condition of things has been found to exist in some cases of traumatic tetanus. *See* Tetanus.

Anatomical Characters.—Strictly speaking, we have to do, in this pathological state, with inflammation of the sheath of the nerve, rather than with changes in the nerve-fibres themselves. It is possible, of course, that the nerve-fibres in this condition may undergo some distinctive pathological changes, but what is at present known is, that the neurilemma, or connective-tissue sheath of the nerve (including its minute prolongations between and around separate bundles of nerve-fibrils) becomes much more hyperæmic than natural, and that on microscopical examination there is to be found, in addition to the increased vascularity, a multiplication of new tissue-elements and the presence of migrated leucocytes. These changes may cause considerable swelling of the nerve-sheath and of its prolongations, and thus may produce either mere irritation or more or less compression of the nerve-tubules, according to the amount of new elements which accumulate in or are produced within the nerve-sheath.

Symptoms.—The symptoms of neuritis will necessarily vary much according to the functions with which the affected nerve is concerned. There may be impairment of special or common sensibility, or pain may exist (referred to the peripheral distribution of the nerve), with more or less distinct tenderness along its course. In these cases the pain is generally paroxysmal, and possibly a pustular or vesicular skin-eruption may present itself along the course of the nerve, after some more than usually severe attack of pain. Where a motor nerve is implicated, there may be twitchings of the muscles to which it is distributed, followed, perhaps, by more or less distinct paralysis. In the case of a mixed nerve, like the sciatic, being involved, both kinds of symptoms present themselves—that is, more or less severe pains and tenderness, together with a distinct paresis of the muscles to which the nerve is distributed.

Treatment.—The treatment of neuritis is both general and local. The general treatment is of especial importance in cases where the condition seems attributable to the influence of syphilis, and then the administration of small doses of bichloride of mercury, in combination with large doses of iodide of potassium, will often produce marvellously beneficial results. Smaller doses of iodide of potassium alone, or with colchicum, are to be given in other cases, in which rheumatism or gout may seem to be one of the factors in exciting the nerve-inflammation. But in these cases, and also in those which are simple results of exposure to cold, the cure may be often expedited, and the patient also temporarily relieved, by local treatment, such as the application of a leech or two (especially in the early stages), hot fomentations, or small flying blisters.

During the course of the treatment special symptoms may become all-important; thus, pain may become so agonising as imperatively to demand measures for its relief; and, where paralysis is one of the symptoms, galvanism must be employed daily, or two or three times a week, in order to prevent as much as possible the muscles from degenerating whilst the pathological condition in the nerve is being cured—that is, in cases in which a cure is possible.

H. Charlton Bastian.

NEUROMA (*νεῦρον*, a nerve).—A tumour connected with a nerve. *See* Nerves, Diseases of.

NEUROSES (*νεῦρον*, a nerve).—Synon.: Fr. *Névroses*; Ger. *Nervenleiden.*

Definition.—Affections of the nervous system occurring without any material agent producing them, without inflammation or any other constant structural change which can be detected in the nervous centres: in other words, functional affections of the nervous system.

Many of the disorders which may be included here are characterised by symptoms such as neuralgia, convulsions, &c., which also accompany other disorders associated with morbid changes. It is very necessary, therefore, in inquiring into any particular case not to rest satisfied with the presumption that the disorder is functional until the condition of the nervous centres has been investigated; lest, regarding the symptom as the disease, the central mischief to which it is due may be overlooked. It is highly probable, moreover, that many of what we now regard as functional diseases will, on further investigation, be found to depend upon some corresponding change in the organ affected.

Enumeration.—The neuroses may be classified according to the organs or functions involved:—

a. Visceral Neuroses, namely, those of the respiratory, circulatory, or digestive organs.

b. Localised Paralyses; for instance, palsy of the facial and other peripheral nerves.

c. Localised involuntary or reflex movements, such as spasm of the facial nerve, and writer's cramp.

d. Disorders of general sensibility, including the various forms of neuralgia—trigeminal, cervico-occipital, sciatic, crural, &c.

e. General Neuroses, namely, chorea, tetanus, epilepsy, catalepsy, hysteria, and allied affections.

f. Disorders of the mental faculties—hypochondriasis, melancholia, and other forms of mental derangement.

P. W. Latham.

NICE, on the French Riviera.—Fairly warm, rather variable and windy, dry, bracing winter climate. Mean temperature, winter, 46·33° Fahr. *See* Climate, Treatment of Disease by.

NICTATION
NICTITATION } (*nictito*, I wink often). A rapid involuntary winking of the eyelids, usually due to some nervous disturbance. *See* Chorea; and Facial Spasm.

NIGHT-BLINDNESS. *See* Nyctalopia.

NIGHTMARE.—This is a condition characterised by an abiding sense of discomfort or extreme uneasiness, occurring in the midst of a disturbed sleep, sometimes associated with a feeling of weight at the epigastrium, in conjunction with more or less definitely oppressive dreams. It is principally associated with the taking of a heavy meal or of indigestible food before going to sleep by some persons, especially those of a nervous temperament, whose digestion is weak. A closely allied condition is, however, apt to be met with as a consequence of brain-exhaustion and chronic disturbance of sleep in those who are overworked, either by application to study, business details, or literary pursuits. Such a condition also has its affinities with certain forms of incipient delirium, occurring either in various febrile diseases or as a result of alcoholic excesses. *See* Sleep, Disorders of.

H. Charles Bastian.

NIGHT-SIGHT. *See* Hemeralopia.

NIGRITIES (*niger*, black).—Synon.: Fr. *Noirceur*; Ger. *Schwärze.*—*Nigrities cutis* signifies blackness of the skin. It may be of various degrees; and results from aberration of deposit of pigment, or, more exactly, from an excess of black pigment in the integument. *See* Melanopathia.

NILE, The.—Very dry winter climate. Unsuitable for cases of active pulmonary disease. Mean temperature, winter, 57° Fahr. *See* Climate, Treatment of Disease by.

NIPPLE, Diseases of.—Synon.: Fr. *Maladies du Mamelon*; Ger. *Krankheiten der Brustwarze.*—Some of the more ordinary affections of the nipple will be found described under Breast, Diseases of, and Lactation, Disorders of. Here it is proposed to treat of certain graver diseases, which claim a separate consideration.

Malignant Disease.—The nipple may be the seat of epithelioma, which commonly commences as a crack or fissure, with an indurated base, often in the areola or at its junction with the nipple. It presents no special features which distinguish it from similar disease of the integument of adjoining parts. Hard carcinoma too may attack the nipple, involving its deeper structures and producing general induration and enlargement, so that the diseased mass projects from the summit of the breast like a knob or large nut. The disease probably originates in the epithelium of the galactophorous ducts, or in that of the sebaceous glands.

Of greater interest than either of these is an affection frequently associated with malignant disease of the breast, to which Sir James Paget has lately drawn attention—an eczematous condition of the nipple and areola. It may occur in the form of a dry, scaly, or branny eruption, affecting the entire surface of the areola and nipple, which is darker-coloured, a little firmer, and less pliant and elastic than its fellow. Or, with more characteristic signs of inflammation, small vesicles or pustules may form, and, breaking or being rubbed off, may leave behind them tiny scabs or ulcers, or a surface raw and red. Either condition may exist for many months or even years with little alteration, and with scarcely any tendency to spread beyond the margin of the areola. But the second form, causing more irritation than the first, is often subjected to treatment, and being very difficult to cure, is sometimes so severely treated with caustics that destruction ensues, not of the disease, but of the nipple, which appears to have been gradually eaten away by the eczematous affection. Both forms are uncommon, but they are rare before the middle age. A study of their clinical and pathological characters leads to the conclusion that they are due to inflammation. The disease has been noticed in men as well as women.

Treatment.—This disease may be treated by protecting the parts with a carefully adjusted, ventilated shield, and by the application of vaseline, or liniment of lead and oil, or similar soothing dressing. But it is very intractable, in some cases apparently incurable. It might seem as if an affection so trivial were not worthy of so much attention; but unfortunately there appears the strongest reason to believe that these conditions of the nipple and areola are not infrequently the precursors of carcinoma of the breast, sometimes by only a few months, sometimes and more often, by a period of years. It is probable, too, that the carcinoma is directly due to the eczematous disease; for it induces changes in the epithelium of the ducts which can be traced deeply into the substance of the breast, whose acini become at length distended with proliferating epithelium. On this account it has been proposed, when all the lesser methods of treatment have been used in vain, to remove the entire breast. Opinions which are divided on the necessity of this measure, so severe, are united in its favour when, with the superficial inflammation, there exists an appreciable induration, however slight, within the breast. Care must be taken not to confound these eczematous affections of the nipple and areola with those more widely diffused surface inflammations of the breast, with which they have little in common, either in the obstinacy with which they resist treatment, or in the deeper disease to which they may give rise.

Henry T. Butlin.

NOCTAMBULATION (*nocte*, in the night, and *ambulo*, I walk).—A term for sleep-walking. *See* Sleep, Disorders of.

NOCTURNAL EMISSIONS.—Involuntary emissions of semen occurring during sleep. *See* Sexual Functions in the Male, Disorders of.

NOCTURNAL INCONTINENCE.—Involuntary escape of urine during sleep. *See* Micturition, Disorders of.

NODE (*nodus*, a swelling).—A circumscribed swelling on the surface of a bone, connected with the periosteum, and usually due to syphilis. *See* Bone, Diseases of; and Syphilis.

NODI DIGITORUM (Latin).—Swellings of the distal phalanges of the fingers, usually associated with gout. *See* Gout.

NOLI ME TANGERE (Lat., Touch-me-not).—A term of dread, which has been applied to a state of severe ulceration of the nose, attended with fungous growth and more or less deformity. The phrase is subjective, and has been used somewhat indiscriminately in connection with lupus, cancer, and syphilis. It has now very properly fallen into disuse, or, when employed, is restricted to lupus exedens of the nose: *See* Lupus Vulgaris. Erasmus Wilson.

NOMA (*νέμω*, I devour).—Synon.: Fr. *Nome*; Ger. *Wasserkrebs*.—A synonym for cancrum oris. *See* Cancrum Oris.

NOSE, Diseases of.—Synon.: Fr. *Maladies du Nez*; Ger. *Krankheiten der Nase*.—The diseases that affect the nose may be conveniently divided into—(A.) The diseases of the **External Nose**; and (B.) the diseases of the **Internal Nose**.

A. Diseases of the External Nose.—

1. Acne Rosacea.—Synon.: Pop. 'Gin-drinker's nose.'—This affection of the nose is generally met with in later adult age. Not unfrequently the cause is to be found in alcoholic indulgence. In other cases it may be associated with some irregularities of menstruation.

Description.—The organ is swollen and red; its surface is shiny and greasy-looking; the skin is highly injected, the venules particularly appearing almost varicose; the sebaceous follicles are enlarged, though not invariably; and the skin is hypertrophied, the whole condition giving rise to an unnatural protuberance. At a later stage of the disease the nose appears tuberculated and blotched, often pustular, and covered with crusts and scales (*acne hypertrophica*). The blood disappears under pressure, and increases under mental excitement.

Treatment.—Mild cases are best treated by lead lotion, a weak solution of the bichloride of mercury, or zinc ointment. In severe cases the subcutaneous division of the larger vessels by a fine tenotomy knife causes a rapid shrinking and improvement. In all cases of acne attention must be paid to the manner of living and general health of the patient.

2. Boil, or Furuncular Inflammation.—A very painful form of boil is liable to develop on the tip or alæ of the nose, causing great disfigurement and often intense suffering. It commences in the subcutaneous cellular tissue, or beneath the perichondrium; and by its gradual increase and extension to skin and fibro-cartilage, causes great swelling, tension, and throbbing pain, owing to the peculiar toughness of the tissues entering into the formation of the integumentary structures.

Ætiology.—This affection is generally met with in young or middle-aged persons of intemperate habits, although frequently it is seen in the delicate and anæmic. Elderly persons, high feeders, who do not attend to the proper condition of their intestinal canal, are also liable to it.

Treatment.—If detected early, boil of the nose may be treated by painting with strong lead lotion, or just touching the part with the acid nitrate of mercury, and immediately rubbing it off. If very severe, and in order to avoid the pit or scar which might be left by allowing the disease to take its course, a very fine tenotomy knife may be passed through the nostril and into the boil, to relieve tension, and to allow of the escape of the pus into the nostril.

3. Deformities.—(*a*) *Congenital absence.*—Cases have been recorded of congenital absence of the nose. It does not appear that this condition can be satisfactorily assisted by surgical interference.

(*β*) *Congenital occlusion.*—Congenital occlusion of one or both nostrils is a very rare affection, and obviously must interfere seriously with sucking and respiration. It is either the result of a continuation of the integument, or is formed of fibrous tissue. The treatment, which should be undertaken at once, consists in making careful incisions through the obstruction, and keeping the nostril dilated with a piece of gum or metal catheter or a bougie for some weeks.

(*γ*) *Deviation of the septum.*—This deformity usually consists of a lateral curvature of the septum, and generally of some hypertrophy of its extremity, causing an inclination of the organ to one side or the other. As a result there is often great disproportion in the nasal cavities or nostrils, in some instances amounting to almost complete occlusion of one side; and the projection of the inferior turbinated bone of one side may be mistaken for a growth, on account of its protrusion. The treatment consists in carefully paring away the thickened septum, and subsequent dilatation of the nostril.

4. Expansion of the Nose, Morbid.—The tip occasionally becomes enormously developed, all the tissues being involved. This condition may require the removal of a wedge-shaped portion of the extremity, including the growth, and the subsequent adaptation of the parts.

5. Fracture.—In fracture of the nasal bones the displaced bone or bones should be raised, by introducing a pair of stout forceps with flat blades into the nostrils, guiding them up to the nasal bones by means of the septum, and then forcibly elevating them. The bones should be retained in position by plugs, or the small screw-clamp lately introduced, assisted in severe cases by some such mechanical appliance as a screw truss, passing round the head, and exerting pressure laterally upon the displaced bones. In cases of fracture of the septum with displacement, and subsequent deformity, the shape of the nose may be restored by this method, great attention being paid to the management of the plugs and clamp.

6. Hypertrophy of the Integument.—Synon.: *Lipoma Nasi.*—This consists of a hypertrophied condition of the integuments and of the subcutaneous adipose tissue, constituting irregular fleshy excrescences, and occurring in cases of severe and old-standing acne rosacea.

Description.—The term 'lipoma' is an inappropriate one, inasmuch as the mass consists of hypertrophied infiltrated skin and cellular tissue, with enlarged sebaceous follicles, which occasionally become developed into distinct cysts and dilated veins. The growth is chronic and painless, varying very much in the degree of its development and appearance, sometimes scattered like small warts, at others pedunculated and lobulated, and often attaining an enormous size. It does not affect the cartilages.

Treatment.—The only treatment is removal by the knife, dissecting the mass carefully off the underlying cartilages, and allowing the surface to heal by granulation.

7. Lupus.—The forms of lupus attacking the nose are fully considered elsewhere in this work. *See* Lupus Erythematosus; and Lupus Vulgaris.

8. **Malignant Disease.**—*Epithelioma* is a rare form of malignant disease in the nose. It commences with the characteristic wart, which passes on to the ulcerative stage; and its first appearance is either at the junction of the skin and mucous membrane, or in the membrane itself. It may be stationary for years, but ultimately ends in destruction of the organ. It must not be confounded with syphilis. The history of the case is often enough to establish the diagnosis; whilst the epithelial patch is nearly always single, and the specific multiple. The disease affects the glands sooner or later.

Schirrus and *Encephaloid cancer* occasionally involve the nose, generally growing from within outwards. These growths may be either excised, or destroyed by escharotics.

9. **Nævus.**—Nævus may exist in all degrees in the external nose, from the merest patch to a large disfiguring tumour. If very small, inoculation with vaccine matter may entirely destroy it. Ligatures invariably, if the growth be large, leave a scar; injection with perchloride of iron is very dangerous. The best method of treatment is the galvanic cautery; or in some instances the entire removal of the growth with the knife.

10. **Rodent Ulcer.**—Rodent ulcer is occasionally met with in the nose. It somewhat resembles lupus, but occurs in later life. The ulcer spreads gradually; and the pain is described as of a severe aching character. It has been classed with the cancers, but it lacks several of the characteristics of that kind of growth. There is no constitutional infection; and it has been abundantly proved that, if entirely eradicated with the knife, it need not return. *See* Rodent Ulcer.

11. **Sebaceous Tumours.**—Sebaceous tumours are occasionally met with on the sides and tip of the nose, and require removal.

12. **Syphilitic Disease.**—Syphilitic ulcers of the nose are of special interest as being one of the causes of ozæna. The symptoms and treatment of this condition are fully described in a separate article. *See* Ozæna.

13. **Wounds.**—Wounds of the integuments or soft parts of the external nose require the neatest coaptation, by the use of very fine silver wire sutures, or of isinglass plaster; and as union is generally very rapid, owing to the great vascularity of the tissues, unless this be attended to serious deformity may result. Any tendency to falling in of the nostril must be counteracted, by introducing a roll of lint or piece of bougie. It may be worth mentioning that instances have occurred where the nose has reunited after its complete removal from the face.

Plastic Operations.—Plastic operations on the nose, for the restoration of lost parts, or for the improvement of deformities, are described in works on operative surgery.

B. Diseases of the Internal Nose.—

1. **Anosmia.**—Anosmia, or loss of the sense of smell, when of traumatic origin, is either the result of injury, such as blows on the head, or of the inhalation of noxious vapour; or it depends on cerebral disease. In the former case, a very frequent cause is a blow on the head, probably rupturing some filaments of the olfactory nerves, as they pass through the cribriform plate of the ethmoid bone, according to Ogle (*Med. Chir. Trans.* vol. liii). The external root only of the olfactory nerve is the one directly concerned in olfaction, 'and it depends upon the degree to which this root or its central termination has been disorganised, whether the loss of smell be complete or partial.' Anosmia from other causes than injury is described elsewhere. *See* Olfactory Nerve, Disorders of; and Smell, Disorders of.

Treatment.—The treatment of anosmia is somewhat unsatisfactory. In cases where it depends on obvious causes, the removal of these may entirely or partially restore the sense of smell; and in other cases the excitation of the Schneiderian membrane of the nasal cavity, by the continuous galvanic current, promises better results than the administration of medicine or local applications.

2. **Blood Clots.**—As a result of injury, or of very violent blowing of the nose, extravasations of blood may take place, and form masses in the nostrils, which often set up inflammation, terminating in ozæna. In a case lately under the writer's care, a large, hardened blood-clot—which had been originally diagnosed as a morbid growth, and given rise to great inconvenience—was detached from the posterior nares, by the repeated use of the nasal douche.

3. **Foreign Bodies in the Nasal Passages.**—Peas, cherry-stones, and the like are often inserted into the nostrils by children, and if found out at once can be, generally speaking, readily removed. When a foreign body has remained for any length of time in the nasal fossæ, it becomes coated with calcareous matter, and forms a calculus, setting up a most offensive discharge, ulceration of the mucous membrane. and necrosis of the cartilages or bones. In all cases of persistent discharge from the nostrils the impaction of a foreign body should be suspected, and examination made by gentle probing or the rhinoscope.

Treatment.—In attempting to remove a foreign body from the nasal passages, it is as well to avoid the use of forceps, as the blades in attempting to catch the body, are liable to cause its impaction. A small slender hook may be passed behind the body, or a very fine screw into it, and so it can be withdrawn, as suggested by Gross. The removal of masses that have long been retained in the nasal passages may sometimes be effected by the nasal douche, using a strong stream directed into the sound nostril; or by means of curved bougies passed from behind. Pushing the impaction backwards into the pharynx is always rather hazardous, as it may pass into the larynx. Occasionally foreign bodies have been so long in the nose, and become so firmly impacted, that external incision has to be made, and the structures forming the external nose freely divided in order to reach them; or the method of Rouge, of operating through the mouth, may be employed.

Insects, leeches, or intestinal worms may get into the nasal passages, and from them pass into the sinuses. It has been proposed to destroy these by vapour of alcohol or turpentine.

4. Inflammation of the Septum Narium.—Acute inflammation of the septum narium is generally a result of injury, and may terminate in abscess, the diagnosis of which from polypus is easy. The abscess should be promptly opened.

In chronic inflammation of the nasal septum, which is very frequently the result of syphilis or scrofula, there is often necrosis of the cartilaginous septum, resulting in perforation, which may give rise to great deformity, on account of the depression of the nose following it. As regards treatment, in some instances, perhaps, the persistent dilatation of the nostril may be useful; and should there be a disposition of the ulcerative process to spread, the edges should be touched with either a strong solution or the solid stick of nitrate of silver. The constitutional treatment must, of course, be dependent on the cause of the ulceration.

5. Rhinolithes, or Nasal Calculi.—These masses are generally the result of the impaction of some foreign body, around which the inspissated mucous and purulent secretion of the nasal passages has formed, retaining it as a sort of nucleus. Or they may occur spontaneously; and, according to Demarquay, consist of phosphates of lime and magnesia, and carbonate of lime, magnesia, and soda.

Rhinolithes cause symptoms of obstruction and irritation, and sometimes set up severe inflammation and discharge. Before attempting their extraction, the posterior nasal douche should be employed to wash away the accumulated secretion, and to assist in dislodging the mass, which may be subsequently crushed, and removed piecemeal or entirely.

6. Submucous Infiltration of the Sides of the Vomer.—This affection has been called attention to by Cohen, and 'consists of a puffy condition of the mucous membrane over the vomer, which, by giving rise to symptoms of obstruction at the posterior part of the nares, has been mistaken for polypus. On examination with the rhinoscope, there is observed on each side of the septum, and confined to its posterior portion, a tumid mass of whitish colour, markedly distinct from the red colour of the adjacent mucous membrane. The affection is usually symmetrical, but often exists to a greater extent upon one side than the other. The masses are roundish, with very convex outlines, and sometimes extend half-way across the fossæ, and occasionally very close to the outer margin of the nares, if not in contact with them. The disease appears to consist in an œdematous protrusion of the mucous membrane, from an accumulation beneath it of serum or serous mucus.'

TREATMENT.—The treatment consists 'of tearing away portions of the protrusions, by forceps carried up behind the palate or through the nostril, and subsequent cauterisation of the parts. The affection is an obstinate one, and may recur again and again.' In the œdematous membrane, removed in one such case, there was abundant evidence of mycelium (Cohen, *Diseases of the Throat.*)

7. Tumours.—*a. Cartilaginous growths* have been met with in connection with the septum.

b. Polypi of the nasal passages are fully described elsewhere. *See* POLYPI.

c. Neuromata have been met with in the nostril, and mistaken for polypus.

d. Adenoma of the pituitary glands has been recorded (*Archives générales*, Oct. 1876), occupying the superior and anterior portion of the nasal fossæ. The growth was removed by external incision.

e. Adenoid vegetations in the naso-pharyngeal cavity have been described by Meyer, of Copenhagen (*Trans. Med. Chir. Soc.*, vol. liii). They may spring from any part of the naso-pharyngeal cavity, except the septum; and the most prominent structural character of the growth is adenoid. They vary in shape according to the wall from which they spring, being sometimes cristate, cylindrical, or flat; and they are in general highly vascular.

SYMPTOMS.—The symptoms of such vegetations depend, of course, on their number, size, and locality; but one is led to their detection by observing that the patient is compelled to keep the mouth open, on account of the closure or partial closure of the air-passages through the nose; by the attenuation of the external nose; and by the voice losing its resonance in the naso-pharyngeal cavity, which causes a peculiar 'deadness' of the pronunciation. There may be, moreover, a sensation of the existence of a foreign body, from the involvement of the Eustachian orifice. Meyer lays down the general rule that 'a deaf patient who breathes through the mouth, and has a thin compressed nose, is affected with vegetations in the naso-pharyngeal cavity.' The detection of these growths is often best accomplished by the finger passed up behind the velum, when they may be felt as soft masses yielding to the finger, and giving the sensation of a bunch of earth-worms. Rhinoscopic examination is very difficult and, as a rule, unsatisfactory in these cases. The writer has recently met with a case of this nature, which was readily diagnosed by the finger.

TREATMENT.—The treatment consists in cauterisation, if the growths are soft and small, and the use, by means of the nasal douche, of a watery solution of common salt, or bicarbonate of soda (1 in 500), which washes away the mucus, and also alters the condition of the secretory surfaces. When larger vegetations exist, operative methods, such as crushing or scraping off the masses as near their bases as possible, must be resorted to through the nose, or the employment of the galvano-cautery.

f. Cancer in all its forms may involve the nasal fossæ, originating most often in the antrum; epithelioma usually commencing on the outside, or edge of the alæ. The only treatment is obviously prompt removal on detection, and even then the prognosis is most unfavourable.

g. Osseous tumours occur frequently in the internal nose. Dr. Olivier (*Sur les Tumeurs osseuses de Fosses Nasales et des Sinus de la Face:* Paris, 1869) calls attention to growths of this nature, which are developed either in the nasal fossæ, or in the tissues connected therewith, and states that they are characterised by the following conditions. 1. That they contain in their anatomical constitution only the elements of osseous tissue, spongy or compact. 2. That they are primarily developed in the fibro-mucous membrane which lines the cavities of the nasal fossæ and the sinuses. So far as they involve the nasal cavities, the following facts present themselves. The tumour is generally to be seen at the anterior portion of the nostrils. If the bony tissue be still covered by the mucous membrane, that membrane retains its usual characters; but if the growth be carious, it becomes of a greyish hue; and in the event of ulceration, the growth can be readily distinguished. These osseous tumours of the nose invariably cause some exophthalmos, whilst respiration and phonation are interfered with.

Treatment.—The treatment of osseous tumours of the internal nose consists in their removal by methods which must be obviously conducted according to their position, size, or nature. Sometimes they are so enormously hard that no instrument will touch them, and sometimes so soft and friable that the greatest care is necessary to remove them in their entirety; and indeed it has been suggested by Ollivier, in the instance of these friable growths, to attempt to remove them in fragments before making external incisions, which will expose the growth entirely. In a case of the ivory variety lately under the writer's notice, the tumour sprang from the frontal sinus and extended along the infundibulum, presenting in the nose as a large round nodule about the size of a marble, covered with mucous membrane, and of stony hardness; there was little if any displacement of the external parts. With regard to the operative proceedings for the removal of such growths, or indeed for gaining a thorough view of the nasal passages, the method devised by Rouge, of Lausanne, is by far the most effective. It consists in dividing the mucous membrane of the upper lip, at its junction with the jaw, freely, into the base of the anterior nares; in cutting subsequently through the nasal cartilages; and in turning the lip and external nose upwards, so that a complete view of the nasal cavities is thus obtained over the roof of the palate.

Other diseases affecting the internal nose are discussed in separate articles. *See* Coryza; Epistaxis; Influenza; and Ozæna.

Edward Bellamy.

NOSOPHYTA (*νόσος*, a disease, and *φυτὸν*, a plant).—A term employed by Gruby to designate a group of cutaneous affections, in which a fungus-formation constitutes an essential part of the disease. Naturalists have identified this fungoid growth with vegetable fungi in general, and have noted several species. Pursuing the same idea, they have regarded this fungoid matter as real fungi, vegetating in the skin, drawing their sustenance from the juices of that tissue, producing sporules, and diffusing those sporules, after the manner of seeds, as the means of propagating the species, and consequently, the disease.

In this view of the nature of the fungoid development, those diseases in which the fungi are found are termed 'parasitic,' and the contagious nature of such affections is thence inferred. One additional factor becomes necessary, namely, that the skin should be in a condition favourable for the reception and development of the parasitic plant. The precise pathological state constituting the disease may be denominated 'phytosis,' whilst the seat of its manifestation is the epidermis, the rete mucosum, the epithelium of the follicles, the nails, and the hair.

One of the most important of the cutaneous nosophyta is tinea, or ringworm; hence the word tinea is employed synonymously with phytosis; and we are enabled to enumerate as examples of the disease:—Phytosis *seu* Tinea tonsurans, circinata, favosa, and versicolor; whilst we also note that phytosis is present in certain forms of folliculitis, for example, in lichen marginatus and in sycosis. Phytosis, moreover, is a concomitant of onychogryphosis. *See* Phytosis; Ringworm; and Tinea.

Erasmus Wilson.

NOSTALGIA (*νόστος*, return, and *ἄλγος*, sadness).—Synon.: Fr. *Nostalgie*; Ger. *Heimweh*.—A form of melancholia, sometimes occurring in persons who have left their homes. The symptom from which it derives its name is an intense desire to return home; and this is accompanied by great mental and physical depression, which may end fatally. *See* Melancholia.

NUMMULATED SPUTUM (*numma*, a coin).—A form of sputum which, when spreading out on a surface, resembles a coin in shape. *See* Expectoration.

NURSES, Training of.—Training is to teach not only what is to be done, but how to do it. The physician or surgeon orders what is to be done. Training has to teach the nurse how to do it to his order; and to teach, not only how to do it, but *why* such and such a thing is done, and not such and such another; as also to teach symptoms, and what symptoms indicate what of disease or change, and the 'reason why' of such symptoms.

Nearly all physicians' orders are conditional. Telling the nurse what to do is not enough and cannot be enough to perfect her—whatever her surroundings. The trained power of attending to one's own impressions made by one's own senses, so that these should *tell* the nurse how the patient is, is the *sine quâ non* of being a nurse at all. The nurse's eye and ear must be trained—smell and touch are her two right hands—and her taste is sometimes as necessary to the nurse as her head. Observation may always be improved by training—will indeed seldom be found without training; for otherwise the nurse does not know what to look for. Merely looking at the sick is not observing. To look is not always to see. It needs a high degree of training to look, so that looking shall tell the nurse aright, so that she may tell the medical officer aright what has happened in his absence—a higher degree in medical than in surgical cases, because the wound may tell its own tale in some respects; but highest of all, of course, in children's cases, because the child cannot tell its own tale; it cannot always answer questions. A conscientious nurse is not necessarily an observing nurse; and life or death may lie with the good observer. Without a trained power of observation, no nurse can be of any use in reporting to the medical attendant. The best one can hope for is that he will be clever enough not to mind her, as is so often the case. Without a trained power of observation, neither can the nurse obey intelligently his directions. It is most important to observe the symptoms of illness; it is, if possible, more important still to observe the symptoms of nursing; of what is the fault not of the illness but of the nursing. Observation tells *how* the patient is; reflection tells, *what* is to be done; training tells *how* it is to be done. Training and experience are, of course, necessary to teach us, too, *how* to observe, *what* to observe, *how* to think, *what* to think. Observation tells us the fact; reflection the meaning of the fact. Reflection needs training, as much as observation. Otherwise the untrained nurse, like other people called quacks, easily falls into the confusion of '*on account of*,' because '*after*'—the blunder of the 'three crows.' The nurse is told by the medical attendant, 'If such or such a change occur, or if such or such symptoms appear, you are to do so and so, or to vary my treatment in such or such a manner' In no case is the physician or surgeon always there. The woman must have trained powers of observation and reflection, or she cannot obey. The patient's life is lost by her blunder, or 'sequelæ' of incurable infirmity make after-life a long disease; and people say, 'The doctor is to blame;' or, worse still, they talk of it as if God were to blame—as if it were God's will. God's will is *not* that we should leave our nurses, in whose hands we must leave issues of life or death, without training to fulfil the responsibilities of such momentous issues.

To obey *is* to understand orders, and to understand orders really is to obey. A nurse does not know how to do what she is told without such 'training' as enables her to understand what she is told; or without such moral and disciplinary 'training' as enables her to give her whole self to obey. A woman cannot be a good and intelligent nurse without being a good and intelligent woman. Therefore, what 'training' signifies in the wide sense, what makes a *good training-school*, what moral and disciplinary 'training' means, and how it is to be attained, are to be clearly understood.

I. *What makes a good Training-school for Nurses?*

(1) A year's practical and technical *training* in hospital wards, under *trained* head-nurses (so-called 'sisters' of London hospitals), who themselves have been *trained* to *train*.

For a district nurse, an additional three months' training in nursing by the poor bedside, under a trained and training district superintendent, is essential.

The training of probationers should be as much a part of the duty of the head nurse ('sister,') as directing the under-nurses or seeing to the patients.

To tell the training, you require weekly records, under printed heads corresponding with the 'List of Duties,' kept by the head-nurses of the progress of each probationer (pupil) in her ward-work, and in the moral qualities necessary in her ward-work; a monthly record by the matron of the results of the weekly records; and a quarterly statement by her as to how each head-nurse has performed her duty to each probationer. The whole to be examined periodically by the governing body.

(2) Clinical lectures from the hospital professors; lectures on subjects connected with nurses' special duties, such as elementary instruction in chemistry, with reference to air, water, food, &c.; physiology, with reference to a knowledge of the leading functions of the body; and general instruction on medical and surgical topics; examinations, written and oral, at least four of each in the year, all adapted to nurses; as also lectures and demonstrations with anatomical, chemical, and other illustrations, adapted especially to nurses—all in the presence and under the care of the matron (Lady Superintendent) and mistress of probationers (Class-mistress and 'Home'-sister); together with instruction from a medical instructor, one of the hospital professors and hospital medical staff, specially selected to teach the nurses.

A good nurses' library of professional books, not for the probationers to skip and dip in at random, but to be made careful use of, under the medical instructor and class-mistress.

(3) Classes for a competent mistress to drill the professorial teaching into the probationers' minds; the mistress of probationers to be above all a 'home'-sister, capable of making the 'home' a real *home*, and of training and disciplining the probationers there in all good—in moral qualities, customs and habits, and manners, without which no woman can be a nurse, and in their duty and feeling to God as well as to their neighbour.

(4) The authority and discipline over all the women of a trained lady-superintendent, who is also matron of the hospital, and who is herself the best nurse in the hospital, the example and leader of her nurses in all that she wishes her nurses to be, in all that training is to make her nurses.

(5) An organisation not only to give this training systematically, and to test it by current tests and examinations, but also to give the probationers, by proper help in the wards, time to do their work as pupils as well as assistant-nurses, and above all to make it a real moral as well as nursing probation—for nursing is a probation as well as a mission.

(6) Accommodation for sleeping, classes, and meals; arrangements for time and teaching and work; surroundings of a moral and religious, and hard-working and sober, yet cheerful tone and atmosphere, such as to make the training-school and hospital a 'home' which no good young woman of any class need fear by entering to lose anything of health of body or mind; with moral and spiritual helps, and an elevating and motherly influence over all, such as to make the whole a place which will train really good women, who can withstand temptation and do real work, and neither be 'romantic' nor 'menial.' For, make a hospital as good as you will, hospital-nurses require more such helps, and get less, than women either in their own homes or in domestic service.

Every hospital should have and *be* such a school for training nurses for itself and other institutions, including district and private nurses, who must be trained in hospitals, and therefore cannot have a training-school of their own. Professors and medical staff cannot be always, or indeed ever at hospital bedsides, showing nurses what to do. Let each give the pupil-nurses a clinical lecture once a week. Above all, this is necessary for those who are to be head-nurses, matrons, and lady-superintendents. The success of any training-school depends mainly upon having trained nurses themselves capable of training others—(*a*) in ward-nursing; and (*b*) in cases, so as to be able to understand what physician and surgeon order, and do it.

II. *Course for all Probationers.*

(1) To do duty as assistant nurse and probationer successively in one or more wards of each of the hospital divisions, one or two or three months in each, male and female surgical, male and female medical, children's, obstetric, ophthalmic, Magdalen; ending her course, if possible, in the medical-instructor's wards.

The course should, if possible, *begin* in the female medical wards. No two *fresh* probationers to be in the same ward. One nurse-probationer and one lady-probationer to be together, where possible.

(2) To learn ward-management by being in charge of wards during the head-nurse's dinner-hour, and during nurses' recreation hours; to take, when sufficiently advanced in the year's training, day or night staff duty for staff-nurses on their holidays; to have at least one month's night duty—a fortnight at a time—in the year's training.

(3) To take, when sufficiently advanced, special duty, by day or by night, upon special cases, such as ovariotomy, lithotomy, tracheotomy, typhoid, &c., in the single-bed wards.

(4) To make a set of all the different bandages required.

(5) To learn from the head-nurse to read the 'cards,' or patients' bed-tickets, especially in the medical wards.

(6) To keep a diary of her ward duties.

Besides this diary, each probationer at least once a month to draw up a sketch of her day's work, not merely as a ward assistant or assistant nurse, but as a probationer in training, namely, what she has learnt that day from ward-sister and staff nurse, what she has observed on special cases in the ward, &c.

Warning is given out only *after* the day's work, that it is such and such probationer's day to write it out.

(7) To take careful notes of cases. A case-paper should be regularly kept by every probationer of cases selected by the medical instructor.

The case-paper to have printed headings, such as 'Temperature,' 'Pulse,' 'Respiration,' to be taken morning and evening [in some cases the physician will require the 'temperature' to be taken as often as every hour, or even every quarter of an hour]; 'Sleep,' 'Nourishment,' 'Urine,' 'Stools,' to be noted every twenty-four hours—in each case character as well as quantity; 'treatment,' to be noted daily, in English, and not copied off the 'cards;' and other such heads; preceded by a real medical history of the case—of the causation of the disease; for example, in typhoid fever and other dirt diseases, produced by foul air and foul water. This is followed by remarks on the termination of the case. These case-papers should be rigorously overhauled by ward-sisters and the class-mistress, as well as by the medical instructor, who should also at his own hospital-beds check the case-taking.

(8) To take careful notes of all lectures, also overlooked by class-mistress and medical instructor.

(9) To read and be shown illustrations of the cases nursed in the wards, [the keen professional interest felt by a promising probationer in finding her own cases in a book must be encouraged.]

(10) To jot down afterwards, but while still fresh in the memory, any remarks suitable for her own instruction made to the students by the hospital physicians and surgeons in going their rounds, and to write out her jottings in the class-room under the superintendence of the 'home'-sister.

(11) To write out under the superintendence of the 'home'-sister what has been learnt both from ward-sisters and medical instructor as to what is to be done and how to do it in nursing; as to *why* it is done, and why something else is not done; as to symptoms and the 'reason why' of such symptoms.

Without (*a*) time for these things, average nurse-probationers degenerate into conceited ward-drudges. Without (*b*) a system for these things, they potter and cobble out their year about the patients, and make not much progress in real nursing, that is, in obeying the physicians' and surgeons' orders intelligently and perfectly.

III. *Training to Train.*—To enable nurses to train nurses, a special training is required; and for this a longer period than a year in the hospital is necessary. To *train* to *train* needs a system:—

(1) A systematic course of reading, laid down by the medical-instructor, who recommends the books for the training-school library. Hours of study, say two afternoons a week; class-mistress ('home'-sister) to lead one at least of these afternoons.

(2) Regular oral examinations by medical-instructor; each training-nurse must acquire powers of expression to train others. He must cultivate these in answering him. Some system of mutual examination.

(3) At least four written examinations in the year on written questions, by the medical instructor. Essays to be written on given subjects in nursing.

(4) Pre-eminently careful notes of lectures, in order to enable nurses in future to drill others in understanding the professorial lectures, as they have themselves been drilled.

(5) Pre-eminently careful notes of cases—the touchstone for the future trainer. If she cannot observe and understand her own cases, how can she teach others to observe and understand them? If she never learn the reason of what is done, how can she train others to learn it? 'Reading up' her own cases.

(6) A current constant course of careful learning from head-nurses and medical instructor and physicians or surgeons in wards where she

is probationer, to know not only what symptoms are there, and what symptoms are to be expected in such and such an event, but also the *meaning* of such symptoms—the 'reason why.' To know not only when a wound or surgical injury or operation 'looks well' and when it 'looks ill,' but *why* it looks well or ill; and to be able to tell others *why*. To know not only what is to be done, and how it is to be done, but *why that* is done, and not something else.

(7) At least twice in the year's training, but not at the beginning, to have a week or more of going the night-rounds with the night-superintendent of nurses, which is equally good for night-superintendent and for probationer.

(8) To spend at least a week, but not at the beginning of her year, in the linenry.

(9) The future superintendent, who is to have a training school, should have *at least* a fortnight in the year, about six or nine months on in her training, in the 'Home,' if possible, taking or assisting at classes, and doing all but the 'Home' sister's secretarial work.

(10) Taking temporary duty of ward-sisters on their holidays, and—the best—of 'Home' sister on her holiday. Of course no fresh probationer, however gifted, would be put on such duty.

(11) Being relieved of the more menial ward-work, such as cleaning lavatory basins, w.c. pans, &c., when she can do it so perfectly of herself without being told, that she can teach others to do it. This will scarcely be, for all kinds of this ward-work, before she is a six months' old probationer.

(12) A second year's training for the higher posts. A future matron or lady-superintendent to have had experience as ward-sister, and to have had at least one year as assistant-superintendent and as night superintendent, in some hospital under a trained lady-superintendent.

(13) The matron must give future matrons or superintendents insight into her duties. There must be an examination and questions given on superintendents' work.

IV. *Current tests, current records of progress, and examinations.*

(*a*) The candidate should fill up a form of application, answering printed questions. Regulations of training printed on the back.

(*b*) Should enter on a month's trial. She receives the time-table and the list of duties.

If the candidate is accepted after the month as probationer—

(*c*) Each ward head-nurse or sister keeps a record of each probationer, under printed heads corresponding with the list of duties. She fills up the columns with suitable marks once a week. The matron, after examining the ward-sister's reports with ward-sister and 'home'-sister present, and questioning each ward-sister on each probationer, records her own opinion on the sister's reports. The medical instructor once a month should examine each probationer separately, upon the duties which the ward head-nurse (sister) has 'recorded' her as defective in, in the presence of ward-sister, 'home'-sister, and matron; and also should examine each ward-sister separately upon her records of each probationer in the matron's presence, but not in the probationer's.

The 'home'-sister also furnishes a record of each probationer's conduct at the classes and in the home.

(*d*) A register with two pages for each probationer should be kept monthly by the matron assisted by the 'home'-sister. It corresponds with the ward-sister's book, and has monthly entries for the whole year of training. The accounts in these books must tally at the end of the year, or somebody has been wanting in moral courage.

(*e*) While the ward-sisters keep a weekly and the matron a monthly record of the progress of each probationer, she is required to keep a diary of her ward work, to keep 'case-papers' with the daily changes in case and treatment, and to keep notes of lectures; and the careful examination of these affords important items in the records of results of training, and of the capabilities of each probationer. The medical instructor enters his verdict on professional points in the monthly register.

(*f*) The medical instructor, and each hospital professor who gives lectures to the probationers, examines them orally in the presence of matron and home-sister. He examines their notes of the lectures and awards marks. It is communicated to each probationer how she stands as to marks.

(*g*) Written questions are given by the medical instructor at least four times a year, to be answered in writing, at least by the probationers who are training to train others. Marks are awarded, and the number of marks received communicated to each probationer. Possibly prizes may be given for proficiency.

These are some of the current tests of the results or non-results of training, of progress or no progress. Without some regular system of this kind, there can be no real organization for training. The heads of the training school *must* 'take stock' and know where each probationer really stands, and what the training is really doing, and must let each probationer know where she stands. The matron must be one whose desire is that the probationers *shall* learn: a rarer thing than is usually supposed. But besides this there is a constant, motherly, intangible supervision and observation to be exercised, for there are qualities which no written tests can touch and no examinations can reach. The probationers must really be the matron's children; the 'home' sister must really be their elder sister.

A training school without a mother is worse than children without parents. And in disciplinary matters none but a woman can understand a woman.

V. *Staff of Training School:—*

1. The *superintendent* of the training school is the matron of the hospital, and head of all the women in the hospital. She is present when possible at the probationers' lectures and demonstrations, and oral examinations, with the 'home' sister, who is always present. The night-superintendent of nurses trains the probationers told off to accompany her at night.

2. The trained '*home*'-*sister* (class-mistress; mistress of probationers) resides in the 'home'; is in charge of the 'home' and its servants and of the probationers. She gives two classes a week at least to the senior nurse-probationers and two

to the juniors, drilling them in the medical instructor's lectures, &c. &c. She superintends two afternoons at least in the week the study hours of the probationers training to train others, that is, all who are to be in future in charge of nurses, whether as ward-sisters, matrons or superintendents, and gives direct instruction on one at least of these afternoons. She gives singing and Bible classes. She must from time to time communicate with the ward-sisters on the defects in the probationers' work, and concerning probationers about whom she may feel uneasy. Cutting off communication between hospital and 'home'-sister is very objectionable; the hospital-sister must not want moral courage to let the probationers know any unfavourable report she has made of them in the Sisters' Records. This is unfair to the probationers. The 'home'-sister must attend all clinical and other lectures, demonstrations, and examinations.

3. *Ward-Sisters* (Head-nurses, Training-nurses).—The ward-sister must train the probationers in all the duties of a nurse. *See* NURSING THE SICK; and above, 'II. Course for Probationers.'

The ward-sister, or—instructed by her—the staff nurse, is to *show* every new probationer how to do her work; not only what things are to be done, but how she is to guard against the *way* they are not to be done, as well as against what is not to be done. She is to instruct the nurses how to instruct probationers. As it is impossible for a 'sister' with a sister's duty in a 'heavy' ward always to have time to show all needful things herself to the probationer; the sister must from time to time question her to see if she has been shown her duties and how she does them, remembering that it is of use to the probationers to put these things into words; and for this purpose each probationer is to be occasionally taken by the sister on her ward rounds, and examined as to what she has done in each case under her charge, whether she has learnt to do it rightly and knows 'the reason why.'

The ward-sister must also train the probationers in alacrity of intelligent obedience to *her* medical authorities, which must be the probationer's lesson of what obedience ought to be. She must regard the probationers less as hospital servants, than as pupils to be trained for hospital 'sisters' and nurses. The training-nurse must be a bridge for the pupil-nurses. 'He who will be a chief, let him be a bridge.' She must not make them too little of pupils, too much of assistant-nurses—or, rather, they cannot be too much of assistant-nurses, but being too little of pupils makes them too little of real assistants, and (for all their future) of real nurses. The training-nurse must interest the pupil-nurse in her cases. The pupil cannot have a nurse's interest in them without knowing *what they are.* Cases she is interested in she nurses with twice the efficiency.

4. *Medical Instructor.*—The medical instructor, one of the hospital staff who will undertake the duties, gives a lecture once a week on medical and surgical topics specially connected with nursing duties; demonstrations with anatomical and other illustrations, specially adapted to nurses; lessons on the elementary knowledge of physiology, anatomy, the situation of the principal arteries, &c.; lessons on bandaging; lessons in hygiene, both of wards and patients; lessons on the causation of disease; on what is to be done in emergencies; on how to make beds for various operations and diseases, &c., &c. He is to lay down a systematic course of reading for the probationers who are to train others; to examine them by written questions at least four times in the year; to give them subjects for essays, and to examine these; to award marks. He is to examine all the probationers orally; to examine their notes of lectures, to award marks; to examine their case-papers. He is to give clinical lectures at least once a week, at his own 'beds' (it would be desirable if each probationer could end her course of wards in the medical instructor's wards), and to examine 'case-papers' taken of his own cases; to teach symptoms, and what symptoms indicate, and *why* such or such a treatment; and what shows a case to be 'doing well' and what 'ill'; and to teach the probationers so that they can teach other probationers in their turn. He will encourage in every way the professional interest of the nurse in the cases she is nursing; he will point out these cases in medical and surgical books. Once a month he will examine each probationer separately upon the duties she is defective in; and each ward-sister separately upon her recorded experience of each probationer. He will fill up the monthly register at the end of each probationer's year of training, with his verdict on her capacities, and on such professional results of her training. He will make up the purely professional columns—such as 'observation,' 'operations'—every month, seeing the matron and ward-sisters for the purpose. The medical instructor should be one of mature age and experience; should be really a father to the pupil-nurses, and one whom the matron can freely consult with. If the hospital have a *permanent* resident medical officer fit for the purpose, he should be the instructor.

5. The medical instructor also gives elementary instruction in chemistry, physiology, anatomy, surgery, medicine, as far as they bear upon nurses' duties.

6. *Lady Visitor.*—The lady visitor should not be resident in the hospital, but should herself have been a trained nurse, so as to know what training is. She will be an essential assistance to the matron, in infusing spirit from without into her training school, and in saving the matron from the appearance even of arbitrary power.

Training, general consideration of.—A year's training is simply teaching the nurse her A B C—teaching her how to go on learning for herself, learning to understand her doctor's orders and to read her own experience, for mere experience may only teach the '*post hoc, ergo propter hoc.*' A nurse without training is like a man who has never learnt his alphabet, who has learnt experience only from his own blunders. Blunders in executing physician's or surgeon's orders upon the living body are hazardous things, and may kill the patient. Training is to enable the nurse to see what she sees—facts, and to do what she is told; to obey orders, not only by rule of thumb, but by giving her a rule of thought or observation. Otherwise she finds out her own mistakes by experience acquired out of death, rather than life, or does not find them out at all.

Medicine, surgery, pathology, and, above all, hygiene, have made immense strides, partly in consequence of improved tools, improved instruments of observation. Nursing, their agent, has to be trained up to them. A good nurse of twenty years ago had not to do the twentieth part of what she is required by her physician or surgeon to do now. And every five or ten years a nurse really requires a second training now-a-days. Nursing needs its instruments nearly as much as surgery, and yet more than medicine. The physician prescribes for supplying the vital force—but the nurse supplies it. Training is to teach the nurse how God makes health and how He makes disease. Training is to teach a nurse to know her business, that is, to observe exactly, to understand, to know exactly, to do, to tell exactly, in such stupendous issues as life and death, health and disease. Training is to enable the nurse to act for the best in carrying out her orders, not as a machine but as a nurse; not like Cornelius Agrippa's broomstick which went on carrying water, but like an intelligent and responsible being. Training has to make her, not servile, but loyal to medical orders and authorities. True loyalty to orders cannot be without the independent sense or energy of responsibility, which alone secures real trustworthiness. Training makes the difference in a nurse that is made in a student by making him prepare specimens for himself instead of merely looking at prepared specimens. Training is to teach the nurse how to handle the agencies within our control which restore health and life, in strict obedience to the physician's or surgeon's power and knowledge—how to keep the health-mechanism prescribed to her in gear. Training must show her how the effects on life of nursing may be calculated with nice precision—such care or carelessness, such a sick-rate, such a duration of case, such a death-rate. FLORENCE NIGHTINGALE.

NURSING THE SICK.—Nursing proper, that is, nursing the sick and injured, will be here treated of, and not Preventive or Sanitary Nursing, or nursing healthy children.

Nursing is performed usually by women, under scientific heads—physicians and surgeons. Nursing is putting us in the best possible conditions for Nature to restore or to preserve health—to prevent or to cure disease or injury. The physician or surgeon prescribes these conditions—the nurse carries them out. Health is not only to be well, but to be able to use well every power we have to use. Sickness or disease is Nature's way of getting rid of the effects of conditions which have interfered with health. It is Nature's attempt to cure—we have to help her. Partly, perhaps mainly, upon nursing must depend whether Nature succeeds or fails in her attempt to cure by sickness. Nursing is therefore to help the patient to live. *Training* is to teach the nurse to help the patient to live. Nursing is an art, and an art requiring an organized practical and scientific training. For nursing is the skilled servant of medicine, surgery, and hygiene.

Nursing may be divided under four heads:—(*a*) *Hospital* nursing. (*b*) *Private* nursing: that is, nursing one sick or injured person at a time, at home; giving the whole time to that one patient, generally of the richer classes. (*c*) *District* nursing: that is, nursing the sick or injured poor at home, taking as many cases as can be well attended to by one nurse. District nursing, or nursing the sick poor at home, is a branch of nursing of the highest importance, and requires the highest qualifications, because the district nurse has not, like the hospital nurse, a medical and surgical staff always at her call, and never hospital appliances to her hand. (*d*) *Midwifery* nursing will not be treated of here. It differs from other nursing in this—that the lying-in woman, the patient, is not, or ought not to be, sick, and that the nursing consists in a surgical operation and in hygienic precautions. [Midwifery and general cases should never be attended by the same nurse. No ordinary precautions will secure the lying-in case from danger arising out of this practice.]

(*a*) *Hospital Nursing.*—Nursing proper means, besides giving the medicines, and stimulants prescribed, or applying the surgical dressings and other remedies ordered:—1. The providing, and the proper use of, fresh air, especially at night, that is ventilation, and of warmth or coolness. 2. The securing the health of the sick-room or ward, which includes light, cleanliness of floors and walls, of bed, bedding, and utensils. 3. Personal cleanliness of patient and of nurse, quiet, variety, and cheerfulness. 4. The administering and sometimes preparation of diet (food and drink). 5. The application of remedies. In other words, all that is wanted to enable Nature to set up her restorative processes, to expel the intruder disturbing her rules of health and life. For it is Nature that cures: not the physician or nurse. We shall now discuss these duties in succession.

1. **Ventilation. Warmth and Coolness.**—*a. Ventilation* is the removal of the air poisoned by the breath and other human emanations, and supplying its place with *fresh* air.

The very first canon of nursing is to keep the air inside as fresh as the air outside, by night as well as by day, without chilling the patient. The best rule of ventilation is still: Poke the fire, open the window, but *at the top*, for fresh air coming in at the ceiling permeates the whole room, without causing draught, and foul air escapes. Air coming in at the floor or at the level of the patient remains there and chills him, and foul air does not escape. Always air from the outside air. Windows are made to open; doors are made to shut. If the nurse ventilate the patient's room or ward through the door—that is, making the room draw the foul air from the rest of the house or building—she ventilates him with foul not fresh air. But ventilation is impossible without sufficient floor and cubic space, and unless the windows open near the ceiling. Where other patients want air, fever patients, for example, want wind; where other sick want a well-aired room, without draughts, pyæmic patients, for example, want the freest possible supply of air about their beds.

b. Warmth or coolness.—This the physician has to prescribe the nurse has to see to it. In fever, for instance, the physician will require her to examine the patient's feet and legs, at least every hour, to ascertain whether they are chilled, and to keep the extremities warm, even though his temperature be high, whether in summer or winter.

In bronchitis, in ovariotomy, &c., an even, high, moist temperature may be necessary, and a steaming kettle may be required on the fire night and day.

But ordinarily it is not advisable to keep the sick-room always at the same temperature. A cooler air at night is necessary. But whether cool or warm, the air must be *fresh.* Sick children become fretful in foul air at night. And young as well as old night-nurses require training to see that the physician's orders are obeyed as to keeping the air of the ward fresh by night, and not above or below a certain temperature.

The head of the sick should never be higher than the throat of the chimney, which ensures the best air. And the chimney should never be closed with a chimney-board.

2. Health of Sick-Room, or Ward.—This might be called 'nursing the room.' The placing the sick-bed in the best position to secure air without draught, light without glare, quiet and cleanliness—and this often necessitates re-arrangement of the furniture of the whole room—is one of the essential arts of nursing. In district nursing of the poor, it must be one of the nurse's first duties to put the room in a state so that the patient *can* recover. So, too, must the hospital and the hospital-ward be built so that the patient shall not 'die of hospital.' To get rid of the conditions which have interfered with health is of course the first nursing step in helping Nature to get rid of the effects of those conditions.

a. Light.—Second only to air is light as an essential for growth, health, and recovery from sickness—not only daylight but sunlight—and indeed *fresh* air *must* be sun-warmed, sun-penetrated air. This should be meant to include colour, pleasant and pretty sights for the patient's eyes to rest on—variety of objects, flowers, pictures. People say the effect is on the mind. So it is; but the enlightened physician tells us it is on the body too. The sun is a sculptor as well as a painter. The Greeks were right as to their Apollo.

b. Cleanliness.—Cleanliness and fresh air do not so much give life as they are life itself to the patient. Cleanliness—clean air, clean water, clean surroundings, and a fresh atmosphere everywhere are the true safeguards against 'infection'—not segregation—or rather segregation by ample floor and cubic space, ample ramparts of fresh atmosphere: not segregation by walls and divisions. You cannot lock-in or lock-out the infectious poison; you cannot wall-out infection. You *can* air it out, diffuse it, and clean it away.

'Infectious Hospitals' and 'Wards,' whether necessary or not, are not a part of hygiene; and the doctrine of 'disease germs,' in the sense in which it may lead to considering 'infection' inevitable, must not be taught as a principle of sanitary nursing. That there is no such thing as 'inevitable' infection, is the first axiom of nursing.

Cleanliness of floors, ceilings, walls, bed, bedding, and utensils, and of sinks; also of lockers, if any, but there should be none.

Floors and walls.—Medical men forbid scrubbing in the sick-room. No sick-room floor ought ever to be washed, except by the doctor's orders and at the hour he orders.

The only clean floor is a floor planed, saturated with 'drying' linseed oil, well rubbed-in, stained (for appearance sake), not too dark, so as *not* to hide the dirt, and beeswaxed with turpentine and polished. The floor to be wiped with a damp cloth and dried with a floor-brush, or cleaned by a brush with a cloth tied over it. Anything offensive spilt to be washed off at once with soap and water. Hospital-ward floors should be scraped and polished every fortnight by a *frotteur* and dry-rubbed by a man every day. The patients should be provided with slippers. No carpet, of course, in a sick-room, except a piece of washing drugget by the bedside. A dirty carpet literally infects the room.

The only clean wall is one that is oil-painted. From this you can wash the animal matters. These are what make a room musty. The worst wall is the papered wall. The next worst is the plastered wall. But the plaster can be made safe by frequent lime-washing and occasional scraping. The paper requires frequent renewing. A glazed paper gets rid of a good deal of the danger. But the ordinary bed-room paper is all that it ought not to be.

Furniture—as little as possible in the sick room—should all be of polished wood, metal, or marble, kept clean by being wiped with a cloth wrung out of hot water.

Air can be soiled just like water. Air is always soiled where walls and carpets are saturated with animal exhalations. Dust consists greatly of organic matter. There should be no ledges out of reach capable of holding dust. An Arnott's ventilator in the chimney will keep an ordinary paper longer clean, showing the connection of ventilation and cleanliness. Inattention to these essential matters all but foils the best nurse's best efforts.

How to clean.—Dust is the harbourer and harbinger of disease. Dust in hospitals may contain epithelial scales from the mouth, skin-epiderm, pus-cells. As there appears no limit to the reproduction of epiderm or epithelium, so there is no limit but excessive cleanliness to its deposit in dust in a hospital ward, 'which,' as a great surgeon has said, 'never rests from fouling itself.'

The only way to *remove* dust is to wipe everything with a damp cloth. And all furniture ought to be so made that it may be wiped with a damp cloth without injury to itself, and so polished or glazed that it may be damped without injury to us. Flapping, by way of dusting, is not cleaning. To 'dust,' as now practised, merely means to distribute dust more equally over a room. To 'tidy' a room, or 'put the room to rights,' means to remove a thing from one place which it has kept clean for itself on to another and a dirtier one.

No one atom of dust ever actually leaves the room under the present system of 'dusting.' The greater part of nursing consists in keeping clean. No ventilation can freshen a sick room where the most scrupulous cleanliness is not kept.

Bed and bedding; linen, &c.—Feverishness is generally supposed to be a symptom of fever; in nine cases out of ten it is a symptom of bedding. The patient has had re-introduced into his system the diseased emanations from himself, to eliminate which from his system Nature had appointed the disease. These, day after day and week after week, soak into his unaired bedding from below as well as from within, if the chamber-utensils are left, as is too often the case, unemptied and without a lid under the bed. Erysipelas and pyæmia are produced by an uncleansed state of bed and bedding. Black flock is sometimes used for fracture pillows. This gets full of dust, and may be the cause of erysipelas.

The most dangerous effluvia we know are from the excreta of the sick; these are placed, at least for a time, where they must throw their effluvia into the underside of the bed, and the space under the bed is never aired; it cannot be with our arrangements—a valance or counterpane down to the floor, or perhaps the quilt so carefully pinned over that no air can pass under the mattress.

An adult in health exhales by the lungs and skin in the twenty-four hours three pints at least of moisture, loaded with matter ready to putrefy; in sickness the quantity is often greatly increased, the quality is always more noxious. This goes chiefly into the bedding because it cannot go anywhere else: and it stays there, because, except perhaps by a weekly or bi-weekly change of sheets, scarcely any other airing is attempted. A nurse will be careful to fidgettiness about airing the clean sheets from clean damp, the clean night-gown from clean damp, the new mattress from clean damp; but airing the dirty sheets from dirty damp, the dirty night-gown (which she is going to put on the patient after washing him) from dirty damp, never so much as occurs to her. And a mattress is supposed to be aired by somebody else sleeping on it and saturating it with his own damp before the patient comes to exhale into it the patient's damp.

The bed is *always* saturated with the patient, and the unfortunate patient who lies in it is always being saturated with the bed.

The ordinary sick-bed of a private patient is generally exactly what it ought to be to bring this poisoning process to perfection: a wooden four-poster with curtains, two or even three mattresses, or even a feather-bed, piled up—perhaps to a height above the throat of the chimney or above the lower chink of the sash-window, which is all that is ever opened; the window not opening or opened at the top; a valance fastened to the frame. Nothing ever thoroughly dries or airs such a bed and bedding.

The best bed and bedding are: An iron bedstead with Rheocline springs, or the woven-wire mattress, no valance and no curtains, of course; one thin hair mattress, light Witney blankets, no heavy cotton counterpane, which retains perspiration; no blanket *under* the patient, which acts like a poultice and promotes bed-sores—bed-sores which are, all but always, a symptom not of the disease but of the nursing.

The patient should, if possible, be able to see out of window from the bed.

Two beds, one for the day and one for the night, are necessary for the best nursing of the patient. A true nurse always knows how to make a bed, and always makes it herself. And bed-making has much to do with bed-sores. She hangs up the whole of the bedding to air for a few hours whenever possible. She makes the changes of linen and bed-linen—sheets and draw-sheets—as often as is necessary, which is a great deal oftener than is usually done. In hospitals, she sees to no patient using his neighbour's towel; and to different towels being used for different purposes. She sees to all dirty linen, and especially bandages, being instantly removed, and, after a previous careful disinfection by steeping in boiling-water with a proportion of carbolic acid, 1 to 100, *being washed at a laundry separate from any other building*—if she has such a laundry. No disinfection will enable dirty linen to be kept with safety a single day in the same building with the sick. It is cruel to allow dirty linen from 'infectious' patients to be taken home by the relatives to be washed in the crowded rooms of the poor. Dirty linen should be removed immediately from the sick-room and sent to the laundry, at least every day. If we are careful to take away and empty bed-pans directly, surely this is still more important with soiled sheets. It must not be supposed that even a good sprinkling of carbolic powder (which besides injures the sheets) over the dirty linen lying in a basket, will at all obviate the necessity of instant removal. Foul-linen shoots, with a receptacle at the bottom to receive the linen in preparation for instant removal, are a necessity of every hospital.

Bandages with pus on them are always to be burnt at once—to be carried straight to the ward fire, or to a furnace. The best economy is to burn them; but one must make up the fire so that the burning shall not smell. Bandages used for fractures, &c., are the only bandages that may be washed. Soak these with chlorinated soda, a diluted pint; then boil them all night with soft-soap, soda, and chlorinated soda—a quart bottle for the two. The bandages are then to be rinsed in a tub. The boiler must, of course, only be emptied in a closet-sink. But this washing of bandages ought never to be done inside a dwelling-house or hospital.

All disinfectants are more or less a 'mystic rite,' as a great surgeon said. Absolute cleanliness is the true disinfectant; but chlorinated soda, if disinfectants are to be used, is about the best. Always have chlorinated soda for nurses to wash their hands, especially after dressing or handling a suspicious case. 'It may destroy germs at the expense of the cuticle;' but, 'if it takes off the cuticle, it must be bad for the germs,' said the same surgeon. Fire is the right way, if a thing is so bad that it wants a disinfectant. Hair (and all hospital beds should be of *hair*) should be heated to about 350°, teased, and exposed to air. Boil, wash, scour with much soap and water and, say, chloride of lime; then dry and expose to air all bed-ticks, blankets, coverlids, &c.

Utensils.—All chamber-utensils and bed-pans should be of white glazed earthenware, with well-fitting lids. None should ever be left under the bed, but be brought to the room, and, when used, carried immediately to the closet-sink, emptied, and rinsed there. No zinc pail, or pail without a lid, should be carried through a ward or sick-room. The pail should be of glazed earthenware with a lid. But better no pail at all in a sick-room. Without care for these things, the doctor will tell us, 'it is impossible to nurse.' Excreta have often to be put by for medical inspection; the nurse must see to this being done properly and inoffensively, in a closed vessel—never in the patient's room or ward. As for urine, if it has to be measured and tested, there are glass-measures, with covers, fit for the purpose. Bed-pans should have carbolic-powder in them lavishly. All bed-pans should have lids. Glass urinals, with wide necks, washed with warm water and soda, are the only really clean ones; zinc and white earthenware, with long necks, are never clean. After being used, they should be put by the bedside, not under, and taken away and emptied at once. Small white chamber-utensils are useful, and district nurses may find old jam-pots the cleanest thing for urinals. Chamber-utensils in a hospital should be ranged on their sides in a sort of hutch open to the outward air through perforated zinc, in the lavatory or other compartment. If in a large hospital-ward chamber-utensils *must* unhappily be allowed under the beds at night, they should all, of course, have lids. Two glazed earthenware (not zinc) pails, with lids, may then be carried round the last thing at night and the first thing in the morning: one pail to empty into, with some carbolic-powder in it; one pail to rinse with, with soda or chlorinated soda in it. The chamber-utensils should be then carried off to the hutch in the lavatory. But this is only a *pis aller*; a slop-pail should really never be brought into a sick-room or ward at all. It should be a rule, invariable—rather more important in the private house than elsewhere—that the utensil should be carried directly to the water-closet, emptied there, rinsed there, and not brought back till it is wanted.

There should always be water and a tap in every water-closet for rinsing.

Towels in a hospital should be kept separate for three separate uses, changed for clean ones as often as possible, and marked 'Hands,' 'Bed-pans,' and 'Basins.'

A bottle of chlorinated soda and a bottle of glycerine should always be by, to wash the hands.

A young nurse, dressing an ulcerated leg, has been known to wipe it with the sheet, and alleged that she had seen it done elsewhere! There should always be a special towel for such cases. *Charcoal* may be employed in offensive cases; it may be placed under the bed in pans, or under the limb (if slung) in the bed. Carbolic powder may be placed in the chamber-utensil (clean), if under the bed, or little bags of carbolic powder in the bed. Condy's fluid is sometimes placed in saucers, but this is not of much use. Carbolized tow may be used for cancer cases to lie upon, and changed frequently. Wool, with salicylic acid, is sometimes used to cover the dressing of an offensive wound, or salicylic lotion for a warm water dressing. Slop sinks may be sluiced down with carbolic acid. *Water-closet pans* should be scrubbed with strong nitric acid, if they have been allowed to get at all offensive. Urinals, if allowed to become furred, must be sluiced out with boiling water, and then, if necessary, scraped with a knife all round and inside the grating. Also water-closet slop sinks. These all should be scrubbed with sand and chlorinated soda at least twice a week. In hospitals the head-nurse ought to mop out and rinse-down the urinals every morning herself with a little bed-pan mop, and let boiling water run through; the same with the water-closet pans. The lavatory basins, when used, should be mopped-out every morning, and scrubbed at least twice a week with sand. There should be two mops—one new one for lavatory basins, appropriated when a little old to the bed-pans, and the old one replaced with new; the new small mop to hang over the lavatory basins, the old one to hang over the slop-sink for bed-pans; an old bottle-brush for the handles of bed-pans, a new bottle-brush, kept in the ward-kitchen, for bottles. Ordinary basins should be washed with tow.

3. Precautions against finger-poisoning, &c.—One of the most important points nurses have to be taught on beginning surgical ward-work (and, indeed, surgeons also,) is how not to poison their fingers. No good nurse will poison her own fingers any more than her patient's.

The following rules should be strictly observed:—

Pare the finger-nails close; keep them, as well as fingers and hands, scrupulously cleaned; anything which has soiled the fingers is a possible source of contagion to others and to yourself: an agnail, or crack, or scratch, or pin-puncture, is as likely to produce a poison-nest to others or to yourself, even more than an open wound or sore. Such poison-nests must be made harmless by first washing with pure water, next by applying styptic colloid, thirdly by putting on an india-rubber finger-stall. Immediately *before* beginning any dressing, and in every case *after* touching the patient, whether in dressing wounds, rubbing in applications, administering enemata, internal syringing, washing out eyes, ears, nose, mouth—dip the hands into watery solution of carbolic acid, 1 to 80, and then wash hands and nails carefully with carbolic soap. 'Dressing forceps,' or syringe, or whatever is used, to be dipped in solution of carbolic (1 to 80) *before* use as well as *after*. The teeth and joints of the 'dressing forceps' to be brushed clean. Remove soiled dressings with 'dressing forceps,' and not with the fingers; on no account scratch up adhesive plaster or other adhering dressing with the nails. Nurses of the old school will boast that they are not afraid. The fear of dirt is the beginning of good nursing. With all internal cases, keep the nails short, fill the same with carbolic soap, and carefully anoint the fingers you are about to use, especially the first and second fingers in attending on vaginal cases, with carbolic oil (1 in 20). Oil the tube or nozzle, &c., to be used for any internal application, with carbolic oil (1 in 20). Otherwise the appliance used might convey contagious matter from one patient to another. Always use two basins in washing wounds, so as not to dip the fingers in dirty water. Catheters must be cleansed and disinfected, first with a stream of warm water, and then with a stream of watery solution of carbolic acid (1 to 40). Catheters of other material than silver should *not* be *soaked* in carbolic acid solutions, as the acid injures varnish and gum. Never 'blow down' towards the eye *first* instead of last, for so some lodgment will always be effected at the bottom. Never fail to take your own carbolic soap, with which you will be provided, in your own soap-tin, into the ward each morning and evening in your pocket. But take it out before beginning 'dressings,' as otherwise you put a dirty hand into your pocket. Always dry your cleaned fingers and hands on towels *not* used for any other purpose. After offensive cases, blow the nose and expectorate, and rinse mouth and throat with Condy and water, or with permanganate of potash, a few grains in water. Cuffs and sleeves and stuff dresses are possible carriers of contagious matter. Always change the apron and over-sleeves which you have worn about the sick before eating or drinking. Report immediately any scratch or agnail or sore you may have to the ward-sister; ask immediate advice after breathing in offensive air. Never go on duty in the morning without having taken a meal.

The nurse must be taught the nature of contagion and infection, and the distinctions between deodorants, disinfectants, and antiseptics.

Mischief done by students and dressers might have been saved, and valuable lives spared, even among surgeons, if such precautions had been always scrupulously observed by them.

4. **Food and Drink (Diet).**—The physician will tell us that, to give food and stimulants in the way, at the time, of the kind, with the cooking and preparing, that will best enable the poor enfeebled digestion to assimilate it, is one of the great nursing arts. No chemical rules can be given for this as absolute. The patient's stomach is the laboratory, and also the chemist. It is the sole judge of whether the physician's orders are right; and the nurse has to watch and tell him what the patient's stomach says. She must be of course trained and cultivated to understand what it says.

The patient's stomach sometimes craves, and assimilates too, what no rules would have prescribed for it. The nurse must ask the physician whether she may gratify these cravings. Sick-cookery should do half the digestion's work; and proper variety is essential. If a patient is sick after taking food or drink, or feverish, or faint, or torpid, it is often a symptom not of the disease but of the nursing. Indeed, how much of the suffering of illness, as well as of its danger, is the fault not of the illness but of the nursing, is well known to the skilful physician and surgeon.

The nurse, of course, has nothing to do with the prescribing of stimulants any more than of medicines. But life often depends—especially in fevers and severe surgical injuries—upon the nurse knowing how to follow the indications of the changes to be looked for in the patient's state given her by the physician, and to change the times of giving the stimulants accordingly.

The nurse must know how to make gruel, arrowroot puddings, egg-flip, drinks, good beef-tea, and other kinds of sick cookery, so as to please the patients' taste and vary their diet. People say 'fanciful patients' must be 'humoured.' So they must; but it is in order to excite the proper secretions of saliva and gastric juice necessary for digestion. Nothing should ever be cooked in the ward or in the patient's room.

But though 'sweet Jack Falstaff' says, 'A nurse is a cook,' the whole of the cooking must not be thrown on the nurse, if she is to nurse; and above all, if she is to eat, she must not be expected to cook for herself. But she will always be required not only to see that the patient's food and drink be as prescribed, but that it be well cooked, and punctually and well served. The physician considers that upon the nurse's power to give weak patients food in the way they like often depends their taking, or at least assimilating, any food at all.

She has also to feed, for example, fever-cases so that they can eat. The mere lifting-up of a patient in bed to give him food may terminate fatally a fever-case. The nourishment or stimulant ordered may have to be put into his mouth perhaps every half-hour—perhaps every five minutes—even during sleep, without rousing the patient—the test of a good nurse. The physician expects the nurse to be able intelligently to make the variations he prescribes in giving these things, especially during the night, according to the state of pulse and other symptoms, which she must know how to observe, in order to follow his conditional directions, upon which hangs the patient's life from hour to hour, often from minute to minute. In convalescence from typhoid fever, one single false indulgence has often induced a relapse and terminated a case fatally.

5. **Application of Remedies.**—The physician or surgeon requires the nurse—

To be able to apply leeches, externally and internally, in the best way; to dress blisters, burns, sores.

To administer stimulants and medicines as ordered, enemas and injections to men and women, and suppositories.

To manage trusses, appliances in uterine complaints; to pass the catheter—at least for women. The district nurse is often now required to pass the speculum, also the catheter for men, because there is no one else to to do it.

To use the best methods of friction to the body and extremities; to make and apply fomentations, poultices, and minor dressings, wet and dry and greasy; to syringe wounds; to syringe the vagina.

To manage helpless patients—fever, operation, and surgical cases—that is to move, to change them, to keep them personally clean, warm or cool.

The medical attendant will expect the nurse to maintain an exquisite cleanliness of the patient's whole person and skin, and, as in fever—the daughter of dirt—to clean herself the patient's teeth, gums, and tongue, with lemon-juice or white-of-egg beat to a froth. A nurse is no nurse who cannot wash or sponge a patient's whole body without exposure or chill to any part. In typhoid and other fevers, this is now an essential part of the treatment.

To give food and stimulants to helpless patients—fever, operation, and surgical cases; to manage the position of such cases; to prevent or to dress bed-sores.

To make the sick-bed, and especially to make the bed with the patient in it; to change the under-sheet without moving the patient, as in fever and operation cases. The 'best way' includes, in this as in all other things, the doing them at the least expense to the patient's vital powers.

To prepare the bed for fever, for accidents, for ovariotomy, and various kinds of operations; to undress, handle, and put to bed accident cases.

To attend at and prepare for operations—including ovariotomy, lithotomy, hernia; to prepare patients for and manage them after operations and anæsthetics—and all this with the least call upon their small strength.

To be able to do the first thing in case of hæmorrhage, namely, compression by hand, by extemporary tourniquet and plugging.

To bandage all the various parts of the body, arm, leg, and chest (in Paris the *infirmiers* of military hospitals are made to practise all this, till not only it is done perfectly, but in a given number of minutes).

To make bandages of the various kinds used: T-bandages, double-headed, compound, 4- and 6-tailed, many-tailed, finger, ovariotomy, triangular, perineal, starched, and plaster-of-Paris, and other stiff bandages.

To make rollers, to line and pad splints, to make gutta-percha splints, fracture and chaff pillows (black flock fracture-pillows harbour dust), and sand-bags.

The nurse is sometimes now required to give subcutaneous injections, to use the galvanic battery, and to dry- and wet-cup.

She is required to be able to apply dry and moist heat, to give inhalations and use the spray-disperser; to apply cold, with the use of siphons and with ice; and antiseptic treatment.

Observation of Patients.—The physician and surgeon require every nurse to be able to observe correctly, and to report correctly, on the state or character of secretions, expectoration, pulse, skin, appetite; effect of diet, of stimulants, and of medicines; eruptions; the formation of matter; as to intelligence, with regard to delirium, stupor, &c.; as to breathing, whether quick or slow, regular or irregular, difficult, &c.; as to sleep, whether sound, starting, heavy, &c.; and as to the state of wounds. The physician also requires the nurse to be able to 'take' and to record the temperature, sometimes every quarter of an hour in critical cases—the pulse, the respiration; to measure and sometimes to test the urine for him. She will be required to make these observations—if possible still more accurately—for child-patients, who cannot tell what is the matter with them; to understand the management of sick children and children's wards, which need a yet more exquisite cleanliness. And children show a much more rapid change of symptoms for life or for death generally than adults. Children are the best air-test, the best test of sanitary conditions.

VI. Other Duties.—She must understand the management of convalescents—a whole department of nursing in itself—and the sooner a convalescent, especially a convalescent child, is removed from hospital to a country 'home' the better.

She must be competent for the charge of linen—a most important item of nursing, when we consider that on extreme cleanliness of bed and patient's linen—in other words, on linen and nurse, depends the not re-introducing disease into disease.

The physician considers that fever, above all other diseases, tests nursing power, and depends upon this for life or death. 'Dr. ——' (of St. Thomas's Hospital) 'doesn't think much of the nurse who loses a fever patient,' was said of that wise man.

Night-nursing.—The physician or surgeon requires the night-nurse to be as good as the day-nurse, or even better—for the most critical times of fever and severe surgical injury often occur at night, or in the very early morning. But quite the same kind of business capacity is not required in the night-nurse as in the nurse in day charge of wards. Night-nurses, to do their work well, must have at least seven or eight hours in bed where they can sleep undisturbed by day; (even horses in the New York 'Horse Hotel,' which work by night, have a separate dormitory to sleep undisturbed by day). They must have hot meals prepared for them when they come off duty in the morning, and before they go on duty at night; besides breakfast at 1 or 2 a.m. They must have one and a half or two hours' exercise. In a hospital they should be obliged to show their pass. It is rather more necessary for a night-nurse to be regular in her habits, if she is to be well and efficient, than for a day-nurse. And there appears no reason why nursing by night, if properly managed, should be more trying than by day. But regularity of habits, of meals, of sleep, of exercise, of personal cleanliness, is the *sine quâ non.* Occasional breaks or transfers to day duty may be necessary; or a night or two in bed every month for a night superintendent.

Holidays. — All nurses, especially night-nurses, must have holidays. A month in the year is not too much. Yet more do matrons and superintendents and all women filling nursing offices of great responsibility require an annual holiday if they are to maintain vigour of body and mind, and not to wear out prematurely. An occasional three months' holiday besides might be great economy.

What a Nurse is to be.—A really good nurse must needs be of the highest class of character. It need hardly be said that she must be (1) Chaste, in the sense of the Sermon on the Mount; a good nurse should be the 'Sermon on the Mount' in herself. It should naturally seem impossible to the most unchaste to utter even an immodest jest in her presence. Remember this great and dangerous peculiarity of nursing, and especially of hospital-nursing, namely, that it is the only case, queens not excepted, where a woman is really in charge of men. (2) Sober, in spirit as well as in drink, and temperate in all things. (3) Honest, not accepting the most trifling fee or bribe from patients or friends. (4) Truthful—and to be able to tell the truth includes attention and observation, to observe truly—memory, to remember truly—power of expression, to tell truly what one has observed truly—as well as intention to speak the truth, the whole truth, and nothing but the truth. (5) Trustworthy, to carry out directions intelligently and perfectly, unseen as well as seen, 'to the Lord' *as well as* unto men,—no mere eye-service. (6) Punctual to a second, and orderly to a hair—having everything ready and in order before she begins her dressings or her work about the patient; nothing forgotten. (7) Quiet, yet quick; quick without hurry; gentle without slowness; discreet without self-importance, no gossip. (8) Cheerful, hopeful; not allowing herself to be discouraged by unfavourable symptoms; not given to depress the patient by anticipations of an unfavourable result. (9) Cleanly to the point of exquisiteness, both for the patient's sake and her own; neat and ready. (10) Thinking of her patient and not of herself; 'tender over his occasions' or wants, cheerful and kindly, patient, ingenious and *feat*. The best definition can be found, as always, in Shakespeare, where he says that to be 'nurse-like' is to be

> 'So kind, so duteous, diligent,
> So tender over his occasions, true,
> So feat.'

A patient wants according to his wants, and not according to any nurse's theory of his wants or 'occasions.' 'Tender over his occasions' she must be; but she must have a rule of thought; and this the physician or surgeon has to give her in his directions; which her training must have fitted her to obey intelligently, using discretion. The nurse must have simplicity and a single eye to the patient's good. She must make no demand upon the patient for reciprocation, for acknowledgment or even perception of her services; since the best service a nurse can give *is* that the patient shall scarcely be aware of any—shall perceive her presence only by perceiving that he has *no* wants. The nurse must always be kind, but never emotional. The patient must find a real, not forced or 'put on,' centre of calmness in his nurse. To call upon a patient by emotion for emotion is the most cruel, because useless, demand upon his strength. It is asking him to bear your troubles and your anxiety as well as his own. Suppressed emotion is as bad—it makes the nurse constrained. It is exposing the patient to both frost and fire. Half the battle of nursing is *to relieve your sick from having to think for themselves at all*—least of all for their own nursing.

FLORENCE NIGHTINGALE.

NUTMEG-LIVER.—A form of disease of the liver, the appearance of which on section somewhat resembles that of the cut surface of a nutmeg. *See* LIVER, NUTMEG.

NUTRITION, Disorders of.—The nutrition of the body, by which we understand the maintenance of its parts in a fit state to perform their functions, depends on three main factors—the supply of suitable food; the assimilation of food; and the prevention or control of waste. When any of these factors are disturbed disorders of nutrition result. If food be inadequate or unsuitable, other things being normal, general atrophy will be the consequence (*see* ATROPHY, GENERAL); and the same result will evidently follow if the organs of assimilation are at fault, or if waste be excessive, even though food be abundant. Hence cancer of the stomach on the one hand, and diabetes on the other, may be taken as the types of 'wasting diseases.' Increased supply of food, on the other hand, does not improve the nutrition or cause hypertrophy with the same certainty as want causes atrophy, causing increase chiefly of a single tissue, as shown in the articles on HYPERTROPHY and OBESITY.

Similar principles apply, *mutatis mutandis*, to local nutrition or the nutrition of parts of the body; in which the three factors are—the supply of nutritive material by the blood; the power of assimilation possessed by the tissues, depending on the condition of their minute elements; and the amount or rapidity of waste. Hence, as shown elsewhere, local atrophy results from obstruction in the blood-supply to a part; or from the inability of the part to appropriate nourishment, either through faulty innervation or the condition of the tissue-elements. In some cases excessive use, leading to waste, is also a cause of local atrophy. Increased blood-supply alone does not, on the other hand, by itself lead to hypertrophy. *See* ATROPHY, LOCAL.

When the disturbance of nutrition, however produced, causes a qualitative rather than a quantitative change in the tissue or organ, this change receives the name of DEGENERATION, of which there are several kinds (*see* DEGENERATION). Besides special kinds of degeneration, there is one general change which often results from impaired nutrition, namely, *softening*, but this is no longer regarded as a distinct process, since it differs, in its minute characters, according to the tissue which is affected. Induration, also, once regarded as among the general consequences of impaired nutrition, can hardly now be regarded as a distinct and substantive process; but may be understood in the sense of *fibroid degeneration*. In this place we can only refer to some instances of disordered nutrition, which are not precisely cases of atrophy or hypertrophy, but are yet dependent on disturbances of some of the factors of nutrition spoken of above. In these cases, where the blood-supply is not interfered with, the assimilative power of the tissues must be in fault, and this will depend upon either innervation or the condition of the tissue-elements. In some of these the nutritive disturbance leads to inflammation.

There are many curious instances of local changes of nutrition in which the blood-supply is quite unimpaired, and the cause has to be sought in some other disturbance, more especially one of the nervous system. Reasoning from certain well-marked cases of disorders of nutrition originating in the nerves, it may be plausibly conjectured that many other changes, and particularly many ordinary diseases, which we usually regard as idiopathic, may be similarly due to disturbance of nervous influence.

Again, the nutrition of a part may be affected, not by direct nervous influence, but by reflex innervation, and thus depend upon the condition of some other organ. A very clear instance of a lesion of nutrition depending on the nerves is seen in the disease herpes zoster, and in some other skin-diseases, the distribution of which is obviously regulated by the distribution of certain nerves. The dependence of nutrition upon the nervous system is also seen in some instances of healing, as in the case of ulcers of the leg, pointed out by Mr. Hilton, where rapid healing follows the section of a nerve-branch leading to the ulcerated patch. On the other hand, the loss of vitality dependent on nervous disturbance is seen in the rapid formation of bed-sores on the sacrum in cases of paraplegia. The same conclusion must be drawn from the nutritive disturbances, beside the ordinary disturbance of the sensory or motor function of the nerves, which sometimes follow injuries to nerves. Thus injuries of the brachial plexus, not severe enough to cause actual paralysis of motion, may produce a state of swelling and hyperæmia in the fingers —the condition called 'glossy fingers' by Paget. Similar and more complicated changes have been observed as the consequence of gunshot wounds affecting the nerves. These cases, and such as these, have raised the question whether there are 'trophic nerves,' that is, whether, in addition to the fibres passing to the muscles and to the periphery, which are concerned in motion and sensation respectively, there are others distributed to the tissue-elements themselves, whose function it is to keep these elements in a proper state of nutrition. It is impossible to discuss this theory here; but we can only say that some of the phenomena which are thought to make necessary the theory of trophic nerves appear to be explicable by assuming the presence in the mixed nerve-trunks of some fibres derived from the sympathetic system. The connection of the sympathetic nerve-fibres with nutrition, though chiefly displayed through variations in the circulation, is undoubted. In the rare cases which have been observed in the human subject of lesion of the sympathetic nerve in the neck, a permanent change in the nutrition of the affected part is observed when the well-known vascular changes have passed away or become greatly modified. Lastly, it should be pointed out that in certain diseases of the spinal cord, for example, locomotor ataxia, affections of the joints, resembling chronic rheumatism, have been observed, which may be very plausibly, though not yet with certainty, ascribed to nervous derangements. On the strength of these cases it has been supposed that in other forms of rheumatic and rheumatoid disease, the distribution of the morbid changes depends upon the nervous system; but this must be regarded as quite theoretical. Still more uncertain are the theories which have been framed to explain the occurrence of internal diseases, such as inflammation of the lungs, &c., as a consequence of nerve-lesions.

When we find disorders of nutrition neither caused by changes in the distribution of the blood, nor connected with any nervous derangements, the fundamental change must be referred to the tissue-elements themselves; and it is probable that the number of disorders depending upon such changes in the minute tissue-elements is very large; and the field of 'elemental pathology' may be larger even than that of nerve-pathology or blood-pathology. Such an explanation is particularly reasonable when the changes are symmetrical on the two sides of the body, and when they are connected with advancing age; as, for instance, fatty degeneration of the cornea, turning grey of the hair, and primary degeneration of the walls of arteries. In these cases it seems unnecessary to suppose any implication of the nervous system, and disturbances of the circulation plainly do not account for the facts. It can only be supposed that the tissue-elements, like the organism itself, have their natural term of life, and that this term varies in different individuals, in whom, therefore, these failures of nutrition are merely the expression of the, more or less, premature old age of certain elements. These changes may be, and often are, the expression of the general condition of the whole body, which is more obvious in some parts than others, simply because the tissue-elements in these parts are older or less vigorous.

Treatment.—Having spoken of the chief causes of disorders of nutrition, it remains to consider whether there is any general treatment applicable to such disorders, independent of the special treatment proper to many of them as special diseases.

With regard to the general nutrition of the body, we can only refer to what has been said under the head of Atrophy, General, since hypertrophy is not a condition which practically requires treatment, unless exceptionally, as hypertrophy of a special tissue. With regard to local disorders of nutrition, the first and only generally applicable rule must be to remove, if possible, the local cause. If the cause is obscure, or, when discovered, cannot be obviated, the treatment must be guided by circumstances, but will usually be more of a *general* character. As an example of the removal of the cause of disordered nutrition, we have instances in which the phenomena of nerve-lesion above referred to have disappeared entirely on removing a fragment of lead or other irritating substance from the nerve-trunk. A more familiar instance is where the lower part of the leg is in a permanent state of malnutrition from stagnation of blood in varicose veins; œdema, eczema, subcutaneous induration, and ulcers may result. If, by suitable pressure or surgical treatment of the diseased veins, the circulation is rendered normal, all these morbid conditions will be healed. On the other hand, certain local disorders of nutrition can only be treated by improving the nutrition of the whole body. Cachectic children, for instance, may exhibit chronic conjunctivitis, bronchial catarrh, eczema of the flexures, and the peculiar sloughing sores of the fingers which have no distinct name, but are well-known indications of malnutrition. If, in place of, or in addition to, local treatment, we use general treatment, directed to improve the nutrition of the body, all these local disorders may entirely and perhaps simultaneously get well, as they depend only upon the deficient power of resistance possessed by the tissues in general. J. F. Payne.

NYCTALOPIA.—Like hemeralopia this word has been used in two opposite and contradictory senses; one signifying *night-sight* or *day-blindness*; the other *night-blindness* or *day-sight*. According to the former, the etymology of the word is *νύξ*, night, and *ὤψ*, the eye; but according to the latter, it is *νύξ*, night, and *ἀλαώψ*, blind-eyed, which in its turn is derived from *ἀλαός*, blind, and *ὤψ*. The testimony of Hippocrates is cited in favour of the former meaning; but it should be remembered that the work in which the term occurs is not genuine, and there is, moreover, some warrant for the assumption that the text may not have been correctly copied. Galen, Aëtius, Paulus Ægineta, Pliny, and most of the best ancient authors, employ the word as meaning *night-blindness*, and we shall use it in this sense here. Nyctalopia may, therefore, be defined as disorder of vision in which objects are seen well, and without pain or discomfort, during the day, or by strong artificial light, but become more or less invisible in a deep shade, or by twilight. It is the opposite of hemeralopia. *See* Hemeralopia; and Vision, Disorders of.

NYMPHOMANIA (*νύμφη*, a woman, and *μανία*, madness).—A form of mental derangement in women, characterised by an insatiable desire for sexual intercourse. *See* Sexual Functions in the Female, Disorders of.

NYSTAGMUS (*νυσταγμός*, from *νυστάζω*, I nod).—An involuntary movement of the eyeball, due to clonic spasm of the muscles of the globe. It usually affects both eyes. The movement is generally horizontal, that is from side to side, and is then called *oscillatory*; but it may be *rotatory*, that is, round the optic axis, or *oblique*, when it is said to be mixed. It may be (*a*) congenital or infantile; (*b*) acquired; or (*c*) symptomatic of cerebral or spinal disease.

O

OBERLAND, the Bernese.—Grindelwald, Gurnigel, Interlaken, Mürren, &c. Cool, bracing, mountain summer climate. *See* Climate, Treatment of Disease by.

OBESITY (*obesus*, corpulent; from *ob*, by reason of, and *edo*, I eat).—Synon.: Corpulence; *Polysarcia*; Fr. *Obésité*; Ger. *Fettsucht*, *Fettleibigkeit*.

Definition.—This term is applied to a general state of disordered nutrition of the body, characterised by an excessive development of the adipose tissue, more especially in those situations where it is normally most abundant, namely, the subcutaneous, subserous, and intermuscular connective tissue.

Ætiology.—*a.* **Predisposing causes.**—The influence of *heredity* in transmitting the liability to obesity is undoubted, and is a matter of common knowledge. *Sex* and *Age.*—That excessive corpulence is more common among women than among men is also well known. Several circumstances have been suggested to account for this, such as the menstrual functions of women, their less muscular activity as compared with men, and their frequently diminished oxidative power, due to poverty of red blood-corpuscles. Age appears to have considerable influence in determining this condition. Under a healthy regimen children get fat from birth, notwithstanding that at the same time the albuminoid ingesta must be largely employed in the construction of the rapidly growing tissues; and hence, at this period of life, the fat and amyloid food-stuffs are the chief source of the adipose deposit. How frequently are seen children improperly fed on excess of starchy matter, very fat, whilst their general nutrition is much impaired. A fat child is far from necessarily being a healthy one. At puberty there is frequently a diminution in weight, both relatively to the height and absolutely; but the contrary to this sometimes accompanies the establishment of menstruation, especially if the subject be very chlorotic—that is, with an enfeebled oxygen-carrying blood-power. After the age of forty, particularly in women at the climacteric, the influence of age markedly asserts itself. Even the manifestation of the hereditary tendency may be postponed until that period, and for women to become fat at that time is almost the rule. The perversion of nutrition now under consideration is, in some unknown way, curiously but distinctly associated with the degree of development of the sexual functions, and in an inverse direction. This is very noticeable in eunuchs and animals whose generative organs have been removed, and the part played by the cessation of ovulation has been already mentioned. Even during pregnancy, when ovulation is suspended, it is no uncommon occurrence for the subcutaneous fat to be increased in amount. *Race.*—Among certain races obesity appears to prevail, as for instance the Hottentots; and whilst amongst some, such as certain castes of Hindoos, the condition has been highly estimated, amongst others, as the Greeks and Romans, it was regarded as disgraceful. *Climate.*—Although very fat people are met with in all climates, there appears to be a special tendency to their predominance in low-lying, damp countries, whilst, with certain exceptions, they are less often seen in very hot and in mountainous districts.

Nervous Influence.—Since the nervous system so directly influences tissue-changes, it is not to be wondered at that certain nervous states favour obesity; it is common in idiots.

Trinity Medical College.

b. **Determining causes.**—Excess of *food* is the first of these to be mentioned. Whilst no doubt a large excess of food may lead to corpulency, it must be confessed that it very often does not do so, and extremely thin men are often large eaters. And, on the contrary, many women who become excessively obese have poor appetites. Nor does it seem in these different classes of cases, that the kind of food makes much difference. Some get fat, eat what they will; others do not, whatever the diet. *Drink.*—It is, however, usually the case that very fat people take a large amount of fluid food. How alcohol acts in the production of fat is not very clear. It is asserted that it does so by diminishing oxidation; but this is not the entire explanation, for the extent of obesity is far from being proportionate to the amount taken, and not unfrequently an excessive ingestion is not associated with corpulency. There would seem also to be something due to the form in which the alcohol is taken. *Exercise.*—Deficient muscular activity, by diminishing the amount of oxidation of tissue, favours obesity; and since, as a rule, the stouter the person the less capable is he of exercise, these two conditions react one upon the other, to the advantage of fat-production. *Disease.*—Exceptional cases of corpulence have followed recovery from fever, and extensive bleedings, even when there had been no predisposition; and a similar result has been met with after prolonged administration of mercurials and arsenic, which is perhaps to be explained by the deteriorating influence that these drugs are said to possess on the red-blood corpuscles.

PATHOLOGY.—Assuming that the current views on lipogenesis or fat-formation are known to the reader, it is sufficient here to state that from whatever source the fat of the body be derived, whether from the fatty, the amyloid, or albuminoid elements of the food, or from all, as is most probable, the fact of its being stored up as adipose tissue must be regarded chemically as an expression of deficient oxidation; a process which, if it had been more complete, would have resulted in the conversion of these elements into carbonic acid and water, to which the fat itself is reduced when it is subsequently used up in the economy. It is thus that the corpulence that frequently attends such morbid states as anæmia, chlorosis, hæmorrhage, some pulmonary and cardiac diseases, and alcoholism, is to be explained; since in all these diseases the oxygenising power of the blood is deficient.

The fat of the body in an average male adult constitutes about one-twentieth, and in the female rather more, of the total weight. It is not for 3½ months after the commencement of development, that the adipose tissue is sufficiently differentiated to be distinguishable; it gradually increases in amount, being considerable at birth and up to puberty, when it often diminishes slightly; during maturity it increases, or the reverse, being very variable in amount; and during old age it decreases. During childhood the adipose tissue is more evenly distributed in the subcutaneous tissue than in later life, when fat tends to diminish on the surface in proportion as it becomes deeper-seated.

In the three situations in which the fat is chiefly deposited—namely, the subcutaneous, subserous, and inter-muscular connective tissue—there are certain areas which are preferred by it, as there are others which escape. Whilst the abdomen, buttocks, and back of the neck are especially prominent, the wrists, ankles, eyelids, scrotum and penis are free from fat. Beneath mucous membranes it is very unequally distributed. Fat is never seen beneath the peritoneal coat of the stomach or intestines, the parietal pericardium, or the visceral pleura; whilst the great omentum, which usually weighs about ½-lb., may reach to 7 lbs. or 8 lbs., or, it is said, even 30 lbs.; and under the synovial membranes fat may be deposited to such an extent as to interfere with the movement of the joints.

The ordinary state of the organs found in very corpulent people is, that the lungs are small; the heart and the liver large, and infiltrated with fat; the gall-bladder containing only a little pale bile or mucus; the stomach large and muscular, but well-developed; the kidneys small; as also the spleen and lymphatic glands; and the pancreas largely developed.

Like many other conditions of disease, it is impossible to define the exact line at which a morbid obesity may be said to commence. All degrees of corpulence, indicated by such terms as 'stout,' 'embonpoint,' &c., occur, to which the notion of disease is wholly inapplicable. Nor, as will be seen, can the disturbance of function be taken in all cases as the measure of a morbid state, since the impairment of function is not always proportionate to the amount of fat.

As instances of extreme corpulency the following may be quoted:—

Daniel Lambert, who at twenty-three years old weighed 32 stone, but could walk from Woolwich to London. His subsequent maximum weight reached to 52 st. 11 lbs.

Edward Wright, 44 st.

Dr. Wardell records the case of a young married woman, who, at eighteen was thin and delicate, had no children, and lived well; she died at the age of forty-one; the thickness of the subcutaneous fat on the sternum was 4 inches, and midway between pelvis and umbilicus 8 inches. The heart weighed 36 oz., the liver 118 oz., and there were prolongations of fat from the omentum 1 to 4 inches long, as thick as a candle.

As illustrations of precocious obesity, cases are on record of a girl weighing 13 st. at the age of twelve years; and a boy weighing 8 st. 12 lbs. at three years. This boy had three teeth at birth, and twenty-six at thirteen months old.

Thus, in extreme cases, one-half, or four-fifths even, of the body-weight may be fat.

SYMPTOMS.—The general appearance of a corpulent person scarcely needs description. The condition may be associated either with a hyperæmic or full-blooded, or with an anæmic state of body, and it is desirable to recognise this in view of treatment. Owing to the fatty infiltration of the muscular tissues, and the degeneration of the fibres, the muscular energy is diminished, this being especially noticeable in regard to the heart, the action of which is easily disturbed, and palpitation is a frequent symptom, accompanied by dyspnœa, induced by slight exertion. The affection of the voluntary muscles manifests itself in an indisposition to active exercise. The digestive power is often very well maintained, and this notwithstanding the frequent excess both in the quantity and in the quality of food indulged in. Periodical impairments are, however, frequent, and flatulence and constipation are often troublesome. The cardiac sounds are usually feeble and distant, though the reverse obtains when there is a hypertrophied ventricle. The pulse is full, or small and weak, according to the plethoric or feeble state of the individual. The mental activity is variable, and many external causes tend to modify it; but the temperament is proverbially 'easy-going,' indolent, and lethargic, especially after meals, although very frequently interrupted by attacks of peevishness and irritability, or by unusual somnolence and quiet. Examples, however, of considerable intellectual attainments are not unknown among the corpulent. The excretions are usually copious. Profuse sweating is induced by slight exertion, and the secretion of the sebaceous glands is abundant. The urine generally is acid, and contains an excess of uric acid. Partly from chafing, and partly from the excessive cutaneous secretions, intertrigo and other eruptions are apt to occur in the folds of the groin, below the mammæ, and in similar parts. The vessels share in the general malnutrition of the tissues, and atheroma of the arteries is often found, whilst the veins become distended and varicose, forming hæmorrhoids and varicocele. Depending upon these vascular changes are the congested and bloated appearance of the face, and the liability to headaches, vertigo, and giddiness. The sexual appetite is frequently deficient in both sexes, and sterility is common in women. Disturbances of sight and hearing are frequently noticed in fat people.

The condition of obesity, like other general perversions of nutrition, such as tuberculosis and rickets, most distinctly presents other characteristics than the mere signs and symptoms above enumerated. There are certain tendencies and liabilities which the state engenders; and intercurrent maladies come to possess special features. Periodically, the fat man ails without perhaps any obvious cause, and such ailments must be regarded as the expression of malnutrition of the tissues produced by the excess of fat. Among the more prominent of these affections is a proneness to catarrh of the respiratory and alimentary mucous membranes, and periodical 'colds' and diarrhœas are frequent. This is in great part due to the fact that the power of self-regulation of temperature, which the body possesses, is diminished by the thick layer of subcutaneous fat, which is a bad conductor of heat, and interferes with compensatory radiation. At the same time the plethoric condition, the hyperæmia, and the enfeebled circulation due to the weak heart, all tend to the same end, namely, a liability to congestion of the ill-supported tissues, such as the mucous membranes, with the results of such congestion in excessive secretion and other derangements of function.

The obese subject is quite as liable to the acute diseases as is the thin man; and these maladies run in him a singularly unfavourable course. The diminished power of heat-radiation increases the pyrexia; and the weak heart favours the establishment of the adynamic state. Such means for lowering the temperature as cold applications have but little effect through the thick fat; and aconite is contra-indicated by the pulse. But since the oxidising process in the corpulent is diminished, the temperature in the febrile state is rarely very high, and at the same time is but ill resisted.

The effective agent in lipogenesis, namely, deficient oxidation of the ingesta, especially the albuminoids, also favours the formation of uric acid, and hence the fat are often gouty. Saccharine urine (a condition which, whatever view be taken of its pathology, is manifestly a state of deficient oxidation of certain tissue-elements)—especially that form which is met with in those advanced in life—very frequently occurs in stout people. In 32 of 140 cases of diabetes observed by Seegen, obesity preceded the glycosuria.

Progress and Prognosis.—The progress of obesity is essentially chronic, and rarely, if ever, tends to other than increase of this state. Extreme fatness in the very young, as said, usually subsides; but the obesity of advanced life never does, unless any exhaustive disease should coexist, such as cancer or diabetes; and the latter by no means produces then the emaciation that it causes in young people. Obesity should, on the whole, be regarded as a grave matter, since very fat people rarely reach an advanced age; whilst a decrease of fat at middle age in a person hitherto stout should be regarded with suspicion.

In obesity death by syncope may result from an extremely fatty heart; from apoplexy, caused by rupture of an atheromatous vessel in the brain; or from bronchitis, with general œdema from cardiac dilatation.

Treatment. — Limited space prevents even an enumeration of the nostrums that a fanciful empiricism has suggested for the prevention or cure of obesity.

Recognising that accumulation of fat is a perversion of nutrition, which, if once established, and with a strong hereditary predisposition, cannot be cured, it follows that we should endeavour to prevent as far as possible its increase, by avoidance of those factors which pathology tells us are favourable to its development. The cardinal rule in any procedure that may be adopted is to avoid heroic treatment, for though thereby the fat may be diminished, the result may be attained by establishing a worse state of the body, if not one leading even to a fatal termination. The guides as to how far a given plan may be proceeded with are, first of all, the age and general condition of the patient, especially as regards the heart's power; and, secondly, the feelings and capability of the patient as the treatment is pursued. Each case must be treated according to circumstances, bearing in mind that the objects to be aimed at are to diminish the sources of the fat, and to increase the oxygen-carrying power of the blood and oxidising power of the tissues.

The diet must be regulated in quantity and quality. Since a healthy diet should consist of certain proportions of nitrogenous, amyloid, and fatty principles, and since from all these three substances fat may be formed in the body, the question arises which can be most advantageously diminished. Experience supports our pathological knowledge in advocating a withdrawal as far as possible of fatty and starchy food, whilst at the same time a moderate increase in albuminoid matter is permitted; for with a fair quantity of the other food-stuffs, proteids increase tissue-change. It is on this principle that systems of dietary for the corpulent are founded, the best known of which bears the name of Banting, who for a year (1863) successfully followed out a plan laid down for him by Dr. Harvey, with the result of losing 44 lbs. in weight, and without the recurrence of corpulence when ordinary diet was resumed. There are many other cases recorded. Dr. Cheyne, who weighed 32 stone, reduced himself a third in weight, and lived afterwards in good health to the age of seventy-two (Dr. Wadd on *Corpulence*, 1822). Lean meats, sweetbreads, fish, except rich kinds, such as salmon and eels, clear soups, poultry, game, eggs, cheese, green vegetables, toast, gluten bread, fresh fruit, and pickles are allowable articles of diet. An average diet for an adult would be 12 oz. lean meat, 6 oz. rusks or gluten bread, 4 oz. green vegetables, 1 oz. butter, and tea ½-pint. Much difference of opinion exists as to how far water should or should not be freely allowed. Alcohol generally should be avoided, but especially spirits and beer, which must be absolutely forbidden, except on emergency; cider or the light dry wines, both white and red, diluted with water, are less objectionable. Tea and coffee are supposed to interfere with tissue-change, and therefore should be taken sparingly; and milk, from the quantity of fat it contains, is to some extent inadmissible.

Exercise, within the limits of the patient's powers, such as riding, walking, rowing, and gymnastics, is of great benefit, by directly inducing an increased oxidation of tissue, and improving the quality of the blood, and therefore its oxygen-carrying power. Cold-bathing, if well borne, is of advantage on similar grounds, but extreme sweating is unadvisable, and may be dangerous. Breathing compressed air, with the object of increasing the tissue-oxidation, has been recommended.

It is in carrying out a system rather than in devising one that the difficulty occurs. The regularity and restraint prove irksome to the patient, and are frequently broken. Hence it is that the regimen and spare diet of the various spas, such as Carlsbad, Marienbad, Kissengen, and Ems have great advantages, since at such places, and in such surroundings, the patient more readily and willingly pursues a given plan.

In the treatment of intercurrent diseases it is essential to remember the enfeebled resisting power of the patient, and the necessity for stimulants.

Among the many drugs that have been used, may be mentioned alkalies, iron, and iodine. Soap was formerly much employed, as much as three ounces being given daily with milk and lime water; and some of the good effects of the various 'waters' are ascribed to their alkaline properties, especially the alkaline aperients of the above-mentioned spas. Iron is an essential in those forms of corpulence associated with anæmia, and most satisfactory results follow its administration, as the health improves and the fat diminishes. Young chlorotic subjects benefit by this treatment, which may be advantageously carried out at some chalybeate spring, such as Tunbridge Wells, Harrogate, or Spa. The iodides, such as those of potash and iron, given in large doses, undoubtedly effect a reduction in the amount of fat, but not always with a corresponding improvement in health. So long as this does not suffer and the patient improves, the drug may be persevered in, but it is frequently very badly borne when taken in quantity. The preparations of *fucus vesiculosus*, the basis of certain quack remedies, appear to depend for their value on the iodine contained in them.

W. H. Allchin.

OBSOLESCENT, (*obsolesco*, I grow out of use).—A term applied to miliary tubercle, when instead of undergoing destructive changes, it becomes dried up, shrunken, and hard, and thus remains inert. *See* Tubercle.

OBSTRUCTION, and OCCLUSION.—Obstruction and occlusion of the different tubes and orifices of the body are mainly effected in three different ways:—first, by ***blocking of a tube*** by its contents; secondly, by ***alteration in its walls***; thirdly, by ***pressure from without.***

1. **Blocking.**—The first mode of obstruction is met with in most of the tubes of the body, and may be produced in various ways. The occluding mass may be composed of the normal contents of the tube; of these contents variously altered; or, lastly, it may be some foreign substance introduced from without. Examples of the first of these modes occur in the intestine, in cases of impacted fæces or intestinal concretions; in the biliary and urinary passages from calculi; in the ducts of glands from the products of catarrh or inspissated mucus; and in the blood-vessels from deposits of fibrin. Obstruction by foreign bodies may of course occur in all tubes in direct communication with the external surface, but even internal tubes are sometimes obstructed in this manner. As examples of this may be cited the occasional obstruction of the bile-ducts by hydatid cysts, or by the ascaris lumbricoides; of the pulmonary artery by hydatids; of capillaries by masses of bacteria; and of the pulmonary capillaries by air sucked in by a wounded vein.

2. **Parietal Changes.**—Obstruction of tubes from alteration in their walls is the most common cause of the various forms of permanent stricture, and may arise from many different conditions. First, in those tubes whose walls are muscular, it may be the result of spasm. This form of obstruction is usually only of temporary duration, and is probably not of very frequent occurrence. It is supposed to take place in the urethra and the bile-duct, but the most important instances of it are met with in the respiratory and vascular systems. In the former we have examples in spasmodic closure of the glottis, and also in the narrowing of the bronchial tubes in spasmodic asthma; in the latter in the obstruction by spasm of the small arteries of the base of the brain, to which the initial phenomena of the epileptic seizure are ascribed. To a similar spasmodic occlusion of the arterioles of the lungs Dr. George Johnson ascribes many of the

phenomena of cholera. To a more prolonged spasm of the blood-vessels the gangrene produced by ergot has been attributed.

Obstruction from more permanent alterations in the walls of the tubes may be produced, first, by acute inflammatory swelling and œdema, and by the formation of false membranes; and secondly, by chronic inflammatory thickenings and cicatricial contractions. These form the non-malignant permanent strictures, as of the urethra, œsophagus, pylorus, and intestines. Thirdly, the growth of some malignant or other tumour in the walls of tubes may lead to the same result. This form of stricture is especially common in the digestive canal, from the pharynx downwards.

3. **External Pressure.**—Lastly, obstruction and occlusion are often the result of pressure from without. This pressure may be exercised by a tumour of some kind, or by enlargement of an organ, as, for example, the obstruction of the trachea produced by an enlarged thyroid body. Or the pressure from without may be produced by the effects of inflammatory processes occurring in the surrounding parts. We have examples of this in occlusion of the intestine by fibrous bands, and in obstruction of the tubuli uriniferi of the kidney by the cirrhotic process. Other examples of pressure from without, causing obstruction, occur in displacements of the intestine in hernia, with which may be classed the various forms of volvulus.

Effects.—The effects of obstruction and occlusion differ, of course, according to the tube or orifice affected. They are in part due to the arrest of function of the tube, and in part are purely mechanical. The most general mechanical effect is dilatation of the tube behind the seat of the obstruction, owing to the accumulation of its contents (*see* Dilatation), and arrest of function beyond it. When these contents are themselves irritating, or when the disturbing cause also constricts the blood-vessels, ulceration, or gangrene and perforation, are liable to occur. The other effects are mainly due to the backward pressure of the accumulation. In cases where the tube is the duct of a gland, the ultimate effect is to arrest the secreting function, and cause atrophy of the gland. This is attended by cessation of any further accumulation; and sometimes complete absorption of the previous accumulation takes place, and the dilated duct shrinks and becomes completely atrophied. Examples of this series of changes occur not infrequently in the ureter and kidney. W. Cayley.

OCCUPATION, Ætiology of.—*See* Disease, Causes of; and Public Health.

ŒDEMA (*οἰδέω*, I swell).—Synon.: Fr. *Œdème*; Ger. *Œdem.*—A dropsical effusion in the cellular tissue, whether subcutaneous, submucous, subserous, or in the interstices of organs. *See* Dropsy.

ŒSOPHAGUS, Diseases of.—Synon.: Fr. *Maladies d'Œsophage*; Ger. *Krankheiten der Speiseröhre.*—The diseases of the œsophagus may be considered in the following order:—

1. **Œsophagitis.**—Inflammation of the œsophagus.

Ætiology.—Inflammation of the œsophagus, arising in its structures and confined to it, is an affection of rare occurrence; or it may be that it offers so few marked symptoms that but small attention is paid to it, and it never comes before the physician. But by no means uncommon is the extension of inflammation to the œsophagus from neighbouring structures. Thus, a catarrhal inflammation of the throat and fauces may pass down the œsophagus. In children thrush has been seen to extend into the gullet, setting up a certain amount of inflammation; and the same holds good with regard to diphtheria and croup. Where organic disease of this organ exists, a certain amount of inflammation is liable to be set up. But by far the most common causes of acute œsophagitis are the ingestion of irritating or corrosive substances, such as boiling water, alkalies, or acids; and mechanical injury from the introduction of foreign bodies.

Symptoms.—Somewhere in the line of the œsophagus pain, varying in intensity, of a burning or lancinating character, is complained of, at times so severe as to induce vomiting. This pain is rendered intensely acute by all attempts at swallowing. Even the passage of the saliva is sufficient to set it up, and hence it is that this fluid is seen dribbling from the mouth of the child who is the subject of this disorder. Thirst is a usual accompaniment of œsophagitis; but rather than endure the agony of swallowing fluids, the individual will put from him all fluids, however bland. If the attendant insist upon an effort being made to swallow some sustenance, most usually this is speedily rejected, accompanied with much viscid mucus, flakes of lymph, membranous shreds, and sometimes blood or pus. The amount of fever and constitutional disturbance is in proportion to the intensity of the inflammation.

Prognosis.—If simple, acute œsophagitis usually terminates in resolution, and somewhat speedily. If it be due to the passage of acrid or hot substances, ulceration of the œsophagus may result; or simply a permanent thickening of the coats of the tube, whereby its calibre is reduced, and stricture is the result.

Treatment.—It is best to abstain from all attempts to give nourishment in the ordinary way, and to rely entirely upon nutritive enemata till the acuteness of the affection has passed. Ice may, however, be given to the patient to suck, if it prove agreeable to him. For the relief of the pain warm poultices may be applied externally, or opiate fomentations. Opium may be administered either by enema, or subcutaneously. The state of the bowels must be attended to.

2. **Ulceration.**—Ætiology.—This affection, as we have already seen, may arise as the result of the passage of irritating fluids through the œsophagus. More commonly it is brought about by the swallowing of certain pointed or angular bodies which stick in the gullet, and cannot be dislodged, or before their removal have eroded the mucous membrane and produced ulceration. Simple ulcer and perforating ulcer of the œsophagus have also been described; they are similar to those which are observed in the stomach, but are of rare occurrence.

Symptoms.—These are similar to the phenomena described under œsophagitis, only the pain is more localised, and is more generally referred to a circumscribed spot between the scapulæ in the back, at the top of the sternum, or in the præcordia. The same difficulty in swallowing is experienced, and, on account of the slowness of the ulcerated surface to heal, is much more protracted, so that the patient emaciates rapidly, and death from starvation has even been known to occur. In the perforating variety a communication may be established between the œsophagus and one of the bronchi—more likely the left, the pleura, or the pericardium. Auscultation may reveal a change of tone in the sound of the swallow, it being more dead in quality than in health. The bolus swallowed seems also as if it were diminished in bulk, but much elongated, so that it takes longer to pass the ulcerated spot than it does at any other portion of the tube.

PROGNOSIS.—This must be founded on the nature of the ulcer, but it is always serious.

TREATMENT.—Not much reliance is to be placed upon medicinal treatment. The patient's strength must be sustained by the liberal use of generous diet if he can swallow, or by nutrient enemata. It may be possible to pass into the stomach a small-sized œsophageal tube (catheter No. 15) and, by attaching it to the stomach-pump, thereby introduce plenty of nourishment. Stimulants will also most likely be called for. Ice may be freely allowed. Local application of nitrate of silver, tannic acid, borax, and other agents, by means of bougies, has been advised.

3. **Dilatation.**—Dilatation may affect the œsophagus in its entire length, but more commonly involves merely a portion of the tube, as is frequently observed in cases of stricture of the œsophagus. In addition to this, sacs are met with in the walls of the canal, which communicate with it. These diverticuli are usually formed by the distension of all the coats of the œsophagus, but sometimes by the mucous membrane alone becoming dilated, and pushed between the other coats. The *causes* which give rise to this condition, in addition to stricture, are the lodgment of some foreign body in the walls of the œsophagus (this is one of the most frequent origins of the diverticula), and paralysis of the walls induced by chronic catarrh.

SYMPTOMS.—These are not marked. If the dilatation be idiopathic, and involve the whole length of the tube, nothing very abnormal will be present to lead to the discovery of this condition. If it be secondary, dependent upon stricture, then in addition to the symptoms described under that head, it will be observed that the food, after it has been swallowed, is much longer retained than formerly. There is also experienced a sensation of fulness, which may sometimes be perceptible to vision, at the point above the stricture, and this is accompanied by a desire to relieve the sensation by vomiting, which sooner or later occurs, spontaneously or induced by the patient himself, and affords great and immediate comfort. In the case of diverticula, when of some size, the symptoms are very similar to those above described. In addition, it may be noticed that a very bad odour is given off from the mouth of the patient, due to the retention and decomposition of the food in these pouches. According to their site, tumours, varying in size as the individual has more or less lately been partaking of food, may be observed. These may sometimes interfere with respiration or circulation. Auscultation in the case of simple dilatation indicates that no obstruction to the passage of the bolus exists, and there is no prolongation of the time it takes to pass into the stomach. But an alteration in the vigour of the peristaltic action is observed. There is a deficiency or entire loss of the contraction of the muscles, and the gradual transmission of the bolus onwards is no longer heard, but it appears to run or drop at once into the stomach. It is generally believed that men are more subject to this affection than women; and it is met with in the decline of life.

TREATMENT.—Treatment is of no avail for dilatation of the œsophagus, except so far as to remove the cause, if possible, and to treat symptoms.

4. **Stricture.**—This affection may be the result of either of the two first-named disorders; or of a changed condition of the walls of the œsophagus, brought about by the existence of some new growth, such as that resulting from cancer or syphilis. Further, contraction of the œsophagus may be due to the presence of a tumour or other growth pressing upon, and so narrowing its calibre. Or, finally, it may be simply functional in its nature, giving rise to temporary obstruction, known as *spasm (œsophagismus)* and functional *paralysis* of the œsophagus.

SYMPTOMS.—Organic stricture of the œsophagus may have existed for some time before the patient or his medical attendant realises the gravity of the complaint, because the symptoms develop themselves only very gradually. The most noticeable of all is the difficulty in swallowing. At first this may be merely occasional, and only perceived when a tolerably large bolus is attempted to be passed down the gullet; but gradually the difficulty increases, and it is now not only confined to the attempt to swallow solids, however finely masticated, but semi-solids give rise to the same sensation as if the food never passed a certain point, this point being usually referred to the manubrium sterni, at the upper or lower portion, wherever the stricture is situated. If the patient, by dint of great resolution and perseverance, overcome the difficulty to such an extent as to swallow some food, the first morsel passed being always the greatest trial, it may be retained for a time, but is ultimately rejected. This desire to get rid of the food swallowed increases to such an extent, that all aliment is regurgitated, rather than vomited. The rejected matter consists of the food, but little altered, largely mixed with mucus, or sometimes with a little blood and pus. The reaction is always alkaline. Finally the dysphagia becomes so marked that even the attempt to swallow liquids is given up as hopeless. Coincident with the advance of this dysphagia does the emaciation progress; the abdomen falls in; and the patient dies from starvation. The passage of a bougie will definitely settle any doubt as to the existence of an organic stricture, besides affording information as to its site, extent, and form; but the operation must not be performed without due consideration, as it has happened that an unrecognised aneurism has been opened by this instrument. Auscultation will also aid in the diagnosis. It will reveal the same slowing of the passage of the bolus already referred to, and the same elongation of it. In addition, if the stricture be very narrow, then the food will be heard to pass through it with difficulty and with a creaking sound; while if it be narrower still, particularly if the food be fluid in its consistence, 'it eddies as it were in a funnel, with a prolonged resonant gurgle,' as described by Allbutt.

Spasmodic stricture of the œsophagus differs from the organic form in the suddenness with which the dysphagia comes on; its paroxysmal nature; its not unfrequently being but one of the many symptoms of hysteria; its occurrence in young anæmic females, or hypochondriacal men; and though dyspepsia may be complained of, and even prove an exciting cause, still emaciation does not exist. The point where the impediment to the passage of the food is experienced is usually at the upper part of the œsophagus or pharynx. Occasionally pain is complained of on attempting to swallow, and food taken is sometimes ejected. But the spasm soon yields, and food finds its way into the stomach. The difficulty in swallowing is much increased by the attempt being witnessed by sympathising friends, and a stern command to cease from such frivolous efforts often succeeds, to a surprising degree, in overcoming the dysphagia. On introducing a bougie, it will of course be stopped if the spasm exists at the moment; but gentle, careful, continuous pressure will ultimately cause the spasm to give way, and thus its true nature will be revealed.

Prognosis.—The prognosis in cases of real organic stricture cannot be otherwise than always grave. If it be due to cancerous growth, then it must necessarily be most unfavourable. Spasmodic stricture is very hopeful.

Treatment.—The treatment appertains more to the domain of surgery than of medicine. In the case of organic stricture, the frequent passage of bougies of varying size often proves valuable, except in the case of cancer, when it should never be attempted. Diet must be attended to, the state of the stomach looked to, and dyspeptic indications combated. If food cannot be swallowed a small catheter may be introduced through this stricture, and the patient fed by the stomach-pump; or nutrient enemata may be administered. For the spasmodic variety, the general system must be braced, tonics prescribed, and the usual anti-hysterical remedies ordered.

5. **Morbid Growths.**—By far the most common form of growth in the œsophagus is cancer. Occasionally fibroid tumours are seen, either as such, or as polypi, situated about the level of the cricoid cartilage. When carcinomatous, the growth may be any of the usual varieties of cancer; and it will frequently be found to affect the upper third, more commonly the lower third, and very rarely the middle of the gullet. It commences in the submucous tissue, speedily involving the other coats of the tube. From this it may extend to other organs, and perforation of the trachea, bronchi, aorta, or pericardium may take place.

Symptoms.—Confining the attention to cancer of the œsophagus, this disease may well be suspected if, in an individual above middle age, gradually increasing dysphagia be complained of; if symptoms of stricture be pronounced; if pain be experienced, especially of a lancinating character, about the spine and shoulder-blades; if nausea and retching be observed, together with irritating cough, and occasional hiccough; if the patient continue to emaciate, and present the dirty greenish-yellow complexion common in cancerous cachexia, together with enlargement of lymphatic glands: and most certainly shall we be confirmed in our diagnosis if, on examination of the vomited matters, cancer-cells be seen.

Prognosis.—The prognosis is of the worst description. The patient gradually becomes exhausted, and dies of inanition.

Treatment.—Treatment can be merely palliative. It consists in relieving the pain by narcotics; and endeavouring to sustain the patient's strength as long as possible.

Claud Muirhead.

ŒSTRUS (*οἶστρος*, a gadfly).—Synon.: Fr. *Oestre*; Ger. *Bremse*.—A genus of dipterous insects, called gadflies, the larvæ of which, vulgarly known as maggots or bots, live parasitically in man and animals. The ordinary human bot, *Œstrus hominis*, is of rare occurrence in England, but is not unfrequently met with in warm countries, especially in South America. The larva of the gadfly of the ox, *Œstrus bovis*, also occasionally attacks man. Dr. J. M. Duncan has recorded an interesting case of the latter kind (*Edinburgh Monthly Journal*, 1854), and Bracey Clark long previously noticed a similar instance. Cases of *Œstrus hominis* were either described or noticed by many earlier observers, amongst whom were Linnæus, Gmelin, Rudolphi, Olivier, Gill, Howship, and Treherne. The writer is in possession of full particulars of a case forwarded to him, with the parasite, by Mr. Higginson of Liverpool. It occurred in a boil at the back of the thigh. A third species of human bot, *Œstrus guildingii*, from Trinidad, is described by Guilding; besides which, nearly a score of other similar cases have been placed on record by various authors who were not able to identify the species.

True maggots and other bot-like larvæ are continually encountered in medical practice. As a rule, their identification as species can only be determined by skilled entomologists. Some forty years ago Mr. Hope referred the forms then known to upwards of twenty separate genera of insects (*London Medical Gazette*, 1837-38). Amongst cases of insect larvæ possessing more than ordinary interest we may particularise the following:—1. Several cases in which the larvæ of the coleopterous insect Blaps (*B. mortisaga*) passed from the stomach and intestines. In Pickell's celebrated case 1,206 larvæ were found, besides several of the full-grown insects, which are popularly known as the churchyard beetle. The writer recorded a case (*British Med. Jour.*, 1877), from the practice of Dr. Horne, of Barnsley, where a living larva was passed by an infant. 2. Numerous cases of the larvæ of *Anthomyia canalicularis*. Several of these have occurred in the writer's practice. 3. In Hope's list (*loc. cit.*) nine cases of mealworm are given (*Tenebrio molitor*). 4. The occurrence in the human body of the maggots of various species of fly has frequently been noticed (*Musca domestica*, *M. carnaria*, *M. sarcophaga*, *M. vomitoria*, &c.). 5. In several instances, the so-called rat-tailed larvæ (*Helophilus*) have been passed *per anum*. One such case was brought under the notice of the writer by Mr. Noot; and a more recent instance has occurred in the practice of Dr. W. H. S. Westropp, at Lisdoonvarna, Ireland. The writer identified the parasite in both cases. 6. The late Dr. Livingstone, when in Africa, was attacked in the leg by a small bot-like larva, which Dr. Kirk removed by incision. The specimen was presented to the writer, and is now preserved in the museum of the Royal College of Surgeons (*Catalogue of Entozoa*, No. 196). In actual practice it is not uncommon to find the larvæ of various species of moths (*Noctuæ*), either in the night-stool or chamber-utensil; these, for the most part, being accidentally introduced. In like manner the maggots of various butterflies and other insects, are often passed, having been previously swallowed along with food. Lastly (7), we may refer to the horrible habits of the larvæ of the golden fly (*Lucilia hominivorax*). This insect, according to M. Coquerel, is particularly destructive to the convicts of Cayenne. The larvæ, hatched from eggs previously deposited in the mouth and nostrils of the victim, penetrate and devour the living tissues, after the manner of ordinary maggots in putrid flesh. According to M. Bouyer (*Tour du Monde*, 1866), the majority of the cases prove incurable. Other species of *Lucilia* have the habit of attacking the eyes, mouth, and nostrils of toads and frogs, the maggots eating into the tissues of the living batrachians. Dr. McMunn (of Wolverhampton) and the writer have seen instances of this, and have confirmed the observations of Herr Boie, and of M. Girard, M. Moniez, and others.

Treatment.—As regards the treatment of intestinal insect-parasites, ordinary purgatives, salines, and vermifuges, especially turpentine, will usually dislodge them; whilst for those that occur in wounds or ulcers at or near the surface, nothing is better than the application of carbolic acid solution. *See* Entozoa. T. S. Cobbold.

OEYNHAUSEN, or REHME, in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

OFEN, in Hungary.—Sulphated waters. *See* Mineral Waters.

OÏDIUM ALBICANS.—A vegetable parasite, associated with aphthæ or thrush. *See* Aphthæ.

OINOMANIA (οἶνος, wine, and μανία, madness).—A synonym for dipsomania. *See* Dipsomania.

OLD AGE, Signs of. *See* Senility.

OLFACTORY NERVE, Morbid Conditions of.—The principal morbid conditions that occur in connexion with the nerve of smell are the following:—

1. Olfactory Hyperæsthesia. Synon.: Hyperosmia.

Definition.—Increased sensitiveness of the olfactory nerve.

Ætiology and Symptoms.—This condition is seen in the increased nervous sensibility which results from chronic debilitating illness. It occurs also in hysteria, in which remarkable, almost animal, acuteness of the sense is sometimes present, so that not only objects but persons have been discriminated by this means. In insanity the same condition is sometimes seen. It is usually associated with, and has to be distinguished from, an altered appreciation of odours, shown in the abnormal enjoyment of or disgust at the odours which are recognised with natural or preternatural acuteness.

Treatment.—The condition rarely calls for special treatment.

2. Subjective Sensations of Smell.—Subjective sensations of smell occur from central disease, or from irritation of the nerve of smell. In the insane olfactory hallucinations occur, though less commonly than those of the optic or auditory nerve. Schlager met with them in five cases out of six hundred. In epilepsy subjective sensations of smell occur as occasional prodromata of fits, and the disease in these cases probably involves the olfactory centre in the anterior part of the temporo-sphenoidal lobe. It was so in a case of tumour recorded by Sander. Irritation of the nerve, from meningeal disease or injury, also, in rare cases, causes olfactory hyperæsthesia. Dr. Quain has recorded an interesting case of perityphlitis, in which an apparently subjective sensation of a foul odour was persistently complained of by the patient, until evacuation of the contents of the abscess, when the supposed smell completely disappeared.

3. Perversion of the Sense of Smell.—Synon.: Parosmia.—This is a rare condition which occasionally results from irritation of the nerve or central organ. In a case recorded by Legg, some time after an injury to the head all substances 'tasted' of gas or paraffine, and there was marked diminution in the acuteness of the sense of smell.

4. Olfactory Anæsthesia.—Synon.: Anosmia.

Definition.—Loss or diminution of the sense of smell.

Ætiology.—The causes may be local changes in the organ of smell; disease of the nerve; or disease of the centre.

a. Among *local* causes may be mentioned the following:—(1) acute and chronic catarrh of the olfactory mucous membrane, the latter causing thickening; a condition sometimes produced by excessive snuff-taking. (2) Dryness of the mucous membrane, as in cases of destruction of the external nose (Notta), or in paralysis of the fifth nerve. (3) Occlusion of the passage by polypus, preventing the access of air to the olfactory region. (4) Impaired access of air consequent on facial paralysis. The loss of the power of dilating and keeping expanded the nostril prevents a due quantity of air being drawn through the nasal passage; and, moreover, the loss of power of compressing the nostril in 'sniffing,' prevents the air being directed into the olfactory region. (5) In rare cases loss of pigment in the nose, consequent on general loss of pigment, has appeared the cause of loss of smell.

b. Damage to the olfactory nerve may result from injury or disease. It is not an uncommon result of blows or falls upon the head, and it is probable that in these cases the delicate olfactory nerves are torn from the bulb (*see* NOSE, Diseases of). The bulb, or tract, may also suffer in adjacent disease, as tumour, abscess, caries of the bone, and meningeal changes, especially syphilitic. Spontaneous atrophy of the olfactory bulbs occasionally occurs in old age (Prévost), and has been met with in younger persons in the 'essential anosmia' of Notta.

c. In *cerebral disease* the sense of smell is sometimes lost. It may be impaired in so-called functional disease, as in hysteria, and in degenerative disease, as paralytic dementia. It is occasionally lost in organic disease involving the roots of the olfactory nerve. Unilateral anosmia has been met with in cases of aphasia (Hughlings Jackson), an association which is explained by the passage of the external root of the olfactory nerve past the island of Reil to the anterior part of the temporo-sphenoidal lobe.

It is to be remembered that the olfactory nerves are sometimes congenitally absent.

SYMPTOMS.—The evidence of anosmia is the loss of the perception of odours. This may be partial or complete, according to the extent of involvement of the nerves. It may be lost on both sides; or when due to degenerative changes, on one side only. When due to organic brain-disease it is lost on the side on which the cerebral lesion is situated.

DIAGNOSIS.—The diagnosis presents little difficulty. The affection is commonly complained of, but often as 'loss of taste,' the diminished perception of *flavours* being more obvious to the patient than the loss of smell. The sensations included under the term 'flavour' are, it need hardly be said, really olfactory and not gustatory. In examination, care must be taken to employ only substances—as aromatic oils, &c.—which affect the olfactory nerve, and not acrid substances, as ammonia and acetic acid, which stimulate also the fifth nerve.

PROGNOSIS.—The prognosis in anosmia is favourable when due to a local cause, but when there is reason to suspect injury or disease of the olfactory nerve or centre, recovery is improbable.

TREATMENT.—Anosmia, as a symptom, rarely calls for treatment, which should be directed to its cause. Sometimes local stimulation is of service; and occasionally counter-irritation, by blisters to the neck, has appeared to assist recovery. In hysterical cases faradisation of the nasal mucous membrane has been recommended; but the olfactory nerve itself is not accessible to electrical stimulation. W. R. GOWERS.

OLIGÆMIA (ὀλίγος, small, and αἷμα, blood). Deficiency of the total amount of blood in the body. *See* BLOOD, Morbid Conditions of.

OMAGRA (ὦμος, the shoulder, and ἄγρα, a seizure).—SYNON.: Fr. *Omagre*; Ger. *Schultergicht.*—A name for gout in the shoulder. *See* GOUT.

OMENTUM, Diseases of. *See* PERITONEUM, Diseases of.

ONANISM (Onan).—A synonym for masturbation. *See* MASTURBATION.

ONYCHIA (ὄνυξ, the nail).—An inflammatory affection of the matrix of the nail. *See* NAILS, Diseases of.

ONYCHOGRYPHOSIS (ὄνυξ, the nail, and γρυπός, curved).—This term is applied to curvature of the nails; and, more particularly, to the oblique elevation of the nails from their matrix by the accumulation beneath them of crude cell-substance, which forms a kind of wedge, and crumbles away upon desiccation. *See* NAILS, Diseases of.

ONYCHOMYCOSIS (ὄνυξ, the nail, and μύκης, a fungus).—Parasitic disease of the nails. *See* EPIPHYTIC SKIN-DISEASES; and NAILS, Diseases of.

OPHIASIS (ὄφις, a serpent).—A form of alopecia areata, which assumes a serpentine figure, either by creeping onwards, or by the blending of two or more of the circular discs. *See* BALDNESS.

OPHTHALMIA (ὀφθαλμός, the eye).—SYNON.: Fr. *Ophthalmie*; Ger. *Ophthalmia.*—A general term which might be used to express any morbid condition of the eye, but which is restricted by custom to the forms of inflammation which originate in the superficial structures of the organ, such as the varieties of conjunctivitis, or the phlyctenulæ which sometimes appear upon the cornea, and may give rise to shallow ulcers. Thus we have mention by authors of *infantile, catarrhal, contagious, purulent*, and *strumous* or *phlyctenular*, ophthalmia. *See* EYE AND ITS APPENDAGES, Diseases of.

OPHTHALMITIS (ὀφθαλμός, the eye).—SYNON.: Panophthalmitis; Fr. *Ophthalmite*; Ger. *Augenentzündung.*—A term which has been used to express inflammation affecting the whole of the structures of the eyeball, superficial as well as deep. Such a condition is most frequently seen after operations upon the eye, and was described by the late Dr. Jacob as *eyeballitis!* *See* EYE AND ITS APPENDAGES, Diseases of.

OPHTHALMOSCOPE (ὀφθαλμός, the eye, and σκοπέω, I examine).—SYNON.: Fr. *Ophthalmoscope*; Ger. *Ophthalmoskop.*

The ophthalmoscope is an instrument for lighting up the interior of the eye, in such a manner as to render the contained structures clearly visible.

DESCRIPTION.—The first ophthalmoscope was invented about 1847, by the late Mr. Charles Babbage, who laid it aside because an ophthalmic surgeon to whom he showed it, and who failed to perceive its probable utility, afforded him no encouragement. In 1851 another form of the instrument was invented by Helmholtz; but, in 1852, Babbage's original form was re-invented by Ruete, and this, with a few unimportant modifications, has ever since held its ground in practice. It consists, essentially, of a slightly concave mirror, with a small central perforation; or, if the mirror be of silvered glass, with the silvering removed from a small circle in the centre. A mirror the size of a shilling is large enough for all practical purposes, and a central aperture of not more than 2 or 3 millimètres in diameter is better than a larger one. The mirror may be attached to a handle of any proportions preferred by the owner, or may be left without one; but it must be accompanied by certain auxiliary convex and concave lenses, the uses of which will be presently explained. The focal length of the mirror is usually about 8 inches.

Method of Use.—In order to learn the use of the ophthalmoscope, the beginner will do well to avail himself of a contrivance called Perrin's artificial eye, or of the more elaborate one lately designed by Landolt. The former consists of a small hollow sphere of metal, to represent the eye, closed in front by a lens, which can be changed at pleasure, and behind by a door for the insertion of pictures of various healthy and diseased conditions of the retina. When an artificial eye is not available, the learner should take the patient into an obscurely lighted room, and should stand or sit facing him, with the two heads upon the same level. A gas or oil flame—preferably, from its greater steadiness and superior illumination, that of an argand burner—is then placed upon the same level as the eye which is to be examined, on the same side of the head, and a little behind it, so that no direct light shall fall upon the cornea. The observer, commencing with his face exactly opposite that of the patient, and about eighteen inches distant from it, places the back of the ophthalmoscope mirror against his eye, using preferably that which is opposite to the eye to be examined, the right eye for the patient's left, and *vice versâ.* The patient is directed to look as if at a distant object, over the shoulder of the observer which is most remote from the eye under inspection, thus looking over the observer's left shoulder when the right eye is being examined. In this position, the observed eye is turned a little towards the nose; and the optic nerve-entrance, which is somewhat on the nasal side of the posterior pole, is brought opposite to the pupil. Looking through the mirror-aperture, the observer directs the light of the flame, reflected from the polished surface, in such a manner that it falls into the pupil of the observed eye; and this light, returning from the eye, reaches him through the perforation. It exhibits the cavity of the eye illuminated, but, as a rule, shows no objects, but only the pupil as a reddish or yellowish circle. In order to see the contained structures, two methods are employed, the *indirect* and the *direct*; the former of which gives the better general view of the fundus, the latter the greater facilities for studying the condition of single points on the nerve or on the retinal surface. It is therefore necessary to be conversant with both, and to use one or both as circumstances may require.

Indirect Method.—In using the indirect method, the observer takes a biconvex lens, of about two inches focal length, and holds it with his free hand in the track of the returning light, and at about two inches from the eye of the patient. The rays of light, thus rendered convergent, become united into an aerial inverted image of the fundus of the eye, which image, and not the fundus itself, will be the object of vision to the observer. The position of the image is in the focal plane of the lens, nearer to the spectator; and, in order to see it clearly, nothing is necessary but to have the observing eye in the track of the returning rays, and at the right distance from the image; which, it must be remembered, with a two-inch lens, will be four inches or more nearer to the observer than the eye of the patient. The whole art of using the ophthalmoscope for the indirect method may be said to consist in moving the eye to and fro upon the line of sight until the right distance is attained, without moving it laterally so as to get out of the track of the rays, and without losing the illumination. As soon as a vessel, or any other defined object, is seen, the observer knows that his distance is correct, and he then causes the patient to change the direction of his eye until every part of its fundus has come successively into view. The image, it must be remembered, is inverted in every particular; its nasal side representing the temporal side of the retina, and its upper portion the lower portion of the retina. In first attempts to use the ophthalmoscope it is desirable to have the pupil of the observed eye dilated by atropin or duboisin, but, after dexterity has been attained, the dilatation may in most cases be omitted. The details of the retinal image are sometimes more or less obscured by an image or images of the lamp-flame; of which there may be two, one formed by the anterior and one by the posterior surface of the lens. These images are only sources of embarrassment when the lens is held vertically, and may be displaced and put out of sight by giving it a small degree of obliquity. A bright image of the mirror itself upon the retina, showing the central perforation as a dark spot, is sometimes troublesome to beginners; and it is said that this image has even been mistaken for that of the optic nerve. The blackness and sharp definition of the perforation should render such a mistake impossible; and the image may readily be displaced by a slight alteration of the angle at which the mirror is held.

In order to magnify the inverted image, and to increase its brightness by bringing the mirror nearer to the eye of the patient, a convex lens may be placed behind the mirror for the observer to look through. Something of this kind is always necessary for observers who have reached the period of life at which spectacles are required for reading; and it is advantageous to all persons. The writer's practice is to use a lens of about seven inches' focal length in this manner; and there is thus obtained an image which for many purposes is as good as that afforded by the direct method. With such a lens, the eye of the observer can be only seven inches from the image, and, as this will be formed four inches in front of the eye of the patient, it follows that the two faces will be only eleven inches apart. At this comparatively small distance, the illumination of the fundus of the observed eye, which is afforded by a good mirror, is exceedingly satisfactory.

Direct Method.—In the direct method, the observer does not apply any intervening glass between the mirror and the eye of the patient, but comes as close to the latter as possible, and looks, not at an aerial optical image, but at the actual fundus itself, magnified by its own crystalline lens. It is only when the eyes of both observer and patient are of normal refraction, or emmetropic, that this can be done without the aid of a lens, which when required is most conveniently placed behind the mirror. The lens employed for this purpose must be such as to correct the sum of the error of refraction of both the eyes; and must therefore be concave when this error is on the side of myopia, convex when it is on the side of hypermetropia. An observer who is short-sighted will begin his investigation with a concave lens behind his mirror, which corrects his own short sight; and he will add to or diminish the power of this lens to meet any degree of ametropia which the observed eye may present in addition to, or in diminution of, his own. In order to facilitate the required changes, all necessary lenses are now usually mounted upon a revolving disc placed behind the mirror, and so arranged that each one of them can be brought in turn before the aperture. In one of the best of the modern forms of instrument, that of Dr. Loring, of New York, the mirror itself is made to turn upon pivots in a vertical line independently of the disc of lenses, so that the correcting lens receives no obliquity from the position of the mirror. This contrivance is valuable in some cases, especially when a correcting lens of high power is required, because such a lens, if held obliquely, is liable to produce some distortion of the objects seen through it. In using the revolving disc, a normal-sighted observer commences with no lens behind the aperture; and, if he then obtains clear definition, he knows that the eye into which he is looking is normal-sighted also, or at most is only in a slight degree hypermetropic. If, on the contrary, he does not obtain a clear image, he knows that the eye into which he is looking, unless the transparency of its media be impaired, is not normal-sighted, but that it is either myopic, or hypermetropic in a somewhat high degree. Keeping the fundus in view, he causes the disc to revolve, until a lens comes over the aperture which renders the picture distinct; and he has then only to see the number and kind of the lens in order to know the degree as well as the nature of the defect of refraction. In many cases it is even possible to prescribe spectacles, as the result of such an examination, with a very fair degree of correctness and success. But the chief use of the direct method, especially in the applications of the ophthalmoscope as an instrument of diagnosis in general medicine, is to scrutinise, as already stated, some portion of the fundus of the eye which has been shown, by the indirect method, to require more minute examination than that method will itself permit the observer to accomplish.

OPTHALMOSCOPIC APPEARANCES.—In order to interpret ophthalmoscopic appearances, and to distinguish physiological variations from pathological changes, it is before all things necessary to bear in mind the anatomy of the structures which are, or may be, rendered visible, and the relations which they bear to one another. The fundus of the eye is composed of several layers, the more anterior of which commonly conceal the posterior; and conceal them in such a manner that, when the former are rendered more transparent by malformation or disease, the latter are brought into view.

1. *Sclerotic.*—Commencing with the posterior layer, it consists of the inner surface of the sclerotic, a smooth and shining white surface, which is ordinarily entirely concealed by the pigmentation of the choroid and of the posterior or epithelial layer of the retina. The sclerotic is naturally visible, as a general white background to a vascular network, in cases of albinism, in which the natural pigment of the eye is congenitally absent; or in some very fair persons, who are not albinos, but whose eyes are very sparingly pigmented. It is rendered visible in patches, as a result of malformation or disease, in cases in which it is exposed by a fissure through the choroid, such as generally accompanies *coloboma iridis*; in cases in which the choroid has suffered atrophy as a result of antecedent hæmorrhage or inflammation; and in the immediate neighbourhood of the optic discs, in the so-called crescents of choroidal atrophy which are so often associated with high degrees of myopia. The whiteness of an exposed sclerotic may be distinguished from that of an opaque white deposit in the choroid or in the retina, by many small physical characters, such as the relation of the borders of the whiteness to the neighbouring tissues and vessels, which will show the one to be the result of the removal, the other of the addition, of material. The most conspicuous white deposits are those associated with albuminuria or diabetes, with syphilitic retinitis, and with the first stages of retinal glioma. In all these the deposits manifestly cover and conceal vessels, which may be seen to emerge from beneath them; while in complete atrophy of portions of the choroid, it is not uncommon to see a few remains of dwindled vessels, and other shreds of choroidal tissue, rendered unusually conspicuous by their white background, and manifestly situated in a plane anterior to it.

2. *Choroid.*—The next layer from behind forwards is the choroid, which is essentially a vascular network, containing more or less pigment in the intervals between the vessels. In very fair eyes, as already mentioned, the choroid may allow the general whiteness of the sclerotic to shine through; but, in the great majority of cases, it conceals the latter entirely. In like manner, the actual structure of the choroid is itself usually concealed by the pigment in the epithelial layer of the retina; and the choroid generally only plays the part of a red background, varying up to dark chocolate colour in very dark eyes, and exhibiting neither structure nor vessels. When the retinal epithelium is scantily pigmented, as occurs in light eyes, the larger choroidal vessels may be seen through the retina; and they are readily distinguished from those proper to this structure by their different arrangement; the vessels of the retina being arborescent, whilst those of the choroid are either nearly parallel to one another, or arranged in more or less diamond-shaped reticulations. When both sets are visible together, moreover, the vessels of the retina will be clearly seen to be in a plane anterior to that of the vessels of the choroid, and a variety of minute

differences of colour and aspect will suffice to show that the two sets form parts of different circulatory systems.

3. *Retina.*—The retina itself is formed of several layers, the deepest of which contains the perceptive elements, or the rods and cones of the so-called Jacob's membrane. In front of the perceptive elements there are ganglionic and granular layers, subservient to the functions or to the nutrition of the rods and cones; and, in front of these again, a layer of connective-tissue, containing and supporting the conducting fibres which are ultimately massed together in the trunk of the optic nerve, and which convey impressions from the retina to the brain. The fibre layer and its connective tissue are necessarily thickest in the immediate neighbourhood of the optic nerve, and they thin off towards the peripheral parts of the retina; whilst all but the perceptive elements are wholly wanting over a small circle or depression at the posterior axis of the eyeball, a little to the outer side of the nerve, and known as the 'yellow spot,' with its *fovea centralis.* The central artery of the retina enters the eye in the trunk of the optic nerve, and the central vein emerges in the same manner, the circulation between the two being almost a closed one, save for a few very small and insignificant anastomoses of the terminal vessels, some at the nerve-entrance itself, others in the ciliary region. The retinal blood-vessels are chiefly lodged in the connective tissue of the fibre layer, and only small twigs dip down into the deeper retinal tissues. The arteries and arterioles divide, and the veinlets and veins unite, in an arborescent fashion; and the two sets of vessels are readily distinguished apart by the larger calibre and deeper colour of those which carry venous blood. At the nerve-entrance, both sets bend at a right angle or nearly so, in order to pass from the axis of the nerve-trunk into the plane of the retina, or *vice versâ.*

Between the rods and cones of Jacob's membrane, and the anterior or capillary layer of the choroid, there is a sheet of pavement-epithelium, the cells of which contain a larger or smaller quantity of pigment. This epithelial layer was at one time regarded as part of the choroid, but more recent histologists refer it to the retina. When full of pigment, it forms an opaque screen, by which the choroid is concealed from view, and against which the delicate retinal structures, especially near the nerve, may become apparent as a thin, almost pellucid, film, in which blood-vessels ramify. In the eyes of fair people, with only scanty pigmentation, the epithelium neither completely conceals the choroid, nor does it throw up the retina with anything like the same distinctness, so that the retinal blood-vessels are clearly seen, but not the structure which supports them. When the pavement-epithelium has been removed, either by disease or by senile changes, the choroidal tissues become conspicuous.

4. *Optic Nerve.*—The general aspect of the optic nerve varies greatly, within limits defined by differences in the degree of its capillary vascularity, by the effects of contrast arising from the degree of pigmentation of the surrounding parts, and by the mechanical arrangement of the structures of which it is composed. The aperture in the sclerotic, by which the nerve enters the eye, is closed by a cribriform plate of condensed connective tissue, the *lamina cribrosa*; and the fibres normally leave their sheaths on the outer side of this lamina, only the axis-cylinders passing through its perforations. The combined axis-cylinders constitute a mass the whiteness of which is subdued rather than glistening, and which derives a certain amount of reddish, roseate, or pink colour from the capillary vessels by which it is permeated. The axis-cylinders, like the vessels, bend round as they pass from their original direction into that of the retinal surface; and, in the majority of instances, they leave a central depression in the nerve-disc as they separate, a depression at the bottom of which the glistening whiteness of the lamina cribrosa is visible, and which has been called the *porus opticus.* In other instances, this central depression does not exist, but the axis cylinders are gathered chiefly towards one side of the nerve-entrance, and the lamina is visible laterally instead of centrally. The size of the *porus opticus* is very variable, insomuch that sometimes, when it constitutes quite a large central depression, it is described as congenital or physiological excavation of the nerve. This congenital excavation is always readily distinguishable from the excavation produced by the pressure consequent upon excess of internal tension; because the former never, and the latter always, extends to the extreme margin of the nerve. In other words, the congenital excavation, however large and remarkable, is always surrounded by a ring of nerve-tissue; while the morbid excavation always extends to the margin of the opening in the sclerotic. The position of the blood-vessels in the nerve-entrance is also another variable factor, since they are sometimes nearly central, and at others are seen to pass into or out of the nerve-tissue close to its margin. In a few cases, moreover, the axis-cylinders at some portion or portions of the circumference carry their sheaths for a short distance into the retina; and the nerve is then surrounded by white glistening processes, with brush-like terminations. Sometimes, again, the margin of the opening in the choroid is richly pigmented, and the nerve is surrounded with a ring, or bordered by a crescent, of chocolate or black colour.

5. *Fundus as a Whole.*—The general appearance of the healthy fundus oculi may be summed up somewhat in the following way: the background seen in the inverted image ranges in colour from an almost chocolate tint in very dark people or in the dark races, to a closely woven reticulation of vessels carrying red blood, and affording indications of the white sclerotic lying behind them. In light eyes, the retina itself is invisible; but in dark eyes its thickest portion appears as a delicate film, which has been compared to moistened tissue-paper, over the portion of the field which immediately surrounds the optic nerve. Except in very light eyes, the vessels of the choroid are not individually visible, being concealed by the pigmentation of the pavement-epithelium; and, when visible, they are distinguishable by their parallel direction, and by the absence of branches. The vessels

of the retina are always clearly visible, and may be traced along their numerous arborescent ramifications to twigs of extreme fineness. The arteries are smaller and brighter than the veins, and often present the appearance of a white line running along the axis of the vessel, almost as if it were a translucent red tube, carrying a white fluid. The veins, larger and darker than the arteries, seldom display the white line. The vessels pass off the optic disc on all sides, but make bold curves which carry them clear of the region of the yellow spot. In the close vicinity of the disc, the vessels are sometimes attended by fine white threads, pursuing the same general course with them, and which are apparently coarser portions of the connective tissue by which they are sustained. The optic disc, or termination of the optic nerve itself, the most conspicuous object in the ophthalmoscopic image, stands out boldly against its surroundings, and presents a general colour-effect which depends partly upon the richness of its capillary blood-supply, and partly upon the greater or less degree of pigmentation of the tissues around it. Over part of its surface, generally in or near the centre, but sometimes laterally, it displays the whiter colour of the lamina cribrosa, and the mottling of its perforations for the passage of the nerve-fibres. It is often bordered, either entirely or partially, by a line of dark pigment situated at the margin of the choroidal opening; and it often exhibits also a fine white line at its margin. which is the edge of the opening in the sclerotic, seen through the semi-transparent nerve-tissue. The vessels pass over its margin without deviation or change of plane. The apparent size and shape of the disc depend much upon the refraction of the eye. As seen in the inverted image, it appears comparatively small in a myopic eye, and large in a hypermetropic; while, in cases of astigmatism, it is distorted into the appearance of an oval. In the same way, the refraction modifies the apparent actual, but not the relative calibre of the vessels. In the myopic eye the vessels appear of small diameter, and in the hypermetropic they appear of large diameter; so that no conclusions about their actual size can be drawn until the state of refraction has been taken into account. The fact that the veins are relatively larger or smaller than usual, when compared with the arteries, is, of course, not influenced by refraction, except that, in a hypermetropic eye, such a difference would be more conspicuous than in a myopic, by reason of the more magnified image produced by the optical conditions of the media.

6. *Circulation.*—In a general way, the blood-currents in the vessels of the retina are continuous and uninterrupted; but any hindrance to the entrance of blood may be attended by pulsation, first in the veins and subsequently in the arteries. Such hindrance may arise from disordered action of the heart, as in cases of insufficiency of the aortic valves; from disease of the coats of the arteries; or from increased resistance on the part of the fluids already occupying the cavity of the eyeball. The venous pulse depends upon an arrest of the outflow through the veins by the pressure of the entering arterial current; which, at the acme of the pulse-wave, has force enough to push back the venous current when there is not room enough for both. Hence, in the venous pulse, the vessels empty themselves in a direction from the centre of the disc towards its periphery, and refill in the opposite direction. The ordinary cause of venous pulse is increased tension or fulness within the eyeball, so that it is among the early symptoms of glaucoma; but it is also to be seen in a small proportion of cases in which no excess of tension is to be discovered either by touch or by symptoms, and in which the eyes appear to be healthy. In the arterial pulse, the resistance to the entrance of blood, or rather the disturbance of the balance between the propulsive and the resisting forces, must be considerable; and the course of events is that the arterial current can only make its way into the eye at the acme of the pulse-wave, during which the arteries fill from the periphery of the disc to the centre, to collapse again as soon as the impulse of the systole diminishes. In such a condition, the impediment to the entrance of arterial blood is sufficient to imperil the nutrition of the nerve-tissue; and the writer has seen at least one case of partial nerve-atrophy, attended with arterial pulsation, for which no other cause than excessive arterial tension could be assigned. Arterial pulse is probably always present in advanced stages of glaucoma, but by the time it is produced the fundus is usually obscured or rendered invisible by other changes. Apart from glaucoma, its most frequent cause is aortic regurgitation; and in this form the eye does not suffer, except together with other parts of the organism.

7. *Optic Neuritis and Atrophy.*—The morbid appearances seen with the ophthalmoscope, and interesting to the physician, are chiefly those which point to the existence of some diathesis, or to the presence of disease in other organs. Swelling of the intra-ocular extremity of the optic nerve, with obliteration of its margins and obstruction to its vessels, occurs in many forms of intracranial disease, especially in connection with intracranial tumour, and is often followed by atrophy and blindness when life is sufficiently prolonged. The most interesting characteristic of these cases is that, since the swelling affects only the connective-tissue layer, which is absent over the region of the yellow spot, there is commonly no diminution of the acuteness of central vision until the atrophic changes have commenced; by which time, in many instances, the primary swelling has passed away. Hence, for many years, there existed great uncertainty about the cause of the atrophy, and this uncertainty was only removed when physicians began to examine the fundus oculi in all cerebral cases, without regard to the state of sight. Prior to that time, the intra-ocular changes were apt to remain undiscovered in their primary stage, and until commencing impairment of vision produced resort to an ophthalmologist, followed by an ophthalmoscopic examination in due course; and then the atrophy was often attributed to many fanciful causes, among which the smoking of tobacco held a prominent place. It is not necessary to assume that tobacco is never injurious to the optic nerves, in order to be quite sure that the majority of the instances of atrophy once attributed

to its influence were, in reality, due to a totally different cause. The changes associated with intracranial diseases will be found described in a special article. *See* OPHTHALMOSCOPE IN MEDICINE.

8. '*Albuminuric Retinitis.*'—Very frequently in albuminuria, and occasionally in diabetes mellitus, the fundus of the eye becomes studded over with spots or patches of a glistening white colour, which are probably due to fatty degeneration of the connective tissue of the retina, and which are often associated with scattered hæmorrhages. The blood, in these instances, is usually effused into the fibre-layer, and, following the course of the fibres, becomes spread out into somewhat striated spots, with brush-like terminations. Every case in which either the white patches or the hæmorrhages, or both, are detected by the ophthalmoscope, whether with or without impairment of sight, calls for a careful examination of the urine, and renders it proper to follow mainly the indications of treatment which such an examination may afford.

9. *Hæmorrhages.*—Without the white patches, hæmorrhages may occur in the retina under various conditions. Sometimes they are distinctly arterial, in which case they are generally small in absolute amount, and may often be traced to some manifest point of rupture in the vessel from which they have occurred. These hæmorrhages seldom produce extreme impairment of vision, although they are usually discovered on account of some degree of impairment; and their chief importance is derived from the warning they may give of a state of brittleness of the arteries, and of a consequent liability to similar bleedings elsewhere, as in the brain. They call for all the precautions which such a state would suggest, as for the consumption of a diminished quantity of fluid, and for the avoidance of constipation and of all violent bodily efforts.

Hæmorrhages which are distinctly venous occur not unfrequently in connection with the disturbances of circulation which are incidental to the cessation of the menstrual function, or to the irregularities by which cessation is preceded. The blood may proceed from comparatively large veins, in which case it often forms a layer immediately beneath the *membrana limitans* of the retina, causing great temporary impairment of sight, or even total blindness; and yet, in many cases, being quickly absorbed without permanent injury. In other instances it may proceed from smaller and deeper-lying veinlets, in which case the effusion will usually be situated in the fibre-layer, and will be moulded, so to speak, by the fibres, into what have been described as 'flame-shaped' hæmorrhages. These are generally multiple, and usually cause an impairment of function, which is decided although not total, and is often permanent. The flame-shaped hæmorrhages are said by Mr. Hutchinson to occur preferably in persons of gouty diathesis, and he holds the same doctrine with regard to a less common form, of which some remarkable examples have been observed by himself, and by Mr. Eales of Birmingham. In these cases, the subjects were young males, of constipated habit, and in many instances of gouty family history. The bleedings were large in amount, so as to penetrate into the vitreous body and to cause for a time total loss of sight, and were frequently recurrent. To what extent they were due to deficient plasticity of the blood, to abnormal friability of the vessels, to variations in vaso-motor tension, or to the withdrawal of external support from the vessels by diminished tension within the eyeball itself, is at present a matter of conjecture. It is obvious that the treatment of such cases, and of retinal hæmorrhages generally, must resolve itself into that of the constitutional conditions with which they are associated. The only special indications, as regards the eye, will be the enforcement of functional rest, and the maintenance of an elevated position of the head during sleep. In cases connected with the cessation of the menstrual function, the absorption of the effused blood often appears to be promoted by the careful administration of iodide of potassium, which should usually be combined with ammonio-citrate of iron, or with some other suitable tonic, and care should always be taken to maintain a moderately relaxed condition of the bowels. Even apart from the injurious effects likely to be produced by straining, constipation appears to predispose to hæmorrhage.

10. *Embolism of the Central Artery.*—Sudden loss of vision is sometimes occasioned by the plugging of the central retinal artery by an embolus. This is especially to be suspected in cases of known valvular disease of the heart, and the condition is readily recognisable with the ophthalmoscope. The retinal veins are usually somewhat dilated, but their contained blood is broken up into irregular portions, in which an uncertain or wavering movement may sometimes be detected. The arteries are either obliterated, or so dwindled as to be scarcely visible. The connective tissue of the retina rapidly becomes cloudy and opaque, so that the general surface of the fundus is milky or opalescent; but in the region of the yellow spot, where there is little or no connective tissue, this opacity cannot be produced, and the red colour of the choroid shines through, producing the effect of a cherry-red spot on a white ground. After a few weeks the retina regains its transparency, but the optic nerve passes into a state of absolute atrophy.

R. BRUDENELL CARTER.

OPHTHALMOSCOPE IN MEDICINE.

In a large number of diseases which come under the care of the physician—diseases of the nervous system, kidneys, blood, and other structures—intra-ocular changes occur, and may be observed with the ophthalmoscope. Hence this instrument is highly useful to the physician. By its aid we can observe, magnified about twenty diameters, the termination of an artery, of a vein, and of a nerve; a peculiar vascular structure (the choroid); and a peculiar nervous structure (the retina). Nowhere else are nerve and vessels exposed to direct observation. Many changes affecting these tissues throughout the body may be first and best detected here, and in some other diseases these intra-ocular structures are affected in a special manner.

The chief changes in the fundus oculi which are of importance to the physician are the following:—(*a*) In the *retinal vessels*:—variations in size, in the condition of their walls, the existence of aneurisms, the tint of the blood, the occurrence of visible pulsation in arteries or veins, of hæmorrhages, or of vascular obstruction. (*b*) In the *optic nerve* or *papilla*:—congestion, neuritis or papillitis; atrophy, simple, consecutive (after neuritis) or choroiditic. (*c*) In the *retina*:—various inflammatory or degenerative changes or growths. (*d*) In the *choroid*:—inflammatory exudations, with their resulting disturbance of the choroidal pigment, atrophy, growths. For a description of these various changes the reader is referred to the special articles. In this place it is only possible to point out the changes which present themselves in the various special diseases which come under the physician's care.

I. Diseases affecting the Nervous System.

1.—**Brain.**—Two forms of ocular changes are met with: (1) 'associated,' the consequence of the cause of the cerebral disease; (2) 'consecutive,' the direct result of the cerebral disease. *Anæmia* and *hyperæmia* of the brain are not, as a rule, revealed by any corresponding change in the retinal circulation, this being regulated in a special manner by the intra-ocular tension. Such changes, when affecting the whole head and considerable in degree, are, however, shared by the retinal vessels. Moreover, acute cerebral hyperæmia may, after a time, lead to congestion of the optic papilla. *Acute general cerebritis* is usually accompanied by meningitis, and to the latter the ophthalmoscopic changes are probably in part due. There is a form of *chronic cerebritis* or *encephalitis*, of which the symptoms are somewhat like those of tumour, but the only changes to be found after death are microscopic. In this condition well-marked neuritis (papillitis) may be present.

In *cerebral hæmorrhage* consecutive changes are extremely rare, and are almost confined to cases of meningeal hæmorrhage, from which slight neuritis may result. Of associated changes, aneurisms are rare, but have been noted; retinal hæmorrhages are not unfrequent. They are most significant in blood-states, although most common in renal disease associated with albuminuric retinitis. In the latter they indicate vascular disease, but not necessarily that a cerebral lesion is hæmorrhagic, since they are often associated with softening of the brain.

In *softening from embolism*, retinal embolism may be, in rare cases, associated. In ulcerative endocarditis septic hæmorrhages may be seen in the retina. Consecutive changes are, as a rule, absent; occasionally slight optic neuritis is developed.

In *softening from arterial thrombosis*, when this is due to atheroma of the vessels, associated changes (hæmorrhages, or renal retinitis) may be found in the retina, but there are usually no consecutive changes. The latter are also absent in thrombosis from syphilitic disease of arteries; but associated changes—the various ophthalmoscopic manifestations of syphilis—are common, and are often of the highest diagnostic importance.

In *abscess of the brain*, optic neuritis occurs in a considerable number of cases, although not in all. It has no known relation to the position of the abscess, but is perhaps most frequent in the cases in which the abscess results from an injury.

Tumours of the brain.—Associated changes are very rare, and are confined to the cases in which a similar growth (glioma or tubercle) exists within the eye. Consecutive changes are more common than in any other cerebral affection. Optic neuritis occurs in about four-fifths of the cases. On what its occurrence or absence depends we do not know. Neither position, size, nor nature of growth seems to influence it in any considerable degree. It does not depend on increase of intracranial pressure. In some cases it is at least aided by the occurrence of meningitis. In many cases a slight descending inflammation may be traced from the optic tracts down the nerves to the eyes, and this, at the papilla, seems to excite a more intense degree, perhaps aided by mechanical congestion or œdema of the sheath. The latter is commonly found after death, but probably does not constitute the chief mechanism by which neuritis is produced. A tumour may exist for a long time without neuritis, or the neuritis may be present as soon as the symptoms of tumour manifest themselves. Often the neuritis and the tumour correspond in their course, each being acute or chronic. Both may even be almost stationary for years. An acute neuritis, occurring during the course of a tumour which appeared chronic, usually indicates an increase in the growth, and is of bad prognostic significance. The degree of neuritis varies; it is least in the tumours of most chronic course, and greatest in the rapid growths. It is often accompanied by hæmorrhages. Commonly bilateral, it is in rare cases unilateral, and is then usually in the eye opposite to the seat of the tumour. It may exist in considerable degree without impairing sight. Perception of colour may be affected before acuity of vision. If the tumour be arrested by treatment, as in syphilitic and tubercular growths, the neuritis will subside, but too often, before this result is obtained, sight has been damaged beyond recovery. Simple atrophy of the optic nerves sometimes results from tumours, although far less commonly than 'consecutive atrophy.'

Intra-cranial aneurisms are rarely accompanied by intra-ocular changes. Now and then, an aneurism of the internal carotid has caused atrophy by pressure, and even optic neuritis, single or double.

Internal hydrocephalus is usually accompanied by no other ophthalmoscopic changes than slight fulness of the veins. Occasionally simple atrophy occurs, commonly from the pressure of the distended third ventricle on the optic chiasma.

Meninges.—Growths in the meninges lead to optic neuritis, just as do tumours in the cerebral substance. The effect of meningitis varies according to its form and seat. Simple meningitis of the convexity is rarely attended by ocular changes. It is very different with basilar tubercular meningitis. Occasionally, though rarely, tubercles of the choroid may be seen. In a considerable number of cases there is distinct neuritis; it is well-marked in at least half. Usually too late to be of diagnostic importance, it is now and then sufficiently early to decide the nature of the case. A similar change is common in both syphilitic and traumatic meningitis, but is very rare in the epidemic cerebro-spinal form.

Diseases of the cranial bones.—Caries of the sphenoid bone may cause descending neuritis; caries elsewhere usually only affects the eye by causing meningitis or abscess. Thickening of the cranial bones may be attended by well-marked, sometimes intense, neuritis, with hæmorrhages. This is apparently produced by the resulting constriction of the nerve and sheath at the optic foramen. Inflammatory mischief, or growths in the orbit, frequently cause neuritis or atrophy, the optic nerve-trunk being damaged directly. In these cases the affection is unilateral, at least for a long time, and is often accompanied by prominence of the eyeball, and tenderness when it is pushed back.

Injuries to the head may affect the eye in various ways. (1) The retina may suffer in consequence of the immediate concussion. (2) Optic neuritis may come on after a few days, commonly as the result of a traumatic meningitis. (3) Direct injury to the optic nerves may cause loss of sight and simple atrophy. (4) Optic neuritis may come on some weeks after the injury, and is usually due to inflammatory processes in the damaged brain.

2. **Spinal cord.**—*Acute myelitis* and *spinal meningitis* are very rarely attended by eye-changes. In one or two cases coincident optic neuritis has been observed. The connection between the two is obscure. *Sclerosis of the posterior columns* (locomotor ataxy) is accompanied by atrophy of the optic nerves in a considerable number of cases, although not perhaps in more than fifteen per cent. When it does occur it is frequently an early rather than a late symptom. It is always the simple form of atrophy, often grey with unnarrowed vessels. Sight usually suffers gravely; the field of vision is much restricted; and perception of colours may be lost. The atrophy is not the result of any extension upwards of the disease in the posterior columns. It may occur when this has scarcely commenced, and even years before the earliest symptoms. It is apparently an associated degeneration. In *lateral sclerosis* oculur changes are doubtful. In *disseminated sclerosis*, optic nerve-atrophy may occur, just as in posterior sclerosis, but less frequently. Damage to sight, without opthalmoscopic changes, occasionally results from the sclerosis invading the optic commissure or nerves. In caries of the spine changes in the optic disc are practically unknown. In very rare cases of injury to the spine, neuritis and subsequent atrophy have been observed, but these results are so rare that their precise significance is doubtful.

3. **Functional Diseases.**—In *exophthalmic goitre* the only ophthalmoscopic change is increased size of the retinal arteries, which may pulsate visibly. In *chorea*, embolism of the central artery of the retina has been once or twice observed; and so also has optic neuritis, slight in degree. As a rule, however, the fundus is normal. With *neuralgia* of the fifth, optic nerve atrophy has been observed; the nature of the association is doubtful. In *idiopathic epilepsy* the appearance of the fundus is, as a rule, perfectly normal. Even during an attack it is probable that the only change is venous distension during the stage of cyanosis. But during the status epilepticus, when attacks recur with great severity for several days, a condition of slight neuritis may be produced, subsiding after the attacks are over. In cases of *convulsions* from organic brain-disease, it must be remembered, optic neuritis or its effects are often met with. The frequency with which morbid appearances are to be seen in the eye in *insanity* has been variously stated, and by some writers unquestionably exaggerated. They are most frequent in general paralysis of the insane. Optic-nerve atrophy is the usual change, and is sometimes an early event, just as in locomotor ataxy. In very rare cases slight neuritis has been seen. In mania, melancholia, and dementia it is probable that there are no related morbid appearances in the eye.

II. Diseases affecting the Urinary System:—

1. **Bright's Disease.**—Sight may be impaired in this complaint by uræmic poisoning, or by retinal changes. The latter may occur, even in considerable degree, without any affection of vision. The arteries may occasionally be conspicuously narrow (contracted), and in rare cases may present sclerosis of the outer coat, or minute aneurisms. Aneurismal dilatations of the capillaries may often be found *post mortem*, in association with other degenerations, and probably lead to the occurrence of a very common change in the retina—hæmorrhages. These are usually striated, situated in the nerve-fibre layer; sometimes they are irregular in shape, and situated in the deeper layers. They may detach the retina from the choroid, or burst through into the vitreous. Sometimes they exist alone; more commonly they are conjoined with other changes, to which the term 'albuminuric retinitis' is given. This latter change may occur in all forms of renal disease, but is by far the most common in the granular kidney. It is a late symptom, never appearing until the general system is suffering. The disease of the retina presents certain elements which are variously combined in different cases. 1. Diffuse slight opacity and swelling of the retina, due to the infiltration of its substance by an albuminous coagulable liquid (œdema). 2. White spots and patches of various size and distribution; some large and soft-edged; others minute, and of pearly whiteness. They are due to fatty degeneration of the retinal elements, or to granular degeneration of albuminous exudations. The small white spots often radiate around the macula lutea. 3. Hæmorrhages. 4. Inflammation of the optic papilla—'neuritis.' 5. The subsidence of the inflammatory changes may be attended with the signs of atrophy of the optic nerve and retina. According to the predominant character, four types of retinal affection may be distinguished: a degenerative, hæmorrhagic, inflammatory, and neuritic form. In the first the white spots predominate, and there are usually extravasations, but there is little diffuse opacity. In the second the hæmorrhages are so abundant as to be the chief feature. In the third there is much diffuse opacity and swelling of the retina. In the fourth the optic neuritis is in excess of the other

changes, and the appearance may easily be ascribed to cerebral disease—the more so that it is often conjoined with headache, and other evidence of cerebral disorder. The conspicuous combination of white spots and hæmorrhages usually enables the retinal affection of albuminuria to be recognised without difficulty. It may be confounded with the degeneration left by a previous wide neuro-retinitis, but in such cases the signs of atrophy will be conspicuous. The course of the affection in Bright's disease is often progressive, but arrest and even recovery may be obtained by the treatment of the renal disease. When extensive, sight is usually impaired, but is rarely completely lost.

2. Diabetes.—In diabetes, in rare cases, retinal changes have been observed exactly similar to those of the degenerative form of the albuminuric affection, and this when there was no albumen in the urine. Miliary aneurisms have been found *post mortem*. A distinction from the renal form is the frequency with which there are opacities in the vitreous, due probably to slight extravasations of blood.

III. Diseases of the Heart.—The peculiar conditions of the intra-ocular circulation prevent any dynamical changes in the circulation. Venous distension, if considerable, may be visible in the eye, especially in cyanosis. When arterial pulsation is strong it may be visible in the retinal arteries, as in exophthalmic goitre and in aortic regurgitation. In these cases also the arterial pulsation may (probably in the sclerotic ring) be communicated to the vein, and this also may pulsate. Embolism of the central artery of the retina may occur, and, like embolism elsewhere, is most common in mitral constriction. In ulcerative endocarditis, accompanied with multiple embolism, retinal hæmorrhages occur, for the most part round, with a pale or white centre. They are almost pathognomonic.

IV. Diseases of the Blood.—Acute *anæmia* from hæmorrhage may be followed by loss of sight, slight or considerable, transient or permanent. The accident most commonly follows hæmatemesis, uterine hæmorrhage, or venesection. In some cases no ophthalmoscopic changes have been found; in others there has been neuro-retinitis. The mechanism of the affection is obscure. Simple chronic anæmia is accompanied by marked pallor of the veins, sometimes of the choroid and disc, but the latter is always within the physiological variations in tint. Occasionally in chlorosis optic neuritis is met with, disappearing rapidly under iron. In *pernicious anæmia* the choroid is notably pale, the arteries small, the veins very broad (atonic) and pale. Hæmorrhages are frequent, especially around the optic disc, and they are often associated with white patches. Some extravasations are rounded, with a white or pale centre. Occasionally there is marked neuritis. In *leucocythæmia* the pallor and width of the veins are very striking. Extravasations are almost invariable at some period: white spots are frequent, some degenerative, others due to aggregations of leucocytes. Some are surrounded by a halo of extravasation. There may also be considerable general swelling of the retina, throwing the distended veins into conspicuous antero-posterior curves. In *purpura* and *scurvy* retinal hæmorrhages also occur. In the intense forms of purpura, indeed, they are probably constant.

In rare cases of *menstrual* disorders, and still rarer instances of *intestinal* disturbance (chronic diarrhœa) optic neuritis has been observed. Suppression of the menses has been followed by retinal hæmorrhages. The connection between the several events is obscure.

V. Chronic General Diseases.—In chronic general diseases ophthalmoscopic changes are met with occasionally. In *tuberculosis*, tubercles may form in the choroid, and be recognisable as small, round, yellowish-white spots, free from pigment. They have more frequently been found in this situation after death than during life, perhaps because not looked for with sufficient perseverance, since they may form rapidly. In *syphilis* ocular changes are, as is well known, common, but they come chiefly under the care of the surgeon. Traces of past iritis, or of choroiditis—areas of choroidal atrophy with irregular accumulation of pigment, frequently afford the physician important evidence of the previous existence of syphilis, acquired or inherited. In the latter the choroidal changes are of especial importance, and may be confined to small round white spots with pigment in the centre, or there may be evidence of more extensive choroiditis or merely of choroiditic atrophy, a yellowish disc, with the edge a little blurred, and very small retinal vessels. *Gout* has been supposed to cause retinal hæmorrhage (Hutchinson), but its connection with ophthalmoscopic change (except through the medium of kidney-disease) is not well-established.

In *lead-poisoning*, besides the amblyopia which may come on without ophthalmoscopic changes, atrophy of the disc is occasionally met with, preceded, in some cases, by a stage of congestion, a red disc, with softened edges, without swelling. A considerable degree of neuritis, double, with swelling and hæmorrhages, occurs occasionally, especially in connection with cerebral symptoms, but without any coarse lesion of the brain. In *chronic alcoholism*, optic-nerve atrophy has been described, and also a condition of congestion. The amblyopia which accompanies the atrophy is said by Förster to be characterised by loss of central vision for colour. The same fact is well established with regard to *tobacco* amaurosis, in which similar congestion and atrophy may occur.

VI. Acute General Diseases.—In acute general diseases, changes in the fundus are for the most part rare. After *typhus*, *typhoid*, and *scarlet fevers*, optic neuritis has been occasionally observed, apart from any renal or cerebral complication. The kidney sequelæ of scarlet fever may of course lead to the special retinal changes. *Malarial fevers, ague*, &c., are frequently attended with retinal hæmorrhages (Poncet, S. Mackenzie). Sometimes the extravasations have paler centres. Optic neuritis and atrophy have also been observed. *Erysipelas of the face* has been accompanied by loss of sight, and followed by atrophy, probably by the extension of the inflammation to the orbit, and to the trunk of the optic nerve. *Pyæmia* and *septicæmia* have long been known to be occasionally accompanied by metastatic panophthalmitis, and recent observation has shown that slighter alterations in the fundus oculi frequently accompany the severer forms of these affections. Of these the most important are retinal hæmorrhages, round or irregular, sometimes large, and often with pale centres. It is probable that they are in some cases due to septic embolism, but they may occur without endocarditis, and are probably due, in some cases, to chemical changes in the blood. They are almost invariable in puerperal septicæmia (Litten), and are also found in other forms of ulcerative endocarditis. Usually, they occur only a few days before death. In other cases a peculiar form of retinitis has been observed, with white spots about the papilla and macula lutea (Roth).

Most of the appearances mentioned above will be found figured in the writer's *Manual and Atlas of Medical Ophthalmoscopy.*

W. R. Gowers.

OPISTHOTONOS (ὄπισθεν, backwards, and τόνος, a stretching).—A tetanic spasm, in which the body is arched backwards, so that it rests on the head and heels. *See* Tetanus.

OPIUM, Poisoning by.—In consequence of the extent to which opium and its preparations, including morphia, are used for the relief of pain, and the readiness with which the drug is procurable, poisoning by opium is of frequent occurrence; and there is no doubt that great numbers of infants perish every year in this country through the improper use of quack remedies containing opium.

So far as toxicology is concerned, the effects of opium may be referred exclusively to morphia; since the effects of the other active constituents of the drug are overshadowed by those of the chief alkaloid.

Anatomical Characters.—The *post-mortem* appearances after opium-poisoning may be almost *nil.* As a rule the brain is congested, the *puncta cruenta* being especially marked; and the lungs and right side of the heart may exhibit an engorgement, as if from a modified asphyxia; but this condition is by no means invariable.

Symptoms.—The first effect of the administration of a toxic dose of opium—a state of *bienfaisance* or exaltation—commonly observed also after the administration of a medicinal dose, may be either very short or entirely wanting; and this is commonly the case when morphia is injected hypodermically. A second stage, in which the symptoms closely resemble those of congestion of the brain, soon sets in. The face is either suffused or cyanosed; the pupils strongly contracted; the skin dry and warm; the breathing slow, deep, and becoming stertorous. The patient is apparently unconscious, but may be aroused by shaking, or shouting in the ear; and when he is aroused, the respirations become more rapid, and the skin may regain its normal colour. The symptoms of this second stage may gradually ameliorate under appropriate treatment; or a third stage—that of prostration—supervenes. The coma is now profound, and it may be impossible to arouse the patient. The pupils are contracted to the size of pin-points; or towards the termination of life may be widely dilated. Respiration is now very slow, shallow, with gradually increasing intervals, during which there are no signs of breathing, and the patient lies in a death-like calm. The face is at once pallid and cyanosed; the skin is bathed in perspiration, at first warm, and then cold and clammy. The pulse increases in rapidity, with progressively increasing feebleness. The patient may even now recover, signs of life returning very gradually; or death may occur from failure of respiration, the other functions of life becoming also gradually extinguished.

Unusual symptoms in opium-poisoning are trismus and convulsions. In children toxic doses may produce very rapid effects, the second stage of the intoxication being wanting, and severe collapse and complete unconsciousness rapidly supervening.

Diagnosis.—The certain diagnosis of opium-poisoning is often a matter of great difficulty, as the symptoms may differ in no material respect from those exhibited in congestion of the brain, however produced, apoplexy, and uræmia. The case may also be confounded with profound alcoholic intoxication. It may also be difficult or impossible to diagnose from poisoning by chloral hydrate—a matter of less importance, since the treatment of the two cases would be similar. The differential diagnosis of opium-poisoning rests upon the equally and minutely contracted state of the pupils, a condition which is all but universal in the second stage of opium-poisoning; our ability to arouse the patient temporarily, the rousing being followed by more or less complete disappearance of the cyanosis of the countenance, and by increased rapidity of respiration; and the profuse warm or clammy perspiration. An examination of the urine for albumin, which may have to be drawn off by the catheter, should always be made; but it must be borne in mind that uræmia and opium-poisoning may be co-existent.

Prognosis.—This is at all times doubtful. There is great liability to relapse, even when the patient appears to be doing well.

Treatment.—First, evacuate the stomach by means of the stomach-pump, or failing this, by the use of emetics. These, however, act with difficulty in cases of opium-poisoning; and there is a special danger in the use of depressing emetics, as, for example, tartar emetic, on account of the possible retention by the stomach of a fatal dose of the emetic. Warm mustard and water, and carbonate of ammonia are the best emetics to administer. Secondly, the patient must be prevented lapsing into a state of somnolence by walking him about; alternate warm and cold applications to the chest; flicking the feet with a damp towel; shouting into the ear; and the application of the faradic current. These means will have the additional advantage of maintaining the flagging respiration, and restoring normal breathing. In the last resort artificial respiration must be freely employed. The absorption of the alkaloids of opium may be delayed by the free administration of solutions containing tannin, so as to render the alkaloids insoluble; and among the best media containing tannin are strong infusions of tea and coffee. The caffein which these infusions contain, itself also exerts a powerful remedial influence in this form of intoxication. Atropin, as a respiratory stimulant, appears also to be serviceable as a direct antidote to morphia. It is best given by subcutaneous injection, in doses of $\frac{1}{60}$th grain. Alcoholic stimulants should be freely given.

Thomas Stevenson.

OPPRESSION.—A term applied to a sense of weight in any part of the body, but more frequently used in connection with the chest. The expression is sometimes also employed in reference to a general feeling of the system being over-loaded or over-weighted, which is felt at the commencement of certain acute diseases.

OPTIC NERVE and TRACT, Diseases of.—The optic nerve may be damaged by various intra-ocular processes; but these, and also its primary atrophy, have been already described (*see* Eye and its Appendages, Diseases of; Ophthalmoscope; and Ophthalmoscope in Medicine). In this article only those affections which are situated behind and independent of the eye will be described.

Passing from the orbit into the intracranial cavity by the optic foramina, into which they closely fit, the optic nerves are connected at the chiasma, where an approximate semi-decussation takes place. In spite of recent assertions of Besiadecki and others, the existence of the semi-decussation is quite beyond doubt. From the chiasma each optic tract, containing fibres from the corresponding halves of both retinæ, passes backwards, between the crus cerebri and the inner edge of the temporo-sphenoidal lobe, to the posterior portion of the optic thalamus, where it becomes connected with the corpora geniculata. Fibres pass thence in three directions, namely:—(*a*) to the posterior extremity (pulvinar) of the optic thalamus; (*b*) to the corpora quadrigemina, especially the anterior; and (*c*) to the convolutions (occipital lobe and angular gyrus). Experiments on monkeys (Ferrier) demonstrate that these convolutions are concerned in vision.

Ætiology.—In the orbit the nerve may be damaged by inflammation; such as orbital cellulitis, arising by the extension of facial erysipelas, or produced by exposure to cold. The inflammation rarely invades the nerve, on account of the thickness of the sheath which invests it, but the nerve is damaged by the pressure of the inflammatory products. It may also be compressed by an aneurism of the ophthalmic artery or by orbital tumours; or may be itself the seat of morbid growths or of hæmorrhage. At the optic foramen the nerve may be compressed by a narrowing of the foramen, such as occurs in thickening of the cranial bones, an occasional consequence of syphilis, acquired and congenital. Within the skull, the nerve in front of the chiasma may be damaged by the extension of inflammation from the meninges. The optic commissure is occasionally involved in growths, and may be compressed by growths in, or great distension of, the third ventricle. The nerves in front of the chiasma, and the chiasma itself, are liable to be damaged by the pressure of aneurisms of adjacent arteries. The optic tracts may be involved in hæmorrhage into, or softening of, the crura cerebri; but the most frequent cause of their damage is a tumour arising at the base of the brain, or in the adjacent part of the temporo-sphenoidal lobe. The central connections of the optic nerves, the corpora geniculata, optic thalamus, white substance outside it, and convolutions, may be damaged by tumour, softening, or hæmorrhage. The corpora quadrigemina are rarely affected, so as to cause ocular symptoms, except by growths.

Symptoms.—Damage to the optic nerve, between the optic commissure and the eye, is evidenced by affection of sight in that eye only. There may be either a concentric or sector defect in the field, or complete blindness; the reflex action of the pupil is impaired. When the nerve is slowly compressed, the loss of sight is followed by slow atrophy of the intra-ocular extremity. When it is invaded by inflammation, this usually descends to the eye, and is visible as intra-ocular neuritis, and may ascend to the commissure, so that the sight of the other eye may subsequently suffer. Inflammation at the back of the orbit usually also involves the motor nerves, and so may cause paralysis of all the ocular muscles. These recover, however, much more readily than does the optic nerve. When the nerve is compressed by narrowing of the optic foramen, the loss of sight is usually accompanied, sometimes preceded, by intra-ocular neuritis. This is also present in most cases in which inflammation extends from the meninges to the intra-ocular part of the optic nerves, the optic chiasma, and even in extension to the optic tract. Damage to the chiasma usually affects the sight of both eyes. In most cases the decussating fibres suffer chiefly or alone, and consequently there is loss of function of the inner half of each retina, and loss of the outer half of each field of vision—*temporal hemiopia* or *hemianopsia*. Damage to the outer part of the commissure on each side affects the fibres which do not decussate, and so causes loss of function of the outer half of each retina, and so loss of the inner half of each field—*nasal hemiopia*. This is very rare, but has been seen from disease of arterial trunks on each side (Knapp). In irregular damage to the chiasma the loss of vision may be irregularly distributed in the two eyes.

The optic tract receives fibres from the half of each retina on the same side, and its damage thus causes loss of sight in the opposite half of each field of vision—*lateral hemiopia* or *hemianopsia*. The area affected is often rather more extensive in the eye on the side opposite to the lesion than in the eye on the same side. Since the motor tract, in the adjacent crus cerebri and hemisphere, has decussated at the medulla, if it is also involved in the lesion, there is hemiplegia on the same side as the loss in the field of vision. The patient is unable to see to the side on which he cannot move the limbs. Thus the writer has recorded a case in which a patient had, first, right hemiopia, and afterwards right hemiplegia. Both were due to a small tumour of the inner part of the temporo-sphenoidal lobe, which had first invaded the optic tract and then the crus.

Disease of the corpora geniculata also causes hemiopia.

Regarding the effect of lesions of the fibres which extend from the corpora geniculata to the posterior part of the optic thalamus and to the convolutions, there is some difference of opinion. It has, until lately, been held, with Von Graefe, that lesions of the convolutions to which these fibres proceed, or of the fibres themselves, cause hemiopia, just as does a lesion of the optic tract. But Charcot has called attention to the fact that hysterical hemianæsthesia, believed to be due to a disturbance of the sensory function of one hemisphere, is commonly associated, not with hemiopia, but with 'crossed amblyopia,' that is, with partial loss of sight of the eye on the anæsthetic side, diminished acuity of vision, restricted field, and the fields for colour-vision are also lessened. These fields vary normally, in extent, for the several colours, and some or all may be so lessened as to cause partial or complete colour-blindness. Similar crossed amblyopia has also been observed as a consequence of organic lesions causing hemianæsthesia, and therefore probably involving the fibres of the posterior part of the internal capsule, outside the optic thalamus. Hence Charcot has put forward the hypothesis that the fibres which pass from the optic tract to the corpora quadrigemina are those which have not decussated at the chiasma, and that in the corpora quadrigemina a complementary decussation takes place, the fibres passing to the other side and there joining the fibres which decussated at the chiasma, so that the convolutions of each hemisphere receive the fibres, not from one half of each retina, but from the whole of the retina on the opposite side, and so the association of crossed amblyopia with hemianæsthesia is intelligible. Hemiopia, Charcot believes, is always due to damage to the optic tract, and diseases of the hemisphere which cause hemiopia only do so by pressure on the optic tract. The facts available as evidence on this question are not very numerous, but they are decidedly opposed to Charcot's theory. Clinically, hemiopia is not unfrequently met with in association with hemiplegia, hemianæsthesia, and occasionally with aphasia, in cases in which there is no reason to believe that there is more than one lesion, or that it is situated elsewhere than in the hemisphere. Such clinical evidence alone is of little weight, but it derives significance from a few reliable pathological facts, in which a lesion near the surface of the brain, such as a hæmorrhage, the size of a walnut, beneath the occipital convolutions (Baumgarten) has caused hemiopia. The symptom has been due to tumours in this situation in many recorded cases, and in one which has come under the writer's notice. These facts make it probable that when crossed amblyopia results from a unilateral cerebral lesion, the effect is due to a reflex rather than to a direct influence. The direct effect of a unilateral cerebral lesion is to cause hemiopia. The same symptom may also result from a lesion of the posterior part of the optic thalamus. Charcot suggests that this always results from tumour or hæmorrhage in this situation, which has compressed the tract. But no case exists which affords support to the opinion that the pressure of an adjacent hæmorrhage on the optic tract could cause hemiopia, and two cases have come under the writer's notice—one in a patient of Dr. Hughlings Jackson, who has published the case—in which hemiopia resulted from a simple softening of the pulvinar.

Disease of the corpora quadrigemina has usually caused complete loss of sight in both eyes, but in almost all cases the lesion has been a tumour, which may have compressed the adjacent corpora geniculata, or caused optic neuritis. If Charcot's theory were correct, a lesion here should cause nasal hemiopia, but such an effect has never been observed.

Diagnosis.—The chief points which are our guides in determining the position of post-ocular disease, causing loss of sight, have been already stated. If the affection of sight is confined to one eye, it is probably—and, if associated with unilateral optic neuritis, it is almost certainly—due to disease of the nerve in front of the chiasma. In this case the reaction of the pupil to light is impaired. On the other hand, if the unilateral affection of sight is associated with hemiplegia, and especially with hemianæsthesia, on the same side, it is probable that the disease is in the hemisphere, and the failure of sight is produced in some manner at present unknown. In this case the pupil often acts well to light. Lateral, homologous, hemiopia indicates disease of the tract, posterior part of the thalamus, or white substance between the thalamus and the occipital and angular convolutions, or of these convolutions themselves. In which of these positions it is must be determined by the indications of the localisation of disease of the brain (*see* Convolutions of the Brain and Cortex Cerebri, Lesions of). Nasal or temporal hemiopia indicates disease of the optic chiasma.

Prognosis.—This must be influenced by the position of the disease, and by its nature. When there is simple pressure on the optic nerve, sufficient to abolish sight, the prognosis is very unfavourable. Damage by the extension of inflammation often lessens considerably. In disease of the optic commissure or optic tracts the prognosis is also grave, because the morbid processes, from which these parts suffer, rarely recede. On the other hand, in disease of the hemisphere, considerable improvement often takes place, just as it does in other symptoms. Often, however, the symptom is thought to have disappeared when it still persists in a diminished degree.

Treatment.—The treatment is essentially that of the disease to which the symptom is due, and need not be further discussed in this place.

W. R. Gowers.

OPTIC THALAMUS, Lesions of. *See* Thalamus Opticus, Lesions of.

ORBIT, Diseases of.—Synon.: Fr. *Maladies de l'Orbite*; Ger. *Krankheiten der Augenhöhle.*—The diseases of the orbit are not numerous, and are almost exclusively surgical in their character. The bony walls of the cavity are liable to be fractured by direct injury, which generally implicates other portions of the skull; the contained tissues are liable to phlegmonous or suppurative inflammation; and the cavity may be the seat of tumours of various kinds, arising either from the walls or from some portion of the contents.

1. **Hæmorrhage.**—Hæmorrhages into the

orbit, excepting as results of injury or from the rupture of aneurismal tumours, are extremely rare; and the few cases which have been recorded have nearly all occurred in persons of generally hæmorrhagic tendency, as one local manifestation among others of a constitutional malady.

2. **Emphysema.**—Emphysema of the orbit is not unknown, and the writer has seen a young man who, in blowing his nose violently, must have ruptured some of the ethmoidal cells, for he distended his left orbit with air, and, in his own words, blew his eye nearly out of his head. The distension soon subsided, and no permanent injury was done.

3. **Inflammation.**—Inflammation of the tissues within the orbit is not a common affection, but it is liable to occur as a complication of fevers and other debilitating diseases, and especially as a complication of erysipelas of the head and face. It is marked by brawny swelling of the eyelids, with some protrusion of the eyeball and some limitation of its movements, the symptoms appearing too suddenly and increasing too quickly to be attributable to the growth of a tumour. The injection of the conjunctiva is generally less marked than that of the lids, and sight is scarcely or not at all impaired as long as the swelling is only moderate in amount. When the injected conjunctiva of the eyeball becomes œdematous, and more especially when the œdema is limited to one sector of the globe, or is much more pronounced over one sector than elsewhere, it is, in the opinion of the writer, an almost pathognomonic sign of suppuration; and the localisation of the œdema will serve as a guide to the position in which pus may be looked for. Other symptoms of suppuration, such as rigors, must of course be taken into account.

Treatment.—As soon as pus is believed to exist, it should be evacuated, since its retention among the orbital tissues may be productive of serious injury, not only to the eye, but also to the ocular muscles and to the nerves which traverse the orbital cavity. The evacuation is usually best effected by introducing a narrow straight knife through the skin, near the margin of the orbit in the selected position, and by thrusting it carefully onward as far as may be prudent, giving the blade an occasional turn upon its axis, to allow of the escape of pus as soon as it is reached. The direction of the point should be governed by complete knowledge of the anatomy of the parts; and it is better to withdraw the blade too soon than to incur any risk of wounding important structures. When it is withdrawn, if no pus follow, the puncture may be carefully deepened or extended laterally by a probe; but it is not necessary to be very strenuous in such endeavours, because if the wound through the skin and fascia be kept from healing by the introduction of a strip of lint, or of a bit of drainage-tube, the pus will soon find its way into the channel of escape thus provided for it. The cavity of the abscess should be syringed out from time to time, according to the amount of discharge, with some suitable astringent or antiseptic lotion; and care must be taken that a free opening is maintained as long as pus continues to be secreted.

4. **Caries.**—In strumous children, caries of some part of the margin of the orbit is not uncommon; and, after the diseased bone has come away, we frequently see much deformity of the lids produced by adhesions between the skin and the deeper tissues, or by the contraction of cicatrices. Many of such cases require plastic operations; but each one, before any operation is undertaken, must be carefully studied in order to discover the most promising method of procedure. In a lad with inherited syphilis, the writer has seen very extensive necrosis of the orbital margin, subsequent to the partial removal, and partial absorption, of a large gummatous tumour in the cavity.

5. **Tumours.**—Tumours of the orbit may be cysts (hydatid, dermoid, or sebaceous); lipomata; gummata; sarcomata, originating in connective tissue, and presenting the characters of myxoma, or of the sarcomatous growths distinguished respectively by round and by spindle-shaped cells; or they may be gliomata, springing from the connective tissue of the optic nerve. In other instances they may commence as an apparent hypertrophy of the lachrymal gland; or they may be cartilaginous, or osseous. All alike produce protrusion of the eyeball, and limitation of its movements, together with an amount of disturbance of vision, which depends upon the degree of pressure or of stretching to which the optic nerve is subjected, or upon the degree in which the intra-ocular circulation is impeded. Many of the forms are liable to recurrence, and may thus ultimately destroy life.

Treatment.—All tumours of the orbit alike require removal, if possible, without sacrifice of the eyeball.

R. Brudenell Carter.

ORCHITIS (ὄρχις, a testicle).—Inflammation of the testis. *See* Testes, Diseases of.

OREZZA, in Corsica.— Iron waters. *See* Mineral Waters.

ORGANIC DISEASE.—This expression indicates the nature of a disease in which there is a structural change in the part affected, as distinguished from a merely functional disorder, in which there is no evidence of such change *See* Disease.

ORGANS, Displacement of.— The special malpositions of the chief individual organs are considered in the articles which are respectively devoted to these organs, and it is only intended here to discuss the subject from a general point of view. A distinction is sometimes made between *malposition* and *displacement*, the former including all changes of position, from whatever cause; the latter implying that the organ has by some force been removed from its normal situation after it has occupied it; and the term *dislocation* has also been used in the same sense. For all practical purposes they may be considered together,

Ætiology and Pathology.— The circumstances under which an organ comes to occupy an abnormal position may be thus summarised:—1. The condition may be *congenital*, the organ never having been in its proper place. In this way all or part of the organs occupying the chest and abdomen may be transposed to the wrong side of the body (*see* MALFORMATIONS). In this connection may also be mentioned the fact that an organ, which some time or other after birth changes its place in the ordinary course of development, may fail to do so, and thus remain in a wrong situation. This may be illustrated by the testis, which occasionally is retained in the cavity of the abdomen or the inguinal canal, instead of descending into the scrotum. 2. A violent strain or effort is liable to cause displacement of an organ, especially if repeated several times. This has been made to account for some cases of movable kidney; and hernia may certainly arise in this way. 3. Malposition may depend upon imperfection in the attachments of an organ. This may be congenital, the attachments being unusually long or loose; or they may become repeatedly stretched from different causes, and thus rendered inefficient. The kidney will again afford an illustration of this cause of displacement, and also the intestines, certain portions of which may come to occupy an abnormal position owing to the unusual length of their peritoneal attachment. 4. Another cause of displacement of organs is to be referred to abnormal conditions connected with orifices or canals, which either remain patent or too large, when they ought to have closed or contracted; or which have been artificially formed, as the result of injury or other causes. Thus, a large inguinal canal and orifice, or non-closure of the peritoneal prolongation, may account for inguinal hernia; or a new opening may be produced in some part of the muscular or tendinous structures of the abdominal wall, leading to some form of ventral hernia; or an opening may remain, or be formed after birth, in the diaphragm, and hence an organ be displaced from the abdomen into the thorax, or *vice versâ*. 5. Pressure is an important cause of displacement of organs. This may come from without, as from wearing tight stays or a belt; but is of most importance in connection with morbid conditions within the body. Accumulations of liquid, gas, or solid, whether the last-mentioned be due to enlarged organs or separate tumours, are frequent causes of malposition of organs, either temporary or permanent. This is well illustrated by the effects of pneumothorax, pleuritic effusion, or an intra-thoracic growth upon the lungs and heart, or even upon certain abdominal organs; and the same thing occurs from similar conditions within the abdominal cavity. 6. Traction is another force which causes displacement of organs. The action of the lung free to expand in cases of unilateral pleuritic effusion has been supposed to aid in the lateral displacement of the heart, by exercising a kind of elastic traction upon it; but this cause is best exemplified by the effects of the contraction of diseased organs upon neighbouring organs, to which they have become adherent. For instance, the heart is frequently altered in its position as the result of a contracted cavity at the apex of the lung, in cases of phthisis. The contraction of adhesions themselves may assist in originating more or less malposition, and they frequently cause the altered situation of an organ to be permanent, by fixing it in its new position. 7. Disease in an organ itself may originate its own displacement. It commonly happens that such disease enlarges or contracts an organ, and thus causes it to pass beyond or to be drawn within its normal limits; but further, an organ may become so heavy as the result of disease, that by its own weight it displaces itself. 8. In the case of certain muscular hollow organs, such as the intestines, excessive or irregular action of the muscular coat may lead to malposition. In this way hernia may be originated, or internal strangulation of the intestine, or intussusception of one part of the bowel into another. In this connection the influence of straining at stool in causing protrusion of the lower part of the rectum may be alluded to. 9. The displacements of the uterus constitute a special group, the causes of which are much discussed. Probably prolonged standing is one element in the causation of some of these displacements in certain cases.

VARIETIES.—The principal varieties of malposition of organs have been casually indicated in the preceding remarks, but it may be useful to arrange them more systematically. 1. An organ may lie in a wrong cavity altogether; for example, the stomach or liver may lie in the chest, or partly in both chest and abdomen. 2. There may be a transposition of one or more of the viscera to the wrong side of the body. 3. An organ remains in its proper cavity, but is more or less removed from its normal position. This may merely be a temporary change, the organ returning to its place when the cause of the displacement is got rid of; or it is a permanent condition, the organ being fixed in its new site. 4. Instead of being fixed, an organ may be more or less freely movable, so that its situation alters with change of posture, manipulation, or other causes of movement. 5. A portion of an organ may pass out of its cavity, so as to lie under the skin or amongst the muscles, as in external hernia; or it may even come altogether out of the body, as happens when organs are protruded in consequence of injury, with an external wound. The displacements named *procidentia* and *prolapsus* may also be mentioned here. 6. In the case of the intestine, one part may alter in its relations to other parts, as happens in the case of invagination. Coils of the bowel also occasionally find their way into curious positions, owing to the presence of bands of adhesion, openings in the mesentery, and other abnormal conditions which predispose to their displacement. 7. The uterus presents special malpositions, both as a whole, and in relation to its different parts, which need not be discussed here. *See* WOMB, Diseases of.

EFFECTS AND SYMPTOMS.—There may be no manifest results whatever of the displacement of an organ, or at least such as can be regarded of much or any consequence. On the other hand, this condition may, if brought about suddenly or acutely, be attended with immediate symptoms of a grave nature. For instance, in the case of the intestine, the passage of its contents is often prevented, and other serious results ensue, familiar enough in cases of hernia; while rapid displacement of the heart may lead to grave embarrassment of its action, and prevent the passage of blood into the arteries, by altering the relation of their orifices to the cardiac cavities. In chronic cases also displacement of an organ frequently gives rise to phenomena of greater or less importance. Thus, its own functions are not uncommonly disturbed, and may be seriously interfered with, as happened in a case observed by the writer, where the stomach passed through the diaphragm into the thorax. The displaced organ may also produce physical effects, such as irritation or pressure, and thus give rise to pain or other subjective sensations, or to symptoms obviously connected with other structures and organs. Physical examination often reveals malposition of an organ, and this is one of the conditions which should always be borne in mind when examining either of the more important viscera. In some instances it assumes the characters of a tumour, as in the case of movable kidney; and this may prey so much upon the mind of the patient as to lead to considerable general disorder, although the condition may really not be of much moment. It must be remembered that an organ may be diseased at the same time that it is displaced, and then the symptoms are likely to be more marked.

TREATMENT.—When an organ is suddenly or acutely displaced, and the displacement is attended with serious symptoms, the first aim in treatment should be to get it restored to its normal position as soon as possible. This may be illustrated by the treatment of hernia and other forms of intestinal displacement, or of protruded organs, as the result of injury; and by the removal of pleuritic effusion, by means of aspiration, when it gravely impedes the cardiac action in consequence of displacing the heart. In chronic cases the same principle should be kept in view in the first instance. For this purpose any causes of displacement should be removed, and it may be necessary to employ mechanical means, or even to adopt operative procedures, to prevent a recurrence of the malposition. This may also be exemplified by the treatment of hernia, and of displacement of the uterus. In many cases, however, the restoration of an organ to its normal position is impracticable. Under these circumstances no particular treatment may be required; or perhaps any ill-effects resulting from the malposition may be obviated by the application of a bandage or other means of support, as in the case of movable kidney. Medicinal agents may be of service in combating symptoms, and in improving the general condition, if required. When a malposition is of no consequence, the patient's mind should be made quite easy on the point, especially if any notion is entertained of the existence of a tumour.

FREDERICK T. ROBERTS.

ORTHOPNŒA (ὀρθός, erect, and πνέω, I breathe).—A form of difficult breathing, in which the patient is unable to lie down, and is compelled to assume the sitting or erect posture. *See* RESPIRATION, Disorders of.

ORTHOTONOS (ὀρθός, straight, and τόνος, a stretching).—A form of tetanic spasm, in which the body is rigidly extended. *See* TETANUS.

OSMIDROSIS (ὀσμή, odour, and ἱδρώς, sweat).—A condition of the perspiration in which it yields an unusually strong or fœtid smell. *See* PERSPIRATION, Disorders of.

OSSEOUS DEGENERATION.—A kind of degeneration, in which the affected textures assume the characters of bone. *See* DEGENERATION.

OSSEOUS SYSTEM, Diseases of. *See* BONE, Diseases of.

OSTEITIS (ὀστέον, a bone).—A synonym for inflammation of bone, which may be of various kinds. *See* BONE, Diseases of.

OSTEOCOPIC PAINS (ὀστέον, a bone, and κόπος, fatigue).—Aching pains in bones. *See* SYPHILIS.

OSTEOID CANCER.—This term has been vaguely employed, as implying a cancer including bony structure, or with reference to malignant disease involving a bone. *See* BONE, Diseases of; CANCER; and TUMOURS.

OSTEO-MALACIA (ὀστέον, a bone, and μαλακός, soft).—A synonym for mollities ossium. *See* MOLLITIES OSSIUM.

OSTEO-MYELITIS (ὀστέον, a bone, and μυελός, the marrow).—A name for inflammation of the medulla of bone. *See* BONE, Diseases of.

OSTEO-SARCOMA (ὀστέον, a bone, and σάρξ, flesh).—A sarcomatous growth in connection with bone. *See* BONE, Diseases of; and TUMOURS.

OTALGIA (οὖς, ὠτός, the ear, and ἄλγος, pain).—Pain in the ear; ear-ache. *See* EAR, Diseases of.

OTITIS (οὖς, the ear).—Inflammation of the ear. *See* EAR, Diseases of.

OTORRHŒA (οὖς, the ear, and ῥέω, I flow). Discharge from the ear, usually purulent. *See* EAR, Diseases of.

OVARIES, Diseases of.—SYNON.: Fr. *Maladies des Ovaires*; Ger. *Krankheiten der Eierstöcke; Krankheiten der Ovarien.*

In the article ABDOMEN, Diseases of, a section is arranged in one of the groups for diseases of the female generative organs, including the uterus and its broad ligament, the Fallopian tubes, and the ovaries. Under the heads MENSTRUATION, Disorders of, and HYSTERIA, much information may be found upon subjects which might be included among the diseases of the ovaries. But there remains something regarding the pathology, diagnosis, and treatment of ovarian diseases interesting to the physician, without entering upon the more surgical question of such cysts and tumours of the ovaries as call for tapping or ovariotomy.

In proceeding to estimate the frequency and importance of the diseases of the ovaries, we have to consider the wonderful series of periodical processes which go on in women every month for some thirty-five years; sometimes without any interruption by pregnancy, sometimes interrupted by many pregnancies; some carried on to the full period, some interrupted at different stages, followed by lactation for periods variously prolonged, and perhaps suddenly stopped by the death of the child or by another pregnancy, attended by losses of blood of less or greater quantity, and ceasing usually from forty-five to fifty-five years of age, after more or less irregularity. We have to remember that at each menstrual period one or other ovary becomes swollen; that one or more of its ovisacs enlarges, opens, and admits of the escape of the ovum it contained; that the fimbrial end of the Fallopian tube grasps the ovary, receives the ovum, and allows of its passage into the uterine cavity; that the uterus itself receives an increased supply of blood; and that its mucous membrane undergoes a series of exfoliative changes. We must consider, further, how these periodical processes are associated with much that is of supreme importance in the state of the nervous centres, and in the mental condition of woman; that the normal process, instead of recurring at regular intervals, and ceasing in a few days, may be abnormally prolonged, and may recur at most uncertain periods; and that evolution and involution may be both affected by pregnancy and lactation. When we bear in mind all these highly complex conditions, processes, and relations, the wonder is, not that ovarian diseases should be frequent, but that so many women pass through life without suffering from them. If an ovary become swollen and tender, its blood-vessels overdistended, and extravasation (or apoplexy of the proper ovarian tissue) take place; or if blood escaping into the peritoneal cavity, becomes encapsuled, or forms a hæmatocele of the loose cellular tissue between the layers of one or both of the broad ligaments, we can only wonder that such an accident does not happen more frequently, and be prepared to recognise the effects of repeated slight extravasations. These are uneasiness in the abdomen, increasing to pain, more or less severe, want of sleep, and raised temperature, preceding discharge of blood from the uterus; then swelling and tenderness in one or both groins, bearing down, like labour-pains, recurring at intervals, with discharge of fluid or clotted blood or of membranous shreds; extension of pain to the loins, and irregular flow of urine—all symptoms so often observed as to be almost neglected. And if a vaginal examination is made, especially when combined with examination by the rectum, not only may one or both ovaries be felt larger and lower down than they ought to be, behind and on either side of the uterus; but they may be extremely tender on pressure, and there may be more or less evidence of peri-uterine extravasation. After repeated attacks of this nature, permanent hardening and enlargement of ovaries and uterus, and their impaired mobility, due to organisation of blood-clot or of plastic lymph, are among the most frequent pathological changes which the practitioner is called upon to treat.

The diseases of the ovaries, which will be specially described in this article, are as follows:—1. Abormalities; 2. Displacements; 3. Disturbances of Circulation; 4. Acute Inflammation; 5. Chronic Inflammation; and 6. Tumours, including Cysts.

1. **Abormalities.**—Absence of the ovaries, or their imperfect development, may occasionally be inferred; and the presence of a third or accessory ovary, now and then observed in the dissecting-room and on the operating table, may probably account for the recurrence of regular menstruation in spite of serious disease of both ovaries, or after the removal of both by ovariotomy.

2. **Displacements.**—Congenital or acquired displacements are also observed, as hernia into the inguinal canal, or prolapse to the bottom of Douglas's pouch.

3. **Disturbances of Circulation.**—Hyperæmia, when not excessive, may be considered as an essential part of normal menstruation. A very little excess may lead to the formation of a large clot in an unbroken ovisac, or extravasation into the stroma of the ovary, constituting apoplexy; or between the layers of the broad ligament, or into the peritoneal cavity, thus forming peri-uterine or pelvic hæmatocele. In some cases, apoplexy of the ovisacs is clearly traceable to torsion of the ovary upon its nutrient blood-vessels.

4. **Acute Inflammation.**—Acute oophoritis and peri-oophoritis are probably of much more frequent occurrence than acute orchitis in the male. The testicles are far more liable to mechanical injuries, but are probably not more liable to extension of the poison of gonorrhœa, or its sympathetic effects, and they are free from the periodical hyperæmia which may be regarded as the first step in the process of ovarian inflammation. This periodical hyperæmia, influenced by accidental sudden suppression of discharge of blood from the uterus, is the usual history of an acute attack of oophoritis.

SYMPTOMS.—The symptoms of acute inflammation of an ovary are pain over the pubes, tenderness on pressure in one iliac region, irritation of the bladder, tenderness of the vagina, and pain on moving the cervix uteri, and on passing the finger behind and on one side of the cervix towards the sacro-iliac synchondrosis. In patients with lax tissues, by combined rectal and vaginal examination, the swollen ovary may very often be felt. If one ovary can be felt and moved, the patient at once complains of greatly aggravated pain.

TREATMENT.—The treatment should consist in absolute rest on the back, with the hips raised and thighs flexed; or on the side not affected, if dry-cupping glasses can be applied over the sacrum. Mustard poultices, or turpentine and chloroform liniment, may also be applied over the sacrum and on the iliac region. The bowels should be well cleared out, and small doses of blue pill and Dover's powder given frequently, with a sufficient quantity of bromide of potassium. Leeching the cervix uteri has been recommended; but the local disturbance caused by it usually does more harm than the loss of blood can make up for. Sometimes the pain is so very severe that it may be necessary to give chloroform or some other anæsthetic, and repeat it more than once before the pain subsides.

5. **Chronic Inflammation.**—Chronic oophoritis, distinguished by those paroxysmal attacks of pain recurring at the menstrual periods, com.

monly known as ovarian dysmenorrhœa, is a much more common condition than the acute form of the disease. And there can be little doubt that both amenorrhœa and menorrhagia may be often due to changes in the ovaries, which are the result of repeated attacks of subacute inflammation. Some turgescence of the mucous membrane of the uterus and Fallopian tubes is a condition attendant upon ovulation; and is physiological or pathological in close relation with the normal or abnormal process in the ovary. So far as anatomical examination teaches us, it is rare to find much change in the ovaries alone, without proof of what is called peri-oophoritis; adhesions between the surface of the ovary and the fimbriæ of the Fallopian tube or the tube itself; adhesions due to pelvic peritonitis; hardening and enlargement of the ovary itself; hard clots in some of the orisacs; or, on the other hand, a shrivelling, or contraction, or atrophy of the gland.

Treatment.—Whether the chronic form of the disease has succeeded an acute attack—non-puerperal or puerperal—or one or more attacks of gonorrhœa, or repeated abortions, or has merely increased in intensity or duration after repeated recurrence, the treatment must still be the same: namely, avoidance of known causes, rest, attention to the general health, counter-irritation, and the use of sedatives, especially conium and the bromides. In cases of distinct falling downwards of one or both ovaries, an elastic ring pessary, worn in the vagina for a few weeks, is sometimes of signal service. Hard pessaries are not well borne. When all other means fail, the operation of extirpating both ovaries—Battey's operation—must be seriously considered in consultation. We require more facts, accurately observed and faithfully recorded, especially as to the mortality, and to the results obtained by the operation when it does not prove fatal, and the state of the patient's health of body and mind for some years afterwards, before the true value of the operation can be estimated. But enough evidence has been already collected to prove that, after ordinary measures have failed, and morbid physical and mental conditions are clearly dependent on abnormal menstruation, and possibly upon morbid conditions of the ovaries, the physician would be fully justified in advising the patient or her friends to call for the aid of surgery.

6. **Tumours.**—Of all the diseases of the ovaries, far more common than any malformation or displacement, even more commonly the cause of such suffering as to lead a patient to seek for medical advice than either the acute or chronic forms of ovarian inflammation, or than the ovaralgia or nervous hysterical form of ovarian irritation associated with dysmenorrhœa, and with various forms of eccentricity, and possibly of hypochondriasis, melancholia, or maniacal excitement—common though these conditions may be—cysts of one or both ovaries are the most frequent of all the diseases of these organs. So far as regards their pathological anatomy, for all practical purposes of diagnosis and treatment, they may be divided into *simple* or *unilocular*, and *compound* or *multilocular*—the former a dilated dropsical orisac, the latter a proliferating cystoma or a dermoid cyst. A still more practical, if less scientific, division might be made into (1) *Cysts*, and (2) *Tumours* of the ovaries, including in the former division such simple or multiple cysts as from the preponderance of fluid and small amount of cyst-wall, may properly be considered as ovarian dropsy—*hydrops ovarii*, or *hydrops folliculorum Graafii*; and in the latter such solid or semi-solid tumours as, under a general class of proliferating cystomata, include pseudo-colloid tumours, myxo-cystoma, cystoid adenoma, sarcoma, fibroma, papilloma, carcinoma, and (as a separate class) dermoid cysts. The histogenesis and the microscopic character of these varied forms of disease must be studied by the aid of special treatises or monographs. Here their clinical history is of chief importance.

Symptoms and Diagnosis.—Clinically the main points for consideration in cases of fluctuating abdominal tumours are whether the fluid is contained within a cyst, or whether it is in the peritoneal cavity, either free or limited by visceral adhesions. In solid tumours the seat and nature of the tumour must be investigated.

The diagnosis between fluid in an abdominal cyst and in the peritoneal cavity has been laid down in the article Ascites. Here it is only necessary to add that the limit of fluctuation as recognised by palpation, and the limit of dulness as ascertained on percussion, exactly correspond when the fluid is encysted. The wave of fluid cannot be made to pass beyond the line of dulness on percussion. But, when the fluid is free, the resonant intestines are floating in it, and fluctuation may be detected where percussion gives a resonant or tympanitic note. The wave of fluid is not stopped by any cyst-wall.

Chemical and Microscopical Examination.—If tapping have been resorted to, in order to give temporary relief to urgent symptoms, or to complete a doubtful diagnosis, chemical and microscopical examination of the fluid affords valuable information. The albumen in the serum secreted by the peritoneum is ordinary albumin, which is coagulated by heat, and will not redissolve in double its volume of strong boiling acetic acid. The albumen secreted by the epithelial layer of an ovarian cyst is that secreted rather by mucous than by serous membranes, known as metalbumin and paralbumin, which (like true albumin) is coagulated by heat, but (unlike true albumin) is re-dissolved, or converted into a translucent gelatiniform liquid, after having been boiled in double its volume of strong acetic acid. Then on examining the deposit which subsides after ovarian fluid has been at rest for some hours, there may be found in the field of the microscope the nuclei of the epithelial cells which line the interior of the cyst. The scales are thrown off, the cell-walls break down, and the nuclei remain. These are the so-called 'ovarian granule-cells' of Nunn, Bennett, and Drysdale, and are characteristic of innocent growth. In addition to these there are found in malignant growths characteristic groups of cells of different sizes, described about the same time by Foulis and Thornton as large pear-shaped round or oval cells, containing a granular material, with one or several large clear nuclei, with nucleoli and a number of transparent globules or vacuoles. The great variety in size and shape of the cells composing the groups is the characteristic feature. When these large groups are found in fluid removed from a cyst, it is extremely probable that a malignant growth projects into the cavity of the cyst. When the groups are found in peritoneal fluid, there is either some malignant growth, or an ovarian cyst of a malignant character has burst into the peritoneal cavity. Some of the cells have planted themselves upon the surface of the peritoneum, where they have grown and multiplied. Some observers believe that when such groups of cells are found in fluid removed from a cyst or from the peritoneal cavity, the evidence of the malignant nature of the disease is so strong that no other than palliative treatment is justifiable. But microscopic knowledge has certainly not yet reached such perfection as to justify a surgeon in refusing to attempt to save life by removing a tumour, if it can be removed, even if it be characterised by the formation of such groups of cells as have been described. Several such ovarian tumours have been removed after they had burst, and after several tappings of the peritoneal cavity, with the happy result of recovery from the operation and subsequent good health. After the removal of a proliferating cystoma recurrence of the disease has been observed, but there is good ground for believing that recurrence is exceptional.

Semi-solid tumours.—Semi-solid ovarian tumours are more common than simple cysts. Instead of a smooth uniform surface, irregularities may be felt, due to cysts, or groups of cysts, of different shapes and sizes, or to thickening of portions of the wall of the main cyst. The wave of fluctuation is interrupted by septa in different directions; and hard nodules, or bone-like projections, may perhaps be detected. Occasionally a deep sulcus between two portions of a semi-solid tumour, with resonant intestine in the sulcus, may lead to doubt whether both ovaries are not affected.

Solid tumours.—Ovarian tumours which are entirely solid, not fluctuating in any portion of them, are very rare, but still are occasionally met with, both as innocent fibroma and as true cancer.

Adhesions.—Any ovarian tumour—cystic, solid, or semi-solid—may be free from adhesion to the abdominal wall or to the omentum or viscera, or may be adherent anywhere within the abdominal or pelvic cavities. But as the result of ovariotomy is very little affected by the presence or absence of adhesions, a very minute diagnosis of the nature and extent of adhesions is not of much practical importance. Still if there are firm adhesions low down in the pelvis, fixing the uterus, rectum, and bladder together, or fusing them, as it were, into one mass with the ovarian growths, ovariotomy should not be performed, or only after a very guarded prognosis.

Inflammation, hæmorrhage, and *gangrene.*—Any ovarian cyst, simple or compound, may be the seat of inflammation either on its surface, when the symptoms do not differ from those of peritonitis, or in the cyst-wall or lining membrane, when (without any peritonitis) there may be pain and considerable fever, sometimes followed by rigors and suppuration. Hæmorrhage into one or more of the cyst-cavities may lead to all the symptoms and effects of internal hæmorrhage. Or the whole or portions of the tumour may become gangrenous, from a twisting of the pedicle obstructing the circulation of blood in the vessels of the tumour. In some cases twisting of the pedicle may be followed by a complete separation of the tumour from its ordinary supply of blood. In this condition the tumour is nourished by vessels in the omentum, abdominal wall, or some other structure adherent to the peritoneal coat of the tumour, if the woman's death is not speedily caused by gangrene of the growth.

Other abdominal tumours. — The abdominal tumours most frequently mistaken for ovarian tumours are fibroid or fibrocystic tumours of the uterus, and tumours or cysts of the spleen, liver, or kidney. Pregnancy, either normal or extra-uterine, may also be mistaken for an ovarian tumour, or may be present at the same time. It is not rare to find a woman with an ovarian or a uterine tumour to be also pregnant; so that the ordinary signs of pregnancy must be borne in mind in examining any woman who has an abdominal tumour. And the frequency of fæcal accumulations, or of tympanitic distension of the intestines, with thick or rigid abdominal walls and a fat omentum, must also be remembered and excluded, as well as fatty or fibro-fatty tumours which may form in the omentum, or consist of hypertrophied appendices epiploicæ, and fibro-plastic growths, from any part of the peritoneum or sub-peritoneal cellular tissue. Peritoneal hydatids, or hydatid cysts of the liver, spleen, or omentum, retro-peritoneal abscesses, pelvic cellulitis followed by abscess, distended bladder, pelvic hæmatocele, enlarged mesenteric or lumbar glands, aortic aneurism, and enchondroma, are all conditions which must be borne in mind in cases where the ordinary signs of an ovarian cyst or tumour are not sufficiently characteristic to exclude doubt.

But the most frequent source of error is cancer of the peritoneum, not necessarily involving the ovaries, although these organs may not be free from the disease. In some cases the uterus, and both ovaries, and the peritoneum everywhere become covered or infiltrated with cancerous deposits or growths, and in nearly all cases there is considerable accumulation of fluid in the peritoneal cavity. If the coats of the small intestines are involved, the very characteristic signs are manifest of movable tumours, which are both hard and resonant, and which on being pressed or kneaded gurgle under the fingers. In any case of abdominal tumour, with or without peritoneal fluid, where the loss of flesh and strength is rapid, although the tumour may not be large, where there is much pain, and the patient is subject to vomiting or diarrhœa, the diagnosis of intra-abdominal cancer generally proves too true.

Prognosis and Treatment.—1. *Medical.*—It must be confessed that the medical treatment of ovarian cysts and tumours in a curative sense is quite hopeless. In cases of supposed simple cysts, where powerful purgatives and diuretics have been followed by disappearance of the fluid, the true explanation has been either a mis-

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take in diagnosis, or an accidental rupture of a thin cyst. In the compound cysts, or the more solid tumours, iodides, bromides, mercurials, and every other remedy that has been tried, has proved useless at the best, and has often injured the general health of the patient without affecting the morbid growth. Beyond attending to the general health of the patient and palliating any urgent symptom, the chief aim of the physician should be to do no harm, to encourage a cheerful state of mind in his patient by the assurance that the disease is curable, and while postponing surgical treatment so long as it is not clearly necessary, not allowing a patient to wait so long that, after unnecessary and prolonged suffering, she falls into a condition unfavourable for the result of an operation.

2. *Surgical.*—If, after exposure to cold, or as the result of a blow or fall, a patient with an ovarian tumour presents the signs and symptoms of inflammatory changes in the tumour or in the peritoneum, rest, fomentations or poultices, and opiates are indicated. If very severe symptoms point to hæmorrhage or cyst-rupture, immediate ovariotomy may afford the only hope of saving life.

In considering the very important question how long a patient should be left to ordinary hygienic or medical treatment without any assistance from surgery, it may be said: 'So long as the patient does not suffer much pain, is not annoyed by her size and appearance, has no great difficulty in locomotion, does not suffer from injurious pressure on the organs of the chest, abdomen, or pelvis, and so long as the heart and lungs, digestive organs, kidneys, bladder, and rectum perform their functions tolerably well, surgical treatment is seldom called for. It is only a projected marriage, or a necessary voyage, or some such family circumstance, that may justify or render expedient earlier resort to surgical aid. Under ordinary circumstances the surgeon would not interfere until an ovarian tumour either distressingly deforms a patient, or seriously impedes her locomotion, or prevents the free action of heart or lungs, or obstructs the circulation through the large veins of the abdomen, or, by deranging the digestive organs, leads to emaciation and weakness, or by its pressure causes pain, loss of rest, or mechanical obstruction to bladder or rectum.' These are the rules laid down by the writer of this article in 1872. Subsequent experience of the ill effects of delay, and of the diminished and diminishing mortality of ovariotomy, lead to the conclusion that these rules rather err on the side of over-caution and too-long delay; and that the welfare of most patients is better promoted by advising an earlier adoption of surgical treatment, and probably the removal of an ovarian tumour, as soon as its nature and connections can be clearly ascertained, and it is beginning in any way physically or mentally to do harm.

In cases of single cysts the question of palliative treatment by tapping, or the radical cure by ovariotomy, must be seriously considered. And when a cyst is really single, the removal of the fluid not only gives great relief for a considerable period, but in some cases fluid does not collect again for several years, sometimes never. Even when a cyst is not absolutely single, but contains one cavity so large that smaller cavities are practically insignificant, tapping may give sufficient relief to warrant its recommendation in cases where patients desire to postpone any more hazardous operation. But in all cases it should be done with the strictest antiseptic precautions against the entrance into the emptied cyst-cavity of atmospheric air, containing any germ or material which may set up putrefactive or infective changes within the body.

Tapping by the abdominal wall, vagina, or rectum, alone or followed by pressure, by drainage, by injection of iodine, by incision, or by the formation of a permanent communication between the cyst-cavity and the peritoneal cavity, in these days can only be regarded as substitutes in cases where ovariotomy is rejected by the patient, or where the surgeon finds that the ovarian tumour cannot be removed. In a very large majority of cases the only hope of cure is in ovariotomy.

Question of Ovariotomy.—When it has to be considered in consultation whether a patient should be advised to submit to ovariotomy or not, the chief points for discussion are:—1. How long is she likely to live if left alone, or relieved by palliative treatment only—hygienic and medical—or by tapping? 2. What is the risk of ovariotomy at the average rate of mortality, and how far is the risk in the one patient who is the subject of consultation likely to be above or below the general average?

In reply to the first question, it is believed that after an ovarian tumour has attained such a size as to inconvenience a patient she rarely lives four years—even if relieved by occasional tapping—and that, with due allowance for a few exceptional cases of many years' duration, two years would be the full average expectation of life. Two years of invalid life is what is lost if ovariotomy is done and the patient's death is hastened by the operation.

The average risk of ovariotomy in a large number of cases, including the most and the least favourable, has been diminishing for many years past; and the diminution during the last two or three years has been much greater than before the adoption of antiseptic precautions during the operation. Before 1860 so many unsuccessful cases were concealed, and the numbers who died, of the cases reported, were so great, that the calculated mortality of about 50 per cent., or half the patients operated on, is probably far too small, and it would be more correctly estimated at 70 to 80 per cent. Since 1860 it has been gradually diminishing from 35 to 15 per cent; and since 1878, when antiseptics came into general use here and in Germany, it has fallen below 10 per cent., whilst well-founded hopes are entertained of a still smaller mortality.

Whether any one patient is likely to have more or less than the average probability of ten to one in her favour must depend upon her general health. For the rule holds good, that while the easy removal of small free tumours from women with a feeble heart, or unsound lungs, kidneys, or liver, or shattered nervous system, may hasten death; so may very large adherent tumours be removed with extreme difficulty from sound, healthy women, and complete recovery may follow, without fever or any unpleasant symptoms; and, most satisfactory of all, perfect health may afterwards be enjoyed for many years, the operation leading to no appreciable modification in subsequent pregnancy or parturition. The removal of one ovary does not appear to affect the number of pregnancies, nor the sex of the children, nor the occurrence of twin pregnancy; and it is quite exceptional to observe that the removal of both ovaries leads to obesity, or any other mental or bodily peculiarity.

T. Spencer Wells.

OVERLYING.—Overlying is an accident which, it is alleged, not unfrequently happens to young children, whereby they are killed by suffocation. On an average rather more than 400 children per annum are registered in London as dying from 'overlying' in bed. The post-mortem signs of overlying are those of suffocation. Evidence that a child has really died from this cause is afforded by (1) the post-mortem appearances of death from asphyxia; (2) the absence of any other mortal disease; (3) the absence of evidence of any cause of asphyxia other than overlying.

The statement that a child has been overlain should be received with caution. It is reasonable to suppose that a vigorous child would escape from a suffocating position beneath the bed-clothes, or the body of its nurse, by its own efforts; or at least succeed, by its crying and struggling, in waking its nurse. On the other hand, a very weakly child, whose lungs possibly have only partially expanded, might be killed by a very trifling cause, such as the position of its mouth and nose against the body of its nurse, or the accidental temporary obstruction of its air-passages by the bed-clothes. A medical witness before committing himself to a theory of death from overlying, must consider all the points alluded to above, and must take care not to bring a charge of almost criminal carelessness against a careful nurse, or allow an act of wilful murder to pass under the guise of accidental death.

G. V. Poore.

OXALIC ACID DIATHESIS—OXALURIA—OXALATE OF LIME CALCULUS.

1. Oxalic Acid Diathesis.—Synon.: Fr. *Oxalurie*; Ger. *Oxalurie*.

Ætiology.—Oxalic acid, when it occurs in the urine, may be derived from various sources. 1. It may come from certain articles of the vegetable kingdom taken as food. 2. It may be derived from imperfect metamorphosis of the waste tissues of the body. 3. It may be due to the conversion of urea and uric acid after the secretion or the emission of urine. 4. It seems to have been proved that oxalic acid sometimes exists in the blood, and may then simply be eliminated by the kidneys.

Characters and Composition.—Oxalic acid in the urine is always found combined with lime, and is recognised thus:—1. As minute octohedral crystals with cross markings. These crystals assume apparently different shapes, according to their varying position in the field of the microscope. 2. As spheroidal, ovoid, or dumb-bell sub-morphous masses. These latter may be mistaken for somewhat similar bodies composed of lithates, but the colour of the lithates, and the almost invariably concurrent presence of the octohedra, will distinguish them (*see* Microscope in Medicine). The urine containing oxalate of lime is always acid, generally of an amber tint, and contains a faint cloud of mucus. This cloud, however, may be so slight as to be unnoticed, and then the presence of oxalates is apt to be overlooked.

Symptoms.—However derived, the presence of oxalate of lime in the urine frequently, or in any considerable amount, cannot but arrest attention and suggest the question: Is there any special condition of the system dependent on or associated with this occurrence? In other words: Is there any peculiar habit of body to which the term 'oxalic acid diathesis' can be rightly applied? Prout, and especially Golding Bird, so fully described the symptoms of nervous exhaustion, dyspepsia, and hypochondriasis, which are said to characterise this so-called diathesis, and so fully impressed the professional mind with the clinical association of these symptoms with—if not their actual dependence on—oxaluria, that the more accurate and recent observations of Beale, Beneke, and W. Roberts, have scarcely yet succeeded in dissipating the error. These observers have proved that, in the large majority of cases in which the characteristic symptoms are present, no oxalates are found in the urine; and conversely, where oxaluria is most pronounced, the symptoms are absent. Oxalate of lime in the urine is often found in persons enjoying good health. From what has been said of its ætiology, its presence in various chronic diseases, such as phthisis, chronic bronchitis, cardiac lesions, &c., in which oxidation is retarded, is explained. So, too, oxaluria is present in many conditions of deranged digestion and mal-assimilation, and in diseases which lower nervous tone and power.

Treatment.—It will be gathered from the foregoing remarks, that oxaluria demands no direct or uniform therapeutical treatment. The indications are, to obtain perfect digestion by selecting a diet not too rich in nitrogenous or animal food, and by prudence as regards quantity, so that crude or imperfectly assimilated matters are not absorbed; to promote the healthy action of the skin and lungs by sponge or shower-baths, and free exercise in a bracing country or at the seaside; and by tonic remedies to improve digestion, and strengthen the nervous system.

2. Oxalate of lime calculus.—Description. Mulberry or oxalate of lime calculus is usually of a dark brown, sometimes almost black colour; generally ovoid or spheroidal in shape; with a rough and tuberculated exterior; and of a hard compact interior. The absolute nucleus is composed of dumb-bell crystals, united by molecular coalescence in, and through the medium of, some viscid organic matter. The influences which control this deposition and growth of calculi have been much elucidated through the researches of Dr. Carter and Dr. Ord, but need not be specially described here. *See* Calculus.

The great insolubility of oxalate of lime favours the chances of its deposition in the renal tubules. It has been detected in the kidneys of the fœtus; it is especially liable to occur during childhood; and this liability decreases as age advances. In England calculi composed entirely of oxalate of lime are rare in the adult, but in India they are comparatively frequent. Mulberry calculus in the young causes intense suffering; but in the adult, notwithstanding the formidable tubercles and rough exterior, the symptoms of stone are often mild; not improbably because these projections become entangled in the muscular columns of the bladder, and the calculus is thereby fixed in position. The symptoms of renal calculus are fully described in another article. *See* Renal Calculus.

Treatment.—Microscopic mulberry calculi, were it possible to detect their existence, could probably be washed away and carried off by diluents and diuretics; but a palpable stone is a subject for surgical treatment only.

W. Cadge.

OXALIC ACID, Poisoning by.—*See* Poisons.

OXYURIS (ὀξὺς, sharp, and οὐρὰ, a tail).—Synon.: Fr. *Oxyure*; Ger. *Spitzschwanzwurm*; *Fadenwurm.*—A genus of nematoid parasites of which the little threadworm or seatworm forms the best known type. Most English practitioners still speak of the common threadworm, *Oxyuris vermicularis*, as belonging to the genus *Ascaris*. In nine cases out of ten, when children are said to be suffering from ascarides, it is meant that they are infested with oxyurides or threadworms. These parasites not only differ from the ascarides proper in respect of size, but also as regards the form of the body, which is more or less spindle-shaped, the tail being sharply pointed. Hence the generic title. Oxyurides infest animals as well as man, the large species of the horse, *Oxyuris curvula*, being almost as injurious to that animal as the little threadworm is to ourselves. *See* Ascarides; Seatworm; and Threadworm.

T. S. Cobbold.

OZÆNA (ὄζη, a foul odour).—Synon.: Fr. *Punaise*; *Ozène*; Ger. *Stinknase.*

Definition.—Ozæna is generally understood to mean a chronic, highly fœtid discharge from the nose, or its accessory cavities. This discharge, however, and its characteristics, are rather to be regarded as symptomatic of disease, than as disease itself, and is a result of some unhealthy ulceration of the mucous membrane.

Ætiology.—The causes of ozæna are various, the most common being syphilis, struma, lupous ulceration, caries, or necrosis of the bones or cartilages, although these may themselves be dependent upon the presence of some foreign body, or other cause of occlusion of the meatus. Ozæna may exist in an idiopathic form, which is regarded by some authorities as depending upon an abnormal condition of the nasal secretion, or as analogous to the offensive odour sometimes met with in the feet or axillæ. Ozæna has been by some attributed to the abuse of mercurials, but more conclusive evidence on this point is wanting.

Symptoms.—The ulceration, on which ozæna depends, generally commences high up in the nose, though it may be first noticeable as low down as the inferior turbinated bone or septum. In the strumous form only one side may be affected, whereas in the syphilitic variety both are generally involved, and there is a greater derangement of health. The diagnosis, however, is rendered the more difficult in children, since it frequently occurs that the two conditions coexist.

The nature of the discharge varies with the case and with its progress, whatever may have been its origin, and it may be influenced by a cold, overwork, or the approach of the menstrual period. It may be either profuse or scanty, thick or thin, purulent or sanious, almost colourless or greenish yellow, and streaked with blood. It often forms crusts, or masses of inspissated mucus, which may accumulate at the posterior nares, being discharged from the nostril as horribly offensive concretions, every few days, and quickly reforming.

The complications consist in the implication of the bones and destruction of the septum, most frequently occurring in the strumous or syphilitic form, so that the nose falls in, producing great deformity.

Diagnosis.—It is of the greatest importance to distinguish between ozæna and the various forms of fœtid breath consequent on bad teeth, ulceration of the mouth and fauces, the presence of foreign bodies or of retarded secretion, or disturbance of the general health—a point which may be readily made out by causing the patient to close the mouth and nostrils alternately, or by rhinoscopic examination.

Treatment.—The treatment of ozæna must be both *local* and *constitutional*, and obviously directed to the exciting cause. *Local* treatment consists in the removal of all sources of irritation, by washing out the choanæ, and by the insufflation of powders, although this latter is not so frequently resorted to. The most valuable, undoubtedly, is the nasal douche of Thudichum, the action of which is dependent upon the fact that, while the mouth is kept open, the nares can be thoroughly washed out, and no fluid pass into the mouth, since the velum pendulum palati is closely forced against the upper portion of the pharynx. The instrument itself consists of a tube of varying length, with a perforated nozzle, which is to fit accurately to the nostril. This tube descends from a small cistern, placed at such an elevation that, by turning a stopcock, a current of fluid is injected into the cavity. The fluid used depends on the nature of the case, but is generally some saline solution, such as a weak one of common salt, or salt and carbonate or phosphate of soda; a weak solution of carbolic acid, of Condy's fluid, or of chlorinated soda; or a mercurial in some cases. An ordinary well made syringe, capable of supplying a tolerably continuous stream, will answer very well in many instances.

Where ulcerating surfaces can be seen or reached, they should be touched by a sponge or camel's-hair brush steeped in a solution of nitrate of silver, nitric acid, or carbolic acid, and the apposed surfaces kept from contact by sponge tents or laminaria. The great pain attendant on idiopathic ozæna may be relieved by applying to the frontal region an ointment containing about 2 or 3 grains of morphia to the ounce. The injection of glycerine is often of great use, especially in strumous ozæna, and it may be combined with a grain of iodine to every ounce with advantage.

With regard to insufflation, or the snuffing up or administration of medicated powders by an instrument, benefit is obtained in some instances from the use of sub-nitrate of bismuth rubbed up with Venetian chalk, or calomel rubbed up with sugar, in the proportion of a grain to an ounce. Tannin, camphor, and cubebs have all been recommended. The principal remedies used in the form of vapour, have been mercurials, such as calomel or bisulphide of mercury, sublimated by a lamp and inhaled. The vapour of hydrochlorate of ammonia is also useful in all forms of ozæna.

With regard to the *constitutional* treatment, in the strumous variety, cod-liver oil, quinine, iodide of iron, and arsenic seem to be of most service.

Those cases which are obviously syphilitic are usually more tractable than either the strumous or idiopathic varieties, under the influence of bichloride of mercury or iodide of potassium, if the patient be robust. In cases where the health is impaired, generous living, with quinine and iron, would be indicated before entering upon specific treatment. Edward Bellamy.

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PACHYDERMIA (παχὺ, thick, and δέρμα, the skin).—A state of thickening and condensation of the integument, which is sometimes observed in the lower limbs, associated with infiltration and induration. In chronic cellulitis a state of pachydermia is also met with; and thickening of the epidermis, as in the instance of callosity, has received a similar name. But the term is wanting in the scientific precision necessary for its adoption in pathology.

Erasmus Wilson.

PACHYMENINGITIS (παχύς, thick, and μήνιγξ, a membrane).—A synonym for inflammation of the dura mater. *See* Meninges, Cerebral, Diseases of.

PAIN.—Synon.: Fr. *Douleur*; Ger. *Schmerz.*

Definition.—Pain is the representation in consciousness of a change produced in a nerve-centre by a certain mode of excitation. It would seem that some special perturbation of nervous impulses, and not a mere exaltation of the normal functioning of the sensory apparatus, is necessary to the production of pain. For it will sometimes happen, in disease, that whilst the faculty of perceiving painful impressions made upon the skin is wholly, or in great part, lost, touch is felt nearly as well as in health. On the other hand, in hyperæsthesia of the surface, where the slightest impression produces exquisite pain, the power of tactile discrimination is actually diminished.

Ætiology and Pathology.—Pain is excited by many agencies applied to the skin—mechanical, thermic, chemical, electric, pathological. Of these it is probably only the last which are able to produce pain when applied to the viscera, bones, and blood-vessels. The situation of the stimulus exciting pain may be at any part of the sensory apparatus, from the end-organ in the skin to the central ganglion; but the feeling of pain is always referred to the periphery of the sensory fibre, no matter what portion of the sensory tract has received the irritation. As regards pain, therefore, which is referred to some part of the interior of the body, it must be remembered that the cause (always some pathological agency) may be operating either upon the termination of a nerve, its trunk, or upon the nervous centre in the spinal cord, or superior ganglia. There may be encroachments upon the structure of the nerve-fibre or ganglionic centre, arising from hyperæmia, effusion, or growth in neighbouring tissues.

Pathologically, pain is of at least twofold importance. 1. It causes distress and exhaustion of nervous energy, interferes with sleep, interrupts the appetite and digestion, so that the nutrition of the body is damaged, and thus, if long-continued, it can lead to changes shortening existence; or it may be so severe as of itself to occasion death. 2. Its aid in diagnosis is frequently of higher value than that of any other single symptom.

Varieties and Diagnosis.—It may be useful to refer briefly to a few examples of the diagnostic importance of pain.

Pain in the head.—When of a continuous, dull, aching character, pain in the head may be due to rheumatism of the scalp, and this is especially likely if it be increased by bending the head down. A headache of similar character, and affecting the forehead, may be dependent upon gastric derangement. Fixed in one spot, either on the head or face, and darting from that spot, if sharp and paroxysmal, it is likely to be neuralgic. If, in addition, it be accompanied by vomiting and giddiness, it may indicate migraine. Now, migraine much more often than not, endures for a day only at a time, or a little more. If, therefore, these symptoms be continued beyond this period, they should always be regarded with anxiety, as probably connected with brain-mischief. The use of the ophthalmoscope in most important here. Should pain in the head be accompanied not only by vomiting and giddiness, but by squint, or some other evidence of a localised paralysis of a cranial nerve, it is almost certainly due to intracranial disease of a coarse kind—tumour, aneurism, abscess, hæmorrhage, or meningitis. In cases of more or less complete hemiplegia from vascular changes and thrombosis, after the apparent recovery of the patient, more or less fixed pain in the head will often remain. Whilst this persists, a guarded prognosis is essential, for much more often than not further mischief will follow before long. In all cases of persistent pain in the head, the urine should be carefully examined, not only for albumen, but also for sugar. Pain of a severe kind, especially apt to attack the back of the head, is often found in the course of Bright's disease. It will then be accompanied by albuminous urine; and the ophthalmoscope will very likely show albuminuric retinitis. There is also a form of more or less continuous headache, with occasional violent exacerbations, which accompanies glycosuria.

A recurrent pain in the head, of excessive violence, and described as a feeling as though the bones were being crushed, whilst it may occasionally be due to rheumatism, is far more often dependent upon syphilis. Generally speaking, persistent pain in the head, in a person unaccustomed to it, is a symptom which should always be regarded with anxiety, and the use of the test-tube and ophthalmoscope should never in such circumstances be omitted. This should especially be insisted upon if the patient be a female, and certain concomitant symptoms incline the observer to believe the affection to be hysterical.

In obscure cases the possibility of the toxic influence of lead in causing pain in the head should not be forgotten.

The pain in the head which accompanies chlorosis is often fixed in one spot, and described by the patient as a feeling of a nail being driven into the head. This symptom not unfrequently accompanies hysterical conditions. The pain in the head complained of by school children, as attacking them in their studies, is very often due to some abnormality of refraction or weakness of certain muscles of the eye, which needs the help of an ophthalmologist to investigate. Pains in the head of a darting, shooting character, are sometimes due to locomotor ataxia.

Pain in the neck.—This is not at all uncommon, and is usually due to rheumatism affecting the fibrous covering of the large muscles. It is probable, too, that in many cases it depends upon irritation of the loose connective tissue which enables one muscle to glide over another, and which is really an expansion of the lymphatic system. Uric acid, or some equivalent, becoming deposited in this lymphatic space, will excite a little subacute inflammation, and produce a very acute pain. The diathesis of the patient should be inquired into, his urine and evacuations observed, and his mode of living investigated. There may be, too, sometimes pain in the neck from neuralgia. This will be distinguished by its paroxysmal character, and its being independent of muscular movement. Neuralgic pain in the neck is usually accompanied by pain in the district of one or other of the divisions of the brachial plexus in the arm.

Pain in the chest.—This may be referred to the chest-wall, or to the interior of the cavity. In the former case it is necessary to determine whether the pain be due to muscular rheumatism, syphilitic periostitis, intercostal neuralgia, or the encroachment of an aneurism or a tumour. Absence of febrile movement, as shown by the thermometer, and the entire dependence of the pain upon movement, point to the first of these causes. A node perceived by the finger upon the sternum, clavicle, or ribs, would indicate syphilitic periostitis. The character of the pain, and the presence of tender points, coupled very probably with a history of previous neuralgic attacks in some other part of the body, suggest intercostal neuralgia. Physical examination will detect or exclude aneurismal tumour. Pleurisy causes a pain referred to the chest-wall, which, as it is particularly marked when the patient coughs, may be confounded with muscular rheumatism or intercostal neuralgia. The elevation of temperature by which pleurisy is accompanied, will ordinarily distinguish it without difficulty, even before there are any auscultatory signs. Continued dull pain deep in the chest may indicate an intrathoracic growth, abscess, or aneurism. Careful physical examination and observation are the means by which the diagnosis of this condition can be made.

Pain is often experienced about the heart more or less early in the course of acute rheumatism. It may be dependent upon commencing peri- or endocarditis, which will be disclosed by the stethoscope. There is a dull, more or less constant pain about the heart, which occurs in conditions of nervous debility, and is not connected with organic disease of the organ. There is also a rather sharp pain just under the mamma, accompanied by cardiac palpitation, which is often complained of by epileptics, and by persons affected with hysteria. It is not accompanied by any evidence of organic change in the heart, and its origin is probably in the central nervous system. Pain in the heart, of an extremely sudden character, as though the muscle were being grasped, and accompanied by intense apprehension of death, with facial pallor and some dyspnœa, points to angina pectoris. The pain is not confined to the heart, but extends to the left arm, and to various parts of the chest. The pains in the chest which accompany various diseases of the lungs and pulmonary tubes will require to be investigated with reference to these conditions.

Pain in the spinal column.—Acute pain and tenderness of any of the vertebral spines is a symptom, not of disease of the spinal cord, but of a peculiar state of nervous exhaustion. It is common in hysterical persons, and in others who have from any cause become greatly debilitated. As a rule there is very little pain in the spine in diseases of the cord. In spinal meningitis the patient only complains of pain on movement, and especially if he endeavour to turn over in bed. Pressure upon any part of the vertebral spines usually causes no complaint. There may be a little uneasiness complained of when they are strongly percussed. Pain of an encircling kind, in a sort of band in the wall of the chest or abdomen, accompanied by what is often described as a 'bloated feeling,' is a serious symptom, and points to myelitis. There should be, however, some other confirmatory symptoms, ere this view is decisively fixed upon. In such a condition there would probably be found more or less weakness of the lower extremities, with some cutaneous anæsthesia, below the band of pain. It may happen that an aneurism encroaches upon the spinal vertebræ, or a malignant growth invades some of them. In such conditions there is often constant and excessive pain, with, not uncommonly, a good deal of tenderness of the surface. The possibility of these conditions should always be borne in mind.

In commencing caries of the vertebræ a 'stinging' pain is often complained of in the chest-wall, and pain may also be complained of on pressing somewhat heavily upon a vertebral spine. In such a case, too, the act of stooping and lifting weights is apt to cause complaint of pain in the spinal column.

Pain in the abdomen.—This may, like pain in the chest, be referred either to the abdominal wall or cavity. There may be inflammation and abscess of the abdominal wall. There may be neuralgia of the superficial branches of the lumbar plexus, in which case the pain is paroxysmal, sharp, and may be accompanied by herpes. But pain in this situation is more often myalgic, and will be found to correspond to the insertion of some abdominal muscle, which is subject to over-strain or fatigue.

Acute abdominal pain referred to the contents of the belly, may be dependent upon internal strangulation of the bowel, in which case it will be accompanied by vomiting, constipation, and probably by abdominal distension, with marked peristaltic writhings of the intestines. Or the cause may exist in a hernia which is strangulated. The symptoms in this case will be much like those above described, and therefore it is in all cases of acute abdominal pain with constipation absolutely necessary to make, first of all, a thorough examination, to ascertain that no hernial tumour is to be found. If pain in the abdomen be accompanied by tenderness on pressure, and be increased by coughing, there is probably peritonitis. In such a case the pulse will be found quick and small, and the temperature somewhat, but not necessarily, much raised. The patient will prefer to lie on the back with the knees bent, and the face will betray anxiety. In hysterical women great abdominal pain and tenderness is often complained of, and it is sometimes not very easy to distinguish this from peritonitis. It is best done by engaging the patient's attention, and noting that there is then no evidence of tenderness at a point which had been previously exceedingly painful. The pain and tenderness may be due to enteritis or perityphlitis, in which case there will be obstinate constipation, a tympanitic state of the whole intestine or the cæcum, and most probably vomiting. Cancerous tumours of various abdominal organs will have to be diagnosed by careful palpation, and discriminated from fæcal accumulation. Colic due to the poison of lead, causing violent abdominal pain without rise of temperature, requires to be distinguished from the symptoms which mark the passage of a biliary calculus. Extreme suddenness and severity characterise the latter, and there is usually more vomiting in the passing of a gall-stone than in colic. But the history will have to be investigated, and the evacuations, if any take place, should be examined. The absence of a blue line on the gums should be ascertained ere the possibility of the existence of lead colic is abandoned.

Pain in the loins and back.—There are many conditions which give rise to pain in these situations, and which require to be borne in mind in examining a patient. Congestion of the kidneys, or nephritis, will be shown by the scanty, high-coloured urine, containing albumen and probably blood. Renal calculus will be attended by unilateral pain in the loin, following the direction of the ureter, and affecting the corresponding testicle. It is paroxysmal in character, and often horribly severe. The urine will contain blood, and possibly pus, and will be passed very frequently. As between such a condition and the presence of an abscess or morbid growth in the kidney, the points of diagnosis are not strongly marked, and careful observation will be requisite, in order to form an opinion. The presence of a bad stricture in the urethra, by causing retention and over-distension of the bladder with urine, will cause pain referred not only to the hypogastric region, but also to the back.

Lumbago is characterised especially by inability of the patient to rise from his chair without the greatest distress, and only slowly and with difficulty. It may depend upon rheumatism of the muscles, or, still more probably, of subacute inflammation of the connective tissue between the muscles. Or it may be neuralgic in character, in which case it will be acutely stabbing, paroxysmal, and independent of muscular movement.

Pain in the back is frequently caused by flatulent distension of the bowels, and by accumulation of retained fæces. It may be dependent upon a tumour connected with the bowel (especially likely in the sigmoid flexure and rectum), which may or may not be felt by external palpation, or reached by the observer's finger, introduced *per anum*. Nor must it be forgotten that an abscess in the wall of the rectum will cause long-continued and severe pain in the back. It is well to remember that an undiscovered hernia may give rise to little or no inconvenience except pain in the back. So likewise flexions and morbid growths of the uterus, and ulcerations about the cervix, may be the cause of pain, as well as the approach of the catamenial period, which in some women is the cause of great pain in the back.

Pains in the extremities.—These may be due to neuralgia, in which case they will be found to occupy the district of one or more branches of nerves, and to be paroxysmal in character. The pains which affect the extremities and the trunk, but especially the legs, in the early stage of locomotor ataxy, are peculiar in this. A patient who has little complaint to make of his health, will every now and then be kept awake all night, and incapacitated in the day, by sudden, sharp, lightning-like pains darting through one or more limbs, and often severe enough to make him call out. They will occur in paroxysms, lasting hours, days, or, less often, weeks; and will subside as suddenly as they began. With such symptoms the patellar tendon reflex should always be tested. Other pains affecting the extremities are rheumatic; or of the nature of the gnawing and aching pains which occupy the joints in acute inflammation from any cause, including rheumatism, and in arthritis deformans. The joints may also be the seat of pains of a neuralgic character.

Treatment.—The treatment of pain is so involved in the causation, that but little can here be said with advantage on this point. It may be said generally, that pain ought, if possible, to be relieved, for its continuance is exhausting and mischievous to the nervous system. Rest is, as a rule, the first essential. Local applications, in the form of simple poultices, sinapisms, and counter-irritant or anodyne liniments, constitute the most ready means of relieving pain in many cases. Food of a suitable kind will often be the best means of relieving pain, and where the condition of the stomach prevents its being swallowed, it is frequently desirable to inject sustenance by enemata into the bowel. Constipation of the bowels, when accompanied by pain, should never (except perhaps in the case of lead colic) be treated by purgatives. Belladonna, accompanied by minute doses of opium, is the best treatment. The drugs which have the greatest influence as anodynes are, doubtless, opium and chloroform, but belladonna and Indian hemp are often used with advantage. They both require to be used with caution. A habit of increasing the dose of opium (even when it is employed in the form of morphia with the hypodermic syringe) is soon acquired. It is undesirable to allow patients to inject themselves. It is well, in all cases, to begin with a small dose, say gr. $\frac{1}{10}$ morphiæ—a dose which is stimulant and not narcotic. It is the narcotic dose which apparently is followed by a sort of recoil, which suggests the need for a repetition and in larger quantity. T. Buzzard.

PAINTER'S COLIC. — Synon.: *Colica Pictonum*; Lead colic; Fr. *Colique des peintres*; Ger. *Malerkolik*.—A form of intestinal colic, due to the presence of lead in the system; so called on account of the frequency of its occurrence amongst house-painters. *See* Colic, Intestinal; and Lead, Poisoning by.

PALATE, Diseases of.—1. Paralysis.—The chief causes of paralysis of the palate are diphtheria (*see* Paralysis, Diphtheritic); degeneration of the nuclei of the medulla oblongata (*see* Labio-glosso-laryngeal Paralysis); growths in the basis cranii; and pressure on the nerves of the medulla. The two first usually cause bilateral paralysis. Unilateral paralysis is commonly due to one of the two last causes. Disease of the trunk of the facial nerve is commonly regarded as an occasional cause of paralysis of the palate. But this is certainly extremely rare in facial paralysis, and, in the writer's opinion, its occurrence even is open to question.

Symptoms.—In *bilateral* paralysis the palate hangs flaccid, and irritation of the mucous membrane excites no reflex movements. It is not raised in breathing or phonation; a convenient test is to make the patient utter the sound 'ah' in a high tone; the central palate should be raised by the levator. Deglutition is interfered with, the soft palate being no longer raised so as to shut off the posterior nares; and liquids are forced up into the nose by the contraction of the pharyngeal muscles. Speech is also affected; the resonance of the nasal chambers gives to it the 'twang' which only the *n* and *ng* sounds should possess. The explosive consonants cannot be well pronounced, because the open passage through the nose prevents the air being sufficiently compressed to give the sudden sound when the passage between the lips is open. Hence *p* and *b* become *f* and *v*.

Unilateral paralysis of the palate causes little interference with deglutition. The chief muscles which raise the palate meet, it will be remembered, in the middle line of the soft palate, and for this reason one muscle is able to effect sufficient elevation of the whole palate to prevent the regurgitation of liquids. The voice may have a slight nasal twang, but the articulation of the labial explosives is not interfered with. When at rest, the paralysed half is usually a little lower than the other. The uvula is said to be oblique, inclined towards the opposite side. It is, however, sometimes straight in the middle line. A change in form when the azygos contracts may be expected, but is not always to be observed. The chief indication of the paralysis is the unequal movement, which is best recognised during the utterance of the sound 'ah.' The elevation of the middle part being confined to one side, the base of the uvula is drawn a little towards the non-paralysed side, and a dimple forms above the base of the uvula on that side only. By faradisation a difference in the contractility of the muscles may be recognised, but the special apparatus and difficulties of application render this test not one of general application. Unilateral paralysis of the palate is often associated with paralysis of the vocal cord on the same side, and often with paralysis and wasting of the same side of the tongue. This combination is met with especially when there is pressure on the nerves at the anterior part of the medulla. The paralysis of the tongue is, of course, due to disease of the roots of the hypoglossal; that of the vocal cord to damage to the highest roots of the spinal accessory nerve. These nerves-fibres arise in proximity, and the association of these three paralyses (first pointed out by Dr. Hughlings Jackson) constitutes strong evidence that the nerve-supply to the levator palati is derived from one of these nerves.

Diagnosis.—The recognition of bilateral paralysis of the palate depends on its immobility on voluntary and reflex stimulation; that of unilateral paralysis essentially on the inequality of movement in the utterance of certain sounds. Difficulty in diagnosis is due to the frequent inequality of the arches, and obliquity of the uvula. The latter is so common under normal conditions that no weight can be attached to it as an indication of paralysis. The opinion that the palate is sometimes paralysed in facial paralysis rests apparently upon the uvula being found to be oblique, and observers have been strangely puzzled by the frequency with which the uvula deviates to, as well as from, the paralysed side, and have formed various ingenious theories to account for the phenomenon. The writer has never observed any defective movement of the palate or uvula in facial paralysis, although he has looked carefully for it in scores of cases of various kinds. In the face of the strong assertions which have been made, he does not venture to deny its occurrence, but he is convinced that most of the supposed instances have been examples of natural obliquity.

Prognosis and Treatment.—The prognosis and treatment of paralysis of the palate are those of its causes. Locally the muscles may be galvanised by a long electrode, insulated except at its extremity, and furnished with a contact key, so that the circuit is not completed until the instrument is in position. The difficulty of applying electricity for any length of time lessens, however, its practical value as a means of treatment. Food which is semi-solid is usually swallowed better than liquids.

2. For other diseases of the palate *see* Throat, Diseases of. W. R. Gowers.

PALERMO, in Sicily.—Moist, warm, equable, winter climate. Mean temperature winter, 52·7° Fahr. Eighty days' rain. Season, October to April. *See* Climate, Treatment of Disease by.

PALLIATIVE (*pallium*, a cover).—A term used in connection with the treatment of disease, when it is directed merely to the relief or mitigation of symptoms. *See* Disease, Treatment of.

PALLOR (Lat.).—Synon.: Fr. *Pâleur*; Ger. *Blässe*.

This term, which signifies whiteness or absence of colour, is generally applied in descriptive medicine and pathology in connection with the state of the blood-supply of any part or organ. Pallor then denotes extreme deficiency of that healthy colour of the tissues which is referable to the presence of the red-corpuscles in the capillaries; and indicates anæmia, whether due to contraction of the blood-vessels, diminution in the quantity of blood generally, reduction in the number of red-corpuscles, or relative deficiency of hæmaglobin in the individual corpuscles. In clinical medicine, pallor is most frequently associated with the visible portions of the surface, especially the face, the lips, and the conjunctivæ; or with parts which may be readily seen by special methods of examination, such as the tongue, fauces, larynx, mucous membrane of the nose, and fundus of the eye. *See* Anæmia. J. Mitchell Bruce.

PALPATION (*palpo*, I handle gently).—A method of physical examination, in which the hands are employed to appreciate certain conditions perceptible by the sense of touch. *See* Physical Examination.

PALPITATION (*palpito*, I beat or throb). *See* Heart, Palpitation of.

PALSY.—A popular synonym for motor paralysis. *See* Paralysis.

PALSY, Shaking.—A synonym for paralysis agitans. *See* Paralysis Agitans.

PALUDAL
PALUSTRAL } (*palus*, a marsh).—Of or belonging to a marsh. A term generally used in connection with malarial, or marsh fevers, on account of their frequent ætiological association with marshes. *See* Malaria.

PANCREAS, Diseases of.—Synon.: Fr. *Maladies du Pancréas*; Ger. *Krankheiten der Bauchspeicheldrüse*.

The pancreas is an organ of great importance in the animal economy, as it produces a secretion of essential value in the process of digestion. Nevertheless, owing to the comparative rarity of its diseases, their frequent association with other lesions when they do exist, the position and relations of the organ in the abdomen, and other causes, it must be acknowledged that perhaps there is no organ in the body disease of which it is more difficult to recognise during life, at least with anything like certainty. At the same time, it may be remarked that if more attention were paid to the pancreas by the general body of medical practitioners, our knowledge concerning its morbid states would probably be greatly increased, and we should have more definite and precise data upon which to form a diagnosis. Many seem to forget entirely that there is such an organ, and even when symptoms or signs point to it with sufficient clearness, at any rate as being the possible seat of mischief, they ignore it altogether, and it never seems to enter into their calculation. The writer's experience has constrained him at the commencement of this article to offer these remarks; but, on the other hand, he feels it his duty to warn against attaching too much importance to the pancreas, and emphatically to express his dissension from all views which attribute the origin of certain special diseases to functional disorders of this organ.

Symptomatology.—Before considering the diseases of the pancreas individually, it will be expedient to discuss generally the clinical phenomena which may arise when this organ is involved. The most striking of these are due, not so much to the implication of the pancreas itself, as to its effects upon other structures with which it is anatomically so closely related; to their being involved in the morbid condition; or to the intimate relation existing between its vessels and nerves, and those of other organs.

1. **Subjective sensations.**—Subjective sensations cannot be said, as a rule, to be of much value in the diagnosis of pancreatic affections. They are often absent, even when there is grave disease; and when present are in many cases of a very indefinite character. As regards their site, the localisation of morbid sensations deep in the abdomen, in the region of the pancreas, a little above the umbilicus, might point to this organ. There is no reliance whatever to be placed upon the influence of changes of posture in modifying them, as has been affirmed. With respect to their nature and causation, it may, in rare instances, happen that pain is felt in the pancreas itself; or there may be merely an ill-defined sense of uneasiness and discomfort, or of weight and oppression. Deep pressure may then bring out more pain or oppression, or these feelings may only be experienced when such pressure is made. More commonly, however, pancreatic disease gives rise to subjective sensations by its effects on surrounding structures. It may cause pain and a more superficial tenderness than usual, by irritating the overlying peritoneum. When the organ is enlarged and heavy, it may produce a sensation of stretching and dragging, amounting occasionally to actual pain, and it is probable that under these circumstances different postures

might influence the sensation, it being most felt in the erect posture. The most important pain, however, connected with pancreatic disease is that due to implication of the solar plexus and its ganglia, of which the writer has met with two striking examples. Sometimes acute inflammation occurs, when the pain is of an acute character; or more commonly the nerves are merely irritated, and this is attended with paroxysms of severe neuralgic pain shooting in various directions, which may amount to extreme agony. In either case there is a feeling of great oppression, restlessness and anxiety, with a tendency to faintness, or actual syncope or collapse. The suffering may be very obvious in the appearance of the patient. In one case the pain was greatly relieved by pressure. It might be supposed that a paroxysmal pain would be associated with the passage of pancreatic calculi, but of its occurrence there is no adequate proof. It might happen that a continuous dull pain arises from erosion of the spine, as the result of pancreatic disease.

2. **Disorders of Secretion.**—It may be regarded as a settled point in physiology that the pancreatic secretion is concerned in the digestion of the starchy, albuminous, and fatty elements of food; and that it not only forms an emulsion with the fat, but breaks it up into fatty acids and glycerine. Hence it might be anticipated that very obvious and definite consequences would arise from any disorder of this secretion, whether affecting the quantity which is formed or which reaches the intestine, or the quality and composition of the fluid. Such consequences have been attributed to pancreatic diseases, though their connection has been by no means clearly proved.

Hyper-secretion has been supposed to give rise to a form of pyrosis, the pancreatic juice entering the stomach, and being discharged through the mouth by the act of eructation, as a more or less slimy and viscid fluid; or there being a constant spitting of a fluid like saliva. This has likewise been attributed to salivation, the salivary glands secreting unduly, either from sympathy or vicariously—but this is a mere theory. A form of chronic diarrhœa has also been attributed to excess of pancreatic secretion, which might at the same time be of irritating quality, and this formerly received the name of *diarrhœa* or *fluxus pancreaticus*, and was supposed to be characterised by the discharge in the stools of a quantity of viscid or tenacious liquid. That there is any such special form of diarrhœa is, however, extremely doubtful.

A *deficiency* or *absence* of pancreatic juice from the intestinal canal, or an *abnormal quality* of this secretion, may be attended with phenomena, probably of a more reliable character, although here again caution is needed; among other reasons because it must be remembered that the different secretions employed in digestion tend to make up for each other's deficiencies. It is not unlikely that these disorders may assist in originating symptoms indicating deranged intestinal digestion as well as constipation. More important and definite phenomena, however, have been referred to this cause. The chief of these is the presence of a quantity of free fat or oily matter in the stools, which has not been digested and absorbed, owing to the want of pancreatic juice. By some writers this symptom has been regarded under certain circumstances as pathognomonic of pancreatic disease. It has been found in a considerable number of cases, and experimental investigations lend support to the importance of the phenomenon. On the other hand, it has been chiefly noticed where the entrance of bile into the intestine was at the same time interfered with, and sometimes when this condition alone was present, the pancreas being healthy; while it certainly is not always observed even in grave organic disease of the pancreas, as the writer can testify. The amount of the fat has varied much in different cases, and also its character. It has come away like oil, with scarcely any fæcal matter; or, after standing, oil has floated on the surface of liquid fæces. In other instances lumps of fat have been discharged, white or pale yellow and tallow-like, and the stools have even consisted almost entirely of these lumps. In other cases, again, it has been more or less crystalline; or an oily fluid was discharged, which condensed on cooling, either around the containing vessel, or on the surface of the fæces. It has been observed occasionally that the fat was far greater in quantity than had been taken as food; this has been accounted for by the absorption of fat from the general system, in connection with wasting, to which reference will again be made, and its escape from the vessels into the intestinal canal. Another condition of the stools attributed to want of pancreatic secretion is the presence of an abundance of undigested muscular tissue in them; but it is obvious that this can in no respect be regarded as a reliable sign.

It will not be out of place to refer here to the proved value of the pancreas itself, or of preparations made from it and containing the active principles of its secretion, in aiding digestion in many cases, or in digesting certain foods before administering them, especially according to the plan so admirably worked out by Dr. William Roberts (*see* PEPTONIZED FOOD). This may prove of some consequence in relation to the diagnosis of pancreatic diseases, for it has been suggested that if, with the daily administration of calf's pancreas, the conditions of the stools above described disappear, this is an additional sign of the existence of pancreatic disease.

3. **Symptoms from physical effects.**—The intimate relations of the pancreas to important structures in its vicinity give rise to some of the most striking symptoms associated with its diseases, apart from the mere subjective sensations already referred to. Of these, one of the chief is permanent jaundice, which often becomes extreme, due to closure of the bile-duct. In the writer's opinion this symptom becomes under certain circumstances a most important evidence of pancreatic disease. The pylorus or duodenum are also very liable to be obstructed, thus leading to chronic vomiting, often obstinate, with signs of dilatation of the stomach; by pressure on the body of this organ pancreatic disease has been known gravely to disturb its functions, and even to obstruct its cavity; or it has ulcerated through its walls, and given rise to gastric

perforation and hæmatemesis. The vessels in relation to the pancreas are also important, as being liable to be obstructed, and thus to give rise to symptoms. The veins are especially to be remembered, namely, the portal, superior and inferior mesenteric, and splenic, which may be pressed upon or closed by thrombosis. Hence may arise ascites, intestinal hæmorrhage, enlarged spleen, and other phenomena, although in the writer's experience they have been absent. The vena cava inferior or the aorta may also be more or less compressed, and in the latter case a pulsation or even a murmur may be transmitted through the pancreas, simulating an aneurism; indeed this lesion has been actually caused by the compression of the aorta by an enlarged pancreas. By the extension of pancreatic disease other structures at a more or less remote distance may be interfered with; thus the ascending colon has been obstructed, and also the ureter, leading to hydronephrosis.

4. **General symptoms.**—It certainly happens that pancreatic disease is not uncommonly attended with marked general symptoms, in the direction of wasting, which may reach extreme emaciation, with proportionate debility and anæmia. There are strong reasons for concluding, however, that these do not depend merely on the want of pancreatic secretion, provided the other secretions are in sufficient quantity to make up for it. In those cases in which the general symptoms are observed, there are other causes to account for them, such as absence of bile from the intestine as well as of pancreatic juice, the nature of the disease itself, interference with the passage of food through the pylorus or along the duodenum, the implication of other structures besides the pancreas, or the presence of severe pain, causing much constitutional disturbance. It has been suggested that some cases of so-called Addison's disease, with bronzed skin, are due to pancreatic disease, but this only occurs when the solar plexus becomes involved in a certain morbid process. Patients suffering from grave pancreatic disease are often very low-spirited and despondent. This may be easily accounted for, without attributing any peculiar influence to the pancreas in relation to melancholia and hypochondriasis, a notion which was at one time advanced and entertained.

5. **Changes in the Urine.**—In exceptional cases of pancreatic disease it has been affirmed that fat appeared in the urine as well as in the stools, either in the form of oil-globules, or of a greasy substance, becoming like butter on cooling. This was supposed to be due to the absorption of fat in the process of wasting, but further observations are needed on the subject. More important is the fact that various morbid conditions of the pancreas have been found associated with diabetes. These conditions include chronic inflammatory enlargements, atrophy, fatty degeneration, pancreatic calculi, and cystic dilatation of the ducts. In some instances diabetes follows the pancreatic disease; in others it precedes it. In either case the diabetic condition probably depends, not on the pancreas, but on the implication of the solar and cœliac plexuses and semi-lunar ganglia, which undoubtedly are sometimes concerned in the development of glycosuria. A theory has been advanced to account for the presence of sugar in the urine, founded on the power of the pancreatic secretion in decomposing fats and setting glycogen free, but for this hypothesis there is no foundation.

6. **Physical signs.**—It is only in very rare instances that physical examination can detect the pancreas in health, and most of its diseases do not alter the organ in such a manner as to render such examination of any value in diagnosis. Moreover, even more or less marked physical changes are often difficult to be detected, owing to the situation of the pancreas, and to distension of the stomach, or pushing forward of the liver. It may be affirmed that palpation or manipulation is really the only practicable mode of examination in the investigation of pancreatic diseases, and it must be made when the stomach and transverse colon are empty, and the abdominal muscles thoroughly relaxed. The patient should not only lie on his back, but in some cases help may be derived from placing him on his elbows and knees; and pressure should not merely be made deeply from before backwards, but with both hands laterally from the hypochondriac regions. It may be possible to detect a general enlargement of the pancreas, as a slightly movable swelling, lying across the abdomen in its usual position; but the important condition to be looked for is a tumour of the head of the organ, which is deeply situated, always of small dimensions, rounded, smooth or nodular, usually very firm or hard, and firmly fixed, as if it were rooted in the depths of the abdominal cavity. Even if such a condition were found, however, it would be difficult to associate it distinctly with the pancreas alone, but for all practical purposes it would be sufficient for diagnosis. The possibility of an enlarged pancreas being the means of communicating a pulsation or murmur from the abdominal aorta has been previously alluded to.

Special Diseases.—Excluding certain conditions of the pancreas, which are of little or no practical importance, such as malformations, displacements, and certain exceptional cases of sudden hæmorrhage into its substance, the individual diseases of the pancreas may be conveniently considered under two main groups, namely:—

1. **Acute Inflammation.**
2. **Chronic Diseases.**

1. **Acute Inflammation.**—Synon.: Acute Pancreatitis.—This is an extremely rare disease, and it is one which, even when it does occur, is with great difficulty recognised during life. The results of the inflammatory process vary under different circumstances.

Ætiology.—Acute pancreatitis, as a primary affection, might possibly arise from some injury over the epigastrium, and it has occurred under other circumstances; but the causes to which it has been referred are extremely doubtful, and it is better to acknowledge that we are ignorant as to their nature. As a secondary affection, it has been met with in severe cases of acute febrile diseases, such as typhoid fever and acute tuberculosis; and also in pyæmic and septicæmic conditions of various kinds. It has been affirmed that pancreatitis has occurred as a metastatic inflammation, in connection with a like condition affecting the salivary glands or testicle; but this is also a very questionable statement.

ANATOMICAL CHARACTERS.—These differ under different circumstances. At first usually the pancreas becomes injected and hyperæmic, enlarged, and firmer in consistence; and probably, in some instances, the changes may not go further, the gland returning to its normal condition. Small hæmorrhages may take place into its cellular tissue, or around it, or these parts may become the seat of exudation. Subsequently, in certain forms of inflammation, suppuration is liable to ensue, either in the form of a purulent infiltration, or of one or more abscesses, beginning in the latter case as separate points of suppuration, which afterwards enlarge and coalesce. It is a matter of dispute whether the pus is formed within the ducts and acini, or in the cellular tissue. In rare instances gangrene has occurred, and, it would seem, especially where there have been hæmorrhages. From mere irritation, or the bursting of an abscess, peritonitis may be set up. In the form of pancreatitis occurring in febrile diseases, the inflammation assumes a parenchymatous form, other organs being similarly affected, a so-called acute parenchymatous degeneration taking place, and the gland becoming filled with granular and turbid material, of an albuminoid nature.

SYMPTOMS AND DIAGNOSIS.—In certain cases acute pancreatitis occurs under circumstances in which no clinical indications whatever of such a disease can be expected, or at least any of a definite nature. The earlier symptoms, which might lead to the suspicion of pancreatitis, are deep-seated pain in the epigastrium, with gastric disturbance, and some degree of pyrexia. Possibly the slighter cases may subside after this, and recovery take place. In those cases, however, in which the presence of the disease has been verified, the pain has speedily become intense and continuous, and either of a dull character, or shooting towards the back or shoulder. This was accompanied with deep tenderness, and tension of the epigastrium, preventing examination being made. The gastric symptoms became more marked, including eructations, nausea, and vomiting of a thin or viscid liquid, often containing bile. There was thirst, and the bowels were constipated. Other symptoms included great restlessness, præcordial anxiety, hurried breathing, and a tendency to syncope, with weak pulse. In fatal cases the symptoms rapidly became worse, and death was preceded by the usual signs of collapse. Most of these phenomena have been attributed to implication of the solar plexus. Signs of peritonitis might arise. The diagnosis of acute pancreatitis must always be extremely uncertain, but in endeavouring to make it, it is important to try to exclude acute gastritis or duodenitis, and conditions connected with the liver or bile-ducts. This affection does not seem ever to cause jaundice.

TREATMENT.—But little can be definitely said on this matter. The most obvious indications are to keep the patient at rest; to give only small quantities of liquid food; to relieve the pain and gastric symptoms by means of ice, effervescents, with hydrocyanic acid, opium, or morphia, and other suitable remedies; to open the bowels; and to give stimulants for the support of the patient, when these seem to be called for. Ice, or, on the other hand, fomentations or poultices, might be applied with advantage over the epigastrium in different cases; and it has been recommended to apply a few leeches. Peritonitis must be treated if it should be set up.

2. **Chronic Diseases.**—It will be most convenient to indicate, in the first place, the nature and origin of the several chronic diseases of the pancreas; and then to discuss as a whole their clinical relations and treatment.

(*a*) *Changes affecting circulation.*—Under this head it will only be necessary to mention that, in cases of general anæmia, the pancreas suffers along with other organs; that in all conditions which impede the portal circulation, whether in connection with the liver, or with the heart or lungs, this organ becomes the seat of mechanical venous congestion and its consequences; and amongst the latter hæmorrhage is to be noted, which occurs in separate points, the blood subsequently undergoing changes, and its sites being indicated by altered pigment, or by spaces containing coloured serum, and having pigmented walls. Considerable hæmorrhages, leading to the formation of apoplectic cysts, may take place into the pancreas, as the result of rupture of a diseased artery. A peculiar form of hæmorrhage has been observed in connection with this organ, in which it becomes hæmorrhagic throughout, and no marked change can be found in its substance or in its vessels. Cases of this kind seem to be sudden in their onset, and rapidly prove fatal, but their nature and the real cause of death are undetermined.

(*b*) *Changes in growth.*—Many cases of either general or partial hypertrophy of the pancreas have been described; but some writers doubt the reality of a true hypertrophy or hyperplasia of the glandular elements, and maintain that the increase in size and weight of the organ in these cases was due to an increase in the interstitial tissue, or to other causes. This is one of the conditions said to have been observed in connection with diabetes. Atrophy is an undoubted morbid condition to which the pancreas is liable. It has been observed as the result of old age; in cases of general wasting from various causes; in connection with diabetes, where it may become extreme; or from certain local causes, namely, pressure upon the gland by morbid conditions in its vicinity, or by diseases within the organ itself. The degree of wasting varies; but it may be so considerable that nothing is left except a fibrous cord indicating the former site of the pancreas. In lesser degrees the change is often associated with more or less fatty degeneration.

(*c*) *Chronic Inflammation.*—That the pancreas is subject to a chronic inflammatory process cannot be doubted, but it is by no means clear what should be included under this term. The condition usually recognised, and which is most common, is that in which the organ becomes more or less cirrhotic or fibroid, either throughout its whole extent or in some portions of it; the head is very liable to be thus affected. The changes essentially consist in an increase of the interstitial connective tissue, with wasting of the glandular structures, and the organ becomes proportionately indurated, dense, firm, and tough, and may be granular or irregular. Distinct tracts of connective tissue may be visible. This form of chronic pancreatitis may in various degrees result from prolonged venous congestion; chronic alcoholism, especially indulgence in strong spirits; retention of the pancreatic secretion, with dilatation of the ducts; the irritation of morbid growths, such as cancerous or syphilitic growths; or neighbouring disease, which affects the pancreas either by directly spreading to it, or by causing pressure or irritation. In some of these cases a chronic parenchymatous inflammation seems also to be going on.

Very rarely the pancreas becomes the seat of chronic suppurative inflammation, either by extension from parts around, or from conditions in the organ itself, such as the presence of calculi or the formation of cysts. The pus either infiltrates or collects in one or more abscesses, and the latter may burst into the abdominal cavity or other parts, or dry up and become calcareous. Caseous masses, following chronic inflammation, may form in the pancreas, associated with similar products elsewhere, in cases of scrofulous or tubercular disease.

(*d*) *Degenerations.*—The pancreas is liable to the usual two forms of fatty change, namely, a *fatty hypertrophy* or *infiltration*, associated with obesity, which, though affecting the interstitial tissue, may eventually cause complete wasting of the glandular structure by pressure; and *fatty degeneration*, which affects the gland-cells themselves; or the two conditions may be associated. In simple fatty degeneration the organ becomes gradually smaller, softened, and flaccid; pale or whitish-yellow or brownish; but its acini are distinct. A fatty emulsion may form in the ducts. The products of degeneration are absorbed or discharged, and coincident atrophy takes place, so that at last the organ may entirely disappear. This degeneration has been noticed as the result of alcoholism, in wasting diseases, and in cases of diabetes.

Amyloid disease may affect the pancreas, but it cannot be said to be of any practical consequence.

(*e*) *Morbid Growths.*—Cancer is the most important disease affecting the pancreas. The growth is usually of the scirrhous variety, rarely of an encephaloid, a melanotic, or a colloid nature. In most cases it is secondary, the organ being usually involved by extension from neighbouring structures, or now and then a distinct growth being formed; but it also occurs as a primary affection. Pancreatic cancer is decidedly more frequent in males than females, and it is rare under forty years of age. The writer has, however, known it to occur in a young man twenty-three years old. Primary cancer has been attributed to injury over the epigastrium. As a rule the head is first implicated, rarely the body or tail; often the disease remains confined to the head, but in other instances it spreads, so as finally to involve the entire organ, or separate deposits form. When the morbid condition is confined to the head, it presents a more or less rounded tumour, varying in size, but never attaining large dimensions; somewhat irregular or nodular; very dense and hard in consistence; and whitish on section. If the entire gland be affected, similar appearances are evident throughout its whole extent; but, if not, the unaffected portion may be the seat of atrophy, chronic inflammation, or dilatation of the ducts, with the formation of calculi. Distinct small tumours are found in some instances. If the cancer be of other kinds than scirrhus, it will present the characters peculiar to each. Usually it exhibits under the microscope the structure of scirrhous cancer, there being a large amount of fibrous stroma.

Pancreatic cancer always affects, in some way or other, neighbouring structures. It may simply press upon them; or it causes irritation, and thus sets up chronic inflammation, becoming adherent to various parts; or the cancer may spread; or destruction and ulceration take place, involving the duodenum, stomach, vessels, peritoneum, diaphragm, vertebræ, or other structures; but not uncommonly the parts are found so matted together at the post-mortem examination, that it is impossible to separate them, or to say where the disease began. The consequences of the secondary effects of pancreatic disease have already been pointed out, and need not be further discussed here, except to remark that the obstruction of the bile-duct, which is a frequent event, seems to be due, not so much to pressure as to contraction at the orifice or along the course of the duct, the result of chronic inflammation.

As rare morbid growths found in the pancreas, it will suffice to mention sarcoma; tubercle, either as a caseous nodule, or in the form of granulations; and syphilitic formations, which may be of the nature of gummata, or of a cicatricial tissue, involving the gland generally or locally.

(*f*) *Obstruction and Dilatation of the Ducts—Cystic formations.*—The main duct of the pancreas—canal of Wirsung—may be obstructed at or near its orifice; or some of its divisions may be thus affected. The former depends either upon conditions outside the gland, causing pressure, such as tumours in the vicinity, enlarged glands, a large gall-stone in the bile-duct, or thickening and adhesions due to inflammation; or upon conditions in the gland or duct itself, namely, malformations causing a bending of the duct, calculi, new growths, chronic interstitial inflammation, or catarrh of the duct. One or other of these conditions also accounts for any localised obstruction. The effects of the obstruction will be to produce retention of the secretion, with dilatation of the main duct and all its branches, either uniform or unequal, or of limited portions of these, according to the seat of the impediment; and ultimately one or several cysts usually become developed, which may attain a considerable size. In the early stage the contents resemble more or less the ordinary pancreatic secretion, but subsequently they become either serous, purulent, hæmorrhagic, caseous, or cretaceous. The walls of the cysts become thickened and indurated, and, by encroaching upon the substance of the pancreas, at the same time setting up chronic interstitial inflammation, they may ultimately cause complete destruction of the organ. These conditions have been occasionally found in connection with diabetes. In rare instances pancreatic cysts have been known to rupture into the stomach or duodenum. They have originated, in exceptional cases, from hæmorrhage into the pancreas.

(*g*) *Calculi and Parasites.*—Calculi occasionally form in connection with the pancreas, either in its main duct, or, less frequently, in the divisions, or in both places. There may be but one, or a large number. They may be very minute, or attain the size of a nut or walnut, or even larger dimensions. The concretions are usually white, or greyish-white, occasionally dark or blackish, round or oval in shape, rarely branched, and smooth or rough on the surface. As a rule they consist mainly of calcic carbonate or phosphate, or of both salts; very rarely of solidified protein substances. They originate from the pancreatic juice, the inorganic constituents of which are precipitated, usually owing to its retention; but it is supposed that the products of catarrh of the ducts, or an abnormal composition of the secretion, may also be the primary cause of the precipitation which leads to the formation of pancreatic calculi. Their effects have been already pointed out in the description of the preceding diseases, and it will suffice to mention that the principal conditions they are liable to produce are dilatation of the ducts and cysts; inflammation leading to abscesses; chronic interstitial inflammation and its consequences; or inflammation in the structures around. They probably escape in some instances through the canal of Wirsung.

As regards parasites, it will be enough to state that roundworms occasionally find their way into the pancreatic duct.

SYMPTOMS.—It will be easily understood that most of the cases of chronic disease of the pancreas are unattended with any symptoms drawing attention to this organ, or with such as are at all characteristic, while a large number present no symptoms whatever, being latent from first to last, the lesion being only discovered at the *post-mortem* examination. Moreover, in the case of the affections which might be expected to originate prominent symptoms, they are so often associated with morbid conditions of one or more of the other organs concerned in the digestive process, or of other structures, that it frequently becomes most difficult or impossible to assign to each its share in the production of the phenomena observed. Under any circumstances, several of the chronic pancreatic diseases which have been described can only lead to more or less derangement affecting the formation or escape of the secretion, and all of them tend to produce this result, so that symptoms might be expected to arise from this cause, but those which are regarded as at all significant, whether of excess or deficiency of pancreatic juice in the intestines, are only present in comparatively few instances, even of those complaints which are of a grave character.

In addition to what has just been stated, it will only be necessary further briefly to allude to other points in the symptomatology of those pancreatic affections, in connection with which more evident clinical phenomena might be anticipated; the explanation of the symptoms has already been sufficiently discussed.

Chronic inflammation may be attended with deep-seated epigastric pain and tenderness, constant or increased paroxysmally. It certainly tends to be complicated with symptoms due to pressure on neighbouring structures, or their implication in the inflammatory process, such as jaundice, ascites, or signs of obstruction of the pylorus or duodenum; and glycosuria might possibly set in. It very rarely happens that the enlarged pancreas, or its head, can be detected on physical examination. More or less general wasting might be present.

Cancer is by far the most important disease of the pancreas, and the one most likely to give rise to symptoms of a somewhat definite character, though even here there is often much uncertainty. Deep-seated epigastric pain is a very frequent symptom, at some period or other in the course of a case, and it has been regarded as of much importance; but it must be remembered that it may be absent from first to last, or may only come on late in the progress of the disease. This pain is also characterised by its intensity, and the difficulty experienced in relieving it. It is usually more or less constant, and of an aching or gnawing character, or lancinating, shooting across the epigastrium, especially towards the right, or backwards towards the shoulder, or all over the abdomen. Sometimes a sensation of burning, or of tightness and dragging is described. An important feature often observed in connection with this pain is that it tends to become greatly aggravated in paroxysms, of which the writer has seen some striking examples, where the attacks were most agonising and almost unbearable. It may be influenced by food, coughing, deep breathing, movement, or posture. It is in some instances decidedly worse in the erect and supine postures; and during the paroxysms the patient may bend forward, and press upon the epigastrium, in order to obtain relief. Gastric symptoms are usually prominent in cases of pancreatic cancer, especially nausea and vomiting, and eructations, much importance being attached by some writers to the occurrence of an abundant watery pyrosis. The tongue frequently continues clean and moist throughout. The bowels are constipated, and fatty stools may be observed; but they are by no means constant. Thirst is sometimes a marked symptom. Jaundice and other phenomena indicative of interference with neighbouring structures are of common occurrence, and jaundice may be the most prominent symptom in cases of cancer of the pancreas. Physical examination is of essential importance in the detection of this disease, and it should be made again and again in doubtful cases, under the most favourable conditions obtainable. In many instances, however, nothing can be detected, at any rate of a definite character; or there may be only a sensation of undue firmness, resistance, or induration. Sometimes the enlarged organ may be made out; or a tumour of the head, having the characters already described. The general symptoms are always of a serious character, namely, emaciation, anæmia, weakness, and depression, and they often become extreme. There may be distinct signs of the cancerous cachexia.

Cysts in the pancreas in rare instances attain such a size as to cause an enlargement perceptible on examination, in the form of a deep-seated tumour, rounded and smooth, soft, and perhaps yielding a sense of fluctuation. Pressure-signs might be present; but in the cases observed there has been little or no pain, and general symptoms were absent or slight.

Calculi in connection with the pancreas are almost always latent, but they may produce secondary effects causing symptoms. There is no authentic history of any case of colic from the passage of a pancreatic calculus into the duodenum.

Diagnosis.—Sufficient has been said in discussing the symptoms to indicate how difficult or impossible it must be to diagnose positively, in the great majority of cases, the existence of chronic disease of the pancreas. Cancer is the affection most likely to be recognised; but some of the others might be suspected under certain circumstances. What has been stated will explain how they are to be distinguished from each other, but it is often very difficult to diagnose between chronic pancreatitis and cancer. With regard to the diagnosis of pancreatic lesions from those affecting some neighbouring structure, it must be remembered that they are liable to be involved together, and it may then be of little practical moment to determine precisely what structures are implicated. It is necessary to be particularly cautious against referring symptoms connected with the liver or stomach, induced by pancreatic disease, to a morbid condition of either of these organs; while it must always be borne in mind that enlargement of the liver may result from accumulation of bile, due to obstruction of the hepatic duct; and also that dilatation of the stomach will follow narrowing or closure of the pylorus or duodenum. It may be stated as a general rule that serious disease of the liver or stomach will probably reveal itself by obvious signs; and if this can be excluded in certain cases, the diagnosis of pancreatic disease will be appreciably aided. The painful paroxysms connected with pancreatic cancer may readily be mistaken for the passage of gall-stones, if jaundice should be present. If a tumour should be felt, it may be difficult to distinguish it from an omental tumour. When distant effects are produced, such as hydronephrosis, the diagnosis becomes almost impossible. It must be remembered that a pancreatic tumour may present pulsation and bruit, conducted from the aorta, and thus simulate aortic aneurism. In conclusion, the writer would insist once more, as bearing upon the diagnosis of pancreatic disease, on the importance of remembering that there is such an organ as the pancreas; and also of making a thorough physical examination, again and again if required, in any case in which disease of this organ is suspected.

Prognosis.—But little need be said under this head. Even if certain forms of pancreatic disease should be recognised, they may not affect life, but no positive opinion can be given. It has been affirmed that chronic pancreatitis is curable in the early stage, but of this there is no real proof; it probably aids in bringing about a fatal result sooner or later in those cases in which it exists. Pancreatic cancer is necessarily a fatal disease, and it usually terminates in death within a year after the symptoms have become prominent.

Treatment.—The indications in the management of cases of chronic disease of the pancreas are within a very limited compass, even if it should be recognised. Rarely can there be any possibility of curative treatment being effectual, although supposed cures of chronic inflammation have been brought forward, obtained by the administration of calomel, to act upon the pancreas, of saline purgatives, or of mineral waters of this class; or, when there has been a syphilitic history, by the use of mercury to produce its constitutional effects, or of iodide of potassium. In many cases the employment of saline aperients would be beneficial, to keep the intestinal canal free, and to unload the portal circulation. An occasional dose of calomel or blue pill might also be advantageous. In the large majority of cases of pancreatic disease the treatment would have to be chiefly symptomatic, directed especially to the relief of pain, to the symptoms connected with deranged digestion, and to the state of general wasting and debility. Hence, every case must be treated on its own merits, in accordance with well-understood principles. For the relief of the severe paroxysms of pain attending pancreatic cancer, subcutaneous injection of morphia is the most reliable remedy. The use of digestants, particularly as recommended by Dr. William Roberts, would probably prove of considerable practical value in the treatment of cases of chronic pancreatic disease. Sweetbreads might be employed as an article of diet; or pancreatic emulsion, or liquor pancreaticus, might be given; but the previous digestion of the food by means of Benger's liquor pancreaticus is the plan likely to be followed by most benefit, and from this plan great advantage might be anticipated in appropriate cases. Frederick T. Roberts.

PANDEMIC DISEASES (πᾶν, all, and δῆμος, the people).—Epidemic diseases which affect groups of several countries or the world generally. *See* Epidemic; and Periodicity in Disease.

PANTICOSA, in the Spanish Pyrenees. Thermal Waters. *See* Mineral Waters.

PAPILLOMA (*papilla*, a nipple, a wart). A tumour composed of hypertrophied papillæ, either of the skin, or of a mucous or a serous membrane. *See* Tumours.

PAPULA (Latin).—Synon.: Pimple; Fr. *Papule*; Ger. *Papel.*

Definition.—A minute prominence of the skin, for the most part conical, but often round, and sometimes flat; and resulting from vascular congestion, hypertrophous growth, or accumulation of secretions.

A rude kind of distinction might be drawn between inflammatory pimples and non-inflammatory pimples. In the classification of skin diseases adopted by Willan the term *papulæ* represents a group of pimply affections; and he defines the word *papula* as follows: 'A very small and acuminated elevation with an inflamed base, very seldom containing a fluid or suppurating, and commonly terminating in scurf.' He thereby gives the word pimple a special signification, which is highly objectionable. A more correct view of pimples would be to regard them in their several relations to vascular congestion, abnormal growth, and retained cutaneous products. A typical papula is presented to us in *cutis anserina*, where the pore of the skin or aperture of a follicle is projected outwards, in consequence of a certain rigidity, which opposes the contraction of the interporous tissue. This may be considered as a physiological papula; but the pathological papula is similarly located in the follicle of the skin, the prominence being produced by congestion of the vascular coat of the follicle, with more or less exudation into its capillary network. Such is the precise pathology of lichen; and this condition, with accumulation of follicular contents, constitutes conical acne.

A papula from hypertrophy of tissue may be illustrated by acrochordon, minute verrucæ, and milium; and a papule from accumulation of cutaneous products, by acne punctata and imperforate follicles. ERASMUS WILSON.

PARACENTESIS (*παρὰ*, through, and *κεντέω*, I prick).—SYNON.: Tapping; Fr. *Paracentèse*; Ger. *Paracentese*.

DEFINITION.—The operation of tapping any cavity, to draw off fluid or gas.

The term is usually confined to operations on the peritoneum, pleura, pericardium and cranial cavity; the tapping of cystic tumours not being included. Most of these are now performed with the aspirator (*see* ASPIRATOR.) All those here described are performed with the cannula and trochar. The more extensive operations on the pleura, such as antiseptic opening, free drainage, trephining the ribs, &c., are described with the diseases which necessitate them. *See* PLEURA, Diseases of.

INSTRUMENTS AND OPERATION.—The best form of instrument for tapping the pleura or peritoneal cavity is that known as Thompson's syphon trochar. In this the cannula is fixed to the handle, and has a lateral opening about its middle, to which a long india-rubber tube is attached. The trochar is continued through the handle of the instrument and terminates in a button. In the handle the stem of the trochar is surrounded by air-tight packing. The instrument is inserted in the ordinary way; the trochar is then drawn back till its head is past the lateral opening in the cannula, through which the fluid will then flow. The india-rubber tube must be carried into a vessel containing carbolic acid solution (1 to 40). The result is that a syphon action is established, of sufficient force to exhaust the cavity operated on, and at the same time the accidental entrance of air is rendered impossible. Should the instrument described not be at hand, the following simple plan, suggested by Reybard, will be found very efficient. The cannula immediately below its external extremity is surrounded by a linen petticoat, from two to three inches in length, which is well soaked in carbolic oil (1 to 10) before the instrument is used. On withdrawing the trochar the petticoat hangs down, forming a channel through which fluids readily pass outwards, but which collapses instantaneously if there is any tendency to the entrance of air. This is especially useful in tapping the pleura. The same result can be obtained by applying a large veil of lint or rag, soaked in carbolic oil, over the cannula the moment the trochar is withdrawn. In tapping the cranial cavity or the pericardium very fine instruments, usually known as *exploring trochars*, must be used. In some cases, when the ribs are very close together, a flat cannula with a lancet-shaped trochar, may be useful. Before using a trochar it should be passed between the finger and thumb to feel if the free edge of the cannula is perfectly concealed by the wider head of the trochar. This is frequently not the case with old instruments, in which the cannula has lost the spring given to it by the two slits at the end. If the cannula project it may push the pleura before it, the head of the trochar only entering the cavity. A cannula and trochar should be always kept separate when not in use, to prevent rusting, and the head of the trochar should be well pushed into a soft cork. A blunt or rusty trochar doubles the suffering of the patient. Immediately before use the two parts of the instrument should be separately well washed with carbolic acid solution (1 to 20), or with some other powerful antiseptic, and the trochar will enter more easily if it is greased with carbolic oil (1 to 10). These precautions are of the utmost importance. A dirty instrument has often caused the death of the patient, by exciting decomposition in the cavity operated on; and real cleanliness can only be ensured by dipping the instrument immediately before use in some powerful antiseptic. A perfectly bright and apparently clean instrument may be in reality coated within and without with microscopic dirt, which antiseptics alone can render innocuous.

In using a trochar the instrument is held under the hand with the end of the handle in the hollow of the palm; the thumb is placed upon the rim of the shield of the cannula, ready to push it off without necessitating the employment of the other hand, and the forefinger is firmly pressed against the side of the cannula, at the point to which it is intended to limit the advance of the instrument. No preliminary incision is required if the instrument is in good order. It will only double the patient's pain and increase the risk of non-union of the wound. It is advisable to draw the skin aside from its normal position before introducing the trochar, so that the superficial and deep parts of the puncture may not correspond when it is withdrawn. A valved opening is thus made, which can hardly fail to close readily.

PRECAUTIONS.—When either of the large cavities is tapped, if a large quantity of fluid is rapidly removed, the patient is apt to become faint. These operations should, therefore, be always performed in the recumbent or semi-recumbent position, and stimulants should be at hand, the patient being carefully watched. Should faintness occur the operation must be immediately suspended. If the patient fears the pain of the puncture, the skin may be frozen, either by the ether-spray apparatus, or by the application of a piece of ice dipped in salt.

1. **Paracentesis Abdominis.**—This term is usually applied exclusively to the operation of tapping the peritoneal cavity for ascites, or, in very rare cases, for free gas. When the trochar

is used for the relief of a distended bladder, or to empty an ovarian cyst or a hydatid of the liver, the simpler term 'tapping' is invariably used. The operation for ascites is performed in the following way:—the patient must be made to empty the bladder immediately before the operation; if there is the remotest possibility that this cannot be done perfectly by natural means, a catheter must be passed. A strip of flannel wide enough to reach from the nipples to the pubes, and long enough to go two and a half times round the abdomen, must be in readiness. Each end is to be torn into four or five tails. The middle of the flannel is then to be applied to the front of the abdomen, and the tails so arranged as to interdigitate with each other opposite the spine. By pulling on the tails on each side a uniform elastic pressure is maintained over the abdomen during the operation, which facilitates the flow of the fluid, and diminishes the tendency to fainting. A circular hole is cut in the flannel at the point at which the puncture is to be made. The patient must be brought to the edge of the bed, and placed in the recumbent position, with the head low. If the quantity of fluid is not great, and the small intestines float up so as to come in contact with the lower part of the abdominal wall, it may be necessary to raise the patient into a semi-recumbent position, in which the intestines will float to the epigastric region. Having put the patient in position, the operator must himself percuss the abdomen between the pubes and the umbilicus immediately before inserting the trochar, and he will, of course, not proceed with the operation unless there is absolute dulness. Having ascertained that everything is in proper order, the skin is drawn a little to one side, and the trochar is plunged sharply through the abdominal walls in the linea alba, at a point midway between the umbilicus and pubes. Other points have been recommended, as the linea semilunaris, but the middle line is now universally preferred. As soon as the trochar is withdrawn, the assistants pull firmly on the tails of the bandage, and continue to do so as long as any fluid flows. As soon as the fluid ceases to flow, the cannula is withdrawn, and a piece of lint, soaked in collodion, is applied over the puncture. The corresponding tails of the flannel bandage are then firmly tied together over the middle line of the abdomen. For ordinary cases the aspirator is in every way inferior to the syphon trochar, and should never be used. If the patient should become faint during the operation the instrument must be withdrawn, the head put as low as possible, and some stimulant administered.

Dr. Reginald Southey has recommended a more gradual evacuation, in preference to the rapid method above described. He employs a very fine cannula, perforated laterally by numerous openings, and provided with a bulb-head and a shield. To the bulb-head is attached a long india-rubber tube. The cannula is inserted in the middle line, and fixed in position by strapping; and the fluid drains slowly away at the rate of about one pint per hour. The cannula may be allowed to remain in position, if necessary, for about twelve to twenty-four hours. Dr. Southey claims for his method the following advantages—simplicity; freedom from pain; absence of any tendency to syncope; and the avoidance of the necessity for bandaging afterwards. Experience has shown that there is no risk of peritonitis.

2. **Paracentesis Thoracis.**—SYNON.: Thoracentesis.—This is required for serous fluid or pus in the pleura, and more rarely for blood or air. Aspiration should always be preferred to the operation by the cannula and trochar (*see* ASPIRATOR). Should the aspirator not be at hand, the syphon-trochar should be used; or, failing that, one of the plans before mentioned must be adopted to prevent the entrance of air during inspiration. The patient must be brought to the edge of the bed, and placed in a semi-recumbent position, well supported by pillows. The spot selected for puncture varies greatly. It is generally agreed that the trochar should never be introduced below the tenth rib on the left side and the ninth on the right, for fear of wounding the diaphragm. The point most commonly chosen is above the sixth or seventh rib, between the digitations of the serratus magnus, which can usually be clearly seen. Should they not be visible, any point may be taken in the proper intercostal space between the mid-axillary line and the junction of the posterior and middle thirds of the lateral aspect of the chest. The trochar must always be kept close to the upper border of the rib, in order to avoid the intercostal nerve and artery. In whatever space the operation may be performed the lower border of the rib below the space should first be clearly felt; the skin is then to be drawn upwards for the width of the rib, and the trochar thrust sharply in immediately above its upper border. If the instruments are in good order, and the rib can be clearly defined, no preliminary incision is necessary. If, from partial absorption of the fluid, without corresponding expansion of the lung, the ribs have fallen very closely together, it may be necessary to use a flat trochar, with a lancet-shaped head. The precautions as to faintness and the closure of the wound are the same as in paracentesis abdominis.

3. **Paracentesis Pericardii.**—This operation is now invariably performed with the aspirator, as the results of the use of the ordinary trochar have been extremely unsatisfactory. *See* ASPIRATOR.

4. **Paracentesis Capitis.**—This operation has been occasionally performed in cases of chronic hydrocephalus, but without any very marked benefit. It is not safe to use the aspirator, as the vacuum might do unexpected damage to so soft a structure as the brain, while a small trochar may be passed through the expanded hemisphere into the ventricle without risk. The instrument used should be the smallest exploring trochar. An elastic bandage must be first applied, so as to exert a very gentle pressure on the head. The trochar is then introduced at any point where bone is wanting, except in the situations of the sinuses. The best place is at one side of the anterior fontanelle. The middle line must be avoided, not only because of the longitudinal sinus, but because in the vast majority of cases the fluid is contained in the ventricles. The quantity of fluid removed should

not exceed two ounces. The elastic pressure must be maintained after the operation, which may be repeated at intervals of four or five days.

Marcus Beck.

PARÆSTHESIA (παρὰ, a prefix indicating irregularity, and αἴσθησις, sensation).—A term applied to abnormal sensations experienced by a patient, distinct from mere excess or diminution of feeling; for example, tingling, itching, and formication. *See* Sensation, Disorders of.

PARALYSIS (παρὰ, beside, and λύω, I loosen or relax).—Synon.: Palsy; Paresis (incomplete paralysis); Fr. *Paralysie*; Ger. *Lähmung.*

Definition.—Loss of the power of voluntarily exciting the contraction of one or more muscles, is the essential condition met with in all forms of motor paralysis. And similarly, a loss of the possibility of transmitting impressions, either of the special senses or of common sensibility from various parts of the body, from their seats of peripheric commencement inwards to those portions of the brain which are concerned with their realisation in consciousness, is what is commonly known as 'sensory paralysis.' These latter defects are, however, considered under the head of Sensation, Disorders of. Here attention will be confined to the subject of motor paralysis, to which, indeed, the term paralysis ought to be limited. It is more fitting to speak of loss of sensation than of paralysis of sensation.

Paralysis Motor.—Motor paralysis may, in different cases, be occasioned by defects in various parts of the neuro-muscular apparatus. Certain primary differences of kind have first to be considered.

(*A*) Certain muscles may not contract because their customary neural incitations are impeded or abortive at their source in the cerebral cortex —as in certain forms of hysterical paralysis, or as a result of definite lesions in some portions of the brain-region above mentioned.

(*B*) Other forms of paralysis result because voluntary motor incitations are impeded in transmission during some part of their course through the nerve-centres, but below the cortical stratum of grey matter in which they take origin. Under this head are to be included by far the larger number of cases of paralysis actually met with; and according as the situation varies in which the impediment to the transmission of motor stimuli exists, so do we get the paralysis occurring in different forms, that is, affecting different distinctive groups of muscles, with or without certain characteristic associations, in the shape of sensory paralysis or disturbance, alterations in the temperature of the skin over the parts affected, and, after a time, alterations in the nutrition of the muscles whose functions are in abeyance. These very numerous forms of paralysis fall into different classes, according as the disease or injury preventing the proper transmission of motor stimuli occurs (1) in some portions of their cerebral path; (2) in some portions of their spinal path; or (3) in their passage through some of the peripheral nerves—that is, in any part of their passage to the muscles outside the medulla or spinal cord.

(*C*) Lastly, though voluntary motor incitations may be normally generated, and properly transmitted through the nerve-centres and along the peripheral nerves, an incomplete paralysis of certain muscles may still result if such stimuli, owing to degenerative atrophy in the muscles, are incapable of evoking their contraction. In these, as in the other cases, the resulting loss of movement (akinesis) would represent a true paralysis. The fact that such forms of paralysis are often incomplete, is dependent upon the peculiarity that some healthy muscular fibres usually remain in muscles which are the seat of atrophic changes (*see* Progressive Muscular Atrophy). Whilst conceding the possibility or the existence of a group of diseases in which the changes in the muscles are primary, it must be said that modern researches have tended to show that in a very large majority of the cases of muscular atrophy such changes are sequential to previous minute lesions in the spinal cord or nerves. *See* Pseudo-Hypertrophic Paralysis.

The Ætiology and Pathology of the various forms of paralysis will not now be further referred to, but will be discussed in the following articles. Some general remarks on this subject will be found under the heads of Nervous System, Diseases of; Brain, Diseases of; and Spinal Cord, Diseases of. Reference may also be made to the various special articles dealing with the pathological causes of brain-disease and to the articles on the diseases of the different cranial and other motor nerves.

Diagnosis.—The diagnosis or recognition of the cause or nature of any particular case of paralysis is always a many-sided problem. Having previously satisfied ourselves that it is a real and not a merely apparent case of paralysis (due perhaps to some arthritic disease), we have to endeavour to make out to which of the foregoing divisions or subdivisions the instance before us happens to belong. Paralysis of any group of muscles (in the limbs or elsewhere, and howsoever occasioned) may, of course, be either complete or incomplete; and it may be as well here to add, that it is the incomplete forms of paralysis in the limbs (cases of '*paresis*' as they are often termed) which are most apt to be confounded with certain weaknesses or motor defects due to joint-disease.

In actual practice the *primary* question as to the nature of the paralysis may be, and commonly is, somewhat simplified, inasmuch as the varieties included under class A may be well merged in the first instance with the primary category of class B, just as those of class C may be included under the second and third categories of class B. Thus the recognition of the varieties of paralysis included under classes A and C, belong to the secondary or more special problems connected with diagnosis. The so-called 'hysterical' forms of paralysis, for instance, are to be regarded as due to functional perversion rather than to actual structural damage in certain portions of the nervous system; it seems, evident, however, that in the first place we should decide whether we have to do with a disease of the brain or of the spinal cord, before taking up the secondary question as to such disease being of the merely functional or of structural type.

Thus, for practical purposes the several kinds of paralysis are primarily divisible into three distinct categories, based upon the situation of the damage, lesion, or defective activity by which they are occasioned. We have:—

1. *Paralyses of Encephalic Origin;*
2. *Paralyses of Spinal Origin;*
3. *Paralyses of Peripheric Origin;*

according as the cause is one which operates upon or within some part of the great centres within the cranium; upon or within some part of the spinal cord; or upon or within some one or more of the nerve-trunks, in parts situated either inside or outside the cranium or the spinal canal.

It will easily be understood that each of these primary groups of paralysis, and especially the first, includes very many varieties, and that the recognition of these several varieties is often a matter of extreme difficulty—only to be achieved after an attentive and minute study of all the details of a case by those who are well instructed as to the anatomy and physiology of the nervous system, and most familiar by daily practice with the estimation of the import of the various signs and symptoms in the light supplied by this knowledge.

The primary diagnosis should, however, in the great majority of cases, be capable of being made by the practitioner with comparative certainty. In so doing he will be guided by the general agreement as to signs and symptoms presented by the case before him with one or other of the following *combinations* of signs and symptoms.

1. **Paralyses of Encephalic Origin.**—These may or may not be ushered in by an apoplectic attack, or by an epileptiform fit, or a series of them. The paralysis is usually confined to one half of the body, though only certain parts of this are affected, namely, more or less of one half of the face, with the arm and the leg (either incompletely or completely) on the same side, whilst the muscles of the trunk are comparatively little affected. Where the paralysis is incomplete, the arm is commonly more affected than the leg. Except where loss or impairment of consciousness still exists, or where both sides of the brain are affected, the patient almost invariably retains control over the bladder and rectum. The common sensibility of the same half of the body may for a shorter or longer period from the commencement of the disease be more or less diminished. The electrical irritability of the paralysed muscles is not notably altered. The superficial reflexes may be diminished, and the deep reflexes may be exalted on the paralysed side of the body. *See* SPINAL CORD, Diseases of.

These are the general characters of a form of paralysis commonly known as *Hemiplegia.* It is met with almost as frequently on the one as on the other side of the body, and may occasionally affect both sides simultaneously.

2. **Paralyses of Spinal Origin.**—These forms of paralysis usually commence without convulsions or impairment of consciousness, though, like those of the last category, they may be either sudden or gradual in their mode of onset. They are, however, commonly characterised by their implication, to a variable extent, of both sides of the body. In the great majority of cases the lower extremities, either alone or with the trunk-muscles up to a certain level of nerve-supply, are the parts that are paralysed. The arms are much less frequently affected. It is common for control over the bladder and rectum (one or both) to be more or less lost. The motor paralysis may exist with little or no impairment of sensibility; though in some cases sensation, in one or other of its modes, is defective in the paralysed parts. The upper limit of defective or altered sensibility is often marked round the trunk by a sense of constriction, or a feeling as if a band were tied round the body ('girdle sensation'). The electric irritability of the paralysed muscles may be either little altered, or it may, especially in some parts, be modified in the manner to be described in the next section as characteristic of the 'reaction of degeneration'—and in this latter case early and marked atrophy of such paralysed muscles may be looked for.

These are forms of paralysis commonly known by the name of *Paraplegia.* Both sides of the body are usually affected—equally or unequally—because of the frequency with which the lesion, or cause of the disease, involves both halves of the spinal cord. Where this is not the case, however, and the injury or lesion is confined to one half of the cord, in one or other region, a condition known as *Hemiparaplegia* results, in which, in addition to other special characters, there is an absence of any trace of facial paralysis, even though the arm and leg on one side of the body (where the lesion exists high up in the cervical region of the cord) may be implicated in much the same manner as they are in hemiplegia. Here, however, the paralysis of motion occurs on the same side as the lesion.

3. **Paralyses of Peripheric Origin.**—The majority of paralyses resulting from disease or injury of nerve-trunks are rendered comparatively easy of recognition by the fact that the loss of power is in each case limited to the muscles supplied by particular nerves. This circumscribed nature of the paralysis is a fact of great value for diagnostic purposes—especially when the loss of power is complete rather than partial, because it is in these cases more particularly that we are apt to get another characteristic sign of peripheral paralysis, namely, an altered electrical excitability of both nerve and muscles. Where the injury to or disease of a nerve-trunk is well-marked, so that its fibres are either severed or rendered incapable of conducting stimuli from the centres, owing to pressure or other causes, it is found that within a period of six to fourteen days the following electrical phenomena may be detected:—Loss of irritability of the affected nerve-trunk to both electric currents; loss of or greatly diminished irritability of the affected muscles under stimulation by the Faradic current, together with an increase of their sensitiveness to the Voltaic or continuous current—so that they respond to the latter even more readily than the corresponding muscles of the opposite side. These characteristics, as a whole, together with certain minor peculiarities, constitute the so-called 'reaction of degeneration' (*see* ELECTRICITY). To these characters must be added the further peculiarity that the muscles thus affected are apt speedily (within two or three weeks from the onset of the paralysis)

to show a marked amount of atrophy—a change easily to be appreciated in limb-muscles, and in some of those pertaining to the trunk, but by no means so obvious in the muscles of the face.

The above constitute the characters which are in the main to be relied on for the diagnosis of paralyses of peripheric origin. Still it must not be forgotten that when the ganglion-cells in the medulla or spinal cord, which constitute the nerve-nuclei of the several motor nerves, are diseased, we may have almost precisely the same effects produced as if the nerve-trunks had been damaged in some part of their course—that is, we may have in each case the electrical 'reaction of degeneration' followed by speedy atrophy of the affected muscles. In this case, indeed where we have disease of an atrophic character limited to the nerve-cells composing the nucleus of a motor nerve or nerves, we should have a form of paralysis, tolerably well typified by 'labio-glosso-laryngeal paralysis,' which might almost with indifference be placed either in the category of spinal or of peripheric nervous diseases. They would be, it is true, spinal in seat; and yet they would be attended by all the clinical characters pertaining to disease of the nerve-trunks—and this naturally enough, seeing that the disease would in fact simply affect the proximal extremities of nerve-trunks.

What has just been said will serve to explain how it is that in many cases of paralysis of spinal origin, that is, due to large 'transverse' lesions, seriously damaging the grey matter of the cord, we may get, together with the wide or general distribution of such a paralysis, evidence that *in some* of the muscles the electrical 'reaction of degeneration' may be detected as well as early wasting. These characteristics of peripheral paralysis will, in fact, occur in muscles where the grey matter at the roots of their nerves has been destroyed. In cases of paraplegia due to large transverse lesions limited to the cervical or to the upper dorsal region, we might, therefore, look for and find the 'reaction of degeneration,' with early wasting in some of the muscles of the upper extremities or of the trunk, whilst we should not find these characters, nor be warranted in looking for them, in the muscles of the equally paralysed lower extremities.

Of course, in most cases of paralysis, the patient's personal and family history, as well as the mode of onset of the disease, will help to throw light upon the question whether, in the case before us, we have to do with a paralysis of encephalic, of spinal, or of peripheric origin.

The further characters of paralyses of spinal origin (paraplegias and hemiparaplegias) will be found in the article SPINAL CORD, Diseases of; whilst those of the paralyses of peripheric origin will be found in the various articles on diseases of special motor nerves, such as the facial, the sciatic, &c. Diphtheritic paralysis is also an obscure affection commonly supposed to pertain to this class. *See* PARALYSIS, Diphtheritic.

But the type of those diseases included under the head of *Paralyses of Encephalic Origin* will now be more particularly described.

This account of the characters pertaining to an ordinary form of **Hemiplegia** can perhaps best be given by detailing the combination of signs and symptoms produced by disease, either in the form of hæmorrhage or of softening, in one of the corpora striata. We may suppose such disease to be situated on the right side of the brain, and then, as a consequence, we should meet with a left hemiplegia.

Characters of left hemiplegia from disease in or near the right corpus striatum.—Where there is a sudden onset of the disease and a large lesion, such as may occur especially in some instances of hæmorrhage, the symptoms may be ushered in by an apoplectic attack, and a condition of unconsciousness may remain, as a result of general brain-shock, for minutes, hours, or even days. Convulsions rarely occur in such a case. Where the hæmorrhage is slighter in amount, or where the causes of softening, in the form of vascular obstruction, are limited in seat and not abruptly brought about, there may be no loss of consciousness whatever at the onset, nor any sensation referred to the head. The patient may perhaps experience a mere momentary vertigo; and sensations of numbness or tingling rather than of actual pain may be felt for a minute or two in one or other, or perhaps in both limbs, before their weakness or actual paralysis is detected.

In a case of this kind, or after recovery of consciousness in the more severe form of the disease, the patient will on examination be found to present the following characteristics:—(1) An absence of any decided mental disturbance; (2) slight 'thickness' of speech; (3) more or less deviation of the tip of the tongue towards the paralysed side, when it is protruded; (4) partial and incomplete paralysis of the facial muscles on the side on which the paralysis of the limbs exists—the angle of the mouth is lower, and the naso-labial fold less distinct than on the opposite side, though the two eyes can be closed almost equally well; (5) more or less complete loss of voluntary power over the left arm and leg; (6) a flaccid state of the muscles of these limbs, which are found to respond naturally, or perhaps even a little too readily, both to the Faradic and Voltaic currents; (7) some slight loss of sensibility, as well as a feeling of numbness, on the paralysed half of the body; (8) slight elevation of temperature on the paralysed as compared with the non-paralysed side of the body—the difference being seldom more than one degree of the Fahrenheit scale.

Of these signs, the thickness of speech, the deviation of the tongue, the paralysis of the face, and the diminished sensibility, soon either grow perceptibly less or actually disappear. In the slighter cases, after some days or a week or two, there may also be some return of voluntary power over the leg and the arm; but in the more severe forms of complete hemiplegia, not proving fatal, any recovery of motor power in the limbs may be delayed for months instead of weeks, and then perhaps the recovery may be only very slight. In all cases, however, the recovery of power usually begins to show itself in the leg sooner than in the arm; and the muscles about the joints nearer the body are in each case capable of being called into action before those moving joints which are more remote. Sometimes in the early stages of the disease some amount of rigidity may be met with in the arm or in the leg, or in both simultaneously, which is found to disappear during sleep—'early rigidity'; whilst later on a more permanent form of rigidity associated with organic changes in the muscles and tendons—'late rigidity'—is apt to supervene. See the writer's *Paralysis from Brain-disease*, pp. 151–178.

The particular combinations of symptoms met with in different cases of hemiplegia vary in an almost endless manner, as the situation of the brain-lesion varies, and also to a less marked extent in accordance with variations in its magnitude, and in the suddenness with which it is brought about. Thus, in regard to variations in the extent and completeness of motor paralysis alone, we may have merely a slight facial paralysis, with some weakness of the arm on the same side, and none of the leg; or the paralysis of arm and face may be more marked, together with slight paralysis of the leg; or paralysis may be pretty complete in all three situations. More rarely the leg may be more completely paralysed than the arm; and where lesions exist in both hemispheres of the brain, or in the pons Varolii, a double hemiplegic condition may exist—either complete or incomplete, and in the latter case probably unequal in degree on the two sides of the body. Similar variations exist in regard to many of the other concomitants of the hemiplegic state; for example, as regards the amount of mental disturbance, the kind and degree of impairment of speech, the amount of paralysis of tongue and difficulty of deglutition, the amount of paralysis of the face and of implication of the ocular muscles, the amount of impairment of common sensibility and of the special senses, the amount of difference in temperature between the two sides of the body, and the amount of command over the sphincters of the bladder and rectum. Combined in different groups, owing to the different relative development of these or those particular symptoms, we get all the different grades and kinds of hemiplegia actually met with in practice.

The attempt to connect this difference in grouping of the signs and symptoms with differences in the locality of the lesion, is to concern ourselves with the *secondary*, as opposed to what has been previously termed the *primary*, problem of diagnosis. We should then have to consider what is more especially termed *regional diagnosis*, which, however, can only be attempted after careful study has been given to the several distinctive effects produced by disease in the different regions and parts of the encephalon.

In attempting to arrive at a *pathological diagnosis* in any case of paralysis, our attention must be given more to the mode of onset of the affection, and to the state of other organs and parts of the body, than to the signs and symptoms of the established disease, though we are compelled to rely most upon these latter for the establishment of a regional diagnosis. Still these two sides to the problem of diagnosis are often very intimately related to one another, so that it may be essential to consider them concurrently in order to derive from each side of the problem all the light that may be possible for the elucidation or confirmation of the other half of it.

The questions concerning Prognosis and Treatment are considered separately under the head of the special forms of paralysis, and of the diseases giving rise to the different kinds of paralysis of encephalic, of spinal, and of peripheric origin. H. Charlton Bastian.

PARALYSIS AGITANS.—Synon.: Shaking Palsy; Fr. *Paralysie tremblante*; Ger. *Schüttellähmung*.

Definition.—A disease of advanced life; progressive in its course; and characterised mainly by tremors of the limbs occurring independently of muscular exertion, rigidity of muscles, and a tendency in walking to loss of equilibrium.

Ætiology.—The causes of paralysis agitans are obscure. It is rarely met with prior to forty years of age, but becomes more and more frequent as life advances. It affects both sexes, but men probably more frequently than women. There is little reason to regard it as hereditary. It has been attributed to violent emotion, to excessive bodily fatigue, and to exposure to cold and wet. It has also been referred to wounds or injuries involving nerves. In many cases no cause is assigned or can be discovered.

Anatomical Characters.—The disease, no doubt, is one of the nervous centres. But no distinctive lesion has yet been discovered in these parts. Sclerotic and other degenerative changes, evidences of sanguineous exudations in the course of some of the smaller vessels, diseased arteries, and various coarse lesions, have not infrequently been met with in the cord and brain; but the morbid changes hitherto observed have been variable in seat and character, and such only as are frequently present under other circumstances in persons who die in old age.

Symptoms.—Paralysis agitans, with few exceptions, comes on insidiously. The patient is first attacked with occasional tremors in a hand, a thumb, or a foot. These attacks come on irregularly, without obvious cause, and last for an uncertain period. But gradually they increase in frequency, duration, and severity, and spread from the part first involved, until, at length, probably all the limbs become implicated. In most cases the tremors, commencing in a hand or foot, by slow degrees invade the rest of the limb, and thence spread in hemiplegic fashion to the other limb of the same side. Less commonly the affection spreads in the first instance from one leg to the other. And very rarely do both arms suffer, the legs remaining free, or does the affection involve the limbs diagonally. Associated with the tremors, sometimes preceding them, but much more frequently coming on at a later period of the disease, there may always be observed a peculiar rigidity of the muscles. This is often attended with cramp-like pains, and, like the tremors, is liable at first to more or less obvious and prolonged intermissions. It implicates the muscles of the head and neck and trunk, as well as those of the extremities, and the flexor muscles in greater degree than their opponents. Another remarkable characteristic of the disease, always developed sooner or later, is an inability to maintain equilibrium when walking is attempted.

When the disease is fully developed, and the several phenomena above enumerated are associated, the collective symptoms produce a very remarkable and characteristic picture. The tremors involve the arms and legs; the head and neck remaining, as a rule, absolutely free from them. They consist of fine and rapid oscillations, which are more or less constant, but liable to exacerbations; cease during sleep; can occasionally be arrested temporarily by voluntary effort; and often occur with exceptional violence when the patient is otherwise at absolute rest. The movements of the hands are peculiar. The thumbs are usually extended, and the fingers flexed upon them; and collectively they move as though the patient were rolling a pencil or crumbling bread. The oscillations, however, are not limited to the hands, but involve the wrists and other joints of the upper extremities. The tremors of the lower limbs, especially when the patient stands, are necessarily transmitted to the rest of the body. The rigidity, which affects in a greater or less degree all the muscles, imparts a striking character to his attitude and aspect. It causes the arms to stand out slightly from the trunk; the elbow- and wrist-joints to be slightly flexed; the hands to be tilted towards the ulnar side, and to rest in front of the abdomen at or near the waist; and the fingers to be flexed or distorted at their several joints. It causes the trunk to incline forwards, as the patient stands or walks; the knees to be slightly bent; and the feet to be extended at the ankles; so that he rests upon his toes. But, above all, it causes the head and neck to be thrown forwards, and to be retained rigidly in that position, and the features to be immobile and inexpressive. This peculiar fixity of the head and neck and face, associated as it is with constant tremors in the limbs, constitutes a very striking feature of the disease. The difficulty of maintaining equilibrium, though no doubt increased largely by the presence of muscular tremors and rigidity, is not wholly due to them, for it may be well developed at a very early stage of the disease. Moreover, it may be long delayed. When thus affected the patient has some difficulty in rising from his seat, and, before he starts off walking, probably hesitates a little, as though for the purpose of balancing himself. Then, with his body bent forwards, he begins to walk, perhaps with some care, but soon his steps become rapid and short, and he runs forwards in spite of himself, and if not arrested probably falls. Sometimes the tendency of the patient is to run backwards, even though the body incline forwards. Often in these cases, while the patient is being propelled forwards apparently in spite of himself, a sudden pluck at his clothes will reverse or alter the direction of his accelerating movement. These phenomena are not attended with vertigo.

Other symptoms less striking than the above, but of more or less importance, are usually present in shaking palsy. There is generally, even from the first, a great sense of weariness in the affected muscles, especially after exertion or an attack of tremors; but, contrary to what might be supposed, the tremulous and rigid muscles are, as a rule, markedly stronger than their as yet unaffected fellows. The patient, more particularly late in the disease, becomes excessively irritable and fidgety, so that at night especially he finds it difficult or impossible to place himself in a comfortable position; he is apt also to suffer from a painful sense of heat, mainly referred to the epigastrium and back. Speech generally becomes markedly affected, not from loss of language, but from difficulty of enunciation. Words are uttered slowly, and with manifest effort. Associated with this there is often tremulousness of the tongue. But the slowness and difficulty of utterance, which are often associated with slowness and difficulty of deglutition, constitute only one manifestation of the general slowness and difficulty of movement which, for the most part, characterise the disease. Sensation is not impaired; and the patient retains his mental faculties, and control over the rectum and bladder.

Diagnosis.—The affections with which paralysis agitans are most likely to be confounded are disseminated sclerosis, and mercurial tremors. But in the former of these the tremors occur only when the muscles are in use, and for the most part involve the head; the limbs early become paralysed; the patient has no tendency to run forwards or backwards; and generally nystagmus is present. In the latter affection there is probably a history of exposure to the fumes of mercury, and a blue line on the gums; the tremors involve not only the limbs, but the head and neck, and are symmetrical; and there is an absence of the peculiar gait of paralysis agitans.

Progress and Terminations.—The disease is one of slow and often irregular progress, and usually lasts for many years; indeed it may be many years before it attains its full development. In rare cases it is recovered from in the early stage; but for the most part it is incurable. In its last stage the patient becomes confined to his couch or bed; the muscles waste; the tremors, though generally extreme at the time, occasionally cease; the mental powers fail; bed-sores form; and general prostration ensues. Death is due either to asthenia, or to some intercurrent disorder, more especially pneumonia.

Treatment.—In treating shaking palsy it is of importance to give careful attention to all hygienic measures, and to promote the patient's health, if need be, by tonics. Specific treatment has proved of little or no service. Nervine tonics and sedatives have been largely employed; but those which have found most favour probably are iron, strychnia, and hyoscyamus. The systematic use of baths has occasionally proved of temporary benefit. The persistent application of the continuous galvanic current seems to have been serviceable in some cases.

J. S. Bristowe.

PARALYSIS, Diphtheritic.— Synon.: Fr. *Paralysie diphthéritique*; Ger. *Diphtheritische Lähmung*.—Paralytic affections are so frequently associated with diphtheria, that they have been generally, though perhaps not correctly, regarded as peculiar in their origin, and as constituting a characteristic part of the disease. This question is too extensive for discussion here. Still it is necessary to call attention to the fact that paralysis, in various forms and degrees, occurs associated with, or as a sequel of, typhoid fever, relapsing fever, cholera, dysentery, small-pox, and pneumonia; and that in all, they are attributed by Gubler and others to an essentially similar state incident to most fevers and acute diseases. Though their course and phenomena present points of difference, they have common fundamental characteristics—namely, they seem all to be, as a rule, of peripheral origin; they all manifest a natural tendency to recovery; and when they become protracted, they are apt to become permanent from atrophy of the muscles caused by long disuse.

Symptoms.—The usual period of the first manifestations of diphtheritic paralysis is from eight to twelve days after an apparently complete recovery. To this rule, however, there are exceptions. Sometimes, the paralytic affections do not occur till the patient has seemed to be well for more than a month; and, on the other hand, they sometimes show themselves during the acute stages of the disease, as early, occasionally, as the second or third day from its explosion. When they do not occur till the close of the convalescence, or till an interval of some days or longer after apparent recovery, they are usually much more severe, more protracted, and more generalised. When they show themselves in the course of the acute malady, they are generally slight, transitory, and limited, being then confined for the most part to the veil of the palate, the pharynx, and œsophagus. In many cases, the veil of the palate is alone affected

Generally, the earliest indication of a paralytic affection is a slight difficulty in swallowing liquids. Sometimes, the paralysis announces itself by a choking cough on attempting to eat. The cause of the cough—sometimes an alarming and dangerous symptom—is the food coming in contact with the mucous membrane of the upper part of the larynx, in consequence of the paralysed state of the veil of the palate. This organ is insensible, as may readily be proved by the failure to excite reflex action by touching it. A striking feature usually appears in the changed character of the voice—its whispering nasality. The eyelids droop or remain half-closed; the muscles of the face become affected; the cheeks are expressionless and flabby; and the powerless, flaccid lips allow the saliva to dribble from the mouth, giving the patient an idiotic aspect, which is frequently intensified by the muscles of the neck losing the faculty of supporting the head. The speech of diphtheritic patients is variously affected: it is often more or less slow, difficult, thick, and stammering—manifestations due to different degrees and different combinations of paralysis of the veil of the palate, pharynx, tongue, lips, and cheeks. The inferior extremities are generally paralysed before the superior; but when the former become affected the latter seldom escape. In rare cases the paralysis begins in the arms. More serious aggravations of the situation may be added; or they may arise before the limbs have become affected. The heart, the muscles of the chest, and the diaphragm may one or all be stricken, gradually or suddenly, by loss of power. Paralysis of the heart is a cause of patients dying suddenly from cardiac syncope, when no immediate danger has been apprehended. Sometimes this cause of death is threatened before it occurs. When the respiratory muscles are affected, even in a moderate degree, the condition is one of danger, in consequence of the lungs becoming congested from imperfect expansion of the thoracic parietes. The intestinal canal and the bladder are often paralysed. There may be constipation as inveterate and painful as that of lead colic; there may be obstinate constipation without pain; or the fæces may be passed involuntarily, with or without medicinal interference. The bladder, though at first only moderately sluggish, will probably soon become absolutely paralysed from over-distension, the existence of the paralysis being shown by a constant dribbling from the urethra. The intestinal canal and bladder—one or both—may be distressingly stricken when other paralytic affections are almost or altogether absent. Recorded cases show that all the senses are liable to be affected. The sense of sight is that, however, which is by far the most frequently implicated. Squinting, imperfect sight, and other visual disturbances arise from a loss of co-ordinative muscular power paralysis of particular muscles, dilatation of the pupils, and insensibility of the retina—from these causes separately, or in various combinations. Amblyopia, presbyopia, myopia, and diplopia may be met with; but the first is the most common. Local or general cutaneous anæsthesia is usually associated with diphtheritic paralysis. In cases in which the diphtheritic pellicle has never appeared in the throat, paralytic affections may be met with. Sanné states that he has seen paralytic affections in a child in which the false-membrane existed only on the skin around the navel, and also in another in which it was limited to one ear. Similar exceptional cases have been observed by others.

Course.—There is in all cases of diphtheritic paralysis a strong natural tendency to recovery. Under certain special reservations, therefore, such as extreme debility, or implication of the heart, respiratory muscles, or larynx, the prognosis is favourable. The duration of the paralytic affections is very variable, and is dependent to a considerable extent upon the manner in which the function of nutrition is performed, and the skill and vigilance with which nature is assisted by treatment. The duration is much more frequently weeks than months; and when it is more than a year, there is a great probability of the affection becoming permanent, from the establishment of one or more secondary conditions, such as atrophy of muscles, and the ascent of the morbid state from the periphery to the nervous centres.

Pathology.—There is no proof that there is a specific cause of paralysis in diphtheria. During the course of, and in the convalescence from no other acute disease are asthenia and anæmia so constant and so profound as in diphtheria; and in no other disease is paralysis so frequent. The two facts probably stand to each other in the relation of cause and effect. The treatment for asthenia and anæmia is the treatment for diphtheritic paralysis. The affection extends from the peripheries of the nerves upwards. When the nervous centres are implicated, their implication is secondary.

Treatment.—In principle and in detail, the treatment of the paralysis of diphtheria is to a great extent a continuation or renewal of the treatment of convalescence from the attack of the disease itself. Every available means must be employed to promote nutrition, and the healthful exercise of all the functions. The leading therapeutical indications, in respect to general treatment, are fulfilled by giving the patient a pepsinated diet, a ferruginous medication, and as much of the open air as weather and the circumstances of the case permit. The dietetic and medicinal details must be carefully regulated and modified, in accordance with the progress of the patient, and the personal peculiarities of his case.

Orezza water is a good form in which to administer iron in these affections. When the patient has a repugnance to take this water with his meals, in doses of from an ounce to six ounces, it may be given half an hour or an hour after he has eaten. Artificial preparations of iron may also be used with advantage, such as the liquor ferri perchloridi, in doses of from five to thirty minims in water twice or thrice a day. The carbonate of iron pill, in doses of from three to ten grains twice or thrice a day, immediately before or with meals, often answers remarkably well. Bitter effervescing iron-draughts suit some patients.

When amendment is slow or absent under the use of ordinary doses of iron, though the anæmic condition of the patient seems strongly to proclaim the necessity of this medicine being given, its use must not be hastily abandoned, but it should be administered in very small quantity, and largely diluted. Should we still be disappointed with the result, it will be well to try iron in combination with iodine or with arsenic in suitable forms.

The extract of nux vomica, or the liquor strychniæ, in small doses taken daily with some ordinary combination of laxatives in pills, should constitute part of the later treatment in nearly every case.

In addition to the general treatment, the paralysis of diphtheria frequently calls for other measures of a special character.

Persistent and carefully regulated local stimulation may be required to restore impaired innervation, and to secure an adequate supply of arterial blood to the wasting muscles. There are no other means so likely to arrest and prevent degeneration and atrophy of the muscles—morbid changes, which, if unchecked, lead inevitably to the permanence and incurability of the paralysis. Local stimulation may be accomplished by blisters, liniments, pastes, or shampooing. One or other of these means may be employed either separately, or in conjunction with some of the others. The occasional application of blisters is most useful; but care must be taken not to vesicate too large a continuous surface, so as to interrupt the use of systematic gentler stimulation by liniments, pastes, and shampooing. Care must also be taken not to make the skin too tender to admit of the muscles being exercised from time to time without pain. To limit the blister to the surface intended, securing at the same time rapid and comparatively painless vesication, the best proceeding is to paint the surface which it is desired to vesicate with an acetum cantharidis four times as strong as the acetum of the British Pharmacopœia. The liquor epispasticus is an excellent application for raising an immediate blister; but when time is not all-important, it is better to use a strong acetum cantharidis. Lubrication with liniments combining anodyne with stimulating properties is particularly suitable, in conjunction with shampooing, and the galvanic excitement of contraction of the paralysed muscles. A good application of this description is composed of one part of tincture of cantharides, one part of tincture of opium, and six parts of compound camphor liniment. A good stimulating paste is composed of six drachms of powdered ginger, and two drachms of English mustard, thoroughly rubbed up with just a sufficient quantity of lard to make a paste of suitable consistence. Circular bands of linen, an inch in breadth, smeared with this stimulating paste, are applied at intervals of five or six inches to the whole length of a limb, care being taken to change the position of the bands once, twice, or oftener, in the twenty-four hours, so that, whilst the surface is kept glowing with warmth by the paste, its topical action on the skin is not allowed to exceed the proper limit. When the warm tingling sensations caused by the stimulating bands induce restlessness and prevent sleep, the bands must be removed for eight or ten hours at a time. In paralysis of the respiratory muscles, large sinapisms applied to the chest are of much use. In cardiac paralysis, Duchenne has recommended faradisation of the præcordial region. Galvanic excitement of contraction in the paralysed muscles of the limbs is often decidedly useful; but it is a measure which requires to be employed with moderation, and at intervals of about twenty-four hours. If resorted to too early, or too freely, it exhausts the returning power of the affected muscles.

When the paralytic affections become general, or the improvement is imperceptible or very slow, sea-air, sea-baths, and hydrotherapeutics deserve attention. In obstinate and protracted cases—particularly in strumous subjects—they often prove of much advantage when employed together with, or apart from, other measures.

John Rose Cormack.

PARALYSIS, SENSORY. *See* Sensation, Disorders of.

PARAMENIA (παρὰ, irregularly, and μὴν, a month).—A term for irregular menses. *See* Menstruation, Disorders of.

PARAPHIMOSIS (παρὰ, beside, and φιμόω, I confine).—Synon: Fr. and Ger. *Paraphimosis.* A morbid condition of the penis, in which the prepuce having been drawn or forced back behind the glans, cannot be returned, and thus gives rise to a condition of strangulation of the parts in front of it. *See* Penis, Diseases of.

PARAPLEGIA (παρὰ, incompletely, and πλήσσω, I strike).—Paralysis of the lower extremities, usually associated with paralysis of the lower part of the trunk, bladder, and rectum. *See* Paralysis; and Spinal Cord, Diseases of.

Medical College

PARASITES (παρὰ, upon, and σιτέω, I feed). Synon.: Fr. *Parasite*; Ger. *Parasit.*

Definition.—This term, in its most extended sense, is applied, in general pathology, to those living organisms which derive their nourishment wholly or in part from other living organisms. Parasites may be vegetable or animal—*phyto-parasites* or *zoo-parasites*; may live upon the surface of, or in the textures or cavities of, the organisms they infest—*ecto-parasites* or *ento-parasites*; and may pass through the whole cycle of their existence in the parasitic state, or only during certain stages of their life.

This definition will include those organisms, such as tinea and trichina, which feed upon the living tissues of the hosts they infest; those which subsist on the material prepared by the host for its own nourishment—for instance, torula and tænia; and, lastly, those which only temporarily sojourn on the surface of the body, for the purpose of obtaining food, and do not live, for any period of their existence, upon or within their entertainer—for example, fleas and gnats.

The majority of these parasites may be regarded as direct causes of disease, the pathology of which is now being made the subject of accurate investigation, and will be found described, so far as is known, in other parts of this work. A few only of the fungi, such as the blue moulds (penicillium glaucum), may be looked upon as a result of a morbid condition, being occasionally met with on the surface of old ulcers, in old cavities of the lungs, and on the nails.

Vegetable parasites and animal parasites will be separately noticed in the following articles.

PARASITES, Vegetable.—Vegetable parasites are included under the general term of *fungi.* More accurately they are to be referred to the classes Schizophyta or Protophyta, and Zygosporeæ, which are provisionally the lowest divisions of the sub-kingdom Thallophyta.

To the order Schizomycetes of the former class belong Micrococcus, Bacterium, Bacillus, Vibrio, Spirillum, &c.; and to the order Saccharomycetes of the same class, the various Torulæ or Mycodermata, and Sarcina ventriculi.

These organisms are extremely simple, consisting of minute particles of living matter—spherical, cylindrical, filiform, curved, straight, or spiral. They occur in swarms, which are either free, or imbedded in a gelatinous matrix—the *zooglœa-stage.* They contain no chlorophyl, and a nucleus is often wanting. They multiply by fission. The cells of the Torulæ, or yeast-plants, are frequently aggregated into simple or branching rows; and in Sarcina ventriculi the cells are arranged in groups of four, sixteen, or thirty-two, presenting a very characteristic appearance.

The numerous forms included under the term Bacteria are met with normally in many situations in the body; for example, they are an invariable accompaniment of pancreatic digestion. Pathologically, they are of frequent occurrence in the blood, urine, and other fluids, and are regarded as playing an important share in many contagious and other diseases (*see* Bacteria; Contagion; Micrococcus; and Zyme). The ferment-bodies—Torulæ and Sarcinæ—are also found in the stomach during digestion, and the former are abundant in diabetic urine.

In the class Zygosporeæ are comprised the filamentous varieties, such as Oïdium albicans, and the various parasites to which the term Tinea is applied (Trychophyton tonsurans, Achorion Schœnleinii, Microsporon furfur, &c.).

W. H. Allchin.

PARASITES, Animal.—A strict definition of the term *animal parasites*, in the writer's view, should be understood to include 'all those forms of creatures which in a direct manner, by dwelling in or upon other living animals, or by merely visiting or momentarily alighting on the surface of the body, are thus enabled to acquire means of subsistence.' A definition of this comprehensive character not only embraces a variety of creatures rarely spoken of as parasites, such as bugs, fleas, flies, mosquitoes, and so forth, but it appropriately excludes all those forms of animal life that merely play the *rôle* of fellow-boarders (*commensals* or messmates of Van Beneden), and which, nevertheless, are commonly looked upon as parasites. Regarded from a purely zoological point of view, the classification of the animal parasites is a matter of great difficulty; but, for all practical purposes connected with medicine and hygiene, it is sufficient to speak of the intestinal worms as forming three well-marked groups, namely:—(1) *fluke-worms*; (2) *tape-worms*, including *bladder-worms*; and (3) *round-worms*, including *thread-worms.* Under the heading Entozoa will be found a full list of the human animal parasites. For an explanation of various terms employed in connection with the study of animal parasites, the reader should consult the articles on Intestinal Worms; Helminths; Vermes; and Worms. The insect parasites (bots, maggots, &c.) are noticed under Œstrus.

T. S. Cobbold.

PARENCHYMATOUS (παρὰ, beside, and ἐγχέω, I pour in).—The word *parenchyma* was formerly used to designate the connective tissue of the several viscera; but it is now applied to the protoplasm, or active elements, of a tissue or organ; and morbid processes affecting the actual substance of an organ are hence called *parenchymatous.*

PARESIS (παρίημι, I relax).—A slight or imperfect paralysis of motion. *See* Paralysis.

PARONYCHIA (παρὰ, beside, and ὄνυξ, the nail).—Inflammation in close proximity to a nail. A synonym for whitlow. *See* Nails, Diseases of; and Whitlow.

PAROTID GLANDS, Diseases of. *See* Mumps; and Salivary Glands, Diseases of.

PAROXYSM (παρὰ, indicating increase, and ὀξύνω, I sharpen).—This word is used to indicate the periodic attacks or fits which characterise certain diseases, whether regular or irregular, such as ague, gout, and asthma. It is also used to designate the aggravation of certain symptoms from time to time, such as neuralgic pain, colic, and dyspnœa. Diseases characterised by these phenomena are called *paroxysmal diseases.*

PARTIAL (*pars*, a part).—When applied to disease this term may refer either to its extent, or its degree. Thus we speak of *partial paralysis*; and *partial blindness*, *deafness*, &c.

PASSIVE.—This epithet is used by some pathologists in connection with certain morbid conditions, such as congestion, dropsy, œdema, and hæmorrhage, where there is deficiency of vital power, either general or local, and a want of reaction or resistance in the tissues. Some pathologists employ the term *passive congestion* as synonymous with congestion from obstruction (*see* Circulation, Disorders of; and Hypostasis). *Passive movements* of any part, for instance, of a joint, are movements effected by some agency external to the limb, such as the hands of the practitioner or of the patient himself, in contradistinction to movements produced by the muscles of the affected parts, which are called *active movements*. *See* Movement, Therapeutical Uses of.

PATENT FORAMEN OVALE or SEPTUM. *See* Heart, Malformations of.

PATHOGENIC (πάθος, disease, and γεννάω, I give rise to).—A term applied to the production of a disease, having reference to the mode in which the several causes which lead to it operate in its development.

PATHOGNOMONIC (πάθος, disease, and γιγνώσκω, I recognise).—This word is associated with those symptoms and signs which are specially characteristic of a disease, and which by their presence render its diagnosis certain. *See* Disease, Diagnosis of.

PATHOLOGY (πάθος, disease, and λόγος, a discourse).—Pathology is the name generally accepted for the science of disease, but the subjects which it may include cannot be exactly defined. For, ease and disease, well and ill, and all their synonyms are relative terms of which none can be defined unconditionally. If there could be a fixed standard of health, all deviations from it might be called diseases; but a chief characteristic of living bodies is, not fixity, but variation by self-adjustment to a wide range of varying circumstances, and among such self-adjustments it is not practicable to mark a line separating those which may reasonably be called healthy from those which may as reasonably be called disease.

The impossibility of marking such a line may be tested during changes in any external conditions of life, for instance, in the adjustments of the skin to a widely varying range of external temperatures. Where and when in the changes of skin produced by long contact with water rising from 20° Fh. to 200° Fh. would health cease and disease begin? Similarly, in the consequences of mechanical injuries. The complete repair and reproduction of injured and lost parts is an excellent instance of health; and in many plants injuries elicit a greater production of healthy structures than would occur in their integrity—as in the leaf of a Begonia or a Cardamine, in which a fresh shoot may grow from each of many wounds. But while these, and similar adjustments to conditions produced by injury, may be deemed results and signs of health, many others, such as those which may follow severe crushings and open wounds of limbs, must rather be called processes of disease, even though they may end in some repair of injury. Among all the cases intermediate between these extreme groups of adjustment to consequences of injuries, it is not possible to separate the healthy and the diseased.

In this impossibility of scientific definition the range of pathology is vaguely settled by a general understanding as to what may be called disease, and in this settlement are included all the states which are distant from health, whether they be in the way of diverging from it or in that of returning to it, as in convalescence. And some states are included for which it is hard to assign a better or other reason than that they are not useful to us. When fruits or other parts of plants or animals, which have been made useful by cultivation, revert to their more natural state and become useless, they are generally regarded as diseased.

Moreover, in the study of any disease its processes are found, though different, yet not essentially distinct or separable from those of health. Even in the instances of the widest deviations from health, as in the diseases called specific or malignant, a considerable part of the phenomena are due to processes tending towards a reversion to health, and even the changes most averse from health are limited within certain methods not wholly unlike the healthy ones.

In this view pathology may be regarded as an extension of physiology into the study of living bodies in conditions widely unlike those of their ordinary life. Pathology, herein, accepts the conventional limitation of physiology to the study of the nature of living things; but the limitation is convenient more than just. It is not possible to give a verbal definition of the difference between the study of crystals deformed or repairing after injury, and that of monstrosities and the processes of repair in plants and animals. As physiology is not truly limitable from chemistry and physics, so in pathology many processes are illustrated by things abnormal or contrary to general rule in dead matter.

Pathology finds in physiology its basis, the varying standards of healthy structure and function with which its subject-matters are in contrast, and the models and methods of its study; but its range is wider than that of physiology, inasmuch as the conditions giving rise to disease are much more numerous and more various than those of health. Moreover, the deviations from health may reach so far and wide, that the facts and general principles of physiology can only with extreme caution be applied to them. For instance, the greater part of what may be called personal characteristics in respect of health can only be observed in phenomena of disease. It is from observation of these that our knowledge is derived of diatheses or constitutional peculiarities, and of conditions predisposing to overt disease. Of them and their various minglings and alterations by inheritance, and by tendencies to reversion towards health, physiology can give no account; its suggestions cannot be safely used unless completely subject to the test of pathological inquiry.

It seems certain that many erroneous and too narrow systems of pathology have been dervied from the beliefs of pathologists that they could safely, from the general truths of physiology or even from some section of them, infer what must be true in respect of disease. Hence, by means of inferences from the parts of physiology for the time-being most studied, there have arisen the systems of *vital* and *chemical*, of *humoral* and *neural*, pathology, all containing many truths, but none of them able to stand the test, without which nothing in pathology should be deemed true—the test of a wide and direct study of diseases. It would be well if all systems of pathology which can be thus specially named should be suspected of great error. The science of disease should not be divided or specialised on any other ground than physiology may be, as by the names of *general*, *comparative*, *animal*, *vegetable*, and the like. The study of any one of these divisions, wide as it may be, is not safe unless with frequent reference to the others for their aid; and every study of diseases of one part or of one kind is very unsafe, unless with a constant consciousness of its narrowness and partiality. Even if it could be made sure that many diseases begin in morbid states of the blood or nervous system, or any other chief constituent of the body, it would be nearly as sure that within a few hours, or even minutes, of their beginning the other chief constituents would be involved. For the relations of the several parts are so intimate and, through the nervous system and the circulating blood, their means of communication are so swift, that if one be diseased none can long remain healthy. There is no truth more necessary to be held in pathology, and in its practical applications, than that the health of each part is a necessary condition of the health of all the rest. JAMES PAGET.

PAU, in western district of South of France.—Cool, variable, damp, calm, sedative, winter climate. Mean temperature, winter, 42° Fahr. Much rain and many cloudy days in winter. Soil, gravel. *See* CLIMATE, Treatment of Disease by.

PECTORILOQUY (*pectors*, from the chest, and *loquor*, I speak).—A physical sign, connected with vocal resonance, heard on auscultation in some limited parts of the chest. The sounds of the voice in pectoriloquy are directly conducted to the ear, so that the words spoken by the patient may be distinctly recognised by the observer, as if proceeding from within the chest. *See* PHYSICAL EXAMINATION.

PECTORILOQUY, WHISPERING. *See* WHISPERING PECTORILOQUY; and PHYSICAL EXAMINATION.

PEDICULUS.—Three species of lice are parasitic on man:—(1) *Pediculus capitis*; (2) *Pediculus vestimenti vel corporis*; and (3) *Pediculus pubis*.

1. *Pediculus capitis.*—This species of pediculus infests the head, especially the occiput, and deposits its eggs on the shaft of the hair, usually not far from the root. The ovum is a small, oval, semi-transparent body, somewhat cupped at its free extremity, and very firmly attached by a short peduncle to the hair. The young are hatched in about five days. The louse when full-grown is about a line in length, the female being larger than the male. The head, thorax, and abdomen, which is oval, are distinct. The head is furnished with two short antennæ, and large, black, prominent eyes. Springing from the thorax are six well-developed legs, armed with strong claws, with which the animal grasps the hair. On the back of the male is seen a conspicuous, elongated, conical organ, the penis. The animal is of a semi-transparent, dirty-white colour, and is covered with short scattered hairs.

2. *Pediculus vestimenti.*—This species closely resembles in shape and general appearance the pediculus capitis, but is of larger size. It infests the under-clothing, with a preference for that of a woolly kind, and it attacks and irritates the parts of the skin that are covered by clothes. The ova are deposited, not on the hair of the skin, but on the wool or fibre of the clothing, and the young are hatched in about five or six days.

3. *Pediculus pubis.*—This is much smaller and relatively shorter than either of the other species, and the line of separation between abdomen and thorax is less marked. The abdomen is short and rounded, which gives the animal a crab-like shape. Like the other species, it has six legs, armed with strong claws for grasping the hair. This louse infests the pubic region, and occasionally the axilla and hairy parts of the face. The ova are found firmly attached to the hairs near the roots.

The different species of pediculi do not bite, as they have no jaws; but they pierce the skin and draw blood by means of a sucking apparatus or *haustellum*, and in this way they derive their sustenance from the human body. Regarded in a pathological aspect, the presence of pediculi is described as a disease under the name of *morbus pedicularis*, or phthiriasis. *See* PHTHIRIASIS.

ROBERT LIVEING.

PELLAGRA (*pellis*, the skin, and *ἄγρα*, a seizure).—SYNON.: Fr. *Pellagre*; Ger. *Pellagra*.

DEFINITION.—An erythema of the skin, *Erythema pellagrosum*, which makes its appearance on the parts of the body most exposed to the light, especially the back of the hands and neck and the breast.

Pellagra has been regarded as a local *coup de soleil*, whence it is likewise called *mal del sole*. The disease being indigenous to hot countries, and common among the peasants in Italy, Spain, and the South of France, it has there received the names of *mal de padrone*, *mal de misere*, *cattivo male*, and *scorbuto Alpino*. It has also been designated by authors *risipola Lombarda*, *rosa Asturiensis*, *lepra Asturiensis*, *elephantiasis Italica*, and *elephantiasis Asturiensis*. These several names point to different features of its history, sometimes alluding to its appearance; for example, the 'red disease,' *mal de la rosa*; sometimes to the class of people liable to its attack, namely, agricultural labourers; sometimes to its prosumed cause—the sun, misery, and unwholesome maize (*raphania maistica*); and sometimes to theoretical analogies, as in the instance of scorbutus, lepra, and elephantiasis.

Ætiology.—The local symptoms of pellagra prepare us for the consideration of a neurosis, in which there exists undoubtedly a predisposing cause, as well as an exciting cause and subsequent constitutional disorder. The predisposing causes are heredity, which is unquestionable; poverty; insufficient and improper food and clothing; malaria; and especially unwholesome maize, which constitutes the staple article of diet in some of the countries wherein the disease is endemic. A certain fungus, *sporisorium maydis*, has been accredited with being a special cause of the disease. The sun's rays are regarded as the immediate exciting cause, and its power is more particularly evinced in the spring of the year, and has been expressed by the term 'vernal insolation.'

Symptoms.—The local affection, to the outward eye, is at first an ordinary erythema, with a tendency to centrifugal growth. In the beginning it is of a dark-red colour, without swelling; then it becomes more or less deeply pigmented in the centre; and later on, the area becomes bleached and atrophic, while the margin still remains active. In its early stage the congestion of the skin is attended with tingling and prickling pain; subsequently it loses its sensibility, and is more or less completely benumbed. At a later period of the local disease there occur desquamation, chapping, with exudation and incrustation, and sometimes vesicles and pustules.

The constitutional symptoms of pellagra are such as point to a serious injury of the nervous system. They are:—nausea, vertigo, heat of epigastrium, diarrhœa, lassitude, disturbed vision, cramp and neuralgic pains; the pulse being feeble, the tongue red, and the appetite voracious. These symptoms are attended with prostration of strength and emaciation. They continue for a period of three months, and are liable to be re-excited by every exposure to the sun. The following spring the symptoms return with greater intensity, affecting more and more deeply the nervous system and brain; and finally the patient drifts into dementia, melancholia, or mania. In the later periods of the disease the patient is extremely emaciated; the skin sallow and shrunken; the lips pale; the pulse weak, sixty to seventy in the minute; and the extremities cold and tremulous. Serous effusion occurs in the cavities of the body, cerebro-spinal and visceral; and the sufferers die from exhaustion, sometimes from softening of the brain and spinal cord, sometimes from colliquative diarrhœa, and sometimes from typhoid fever.

Prognosis.—Pellagra is generally fatal after a few years when left to take its course; but it may last for a period ranging between one and sixty years. It is curable, when properly treated, in the proportion of 78 per cent.

Treatment.—The most successful treatment of pellagra is that which may be reasonably deduced from an examination of the causes of the disease, namely, improved hygienic conditions; a sound diet of mixed animal and vegetable food; beer or wine; and tonic medicines, especially quinine, phosphates, and chalybeates. To this general plan may be added, a careful avoidance of exposure to the sun, and the particular treatment needed for complications, for example the nerve-symptoms and diarrhœa. The local treatment should consist in the use of soothing and protective lotions and ointments, such as oxide of zinc and lime-water, or oxide of zinc ointment; and pencilling the margin, when the disease is obstinate, with iodine liniment. In cases of the disease of small extent, such as are occasionally brought to this country from tropical climates, arsenic likewise will be found to be a useful remedy.

Erasmus Wilson.

PELODERA.—The name of a genus of 'free nematoids,' one species of which (*P. setigera*, Bast.), according to the determination of the present writer, has been found as a parasite within the human body, under the following circumstances:—In the autumn of 1879 a febrile epidemic prevailed amongst the boys on board the reformatory-school ship 'Cornwall,' which was investigated, and reported upon by Mr. W. H. Power, for the Local Government Board. The symptoms of the disease were in several respects related to those of typhoid fever; in others to those of trichiniasis. Two months after burial, the body of the only boy who had died was examined by Mr. Power and Dr. Cory. From the absence of all characteristic lesions, they decided that this boy had certainly not died from enteric fever. Mr. Power adds:—'This conclusion was more than confirmed by the results of microscopic investigation conducted with reference to trichiniasis. In the very first specimen examined—a few fibres from one of the abdominal muscles—was found a *wandering and living trichina*; and further search revealed the presence of these parasites in most of the muscles examined. Although tolerably abundant, in none of the muscles had the parasite reached the stage of encapsulation.'

Doubts were subsequently expressed in some quarters, as to whether the parasites were trichinæ; and it was suggested that they were free nematoids belonging to the genus *Rhabditis.*

All the existing microscopical specimens were therefore handed over to the present writer. The result went to show that the creatures found were distinctly different from trichinæ. They were in their mature state, of about the same size as embryo or muscle trichinæ, and, as the drawings furnished by the writer show, they exhibited altogether different anatomical characters (see *Ninth Report Local Government Board*, for 1879; *Appendix*). He determined that the organism was a previously unknown species of the genus *Pelodera*, to which he gave the name *P. setigera.*

In relation to the fact that the members of this genus of free nematoids have hitherto been found 'in damp earth and decaying substances,' and especially in fragments of muscle buried in damp earth, it is of importance to bear in mind that these particular nematoids were found alive in a corpse which had been buried for a period of two months. The facts go no further than this, with the addition that the boy died from the effects of an obscure febrile disease. All intermediate links as to source of infection, and as to the existence of the parasites in the body during life, or even shortly after death, are wanting.

Should subsequent investigation confirm the view that the 'Cornwall' epidemic was occasioned by the presence of the nematoids above referred to, then we should have to admit the existence of two distinct fleshworm diseases in the human subject, the one caused by the trichina fleshworm, and the other by the pelodera flesh-worm. And, just as the one affection is now commonly known as 'trichiniasis,' so might the other be designated 'pelodeiasis.'

H. Charlton Bastian.

PELVIC ABSCESS.—Definition.—An abscess situated in the pelvis, and generally connected with some uterine affection.

Ætiology.—The causes of pelvic abscess are: 1. Breaking down of tubercles; 2. Suppurative action, the result of broken-down hæmatocele or suppurating ovarian cyst; 3. Inflammation of the pelvic peritoneum; and 4. Inflammation of the cellular tissue in connection with the uterine ovaries, broad ligaments, or the general cellular tissue of the pelvis.

Pelvic peritonitis and cellulitis being often combined, pelvic abscess may arise from the joint action of these causes; and, indeed, after an abscess has arisen, it is very difficult, if not impossible, to differentiate as to its primary origin.

Symptoms.—Pain of a shooting character, with increased local tenderness, accompanied by rigors, sweating, and pyrexia, supervening upon the symptoms of pelvic cellulitis or of pelvic peritonitis, will generally indicate the onset of the affection. *See* Pelvic Cellulitis; and Pelvic Peritonitis.

An abscess having arisen in the pelvis, it conforms to the same general laws as abscesses in other parts, its direction depending upon the tension of the surrounding tissues, an abscess generally burrowing in the direction of least resistance. Thus pelvic abscess may open in the following directions, singly or combined:—1. Through the abdominal walls and saphenous openings. 2. Into the pelvic viscera, as the bladder, rectum, vagina, or urethra. 3. Through the floor of the pelvis, near the anus. 4. Through the pelvic foramina, either obturator or sacroischiatic. 5. Through the pelvic roof into the peritoneal cavity. 6. Into the lumbar region, in the position of the kidney.

Such are the many and various courses which an abscess originating in the pelvis may take. Fortunately some of those enumerated are rare, such as opening into the peritoneum. No doubt its starting-point has much to do with its subsequent course, which admits of explanation chiefly on anatomical grounds. Should an abscess open into the peritoneum, then our trouble will no longer be with the abscess, but with the peritonitis that ensues, so that we may lose sight of the primary disease in the gravity of the secondary.

Should the abscess open into the rectum, we shall have a discharge of pus and fæcal matter, of a most fœtid character, by the bowel. On its opening into the bladder long-continued cystitis may supervene. Should a communication become established between these two organs, we shall have the indication of fæcal matter present in the urine.

Treatment.—Pelvic abscess must be treated as deep-seated abscesses in other parts of the body in the early stages, namely, by inducing pointing by hot fomentations or poultices; but when matter has formed the treatment will vary somewhat, according to the position the abscess takes:—1. When the abscess is threatening to point above Poupart's ligament, it is generally wisest not to use the lancet until the skin is seen to be definitely implicated. 2. When the matter is burrowing down the leg, or away from the pelvis, beneath the fasciæ, it must be treated according to the usual rules laid down in surgery for deep-seated abscesses. 3. Should the matter be in the floor of the pelvis, bulging into the vagina and rectum, and highly irritative symptoms exist, then it will be advisable to empty by aspiration, or if pus be clearly observed, to open with full-sized trochar and cannula. When the fluid is evacuated, it is well to pass up a drainage tube, carefully withdrawing the cannula, and leaving the tube in position, through which the cyst should be washed out twice daily with a disinfecting fluid, such as some preparation of iodine; the tube can be removed when the discharge ceases to flow. Should hæmorrhage have occurred in the cyst, the difficulty of evacuation of its contents will be great; in this case it has been recommended to lay open the cyst with a bistoury.

The posture the patient assumes is also of importance, the pus should gravitate to the opening; thus, supposing the opening in the rectum or bladder, then the vertical posture will expedite the cure. In the same way any other position may be assumed which fulfils this end.

The general health must always be kept up by the administration of tonics, good food, and stimulants, so as to counteract the exhaustion due to the prolonged suppuration.

J. Braxton Hicks.

PELVIC CELLULITIS.—Synon.: *Parametritis* (Schroeder, Virchow, and Matthews Duncan); *Perimetritis.*

Definition.—An inflammation of the cellular tissue surrounding the pelvic organs, both in the male and female, but much more frequently in the latter, and therefore more especially of the areolar tissue in connection with the uterus and its appendages. Various views have been held with respect to the pathology of pelvic cellulitis, each author giving a name according to his idea of its origin; though, indeed, two distinct affections, pelvic cellulitis and pelvic peritonitis, are described under the general name of pelvic cellulitis.

Ætiology.—The causes of pelvic cellulitis are many and various, but it may be broadly stated that it may arise from any irritation to the mucous membrane, either of the uterus, vagina, or rectum, whether septic or benign. Of these the principal are traumatic, and consequently most cases are seen in connection with the puerperal state, and after operations connected with the female genital organs; but in some persons, due no doubt to some remarkable idiosyncrasy of the patient, the passage even of a sound, or the retention of a pessary, slight cause as it may seem, is in itself sufficient to excite all the phenomena of pelvic cellulitis. Of the other than traumatic causes may be mentioned dysmenorrhœa, suppression of the menses, and gonorrhœa.

Anatomical Characters.—It was not until Nonat and Bernutz began to study the subject of pelvic cellulitis that any progress can be said to have been made in regard to its pathology. Nonat seems to have considered that the pelvic cellular tissue was chiefly the seat of this affection; whilst Bernutz, writing shortly afterwards, denied that the cellular tissue was in any way affected, and described it as an affection of the pelvic peritoneum; hence we have the term 'peri-uterine phlegmon' of Nonat, and 'pelviperitonitis' of Bernutz. Virchow, and Matthews Duncan, following his suggestion, have used the terms 'para-metritis' and 'peri-metritis;' 'para-' signifying an inflammation of the cellular tissue, 'peri-' an inflammation of the serous membrane surrounding the uterus. Schroeder uses the term pelveo-peritonitis in much the same way as Bernutz, and adopts the 'para-metritis' of Virchow. Cruveilhier, Champonièrre, and Tilt have pointed out the share which they believe the lymphatics play in this disease, and to this they give the name of lymphangitis. The terms pelvic cellulitis and pelvic peritonitis appear in the nomenclature of the College of Physicians, and we see no good reason to alter the names. Pathologically, no doubt, the distinction can be made in most cases, but clinically some difficulty arises, and many and various have been the computations as to their relative frequency. Schroeder points out that, even pathologically, the false cyst in pelvic peritonitis may become so thickened as to resemble that of pelvic cellulitis, and as the majority of cases tend towards resolution, and as there is a clinical difficulty as to diagnosis, coupled with their frequent coexistence, there must always be some diversity of opinion as to their relative frequency.

Pelvic cellulitis being caused, as we have said, by some irritation of the genital organs, the question as to the mode of its production, and the part which the different tissues take in its transmutation, has been frequently discussed. Some, after the suggestion of Dance, supposed that the venous system acted the part of the carrier in conveying the *materies morbi*. For a long time the profession were content to receive this as an explanation of the phenomena, until Cruveilhier and Champonièrre showed the part which the lymphatics played in this disease. Besides this, there is reason to believe that, in those cases where the passage of a sound and such-like simple irritants are the cause of pelvic cellulitis, the nerves must play an important part, to account for such a rapid effusion of so much plastic material.

Pelvic cellulitis begins by an exudation of an albuminous nature into the cellular tissue. This, as in other cellular inflammations, may become absorbed, the fluid portion first, and the more solid portion at a later period; or, instead of ending in resolution, it may take on a retrograde metamorphosis, and end in abscess.

The exuded material thrown out in pelvic cellulitis, follows the same steps wherever it may be situated in the pelvis, although its name and clinical symptoms vary according to its topographical distribution. But inasmuch as the effused material is thrown out into the cellular tissue near such a sensitive organ as the peritoneum, the inflammation is liable at any time to spread to and involve this membrane, by reason of its continuity. The peritonitis may either become localised, or may spread and involve the whole membrane, giving rise to general peritonitis; when the latter result occurs it is generally due to a septic cause, frequently spreading with extreme rapidity. It is highly probable that lymphangeitis plays an important part in cases of this kind.

Symptoms.—A small amount of pelvic cellulitis may in itself give rise to very slight symptoms, perhaps merely a sense of uneasiness in the lower portion of the abdomen. This is often the case in slow recovery from the lying-in state, and may be overlooked, a vaginal examination not being deemed necessary, the symptoms varying much according to the rapidity and the quantity of the exudation. Should a large quantity be exuded, the most prominent symptoms will be more severe, namely, more or less tenderness on deep pressure, with dull aching pain in the pelvis, languor, and pyrexia; along with these there may be obstinate constipation and pain in defæcation. Dysuria also may be a prominent symptom. The presence of the last two symptoms will depend upon the situation of the effusion, and its pressure on the rectum and bladder.

Physical signs per vaginam.—In the early stage, there being only an effusion of fluid, its detection will be difficult; but as the matter becomes more solid, we shall be aware of a dense mass, usually limited to one or other side of the uterus, but if the amount be large, entirely surrounding the organ. This effusion is generally in the layers of the broad ligaments, either attached to or separate from the uterus, but usually fixed to it; and when the effused matter has had time to consolidate, it is of considerable hardness, similar to that of a uterine fibroid, but generally irregular in outline, often following the form of the roof of the vagina. A uterus fixed by hard, irregular, and immovable swelling is considered by some as pathognomonic of pelvic cellulitis. Pain running down the legs, on flexion and abduction of the thigh, owing to implication of the lumbar nerves, simulating hip-joint disease, is also a valuable diagnostic sign in some cases.

At the onset the temperature generally rises in the evening to 101° or 102°, rarely higher, and is lower in the morning.

The pulse, according to Dr. Galabin, is full in the benign cases; but in the septic form it is dicrotic, and towards the end in fatal cases becomes extremely so. The pulse and temperature form a valuable guide as to the state of the case. Favourable cases may recover in a few days, but generally go on for weeks or months, the absorption gradually taking place, its duration depending much on the general state of the patient and the amount effused. But should the case break down and end in abscess, the presence of this will be shown by increased pyrexia, probably rigors, and localised pain of a shooting character. For the signs of inflammation extending to the peritoneum, *see* PELVIC PERITONITIS.

DIAGNOSIS.—The diagnosis of pelvic cellulitis from the diseases with which it may be most readily confounded, will be found in the articles on PELVIC HÆMATOCELE, and PELVIC PERITONITIS.

TREATMENT.—When the pathology of pelvic cellulitis is fully considered, it will be seen that the treatment must depend upon the stage to which it has advanced. In the acute stage we should limit ourselves to the administration of salines, and of sedatives for the relief of pain, opium being given internally; and locally, hot fomentations applied to the lower part of the abdomen, and hot injections given *per vaginam*. Leeches are often applied with much benefit to the groin, perineum, or, still better, to the os uteri—three or four at a time, thereby removing any temporary congestion of those parts. The bowels are better moved by an enema, than by purgatives given by the mouth, which if active may cause extension of the inflammation to the peritoneum. When the inflammatory action has subsided, the re-absorption of the plastic material which has been thrown out is assisted by the administration of tonics, as iron and quinine. Iodide of potassium is much relied on by some practitioners, and may be given with advantage combined with tonics; but probably the best means of promoting absorption is by restoring the general health by every method possible. The Americans and Germans recommend the vaginal douche night and morning for about twenty minutes; they believe that it acts as an absorbent as well as a sedative. In the septic variety much success has attended the exhibition of large doses of quinine, five grains every four hours having been given with advantage. In all cases rest is imperatively called for, even after the inflammatory stage is past.

J. BRAXTON HICKS.

PELVIC HÆMATOCELE.—SYNON.: Peri-uterine Hæmatocele; Retro-uterine Hæmatocele; Pelvic Thrombus.

NATURE.—Nelaton described this affection as a tense bloody tumour situated in Douglas's *cul-de-sac*, which pushed the uterus forward towards the symphysis pubis. Afterwards every bloody tumour in connection with the pelvic organs came to be so described by some authors. Thus Dr. Barnes classes ruptured uterus with an effusion of blood into the peritoneal cavity as an example of pelvic hæmatocele.

Any effusion of blood which takes place either from ruptured uterus or from other organs is not by most authorities now considered as true pelvic hæmatocele; indeed, blood effused from the liver, kidney, or other organ which has found its way into Douglas's pouch, might thus be included under this name. Pelvic hæmatocele consists of two varieties, to which the names of *retro-uterine hæmatocele*, or better, *intra-peritoneal hæmatocele*; and *pelvic thrombus*, have been given. The first of these affections may be described as an effusion of blood into the retro-uterine sac, subsequently shut off from the rest of the peritoneum by an effusion of plastic material. The second variety, *pelvic thrombus*, is an effusion of blood into the cellular tissue of the pelvic organs, and more especially of that in connection with the uterus. Even with this limitation of applications, the frequency of pelvic hæmatocele has been variously stated by different authors; thus Scanzoni and Schroeder reckon it a rare disease, whilst Zeyfurt reckons it as occurring in 5 per cent. of all uterine cases. Inasmuch as most cases recover, the diagnosis must depend solely on a careful analysis of the clinical history.

It is well, however, that we should distinguish between the two affections, and we shall employ the term *thrombus* as applying to an effusion of blood into the cellular tissue around the uterus, and the term *retro-uterine hæmatocele* to blood which has gravitated into the peritoneal pouch between the uterus and rectum. These distinctions are important, inasmuch as they can in most cases be discovered both clinically and pathologically.

A. **Retro-uterine Hæmatocele.**—ÆTIOLOGY.—The causes of retro-uterine hæmatocele are as follows:—1. rupture of the uterine wall from any cause, including aneurisms and varices; 2. rupture of the Fallopian tubes (hæmatometra) from extra-uterine fœtation; 3. ovulation and ovarian tumour; and 4. rupture of other viscera in the abdominal cavity.

SYMPTOMS.—These will be the same as in the rupture of any viscus, and the escape of blood into the peritoneal cavity. Thus, there will be sudden onset of pain; prostration and collapse, greater than can be accounted for by the anæmia; often vomiting, which is at times excessively severe. Nothing can be felt at first on physical examination, owing to the liquid state of the blood; but as the blood coagulates, hardness will supervene, displacing the uterus—the amount and direction of the displacement depending on the position which the blood assumes. This, as has been pointed out, is generally to be found posteriorly, thus pushing the uterus forward towards the pubes. In a short time inflammatory action may be set up, so as to limit the effusion, and in this case will not be of a severe peritonitic type; but, on the other hand, general peritonitis may be established, which generally ends fatally; or, again, the inflammatory process having become limited by plastic material, it may follow the usual course of pelvic abscess.

B. **Pelvic Thrombus.** — ÆTIOLOGY. — The chief causes of pelvic thrombus are hæmorrhage arising from interruption or suppression of the menses, or from sexual excitement; and hæmorrhage from diminished resisting power of the vessels, in the hæmorrhagic diathesis, scorbutus, or purpura.

Hæmorrhage which has thus arisen may follow the usual course of extravasated blood, namely, coagulation and absorption, or proceed to the formation of an abscess.

SYMPTOMS.—These will depend on the amount of the effusion and its position. In general the quantity will be less than in retro-uterine hæmatocele. It is generally greater when it occurs in the layers of the broad ligament, which it may separate to a very considerable extent, reaching sometimes to the level of the umbilicus. However, blood effused into the cellular tissue is necessarily under restraint, though the pain would be thereby increased.

In this, as in the affection just described, we have a sudden onset of symptoms, but we do not have such marked anæmia, for the amount of the effusion is hardly so large. And we miss those symptoms of severe collapse which depend upon an effusion of blood into the peritoneal cavity. In fact, here we have more the symptoms of hæmorrhage *per se*, as in any other case of hæmorrhage, the effusion being situated outside the peritoneum. We seldom have symptoms of peritonitis supervening, but rather those due to the displacement which the mass occasions. The effusion may either be absorbed, or it may end in abscess, which pursues the usual course of pelvic abscess. *See* Pelvic Abscess.

Diagnosis.—These swellings, produced by blood-effusion, are liable to be confounded with many other troubles about the uterus. The most frequent position is in either broad ligament, where they may simulate fibroma, ovarian tumour, and especially cellulitis of the same part. The next position in frequency is behind, in the cellular tissue between the uterus and rectum, where the hæmatocele may imitate retroflected uterus or tumour in Douglas's pouch. When the hæmorrhage is found at the roof of the vagina, or between the bladder and uterus, it gives the physical characters of a fibroma in the anterior wall, of pregnancy, or of cellulitis. It will thus be seen that the diagnosis depends much on a clear clinical history, either from the patient or her friends, which in some cases is difficult to obtain.

Treatment.—This divides itself into two parts, the first of which will be the arrest of the hæmorrhage (should it still be going on); and the second, the application of such means as tend to resolution and absorption of the coagulum. The first indication will be fulfilled by absolute rest, and the administration of hæmostatics, such as gallic acid, lead, turpentine, and other like remedies on which we are wont to place reliance for internal hæmorrhage, combined with opiates. But inasmuch as vomiting is often a severe and prominent symptom, and medicines are with difficulty kept down a sufficient time to be of service, the opiates may have to be given by the rectum or hypodermically. Ice-bags or, if these are not at hand, cold lotions, should also be applied to the lower part of the abdomen, or even introduced *per vaginam*. At the same time a little ice may be given to suck. Small doses of opium, or any of its preparations, repeated at intervals if they can be retained, tend both to quiet the circulation and support the system against loss. Stimulants, however, and hot drinks must be avoided. If rupture of an extra-uterine cyst be supposed the cause, or rupture of an ovarian varix, it may be advisable to perform abdominal section.

The hæmorrhage having ceased, we must still enjoin rest for some time, to prevent its recurrence, and to admit of the blood being absorbed.

In fulfilling the second indication, namely, the resolution of the extravasation, little will be required beyond keeping the system in good general health by the administration of tonics. Iron and quinine are of much service. Some practitioners rely on iodide of potassium as an absorbent; it may be given combined with quinine. Should a recurrence of the hæmorrhage take place at different periods, the bromides and iodides have been considered of some value in quieting the action of the ovaries.

If the case unfortunately end in abscess, the proper treatment will be that of pelvic abscess. *See* Pelvic Abscess. J. Braxton Hicks.

PELVIC PERITONITIS.—Synon.: Perimetritis (Bernutz, Virchow, and Matthews Duncan).

Definition.—A local inflammation of that portion of the peritoneum surrounding the pelvic organs, and especially the uterus and broad ligaments. *See* Pelvic Cellulitis.

Ætiology.—Pelvic peritonitis is often found as an extension from pelvic cellulitis, both in the puerperal and non-puerperal state. In the non-puerperal state it is associated with uterine flexions and versions; various operations on the genital organs; rupture of ovarian cysts; abscess of the ovary; escape of blood from the Fallopian tube; gonorrhœa; malignant disease; carcinoma; and tubercle.

Anatomical Characters.—Here, as in cellulitis, the part which the veins, lymphatics, and nerves take is still open to controversy; but the lymphatics, no doubt, take the most important part.

Whatever the origin of the peritonitis we have, in the first place, an effusion varying in character—either serous, plastic, or purulent. The serum may either be absorbed, or become encysted by plastic material, and form a false cyst, which, in an unhealthy condition, may be of a pyoid nature, forming an abscess having the usual characters of pelvic abscess.

But there is this difference from the exudation of pelvic cellulitis and that of pelvic peritonitis, namely, that in cellulitis the exuded material may be absorbed, leaving but few, if any, relics of the bygone inflammation, whilst in peritonitis the fluid portion is chiefly absorbed, leaving very often strings or bands of adhesions matting together the various organs. A not uncommon occurrence is for the uterus, if previously retroflected, to be bound down posteriorly to the sacrum, but it may be equally fixed in any other direction in which effusion has been poured out. The effect of these adhesions is curious, for the ovary has been rent from its attachment, and fixed to the pelvic brim posteriorly. These adhesions may stretch and give rise to no permanent displacements, but at other times they are irremediable. Pregnancy seems to have most influence in their removal; and, indeed, this has been suggested as a method of cure. In the same way they may hinder the action of the uterus in labour, and cause pain by their rigidity, though they often hinder conception or give rise to abortion, and sometimes to severe and even fatal obstruction of the bowels. The influence of adhesions should always be borne in mind after any case of pelvic peritonitis.

Should the case end in abscess it may open in any of the ways given under the head of Pelvic Abscess.

Trinity Medical College.

Symptoms.—In chronic and subacute cases of pelvic peritonitis, the symptoms are usually obscure, the patient (often after childbirth) complaining only of a dragging sensation at the lower portion of the abdomen. These cases frequently pass unnoticed, rest in bed and other remedies sufficing to effect a cure.

In acute cases, the symptoms begin with complaint of a severe pain, increased by pressure, with fixedness of the abdominal muscles in the lower portion of the abdomen, or the coils of the intestine may be seen mapped out. Along with this there is usually a wiry pulse; but if the disease be of septic origin, it may be dicrotic. The temperature is usually above 102°, but varying night and morning. We may also notice a Hippocratic expression of the countenance. Should this become marked we should have reason to fear an extension to the general peritoneum. At the same time we may have constipation, and generally severe vomiting; and by pressure of effused material on the bladder and rectum, there may also arise constipation and dysuria. *Per vaginam*, we may discover a tumour laterally high up in the pelvis, and not easily felt, both on account of the distance from the examining hand, and from the severe pain to which examination gives rise.

But again, it must be pointed out that cases do occur in which nearly all the symptoms are wanting, although the attack may be of a most malignant type, the rapid pulse and pyrexia, coupled with a peculiar expression of the countenance, being almost our only guide. A vaginal examination fails to give us any indication as to its nature, owing to the matter being purulent and fluid. These cases are almost always of septic origin.

Diagnosis.—Pelvic peritonitis may be diagnosed from pelvic cellulitis by the following considerations:—

Pelvic Cellulitis.

1. Tumour easily reached; generally easily and early felt in neighbourhood of broad ligament, and above pelvic brim.
2. Abdominal pain, increased by deep pressure.
3. Temperature usually not above 102°; pulse full, soft, dicrotic in septic form.
4. Retraction of thigh with abduction. Pain down leg.
5. Nausea; vomiting, not excessive.
6. Not accompanied by tympanites.
7. Marked tendency to suppuration.

Pelvic Peritonitis.

1. Tumour not noticeable for some days.
2. Abdominal tenderness of an acute kind, quickly increased on pressure. Form of coils of intestines mapped out on abdomen. Fixation of abdominal muscles.
3. Temperature above 102° usually; pulse wiry in benign, dicrotic in septic form.
4. Pain down leg and retraction of thigh never present.
5. Nausea; vomiting excessive.
6. Tympanites present in severe cases.
7. Constipation, often marked.
8. Suppuration not often present.

Treatment.—In all cases of pelvic peritonitis, whether acute or chronic, our chief point is rest, and this cannot be too rigidly insisted upon. The stage of the disease, whether chronic or acute, will indicate the amount. Should the case be of a subacute nature, then reclining on a couch will be all that is necessary; but should, on the other hand, the case be acute, however limited in area, then it is essential that we should order absolute rest in bed, as little movement as possible being allowed. In chronic cases this point must be left to the discretion of the physician; it will be for his consideration what part the local condition bears in relation to the general health, and whether continuance of the local trouble will not cease on restoration of the general health.

The next point to be considered—and we know of none in which so much mischief is done by want of appreciation of the true condition—is the administration of purgatives in the acute forms. The same rule holds good here as in the treatment after an operation for hernia, namely, that any increased peristaltic movement of the intestines is liable to cause an extension of the peritoneal complication. We must bear in mind that what the inflamed peritoneum wants is rest, to lessen the friction of the surfaces; and should any unhealthy matter be present, time is urgently required for the effusion of a limiting plastic material, to shut it off from the rest of the abdominal cavity; and after its formation, still further repose is necessary to prevent its being broken down. Thus it is that we find our sheet-anchor lies in the administration of full doses of opium, which not only allays the sensitiveness of the peritoneum, but limits the peristaltic movement of the intestines. If the bowels are unrelieved for fourteen to eighteen days, no harm will accrue. A mild enema of olive-oil and gruel will be the best measure to adopt where necessity requires relief.

In the more chronic cases, for the same reason, we should never purge our patient, for there is always a risk of extending the inflammatory action to the general peritoneum; a mild laxative daily, or, better, an enema, will answer every purpose.

If, from the severity of the constitutional symptoms and the absence of the local, we have reason to believe that we have a case of septic origin to deal with, quinine must be given in large doses, say five grains every four hours, by mouth, by the bowel, or hypodermically. Very marked results have attended the exhibition of this drug in cases otherwise almost hopeless. Sixty grains a day have been given without ill result—indeed with the cure of the patient. Should the peritonitis appear to be of a purely sthenic form, the employment of the old remedy, mercury, will generally be found to be a valuable addition to that of the opiates, at any rate for a short time; but in any case great caution is required lest diarrhœa be induced. In this form the employment of leeches to the abdomen will also assist in the reduction of the inflammation. Care, however, must be observed not to debilitate the patient. Hot opiated fomentations to the lower part of the abdomen in all cases afford great relief. Should the case lapse into a chronic state, iodide of potassium may be of some service in aiding the absorption of the inflammatory products. The bromide has also been given with the idea of lessening congestion and quieting the action of the ovaries.

At a later date much good will result from the administration of tonics, and from change of air, the local trouble being often kept up by the general condition.

Such are the chief indications of treatment. Vomiting, dysuria, and other complications must be treated on general principles.

J. Braxton Hicks.

PEMPHIGUS (πέμφιξ, a bladder).—Synon.: Pompholyx; Fr. *Pemphigus*; Ger. *Blasenkrankheit.*

Definition.—A somewhat rare skin-disease, of indefinite duration; in which blebs or bullæ, containing serous or sero-purulent fluid, form in greater or less numbers on various parts of the body and limbs; burst; dry up, and produce crusts; and finally disappear, leaving temporary stains, but no permanent scars.

Ætiology.—At Vienna Hebra found one case of chronic pemphigus in 10,000 adult persons. In 29,535 patients with skin-diseases of all kinds, excluding the acute exanthemata, there were in thirteen years 66 cases—46 in men, and 20 in women. At Prague, in five years, out of 38,546 sick children, 54 had pemphigus, 24 being boys and 30 girls. Pemphigus is much more frequent in children than in adults, and most frequent in the first eighteen months of life. At Prague 23 of 54 cases were under one month old. In adults all ages are nearly equally disposed to it.

In childhood females seem slightly more disposed than males; in adult life pemphigus vulgaris attacks three times as many men as women. Pemphigus foliaceus is more frequent in women. Neither geographical distribution, season of the year, nor any special diet or habits of life seem to affect the development of the disease. It occurs in persons of all temperaments, and in the healthy as well as in the delicate. No definite relation can be traced between derangements of the kidneys and pemphigus, or between the latter and the gouty or rheumatic diatheses. In a few instances there has been a distinct relation between pregnancy and the outbreak of bullæ. Pemphigus is never endemic. Various epidemics, chiefly among children, have been described by trustworthy writers, of which the latest occurred in 1869 at Halle, and in 1874 in Paris, both in new-born infants, but it seems doubtful whether these were cases of true pemphigus, and not rather allied to varicella. Outbreaks of pemphigus have appeared in more than one case to be determined by a local injury, such as a puncture of the finger. There are one or two instances known in which the disease has been transmitted hereditarily.

A few cases of localised outbreak of bullæ—for example, on one hand and arm—have been reported in connection with injuries of peripheral spinal nerves, and chronic meningitis and myelitis of the spinal cord.

Pemphigus is a non-contagious disease, and all attempts to transfer it from one person to another, by inoculating the contents of the bullæ, have failed.

Anatomical Characters.—In pemphigus the capillaries of a circumscribed portion of skin are dilated with blood, and this hyperæmia is followed by exudation from them of serous fluid, which infiltrates the papillæ and the cells of the rete mucosum, and finally makes its way beneath the epidermis, so as to raise and separate its uppermost layers from the parts below, thus forming a bulla or bleb. The parts of the epidermis which are connected with the hair-follicles resist the pressure longest, but at length give way, and their remains then hang from the under surface of the covering of the bullæ as small threads or processes.

The contents of the bullæ consist at first of nearly pure serum, which gives on heating a flocculent deposit of albumen; later on the fluid contains numerous pus-cells, probably due partly to migration of white blood-corpuscles, and partly to proliferation of the rete cells. Occasionally it contains small quantities of blood exuded from the surface of the cutis. Bacteria were found in one case during life (Sangster). The reaction is at first neutral, but is faintly alkaline in the older bullæ. Soda salts predominate over potash salts. In two cases Jarisch has detected urea. No light has been thrown on the nature of the disease by a chemical examination of the urine, or of the blood, although Bamberger believes that there is an excess of ammonia in the latter.

No *post-mortem* examination has as yet revealed any constant alteration in the organs or tissues which would account for pemphigus. General anæmia, and wasting of the muscles and other parts, have been found in uncomplicated cases, while some patients have died of intercurrent pneumonia and of phthisis. In more than one instance amyloid degeneration of the liver and spleen has been found, just as in other chronic wasting diseases.

Description.—Pemphigus may occur without apparent assignable cause in a previously healthy child or adult. The bullæ may form on a perfectly normal skin, or else a circumscribed portion of skin becomes hyperæmic, and the epidermis over it is raised by a rapid effusion of serum into a bulla, which enlarges quickly, so as to outstrip and cover its base. The bullæ are mostly hemispherical in shape, and may reach the size of an orange, or larger; but, as a rule, they vary from that of a pea to that of a hazel-nut or walnut. Their contents are at first clear and transparent, but in a day or two they become milky and opaque, and finally purulent. The coverings, previously tensely filled, burst; and the discharge dries into flat yellow-brown or blackish crusts. The bullæ tend to a symmetrical distribution on the two sides of the body, and also in some cases to an arrangement in circles or semicircles. They may also spread peripherically, fresh bullæ forming at the edge of the crusts, or stains of old ones. There is no areola or swelling around the bullæ, but red lines are sometimes noticed running outwards from them, probably due to inflamed lymphatic vessels. At the same time as the skin is affected, small bullæ generally form on the mucous membrane of the mouth, nose, and pharynx; and they have been seen with the laryngoscope on the posterior surface of the epiglottis. They have also been found *post mortem* on the mucous membrane of the bronchi and of the intestines, and are probably the cause of the diarrhœa and bronchitis from which pemphigus patients sometimes suffer. Pemphigus has a marked tendency to recur at longer or shorter intervals, each outbreak being made up of a number of successive crops of bullæ. A few bullæ may in no way affect the general health, but if they are numerous they may be preceded by rigors and fever—102° to 103° Fahr.—and even by delirium and other cerebral symptoms in children. The disease may terminate after one or two attacks, or may recur at intervals and with increasing severity for years, until the patient is reduced in health and strength, and finally dies in a marasmic state, or of some intercurrent disorder.

Classification.—We may divide pemphigus into three main varieties:—1. *P. acutus*; 2. *P. chronicus*; and 3. *P. foliaceus.* Other varieties, such as *P. solitarius*, when only one bulla exists at once; *P. gangrenosus*, where ulcers succeed the bullæ; and *P. pruriginosus*, where itching is a conspicuous symptom, have been described, but they scarcely merit detailed notice.

1. *Pemphigus acutus.*—By this we understand a bullous eruption which occurs only once in the same individual, has a short duration of from three to six weeks, and generally terminates in complete recovery. The existence of such cases, which was at one time doubted, is now certain. In its general symptoms *P. acutus* resembles the acute specific diseases. There is a prodromal stage, a rigor, great prostration, and albumin may appear in the urine (Senftleben). Fatal cases have occurred.

2. *Pemphigus chronicus seu vulgaris.*—This, the *P. diutinus* of Willan, is the most usual form, and the one to which the above description corresponds. This form may assume a malignant character by the number of bullæ present at one time, and by their prolonged duration and rapid recurrence, so that the patient's health is undermined.

3. *P. foliaceus* (Cazenave).—Under this name has been described a form of pemphigus of a peculiarly malignant character. The bullæ are few and small at first, and they are never tensely filled with fluid. Other bullæ form round each central bulla, or else the latter spreads peripherically *per continuum*, until at last nearly the whole surface of the body is involved. At the same time the skin does not heal over the situation of the older bullæ, but remains moist and raw, and covered either with crusts like those of impetigo, or else with the loosened coverings of the bullæ, which form large lamellæ or scales, from which the disease derives its name. The scales have been likened to flaky pastry. This form is happily extremely rare, for it is always fatal.

Complications.—Pemphigus has been seen occurring simultaneously with small-pox, and with purpura. Several cases have been reported in which a form of pemphigus occurred in the early weeks of pregnancy, and continued until delivery. In one case the disease recurred during several successive pregnancies. *Pemphigus pruriginosus* is a name which has been given in cases where the disease has been accompanied by severe pruritus.

Diagnosis.—The fully-developed eruption of pemphigus is too characteristic for it to be mistaken for any other disease. The diagnosis may be difficult at the onset, when only a few bullæ have appeared, or else towards the termination of an attack, when only scabs or stains are left; in the first case the absence of cuniculi will distinguish it from some rare cases of scabies of a purely bullous form. At the outset it may be also necessary to distinguish its bullæ from those occurring in erysipelas; from the use of artificial vesicants; from burns; and from the friction of shoes, clothes, or contiguous portions of skin. The bullæ of herpes iris invariably commence on the backs of the hands and feet; run a rapid course; and assume a concentric circular character. The bullæ which not unfrequently occur in anæsthetic leprosy can scarcely give rise to difficulty, when taken in connection with the maculæ and other phenomena attending it. In long-standing cases of pemphigus, portions of skin which are extensively denuded of their epidermis, may take on a considerable resemblance to eczema rubrum; but the history, the emaciation and weakness of the patient, the dark staining of the skin, with absolute absence of infiltration and only slight irritation, will render it easy to form a decided opinion. Syphilitic pemphigus is distinguished from true pemphigus by occurring only in new-born children; by involving principally, though not exclusively, the palms and soles; by leaving the mucous membranes unaffected; and lastly, by forming thick crusts when the bullæ burst, under which deep ulcers form.

Prognosis.—This is favourable in the early attacks, but doubtful as to the ultimate result, since it is impossible to say whether the disease may end with a single attack, or go on to gradual exhaustion of the patient's strength in the later ones.

Treatment.—No specific remedy for pemphigus has as yet been discovered; the nearest approach to one is arsenic, which in some cases of relapsing pemphigus, especially in early life, exerts a marvellous action on the disease, not only removing all traces of it for the time, but restraining its further invasion during long periods (Hutchinson). In other cases all drugs are equally powerless. The treatment which finds most general approval consists in the administration of tonics, especially quinine or bark and iron, and in supporting the strength of the patient by nourishing food and wine. External treatment consists in puncturing the fully-formed bullæ, and then in coating the parts with zinc, lead, or boracic acid ointment, or else in dusting them with starch or oxide of zinc. In the pruriginous form, preparations of tar and warm baths may be tried. In some cases bran baths, and in others alkaline baths, have been found beneficial, but it is impossible to lay down any line of treatment suitable to all cases.

Edward I. Sparks.[1]

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[1] Revised by Dr. Alfred Sangster.

PENIS, Diseases of.—SYNON.: Fr. *Maladies de la Verge; Krankheiten der Ruthe.*—Taken in their widest sense, the diseases of the penis include a number of conditions which are separately described in this work, such as diseases of the urethra, gonorrhœa, balanitis, gleet, syphilis, and priapism. For a discussion of these subjects the reader is referred to the articles under their several names. In this place there remain for consideration the following morbid states:—1, Congenital abnormalities; 2, Phimosis, acquired; 3, Preputial calculi; 4, Paraphimosis; 5, Inflammation; 6, Gangrene; 7, Herpes preputialis; 8, New growths; 9, Cancer; and, 10, Elephantiasis.

1. **Penis, Congenital Abnormalities of.**—Various abnormalities are from time to time met with in the penis, which are more or less important according to the difficulties in micturition or sexual intercourse to which they may give rise, and the consequent ill effects upon the personal comfort and general health. Among such may be mentioned certain rudimentary conditions of the whole organ, associated or not with defective development of other parts of the genito-urinary apparatus—undue smallness or even deficiency; disproportionate largeness; torsion or lateral deviation; in extremely rare cases, multiplication (double or triple penis); abnormalities in excess or deficiency of particular parts of the organ—epispadias; hypospadias; and phimosis. The three last named require special notice.

(*a*) **Epispadias.**—DEFINITION.—A condition in which, from arrest or defect in development, the upper parts of the urethra and corpus spongiosum are wanting, and the corpora cavernosa are not properly closed together; and in which, consequently, the penis appears more or less completely fissured or opened along its dorsal aspect, and the floor of the urethra is exposed.

SYMPTOMS AND EFFECTS.—This condition is most frequently associated with ectopia vesicæ (*see* BLADDER, Diseases of); but the defect may be limited to the penis. In most instances the prepuce is long and pendulous below the glans; and this is important, inasmuch as it may often be advantageously used in remedial plastic operations.

The attendant inconveniences and discomforts, such as incontinence of urine and unfitness for sexual congress, though varying somewhat in degree with the extent of the defect, are so great and so constant, that any reasonable attempt at remedy by plastic operation may be considered justifiable. It must be confessed that such attempts have hitherto resulted much more frequently in failure than in success. In some cases, however, much good has been effected; and in others the patients have been enabled to wear apparatus by which their discomfort has been materially diminished. For a description of the various methods adopted, reference must be made to works on operative surgery and special treatises.

(*b*) **Hypospadias.**—DEFINITION.—A condition in which, from defective development of the urethra and of the corpus spongiosum, the urethra opens on the under surface of the penis, at a variable distance behind the glans; and in which, during erection, the penis arches more or less downwards and backwards. The prepuce usually forms a kind of flap, which overhangs, but does not surround the glans.

SYMPTOMS AND EFFECTS.—The opening of the urethra, which is often very small and slit-like, may be situated either immediately behind the glans, at any point in the under surface of the body of the penis, or just in front of the scrotum. In the first case—by no means an uncommon condition—no material inconvenience results; micturition and sexual intercourse can, as a rule, be fairly well accomplished; and there is no need for surgical interference beyond the enlargement, if needful, of the urethral orifice. But in cases in which the urethral orifice is far back, the urine passes down the thighs, or backwards; complete sexual intercourse is rendered difficult, painful, or altogether impossible; and the semen cannot be properly intromitted. Such a state of things often occasions great mental distress, and, thereby, impairment of health; and it may become justifiable and desirable to attempt to remedy to some extent the defect by surgical operation. A great variety of methods have been devised and practised, the details of which will be found in surgical treatises. Most of them have resulted in complete failure. But in some few instances very considerable improvement has been effected. As a rule, operative measures should be delayed until adult life is reached.

(*c*) **Phimosis.**—DEFINITION.—A condition, often hereditary, in which the orifice of the prepuce is so small as to render it difficult or impossible to uncover the glans properly and to the full extent. In some cases the orifice is a mere pinhole, or even scarcely discoverable; in others more or less of the glans may be exposed to view. Associated with this condition there is often elongation of the prepuce, usually shortness and tightness of the frænum, and not infrequently undue smallness of the urethral orifice.

It is highly important that the existence of congenital phimosis should not be overlooked or ignored, for at all periods of life more or less serious troubles may arise from it; and accidental circumstances—injury, inflammation, ulceration, &c.—may easily convert a comparatively slight *congenital phimosis* into a severe so-called *acquired phimosis.* At all ages phimosis is liable to interfere with free micturition—in severe cases from mechanical obstruction, in less severe, or even comparatively slight cases, from reflex irritation and spasm. The bladder consequently may not be properly evacuated, and gradually cumulative mischief may result.

SYMPTOMS AND EFFECTS.—In infancy and childhood frequent attempts to pass water, accompanied by straining and sometimes screaming, the passage of a small stream, or of a small quantity at a time followed by sudden stoppage; dribbling of the water; irritation and inflammation about the prepuce; and pulling at the penis, are signs and symptoms accompanying, and suggestive of phimosis in the first place, however closely they may simulate the indications of stone in the bladder. General irritability and deterioration of health, the production of hernia by frequent straining, balanitis, the acquirement of the habit of masturbation, and reflex paralyses, are among the evil results that may arise.

In adult life local discomfort, slowness of micturition, imperfect evacuation of the bladder, with all its probable consequences; smallness (from compression) of the glans; difficulty, want of pleasure, or even pain in sexual intercourse; and liability to infection during impure intercourse, are troubles more or less constantly affecting the subject of phimosis; and to these may be added, in more advanced life, increased liability to cancer of the penis.

Treatment.—In comparatively slight cases of phimosis the prepuce may be gradually stretched, and its orifice dilated to the needful extent, by frequently repeated gentle efforts at withdrawing it, and by inserting, between times, strips of dry or oiled lint between it and the glans. In the more severe cases resort to operation is needful. The methods variously adopted are:—(1) Forcible tearing; (2) linear incision to greater or less extent; (3) excision of a portion of the prepuce; and (4) circumcision. The first method is clumsy and altogether to be condemned; the second is easy to perform, but often leaves the part in an awkward condition; the third is incomplete, and rarely satisfactory in effect; the fourth, if carefully and skilfully carried out is uniformly successful, yields excellent results, and, as a rule, is to be recommended.

The best method of performing circumcision consists in first slitting up the prepuce along the median line on the dorsal aspect, by means of a bistoury or scissors, guided by a director, to a point on a level with or rather behind the corona, and in then starting from this point, and with scissors cutting all round, dividing skin and mucous membrane evenly together. As a rule the frænum should be cut; indeed, in most cases it is better to excise a portion. In the infant, sutures are not necessary; but in the adult it is better to stitch the skin and mucous membrane together by very fine sutures inserted as close to the edges as possible. Inrolling is thus prevented, and if the sutures are tied very tightly they will ulcerate out, and the pain and trouble of removing them will be avoided. The simplest dressing only is requisite; but the parts must be kept scrupulously clean, and free from all irritation.

(*d*) **Adherent Prepuce.**—In some cases of phimosis, and occasionally in cases in which the preputial orifice is not unduly small, the mucous membrane of the prepuce adheres, to a greater or less extent, to that of the glans. The smegma and other secretions are thus confined; and considerable local irritation, accompanied by more or less severe symptoms, often closely simulating those of stone in the bladder, may be set up.

Treatment.—The foreskin must be drawn gradually back, the adherent surfaces being separated during the process by the flat end of a probe or other thin blunt instrument; the confined secretions must be removed; the parts washed; the prepuce replaced, unless circumcision has been needful; and strict cleanliness enjoined.

If this condition be overlooked during infancy, the adhesions become firm and dense, and seriously impede the growth of the glans. Their division in the adult may require the use of the knife during circumcision.

2. **Phimosis, Acquired.**—This condition may arise as a result of repeated attacks of inflammation, with or without chancrous ulceration, followed by induration, thickening of the prepuce, and contraction of its orifice. It is most frequent in those who have had slight congenital phimosis. *See* Venereal Sore.

Circumcision is the proper treatment.

3. **Preputial Calculi.**—The subpreputial secretions, if allowed to remain and accumulate, occasionally undergo changes, and become formed into hard concretions, which give rise to more or less serious discomfort and inconvenience. Such concretions are found to consist mainly of phosphate of lime and ammonio-magnesian phosphate, with a variable amount of organic matter.

4. **Paraphimosis.**—Paraphimosis is a condition in which a tight foreskin, having been forced back, during coitus or otherwise, has led to strangulation, œdema, and inflammatory swelling of the glans and a portion of its own mucous membrane. The appearance presented is most characteristic.

Treatment.—Reduction must be effected at the earliest possible moment. If the case be neglected severe inflammation, ulceration, and sloughing to greater or less extent, followed by more or less permanent deformity, are liable to ensue. The method ordinarily adopted consists in grasping the body of the penis between the middle and forefingers of both hands, drawing the foreskin forwards, and at the same time compressing and pushing back the glans by both thumbs. This method is very painful and not always readily successful. A better method, which very rarely fails, consists in slowly bandaging the glans (beginning at the extremity), and all the swollen parts, with a piece of narrow elastic webbing, the effect of which is gradually to empty the engorged vessels and squeeze out the serum from the swollen parts. On the removal of the bandage after a few minutes, reduction is, as a rule, very easily effected. The process may be facilitated by a few needle or lancet-point punctures, made before the application of the bandage.

In some neglected cases it may be needful to divide the constricting band by means of a bistoury. In attempting this it must be borne in mind that the constriction is not immediately behind the glans, but behind the swollen portion of the preputial mucous membrane.

After reduction cooling and soothing applications are useful.

5. **Penis, Inflammation of.**—Synon.: Penitis.—Inflammation of the penis in its totality is very rarely met with except as the result of injury, or in association with severe venereal diseases. In some rare instances it is said to have been induced by excessive sexual intercourse, and in other instances by persistent masturbation. Cases, however, are on record in which it has occurred during, or among the sequelæ of exanthematous fevers.

The treatment must be conducted on general principles, due regard being paid to the cause or condition in connection with which the inflammation has arisen. If the patient survive, the part may recover.

6. **Penis, Gangrene of.**—Gangrene of the penis, except as the result of injury, or constriction by ligature, rings, &c., in the majority of cases has followed impure sexual congress during a depressed general condition. In some cases it has occurred in association with small-pox, typhus, and typhoid fevers. Death has been the common result. In some few cases life has been preserved, though the part has been lost.

7. **Herpes Preputialis.**—This is a vesicular eruption, occurring on the cutaneous or mucous surface of the prepuce, running its course in about a week, but liable to recur at irregular intervals. A similar eruption sometimes occurs on the glans.

The due recognition of this affection is important, because its appearance after doubtful intercourse often excites alarm, and may lead to mischievous treatment.

TREATMENT.—The simplest treatment only is requisite. The avoidance or prevention of all irritation by the clothes or otherwise, and sometimes a little sedative lotion, are, as a rule, all that is needful.

8. **Penis, New Growths of.**—*Cystic, vascular, fibrous*, and other new growths of benign character are occasionally situated on the penis. They may be left uninterfered with, or may be got rid of by operation, according to the inconvenience they cause, and the indications afforded. *Bony formations* or *calcareous deposits* in the fibrous sheaths of the corpora cavernosa are of rare occurrence. The discomfort they have in some instances caused has necessitated their removal by operation, which has been successfully accomplished. *Papillomata*, or warty growths, are not infrequently met with in persons of uncleanly habits. In the majority of cases they are associated with venereal disease; but they may arise independently of such association, especially if the prepuce be long, and due regard be not paid to cleanliness. They may be few and scattered, or many and massed 'cauliflowerlike' together. Sometimes they entirely surround the corona, and sometimes in patches or continuously cover more or less completely the mucous surfaces of the prepuce and glans. In some instances the diagnosis between such growths and papillary epithelioma is not obvious; ulceration of surface indicates the latter.

TREATMENT.—Removal by curved scissors, or twisting off by forceps, is the most speedily effectual treatment of papillomata of the penis. But if the warts are few and small, they may be made to shrivel and dry up and disappear, by repeated applications of oxide of zinc, calomel, tannic acid, or burnt alum, and the pressure of dry lint between the foreskin and glans. Cleanliness is essential.

9. **Penis, Cancer of.**—Cancer in the male subject in a considerable proportion of cases primarily affects the penis. By far the most common form is *epithelioma*, and the most common seat of first appearance is the glans, or the part of the preputial mucous membrane nearly or immediately adjoining. In comparatively rare cases *scirrhus* is described as having commenced 'lumplike' in some part or other of the body of the organ. In still more rare cases, *soft cancer* has been met with in young subjects after injury, and the diagnosis from suppuration in the corpus cavernosum has at first been doubtful.

Epithelioma seldom appears in the penis before the age of forty, most frequently between the fiftieth and sixtieth years. In 161 cases out of 243 the sufferers had been the subjects of phimosis. In some few instances the origin of the malady has been attributed, rightly or wrongly, to marital connection with wives suffering from cancer of the uterus. Epithelioma is first noticed as a small, warty outgrowth, early ulcerated; or as a flat, excoriated surface, with slightly indurated base, occasionally disposed to bleed, and sometimes painful. Scabs form from time to time, which, when removed, leave exposed a gradually extending ulcerated surface. The malady persists and progresses in spite of treatment, infiltrating and destroying. The discharge is thin and sanious, bloodstained and offensive. The ulcer is irregular in outline, with more or less everted hard edges; and the induration extends into the surrounding parts. Sooner or later the inguinal glands become infected, and the general health seriously deteriorates.

DIAGNOSIS.—The diagnosis of cancer of the penis from any form of venereal ulceration is, as a rule, sufficiently easy. Difficulty can scarcely arise, except in the comparatively rare cases in which there is exuberant warty growth before obvious ulceration.

TREATMENT.—The only treatment worthy of consideration consists in amputation of the penis, well behind the point to which the disease has extended. If the inguinal glands have become infected, they should be removed at the same time, if practicable. If they are affected to such an extent as to render their removal impracticable, amputation of the penis can do little, if any, lasting good.

10. **Penis, Elephantiasis of.**—Elephantiasis of the penis is almost always associated with elephantiasis of the scrotum, and may demand simultaneous treatment by operation.

ARTHUR E. DURHAM.

PENTASTOMA (πέντε, five, and στόμα, a mouth).—A genus of entozoa belonging to the family *Acaridæ*. They are sometimes placed in a separate order termed *Acanthotheca*. The species, two of which are liable to infest man, are characterised by the presence of a ringed or segmented body, the head being armed with four large hooks or claws, arranged in pairs on either side of the mouth. The older writers misunderstood the nature of these cephalothoracic feet; hence the generic misnomer which the term pentastome implies. The so-called *Pentastoma denticulatum* infesting the liver, although tolerably frequent in various parts of Europe, gives rise to no functional disturbance, and is consequently destitute of clinical importance. It is the larval condition of a worm that infests the nasal cavities of the dog, *Pentastoma tænioides*.

The other human pentastome, *Pentastoma constrictum*, infests the liver and lungs, and, on account of its comparatively large size, is capable of giving rise to serious and even fatal symptoms. It measures from half an inch to an inch in length; being also easily recognised by the presence of twenty-three rings. This entozoon not only occurs in Africa, but also in the West Indies, where European residents are liable to be attacked by it. The museum of the Army Medical Department at Netley contains examples of this parasite, from a case in which the entozoon appears to have proved fatal. The history of the case, originally sent by Dr. Kearney, is given by Dr. Aitken in the later editions of his treatise *On the Science and Practice of Medicine*. To this work the reader is referred for other particulars of clinical interest.

T. S. Cobbold.

PEPTIC GLANDS, Diseases of. *See* Stomach, Diseases of.

PEPTONISED FOOD.—This term may be used as the equivalent of the phrase 'artificially digested food.' In natural digestion albuminoid substances are changed into peptones, and starchy matters are changed into dextrine and sugar. These processes are of a purely chemical nature, and they can be imitated outside the body very closely by means of artificially prepared digestive juices. An extract of the stomach, or of the pancreas, in water, has approximatively the same powers as the natural secretions of those organs. Hence it is possible for us to subject articles of food beforehand to complete or partial digestion; and to administer such artificially digested food to our patients. In cases where the natural digestive powers are more or less in abeyance, it would be an obvious advantage if we had at command a supply of food thus modified, and yet not so changed as to have lost its agreeable appearance and flavour. Nor is there anything repugnant to physiological science or to the custom of mankind in such a proposal. The essential acts of digestion are not vital operations, but chemical transmutations; and the theatre of these operations is on the surface of the gastric and intestinal membrane, and not in the true interior of the body. In the practice of cooking we have, as it were, a foreshadowing of the art of artificial digestion; and although the latter art may never pass beyond the needs of the sick and debilitated—may never serve the healthy and robust—it is not more absolutely alien from the life of animals in a state of nature than is the art of cooking. The practice of cooking is an exclusively human practice, and it is now spread among all the races of mankind, whether civilised or uncivilised; and among the higher races the two most important groups of alimentary substances—albuminoid and starchy matters—are eaten almost exclusively in the cooked condition.

Now the changes impressed on articles of food by cooking are not merely mechanical; nor are they confined to alterations in the appearance and savour of the food. By far the most important changes produced by cooking consist of certain chemical transformations, whereby several of the chief alimentary principles are rendered incomparably more amenable to the action of the digestive juices than in the uncooked state. In a sense we may speak of cooked food as food which has undergone the preliminary stage of digestion. This preliminary stage is accomplished for us of the human race by the artificial aid of heat; but in the case of all the lower animals it has to be accomplished by the labour of their own digestive organs. The affinity of digestion to the process of cooking goes even much beyond this. It has been shown experimentally that albumen, when subjected to the prolonged action of superheated steam, yields a substance resembling peptone, and that starch when similarly treated yields dextrine and sugar. So that it would not be inappropriate to describe digestion as the process of cooking carried a step further.

Methods of preparation.—Peptonised or artificially digested food may be prepared, either by following the gastric method with pepsin and hydrochloric acid, or by following the intestinal method, and using extract of pancreas. The latter method yields by far the better results. The pancreas not only acts upon albuminous substances, but also upon starch. Pepsin, on the other hand, is quite inert in regard to starch. Moreover, the products of artificial digestion with pepsin and acid are much less agreeable to the taste and smell than those produced by pancreatic extract. By the latter method articles of food can be profoundly peptonised with little deterioration of that agreeable savour which makes them inviting to the palate. The writer will, therefore, in what follows, confine himself to the pancreatic method, and describe the modes in which food may be partially digested beforehand, and yet constitute an acceptable nourishment for invalids.

The first necessity is to procure an active extract of the pancreas. Water is the proper solvent of the digestive ferments; but, in order to obtain a stable preparation, some preservative agent must be added to prevent decomposition. After a trial of various media the writer has come to the conclusion that, on the whole, the best solvent is dilute spirit. A mixture of one part of rectified spirit with three parts of water answers every purpose. The pancreas of the pig yields the most active preparation; but the pancreas of the ox or the sheep may be employed, if that of the pig is not obtainable. The pancreas of the calf also yields an extract which is active on albuminous substances, but it is not active on starchy materials. In procuring a supply of pancreas from the butcher, it is well to remember that the word 'sweet-bread,' which is the English vernacular for pancreas, is likewise applied to the thymus gland; and that the genuine sweetbread of the kitchen is the thymus of the calf. Butchers distinguish the true pancreas as the 'liver sweetbread,' and it is by this name alone that the pancreas must be asked for in the shambles.

Mode of preparation of Extract of Pancreas or Liquor Pancreaticus.—The pancreas is first well freed from fat, and cut up into small pieces with a knife or a pair of scissors. It is then mixed with four times its weight of the dilute spirit, put into a well-corked wide-mouthed bottle, and set aside for a week. The mixture should be well agitated at least once daily. At the end of a week the mixture is strained through muslin, and then filtered through paper until it is clear.

A very active extract of pancreas is now prepared on the large scale by Mr. Benger, under the name of *Liquor Pancreaticus*, and sent out by Mottershead & Co., chemists, Manchester. As it is a troublesome matter to get a supply of pancreas from the butcher, and as the filtration of the product is a tedious process, it will be found much more convenient to employ Mr. Benger's preparation, if it can be procured, than to rely on home manufacture. In the succeeding instructions for the preparation of peptonised food it will, therefore, be supposed that a supply of Benger's liquor pancreaticus is available.

Directions for the preparation of various kinds of peptonised food.—The articles which are most easily prepared, and are most likely to be serviceable to invalids are the following:—

Peptonised milk.—A pint of milk is diluted with a quarter of a pint of water, and heated to a temperature of about 140° Fh. Should no thermometer be at hand, the diluted milk may be divided into two equal portions, one of which is heated to the boiling point and added to the cold portion, when the mixture will be of the required temperature. Two teaspoonfuls of the liquor pancreaticus and ten grains of bicarbonate of soda are then added to the warm milk. The mixture is poured into a covered jug, and the jug is placed in a warm situation under a 'cosey,' in order to keep up the heat. At the end of an hour, or an hour and a half, the product is boiled for two or three minutes. It can then be used like ordinary milk.

The object of diluting the milk is to prevent the curdling which would otherwise occur, and greatly delay the peptonising process. The addition of bicarbonate of soda prevents coagulation during the final boiling, and also hastens the process. The purpose of the final boiling is to put a stop to the ferment-action when this has reached the desired degree, and thereby to prevent certain ulterior changes which would render the product less palatable. The degree to which the peptonising change has advanced is best judged of by the development of a peculiar bitter flavour, which is always associated with the artificial digestion of milk. The point aimed at is to carry the change so far that the bitter flavour is just perceived, but is not unpleasantly pronounced. As it is impossible to obtain pancreatic extract of absolutely constant strength, the directions as to the quantity to be added must be understood with a certain latitude. The extent of the peptonising action can be regulated, either by increasing or diminishing the dose of the liquor pancreaticus, or by increasing or diminishing the time during which it is allowed to operate. By skimming the milk beforehand, and restoring the cream after the final boiling, the product is rendered more palatable.

Peptonised gruel.—Gruel may be prepared from any of the numerous farinaceous articles in common use—wheaten flour, oatmeal, arrowroot, sago, pearl-barley, pea or lentil flour. The gruel should be well boiled, and made thick and strong. It is then poured into a covered jug, and allowed to cool until it becomes lukewarm. Liquor pancreaticus is then added, in the proportion of a dessert-spoonful to the pint of gruel, and the jug is kept warm under a 'cosey' as before. At the end of a couple of hours the product is boiled, and strained. The action of pancreatic extract on gruel is twofold—the starch of the meal is converted into dextrine and sugar, and the albuminoid matters are peptonised. The conversion of the starch causes the gruel, however thick it may have been at starting, to become quite thin and watery. The bitter flavour does not appear to be developed in the pancreatic digestion of vegetable proteids, and peptonised gruels are quite devoid of any unpleasant taste. It is difficult to say to what extent the proteids of the meal are peptonised in this process. The product gives an abundant reaction of peptone; but there is a considerable residuum of undissolved material. Most of this, no doubt, consists of insoluble ligneous tissue, but it also contains some unliberated starchy and albuminous matter. Peptonised gruel is not generally, by itself, an acceptable food for invalids, but in conjunction with peptonised milk (peptonised milk-gruel) or as a basis for peptonised soups, jellies, and blanc-manges, it is likely to prove valuable.

Peptonised milk-gruel.—This is the preparation of which the writer has had the most experience in the treatment of the sick, and with which he has obtained the most satisfactory results. It may be regarded as an artificially digested bread-and-milk, and as forming by itself a complete and highly nutritious food for weak digestions. It is very readily made, and does not require the use of the thermometer. First, a thick gruel is made from any of the farinaceous articles above mentioned. The gruel, while still boiling hot, is added to an equal quantity of cold milk. The mixture will have a temperature of about 125° Fh. To each pint of this mixture two or three teaspoonfuls of liquor pancreaticus, and ten grains of bicarbonate of soda, are added. It is kept warm in a covered jug under a 'cosey' for an hour or hour-and-half, and then boiled for two or three minutes, and strained. If the product has too much bitter flavour, a smaller quantity of the liquor pancreaticus must be used in the next operation. Invalids take this compound, as a rule, if not with relish, at least without any objection.

Peptonised soups, jellies, and blanc-manges.—The writer has sought to give variety to peptonised dishes by preparing soups, jellies, and blanc-manges containing peptonised aliment. Soups may be prepared in two ways. The first way is to add what cooks call 'stock' to an equal quantity of peptonised gruel or peptonised milk-gruel. A second and better way is to use peptonised gruel, which is quite thin and watery, instead of simple water, for the purpose of extracting the soluble matters of shins of beef and other materials employed in the preparation of soups. Jellies may be prepared by simply adding the due quantity of gelatine or isinglass to hot peptonised gruel, and flavouring the mixture according to taste. Blanc-manges may be made by treating peptonised milk in a similar way, and then adding cream. In preparing all these dishes it is absolutely necessary to complete the operation of peptonising the gruel or the milk, even to the final boiling, before adding the stiffening ingredient. For if pancreatic extract be allowed to act on the gelatine, the gelatine itself undergoes a process of digestion, and its power of setting on cooling is therefore utterly abolished.

Peptonised beef-tea.—A pound of finely minced lean beef is mixed with a pint of water, and ten grains of bicarbonate of soda are added thereto. The mixture is then simmered for an hour and a half in a covered saucepan. The resulting beef-tea is decanted off into a covered jug. The undissolved beef-residue is then beaten up with a spoon into a pulp, and added to the beef-tea in the covered jug. When the mixture has cooled down to about 140° F. (or when it is cool enough to be tolerated in the mouth) a table-spoonful of the liquor pancreaticus is added, and the whole well stirred together. The covered jug is then kept warm under a 'cosey' for two hours, and agitated occasionally. At the end of this time, the contents of the jug are boiled briskly for two or three minutes, and finally strained. The product is then ready for use. Beef-tea prepared in this way is rich in peptone. It contains about 4 per cent. of organic residue, of which more than three-fourths consists of peptone; so that its nutritive value in regard to nitrogenised materials is nearly equivalent to that of milk. When seasoned with salt it is scarcely, if at all, distinguishable in taste from ordinary beef-tea.

Peptonised enemata.—Pancreatic extract is peculiarly adapted for administration with nutritive enemata. The enema may be prepared in the usual way with a mixture of milk and gruel, or milk, gruel, and beef-tea. A dessert-spoonful of liquor pancreaticus is added to it just before administration. In the warm temperature of the bowel the pancreatic ferments find a favourable medium for their action on the nutritive ingredients with which they are mixed; and there is no acid secretion (as in the stomach) to interfere with the progress and completion of the digestive transformation. Experience has satisfied the writer that this method of administering nutriment is a valuable resource when the stomach is obstinately intolerant of food, or when there is obstruction in the higher portions of the digestive tract.

Uses of peptonised food.—The employment of food which has been wholly or partially peptonised is indicated when the natural digestive powers are from any cause enfeebled or suspended. The most striking benefits have been observed in cases of gastric catarrh with pain and intolerance of food; in gastric ulcer; in the anorexia and dyspepsia associated with valvular heart-disease; and in the various forms of pyloric and intestinal obstruction. Good results have also been obtained in cases of defective nutrition and intestinal irritation in infants. In using peptonised food it is well to remember that it does not keep well, especially in warm weather. Accordingly it should either be prepared twice a day, so that it may be never more than twelve hours old; or, if a quantity sufficient for the twenty-four be prepared at once, the portion which remains over at the end of twelve hours should be reboiled.

William Roberts.

PERCUSSION (*percusso*, I strike).—A method of physical examination, performed by striking gently some part of the body, especially the chest or abdomen, for the purpose of producing certain sounds or tactile sensations. It may be performed either by the finger or fingers of one hand striking the surface directly, or indirectly—the fingers of the other hand being interposed; or by means of a special instrument or instruments. Percussion has been recommended by Dr. Mortimer Granville as an agent in the treatment of certain nervous diseases (*Brit. Med. Jour.* Vol. I. 1882). *See* Physical Examination.

PERFORATIONS AND RUPTURES.

It will be convenient to discuss these lesions together, and from a general point of view only, the more important perforations and ruptures connected with particular organs being treated of in their appropriate articles. The word *rupture* is used here in its true significance, and not in the popular sense as applied to hernia. *See* Rupture.

Definition.—Though there is no absolute distinction between *perforations* and *ruptures*, there are certain differences by which they are usually broadly recognised.

The term *perforation* is generally only applied to an artificial opening produced in a hollow organ or tube; seldom, and only under special circumstances, to a lesion affecting a solid tissue. Moreover, it implies that the opening is a small one, or, at any rate, does not reach large dimensions. Again, the mode in which the lesion is produced has, in some instances, to do with the definition of a perforation. Thus, if the opening results from injury by a pointed instrument, or by any other agent which would cause more or less of a puncture, such as a fractured rib penetrating the lung, it would be called a perforation, and in this case the term would apply also to a solid organ or tissue. Finally, the slow destruction of certain structures by aneurisms and other tumours often terminates in an aperture being formed, which is then called a perforation. This is well exemplified by the opening formed in the sternum in some cases of aortic aneurism.

A *rupture* may be associated with any structure, and often involves solid organs and tissues, such as muscles. It implies a lesion of some size, and may reach any dimensions, being more of a tear or rent than a puncture. There is also associated with the term the idea of spontaneous production, or of the lesion originating from within, or from the effects of some compressing or lacerating injury, instead of a penetrating one.

Ætiology and Pathology.—The causes of perforations and ruptures, and the pathological conditions under which these lesions occur, may be thus summarised:—

1. *Injury.*—This often comes from without, and may be of different kinds. The forms of injury most requisite to notice are perforating wounds; severe compression of the body, as between railway-buffers, which may cause extensive rupture, even of solid organs, without any external mark of violence; violent concussion, as in the case of the brain; and straining, which is especially liable to cause rupture of muscles or arteries. To the category of injuries also belong various causes of perforation or rupture coming

from within, such as corrosives which have been swallowed, bones and other foreign bodies similarly introduced, calculi, hardened fæces in the intestines, and worms. Cases have now and then occurred in which important internal organs have been penetrated in the attempt made by showmen to swallow swords and similar instruments. 2. *Violent actions.*—Voluntary muscles have by their own excessive action led to their rupture, as in cases of tetanus. The uterus has been known to rupture itself. In rare instances the healthy lung has given way from violent cough. 3. *Morbid destructive and degenerative processes.*—These are important causes of perforations and ruptures of various kinds, and they include ulceration or gangrene, as of the stomach or intestine; suppuration, leading to the formation of an abscess, either associated or not with an organ, and which may burst into various internal parts, or externally; cancer; acute fatty degeneration and softening of organs; and chronic fatty, atheromatous, or calcareous degeneration. Some of the conditions mentioned are in themselves essentially destructive; others produce such changes that they render a rupture liable to occur from very little extra force or pressure, such as that which arises from a slight strain, a cough, or the act of vomiting or defæcation, as is well exemplified by the heart and arteries. Even in the case of the destructive processes, some exciting cause may lead to the actual perforation or rupture, such as one of the acts mentioned above, or, in the case of the alimentary canal, the injudicious administration of solid food, or of articles which give rise to flatulent distension. Moreover, after ulceration a cicatrix may be left, which for a time is very liable to give way from slight causes, as sometimes happens in connection with typhoid fever. The perforation of the lung in cases of phthisis is a good illustration of the effects of destructive changes. 4. *Gaseous and liquid accumulations.* These may alone lead to rupture of hollow organs or tubes, of the walls of cavities, or of cysts, by causing extreme distension, as may be exemplified by the occasional rupture of the intestines from over-distension, of an emphysematous lung, of the bladder from an accumulation of urine, of the renal pelvis in cases of hydronephrosis, of a distended gall-bladder, of a pleuritic effusion through the diaphragm, of a hydatid or ovarian cyst, or of an aneurism. Some slight strain or injury may be the immediate cause of the lesion in several of these conditions. 5. *Pressure.*—A tumour of any kind may cause perforation of various structures, as the result of its mechanical pressure. In the case of an aneurism the pulsation assists in producing the lesion. In this way the most resisting tissues may be destroyed, and serious consequences are liable to ensue. 6. *Spontaneous.*—In the case of muscular tissues and arterial structures spontaneous ruptures are supposed to happen occasionally, but probably in all such cases there has been previous degeneration, which has been the real cause of the rupture.

Anatomical Characters.—It must suffice to mention here that the morbid appearances consist of those presented by the perforation or rupture itself; and of the effects resulting therefrom. The former vary much in extent and character in different cases, and no general description can be given of them. As regards the effects produced, there may be none, but very commonly hæmorrhage takes place; or the contents of a hollow viscus, or of a fluid collection, may be found poured out in some abnormal situation, and these usually set up inflammation if the patient live long enough, the results of which will be evident on *post-mortem* examination. In the case of slow perforation of structures by tumours, various effects may be produced, of an irritative or destructive character. Particulars on these points are given in other appropriate articles. In the case of the lung, perforation is likely to lead to the escape of air into the pleura or cellular tissue, thus giving rise to pneumothorax or subcutaneous emphysema. On the other hand, liquid accumulations may open into the lung, and thus be found in the air-passages, or they may produce more or less serious effects upon the pulmonary tissues.

Symptoms.—It is not intended here to describe the symptoms which occur in connection with traumatic injuries, but merely to point out those likely to be noticed in different cases which come under observation in medical practice. Under certain circumstances a perforation or rupture may take place without any obvious symptoms, even when it affects an important structure. This may happen, for instance, even when an opening forms in a hollow viscus, such as the stomach or intestine, provided it has become previously adherent to some solid organ, or to another part of the bowel, with which it then forms a communication. On the other hand, very speedy or even sudden death may ensue, as when a large aneurism or the heart ruptures. The symptoms to be anticipated are those due to the actual lesion itself; and those resulting from the consequences mentioned under the anatomical characters. As regards the lesion itself, if it is suddenly produced, the event is usually attended with immediate marked symptoms. Of these, one of the most common is a sudden pain at the seat of mischief, often very intense, but varying in its characters. When a muscle ruptures, a feeling is frequently experienced as if a severe blow had been struck, and power is lost at once in the affected part. This is well exemplified in cases of rupture of the gastrocnemius, an accident not uncommon at the present day in connection with the game of lawn tennis. When a hollow viscus or any fluid collection bursts, or when gas escapes, a sensation as if something were being poured out is often noticed by the patient. At the same time the general system usually suffers more or less gravely, as evidenced by faintness or actual fainting, or by signs of shock or collapse, from which the patient may never rally, if the structure involved is of great importance in the vital economy, or if continuous hæmorrhage should be going on. The symptoms above indicated may be repeated if the lesion should extend after an interval. It may be mentioned that when rupture of an abdominal organ takes place from severe compression of the body, there may be no symptoms of the event at the outset, and only the development of grave general symptoms indicates what has happened. The occurrence of hæmorrhage into internal parts, or the escape of the contents of the viscera or of a fluid accumulation, may be obvious on physical examination. Should the patient survive in cases of rupture into internal parts, local and general symptoms pointing to the occurrence of inflammation may be expected to supervene. For instance, in the case of the abdomen there would be signs of peritonitis, or of localised inflammation in some part of the cellular tissue, probably ending in suppuration. In perforation of the lung, symptoms and physical signs of pneumothorax appear, or the presence of air in the subcutaneous cellular tissue may become evident. When an opening is formed between some collection of fluid and any organ or passage which communicates externally, such as the air-tubes or the alimentary canal, such fluid is likely to be discharged in different ways, and this may be a favourable mode of termination, leading to a cure. In the case of slow perforation by a tumour, should it take place in an outward direction, the lesion will probably become evident on clinical examination; if internal structures be affected, the process of destruction may be accompanied with continuous pain, or other symptoms; and subsequently clinical phenomena indicative of implication of various structures arise, either suddenly or gradually. For example, when an aneurism or solid growth destroys any part of the spinal column, this is attended with a continuous aching or grinding pain; and when the canal is perforated, symptoms arise indicating that the spinal cord is involved.

Diagnosis.—It is scarcely practicable to offer any useful general remarks under this heading, and it must suffice to notice the following points. The difficulty of diagnosis varies much in different cases, being sometimes very easy, in other instances more or less obscure or impossible. The practitioner should always be prepared for the possibility of cases of sudden perforation or rupture of internal structures coming under his notice, of which he may have known nothing previously. Under such circumstances a careful inquiry into the previous history may reveal the presence of symptoms of known conditions, which would clear up any obscurity; but, on the other hand, there may be no such history. There ought to be no difficulty, as a rule, if the lesion occurs from some recognised cause, such as certain kinds of injury; or if it supervene in some case under the care of the practitioner for a disease liable to be attended with perforation or rupture of some part, such as typhoid fever, gastric ulcer, an internal abscess, or an aneurism. In the case of slow perforation, it is very important to be able to recognise the meaning of symptoms which may arise from this cause.

Prognosis.—Any rupture or perforation taking place internally must always be regarded as immediately more or less dangerous to life, and not uncommonly the termination is necessarily fatal. Much will depend on the structure involved, the extent of the lesion, and its direct and remote consequences. Caution must be exercised in giving a prognosis in all cases, for some patients recover when such a result might not be anticipated, and especial care must be taken in offering an opinion if the diagnosis should not be quite clear. In the case of ruptures or perforation taking place externally, or affecting structures not essential to life, such as the muscles of a limb, the prognosis of each case must be determined on its own merits.

Treatment.—In the case of sudden internal perforations or ruptures, the first principle in treatment should be to counteract the immediate effects of the lesion, alleviating pain, and rousing and stimulating the patient by appropriate remedies. Opium or morphia and alcoholic stimulants are of great service, and they may often be advantageously introduced into the system by means of enemata, or, in the case of morphia, by subcutaneous injection. Heat to the extremities, sinapisms, and similar applications, are also frequently of much value. The patient should be kept at rest, and it may be of essential importance to endeavour to keep an organ which has been perforated in an absolute state of rest, such as the stomach or intestines, by withdrawing all food, and checking peristaltic movements by opium or other agents. The same applies to some parts of the body, such as a limb, if a muscle or a vessel should be ruptured, and here often the position of the limb is of much consequence. Other appropriate measures will suggest themselves in other instances. Some special interference may be indicated. For instance, it might be clearly allowable to open the abdomen in certain cases; to strap or puncture the chest to relieve pneumothorax; or to cut down and tie a ruptured artery. Hæmorrhage resulting from a lesion of this kind in internal parts, may sometimes be checked by the constant application of ice externally over the corresponding part of the body. The subsequent treatment of cases of rupture or perforation must be determined by the effects which they produce, which must be dealt with according to their nature, each case being considered on its own merits. The same remark applies to cases of gradual perforation by tumours and other morbid conditions.

Frederick T. Roberts.

PERICÆCAL ABSCESS.—An abscess in the cellular tissue around the cæcum. *See* Perityphlitis.

PERICARDIUM, Diseases of.—Synon.: Fr. *Maladies du Péricarde*; Ger. *Krankheiten des Herzbeutels.*

The pericardium proper is a membranous bag, one part of which—the visceral layer—closely envelopes the heart and the roots of the great vessels connected with it; while the other—the parietal layer—is loosely reflected round that organ, and has its external surface intimately united with a dense fibrous sheath which passes upwards, and is gradually lost upon the external coats of the vessels, whilst it is continuous below with the central aponeurosis of the diaphragm. A serous fluid bedews the interior of this sac, and facilitates the movements of the heart, so that both in structure and function the pericardium may be regarded as a joint—somewhat modified, no doubt, to suit its internal position, as well as the nature of the parts with which it is connected.

The morbid conditions of the pericardium will be discussed in the following order:—1. Dropsy; 2. Inflammation; 3. Gas in the Pericardium;

4. Malformations; 5. New growths; and 6. Pericardial adhesions.

We may first, however, refer to a condition of the pericardium which can hardly be described as pathological, consisting of slight opacities, which are termed *milk-spots*. These are frequently observed upon the pericardium after death, but they give rise to no clinical symptoms, and are merely to be regarded as callosities due to attrition. The most common situation is at the base of the right ventricle in front, but they are also found on the apex, and are occasionally seen as white stripes upon the auricles, and along the course of the coronary arteries. Such *maculæ albidæ* are most common on large, strong, and hypertrophied hearts, but they are not altogether confined to these. When due solely to attrition, these spots are formed by a mere thickening or condensation of the normal tissue; but now and then they are found to consist of a thin layer of fibrinous matter which may be peeled off, leaving the pericardium beneath opaque, but otherwise natural. In the latter case, of course, these spots cannot be regarded as simple callosities, but as the results of some trifling local pericarditis, running its course without symptoms and of no clinical importance, except as affording a probable explanation of those temporary basic frictions which are occasionally to be heard in those otherwise in apparently good health, as far at least as the heart is concerned.

1. Pericardium, Dropsy of.—Synon.: Hydropericardium; Fr. *Hydropéricarde*; Ger. *Herzbeutelwassersucht.*

During life and in health the serosity bedewing the internal surface of the pericardial sac exists in an appreciable quantity, so that an ounce or two of fluid found in it after death is not to be regarded as anything abnormal. When, however, the fluid present amounts to as much as six or seven ounces, or more, the condition is morbid, and is termed *hydropericardium*, or dropsy of the pericardium. The contained fluid is a yellowish, greenish, reddish, or reddish-brown serosity, containing from one to three per cent. of albumen, and occasionally a trifling amount of fibrinous matter, which coagulates on simple exposure to the air—*hydrops lymphaticum* (Virchow, *Gesammelte Abhandlungen*, p. 108). The colour of the fluid is of course due to the amount of blood-colouring matter infused through it; and the reddish, or reddish-brown colouration is specially present when from any cause, such as the co-existence of scurvy, the colouring matter is more readily diffused than usual, or in those exceptional cases where the walls of the capillaries are so altered by nutritive changes as to rupture.

All the phenomena present in dropsy of the pericardium are precisely similar to those associated with a similar amount of inflammatory effusion, and will be referred to under that head. Hydropericardium is a possible occurrence in all diseases, whenever there is, from physical causes, a tendency to transudation of serum into the cavities of the body. According to the nature of that cause it may be either an early or a late phenomenon, and it frequently only attains any considerable proportion during the act of dying. When dropsy occurs from venous congestion due to disease of the heart, or to disease of the lungs, such as emphysema or cirrhosis, some degree of hydropericardium is not uncommon as an early symptom; but when the dropsy results from hydræmia produced by chronic organic diseases of the spleen, liver, or kidneys, or by the exhaustion due to cancerous or tubercular diseases, the pericardial effusion is usually a late symptom.

Treatment.—The treatment of hydropericardium resolves itself into the treatment of the diseases upon which it depends; and it is only when the fluid becomes suddenly effused, in a quantity so large as to threaten death by suppression of the heart's action, that an independent treatment by paracentesis may be found necessary. Such sudden effusion occasionally, but only very rarely, takes place in the course of the acute albuminuria following scarlatina, or even in the more chronic albuminuria, the result of intratubular nephritis.

2. Pericardium, Inflammation of.—Synon.: Pericarditis; Fr. *Péricardite*; Ger. *Herzbeutelentzündung.*

Acute inflammation is the most serious, if not the most frequent, affection of the pericardium.

Ætiology.—This disease, though occasionally idiopathic, is much more frequently secondary in its character. So-called idiopathic pericarditis is usually associated with pleurisy, frequently with bilateral pleurisy, and is not uncommonly latent so far as any direct symptoms of pericardial implication are concerned. Secondary pericarditis may be the result of wounds from without or from within—through the œsophagus; of blows and contusions on the præcordial region; of abscesses perforating from the lung, or from the liver—through the diaphragm; of enteric fever, variola, scarlatina, and pyæmia in all its forms; of the spreading by contiguity of the inflammatory process from neighbouring organs, such as the lungs, pleura, or costal periosteum. It may accompany the local development of cancer or tubercle; or may be due to rheumatism, or to one or other of the chronic forms of Bright's disease. By far the larger proportion of cases of pericarditis occur in connection with the two last-named diseases, in about the ratio of two of rheumatic pericarditis to one of renal pericarditis; all other forms lumped together forming an infinitesimal and incalculable fraction. In rheumatism, pericarditis occurs early; occasionally precedes the joint-affection; and though no period of the disease can be regarded as free from the tendency to this so-called complication, just as any joint may be implicated at any period, yet experience teaches us that the heart-joint is most usually affected within the first week of the rheumatic onset. In renal disease, on the other hand, it is most usually a late phenomenon, being only too frequently the immediate precursor of that fatal uræmia which its occurrence serves to precipitate.

The pathology, symptoms, signs, and treatment of pericarditis, however it may arise, are all very much alike, and may be conveniently treated of together.

Anatomical Characters.—The morbid anatomy of pericarditis is simple enough. Very early pericarditis is rarely seen except as associated with Bright's disease, and then at first we have merely vascular injection with a few shreds of lymph visible about the roots of the great vessels. In a few days, in those dry forms of the disease where but little fluid is effused, the whole surface of the heart may be covered with a thin fibrinous layer, which may, even at this early stage, have connected together the visceral and parietal layers of the pericardium somewhat firmly (Wilks). More usually there is some serous exudation mingled with the fibrinous matter, which then is found covering the pericardium in a reticular or honeycomb pattern, which Laennec has likened to the appearance presented on suddenly separating two smooth pieces of wood between which a small pat of butter has been forcibly compressed. The serous effusion not infrequently amounts to several pints; it is always turbid from the molecular fibrin suspended in it; and is of a yellowish, greenish, brownish, or reddish colour. When along with any considerable layer of lymph upon the pericardiac surfaces, there is much fluid effused, the surface of the lymph is covered with shaggy processes floating in the fluid, these processes sometimes presenting a mammillated appearance. In a very short time a fine network of capillaries is developed in the fibrinous exudation; and the rupture of these newly developed capillaries now and then gives rise to what is termed 'hæmorrhagic pericarditis,' in which the fluid, and even the solid lymph, is deeply stained with the blood-colouring matter. This also happens when pericarditis is associated with purpura or scurvy; and now and then, from similar causes, layers of coagulated blood are found alternating with layers of unstained lymph.

When the disease does not prove fatal, the exudation may be entirely re-absorbed, or it may become organised, or other changes may occur. First of all, the excess of fluid and the molecular fibrin become absorbed; then the coagulated fibrin may become worn away by the continual play of the heart, and gradually entirely absorbed; and a complete cure may be thus effected, leaving at the most only a slight thickening or opacity of the pericardium. But such a cure is only possible when the amount of exudation has been inconsiderable. More usually, connective tissue is gradually developed in the fibrinous layers; either locally, giving rise to partial adhesions, which about the base of the heart are more dense, but at the apex are often drawn out to fibrous strings; or the two layers of the pericardium may be so closely united that they can only be separated with considerable force, and now and then, after the lapse of some time, they cannot be separated at all, the cardiac muscle being torn in the endeavour. Occasionally pus, or the cheesy or calcareous remains of such a deposit is found, encysted, as it were, between the adhering layers of the pericardium; and it sometimes happens that this calcareous layer envelops the whole heart, which then seems to be converted into bone. Laennec, Louis, Allan Burns, and others relate cases of this kind, and the heart described by Burns is still preserved in the anatomical museum of the Edinburgh University. In every fibrinous exudation within the pericardium there is at a particular stage a certain amount of all those elements present which may become pus, and these give rise to a milky opacity of the fluid, or if present in sufficient number, may metamorphose the whole exudation into pure pus. This may be only a transition stage; the pus-cells may break down, a pathological cream may be formed, and the whole may be ultimately entirely absorbed. But true purulent pericarditis, though a rare occurrence under any circumstances, is most frequently fatal, and seems to occur chiefly in connection with serious general disease, or to accompany the rupture of local abscesses, pulmonary or hepatic, into the pericardium. What has been termed an 'ichorous exudation' in the pericardium, is simply a putrefaction of that already existing, which becomes brownish in colour and stinking. It may arise from entrance of the air into the pericardium after paracentesis conducted without antiseptic precautions; but it is also believed that such putrefaction may arise in patients greatly enfeebled by exhausting diseases, such as cancer, without any entrance of air into the pericardium. An exudation that has become ichorous may corrode the pericardium; is incapable of further metamorphosis; and is usually speedily fatal by the development of pneumo-pericardium. *See* Pericardium, Gas in.

Symptoms.—The symptoms of pericarditis are of comparatively little importance, because they are frequently entirely absent in those so-called idiopathic forms of the disease which are probably always fatal, as well as in renal pericarditis, which is fatal in the majority of cases; whilst even in rheumatic pericarditis, in which the mortality is at the most only about 16 per cent., and is *nil* according to other authors (Bamberger, &c.), the symptoms, though rarely absent, are generally not very well marked or distinctive. As a rule, if pericarditis be associated with any other serious disease, such as pneumonia, pleurisy, or rheumatism, the symptoms are apt to be swamped by those of the primary disease. In other instances the advent of the pericarditis is indicated by a rigor, a rise of temperature, a feeling of anxiety and oppression at the chest, and the occurrence or increase of dyspnœa. The decubitus is usually dorsal, and syncope is liable to be induced on raising the patient. There is pain in the cardiac region, with palpitation of the heart. The pulse is at first full and frequent, always compressible, frequently irregular, usually dicrotic, and rapidly becomes feeble; and there is a general exacerbation of all the symptoms of the already existing disease. Occasionally the restlessness and anxiety indicative of cardiac implication pass into delirium, which may be low and muttering, wild and maniacal, occasionally accompanied by delusions, and which may be associated with tetanic or clonic spasms, or with convulsions ending in extreme exhaustion, or in death by coma. The occurrence of delirium in the course of rheumatic fever ought at once to direct attention to the heart; and the sudden occurrence of spasms or coma in chronic renal disease, is only too frequently found to be associated with pericarditis; both of these phenomena being probably caused by the saturation of the blood with the products of retrograde metamorphosis, due to the sudden development of this inflammation. It is only in the very rarest instances that we have that extreme oppression of the chest, violent pain in the cardiac region, hiccough, fainting, and livid countenance, coupled with delirium, and extremely rapid dicrotic pulse, which constitute the classical portrait of pericarditis; and even in those rare cases in which these symptoms are observed, they are rather due to the association of pericarditis with an already existing serious disease, than to the pericarditis itself. In most cases physical examination gives us the first intimation, and in all cases the only reliable information, as to the existence of pericarditis. In all diseases, therefore, in which pericarditis is a possible occurrence, we must carefully examine the cardiac region from day to day, so that we may at once ascertain its occurrence; while at all times, the slightest pain in the chest, or most trifling oppression of breathing, ought to be a sufficient warrant for a most careful physical examination of the chest, because men have been known to go about their ordinary duties—with difficulty, no doubt—even while pericarditis existed.

Physical signs.—Whenever on auscultating over the cardiac area we hear a friction-sound, we are justified in assuming the probable existence of pericarditis. And the probability of this surmise is increased just in proportion as we can eliminate all sources of fallacy, and associate it with those symptoms already described as indicative of pericarditis, and with the other signs presently to be described as having the same significance. A friction-sound due to pericardial roughness may be heard over any or every part of the cardiac area, in front or behind. Its most usual position is over the base of the heart in front, and once heard in that position no amount of subsequent effusion suffices to efface it. The sound of such a friction appears superficial, close to the ear; it may resemble only a slight sound of rubbing, the crackling of paper or parchment, or the creaking of new leather; or at times it may simulate so closely the blowing sound of a valvular murmur as to be indistinguishable from such a murmur by the sound alone. Occasionally a friction-sound is persistently absent throughout the whole course of the disease, and that even where there is abundance of fibrin effused. It is difficult to account for this. Some suppose it to be due to mere softness of the fibrin; more probably feebleness of the heart's action has a good deal to do with it, as well as some alteration of the parts — especially the lungs — overlying the heart, which may render them bad conductors of sound.

Friction-fremitus may occasionally be detected by the hand placed over the præcordia, but this is not always to be felt. Apart from fremitus, within the first few days of the onset of the disease, we perceive by palpation an unusually forcible and turbulent action of the heart, which is also occasionally irregular, and is due to inflammatory irritation of the cardiac muscle. By-and-by, as the inflammation progresses, cardiac debility sets in, and the pulsation becomes less forcible, while in most cases it is still further obscured by the occurrence of fluid effusion, which separates the apex from the anterior wall, with which the base of the heart always remains in contact. In this way we have produced that phenomenon which is termed 'displacement upwards of the apex-beat,' because the more the true apex is pushed inwards by the effusion, the part of the heart actually in contact with the chest-wall approaches more closely the base of the ventricles. Should the heart be greatly hypertrophied, its impulse may remain distinct throughout the whole course of the disease, the fluid accumulating behind it and not in front.

So long as the serous accumulation is inconsiderable, there is no alteration of the percussion-sound; but whenever this attains an abnormal amount, it is revealed by an increase of the cardiac dulness; and in the ordinary dorsal decubitus of the patient this is first observed at the base, in the line of transverse dulness along the level of the fourth rib. By-and-by, however, the ordinary pyramidal dulness of the heart, base upwards, becomes reversed, and we have a pyramidal dulness with the base below and the apex upwards; and this apex may rise as high as the clavicle, or even above it. The base, on the other hand, may in these cases extend beyond the ordinary position of the apex-beat to the left, especially if the patient be made to lie upon his left side; but it is mobile, and on turning the patient on his right side the dulness leaves the left and passes towards the right. Very great emphysema of the lungs may obscure this dulness, but cannot altogether annihilate it; but of course this method of diagnosing pericardiac effusion can only be put in force when both pleuræ are free from fluid. The fluid effusion, even when confined to the pericardium, may amount to several pints, and its pressure may not only embarrass the heart's action, but may also so compress the lungs, particularly the left one, as to give rise to considerable dyspnœa; and the hindrance thus presented to the free passage of the blood through the lungs may give rise to considerable systemic venous congestion, which is readily observed in the turgid condition of the jugular veins.

As a rule inspection gives us little, if any, information in regard to the existence of pericarditis. Should the quantity of fluid effused be very considerable, and the chest-walls flexible, some vaulting of the pericardial region may be observed, due to the effacement of the intercostal spaces, the ribs being occasionally also more widely separated than usual, at least apparently so; and the whole præcordial space under these circumstances takes a less share than ordinary in the respiratory motions. Undulatory movements due to waves of fluid, as described by some, are never seen; such movements, if visible, depend upon the wobbling of an enlarged and feeble heart, and not on any fluid waves.

Diagnosis.—A friction-sound has been hypothetically supposed to be occasionally due to mere dryness of the pericardiac membrane. Possibly this may be the case, but it has never been proved. Even if it be the case, then such dryness, associated with the symptoms described, can only be an early stage of inflammation. Apart from these it may or may not be an indication of commencing inflammation, and must be watched and treated accordingly. It has also been alleged that calcareous concretions, and tubercular and carcinomatous roughnesses may give rise to a friction-sound. Associated with the symptoms described, any friction-sound, even presuming such a possible origin, must be regarded as a form of pericarditis, whilst apart from these symptoms it must still be watched with suspicion. The most difficult cases to diagnosticate are those in which the friction-sound is due to pleurisy alone, and is yet audible during cardiac action, when the respiration is temporarily suspended. This is a rare occurrence, but it does happen, and the diagnosis is almost impossible. The subsequent progress of the case may show that the pleura is certainly affected, but that is no proof that the pericardium is not also implicated; or the pericardium may be assuredly diseased, and yet the friction-sound may be solely due to pleurisy. The general symptoms and the condition of the pulse count for something, but the diagnosis between pleurisy and pericarditis is, in such cases, manifestly a difficult one, only to be solved by the further progress of the case. Now and then we have a friction sound audible towards one or other side—usually the left—of the pericardium, during suspension of the respiratory movements; the base of the heart being entirely free from friction, and in these circumstances the probability seems greatly in favour of the strictly pleural nature of the disease. But even in such cases a perfectly accurate diagnosis is impossible. There is never any real difficulty in determining between a valvular murmur and a frictional pseudo-murmur, because in the case of the latter the sound is restricted to the cardiac area, and usually only to a small portion of that, and not being propagated to any extent out of its position of maximum intensity, and then only equally all round, and not in any of the definite lines in which valvular murmurs are propagated. Moreover, the position of maximum intensity of a frictional pseudo-murmur never coincides with that of any valvular murmur, except occasionally with a diastolic aortic one; while, of course, the natural sounds of the heart are never replaced by the pseudo-murmur, though they may be partially obscured by it, and all the secondary results of the valvular lesion simulated are entirely wanting.

Prognosis.—The prognosis in pericarditis is not unfavourable; one in six, or about 16 per cent., is mentioned by some as the ordinary mortality; but according to Bamberger, pericarditis associated with rheumatism or any other curable disease invariably terminates favourably, though the mortality is always large when it is associated with Bright's disease and other incurable affections, the fatal termination of which is hastened by the pericardiac affection. Pericarditis, like any other acute inflammation occurring in an otherwise healthy individual, may be expected to run a favourable course if not unduly treated; and the danger to life is to be calculated by the seriousness of the coexisting complications, and the age and state of the vital powers of the patient. The unfavourable phenomena are, a large quantity of effusion, great dyspnœa, feeble heart's action, small and irregular pulse, lividity, delirium and other nervous symptoms.

Treatment.—The treatment of pericarditis must be regulated to some extent by the nature of the disease with which it is concomitant. If it concur with pneumonia or pleurisy, it may safely enough be entrusted to the remedies employed for these diseases; or should it accompany rheumatism, then we must treat it as part of the rheumatic affection. If we can hopefully employ blood-letting or mercury in the case of rheumatism, then we may employ the same remedies in pericarditis; otherwise there is no reason why we should make use of doubtful and dangerous remedies, simply because the disease has attacked a more dangerous part, but rather the reverse. Those who have shown the smallest percentages of deaths have been the least perturbative in their treatment, as we might reasonably expect. A rheumatic pericarditis ought, therefore, to be treated simply as a rheumatic affection; but inasmuch as pain implicating the heart has a decided tendency to depress its action, it is of the utmost importance to relieve it at once. With this view a large, warm poultice should be applied over the heart; and morphia injected subcutaneously at once, and repeated by the mouth, or subcutaneously, at regular intervals, so as to keep the patient free from pain. Perfect rest must be enjoined. Should there be much dicrotism of the pulse, or any tendency of the heart to fail, then digitalis should be administered at regular intervals, in doses sufficient to keep up the cardiac action, such as ten minims of the tincture every four hours; and with this may be conjoined the use of chloral in five or ten-grain doses, which is not more useful as a sedative than as an antiphlogistic, and which may very well replace the morphia, having the additional recommendation that it does not interfere with the secretions, which demand attention, nor promote the sweating, so troublesome in rheumatism. Where it may be considered advisable to give an alkali, such as potash or ammonia, with the digitalis, it cannot be combined with the chloral, but must be given separately. In recent times, salicin and the salicylates have been employed with success in the treatment of rheumatism. They are not true specifics for this disease, but they tend to keep down the fever, and apparently shorten its course. They do not prevent the occurrence of pericarditis, but their use is not contra-indicated by its presence. Blisters are frequently recommended in pericarditis, but they may tend to irritate the patient and to excite his heart's action. A few leeches often give relief in suitable cases. We must, in fact, treat the pericarditis as part of the general rheumatic attack, only requiring a little more attention than usual in the way of warmth, and relieving pain; and all the past history of this disease proves that we shall in this way be more likely to promote a favourable termination of the disease, than by jeopardising our patient by dangerous and uncertain medications.

Where the amount of fluid effused is very great, or when the symptoms seem to point to the presence of pus, it may become a question whether paracentesis should be performed or not. The results of this operation hitherto have not been very satisfactory, but that is no reason why it should not be resorted to if it seem necessary, especially as it can now-a-days be so easily done by means of one or other of the aspirateurs. The patient should be placed in the recumbent position, and the needle entered between the fourth and fifth ribs, about half an inch to the left of the sternum, the operation being, of course, performed antiseptically, and the fluid drawn off somewhat slowly. For this reason, therefore, we should be careful in our choice of an aspirateur, as one acting by a powerful vacuum might induce syncope, by withdrawing too rapidly from the heart a pressure to which it has become accustomed. A dilated heart has been said to have been punctured, instead of a distended pericardium, but in the present day such a mistake is scarcely possible, though, of course, it must be carefully guarded against. It now and then happens that after the acute symptoms pass away, the pericardium remains obstinately distended with fluid, and it is, perhaps, chiefly in these cases that *paracentesis pericardii* presents the most hopeful prospects. *See* Paracentesis.

3. Pericardium, Gas in.—The putrefaction of an exudation causes the development of various gases within the pericardium, and the production of so-called *pneumo-hydro-pericardium*. This condition is readily recognised by the clear tympanitic percussion-note over the usually dull cardiac area, with a metallic gurgling accompanying the cardiac movement. Besides the circumstance already mentioned, pneumo-hydro-pericardium may also be caused by the entrance into the pericardium of gases from the stomach and intestines, or of air from the œsophagus or lung, or *ab externo.*

4. Pericardium, Malformations of.—The malformations which may be found in connection with the pericardium are described in the article Heart, Congenital Misplacements of.

5. Pericardium, New Growths in.—Both tubercle and cancer may become developed in the fibrinous layers of a pericarditic exudation, usually secondarily to the occurrence of these processes in other organs. This is a very rare circumstance, however, as is also the occurrence of tubercular or cancerous nodules of a secondary character in the substance or on the surface of the pericardium itself, with which a secondary pericarditis speedily becomes associated. In either case, but particularly in the former, the fluid in the pericardium is usually of a hæmorrhagic character when associated with the development of cancer. Now and then tubercular, and still more frequently cancerous, masses are formed in the lungs or mediastinum, and pressing upon the pericardium give rise to pericarditis, which reveals itself mainly by the signs of effusion, and without any direct symptoms of cardiac implication. Such cases are not often recognised during life. The prognosis is always fatal; and the treatment palliative only.

6. Pericardial Adhesions.—Pathologically speaking, the most important of all the terminations of pericarditis is adhesion of the two layers, which in its most exquisite form was described by the ancients as congenital absence of the pericardium. This is a state of matters impossible to diagnose, though it may be surmised; and too often it escapes even a surmise, unless the previous history of the case be well known. Very rarely there remains a permanent depression over the cardiac area, the result of pre-existing pericarditis and subsequent adhesion of the visceral and parietal layers, and also of the superjacent pleura. More frequently, but still rarely, this state of matters is revealed by a systolic depression of the parts over the cardiac apex. Even more rarely—because the result of a more extensive inflammation—we have a systolic depression over the scrobiculus cordis, caused by adhesion of the two layers of the pericardium to each other, and to the pleura covering the diaphragm, and concomitant adhesion of the diaphragm to the liver.

It can be only rarely that extensive pericarditis exists without a simultaneous myocarditis, and the results of the latter affection were formerly too frequently referred to the pericarditis itself. An adherent pericardium occurring in early life may hamper the future growth of the heart, and may thus produce one form of so-called atrophy of the heart, with all the consequent results of impaired nutrition. But it is only when the subpericardiac layer of muscular fibres has been involved in the inflammation, that we may have atheromatous or fibrous changes taking place; and, as the result of these, encasement of the heart in a calcareous wall; a local or, more rarely, a general thin and fibrous condition of the cardiac muscles; and either local or general aneurismal dilatation. These results are, however, rare. Hypertrophy is not to be regarded as the result of pericardial adhesion, but of any concomitant lesion which may be present, or of some other cause; for though pericardial adhesion may co-exist with cardiac hypertrophy, it does not give rise to it. In the larger proportion of cases simple pericardial adhesion is to be regarded as not productive of any appreciable untoward results.

G. W. Balfour.

PERIHEPATITIS (*περὶ*, around, and *ἧπαρ*, the liver)—Inflammation of the capsule of the liver. *See* Liver, Inflammation of.

PERINEPHRITIS (*περὶ*, around, and *νεφρὸς*, the kidney).—Synon.: Fr. *Périnéphrite*; Ger. *Perinephritis.*

Definition.—An acute or chronic disease of the cellular tissue around the kidney, consisting of inflammatory thickening of, and exudation into, the tissue, frequently followed by suppuration; characterised by fever, local pain, fulness, tenderness on pressure, and in many cases ultimately by fluctuation; and resulting frequently in death, sometimes in spontaneous recovery.

Ætiology.—Perinephritis in most cases originates from pyelitis or suppurative nephritis, by perforation or by extension of the inflammatory process. It is especially related to pyelitis from urinary calculus. It may result from injuries, such as blows, wounds, or severe strains; or from extension of inflammation from neighbouring parts, as from the pelvis, the gall-bladder, or the testicle and spermatic cord. The disease appears in some cases to result from exposure to cold, especially after previous exposure to excessive heat. It arises also in the course of, or as a sequel to fevers, particularly the exanthemata. It is most common in adults, and appears to affect equally the two sexes.

Anatomical Characters.—In the earlier stages the cellular tissue around the kidney is congested; and when exudation has supervened the affected tissue becomes solid and firm. Usually suppuration speedily takes place in the centre of the mass, commencing either at one or at numerous points, and gradually extending. The pus is sometimes odourless, sometimes fœtid. It is important to remember that a fæcal odour may be present without perforation, from the bowel. The perinephritic abscess may become so large as to extend from the level of the liver and spleen to the iliac fossa, and may project so far forward as to protrude the abdominal wall. The pus may burrow and make its way to the surface at the lumbar region, in the lower part of the abdomen, or even in the thigh. More commonly it makes its way into the ureter, or the colon; sometimes into the peritoneum. Occasionally the diaphragm is perforated, and the pus is discharged through the lung. Sometimes rapid gangrene is induced, and sloughy masses are found, mingled with the purulent *débris*. Either without going on to suppuration, or after discharge of the pus, cicatrisation may take place, dense fibrous tissue permanently occupying the place of the structures which had been involved.

Symptoms.—The constitutional symptoms in perinephritis are generally well-marked. The attack may be ushered in by rigors recurring frequently, sometimes periodically. The temperature rises to 100° or even to 105°. The pulse becomes rapid, and either bounding or feeble. The tongue is furred, there is great thirst, the appetite is lost, and there is a tendency to constipation, due in part to the fever, in part to the mechanical pressure upon the bowel. The skin is hot and dry; sometimes there are profuse sweatings, particularly during the later stages of the malady. The local symptoms are pain, usually aggravated by movement, and markedly by pressure; and the presence of a tumour. The tumour rapidly increases, and while it is at first hard throughout, it soon presents deep-seated fluctuation, which becomes gradually more distinct and superficial. The skin in the lumbar region is often œdematous, and is usually pale, excepting when perforation is about to take place. The position of the mass is important. It is situated in the region of the kidney, and is inseparable from it, while as a rule separable from the liver and spleen. The urine may be quite natural, but in many cases it is altered, in consequence of the presence of pre-existing pyelitis or nephritis; but even in cases which do not originate in renal disease, there is a tendency to diminution of the urine at first, and this is apt to continue throughout, accompanied by a dark colour of the secretion.

The onset of perinephritis is generally acute, but it may be very insidious, especially when it follows pregnancy. Probably it sometimes terminates by resolution without going on to suppuration. When suppuration is once fairly established, it extends and makes its way, either to the surface or into some internal cavity. When the pus is making its way outwards, there are the usual features of a burrowing abscess—the skin becomes red and prominent, and at last an opening is formed by ulceration. When the pus makes its way into the colon, a copious discharge of pus by the bowel occurs; and, owing to the nature of the opening, fæcal matter seldom makes its way into the abscess-cavity. If bursting into the ureter occurs, discharge of pus from the bladder takes place. If into the lungs, a sudden discharge may take place with coughing, the layers of the diaphragmatic pleura having been first agglutinated together. With all these modes of termination there is, as a rule, fall of temperature, with relief of the general and local symptoms. When the discharge takes place into the peritoneum, fatal peritonitis is rapidly lighted up. When through the diaphragm, the two layers of the pleura not being adherent, empyema is produced, with sometimes gangrene of the lung. In some instances of perinephritic abscess there is a fatal termination without perforation having occurred, by means of blood-poisoning, either in the form of pyæmia with secondary abscesses, or of septicæmia with affection of the spleen and other blood-glands. In a few cases suppurative pylephlebitis has been met with, accompanied by secondary abscesses in the liver.

Diagnosis.—The concurrence of fever with pain and swelling in the region of the kidney, is distinctive of perinephritis, no other disease presenting this exact combination. The tumour is fluctuating, and is in the immediate neighbourhood of the kidney; it is usually confined to one side; its mass may be tilted forward by pressure on the renal region. It must be distinguished from new formations of the kidney, spleen, liver, or mesenteric glands; from hydronephrosis; and from extravasation of blood into the cellular tissue, due to rupture of an aneurism. From the first group it is distinguished by the fever, and the fluctuation and exact position of the mass; from hydronephrosis by the fever, and the characters of the enlargement; from the aneurismal extravasation by the comparatively slow growth of the tumour, and the absence of the characters of aneurism. In most cases certainty is most readily attained by means of the aspirator.

Prognosis.—The prognosis is always grave, and becomes increasingly so as the disease advances. The duration is commonly short, the case terminating in from a fortnight to a month; sometimes, however, a case lasts several months. A favourable prognosis may be given when perforation outwards has taken place; or when the abscess has burst internally, in such a direction that the pus escapes freely, and there is improvement in the general symptoms.

Treatment.—In the earlier stages counter-irritation by blistering is useful. The internal use of iodide of potassium, and the external application of iodine, may prevent suppuration. Supporting diet should be given, but not stimulants, unless essentially necessary.

When suppuration has taken place the abscess must be discharged by the aspirator, or by free incision. The latter is preferable, because there are often sloughs or masses of tissue which cannot be got rid of by aspiration. When operation by incision is resolved upon, the incision should be made in the lumbar region through the skin and muscular tissues; and the finger should be introduced into the abscess cavity, to tear down any adhesions which may exist. When the pus has been evacuated, a drainage-tube should be introduced, so as to keep the passage open, and give free egress to the pus. The best results are to be expected when free incision is adopted, and Lister's antiseptic method rigorously employed during the operation and afterwards. The patient's strength must be maintained by nutritious food, tonics, and stimulants when required.

T. Grainger Stewart.

PERIOD OF INCUBATION.—The period that elapses between the entrance of an infective substance into the system, and the first appearance of the symptoms of the disease which it produces. *See* Incubation.

PERIODICITY IN DISEASE.—In the older physic the periodical phenomena observed in many diseases exercised an important influence upon medical opinion and practice. In the physic of the present day these phenomena, although not disregarded by current pathology, have scarcely a place in therapeutical teachings. An increased precision of medical observation, while leading to the removal of many errors of the older writers on the subject, has begotten a general doubt as to its value in practical medicine, and brought about a, perhaps, too indiscriminate rejection of the earlier views respecting it.

Two English writers, Thomas Laycock, M.D., and Edward Smith, M.D., have in recent years devoted attention to the phenomena of periodicity in disease. Laycock, from a general review of the periodical phenomena observed in menstruation, in utero-gestation of the human and brute female, in the development of the ova of fishes, and in the metamorphoses of insects, came to the conclusion that physiological changes occur in animals every three and a half, seven, fourteen, twenty-one, or twenty-eight days, or at some definite number of weeks. In other words, he came to the conclusion that there are certain 'critical days' in health, days in which there are marked changes in the vital movements, whether that change be for the better or the worse; and that those days may be stated generally as the fourth, seventh, fourteenth, twentieth (or twenty-first), and the twenty-eighth. Further, from a review of the periodical phenomena observed in disease, particularly in the groups of eruptive, intermittent, and continued fevers, and in gout, he endeavoured to show that the changes observed in them followed a similar rule of periodicity to that manifested in health. He saw reason, moreover, having regard to the three-and-a-half-day period noticed, or seven half-days, to revert to the ancient division of the whole day (νυχθήμερον) into two parts, here following Graves, who had said: 'We should not count three days and a half, but seven half-days; we should not say seven days, but fourteen half-days. If this method were adopted, many of the apparently critical terminations in continued fevers would, I have no doubt, be found strictly conformable to some regular law of periodicity.' Laycock also saw reason to revert to the ancient doctrine of *critical days in fevers*, and he thus elucidates it: 'In the essay on the judicatory, or critical days, found among the writings of Hippocrates, a critical day is shown to be that day on which certain symptoms will appear, enabling us to ascertain—first, the probable duration or termination of the disease, and, secondly, the symptoms likely to appear on certain future days. The acts of mind which deduced these inferences were termed judications (*judicationes*—κρίσεις); and the day on which those acts were to be made was termed judicatory (κρίσιμος). So a day might be judicatory—first, of the disease, its course and termination; secondly, of the symptoms to happen on another day. Thus jaundice and hiccup, appearing on the fifth day of fever, indicated a fatal disease; jaundice, on or after the seventh, indicated diaphoresis; on the seventh, ninth, eleventh, and fourteenth (if unaccompanied by hardness in the præcordia), a favourable termination. In pleurisy, if the fever abates on the seventh day, the patient will recover; if it do not, the disease will be prolonged to the fourteenth, on which day it is sometimes fatal. This is the first and plainest exposition of the doctrine of critical days, and, I believe, it is correct.' Laycock then proceeds to make a comparison of the critical days of febrile diseases, and the order of sequence observed by intermittents; and, further, to compare both these forms of fever with the periodicity observed in the exanthemata, and make the facts bearing upon that part of their pathology harmonise with each other. 'The critical days, according to Hippocrates [doubtless here writing, without knowing he did so, of what we now call continued fevers], are:—1, 4, 7, 9, 11, 14, 17, 20, or 21. The paroxysms of a tertian will take place on the $\frac{1}{1\,p.}$, $\frac{3}{2\,p.}$, $\frac{5}{3\,p.}$, $\frac{7}{4\,p.}$, $\frac{9}{5\,p.}$, $\frac{11}{6\,p.}$, $\frac{13}{7\,p.}$, $\frac{15}{8\,p.}$, $\frac{17}{9\,p.}$, $\frac{19}{10\,p.}$, $\frac{21}{11\,p.}$ The paroxysms of a quartan will take place on the $\frac{1}{1}$, $\frac{4}{2\,p.}$, $\frac{7}{3\,p.}$, $\frac{10}{4\,p.}$, $\frac{13}{5\,p.}$, $\frac{16}{6\,p.}$, $\frac{19}{7\,p.}$ And if a continued fever existed with tertian or quartan exacerbations, the more violent symptoms might be expected to appear on the days indicated. On comparing the order of days, discrepancies between the three are sufficiently obvious on a superficial consideration, but many of them disappear on more particular inquiry. . . . With regard to the exanthematous fevers, it will be seen at once that the "critical days" they exhibit occur in quartan order. . . . Exanthematous typhus exhibits the tertian type, and, as might be inferred, the critical days in this fever are the fifth, seventh, ninth, eleventh, and twenty-first. Scarlatina is sometimes tertian, sometimes quartan.'

Since the discrimination of the several varieties of continued fevers, and after the date when Laycock wrote, medical observation has not tended generally to support the doctrine of critical days, as it relates to this group of febrile disorders, or to confirm the evidence upon which that doctrine appeared to be founded. Murchison's observations (*Treatise on the Continued Fevers of Great Britain*, 2nd edit. p. 187) did not support the applicability to *typhus*; but in this respect, as he notes, they were not in accord with the observations of Gairdner, Russell, and Traube of Berlin. The last-named, indeed, as also Wunderlich, revived the doctrine. *Relapsing fever* may, perhaps, be said to illustrate the doctrine, the paroxysm intermitting on the the third, fifth, or seventh day. According to Murchison (*Treatise*, p. 547) the doctrine fails with respect to *enteric fever*, but he adds that he had 'often noticed' that the disease terminated about the 21st or 28th day. E. Seguin (*Medical Thermometry*, 1876) reproduces the views of Hippocrates on critical days, and Wunderlich's seeming confirmation of them derived from thermometry, himself accepting the 'similitude,' indeed the 'quasi-identity of the results' obtained, in this regard, by the father of Physic and the modern professor. According to Wunderlich's observations the majority of cases of typhoid fever run a regular course, divided into periods corresponding in time with the division into weeks and half-weeks. The ordinary course is about twenty-one days, and Seguin describes an 'effervescence of seven days, a fastigium of seven days, and a defervescence of seven days;' but he adds, with reference to the irregularities which so often mark the disease, 'simple as it looks, how difficult it is to make it out.' In typhus—simple uncomplicated cases—the thermometer marks the fourth day as the height, the sixth to the seventh as the turning point, and a *perturbatio critica* at the end of the second week. 'The doctrine of crises,' says Wunderlich, 'was for the ancients a dogma . . . . for us it must become a law.' Robert Lyons remarks (*Treatise on Fever*, p. 74, 1861): 'We are far from denying that at certain periods febrile disease presents an unmistakable tendency to terminate on critical days; but we think that it is consistent with observation to state that a critical issue of fever . . . . . is far less common in our day than it once was.' And this, indeed, would appear to be a legitimate conclusion from the observations made in this country bearing on the subject. It would almost seem, in fact, on comparing the critical days set forth by the older writers with the order of sequence followed by the paroxysms of intermittent fever, as if the indications of the former, in the progress of the continued fevers of Great Britain at least, had declined with the diminution of sources of paludal malaria.

Laycock, as the general result of his investigation of the *minor* periods—that is, the daily, weekly, monthly, and seasonal recurrences of vital movements—as contra-distinguished from the *major* periods, that is periods measured by a year, or by a series of years, (which he also discussed, but which will be referred to in this article in another connection), laid down the following propositions:—(1) There is a general law of periodicity which regulates *all* the vital movements of *all* animals. (2) The periods within which these movements take place admit of calculations approximatively exact. (3) The fundamental unit,—the unit upon which these calculations should be based,—must for the present be considered as one day of twelve hours. (4) The lesser periods are simple and compound multiples of this unit, in a numerical ratio analogous to that observed in chemical compounds. (5) The fundamental unit of the greater periods is one week of seven days, each day being twelve hours; and simple and compound multiples of this unit determine the length of these periods by the same ratio as multiples of the unit of twelve hours determine the lesser periods.

Inquiring into the causes of the periodical changes in the vital movements of animals, Laycock saw reason to believe that they were in part dependent upon cyclical processes inherent in the system (*esoteric*), partly upon periodic agencies acting from without (*exoteric*), or that they resulted from a combination of the two (*endexoteric*). Prosecuting the inquiry further with special reference to the exoteric agencies, Laycock showed how closely the periodical changes observed in vital movements were linked to the periodical phenomena observed in nature at large, and this not merely with reference to such obvious phenomena as the alternation of sleeping and waking in connection with the diurnal rotation of the earth, and the succession of day and night, but also in respect to the more recondite periodical changes in the vital processes. He set forth data which suggested that those changes, as well as the periodical changes observed in disease, had definite relations to the position of the earth with reference to the sun, and to the position of the sun among the spheres; also to the periodical fluctuations occurring in atmospherical temperature, pressure, and magnetism; and in the magnetism of the earth, whether diurnal, seasonal, or secular. And of the periodicity observed in pathological processes, he endeavoured to show that (whatever the intimate nature of the pathological process might be) neither the beginning, the continuance, the fluctuations, the ending, nor the recurrence could be rightly understood apart from its relations to the phenomena of physiological periodicity on the one hand, and the periodicity of physical phenomena on the other hand. He held that there were not wanting indications in pathological phenomena of a lunar period, and particularly of a lunar cycle (eighteen years, Howard's seasonal cycle); the indications of solar periods were more obvious; and it was to be inferred that in time we should have evidence of greater pathological cycles corresponding with the greater astronomical cycles. Laycock, indeed, saw clearly that so far as exoteric agencies were active in bringing about the periodical phenomena observed, in physiological and pathological processes in man, the changes of least period were linked inextricably to the changes of greatest period, and that the study of the greater periods must be approached, if success were to be hoped for, through the study of the lesser.

Laycock was of opinion that as our knowledge of the periodical phenomena observed in vital changes becomes more exact and extensive, it will be possible to establish a science of *vital proleptics*, having for its object 'to foretell social and individual suffering'—in other words, a science of *pathological forecasting*.

Edward Smith examined the question of periodical changes in living beings, in health and disease, from a stand-point different from that taken by Laycock. He limited his observations to the human system, and prosecuted a series of researches on the daily, weekly, and seasonal changes it underwent, probably unique in their duration and extent. He adopted as criteria of these changes the rates of pulsation and inspiration, the quantities of carbonic acid expired, of air inspired, and of urea and urinary water evolved. The data as to these several changes were determined by a series of observations made upon himself and others, some phthisical, at hourly intervals, without intermission, throughout the twenty-four hours, during several days in succession, for the daily period, and at daily intervals for the longer periods of time. The fluctuations observed in the different phenomena of health, being taken as indications of changes in the activity of the vital processes, it became possible to determine the progression and retrogression of that activity within the several periods to which the inquiry was directed. These may be briefly stated as follows:—

Daily period (*cycle*).—Vital activity is at the lowest between the hours of 1 and 3 o'clock a.m. After 3 o'clock a.m. the activity increases, at first slowly, then more quickly, until a maximum is reached between the hours of noon and 2 p.m. A progressive decline follows, rapid at first, slower as the evening draws on and falls into night, until the minimum is reached between 1 and 3 a.m. The day, in fact, as concerns the changes undergone in the human system may be divided into two periods, one of minimum change (approximatively from 8 p.m. to 8 a.m.); and one of maximum change (approximatively from 8 a.m. to 8 p.m.) Within this daily cycle, smaller cycles are observable, according to the time and quality of the meals.

Weekly period (*cycle*).—A weekly period is not shown by a clear line of progression of vital change throughout the week, but by the indications of a higher degree of change which follow upon the first-day rest than are manifested at the close of the sixth day of labour. The evidence of a seven-days' period of change in the healthy system, on the line of investigation pursued by Smith, and apart from the social habit of periodical rest, is obscure; but the social habit is probably the expression of a physiological want of the system.

Seasonal (*annual*) *period* (*cycle*).—A seasonal cycle is very definitely marked by the intimate vital changes observed in the human system. Towards the close of summer vital change has reached its lowest point. With the commencement of autumn a progressive increase commences, which continues through the autumn and the winter, and reaches its highest degree in spring. Towards the close of spring vital change begins to decline progressively. This decline proceeds throughout June and July, at an increasing rate in the latter month, and attains its lowest degree early in September. The *summer* changes in the system exhibit the following minimum and maximum conditions: a *minimum* of carbonic acid and vapour exhaled, of air inspired, of the rate and force of inspiration, of alimentation and assimilation, of animal heat generated, of muscular tone and endurance of fatigue, and, in general, of resistance to adverse influence. A *maximum* of the rate of pulsation, of the action of the skin, and the elimination of vapour, of the dispersion of heat, of the supply of heat from without, and of excess of heat, of the elimination of urea and urinary water, of the distribution of blood to the surface, of the imbibition of fluids, of relaxation of the tissues, and of poverty and carbonisation of blood. In the *winter season* the above conditions are, for the most part, reversed. The *autumn season* is marked by the conditions peculiar to the summer or the winter, as the character of the season resembles the one or the other; it is essentially a period of change from the minimum to the maximum. The *spring season* is characterised in its early and middle parts by the highest degree of efficiency of every function of the human system, but as the season advances to the close, these conditions merge into those peculiar to summer.

The effect of season, Ed. Smith observes, is more than the physical phenomena of temperature and atmospheric pressure explain, and is so universal that even the same amount of exertion, made at two different seasons, produced different degrees of effect upon the vital changes—less carbonic acid being evolved from it in summer than in winter, in proportion to the relative amounts when at rest at these two periods.

The periodical changes here set forth have important bearings both upon the liability to and the treatment of disease. Smith endeavoured to formulate these bearings and thus to furnish a rational statement of many facts which the experienced practitioner learns at the bedside, and which he applies empirically.

But the interest of the seasonal period is more conspicuously marked as it influences the liability to and recurrence of disease and particular kinds of disease. And here it should be noted that Ed. Smith discusses a question which, perhaps, has been too little considered, namely, the viability of children born in the different seasons of the year. This question he believed to have an important bearing upon the great loss of infant life which occurs in the summer season. Smith concludes that the viability of those children is greatest who are born in the winter and spring months.

The periodical fluctuations observed in the progress of current diseases in the course of the year appear to be mainly determined by the influence of seasonal changes on the individual. This subject has recently been examined by Alexander Buchan and Arthur Mitchell, M.D. (*Journal of the Scottish Meteorological Society*, Nos. xliii.-xlvi.), with reference to the variations of mortality in relation to the weather for different diseases, at different ages, in London, for a period of thirty years. The results obtained by these gentlemen are of exceptional value for the length of period over which it has been practicable to extend their examination—a period unattainable, for a like number of diseases and approximate correctness of data, in other natiological records. A series of researches made by Edward Ballard, M.D., on the prevalence of certain sorts of sickness, in a particular district of London, with reference to meteorological conditions, corresponds closely with the results shown for the mortality in similar kinds of sickness by Buchan and Mitchell, the minima and maxima of the sicknesses necessarily preceding by a longer or shorter period the minima and maxima of the mortality arising from them. The general results obtained from the London mortality may be taken as representing the influence of seasonal changes on disease; but the progress of the diseases will be found to follow the progress of the seasonal changes, as these may be found to differ in, and may be modified by, different localities. The following is a brief tabular statement of the seasonal mortality of the more important diseases current, or occasionally present, in London:—

	Winter.			Spring.			Summer.			Autumn.		
	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Small-pox	+	+	+	+	‡	+	−	−	=	−	−	−
Measles	+	−	−	−	+	‡	+	−	−	−	+	‡
Scarlatina	−	−	−	−	−	−	−	+	+	‡	+	+
Diphtheria	+	+	−	−	−	−	−	−	+	+	‡	‡
Quinsy (16 years) .	+	+	+	−	−	−	−	=	−	+	+	‡
Croup.	+	+	+	+	−	−	−	−	−	−	+	+
Whooping Cough .	+	+	+	+	+	−	−	=	=	=	−	+
Fevers	+	−	−	−	−	−	−	−	+	+	+	−
Typhus (6 years). .	+	+	+	+	−	−	+	−	−	+	−	+
Typhoid (6 years) .	+	+	−	−	−	=	−	+	+	+	‡	+
Simple contind. fever	+	+	‡	−	−	+	−	−	+	−	−	+
Erysipelas	+	+	−	−	−	−	−	−	−	+	‡	‡
Puerperal fever . .	+	+	+	−	−	−	−	−	−	+	‡	+
Dysentery	−	−	−	−	−	−	+	+	‡	+	−	−
Diarrhœa	−	−	−	−	−	−	‡	‡	+	−	−	−
Cholera	−	−	−	−	−	−	‡	‡	+	−	−	−
Rheumatism . . .	+	+	+	+	+	−	−	−	−	−	+	+
Privation	−	−	−	−	−	−	+	+	+	−	−	−
Purpura and Scurvy	−	−	+	+	+	+	−	−	−	−	−	−
Alcoholism	−	−	−	−	+	+	+	+	+	−	−	−
Thrush	−	−	−	−	−	−	+	+	+	+	−	−
Gout	+	+	+	+	+	−	−	−	−	−	−	−
Phthisis	+	+	+	+	+	−	−	−	−	−	−	+
Tabes Mesenterica .	−	−	−	−	−	−	+	+	+	−	−	−
Hydrocephalus . .	−	+	+	+	+	+	+	−	−	−	−	−
Heart-disease . . .	+	+	+	+	−	−	−	−	−	−	+	+
Laryngitis	+	+	‡	+	+	−	−	−	=	−	−	+
Bronchitis	‡	+	+	+	−	−	−	=	−	−	+	+
Pneumonia	+	+	+	+	−	−	−	=	−	−	+	+
Asthma	‡	+	+	+	−	−	−	=	−	−	+	‡
Pleurisy	+	+	+	+	−	−	−	=	−	−	+	+
Lung-disease . . .	+	+	+	+	−	−	−	=	−	−	+	‡
Enteritis.	−	−	−	−	−	−	+	+	+	+	−	−
Teething	+	+	+	+	+	−	−	−	−	−	−	−
Old age	‡	+	+	+	−	−	=	−	−	−	−	+

+ Above the average.	‡ Maxima.
− Below the average.	= Minima.

This table indicates the seasons of prevalence of the several maladies above and below the average, as shown by their mortality, also the seasons of maximum and minimum prevalence, but it does not exhibit the order of progression and magnitude of movement of the diseases in the different seasons. In this place, however, we are concerned solely with the fact of periodical changes in the prevalence of disease corresponding with and, it is inferred, depending upon the seasonal changes. These changes, while occurring more or less in each of the particular affections, and notably in certain groups of affections, such as the diarrhœal and pulmonary, manifest widely varying relations between the several kinds of maladies, except in the groups referred to and the different seasons.

Periods of Seasons or of Years.—Epidemics.—A series of periodical phenomena have now to be considered which have been a source of the most eager speculation from the earliest times of medicine to the present day. So far as medicine is concerned these periods have been marked by epidemic morbid phenomena—epidemics in man, epizootics in animals, epiphytics in plants. The recurrence of these phenomena at intervals shows that over and above the periodical morbid changes which have hitherto been noted, and which are completed within the day, the week, or a series of weeks, and the seasons within a year, there are periods of change which require for their completion a series of years of longer or shorter duration, and which for their elucidation (as Laycock showed) require to be considered in connection with the previously-mentioned periods. These periodical morbid phenomena are of two sorts, the one relating to particular localities, districts, or countries (*epidemics*); the other to groups of several countries or to the world generally (*pandemics*). There are, in fact, circumscribed (local) and general epidemics, the small and the great epidemics of some writers; the former, local evolutions of disease having relation chiefly to the physical and moral states of communities, the latter, secular evolutions (to use Charles Anglada's phrase: *Maladies Éteintes et les Maladies Nouvelles*, 1869), which appear to have relation to, as yet, undetermined cosmical phenomena. To these secular evolutions of disease ('facts of cosmo-chemical disturbance'—John Simon) some epidemiologists would restrict the term epidemic.

The law of periodicity of the several diseases current in a country, and which are apt to become epidemic, has not been determined. Each disease will need to be considered apart; and in those which are communicable from the sick to the healthy, the influence of an accumulation of susceptible persons in the intervals between epidemic prevalence[1] will have to be distin-

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[1] The writer has the following from a mathematical friend:—As a first case, let all epidemics be of equal intensity; and let there be no condition operative in determining an epidemic beyond the accumulation of susceptible people.

Let p be the number of susceptible people remaining in a population after an epidemic.

Let r be the annual excess of births over deaths (all causes), with other increments of susceptible population.

Let x be the number of people attacked, or otherwise rendered insusceptible during an epidemic.

And let n be the cycle of an epidemic.

To find n.

After an epidemic, the susceptible $= p$.
Next year " " $= p+r$.
" " " $= p+2r$.
When epidemic comes " $= p+nr$.
After epidemic gone " $= p+nr-x$
But this $= p$.

$$\therefore\ nr = x;\ \text{and}\ n = \frac{x}{r}.$$

On this rule, take the case of scarlatina (always present and waiting to be epidemic until accumulation of nr over and above p has taken place, and let us suppose ourselves concerned with a community of 1,000, of whom a guished from extraneous conditions presumably operative in determining the periodicity. Thus, after the year 1840, the fluctuations of small-pox in the metropolis were observed to have a close relationship with the fluctuations in quantity of unvaccinated children—so close, indeed, that the periods of recurrence of epidemic small-pox could be pretty certainly forecasted; but in 1871, when one of the periods of epidemic increase arising from an accumulation of unprotected individuals was due, some other undetermined condition concurred and gave to the epidemic of that and the following year a character which had not been observed in small-pox since the general introduction of vaccination. The usual histories of epidemics are almost valueless for scientific purposes: they do not discriminate those outbreaks which are essentially of a local nature, and dependent chiefly upon the state of a particular place and population, from those which are governed by more widely operative influences. In England the data available for such determination do not exist for more than forty years. Previous to the compulsory registration of deaths, and for a short time afterwards, the records of the causes of death (which can alone at present be applied to the purpose) were too imperfect to be made use of, and the popular accounts of the recurrence of maladies were untrustworthy. From the Registrar-General's Reports, for the 28 years 1850–77, it may be inferred that *small-pox* was epidemic in 1850–52; 1858; 1863–65; and in 1871–72. *Measles* in 1851; 1854; from 1858 to 1863; in 1866; 1868; and 1874. *Scarlet Fever* in 1857–58; 1863–64; 1868–70; and in 1874. *Diphtheria* from 1859 to 1866. *Whooping Cough* in 1850; 1854–55; 1857–58; 1861–63; 1866–67; and 1872. '*Fever*,' from 1851 to 1855; in 1857–58; from 1862 to 1866; and in 1868. *Erysipelas* from 1850 to 1856; 1858–59; 1864; and 1874–75. *Puerperal Fever* in 1864–65; and from 1870 to 1876. *Dysentery* from 1850 to 1859. *Diarrhœa* in 1852; 1854; 1857; 1859; 1865; 1868; and 1870–71; the mortality from this cause being moreover in excess throughout the whole period 1867–74.

With regard to cholera and 'fevers' it must here be noted that Robert Lawson holds, from a widely-extended range of observation, that a series of fluctuations may be distinguished in the prevalence of cholera and 'fevers' following in regular sequence at intervals of two years. These fluctuations are common to both hemispheres, and as they appear to move from east to west, he has designated them '*pandemic waves*.' These waves have a definite relation, he believes, to the magnetic isoclinal lines, and he has laid down rules for determining their position at any time. (*Trans. Epidemiological Society of London*, vol. iii. p. 216.)

The facts relating to the secular evolutions of diseases are amongst the most interesting, if the most lugubrious, in the history of the human race. Although their too-frequent obscurity and their extreme complexity have hitherto interposed an insuperable barrier to the construction of a general doctrine regarding their occurrence, it is not the less necessary that they should receive attention. Here it is possible only to note some of the more salient indications of secular periods of morbid evolution. The following illustrations (chiefly according to Anglada) may be mentioned:—

(*a*) The great pestilence of the 5th century before Christ, of which the so-called 'plague of Athens,' as described by Thucydides, was an incident.

(*b*) The pestilences of the 2nd and 3rd centuries of the Christian era, which are believed to have been of the same nature as the pestilence of the 5th century B.C. After the 3rd century this form of pestilence disappeared from history.

(*c*) The explosion of bubonic (inguinal) plague in the 6th century after Christ, when, for the first time in history, this formidable disease assumed the epidemic character which it maintained to the early part of the present century. Breaking out in the reign of Justinian (A.D. 542), the disease quickly occupied the whole of the then known earth, and began a tragic course which has continued even to our own time. For twelve hundred years it had held a pre-eminence among pestilential maladies, sometimes more, sometimes less prevalent, but at all times deadly. In the 16th century, when quarantine was established (*see* QUARANTINE), 69 outbreaks of the disease were recorded in Europe, of which five happened in England; in the 17th century, 56, six in England; in the 18th century, 28, none in England; and in the first half of the 19th century, 15. In the 17th century, the area of prevalence of the disease began to decrease. This decrease went on progressively throughout the 18th and the commencement of the 19th centuries, the latest outbreaks of the malady, however, being not less fatal than the earliest; and in 1844 it apparently became extinct. But about ten years afterwards the disease again showed itself in the Levant, and from that time to the present scattered circumscribed outbreaks have occurred in Western Arabia, (1853, 1874, and 1879), North

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certain number are insusceptible, and another number (p, it does not at present matter what number) are susceptible:—then

let $r=2$ (births − deaths yearly, &c.);

and let $x=10$ (attacks in an epidemic, probably about one death);

then $n=\frac{x}{r}=5$ years as the cycle of epidemic recurrence.

Now, in the same community, with the same r, let x be greater than in another otherwise similar community (*i.e.*, when the epidemic comes it attacks more people, making them insusceptible); the interval between successive epidemics will also be greater; thus if $x=20$, $n=10$ years, and so on. On the other hand, if r be larger (either through large birth-rate or other immigration of susceptible persons) while x is constant: the interval between successive epidemics will be less; thus, if $x=10$ and $r=3$, $n=3\frac{1}{3}$ years, and so on.

So, again, fluctuations in the amount of p (from whatever cause arising) will make a difference in the quantity $p+nr$, the number requisite for the appearance of an epidemic; and the interval between successive epidemics can be altered in this way as well as by change in n or r.

Take now the case of an epidemic influence needing to be introduced from without, and supposing the degree of its intensity not to vary; with this alteration of hypothesis the cycle of an epidemic will not be less than the time n, but may be indefinitely greater, owing to the requisite introduction not taking place.

It is easy, in these considerations, to find reasons for differences in epidemic cycles among different communities, for differences in the intensity of successive epidemics, and for apparent alterations of susceptibility among communities. And these reasons will deserve to be considered before going in search of other reasons.

Africa (1855–59 and 1874), Mesopotamia (1867 and 1873–77), Persia (1863, 1870–71, and 1876–77), and after an absence of thirty-six years from Europe in the province of Astrakhan, Russia (1878–79). Here, then, we appear to have records of one complete secular evolution of plague, and to be witnessing the beginning of another.

The 6th century most probably also gave birth to or determined a new phase of activity in small-pox, measles, and even scarlatina, as great epidemics.

(*d*) The gangrenous pestilence of the middle-age (10th, 11th and 12th centuries), a disease long extinct.

(*e*) The *black-death* of the 14th century, a disease held by the most competent writers to differ essentially in nature from bubonic plague, and long extinct—unless, indeed, according to some writers, the Pali plague of India is to be regarded as the dregs of the *black-death* of the 14th century. *See* PLAGUE.

(*f*) The *sweating sickness* of the 15th and 16th centuries, which, born towards the close of the former century, after five visitations (1485–86, 1507, 1518, 1529, and 1551) disappeared, about the middle of the latter century.

Also, the great epidemic of *syphilis* of the 15th century.

(*g*) The *choleraic pestilence* of the present (19th) century.

(*h*) The exceptional development of fatal *diarrhœa*, especially of *infantile diarrhœa*, in this century.

(*i*) The occasional extension of the *yellow fever* of the tropics into Europe, notably at the beginning of the present century.

(*j*) The great development of *diphtheria*, a disease that had been well-nigh forgotten, within the past thirty years.

(*k*) The appearance within recent years of *cerebro-spinal fever*.

In these phenomena we have evidence of secular pathological changes, to which a clue is sought in studying their relation with secular meteorological and telluric changes. In the epidemics of short recurring periods—the lesser epidemics, so to speak—it is becoming possible to construct a theory of recurrence, founded on the relationship of man to his physical and social surroundings, and the periodical changes which he and they undergo in common and in subordination to the periodical changes observed in Nature at large, and when the disease is communicable in relation to the number of susceptible people among a community. In the epidemics of long-recurring periods—the greater epidemics—the same conditions obtain; but it would appear as if there were in addition some slowly-developed cumulative influences at work, which manifest themselves only after long intervals of time. So far as these influences may consist in meteorological changes we look principally to India, where these changes are more uniform in their occurrence, for the earliest clear light on the subject. There, for example, cholera is constantly present—now as a disease endemic to a particular region, now as a wide-spread epidemic within the limits of the peninsula, but ever and anon breaking its bounds and spreading pandemically throughout the world. James L. Bryden, M.D., has shown that the different developments of cholera within the boundaries of India have very definite relations to particular meteorological phenomena; and it seems not unreasonable to suppose that, following the line of research inaugurated by him, in progress of time it will become possible to discriminate between the meteorological changes which determine or concur with epidemic prevalence of the disease within India, and those which determine or concur with wider extensions of the malady—such as affected Europe in 1829–37, 1847–50, 1852–56, 1865–67, and 1869–73. Blandford's meteorological researches promise much help in this direction, inasmuch as they are tending to show a close relation between the greater cycles of meteorological change in India and cycles of meteorological change in the sun's atmosphere, particularly as observed in the sun-spot period.

It might here be added that the late researches of Crudeli and Klebs on the development of the *bacillus malariæ* in the blood in intermittent fever, and the well-known observations on the appearance and disappearance of the spirillum in relapsing fever, seem to suggest a connection between the periodical character of these diseases and the life-cycle of these organisms.

J. NETTEN RADCLIFFE.

PERIOSTEUM, Diseases of. *See* BONE Diseases of.

PERIPHERAL (περὶ, around, and φέρω, I carry).—Of or belonging to the periphery or circumference, as opposed to the centre. The term is now applied chiefly to morbid conditions connected with nerves or their terminations, as distinguished from those situated in the nerve-centres, for example, *peripheral paralysis*, *peripheral pains*. Peripheral may also be associated with the vessels, as distinguished from the heart, for example, *peripheral resistance*; and with the outer zone of the lobules of glandular organs, as, for instance, of the liver.

PERIPNEUMONIA NOTHA (περὶ, around, πνεύμων, the lungs, and νόθος, false).—An obsolete term, which was formerly vaguely applied to a variety of forms of acute inflammation of the bronchi and lungs.

PERIPROCTITIS (περὶ, around, and πρωκτός, the anus).—DEFINITION.—Inflammation of the tissues surrounding the rectum.

The lumen of the rectum is normally, except in the act of defæcation, obliterated by the mucous membrane being thrown into folds from contraction of the muscular coats of the bowel; so that a transverse section of it in this state would present the appearance of a solid oval, with the long diameter transverse. During defæcation the bowel is distended by the passage of fæces, and in persons subject to constipation or flatulence this distension is often found considerably increased by accumulations of fæces or of flatus. The rectum is, in order to admit of this mobility, surrounded by a considerable quantity of loose cellular tissue, which below passes by direct continuity into the masses of adipose tissue which fill the ischio-rectal spaces.

In consequence of the dependent position, the comparatively great exposure to injury, the vascularity and the liability to congestion from the junction of the portal and systemic venous systems, this cellular tissue is very liable to inflammation, which usually goes on to suppuration.

Periproctitis may be either *acute* or *chronic*.

ÆTIOLOGY.—*Acute* inflammation around the rectum may be of traumatic origin. Unskilful catheterisation in the male subject, by which the point of the catheter is forced through the urethra into the space between the bladder and rectum; penetrating wounds of the bowel, caused by instruments, such as injection-tubes, stricture-dilators, &c., or by foreign bodies introduced by patients themselves, or by sharp substances, such as fish-bones, which have been accidentally swallowed; gunshot wounds of the part; penetrating wounds, caused by falls on sharp substances; or even contusions, the result of falls or kicks, may set up such inflammation. Or it may be the result of extension of inflammation from surrounding parts. Thus prostatitis, cystitis, pericystitis, ulceration in the membranous portion of the urethra, sloughing ulceration of the vagina, and the various kinds of ulcers in the rectum, may be the exciting cause. If perforating ulcers be the cause, so as to lead to extravasation of urine or fæces, the inflammatory process is very severe. In some rare cases no exciting cause can be traced, and such cases are known by the misleading name of 'spontaneous periproctitis.'

Chronic periproctitis always results from the extension of inflammatory processes from neighbouring parts. Disease of the sacrum, coccyx, or lower lumbar vertebræ, or chronic disease of the pelvic viscera, often leads to it. It is characterised by considerable infiltration and thickening of the cellular tissue, as well as by suppuration. Pyæmia resulting from ligature of hæmorrhoids may be attended by abscesses in this tissue; which also, though very rarely, have been found in pyæmia from other causes.

SYMPTOMS.—In acute cases the patient complains of a feeling of weight in the part, and of pain, which is much greater during defæcation. As the thickness of the integument in this region, and the fasciæ of the part retard the pointing towards the surface, extensive mischief may exist with little external sign. Hence the importance in all suspected cases of careful digital exploration of the rectum, by which local tenderness, increased temperature, and either hardness or fluctuation, according to the stage of inflammation, may be detected. In chronic cases the symptoms are usually masked by those of the exciting cause.

TREATMENT.—In all cases accumulation of fæces in the rectum must be prevented by the use of simple enemata; whilst in acute cases early surgical interference is imperatively required. In other cases, the exciting cause must be discovered and treated according to circumstances. JEREMIAH MCCARTHY.

PERITONEUM, Diseases of.—The peritoneum is by far the most extensive serous membrane in the body, while it has numerous folds and attachments, and is in relation with several organs and structures, so that the consideration of its diseases, though similar in their nature, is a much less simple matter than in the case of the other membranes of this class. It must also be remembered that in the female the peritoneal cavity is in direct communication with the uterus, through the Fallopian tubes. The morbid conditions of the peritoneum may be discussed according to the following arrangement:—

1. Peritoneum, Acute Inflammation of.—SYNON.: Acute Peritonitis; Fr. *Péritonite aiguë*; Ger. *Acute Bauchfellentzündung*.

ÆTIOLOGY AND PATHOLOGY.—Acute peritonitis may arise under several conditions, which can be conveniently included under certain heads.

a. Traumatic.—It was formerly believed that any kind of injury to the peritoneum was highly dangerous, and would lead almost inevitably to inflammation. Not only, however, may it be punctured with an aspirator or trochar without any harm resulting, but it may even be freely opened and manipulated, under proper conditions, without any injurious effects, as is constantly exemplified in the operation of ovariotomy, and in performing abdominal section for various other purposes. At the same time a very slight operation affecting the peritoneum may lead to serious or even fatal peritonitis, especially in certain states of the system, or if septic matters are introduced into its cavity. Penetrating wounds of the abdomen are very likely to be followed by peritonitis, but not necessarily. The rupture by violence of an abdominal organ will also lead to this result, should the patient survive long enough, from the escape either of blood, or of the contents of a hollow viscus. Peritonitis has been attributed to a mere contusion over the abdomen. When it arises from a wound, it is probably not the simple injury to the peritoneum that causes the lesion, but its exposure to the air, the introduction of septic matters, or hæmorrhage into the peritoneal sac.

b. Perforations and Ruptures.—In addition to lesions due to injury, there are several other kinds of perforation and rupture which are liable to give rise to peritonitis. These have been discussed at length in a special article (*see* PERFORATIONS AND RUPTURES), and it will suffice to mention here, that acute peritonitis may follow either of the following forms of perforation or rupture, if they do not prove fatal too speedily:—(i.) of hollow viscera, with escape of their contents; (ii.) of solid organs which have become so softened as to give way; (iii.) of cystic or other localised accumulations of fluid; (iv.) of collections of pus in connection with any structure within the abdomen, even the peritoneum itself, or in the abdominal wall; (v.) of an aneurism; (vi.) of a dilated receptaculum chyli; (vii.) of fluid accumulations within the chest, which have burst through the diaphragm into the abdomen, such as empyema, pulmonary abscess, or a hydatid cyst. The peritonitis depends mainly on the materials which thus gain access into the peritoneal sac, whether gaseous, liquid, or solid, and which irritate it more or less according to their nature. Urine is one of the most virulent of such materials; and unhealthy pus or gangrenous particles are also highly injurious. The nature of the irritant will also materially influence the kind of peritonitis which is set up.

c. Direct irritation of the peritoneum.—This is a common source of peritonitis, and the irritation may be *general*, affecting more or less the whole peritoneum; or *local*. Thus it is supposed that *general* irritation may result from distension of the peritoneal sac in cases of ascites; and certainly from extensive morbid deposits, such as cancer or tubercle. *Local* irritation may be excited by many different conditions, including mere mechanical pressure or friction, as from a tumour, an enlarged cancerous organ, or an accumulation in the bowels; as well as localised inflammation, suppuration, ulceration, or gangrene. A very severe form of peritonitis is liable to be set up by a strangulated hernia or certain forms of acute intestinal obstruction; and this complication has also to be borne in mind as a result of mere local irritation in typhoid fever, and in dysentery. In some instances a minute and careful search has to be made for the source of irritation before it can be discovered; for instance, it may be merely a suppurating absorbent gland, deeply situated. Peritonitis thus originating may be limited, or may spread universally, this depending very much on the nature of the irritant. Extension is due either to the products of inflammation passing along the sub-serous cellular tissue, or being conveyed by the absorbent vessels.

d. Extension.—Besides the extension of peritoneal inflammation from a local irritation, it now and then happens that pleurisy or pericarditis, especially if of a septic nature, spreads through the diaphragm to the peritoneum, probably by means of the system of lymph-canals existing between the serous membranes and the diaphragm. Inflammation may also pass along the Fallopian tubes directly from the uterus to the peritoneum. In this connection it may further be mentioned that infectious emboli in branches of the abdominal aorta have given rise to peritonitis; which has also been attributed to phlebitis and peri-phlebitis, extending from the umbilical and spermatic veins.

e. Secondary.—This term refers to cases of peritonitis originating as a complication or local manifestation of some general condition. Under such circumstances the disease usually results from a morbid or poisoned state of the blood—especially when it contains products of excessive tissue-change as in low fevers, abnormal materials, or infective agents. Other causes may, however, assist in its development. The most important diseases in which secondary peritonitis occurs are Bright's disease; septicæmia and pyæmia, to which puerperal peritonitis probably belongs; erysipelas, small-pox, glanders, and other diseases of this class; and perhaps acute rheumatism and gout. It has also been said to follow scurvy; but in a large number of cases of scurvy, which have come under the observation of the writer, peritonitis never occurred.

f. Idiopathic.—Occasionally cases of peritonitis occur, which cannot be referred to any of the recognised causes. These have been called *idiopathic*, and have been attributed to exposure to cold, excessive eating or drinking, and various other causes in individual instances. Many authorities, however, doubt their reality.

g. Contagion.—Peritonitis may be originated by contagion, when of the puerperal variety, and may thus become epidemic.

Peritonitis in Females.—A few special remarks are called for on this point. Peritonitis is much more common in females than males, on account of the relation of the peritoneum to the uterus, and the various conditions connected with the genital organs and functions which are liable to affect it. The following are the principal of these conditions to which peritonitis has been referred:—(1) the uterine congestion attending menstruation, aided by the effects of cold, especially if this should give rise to inflammation of the womb; (2) the puerperal state and its accidents, puerperal peritonitis being a most important form of the disease, which is discussed separately; (3) premature delivery, and especially the use of instruments in procuring abortion; (4) extra-uterine pregnancy; (5) local diseases, such as inflammation of the substance of the womb or its lining membrane, or in the vicinity of the organ; ovaritis; uterine or ovarian tumours; peri-uterine hæmatocele; and inflammation or ulceration of the Fallopian tubes; (6) gonorrhœal inflammation spreading upwards; and (7) injections into the cavity of the uterus.

Predisposing Causes.—In addition to sex, age has to be regarded as a predisposing cause of peritonitis. It is very rare in children, except in new-born infants, in whom it occurs comparatively frequently, either from inflammation or mortification of the umbilicus, or umbilical hernia; or as the result of infection from the mother. The affection is said to be not uncommon in the fœtus, causing its death. In children peritonitis is usually associated with the acute exanthemata or pyæmia, even sometimes following vaccination; but it may also be due to tubercular disease or intus-susception, and in very rare instances has been traced to an undescended testis, or to injury in administering an enema. Peritonitis is predisposed to by previous attacks; and, it is said, by accumulation of fæces, and excessive use of strong purgatives habitually. Chronic renal disease may be regarded as a powerful predisposing, as well as an exciting cause of the complaint, a very slight irritation readily setting it up when this affection is present.

Anatomical Characters.—The pathological changes in peritonitis present much variety under different circumstances, as regards their nature, progress, and extent; and although they resemble in a general way those observed in other serous inflammations, they exhibit in most cases distinguishing peculiarities of a striking kind.

In the early stage increased vascularisation is always noticed, but it may subside at a later period, or be obscured by the inflammatory products. There is capillary injection more or less diffused, the vessels being enlarged and elongated. This is often very marked, giving rise to intense redness, frequently not uniformly distributed, but being especially observed where coils of intestine touch each other, and at the starting-point of the inflammation in certain cases. Small extravasations of blood are not uncommon, and may be numerous.

The products of the inflammatory process are very variable, as regards both their nature and amount. In certain cases they consist almost entirely of a fibrinous exudation or organisable lymph, with a very little serum, often more or less tinged with the colouring matter of the blood, and containing flakes of lymph—*adhesive peritonitis.* The lymph is of a yellowish-grey colour, and at first very soft and easily separable, but afterwards it tends to become firmer and more adherent. It is deposited as a film, which becomes thicker by degrees, and may attain considerable thickness. Usually the exudation forms a continuous layer, though of unequal thickness, but occasionally it occurs in separate patches. It mats together loosely, or more or less firmly, the coils of intestines; and covers the solid viscera, where it tends to attain a greater thickness. The subsequent progress of this form of peritonitis in cases of recovery is towards organisation of the lymph, and the formation of thickenings, bands of adhesion, and agglutinations, which may lead to grave consequences.

In a small proportion of cases of acute peritonitis a fluid effusion constitutes the principal morbid product, varying in quantity, but it may become so abundant as to distend the peritoneum to an extreme degree. There is a little deposit of fibrinous exudation. The effusion may be mere serum, resembling dropsical fluid, and, indeed, some writers have regarded certain cases usually looked upon as those of ascites, as being really of inflammatory origin; while ascites may excite peritonitis, and thus lead to an admixture of inflammatory effusion. In other cases the fluid is sero-fibrinous, being spontaneously coagulable, and greenish-yellow, or turbid or milky; while flakes or larger fragments of lymph float in it. In this condition there is often much fibrinous deposit. If the fluid is absorbed, adhesions will subsequently form.

In the majority of cases the products tend to be of a lower type than those thus far described. The exudation is frequently soft and non-organisable, or sometimes greasy in appearance; not uncommonly it is greenish-yellow, and infiltrated with pus-cells. The fluid is also sero-purulent or actually purulent. It may be thick, laudable pus; or more liquid and unhealthy-looking; or discoloured, and more or less offensive and foul-smelling; or mixed with blood in various proportions, especially in scurvy and low fevers. The pus collects mainly in the pelvis as a rule; but collections of it are also found between the coils of intestine, and in other parts, pent up by lymph or adhesions, which look like abscesses, and may be of some size. These collections sometimes give way, and thus set up secondary peritonitis. In exceptional cases purulent peritonitis becomes chronic, and accumulations of pus burst externally or into the intestines. In rare instances a gelatinous or colloid material constitutes the effusion in peritonitis.

With regard to obvious changes presented by the peritoneum and sub-peritoneal tissue, there may be none, when the lymph is separated, the peritoneal surface being normal. In other cases it is dull, lustreless, swollen, softened, and œdematous, as well as the subserous tissue, so that the serous covering can be easily torn off from the organs. Occasionally the structures are infiltrated with actual pus; and under certain circumstances localised gangrene occurs at one or more spots.

The microscopic changes and appearances differ in the several conditions indicated, but it must suffice to state that they are similar to those observed in other forms of serous inflammation, such as transudation from the vessels; migration of corpuscles; separation of, changes in, and proliferation of the endothelial cells; proliferation of the connective-tissue corpuscles; and the formation of vascular granulations. The proportion of cells, and their vitality, differ very much in the several kinds of exudation. The changes which take place in the formation of adhesions and allied conditions are also like those noticed in other serous membranes. *See* SEROUS MEMBRANES, Diseases of.

In certain forms of acute peritonitis foreign materials of different kinds are found in the peritoneal sac. Fœtid gas may be present, either from decomposition of inflammatory products, from transudation through the intestinal walls, or from perforation. The last-mentioned cause also accounts for the presence of foreign bodies, the contents of the stomach or intestine, worms, bile, gall-stones, urine, and other materials which have set up the peritonitis.

The muscles of the abdominal wall are often found more or less softened, pale, and degenerated in severe cases of peritonitis. The intestines are almost always distended with gas, in some cases to an extreme degree, so that they protrude when the abdomen is opened. Their walls are infiltrated, œdematous, and softened; and the mucous layer can be readily separated. The stomach is usually small and more or less contracted, being covered by the intestines. The liver and spleen are often pale, or discoloured to a slight depth.

The morbid appearances in acute peritonitis may be more or less *general* or *diffuse*, the whole extent of the membrane, however, being rarely involved; or *local* or *circumscribed*, the latter being due to some local irritation, and not spreading, either owing to the nature of the inflammation, or because it is prevented by adhesions. It may lead either to a local formation of lymph, as over the liver or some other organ; or to a circumscribed collection of pus, which becomes practically an abscess, and may burst in various directions according to its seat. Some local varieties of peritonitis have received special names, such as *pelvic*, *parietal*, *omental*, *hepatic*, *nephritic*, and *vesical*.

It must be remarked that special care is required in making a post-mortem examination in cases of acute peritonitis, as in many forms of the disease the products are extremely virulent, and cause dangerous or fatal septicæmia if introduced into the system in the smallest quantity. Moreover, in some forms infection is very liable to be conveyed to other persons, and extreme precautions are demanded in this matter in dealing with women in the puerperal state.

SYMPTOMS.—The fact must be clearly recognised at the outset that the clinical history of acute peritonitis varies considerably in different cases, according to its immediate cause, the condition with which it is associated, its seat and extent, the course which the inflammation takes, the products which it originates, and other circumstances. So far as the peritonitis is concerned, the phenomena to be anticipated are *local* and *general*. The *local* phenomena are due to the inflammation itself; to its products; and to its direct effects upon abdominal organs and structures, especially upon muscular tissues, which it first irritates and then paralyses. They may be further subdivided into *abdominal* and *thoracic*. The *general* symptoms are either of a febrile character; or depend upon the absorption of purulent or septic matters formed in the peritoneum; or are indicative of collapse. It will be expedient, in further discussing this subject, to indicate first the usual clinical course and phenomena of acute peritonitis; and then to point out the more important clinical varieties of the disease.

The *invasion* is usually distinct, being indicated by shivering or actual rigors, which may be repeated several times. If the peritonitis is due to perforation, however, the phenomena attending this lesion constitute the initial symptoms, but even here rigors not uncommonly occur subsequently. The local and general symptoms characteristic of peritonitis speedily supervene.

Local symptoms.—Pain is one of the most constant and striking symptoms of acute peritonitis, and it comes on very speedily, or in certain cases may even precede rigor. It depends directly on the inflamed condition of the peritoneum. As a rule it commences locally, and especially in the lower part of the abdomen, but it rapidly spreads more or less extensively, being often felt over the whole abdomen, though not uncommonly more marked in one or more spots, such as where the inflammation started from, and also in the umbilical region. This may depend upon greater intensity of the inflammation at these points. The pain is usually exceedingly severe and intense, and it may be excruciating or agonising, as evidenced in the expression of the patient's face. In character it is variously described as hot, burning, cutting, boring, shooting, darting, and so on. From time to time exacerbations are liable to occur, owing to spasmodic movements of the intestines disturbing the inflamed structures. Any movement of the body increases the suffering, so that the patient instinctively keeps the trunk at rest, and assumes a characteristic posture, so as to relieve all abdominal tension, namely, lying on the back, with the thighs and knees flexed, and the legs drawn well up. Moreover, abdominal respiration is restrained or entirely checked, as the necessary movements increase the pain; which is also aggravated by any such disturbance as the act of coughing, vomiting, or defæcation causes. At the same time there is the most exquisite tenderness, so that the patient dreads any objective examination, and cannot bear the least touch, though deeper pressure is still more unendurable. In some cases even the weight of the bed-clothes cannot be tolerated.

Prominent symptoms occur in connection with the alimentary canal. The appetite is completely lost, but there is intense thirst. The tongue is furred, and often presents a peculiar appearance, being very small, red, and irritable-looking, and soon tending to dryness. The taste is affected, and becomes bitter or otherwise disagreeable, or even disgusting. Nausea and vomiting are usually urgent symptoms, and, as a rule, set in very early. Vomiting occurs when anything whatever is taken, and even spontaneously, while there is a constant feeling of sickness. At first the vomited matters consist of mucus and altered food; subsequently they present a grass-green appearance; or under certain circumstances they may become fæculent, even quite apart from intestinal obstruction. Gaseous eructations are also common. Obstinate constipation is the rule in acute peritonitis, but exceptionally diarrhœa occurs. At first the intestinal walls are more or less spasmodically contracted, but they soon become paralysed, so that they are distended to a variable degree with gas, and this frequently culminates in extreme tympanites or meteorism. During the development of this symptom, irregular and inefficient peristaltic movements of the bowel often occur, or certain parts are more distended than others, and these conditions may be seen or felt, while they give rise to audible rumbling or gurling sounds or borborygmi. The rapidity of the distension of the abdomen will depend much upon the previous condition of the abdominal walls, as to whether they are firm or lax and yielding; and upon the rapidity with which their muscles become paralysed.

The only other notable local symptoms in the abdomen are referable to the urinary organs. The urine not only presents febrile characters, but is usually markedly diminished in quantity, and may even be suppressed. What is passed is often hot and scalding. Micturition may at first be very frequent, owing to irritation of the bladder; subsequently retention is liable to occur, owing to paralysis of this organ. The urine is not uncommonly albuminous.

Jaundice is now and then observed in cases of acute peritonitis.

The *thoracic* symptoms which may result from the local effects of acute peritonitis are hiccough, which is in many instances very distressing; the form of dyspnœa in which the respirations are very hurried—reaching 40, 50, 60, or more—shallow, superficial, and costal; sometimes cough, although the patient makes every effort to suppress it; and cardiac disturbance, the action of the heart becoming very rapid. The disorder of the respiratory and circulating functions is partly due to the general condition, but they are also locally influenced by the pain accompanying peritonitis; by its direct effects upon the diaphragm; and by the mechanical effects of gaseous or fluid accumulations upon the diaphragm and thoracic contents. Moreover, morbid conditions within the chest may be associated with peritonitis, such as pleurisy, pneumonia, or pericarditis.

Physical signs.—The conditions resulting from peritonitis give rise to certain physical signs, which need to be briefly indicated. It must be remembered that in this disease physical examination ought to be practised most gently and cautiously. The causes of the abnormal physical signs are the pain; the distension and other disorders of the intestines; and the presence of inflammatory products or of other materials in the peritoneal cavity. 1. The abdomen at an early period of the case may be slightly depressed, owing to tension of the muscles, but soon becomes more or less enlarged, and often attains a great size, the skin being stretched, and the lower part of the chest also distended. Generally the enlargement is quite symmetrical, but not always. A transverse groove is sometimes visible, passing across the epigastrium. In very muscular individuals the abdomen may be but little enlarged in peritonitis. 2. There is marked absence of diaphragmatic respiratory movements, and these movements as a whole are restricted. The lower intercostal spaces do not fall in during inspiration. Very rarely a friction-fremitus may be felt in some part of the abdomen when a full breath is taken. 3. Intestinal movements are often seen or felt. 4. Palpation reveals that the abdomen is smooth and regular; at first the muscles are felt to become as it were instinctively contracted when palpation is practised; subsequently the sensation is usually that of more or less tympanitic or drum-like tension. There are exceptional cases in which it is that of fluid. 5. Percussion usually yields chiefly a more or less tympanitic sound, though not necessarily uniform in tone and pitch over the entire abdomen. The hepatic and splenic dulness are diminished or completely annulled, even though there be no gas in the peritoneum itself. A small quantity of fluid cannot be detected, or only by careful examination in certain postures (*see* ASCITES), and it is usually hardly worth while in cases of peritonitis to disturb the patient for this purpose. Generally the dulness due to fluid can be elicited in dependent parts of the abdominal cavity, being as a rule distinctly movable with change of posture. It is said that the line of demarcation between the dulness and tympanitic sound is found to be zigzag when carefully percussed out, owing to the fluid getting in between the loops of intestine. In exceptional cases of acute peritonitis the dulness of fluid is the main percussion-sound noticed. Fluctuation will be present where there is fluid, but it is not a very reliable sign in acute peritonitis. 6. Auscultation, as a rule, merely reveals, if anything, sounds of the movements of flatus in the stomach and intestine; or succussion-sounds, due to the shaking up of fluid and gas in these organs. Friction-sound is for several reasons a rare phenomenon, but may occasionally be heard over some spot if the patient can be made to breathe sufficiently deeply, mainly over a solid organ, and especially the liver. 7. Examination of the chest often reveals more or less compression of the lower parts of the lungs; and displacement of the heart upwards and towards the left.

General symptoms.—Pyrexia usually speedily sets in in acute peritonitis, but in certain cases there is no rise of temperature throughout. While presenting considerable differences, as a rule the temperature rises markedly at an early period, and continues high for a time, though generally with remissions, having, however, no regular course. There are the usual accompaniments of fever; and the urine is markedly febrile, being concentrated, high-coloured, and depositing urates abundantly. The pulse becomes very frequent, reaching 120, 140, or even 160; it is also small, sharp, and often peculiarly hard, wiry, or thready. The increased rapidity of breathing is partly due to pyrexia. The patient soon presents an aspect of serious constitutional disturbance; the expression of the face is one of pain and grave anxiety, and the features are sunken, pinched, and withered. There is much debility or actual prostration, while at the same time the patient is generally uneasy and restless, tossing the arms about, but keeping the trunk motionless. A more or less cyanotic appearance may be evident. There are usually no prominent nervous symptoms at first, except, perhaps, headache and sleeplessness. The intellect generally remains clear to the last, and it occasionally happens that the supervention of peritonitis rouses a patient whose consciousness has been previously more or less blunted. In exceptional cases delirium or impaired consciousness are early symptoms. The further progress of the general symptoms will be indicated under the following heading.

COURSE AND TERMINATIONS.—The large majority of cases of acute peritonitis terminate fatally, and usually within a few days, the progress being rapid. It is important to notice that the patient may feel better, and that the pain often diminishes or even subsides, sometimes suddenly, while the general condition is becoming worse and worse. The tympanites may also become less, or disappear. Sometimes before the close an abundance of dark, blood-stained fluid is discharged from the stomach and bowels, without any effort. Death may occur while the pyrexia is still high; but usually the phenomena observed become those of collapse, combined with signs of impaired respiration and stagnant circulation. The patient is greatly prostrated. The countenance assumes more and more the aspect of collapse, the eyeballs appearing sunken and surrounded with dark areolæ, the cheeks hollow, and the features markedly pinched, with blueness of the lips; the expression is that of extreme anxiety. The temperature falls, and often becomes sub-normal; the extremities are cold; and the skin is covered with clammy sweats, while the prominent parts are peculiarly cold and blue. The pulse becomes extremely rapid; feeble, sometimes to complete extinction; and irregular. The respirations are very hurried and shallow; and the voice is weak or lost. As already stated, the mind generally remains clear to the last; but in some cases the mental faculties are somewhat obscured towards the close, and delirium of a low type occurs; occasionally a comatose condition supervenes. In some instances the symptoms become those of the typhoid state.

Acute peritonitis occasionally subsides into a chronic condition, in which localised accumulations of fluid remain, and the patient lingers on, the temperature continuing elevated, but presenting irregularities. Different events may then occur, such as bursting of fluid-collections in various directions, the supervention of septicæmia or pyæmia, or general wasting and anæmia, death ultimately taking place after a variable interval.

Recovery ensues in a certain proportion of cases, where the inflammation has not been extensive, and where its products are either fibri nous or sero-fibrinous. Improvement is indicated by a concomitant diminution of the abdominal symptoms; restoration of the action of the bowels; sometimes an increase in the quantity of urine; a change in the aspect and expression of the patient; increased fulness and force of the pulse, and diminution of its frequency; a gradual fall of temperature; restoration of sleep; and sometimes the occurrence of perspiration. It is said that occasionally a *crisis*, with critical discharges, occurs, but this is quite exceptional, the decline of temperature being usually by *lysis*. After apparent recovery from acute peritonitis the effects of adhesions may prove serious.

Clinical Varieties.—It will only be practicable to indicate here the most striking of the clinical variations presented by cases of acute peritonitis. Two special forms are described in separate articles. *See* Puerperal Diseases; and Pelvic Peritonitis.

(*a*) **Peritonitis from Intestinal Obstruction.**—Here the symptoms of the obstruction are the most prominent, and the peritonitis only modifies them, and helps to hasten the fatal issue, which is mainly due to the intestinal condition. It is in these cases that the movements of the bowels are most evident, and the meteorism is extreme. The temperature may continue normal or even sub-normal throughout. The course is usually very rapid.

(*b*) **Perforative.**—When general, this is an intense and very fatal form of peritonitis, and usually runs its course very speedily, especially if highly irritating materials gain access into the peritoneum. Usually it is distinctly preceded by the characteristic symptoms of the perforation; or some condition is present in which a perforation may be anticipated. Therefore, if rigors occur, they follow a sudden local pain, which spreads rapidly over the abdomen. The local symptoms are extremely marked, and the vomiting is likely to be most violent, except, it is said, in those cases where the stomach itself is the seat of a large perforation. Moreover, there may be signs of gas in the peritoneal cavity (*see* **Peritoneum, Gas in**). The symptoms of collapse are evident from the first, and quickly become aggravated. The temperature is often below the normal. Should the perforation take place into a limited portion of the peritoneum, the symptoms are correspondingly limited, and less severe.

(*c*) **Adynamic or Typhoid.**—Cases of peritonitis may be thus grouped which exhibit a disposition to the rapid development of adynamic or typhoid symptoms. These may depend upon the condition with which the peritonitis is associated; or upon septicæmia or pyæmia, arising from the absorption of inflammatory products from the peritoneum. In some of these cases the local symptoms are not so evident, and may be quite latent.

(*d*) **Latent.**—This term implies that the characteristic symptoms of peritonitis are either altogether absent, or so indefinite as to be practically valueless for diagnostic purposes. Such may happen in cases belonging to the adynamic group, where the patient's consciousness is so impaired that he cannot feel pain; but even then pressure over the abdomen may bring out indications of pain, if carefully watched for. For some latent cases of acute peritonitis, of which the writer has seen a striking instance, no explanation can be given. To this class may also be referred those cases where it is really difficult to draw the line between mere ascites and peritonitis with abundant fluid effusion.

(*e*) **Infantile.**—This has been described as a variety of peritonitis. In young infants pain and tenderness in this disease are indicated by the expression, and by a short cry or whine. They do not cry loudly, on account of the pain thus caused. The abdomen is greatly distended with flatus. Vomiting is less common in children than in adults. Pyrexia is usually considerable at an early period; and the pulse becomes extremely frequent, even uncountable. Occasionally convulsions occur. The course is very rapid in young children as a rule.

(*f*) **Local or Circumscribed.**—Cases of localised peritonitis belong practically to two groups. The first includes those in which there is a limited fibrinous exudation, set up by some local irritation, especially in connection with some solid organ, such as a cancerous liver, or with a tumour. Such a condition is only indicated by a correspondingly localised pain and tenderness; with perhaps friction-fremitus and sound, elicited during the respiratory movements. The other local, as well as the general symptoms of peritonitis, are absent, and the constitution frequently does not appear to suffer in the least. In the second group a limited effusion occurs, which becomes purulent; or there may be several such effusions. Here the symptoms are more severe, but the pain and tenderness are still circumscribed, and in time external objective signs often appear in the corresponding region of the abdomen, such as limited fulness, a feeling of firmness followed by fluctuation, redness of the skin, and dulness on percussion. The more characteristic local symptoms of acute peritonitis are either absent, or much less prominent than usual. The general symptoms, however, are frequently very marked, but they are merely of a febrile character, preceded in many cases by rigors. The subsequent progress of the symptoms will depend upon the course of events. Thus, general peritonitis may be set up; the accumulation may burst externally; a communication may be formed with some internal hollow organ, especially the intestine, when gas finds its way into the space, giving rise to a limited tympanitic sound on percussion, and the fluid is evacuated by the bowel; pyæmia may occur; or the condition may become more or less chronic, and the fluid is ultimately evacuated in some direction or other, or undergoes a caseous change, or is absorbed, a cure resulting, with the formation of thickening and adhesions. Any organ in the vicinity of localised peritonitis is likely to be disturbed in its functions; and the accumulation of inflammatory products may physically interfere with neighbouring structures. Inflammation of the great omentum is attended with very marked superficial pain and tenderness.

(*g*) **Complicated.**—Clinical varieties of peritonitis not uncommonly result from its associated conditions. Thus it may be modified by some disease to which it is secondary, such as typhoid fever or pyæmia; or it is accompanied by some other affection, such as muco-enteritis, pleurisy, or pericarditis; or the peritonitis gives rise to secondary lesions, which modify the clinical history of particular cases.

DIAGNOSIS.—In well-marked cases the diagnosis of acute peritonitis is sufficiently obvious, as evidenced by the cause of the disease; its mode of onset; the severity and character of the local symptoms; the physical signs; the nature and gravity of the general symptoms; and the rapid progress of the case. More or less difficulty may be experienced when the peritonitis is associated with certain other conditions in the abdomen, modifying its symptoms; when it is obscured by the general state of the patient; when its symptoms are quite latent; or when the disease is local. In some instances it is impossible to distinguish between mere ascites and inflammatory effusion. It is very important to bear in mind the conditions in which latent peritonitis is liable to occur. It may happen that the diagnosis of peritonitis is clear enough, but that its cause cannot be discovered, or only after very thorough investigation.

There are certain affections which must be remembered, as being liable to simulate, and to be mistaken for, acute peritonitis. 1. The writer has seen cases of extreme tympanites, accompanied with pain, in typhoid fever, and in low febrile diseases, such as erysipelas, very much resembling some forms of peritonitis. 2. Painful conditions of the abdominal wall may prove troublesome, namely, muscular rheumatism, localised inflammation, and cutaneous hyperæsthesia. Here, however, although there is superficial and usually diffused pain, with marked tenderness, which may be extreme, there are none of the grave abdominal and general symptoms observed in peritonitis, with the peculiar pulse, and other characteristic phenomena. In connection with hysteria intense hyperæsthesia of the abdomen is occasionally met with, with more or less distension, sickness, and constipation, and even apparently severe constitutional disturbance, a combination of symptoms which may closely simulate peritonitis. Due care should, however, prevent any mistake in diagnosis, for the patient is generally obviously hysterical; no cause of peritonitis can be discovered; the hyperæsthesia is very superficial, and pressure can be borne if the patient's attention is taken off; while the general symptoms are not really those of peritonitis, and there is little or no pyrexia. 3. Painful affections within the abdomen have to be distinguished from peritonitis. These include cramp in the stomach; intestinal colic; the passage of hepatic or renal calculi; painful affections connected with the female generative organs; and perhaps neuralgia implicating certain abdominal viscera. In many cases the pain is accompanied with vomiting, frequent pulse, and considerable general disturbance, tending more or less towards collapse. The previous history of the case; the mode of onset of the symptoms; as well as their precise character, ought as a rule to render the diagnosis at once evident. Moreover, the colicky and neuralgic pains are usually relieved by pressure. Doubtful cases must be watched, when any difficulty will probably soon be cleared up. It must be remembered, however, that some of the conditions mentioned may set up local inflammation, and even peritonitis, and thus the diagnosis will be rendered more obscure. 4. Certain objective morbid conditions within the abdomen must also be alluded to in relation to the diagnosis of peritonitis. It may be impossible to distinguish between this complaint and the graver form of enteritis, especially that resulting from intestinal obstruction, but the diagnosis is not of practical moment, and the two diseases are usually combined sooner or later. The positive diagnosis of peritonitis in some cases of perforation may also be impracticable. In the local forms of inflammation commencing in cellular tissue, such as perinephritis and perityphlitis, it cannot be certainly known whether the peritoneum is involved or not; but it may be assumed that the neighbouring portion of the membrane is very soon implicated, and the peritonitis may become general. Possibly, circumstances might arise under which accumulations of fluid, such as an ovarian cyst, a hydatid cyst, or a distended bladder, might simulate peritonitis with effusion, but there rarely ought to be any real difficulty in these cases. These conditions, as well as other tumours, may, however, set up peritonitis. 5. It must be mentioned that at first acute pleurisy or pneumonia may simulate peritonitis, the pain present in those diseases being referred to the upper part of the abdomen, or even to a more extensive area, and being accompanied with tenderness. It may be that in some of these cases the peritoneum is locally inflamed.

PROGNOSIS.—Acute peritonitis must always be regarded as a serious disease, and in many cases the prognosis is extremely grave, or even hopeless. Moreover, its progress, when general, is usually very rapid, so that the patient may die within thirty-six or forty-eight hours, and generally succumbs within a week. Death may occur, however, in three or four weeks, or even at a later period. In some of the cases of very short duration, death is due rather to the cause of the peritonitis, such as intestinal obstruction or perforation, than to the disease itself. The indications giving hope of recovery have already been pointed out, but the practitioner must guard against being misled into giving a hopeful prognosis from mere improvement in the subjective feelings of the patient, without any corresponding amelioration in the objective local symptoms, and in the general condition. Even in cases where recovery takes place, the effects of adhesions and other remaining morbid conditions must be borne in mind, as these may subsequently become troublesome or even dangerous.

The prognosis of acute peritonitis will be materially influenced by the following considerations:—1. *Its ætiology.*—The most grave forms are those due to perforation; and those of septic origin, especially puerperal peritonitis. That associated with Bright's disease and other forms of blood-poisoning, is also very serious. When the disease arises from direct injury, or from some local irritation, the prognosis is much more hopeful. 2. *The patient.*—In young infants peritonitis is absolutely fatal, and it is extremely grave in children generally. A weak or low condition of the patient, from bad living, intemperance, previous illness, or other causes, renders the prognosis more serious. 3. *The extent, rapidity, and precise nature of the disease.*—Peritonitis is more serious in proportion to its extent, and when it is local the result is much more hopeful, especially if the products of the inflammation seem to be merely lymph or sero-fibrinous fluid, when no particular danger need be anticipated. If the course of the disease is very rapid, the prognosis is exceedingly grave, partly because the inflammatory products are then probably of a low type. When peritonitis shows any tendency to become chronic, there is more hope; but even then a fatal issue may ultimately occur from various causes. 4. *The symptoms.*—It may be stated generally that the more severe the symptoms of peritonitis are as a whole, the more dangerous is the case. Among the chief indications of special danger may be mentioned extreme tympanites; urgent vomiting; the passage of bloody fluid from the stomach or bowels; great dyspnœa; incessant hiccup; very high fever; rapid development of signs of collapse; typhoid symptoms, with low nervous phenomena; and an extremely rapid, feeble, and irregular pulse. 5. *Complications.*—These may increase the gravity of a case of peritonitis, such as pleurisy, pneumonia, or pericarditis.

Treatment.—It will be evident that no uniform plan of treatment can be applicable to all cases of peritonitis, and much judgment and consideration on the part of the practitioner are often needed in the management of this serious disease. There are, however, certain definite indications to be recognised, which will now be pointed out, as well as the principal means by which they should be carried out.

a. Attention must, in the first place, be directed to the cause of the peritonitis, which in obscure cases should be carefully sought for, and, if possible, got rid of, or mitigated. This may be illustrated by an accumulation of fæces, hernia, and other forms of intestinal obstruction. In most cases, however, this indication cannot be fulfilled; but even then attention must be directed to the cause.

b. The next indication is to endeavour to combat the inflammation itself, so as to arrest or subdue it, to influence its products, and to obviate its injurious effects upon the abdominal organs. Rest for the affected structures is most important, so far as it can be obtained. It will rarely be necessary to enjoin rest for the abdomen generally, and relaxation of its muscles, as the patient will instinctively attend to this. It may be desirable to raise the bed-clothes from the body, by means of a cradle or other suitable apparatus, so as to prevent all irritation from this source. If not otherwise indicated, it is extremely important in early cases of peritonitis to give as little as possible in the way of food. Only fragments of ice, or small quantities of iced drinks should be allowed, or iced milk or beef-tea, if they can be retained. Not uncommonly the stomach rejects everything, and then recourse may be had to small enemata, and it might be useful to employ artificially-digested aliments in this way, according to the plan of Dr. William Roberts.

Abstraction of blood, either by venesection or by the application of leeches to the abdomen, is a common practice in acute peritonitis. If this measure is thought desirable, it is certainly preferable to remove the blood locally; from ten to thirty leeches may be applied in different cases, but it certainly can never serve any useful purpose to put on a larger number than this, and would probably be followed by untoward results. Removal of blood can only be of service in the early stage of the disease, and is decidedly injurious when the inflammatory process has progressed considerably, and especially if it has advanced rapidly. Moreover, it must not be practised in low forms of peritonitis, or if the patient is badly nourished and weak from any cause. Healthy, strong, and plethoric subjects are most likely to be benefited by removal of blood. This measure is also likely to be useful in some forms of local peritonitis.

The chief medicines which are employed for their immediate effects upon peritonitis are calomel and opium, and they are usually given in combination, in the form of pill, every two to four hours. The calomel is administered until the system is brought under the influence of mercury; or, in the case of infants, this is sometimes effected by inunction with the mercurial ointment. In the writer's opinion, mercurialisation as a routine plan of treatment in peritonitis is to be strongly deprecated, and he has never seen any good result from its employment. Opium, however, is a remedy of extreme value, and is often our sheet-anchor. Amongst other beneficial effects, it acts upon the stomach and bowels, being generally supposed to arrest peristaltic action in the latter, though some are of opinion that it excites peristaltic action, but diminishes reflex irritation. In whatever way this drug acts, its beneficial effects upon these organs are very manifest. Opium is usually given in the form of pill, containing from gr. ½ to gr. ij of the powder, and repeated every two to four hours. It is remarkably tolerated in acute peritonitis, unless there be renal disease, when it must be given very cautiously, or not at all. In children it must also be administered with due care. If the stomach is extremely irritable, tincture of opium may be administered in the form of enema; or, which is preferable, morphia may be substituted, especially by subcutaneous injection; and this may be also employed as an adjunct to the internal exhibition of opium, if the pain should be very intense. Tincture of aconite, veratrum viride, and digitalis have been employed for their effects on inflammation in the early stages of acute peritonitis, but they cannot be recommended.

The question of local applications to the abdomen, as regards their immediate effects upon peritonitis, is important, and by no means decided. The common practice is in favour of employing hot applications, in the form of light poultices or fomentations, to which anodynes may be added; or turpentine stupes or sinapisms. The use of cold has, however, been strongly advocated by many authorities in the early stage of peritonitis, and deserves a more extended and thorough trial than it has hitherto received. It may be employed either by means of cold compresses, frequently changed; a bladder containing pounded ice, not too heavy; or flannel dipped in iced-water. The effects claimed for this treatment are that it contracts the vessels; allays nervous irritability, and consequently intestinal disturbance; and alleviates pain. The sensations of the patient must be some guide as to its continuance. At a later period hot applications are decidedly to be preferred, as the cold applications can be of no service, and will probably prove injurious.

As certain cases advance, it may be advisable to apply blisters to different parts of the abdomen, with the view of promoting the absorption of inflammatory products. Operative interference is decidedly indicated in some cases of considerable effusion, the fluid being removed by a trochar. It may also become a question whether purulent collections should not be let out, after acute symptoms have subsided. Certainly this measure is indicated if there is any local accumulation of pus.

c. The general condition of the patient in cases of acute peritonitis always demands constant attention, and in many instances it is the chief matter for consideration. Whenever any tendency to collapse or adynamia sets in, alcoholic stimulants are called for, in variable quantity according to circumstances, brandy and champagne being the most suitable. Their administration must not be left until too late a period. They are best given at frequent intervals in small quantities. If stimulants cannot be borne by the stomach, brandy should be given in enemata. Liquid nourishing food is also often required in large quantities, and may be administered in the same way. Quinine in full doses, ether, musk, camphor, ammonia, bark, and turpentine, are the chief medicines which may be called for in bad cases, to combat the general symptoms. Subcutaneous injection of ether or camphor may be of service in extreme conditions.

d. Symptoms often call for special treatment in acute peritonitis, although most of them tend to be alleviated by the measures already considered. It will only be necessary to allude further to the following. Nausea and vomiting may call for small doses of iced effervescents, with hydrocyanic acid and morphia; soda-water and milk; or drop-doses of creasote. Constipation in many cases ought on no account to be disturbed; if any treatment is indicated, calomel at first, followed by enemata, will answer the purpose. Excessive diarrhœa in certain cases may require to be checked by enemata containing laudanum. Meteorism is sometimes relieved by calomel; if very troublesome, the use of enemata containing turpentine, the passage of a long tube *per rectum*, or, in extreme cases, the puncture of the distended intestines in several places with a fine trochar, are the measures indicated. The relief of this symptom is the only direct way of influencing dyspnœa. Hiccup calls for narcotics, ether, the local application of sinapisms or blisters, and, if dangerous, inhalation of chloroform.

e. In cases where recovery ensues, much care is required during convalescence, as regards diet and general management; and the absorption of morbid products may be aided by applying blisters or iodine to the abdomen, and by baths and other measures.

2. Peritoneum, Chronic Inflammation of. SYNON.: Chronic Peritonitis.—This affection, like the acute form, may involve the peritoneum more or less generally; or only over a localised and limited area. The conditions included under the term are somewhat indefinite, but not uncommonly they are well-marked pathologically, as well as of considerable clinical importance.

ÆTIOLOGY AND PATHOLOGY.—Without entering into details, it must suffice to point out the circumstances under which chronic peritonitis may occur:—1. There is no doubt as to its being a sequel of one or more attacks of acute peritonitis in some instances, either general or local, but especially the latter; and after a circumscribed acute peritonitis the chronic affection may spread more or less generally. Moreover, the conditions remaining after acute peritonitis are liable to set up further mischief in a chronic manner. 2. Chronic peritonitis may become associated with ascites, but more particularly when repeated paracentesis has been performed for the relief or cure of this condition. 3. Localised chronic peritonitis is very common as the result of continued irritation, set up by some diseased organ, such as a cirrhotic or cancerous liver, cancer or chronic ulcer of the stomach, old hernias, tumours, and various other obvious conditions. There are, however, cases occasionally observed in which the cause is not so evident, and these have been referred to irritation by accumulations of fæces, or to repeated pressure or other mechanical causes acting from without. 4. Morbid formations in the peritoneum itself are very liable to set up chronic inflammation. Of these the principal are tubercle and cancer, and tubercular and cancerous peritonitis constitute important forms of this disease. 5. In rare instances a chronic inflammatory effusion collects in the peritoneal cavity, without any obvious cause. This cannot be separated by any marked line of demarcation from some latent cases of acute effusion. The fluid may be actually purulent under these circumstances, but is generally serous, and cannot be distinguished from that of mere ascites. This chronic effusion has been noticed during convalescence from fevers; and has also been attributed to cold and wet. It may be mentioned here that some cases of chronic peritonitis have also been referred to chronic renal disease, and to rheumatism.

ANATOMICAL CHARACTERS.—The precise conditions present in an individual case of chronic peritonitis are subject to great variety, as regards their nature, extent, and site; but their general characters can be readily indicated.

Adhesions or thickenings connected with the serous membrane are almost constantly present in different degrees, and not unfrequently they constitute the sole anatomical evidences of chronic peritonitis. They result from the development of the inflammatory products, and the formation of connective or fibrous tissue, with new vessels. The thickening varies much in degree, ranging from what is scarcely perceptible, to the production of a dense fibrous mass, an inch or more in thickness, as the writer has seen. It may be evident in the parietal peritoneum; around organs, forming more or less thick and firm capsules; or in the peritoneal folds, especially the omentum and mesentery. Adhesions or agglutinations also form between different parts, thus uniting organs to each other, to the abdominal walls, or to the mesentery or omentum; or sometimes matting the whole together into an inseparable or indistinguishable mass. They present great variety, and by the movements which take place within the abdomen, they may be stretched or made more loose, or even be got rid of altogether in some instances, when they have formed after an acute attack. On the other hand, in many cases the adhesions and thickenings tend to become gradually stronger and denser, and at the same time to undergo contraction, so that they produce serious effects.

In many cases of chronic peritonitis effusion of some kind is observed. It may be merely serous, or containing fibrinous flakes, sero-purulent, or actually purulent. Blood may also be present in it. Occasionally this is the prominent or only anatomical change; and the fluid may range in quantity from a small to an enormous amount. Usually it is associated with the other conditions already described, so that the fluid is not free to move about, and may be actually circumscribed, or even lie in the substance of great thickenings. Purulent accumulations are likely to make their way in various directions, either outwards or into internal parts.

When chronic peritonitis depends upon the presence of tubercle, cancer, or other morbid formations, these will be evident on *post-mortem* examination. Moreover, the inflammatory products may undergo degenerative processes, and hence caseous or cretaceous particles or masses be found. It is highly probable that tubercle may be formed secondarily, as the result of infection from caseous or purulent collections. Pigment is also often present in abundance.

It is important to notice the obvious effects liable to be produced upon the abdominal organs and other structures by chronic peritonitis. They are fixed by the adhesions and thickenings, and may be displaced at the same time. Compression or constriction is often produced, especially important in the case of hollow viscera, as well as distortion, twisting or torsion, and incarceration. Some of these effects may occur acutely in connection with bands of adhesion, thus giving rise to grave consequences; and fixation of the bowel may also lead to intussusception. The omentum may be greatly distorted, or fixed in some abnormal situation; while the mesentery has been found extremely shortened, so as to contract the small intestine to half its length, its serous covering and longitudinal muscular layer being shrivelled, and its mucous lining thrown into transverse folds. The deeper tissues of some of the abdominal viscera are likely to be affected by long-continued chronic peritonitis; and atrophy from compression may ensue. As one good result of this condition, mention must be made of the fact that it is not uncommonly the means of preventing or modifying the injurious consequences resulting from some forms of perforation of abdominal viscera, by giving rise to previous adhesions and thickenings, and thus obviating the escape of their contents, or limiting their dissemination.

Symptoms.—The clinical history of chronic peritonitis necessarily presents much diversity. The phenomena observed result from the mere presence of the inflammatory products; the effects produced upon the organs within the abdomen by these products, whether in the way of mere functional disorder, or other more obvious derangements; the consequences of direct pressure upon tubes, vessels, or other structures; and the general or constitutional disturbance often present.

According to its mode of origin, chronic peritonitis either remains after an acute illness, or after a succession of more or less acute attacks or exacerbations; or its onset is gradual and chronic from the first, and may be very insidious. Of slight adhesions left after acute peritonitis, or originating from chronic causes, there are often no clinical signs; or there may be uneasiness and discomfort, or even painful sensations at times in some part of the abdomen, especially the iliac region, with a tendency to intestinal disorder, in the way of spasmodic movements and constipation. Even when there are no symptoms whatever, adhesions may at any time cause serious consequences. In well-marked cases of chronic peritonitis the symptoms to be expected are of the following nature:—Abnormal subjective sensations are usually experienced in the abdomen, such as tightness, fulness, dragging, or actual pain. The pain, when present, is of a dull character, not severe, and liable to come and go, or to present exacerbations from time to time; it is often localised, and especially if the peritonitis be circumscribed; sometimes there is a feeling of local soreness or heat. The painful sensations tend to be increased by movement, and by shaking the body. They are sometimes aggravated by posture, in some cases by bending forwards, in others by the erect posture; and they may be increased by going up stairs, especially if the abdomen is distended. More or less tenderness on pressure is very common, even when there is no spontaneous pain, but not invariable; it is frequently more evident at certain spots, where it may be considerable. Colicky pains are not uncommon in chronic peritonitis, and may occur in severe paroxysms, especially after food, being due to the disturbed action of the bowels, associated with the formation and movements of flatus, which may be abundant, even amounting to tympanites. Appetite is often impaired or variable; and dyspeptic symptoms are frequent. Constipation is the rule, and may be very obstinate, even amounting to obstruction under certain conditions. Sometimes diarrhœa is present, or it may supervene at times, and occasionally assumes a dysenteric character. This symptom is very common in tubercular peritonitis, in consequence of the bowel being the seat of ulceration. In some cases vomiting occurs from time to time. When there is considerable effusion in the peritoneum, the secretion of urine is diminished. Respiration may be mechanically interfered with from the same cause. As the result of pressure by thickenings and other conditions upon different structures, jaundice, ascites, œdema of the legs, thrombosis, albuminuria, or neuralgic pains may supervene. When the organs are all matted together, their entire functions must be more or less interfered with.

General symptoms are usually present in various degrees in cases of chronic peritonitis, but in many instances they depend mainly upon the condition with which this disease is associated, especially tuberculosis, though they may also be produced by the peritonitis. These symptoms include pyrexia, not high, and having no regular course, but presenting exacerbations, either persistent or occurring at intervals, and in some cases assuming a hectic character; increased frequency of the pulse; a sense of languor or weakness; and more or less general wasting and anæmia, with dryness and harshness of the skin.

It must be noted that in some cases of chronic peritonitis, even where there is considerable effusion, the local and general symptoms are very slight and indefinite, and the patient only suffers from the discomfort due to the accumulation of fluid. On the other hand the progress is not uncommonly from bad to worse, ending in extreme emaciation and exhaustion, with the formation of bed-sores; or there may be a succession of improvements and relapses; while various phenomena result from the opening of collections of pus in different directions. Thus death may gradually or rapidly terminate a case; or pyæmia may supervene. Even in bad cases, however, comparative recovery may ensue, only the effects of the inflammation remaining, and being more or less troublesome.

Physical Signs. — These require separate notice, and they may be the only clinical indications of chronic peritonitis. They necessarily differ in detail according to the nature of the abnormal physical conditions present in the abdomen, and they are also liable to alter during the progress of a case; but their general characters are sufficiently clear. 1. In general chronic peritonitis enlargement of the abdomen is observed, mainly in proportion to the amount of fluid present; but it depends partly on gas in the intestines, or sometimes on solid exudation. As a rule it is not very considerable, but the abdomen may attain an enormous size, with stretching of the skin and other accompanying phenomena. While regular in shape on the whole, it may present more or less want of symmetry, especially after a time. On the other hand, in some cases the abdomen becomes locally or generally retracted, and may then exhibit marked irregularities. 2. The sensations on palpation are very variable, but often highly characteristic. It may happen that there is a uniform feeling of fluid. More commonly the sensations are not uniform, but differ in different parts of the abdomen, including indistinct fluctuation in localised areas, sometimes very limited and in unusual situations; with firmness or resistance around or in other parts, ill-defined, occasionally nodulated; and even distinct tumours may be felt, more or less irregular. These in some instances are due to morbid growths, such as cancer, but they also originate in organised inflammatory products. Under certain conditions the abdomen yields a peculiar feeling of being movable as a whole. Movements of the bowels are sometimes recognised. When there are localised adhesions between the visceral and parietal peritoneum, if pressure is made at a little distance from the seat of adhesion, a fold of the skin will appear where this adhesion exists. Possibly general adhesions might be made out by palpation. 3. Percussion occasionally reveals freely movable fluid. As a rule, however, it shows that the fluid is not freely movable, or that it is actually loculated irregularly, this condition being associated with more or less solid material. Hence there is extensive and diffused dulness, which may be noticed mainly in front, and not in dependent parts. Not uncommonly patches of dulness and tympanitic resonance are found contiguous to each other, and irregularly distributed, unaffected by posture. Over the fluid fluctuation may, perhaps, be elicited, but indistinctly; and where there is much solid the sensation on percussion is that of resistance. 4. Friction-fremitus and -sound are sometimes present. 5. Changes of posture, as a rule, produce comparatively little or no effect upon the shape of the abdomen, the sensations, or the percussion-sounds.

When chronic peritonitis is localised, it may be practicable to detect the condition by palpation and percussion. Moreover, when organs become fixed by peritoneal adhesions, especially if they are diseased at the same time, this state of things may often be recognised by noticing that the affected organ does not present its normal mobility in relation to manipulation and respiratory movements.

Diagnosis.—In most instances chronic peritonitis, if of any extent, can be recognised without much difficulty, by attending to the history of the case, the symptoms, and the physical signs. It may be very difficult, or even impossible, to distinguish positively between mere ascites and chronic inflammatory effusion. All the circumstances of the case must be taken into consideration; and in doubtful cases the removal of some of the fluid, by means of a small trochar, will aid the diagnosis materially. It is important to determine the cause of chronic peritonitis, when present, and especially whether it is simple or tubercular. Here, again, the whole case must be considered, not forgetting the age of the patient, the family history, the condition of the main organs, and other points. Tubercular disease in other parts may, however, be accompanied with simple peritonitis. It has been said that a hæmorrhagic character of any fluid removed is significant of tubercular peritonitis, but this certainly cannot be relied upon; and the same remark applies to the occurrence of redness and œdema about the umbilicus, which has been supposed to be diagnostic of the tubercular disease.

It is quite impossible to diagnose with certainty obscure cases of localised chronic peritonitis; and it may become very difficult, even in evident cases, to determine the precise conditions within the abdomen.

Prognosis.—The prognosis of each case of chronic peritonitis must be considered on its own merits, as regards the cause of the disease; its extent and products; the progress of the morbid changes; the effects produced on the abdominal organs; and the general symptoms. Some cases are of little or no consequence; others are very serious; but even in apparently serious cases great improvement, or even practical recovery, may take place. The dangers to be feared from the opening of purulent collections in various directions must be borne in mind; and also those liable to arise from the presence of bands of adhesion within the abdominal cavity. Tubercular and carcinomatous peritonitis are necessarily very grave forms of the disease, but the former may certainly be recovered from.

Treatment.—With regard to the *local* conditions in chronic peritonitis, it is often desirable to endeavour to promote the removal of morbid products within the abdomen. For this purpose it may be important to keep the patient entirely at rest in bed for a time. The internal administration of iodide of potassium or syrup of iodide of iron may be tried; and in some instances diuretics might be of use. Possibly the careful employment of some mercurial preparation would be serviceable in appropriate cases. Violent purgation is to be deprecated; but where there is much fluid, advantage might be derived from repeated diaphoresis, induced by means of the hot-air, vapour, or Turkish bath, or by the use of jaborandi. Local measures are in some instances of essential service, namely, counter-irritation, especially by the application of iodine; friction with some oil or ointment; and pressure. The writer has found pressure decidedly valuable in aiding absorption in certain cases, as well as in giving support, the abdomen being covered with cotton-wool, and a suitable bandage applied more or less firmly. A flannel bandage answers best. In cases of large effusion, where absorption cannot be effected, the writer has no hesitation in recommending paracentesis, even repeated when required, having seen signal benefit follow this treatment. A localised purulent accumulation must be treated on general principles.

General treatment is often of essential value in cases of chronic peritonitis. It is directed to the condition upon which the disease depends, such as tuberculosis, or to its effects, but the measures are similar in the main, consisting of good nutritious diet, suitable sanitary conditions, change of air, and the administration of cod-liver oil, quinine, preparations of iron, and other tonics and nutrients. Wine may often be given with advantage.

Symptoms will probably need attention from time to time, such as pain, flatulence, dyspeptic symptoms, constipation, diarrhœa, and various others. The organs generally must be looked to, and their functions promoted. A free flow of urine often follows absorption of fluid, or its removal by operation.

There are many cases of chronic peritonitis which need no special treatment, especially when it has merely caused local changes.

3. **Peritoneum, Gas in.**—Synon.: Pneumoperitoneum; *Tympanites peritonei.*

Gas may be present in the peritoneal cavity from three causes, namely:—1. Its escape from the alimentary canal through some abdominal communication; 2. Transudation of gas through the intestinal wall; 3. Decomposition of materials in the peritoneal sac. The gas may be generally diffused; or limited by adhesions. The condition cannot be said to give rise to any definite symptoms, but it may increase abdominal distension and discomfort. When general it might be recognised by the following *physical signs*:—1. There is extreme and uniform distension of the abdomen, with a specially prominent epigastrium as the patient lies on his back. Sometimes doughy fluctuation is felt in the epigastric region, with a peculiar pitting on pressure. 2. The percussion-sound is markedly tympanitic or even metallic, full and deep in tone; and this sound is very extensive, completely annulling the anterior hepatic and splenic dulness. 3. Succussion-sensations and sounds may be produced, owing to the presence of gas and fluid in the peritoneal sac. These are more uniformly and extensively diffused than when such phenomena arise from similar conditions in the stomach or intestines. The aortic sound may also have a diffused metallic quality over the abdomen. A local collection of gas might cause a corresponding fulness of the abdomen, and yield a localised tympanitic or metallic percussion-sound, as well as succussion phenomena.

4. **Peritoneum, Dropsy of.**—*See* Ascites.

5. **Peritoneum, Hæmorrhage into.**—Blood may escape in quantity into the peritoneal cavity as the result of injury; or from the rupture or perforation of different structures within the abdomen. An important form of hæmorrhage is that which results from the rupture of an aneurism. More or less blood may be present in inflammatory or dropsical effusion; or it may originate in the opening of vessels by morbid growths, or the spontaneous rupture of new vessels. Hæmorrhage is not uncommon in connection with tubercle. It may also occur from scurvy or purpura.

Symptoms.—It might possibly happen that peritoneal hæmorrhage could be recognised, if there were some evident cause for this condition; followed by the physical signs of the presence of blood in the peritoneal cavity; and general indications of loss of blood. As a rule, however, the condition cannot be detected. The hæmorrhagic nature of an effusion can only be recognised by withdrawing it.

Treatment.—This merely consists in the local and general treatment for loss of blood, if anything can be done or is required.

6. **Peritoneum, Injuries to.**—The peritoneum is liable to be injured from without by contusions and wounds of various kinds; and from within by perforations and ruptures, the injury being aggravated in many cases of this kind by the introduction of matters into the peritoneal cavity, causing mechanical or chemical mischief, such as gases, food, fæces, calculi, bile, urine, pus, or worms. The mere injury to the serous membrane itself cannot be said to produce any evident phenomena, unless it be extensive; but it leads usually to serious effects, which have already been considered—namely, hæmorrhage, which may be on a large or fatal scale; and acute inflammation of an aggravated type. Of course it must be remembered that along with the injury to the peritoneum, there is usually associated some more or less severe injury to an abdominal organ or other structure, and the phenomena resulting therefrom will be present.

7. Peritoneum, Morbid Formations and New Growths in.—These require brief notice, and may be considered in the following order:—

a. It is necessary to call attention to the fact that the sub-peritoneal tissue, especially that of the peritoneal folds, becomes in obese persons the seat of a large deposit of fat, an overgrowth of that normally present, and this is particularly noticed in the omentum. As a consequence the functions of the alimentary canal are unquestionably liable to be interfered with, and various dyspeptic symptoms, flatulence, and constipation may arise. Moreover, this condition assists in producing enlargement of the abdomen; and in muffling the natural tympanitic sound. It can be recognised at once by the appearance of the patient; but it is important to remember that it may conceal some other morbid condition within the abdomen. The treatment is that for obesity generally (*see* OBESITY). In very exceptional instances distinct fatty tumours have occurred in connection with the peritoneum; and these may become separated by constriction of their attachments.

b. Tubercle is the most common and important new growth in connection with the peritoneum. It occurs in three classes of cases, namely—(1) as a part of general acute tuberculosis, the tubercle appearing in the peritoneum as a diffuse miliary deposit, presenting the usual characters; (2) in connection with tubercular ulcers in the intestines, localised granulations forming on the corresponding surface of the peritoneum; (3) as an independent disease, usually assuming a more or less chronic course, and accompanied with inflammatory changes. This form is usually secondary to, and associated with, similar changes elsewhere, especially pulmonary phthisis; but it is occasionally primary, and may exist for a time or throughout alone, as the result of infection from caseous glands, from products remaining after peritonitis, from caseous deposits in the epididymis, or from other sources, or exceptionally without any obvious cause. This disease occurs mainly in young persons, but is rare under four years of age.

ANATOMICAL CHARACTERS.—The morbid conditions found on *post-mortem* examination in cases belonging to the third group, consist of a combination of disseminated tubercles in different stages, with signs of chronic peritonitis. Sometimes the tubercle has entirely undergone caseous changes. As the result of the peritonitis, great thickening and extensive adhesions are usually present, with much contraction. Hence the omentum is often drawn up into a firm mass across the upper part of the abdomen; and the mesentery is also contracted, drawing the intestines together, and distorting them. More or less effusion is almost always present, which generally contains altered blood in variable quantity. Sometimes abundant hæmorrhage takes place into the peritoneum. Morbid changes, either of a tubercular character, or resulting from this disease, are usually found in other parts of the body.

SYMPTOMS.—The clinical phenomena present considerable variety in different cases, as regards their nature and progress. In some instances tubercular disease of the peritoneum begins acutely, or in a succession of acute attacks, usually circumscribed, with symptoms like those of peritonitis, then subsiding into a chronic condition. Far more commonly the progress is very chronic and insidious, or latent, ending in signs of effusion. In other cases there are marked remissions of the symptoms during their progress, both local and general. The phenomena may be summarised as those of the peritoneal inflammation; with general symptoms of tuberculosis; and often signs of implication of important organs in the morbid condition. When the peritoneal disease is secondary, it can be readily recognised. The course of the disease is usually chronic; and as a rule it terminates in death, but not invariably.

TREATMENT.—The treatment for tubercular disease of the peritoneum is that of the general disease; with that suitable for chronic peritonitis.

c. Cancer is comparatively rare in the peritoneum. It is by far most commonly secondary, originating from extension, or as a distinct secondary formation; and especially following malignant disease of the alimentary canal, liver, retro-peritoneal glands, and sexual organs. Rarely this disease is primary, and has then been referred to injury in some instances. It occurs almost always after middle life, but has been met with in children.

Peritoneal cancer generally occurs in the scirrhous form, but is occasionally encephaloid, melanotic, or colloid, the last being comparatively frequently found in the omentum, and it may form an enormous growth. Rarely the disease assumes an acute character, the cancer being in diffused nodules. Usually chronic, it either takes the form of separate nodular masses, which may become depressed; or of an infiltration, sometimes of great thickness. Generally there are associated signs of chronic peritonitis, with more or less effusion, which may be hæmorrhagic; extensive hæmorrhages sometimes take place. Abdominal organs are often found implicated; or the cancerous process may lead to their destruction or perforation. In some instances there is large dropsical effusion in the peritoneal cavity.

Cancer of the peritoneum may be usually recognised clinically when it occurs as a secondary event, but even then its diagnosis is not always clear. As a primary disease it is generally difficult to detect. The phenomena include the physical signs of the morbid growth, especially as revealed by palpation and percussion; the signs of ascites or chronic peritonitis; disturbance of the abdominal organs; the general symptoms and cachexia of cancer; and the evidence of the existence of the disease in other parts. Pain is a common symptom, and is usually paroxysmal, being due to the cancer itself, as well as to other causes; tenderness is also marked. The cancerous nodules may originate friction-sound. The course of the disease is occasionally acute, with pyrexia; as a rule it is chronic, with little or no fever, or this only occurs at intervals. Hæmorrhage may cause marked anæmia or fainting. The cancerous masses may also originate pressure-symptoms. This disease is necessarily fatal; and treatment can only be symptomatic.

With regard to colloid of the omentum, it is desirable to notice specially its physical signs:—

1. The abdomen may be greatly enlarged, but is not uniform or quite symmetrical; the umbilicus is only stretched, not everted. 2. Palpation generally reveals firm, irregular masses. If present, fluctuation is very indistinct. 3. The anterior regions of the abdomen are dull extensively. 4. Usually a change of posture produces little or no effect upon the physical signs. 5. A slimy, gelatinous fluid may be removed by the exploratory needle or aspirator; and occasionally a similar fluid is said to be discharged *per rectum*, or from the stomach.

d. Among rare formations found in the peritoneum may be mentioned hydatids, associated or not with a similar disease in one or more organs; serous, dermoid, and colloid cysts; fibromata; myxomata; and remains of blood-clots.

8. **Peritoneum, Malformations of.**—It will suffice to mention under this head that the folds of the peritoneum, such as the mesentery, may be abnormal in length or formation; that unusual bands or openings may be present; and that prolongations of the peritoneum, which naturally become obliterated or shut out from the general cavity, sometimes do not undergo these changes, as may be illustrated by the occasional patency of the process which descends with the testis into the scrotum. As the result of these abnormalities displacements of organs may occur; or their movements are restricted or too free; or constriction of the intestine may take place. These conditions can only be recognised clinically by their effects; and not uncommonly they cannot be made out. Treatment may sometimes be directed to their cure, as is exemplified in the radical cure of a congenital hernia.

Frederick T. Roberts.

PERITYPHLITIS (*περὶ*, around, and *τυφλὸν*, the cæcum).—Synon.: Fr. *Pérityphlite*; *Phlegmon iliaque*; Ger. *Perityphlitis.*

Definition.—Inflammation of the connective tissue behind and around the cæcum.

Ætiology.—The most frequent cause of this not uncommon affection is an extension of inflammation from the cæcum or the vermiform appendix, more especially if the typhlitis caused by accumulation of fæces or by some foreign substance, such as fish-bones or cherry-stones, has proceeded to ulceration. The anatomical relations of the cæcum in the right iliac fossa are favourable to such a result.

Owing to the continuity of the sub-peritoneal connective tissue, it is obvious that inflammation and suppuration in regions somewhat distant from the iliac fossa may also extend into that locality. Perinephritic and psoas abscesses may therefore become causes of perityphlitis.

External injury, such as blows, kicks, or severe compressions, as between the buffers of a train, may induce inflammation of both bowel and surrounding tissues, so that it becomes impossible to say whether the cæcum or the connective tissue becomes first affected.

Occasionally suppuration in this region may result from septicæmia; and exceptional cases occur where no cause can be assigned beyond cold. *See* Cæcum, Diseases of.

Anatomical Characters.—Perityphlitis runs a somewhat variable course. In one set of cases the progress may be acute, marked by active suppuration, and leading to the formation of an abscess in the iliac fossa behind the cæcum. Such an abscess may extend to a considerable distance in the sub-peritoneal tissue, upwards, towards the spine, or downwards into the pelvis; it may open into the peritoneal cavity or the bowel; or point outwards in the abdominal wall, or downwards through the pelvis. The contents of the abscess are usually extremely fœtid, and a putrid destruction of the adjacent tissues, especially the muscular, is frequent. The nerve-trunks of the lumbar plexus escape this, but the large veins—iliac, ileo-colic, &c.—are blocked with coagula.

More frequently, however, the disease is of a chronic and insidious character, often presenting obscure symptoms preventing the real nature of the case from being ascertained; and it may thus last for many months. The inflammatory process leads then to a considerable thickening of the connective tissue, of a tough fibrous variety, rather than to the formation of pus. If the starting-point have been a perforating ulcer of the cæcum or appendix, the bowel may be found to be firmly imbedded in a mass of tough fibrous tissue, which binds it down closely to the iliac fossa and to the abdominal wall, penetrating the muscular tissue and extending even to the bone. Excavated in this new-formed material are numerous irregular shaggy loculi, communicating with one another, and to a variable extent with the gut, thereby allowing extravasation of the fæces, though this may be to only a slight degree. Sometimes the intestine may be so much involved and destroyed that its course cannot be distinctly traced, and the path of the bowel-contents is then, for a certain distance, limited by these new-formed irregular channels. This condition may last for a long time, and death may result from exhaustion rather than from any distinct lesion, such as peritonitis. Not infrequently, however, an acute attack of suppuration may supervene in this state, and give rise to an abscess which may take one of the courses indicated above. Or when even perforation of the bowel has been the cause, the aperture may subsequently become closed up; and, as in the cases where the inflammation has started outside the cæcum, the surrounding connective tissue becomes much thickened and indurated, and, by partly involving the intestine in its contraction, produces obstruction in the canal. The writer has noticed a marked tendency to the deposition of pigment in the new-formed tissue in such cases.

Symptoms and Signs.—These will to a certain degree depend, especially at the outset, upon the nature of the attack, and the extent to which the cæcum is involved. If the symptoms of typhlitis be much prolonged, or if in addition to the signs of that disease, an examination should reveal the existence of a swelling deeply seated behind the cæcum, then we may suspect that the inflammation has extended beyond the gut; and the occurrence of rigor and a high temperature, marked by a daily rise and fall of two degrees, would go far to make the diagnosis certain. But such a deep-seated swelling is not always easy to make out, since the distension of the cæcum and the tenderness render an examination difficult. The recognition of the existence of an abscess will of course depend very much upon the direction which it takes. In the more chronic cases, and in those which originate independently of typhlitis, the symptoms are liable to be obscure for a long time. Long before there are the physical signs of a tumour in the iliac fossa, and when the occurrence of an injury may have been forgotten or not thought of, the patient will complain of pain and numbness or anomalous sensations extending down the right leg as far as the knee, with perhaps slight lameness, and a constant inclination to relieve the pressure of the abdominal walls by leaning over to the right side when standing and sitting, or by flexing the thigh on the trunk when lying down. The temperature is by no means always elevated, and the bowels may present but very little irregularity in their action. Nevertheless, the patient feels generally ailing, in an ill-defined sort of way, and, with a probably diminished appetite, loses flesh. Pain and tenderness on pressure may be absent in the iliac fossa. As the disease slowly advances, however, and the patient emaciates, more definite symptoms will present themselves; an increasingly distinct swelling is appreciable, of a notably fixed character, not shifting under manipulation, tender, and accompanied by an almost constant pain extending down the leg, which may perhaps be slightly œdematous, from pressure on the veins. The abdomen is usually slightly tympanitic; and the local swelling may increase to the extent of being visible. The bowels by this time are markedly irregular. Sometimes there is diarrhœa, sometimes constipation, or alternations of these conditions. The impairment of the intestinal peristalsis, caused by the pressure of the inflammatory new growth in connection with the cæcum, may by irritation produce diarrhœa, or by obstruction lead to constipation. The stools are frequently pale and unformed. Vomiting is sometimes met with in different degrees of severity.

Associated with the formation of abscess, a case has been described by Dr. Quain, in which there existed a certain subjective sensation of smell; a fæcal odour, which could not be recognised by others, being continuously complained of by the patient, to the extent of its being almost regarded as a monomania. This smell gave the patient no further annoyance after the abscess had discharged and subsequently healed.

Course and Terminations.—When an abscess has formed, the result will much depend on where it opens, and to what extent it communicates with the cæcum. Rupture into the peritoneal cavity will almost surely be fatal, and even those abscesses which burst on the surface may lead to death, by the exhaustion caused by a chronic cavity prevented from healing by its discharging fæcal matter. In the most acute cases, where no perforation into the bowel has taken place, the resulting abscess may burst on the surface; and the same may be said for many of the more chronic cases, when the progress of the inflammation has become arrested before it has implicated the bowel to any great extent, and when a partial absorption of the inflammatory tissue has taken place. But in other cases, and especially where there are burrowing sinuous channels in the iliac fossa, with more or less communication with the cæcum, recovery is of rare occurrence, and the patient dies from exhaustion, with perhaps caries of the bone, a fæcal abscess, and a chronic diarrhœa.

Diagnosis.—The diagnosis of these cases, previous to the recognition of a swelling in the iliac fossa, is only provisional. The history of typhlitis, with subsequent tenderness and, perhaps, high temperature, and especially an ill-defined feeling of illness, the patient steadily deteriorating in health, should lead to a suspicion of the extension of the inflammation beyond the cæcum. Should an abscess form and point, it will not be difficult to recognise, and when a swelling is to be felt, its nature will be ascertained by attention to the history of the case, the pressure-symptoms in the right leg, and the fixity of the tumour. The variable state of the bowels renders them of little account in forming a diagnosis. There is reason to believe that this malady is often passed over unrecognised, and is of more frequent occurrence than is supposed. This is said to be the case in children, in whom cases of iliac abscess around the cæcum are liable to be mistaken for hip-joint disease, though with perhaps scarcely sufficient reason.

Prognosis.—In the acute cases where a fæcal abscess forms and bursts, a fatal result, sooner or later, is to be feared. If rupture takes place into the peritoneal cavity, death will follow, and even where perforation of the abdominal wall occurs, the ensuing exhaustion is often fatal. Those cases of abscess in which the communication with the bowel has not existed, or has been cut off, are the most favourable. Among the chronic cases where the suppuration is but slight, the prognosis seems very much to depend upon the extent to which the intestine is implicated; if this be tolerably free a favourable result may be expected.

Treatment.—A large proportion of the cases of perityphlitis are amenable to treatment. Perfect rest in bed is of primary importance; and, since the symptoms are directly relieved by the reclining position, the imprisonment is readily submitted to. Hot poultices of linseed meal, or fomentations over the cæcum, and changed as often as necessary, almost invariably give marked relief; when an abscess is in process of formation, the hot applications favour its development, and so promote the cure, by affording an opportunity for its being opened. This plan, pursued for a week or ten days, may be sufficient. In the more chronic cases it may be necessary to continue them for a longer period, even when the tension appears to be lessened, and the pain in the limb decreased. When the more acute inflammatory symptoms have subsided, counter-irritation, by blisters or by a solution of iodine applied over the affected part, tends to promote absorption, and thus to remove thickened or condensed tissues.

Attention should be especially directed towards maintaining the general health. The diet should be small in amount, frequently administered, and of the most nutritive quality. Advantage is to be derived from the simultaneous administration of the prepared digestive juices of the stomach and pancreas, so that a minimum of indigestible food may reach the lower bowel.

Stimulants, carefully administered, are often necessary. Care is required in giving aperients when the bowels are confined. As a rule this condition is best relieved by enemata and gentle laxatives, such as confection of senna or castor oil. Constipation is more favourable to the patient than diarrhœa, which is often uncontrollable, or obstinately resists the usual treatment of acids and opium, tannin and other astringents, whether given by the mouth or as enemata. It is much easier to relieve the bowels than to arrest their excessive action.

Tonics, such as iron, ammonia, and bark, are of value, and should be given from the outset, since the disease is one that tends to wasting, and it is usually in a somewhat enfeebled condition that the patient first presents himself. When the acute phase has passed, change of air, a sea-voyage, and other aids to convalescence are required. W. H. ALLCHIN.

PERI-UTERINE HÆMATOCELE. *See* PELVIC HÆMATOCELE

PERSONAL HEALTH.—Personal hygiene is the science of individual health. As there are public acts and laws which, observed, promote the health of communities, so there are rules of living and habits of life, inculcated by competent observers, by attention to which the health of the individual may be preserved or increased. Health is a quality of body easily comprehensible, but difficult to define. It is dealt out in different measures at different periods of life, and is perhaps best described as exemption from disease. It admits, however, of being estimated, and we shall first show how this may be done.

First, the form of the individual must be examined, to ascertain how far it agrees with or departs from certain mean standards, such as are laid down by anatomists and practical hygienists, and which give, in tables for each age, what the height, weight, girth of chest, and mobility of thorax ought to be every year of life. Thus above the weight of 161 lbs. avoirdupois, the circumference of the chest ought to increase 1 inch for every 10 lbs. of additional weight; and for every inch in height over 5 feet 8 inches the mobility of the thorax ought to increase in a definite ratio (*see* Parkes's *Hygiene*, p. 480). Then the girth-measurement, taken round the mamma, should be in excess of that taken lower down, at the level of the xiphoid cartilage, in every man, although not disproportionately so, as it is in women who lace tightly.

Secondly, the manner in which the various functions of the body are performed must be ascertained. The situation of the heart's apex-beat is to be determined; its impulse; its mode of action; the rhythm of its sounds; the way in which the circulation is being carried out; how temperature is maintained at the extremities; and what individual capacity exists to resist conditions calculated to lower the body temperature. The respiratory, cerebral, and spinal functions must all be determined; the organs of digestion, sanguification, and excretion, as well as their performances, will have to be examined in due order; and the state of general nutrition and the condition of the skin appraised.

That state of body which enables it to perform every function which can be reasonably required of it, to accomplish each ordinary task, and be equal to some exertion of brain and muscle without painful sense of fatigue, is what we ordinarily understand as health. It would be difficult, however, if not impossible, to lay down the amount of work or exertion, short of positive fatigue, which a child, lad, woman, or man ought to be equal to without preparation or training of any kind. Erectness, firmness, good balance of body and mind, testify to a man, as they do to a racehorse or a gamecock. An experienced eye recognises at a glance the particular build of man suitable to particular taskwork; likely to excel in particular exercises, sports, or games; fitted to labour with his head, or with his hands; to run, swim, or fight well. There is, perhaps, a little less difference between man and man than between carthorses and racehorses, but it is one of degree only. *Fortes creantur fortibus*, and for perfect bodily aptitude for any trade, profession, or particular craft, the individual must be born, bred, and trained accordingly. We arrive at the following signs or evidences of health:—

a. Good construction; *b.* Accommodativeness to change, individual adaptability to widely diverse conditions of life, or of climate, without deterioration of energy; *c.* Endurance; *d.* Self-control—mental, emotional, sexual; and *e.* Resistance to morbific influences.

From birth onwards to old age health is not uniform; it varies as the body varies, according to wear and tear, and treatment—a sufficiently obvious proposition. At different epochs of life the strain, or stress, is felt in different parts, falls upon different organs, and issues in proclivity to disorder of their several functions, or in wear or degeneration of the tissues of which they are built. Our object here is to demonstrate how individual health may be secured; how disease-tendencies may be avoided or diminished; and how a reasonable measure of health may be attained throughout life, and at every period of it. To fulfil this endeavour we divide the life of a human being into the following periods, and consider them separately in relation to their special physiology, to morbid imminencies, and to probable accidents, laying down the best rules of guidance in diet, clothing, habits, exercise of body and mind; indicating whatever appears most conducive to the health of the individual at the age mentioned. It is of course of first importance to be born of a healthy, long-lived stock; but for heredity and its effects the reader is referred to the article DISEASE, Causes of.

Life periods.—The following are the periods of life, as they will be successively considered:—

1. **Intra-uterine life and Gestation.**
2. **Birth.**
3. **Infancy,** the period between birth and the completion of the first dentition.
4. **Childhood,** the period between 2 and 7 years.

5. **Adolescence**, the period between 7 and 14 years.

6. **Puberty**, the period between 14 and 20 years.

7. **Adult age**, the period between 20 and 30 years.

8. **Maturity**, the period between 30 and 45 years.

9. **Turning-time**, the period between 45 and 60 years.

10. **Advanced life**, the period between 60 and 82 years.

11. **Old age**, the period between 82 and 100 years.

1. **The Intra-uterine and Gestation Period.** The health, habits, and conduct of the mother during pregnancy modify the future individual considerably. Whatever affects the blood of the mother affects that of her fœtus, and *vice versâ*. There are grounds for thinking that the mother possesses and exercises purifying and excretory powers over the blood of her fœtus, appropriating into her own eliminating organs, and in some degree removing from her offspring, taints or disease-germs derived from the father of the child, perhaps suffering from these herself vicariously. This surmise has been offered to explain a fact not infrequently observed, that previously healthy wives, born too of healthy stocks, married to consumptive husbands, after breeding one or more children, tend to die themselves of a rapid form of phthisis, although bearing children not necessarily consumptive. On the other hand, delicate women who have been impregnated by exceptionally sound sires are observed to improve in vigour and robustness with each succeeding pregnancy. It is certain that smallpox, scarlatina, and measles may be conveyed by the mother to the child *in utero*; that typhoid fever occurring to the mother is usually fatal to her fœtus; and that the poison of syphilis derived from either parent is extremely pernicious to the growth and development of the fruit.

Alcoholic abuses committed by the mother during pregnancy favour premature delivery, and appear beyond this distinctly prejudicial to the health of the children when these are born alive, the constitutional flaw not showing itself by apparent malnutrition so much as by undue proclivity in them to manifest disorders of the nervous system—chorea and epilepsy in childhood, hysteria and insanity in adult years. Experience shows the hygiene of this period to consist in temperate living. The pregnant woman should avoid excitements of all kinds, take moderate exercise, rise and go to bed early, not alter her habits of life abruptly. In the later months she must dress herself appropriately to her state, not so as to interfere with the emerging of the uterus from the pelvis, or so as to limit the movements of the babe *in utero*.

2. **Birth.**—Beclard in his work (*Hygiène de la Première Enfance*, Paris, 1852) pointed out a fact of some importance in the hygiene of birth. When the fœtus with its membranes and placenta are separated from the mother, and independent existence is commenced, a good deal of blood, properly the newborn child's, remains and is for a short time after actual birth lodged in the cord and placenta. If time enough be allowed, and the newborn be kept properly warm the while, all this blood—some two ounces or thereabouts, and therefore no unimportant quantity when the weight of the child is considered—will find its way into the infant's body; whereas, if the cord be tied and divided too quickly, and before the umbilical vein becomes collapsed and empties itself, the child is mulcted of its natural blood-endowment. According to Pinard's observations, it is easy to distinguish the babies who thus receive their full complement of blood at birth from those who do not. The skin of the former is rose-coloured and well plumped out, whereas the skin of the latter has an anæmic or icteric tint, and is poor; the former infants grow and develop more rapidly, and are altogether more vigorous than the latter. As a guide to the accoucheur's practice, he inculcates careful observation of the cord at birth. All pulsation ceases in the umbilical arteries directly the newborn breathes and cries; but for some while, different in different cases, the umbilical vein remains full; and the blood in it continues liquid up to the moment when its last drop is absorbed into the child's body. But the cord must not be ligatured until the umbilical vein is flat and empty. The accidents incidental to birth are multifarious, and belong to the subject of parturition. We may notice specially asphyxia from prolapse and compression of the cord; and prolonged pressure upon the infant's skull inducing epicranial cephalhæmatoma, and, rarely, apoplexy and paralysis.

If the temperature of the external air is about 60°, children may be allowed to go out when they are eight or fifteen days old, after cicatrisation of the umbilicus. Children born in February and September appear to possess the greatest vitality, those born in June the smallest. According to statistics carefully collected by Dr. E. Smith in his work on *Health and Disease*, p. 267, 'the viability of the infants born in the winter and spring months is greater than that of those who come into the world in summer or autumn.'

No artificial purgative oil, gruel, or sugar-water, should be allowed in lieu of the mother's first colostrum milk.

3. **Infancy.**—The period of infancy might be subdivided into *early* and *late*; *early* comprehending the time from birth to eruption of the first teeth; *late*, that from the commencement to the completion of the first dentition. The leading anatomical feature of this age is the large amount of blood relatively to the solids of the body, the laxity of all the tissues, the disproportionate quantity of component water, and the large relative amount of red blood-corpuscles and of iron, which appears far in excess of that existing in adults. See E. Smith's *Cycle of Ages*, p. 247.

The circumstance of chief physiological importance is that the greatest growth occurs in the first years of life. Quetelet in his essay, *Sur l'Homme*, shows that the near average weight of male infants exceeds that of females; boys at birth weighing 3 kilogrammes 20 grammes, and girls 2 kilogrammes 9 grammes.

There is no indicator so infallible as the balance to prove whether an infant is or is not being properly nourished. It appears that from birth up to the end of the second day all newborns lose weight a little; they do not increase perceptibly till after the end of the first week.[1]

M. Odier states that it is usual to find an infant increase 30 or 40 grammes (461 to 606 grains) *per diem* during the first five months of life, 20 grammes (308 grains) a day from the fifth to the eighth month, and 10 grammes (or 155 grains) daily between the eighth and the twelfth month.

Dentition is the change most characteristic of the infant's growth and development.

In infantile life all the vital functions go on rapidly. The pulse at birth ranges from 130 to 140 per minute; and to the end of the first year is from 115 to 120. The rate of respiration is from 25 to 30. While the circulation is rapid, the skin, from its softness and vascularity, disperses heat rapidly; the cooling agencies are at a maximum; and the heat-maintaining powers, (that is, resistance to depressing influences) are at a minimum. 'The food taken by infants is, in proportion to the weight of the body, from three to six times greater than that taken by adults.' (Dr. Smith, *op. cit.*, p. 247.)

The perils from without to infant life are mainly derived from cold, those from within result chiefly from improper or defective feeding and hyper-nervous impressionability. It is not easy to over-feed young infants. If proper food, that is, their own mother's milk, be given them, they get rid of excess quickly enough by vomiting it, and the part not appropriated in growth or maintenance is stored up for future use as fat. The morbid tendencies of this age are towards the intestinal and mucous tracts. Catarrhal diarrhœa and bronchitis, thrush and stomatitis, are epiphenomena of all febriculas and states of malnutrition. Delirium and convulsions attend all general disorders. Over-rapid dentition is associated often with tubercularisation, retarded dentition with rickets. The more rapid the eruption of the teeth, the greater the attendant disturbance; the more closely the evolution of the teeth follows its normal periods (*see* TEETHING), the less conscious are infant and mother of their appearance. The hygienic rules for this period have reference principally to feeding, cleanliness, clothing, and open-air exercise.

DIET.—For diet the reader is referred to p. 362, where the proper aliment for infants is fully discussed. Experience proves that nature will not be contradicted—that no aliment is so appropriate as the milk of a mother, or of a wet nurse aged between twenty-two and thirty-five. Next best to this comes suckling by a goat; and next, again, a mixture of equal parts cow's and ass's milk given by a feeding-bottle. The suckling of her own infant by the mother for nine months is good not only for the child but for its mother. The uterus passes through its retrograde involution more properly, no periodic uterine congestions delay it, and ovulation is deferred. With respect to the frequency of feeding, and the quantity taken, the reader may be referred to the statements of Proust.[1] During the first day of life, what with scantiness of the colostrum, mechanical obstacles to suction, and the weakness of the infant's efforts, the child does not extract more than a drachm each time it is placed to the breast. It needs no more, however. During the first week of life it should be nursed ten times in the twenty-four hours, arranging times so that the mother gets six hours' consecutive rest at night. On the second day each suckling should furnish about 5 drachms of milk. On the third day each suckling should furnish about 1½ ounces of milk. On the fourth day each suckling should furnish about 2 ounces of milk. During the first month average-sized infants require and obtain nearly 3 ounces of breast-milk at each nursing, and should be nursed nine times in the twenty-four hours, or receive about 27 ounces of milk a day. During the second month each suckling should furnish 4½ ounces of milk, and the number of feedings may be reduced to seven *per diem*, which allows 31½ ounces each twenty-four hours. At three months old the infant sucks about 5 ounces at a meal, an equivalent of 35 ounces each twenty-four hours; and at four months it extracts as much as 6¼ ounces of milk at each meal, which may be again curtailed to six each day, giving 37½ ounces of aliment. This continues to be the quantity of milk and frequency of feeding required of a good nurse up to the end of the ninth month, but the quality of the milk during this period steadily improves, becoming enriched according as the child sucks more vigorously and at longer intervals, a provision fraught with mutual advantage to child and mother.

At the ninth month the child may be gradually weaned, although the age for weaning should be governed by the health of the mother or nurse, the forwardness of dentition, and the infant's own craving for other food. The best time to seize for the purpose is the interval or pause after the four lateral incisors are cut, and before the first molars appear.

Dentition, normal order of.—The two inferior incisors should pierce the gums between the fourth and seventh months; their eruption is attended by a slight six days' disturbance of health. Between the eighth and tenth months the two superior incisors and two superior lateral incisors appear within three or four weeks of each other, their eruption also being attended by slight fever and restlessness. A pause now ensues of from six to twelve weeks' duration, after which, and at some period between the twelfth and fifteenth months, six more teeth burst through within a few weeks. First, as a rule, come the two first molars of the upper jaw, then the two lower lateral incisors, and lastly the two lower first molars. Again a pause follows, lasting from eight to twelve weeks; and now, between the eighteenth and twenty-fourth months, the two lower canines appear, the upper ones succeeding them. Very little disturbance marks their eruption. An interval of six months now intervenes, and between the thirtieth and thirty-sixth months, or nearly on the completion of its third year, the child acquires its four last or permanent molars, the lower preceding the upper, and their cutting being attended often by general disorder, croupy symptoms, diarrhœa, and convulsions.

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[1] The infant should be weighed naked in a warm room lying on a piece of flannel of ascertained weight, in the scale of a balance sensitive to a drachm.

[1] *Traité d'Hygiène*: Paris, 1877, p. 115.

Cleanliness and Care.—The infant requires washing all over from top of head to sole of foot night and morning every day, and is best, because most quickly, immersed in a tub once daily. Infants who have had convulsions at any period of their lives are, as a rule, better washed all over with a sponge in the lap of their nurse than immersed in a bath, as immersion is apt to frighten them. The water should be the softest procurable. Rain water is best. The temperature of the room during the bath should be between 65° and 70° Fahr.; that of the bath itself, fixed by the thermometer, between 70° and 90°. Fixing the temperature of the bath should not be left to the possible indiscretion of a nurse; many a woman's hand will support water at a heat enough to parboil a baby.

The nurse should be required not to dawdle over bath or dressing; the former should occupy five minutes, the latter not more than twenty. Little or no soap, or only soft soap, should be employed. The drying should be accomplished with soft dry cloths, and for baby powder, to prevent excoriations, fuller's earth cannot be surpassed. Eczema and intertrigo are obviated by due attention to the frequent change of diapers and sufficient cleanliness.

Clothing.—No infant ought to be swathed like a mummy; it requires keeping warm, but should not be overweighted with clothes. Its chest must be free to expand, its limbs at liberty to move. The more lightly its head is covered, and the more quickly all caps are dispensed with, the stronger will be its hair and the less its susceptibility to catarrh. Nightcaps are dirt-traps, and in all classes alike promote scalp eruptions by provoking perspiration, with which the skin is softened, and by whose decomposition the sebaceous follicles are irritated and clogged.

General Rules and Hygienic Advice.—Even the youngest infants require sunlight and open air. Due discretion must be employed, however, in sending them out. They are better carried in their nurse's arms, and thus assisted to maintain their own heat by that derived from their nurse's body, than placed in perambulators. So soon as they can crawl they should be encouraged to do so, either on a carpet, in a garden, or on a dry, sandy pathway protected from wind and open to sunlight. Cold and dark places are specially inimical to them; and when the weather is cold they should be encouraged to amuse themselves on a blanket or soft hearth-rug, so as to learn to stretch their limbs and co-ordinate all their muscular movements. They learn first to sit up, then to stand, helped by their arms, against a chair, next to stand without support, and at some period between one year and two years of age should be able to walk about by themselves.

Sleep.—Infants require day as well as night sleep. Very young babies do little else but suck and sleep. As they grow they need and take less and less sleep, and by the time first dentition is accomplished—three years of age—a child may usually dispense with day sleep altogether, except a short hour's nap early in the afternoon or between eleven and twelve. Sound sleep coincides in the infant, as in the adult, with short sleep hours, and the strongest children require least sleep. The infant should have its own cradle, and the child its own cot, placed close beside the bed with its mother or nurse. In extra cold weather, hard frosts, the cot should be artificially warmed by a hot water-bottle. The sleeping nursery ought not to be kept warmer than 65°, or colder than 50°, whilst the nearer it is maintained to 55° during the winter months, and 65° during summer, the sounder the child will sleep. The more freely the whole house and nurseries are ventilated, the less prone the infant will be to all infantile disorders.

4. **Childhood.**—In this period, between the second or third and seventh years of life, the first dentition is accomplished, the second uncommenced. The rate of pulse falls from 115 to 90 per minute, and respiration commensurately. The excretions are all absolutely increased. In the co-ordination of muscular movements and in mental operations great progress is being made. The cerebro-spinal structures, which nearly double in volume between birth and the second year, continue to develop disproportionately to the growth of the trunk and limbs between two and seven. The cellular tissues are loose and vascular still, and the cutaneous and mucous surfaces therefore extra vulnerable. A notable physiological feature of this age is the readiness to swell observable in the lymphatic glands upon the slightest irritation, and the general functional activity of all the lymphatic structures. It might be distinguished as the life period of greatest *lymphatic activity.* From these facts the morbid imminences may be inferred, namely, a tendency to eczema and to catarrh of mucous surfaces, diarrhœa, laryngeal and bronchial catarrh, general anasarca, hydrocephalus, susceptibility to contagious impressions, proclivity to tubercular meningitis, and to functional cerebral disorders like delirium and convulsions. The incontinence of urine, so frequent in early childhood, may be likewise referred to the reflex irritability of the spinal centres characteristic of this age. According to Lébert the cerebellum attains its largest size, relatively to the cerebrum, between four and five, to which circumstance has been referred the occasional sexual excitability and vicious practices discovered in some children at this early age. However this may be, the importance of good nurses and wise supervision cannot be too much insisted on, as also the inculcation of healthy habits and provision of proper amusements and employments.

Diet.—While bread, starch, and flesh foods are taking the place of cows' milk very greatly, they must not be allowed to wholly supplant it. Eight ounces of bread may be reckoned about equivalent in nitrogen content to one pint of milk, but the former exceeds the latter in carbon. The food must be nutritious and abundant. The error committed is far too often that of under than of over-feeding. Young children do not require so much variety in their food as adults do, but are greatly benefited by a change in their bread and meal stuffs, and a dietary not too monotonous. They do not need meat more than once a day, and fish may be substituted for meat, if cream or butter sauce be provided with it, once or twice a week. Milk, bread, porridge, suet puddings and milky puddings should form the staple of their dietaries; fresh vegetables well cooked, watercress, cooked fruit and oranges are most useful adjuncts; while the addition of fried bacon, clotted cream, and oil, or butter, when the drinking water is hard, and the tendency of the child is rather towards constipation than otherwise, is now fairly generally understood. It is usually easy and always beneficial to instruct young children to secure an alvine evacuation directly they rise of a morning and before their bath. Four meals a day are most appropriate—a breakfast at eight, a dinner at twelve, a tea at four, and a supper at eight.

Cleanliness.—Washing all over once a day, and in the morning, is as necessary as ever; but after first tubbing in warm water between 98° and 100°, the child should stand up and be sponged all over from a basin of cold water, and be briskly dried with a large towel.

Sleep.—A child should sleep in a cot or bed by itself, but in the same room with its parent or nurse, since they are apt to show any disorder by night vagaries, delirious talking, restlessness, or sleep-walking.

Between two and five most children are the better for twelve hours of sleep out of the twenty-four. At seven years of age they do not require day sleep, but should be in bed at eight, and up at six in summer and between six and seven in winter. The best bed for this age is an ordinary iron bedstead, with firm and level wool and hair mattresses; not spring beds, which do not adapt themselves so well to light bodies, or keep them uniformly warm. Cotton sheets, blankets, and counterpane must be used according to season. Beyond saying that the day clothing should be warm, and merino or wool put next the skin, we can add nothing further about clothing.

Exercise.—Two things are requisite for healthy growth and development and a happy childhood—a play-room and a garden. Children need a place like an empty barn, in which they can swing and amuse themselves in wet and wintry, as well as in hot sultry weather, practising those games which are requisite alike for the schooling of their muscles and nerves.

Teaching.—Teaching such as they need should be conducted on the Kindergarten system; but the main rule for their lives is open air and exercise, the chief objects being to harden their skins, develop their muscles, and teach them self-control, love and respect for those to whom they render implicit, because well-nigh unconscious, obedience.

5. Adolescence.—The consideration of this, the period of second dentition, between the ages of 7 and 14, is best prefaced by the order of eruption of the second teeth.

About 7 years the 4 anterior molars (permanent teeth) are cut.

About 8 years the 4 central incisors.
„ 9 „ 4 lateral incisors.
„ 10 „ 4 anterior bicuspids.
About 11 years the 4 posterior bicuspids.
„ 12 to 12½ 4 canines.
„ 12½ to 14 4 posterior molars.

The teeth of the lower jaw usually precede those of the upper. Second dentition is accomplished leisurely, and accompanied therefore usually by no such grave disorders as mark first dentition; but in nervous children nervous tricks may manifest themselves, as well as marked lack of emotional control. Some are hypersensitive, others contradictory and difficult; and most parents admit that between 7 and 8, if not between 7 and 14, they learn what the characters of their children really are. Physiologically, absorption of the subcutaneous fat goes on rapidly, while the muscles become more pronounced, the skin gets tougher, its epidermis harder, and it perspires less readily. In our climate the morbid tendencies of this age are to rheumatism, chorea, epilepsy, the exanthemata, and typhoid fever.

Between 7 and 8 the appetite is apt to become capricious; the child physiologically does not require so much hydrocarbonaceous food; and, while growing fast and becoming leaner, protests against fat, often while showing marked longing for fresh fruits, in which nature should be indulged. After 8, however, any marked defect of appetite or loss of weight is suggestive of undue cerebral excitement, attributable to overstudy or some infraction of the laws of health.

Diet.—Three good meals a day are sufficient, but four are more advisable. Constipation at this age signifies usually irregular feeding and overloading with pastrycook supplies, or improper food. Breakfast at eight, dinner at one, tea at five, and supper at eight appears the best distribution. By supper is meant such a meal as growing lads and girls positively need. They require either soup and potatoes, and bread and butter, or some one hot dish of meat or fish, and the drink should be either warm milk or cocoa to about half-a-pint of fluid; aliment enough is needed to improve the circulation at the extremities and obviate chilblains. Boys and girls may retire to bed within an hour of their supper, which, instead of making them dream, will secure good and refreshing sleep. The greatest dangers at this age arise certainly from defective nutrition and an over sensitiveness of the skin. Neither wine nor beer is necessary, nor should it be allowed without medical authorisation.

Clothing.—The objects of clothing are warmth, cleanliness, and convenience. Cotton or silk shirtings should lie next the skin of the chest and trunk. Merino, flannel, or woollen materials should protect the legs and feet; cloth, woollen jerseys, furs, and skins are better adapted for external coverings. But a whole chapter could be devoted to the foot alone, and its clothing during its growth and development. The desiderata appear to be length and breadth enough, low heels, impervious soles, old and flexible skins for uppers. Boots for out-door exercise are advised for children, because their ankles need support; shoes a little later on, because they are cheaper and do not repay re-soling, and may be discarded at once when worn out. The same boots should not be worn day after day, they require time to dry properly in damp weather, and the foot at that age profits by change of pressure. During youth the adaptation of clothes to special sports and exercises is far from unimportant to health. For violent muscular exercise flannel or merino next the skin, and an easy flannel jacket or over-jersey should be worn; both after being used should be hung up to dry and air before being worn again. It is well that youth should be reminded that rheumatism is probably too often inflicted upon those who are careless about their dress, and negligent enough to wear the same clothes which have been saturated over and over again with the secretions from the skin.

Rest and Exercise.—These are requisite for both body and mind at this age; the duty belongs to parents and schoolmasters to study what is appropriate. We annex, therefore a table from Friedländer, which shows how the twenty-four hours may be wisely apportioned:—

Age.	Hours for			
	Exercise.	Work.	Leisure.	Sleep.
7	8	2	4	9 or 10
8	8	2	4	9 or 10
9	8	3	4	9
10	8	4	4	8
11	7	5	4	8
12	6	6	4	8
13	5	7	4	8
14	5	8	4	7
15	4	9	4	7

6. **Puberty.**—The physiological feature of this age is the more rapid growth of the whole body, and the gradual perfectioning in their functions of its several organs. The human plant attains the fulness of its organic life, and the energies are rather expended on corporeal formation than on intellection (if we may coin such an expression). Growth in man, as in plants, proceeds by fits and starts, succeeded by periods of quiescence; seasons affect it, so do supplies of food; boys do not develop so rapidly in autumn and winter as in spring and summer. Girls at this age often fall back, as it were, a little in winter, when they are much more confined indoors, to make a greater push forwards in spring.

It is even difficult for the digestive and assimilative powers to keep pace with the bodily requirements, so that the tendency is for the temperature of the body to fall somewhat, to be ill maintained at the extremities, and for the cold bath to be shunned for lack of adequate reaction in those who are manifestly growing very rapidly.

The heart in some is hardly equal to the task set it, and when diseased we perceive both growth and the attainment of puberty retarded. The lungs, again, as Dr. E. Smith pointed out (p. 288, *op. cit.*), more often in girls than in boys, do not expand in proportionate ratio with the rest of the body. The body runs up tall, but the thorax remains narrow and flat, and the apices of the lungs approach too closely to each other. The definition of a line—length without breadth—is too closely imitated. The morbid imminences of this age are few: disorders of the nervous system, chorea, and epilepsy may arise; anæmia and rheumatism are common enough. Girls suffer more than boys, probably in consequence of insufficient gymnastic exercises, overstudy in cramped postures, and from that folly of follies, a forcing-pit education, 'all articles warranted to be turned out highly finished by eighteen years.' It is the age of all others when good or bad habits of life are formed; the time, too, when the seeds of disease are sown broadcast, to spring up in the after age of man- and womanhood.

Diet.—Food should be abundant, varied, but unstimulating. Three or four moderate meals a day are requisite; if at any period of life fermented liquors are beneficial, now is that time. Light bitter unadulterated table beer or claret and water should be provided at dinner, but not more than half or three-quarters of a pint of it allowed. If violent exercise has provoked thirst, this may be satisfied with plain water or toast-and-water *ad libitum*. Girls should take cocoa-nibs for breakfast, with bread and butter, meat, eggs, bacon, or fish, as much as they like. School dietaries err usually on the side of deficiency. At dinner, as well as substantial meats, fruits, vegetables, suet and milky puddings are required. Tea should be allowed only once in the twenty-four hours, at six o'clock, and a warm supper be provided at nine o'clock.

Clothing.—Nothing need be added to what has been already advised. Without entering into minute particulars, it should be seasonable, rather extra warm, and offer no uncomfortable restraints. When mothers complain of their daughters' neglected figures, the hygienist retorts, What gymnastic exercises did you require of them? It is the age for exercise of the body as well as of the mind; boys' spines are straight and girls' backs crooked because the former use all their muscles and the latter do not; as the body is making its most rapid growth, so the evil of unilateral use of muscles is particularly baneful. Sitting over-long in a slouching attitude will tend to contract the chest, as carrying too heavy weights over the back will spoil the normal spinal curves; so leaning too much on one side, standing too long on one foot, even carrying constantly a pocketful of articles on one side of the dress, will suffice at this age to induce spinal curvature. The daily use of the trapeze, swinging, playing games like *la grâce*, in which both arms are used, badminton, and lawn-tennis, in which arms and legs are employed, and every muscle brought into due action, are quite essential to the proper development of the thorax and the muscles of the trunk. Girls should row and run and ride and swim and skate no less than lads do, in order to become fit mothers for a nation like ours.

The best temperature for a sitting-room is 60°; that for a sleeping-room between 50° and 55°. The hygiene of the bedroom and the bed needs a few words. The temperature of the room should not rise above 65° in summer, or fall below 45° in winter; it must be thoroughly ventilated with a constant amount of fresh air passing through it during the day. The deside-

rata for a bed are coolness for the spine, restfulness for the trunk muscles, and warmth without too great heat or too burdensome a weight of bedclothes: all objects are well attained by a French *somnier elastique.* A horse-hair bolster is preferable to a pillow, and a paper pillow to a feather pillow; a feather pillow enwrapping the neck and head heats the upper part of the spinal cord undesirably. Posture in bed is not unimportant. The head should be low, the feet perhaps a trifle raised, certainly not dependent. 'Sleep not on your back, as a dead man,' is a maxim attributed to Confucius; the opposite attitude, on the stomach, is restrictive of the intestinal movements, and uncomfortable. It is as well to begin the night lying upon the right side so long as food remains in the stomach, and to turn on first waking upon the left side. The best attitude is probably that crouched one habitually selected. Good advice is to stretch yourself straight whenever you wake, in order to render the circulation of the blood freer. In winter the arms should lie under the clothes, in summer above them.

The cold bath, or cold sponge, or shower-bath should be taken by the robust every morning; with an occasional warm or tepid bath once a week, for cleansing purposes, throughout summer and winter. Whilst the young of both sexes should be encouraged to swim, in seasonable weather, the length of time they stay in the water must be strictly limited according to the temperature.

We abstain purposely from any discussion of the hygiene of *mental* education.

7. **Adult Age.**—This is the prime of life, between 20 and 30. Anatomically, the body broadens, the chest deepens; for feats of muscular prowess—short, severe labours—it is at its best. The intellectual and cerebro-spinal sexual energies are at their maximum. What the French call the greatest latitude of health, that is, strength, exists at this period; severe strains are supported with apparent ease. In male adults the body gains weight by small amounts for about twenty-eight days, then relapses to its normal average by a sudden crisis, attended by head-heaviness, loss of appetite, and copious discharge of urine, or seminal evacuation. It is not a time about which the hygienist has much to say. If the preceding periods of life have been wisely ruled, the individual is at his or her best. The morbid imminencies directly belonging to this age should be few, and certainly are usually due to direct contravention of the laws of health: to exposure to contagious influences, to irregular living, especially drinking, to excessive strains upon the heart or its blood-vessels, to pulmonary inflammations, to contravention of proper sexual relations, to over-emotional excitement, or to mental worry and loss of sleep.

The guiding rule for this period is succinct enough: '*Sustine et abstine.*'

Qui studet optatam cursu contingere metam
Multa tulit fecit que puer sudavit et alsit.
Abstinuit Venere et Baccho.

Hitherto excess in feeding was difficult to effect, quickly punished, and admitted of rapid and spontaneous repair; but now he who would rise above the ruck must rule with a tight rein all his appetites. The penalties are not exacted directly after the offence is committed; they are kept in store, but nature inflicts them with pitiless justice.

Total abstinence from alcoholic drinks may be recommended. Not only does it favour health, but lessens all the temptations incident to these important years, in which a man carves out his own career. A question not infrequently propounded is, How shall I know when I have eaten more than is good for me? If individuals are dull or drowsy after a meal they have usually eaten too much; if they can converse, write, or transact business with ease after a meal, they have fed temperately.

Women may be advised to marry not earlier than 21—between 21 and 28—when in our climate they are best fitted to become wives and mothers. Men had better wait till between 28 and 35 to undertake the responsibilities of being parents. For the generality of men and women we must insist once more on their not giving up out-of-door muscular exercises. An entirely sedentary trade or office-life cannot be a healthy one for either body or mind; the latter appears to suffer most from it—the sense of morality becoming blunted. When the struggle for existence is so severe that, with early rising and very limited hours of sleep, no leisure hour remains for sports or amusement, the time has arrived for emigration, war, enforced military service, or revolution.

SLEEP.—Doubtless different constitutions and individuals differently employed require different amounts of sleep. While nothing dulls the intellect and weakens the recuperative faculties more than too much sleep, except over-feeding and drinking at this age, so few things are more certain than that a man may rise too early for making the best use of his twenty-four hours. He must live in the world and keep the world's pace still. John Wesley's advice in this matter is worth recording. He writes that any man can find out how much sleep he really requires to repair his nervous system by rising half an hour earlier every morning until he finds that he no longer lies awake at all on going to rest in bed, or wakes up until it is time for him to get up. Six to eight hours is usually ample for healthy adults, with nine hours every seventh day. The mistake too often made is that of endeavouring to make up for overhard mental efforts by over long sleep hours. Mental over-fatigue is to be repaired not by sleep but by bodily exercise in the open air. Exercise directs the blood-flow from the head towards the muscles, and renews the appetite. As we have pointed this out as the suitable age for marriage, we may mention some things which conduce not slightly to healthful and happy marriages: parity of station, similarity of temper and tastes, and no disproportion either in age or size.

8. **Maturity.**—The body has now reached its maximum weight and solidarity, and the period is that of maximum endurance. Men reach their full weight at 40; women later, sometimes not till 50. At this age the soldier is fittest for service, the labourer for work, the artisan and professional man for their respective duties.

High to soar and deep to dive is given to man at thirty-five.' The morbid tendency is towards anæmia and obesity, the former promoting the latter, and both alike being determined by a too sedentary town-life and by daily occupation in close, ill-ventilated, and badly-lighted chambers. Now are perceived the first attacks of gout; whilst visceral degenerations and atheroma of arteries may manifest themselves—events all of which may be delayed, if not wholly prevented, by attention to the laws of health. It is desirable that each individual should pay heed to his weight at this age, since this indicates whether or no he is living wisely. Celsus (*lib.* 2, *cap.* 1) writes:—'Corpus autem habilissimum quadratum est neque gracile neque obesum. Nam longa statura ut in juventa decora est sic maturâ senectute conficitur. Gracile corpus infirmum, obesum hebes est.' When, however, men are engaged in trades or professions there is no more difficult task than to maintain their weight at this age, the *juste milieu* referred to being a hard matter to secure. The advice given by Celsus (*lib.* 1, *cap.* 1) cannot be surpassed in force or brevity: 'Sanus homo qui et bene valet et suæ spontis est nullis obligare se legibus debet; hunc oportet varium habere vitæ genus, modo ruri esse, modo in urbe, sæpiusque in agro, navigare, venari quiescere interdum; siquidem ignavia corpus hebetat labor firmat.' As to diet, clothing, and habits, we need add nothing to what has been already advised for a previous age; but on exercise of body and mind there is much to be written.

A good rule is laid down by Lynch, too, in his *Guide to Health* (p. 290), that the lean should exercise *ad ruborem*, *i.e.* to glow-point, or until their bodies and spirits are heated, for that will fatten them; and the fat *ad sudorem*. The more luxuriously a man lives, the more exercise, and the more active exercise, he needs. Want of it, and the costive habit thus superinduced, may, as Kotzebec observes, extinguish the divine flame of genius and seriously impair the intellectual powers. Hypochondriasis and hysteria are the special punishments of ease and affluence and indolence. Obviously a portion of each day should be set apart for exercise. In the households of the wealthy a gymnasium is at least as important as a bath-room; and twenty minutes every morning before breakfast might well be devoted to breathing the muscles—that is, calling into play every muscle of the trunk and limbs. The chest should be expanded by clubs and dumb-bells; swinging on the trapeze, and hanging by the arms and legs, may be recommended. Again, before forenoon or mid-day meal, an hour's ride or walk must be obtained, and a third time in the day an hour and a half's exercise—fencing, or walking, or rowing—should be arranged before bed-time, in the spring and summer seasons. A great point is to vary the exercise by every means at hand; to change the set of muscles called chiefly into play upon different days, as Celsus advised; to swim, ride, fence, sail, row, shoot, fish. Lastly, we can recommend only those who are very robust to take a long walk before breakfast. Bodily exercise should not be undertaken immediately after a heavy meal; nor should those who have sweated themselves violently sit down at once to a full meal—at least an hour's rest should intervene.

Mental exertion is advantageous to health; even carried to excess, it lessens, rather than increases, waste of tissue. Over-work of a mental kind, with anxiety, appears attended by lessened appetite, lessened nutrition, and loss of body-weight—proof positive of detriment received.

9. **The Turning Period.**—This period of life, which lies between 45 and 60, is also known as *the grand climacteric*, or *middle age*. The skin wrinkles. Up to 60 years of age the skull may continue to increase in size, principally at its anterior part, by enlargement at the frontal sinus; after 60 the skull-cap loses weight, and the brain may waste but gets tougher and firmer. The heart grows a little larger, and its walls are thicker. The lungs grow denser, a change common to every tissue of the body. The hair grows gray; the features sharpen; the sight alters; and the hearing grows dull. Pressure and wear and tear begin to tell at every part. Upon the blood-vessels their effects are more marked in males than females, because ordinarily the former labour harder than the latter; further, the death-rate of men is greater than that of women at this age. As the sexual powers decline, which they do by a quick descent between 46 and 63, the intellectual powers increase, so that mentally there is often exhibited a marked increase of vivacity and agreeableness, more noticeable in men than in women. In the latter the cessation of the catamenia is attended usually by some rejuvenescence, attributable to their recovering a little embonpoint. It is an age, however, at which women kick rather, and become restless and uneasy, the change of life being attended in many by a renewal of their juvenile tempers, as between 7 and 14, and occasionally by a revival of their youthful ailments, as eczema, skin eruptions, and various neuroses, insomnia, hysteria, and sometimes epilepsy. In character, whatever obstinancy exists reaches its climax.

Morbid Imminences.—The inflammatory disposition is lessened, but there is a tendency to venous plethora of the abdominal viscera and towards vicarious hæmorrhages. Gout assails its victims with well-characterised attacks. New growths, simple and malignant, tend to demonstrate themselves, and rheumatoid arthritis to appear. Dr. Waterhouse, in a letter to Sir T. Sinclair, published in his *Code of Health and Longevity* (vol. i. p. 33, Edinburgh, 1807), notices the three following periods as very important in every human life, as sickly or moulting times. The first he had noticed to befall males chiefly at thirty-six years of age, when the lean person becomes fatter and the fat kine leaner. The second sickly period happens at some time between forty-three and fifty, and lasts a year, or perhaps two. During it the complexion fades, the appetite fails, the tongue becomes furred at the smallest over-exertion of body or mind, the muscles are flabby, the joints are weak, sleep is unrefreshing, and the spirits droop. It is no particular organ that suffers, but a uniform deterioration that is manifested. At this time a man first experiences a reluctance to stoop, prefers a carriage to riding on horseback, and perceives each change of the weather affect him. This observation of Dr. Waterhouse has, according to the experience of many, much justice in it; as also that between sixty-one and sixty-two a similar deterioration of health takes place, but with aggravated symptoms.

Hygienic Rules.—At the menopause women should be advised to abstain, as a rule, from alcoholic drinks, and avoid highly spiced and seasoned dishes. They may be recommended to take meat not more than once daily, and to live chiefly on farinaceous food, milk, eggs, vegetables, and fresh fruits. A tablespoonful of lime-juice taken twice daily occasionally for a week or ten days at a time has a salutary, depurating effect upon both stomach and kidneys, and clears the tongue when this is foul in the morning. Riding and walking exercise are highly appropriate, but very violent muscular efforts should be avoided. If the individual be thin and growing thinner, the clothing should be extra warm. Flannel abdominal belts may be worn advantageously in all seasons, but especially in autumn and winter.

Both sexes should avoid emotional excitement and the stimulation of waning sexual abilities. Prolonged exposure to wet and cold is sure to be seriously resented. Hot or Turkish baths, succeeded as they should be by cold plunge or douches to remove the lassitude otherwise provoked, are very beneficial, and taken once a week may be safely indulged in throughout the year. It becomes extra important as the subcutaneous fat gets absorbed, and the skin wrinkles, to keep its pores clean and open and capable of perspiring.

10 and 11. **Advanced Life, and Old Age.** The period of advanced life—sixty to eighty-two, and old age, from eighty-two upwards, may be advantageously considered together. When a man turns his toes out much in walking and treads upon the whole base of his foot, and is always stopping to look back, he is already old. The sagacious 'boots' at an inn can tell a man's age by the state of his shoe-leather.

'*Senectus ipsa morbus insanabilis.*' Some degenerate earlier than others, but the decline of life is characterised in all human kind alike by an indurating condition of every tissue diametrically opposed to the cellular softness and laxity of infancy. The capillaries thicken, the arteries harden, the nutritive metamorphoses proceed more slowly. The muscles waste; the subcutaneous fat lessens; the blood becomes poorer and paler; the skin dry, sallow, and wrinkled; further, it gets less vascular, and the mucous surfaces become relatively more so. The teeth loosen and fall out; the gums recede from them; and the digestive juices fail. The arteries become atheromatous and calcareous, lose their elasticity, and are liable to fibrinous thromboses, or to embolic pluggings; and while they tend to block up at one part, their coats may split and yield to pressure, bulge out, and form aneurisms or dilatations in other directions. Hence happen apoplexies, brain-softenings, and senile gangrenes. The heart up to an uncertain period grows progressively larger and more muscular, to meet the obstacles offered to the circulation; but finally it, too, degenerates, and its walls grow thinner and dilate. The air-cells of the lungs lose their elasticity, and progressively enlarge; then merge into each other; and become emphysematous at the edges of the lobes where least supported. Emphysema implies degeneration of capillaries and diminution of aërating surfaces; and as the pulmonary area becomes thus lessened, the right heart becomes hypertrophied and dilated.

The dryness and lessened secretion of the skin cast harder work upon the kidneys in eliminating water, and increase the disposition to catarrhal fluxes from the nasal passages, the bronchi, and the intestines. Thus, while there is a constant predisposition to skin-irritation from its dryness, and to eczema from scratching and rubbing it, the other morbid imminencies towards bronchial catarrh and diarrhœa very closely follow the direction given them by the season of the year and greater or less degree of external cold. The bladder grows thicker with age, and its capacity is less; the prostate gland enlarges. Few persons after 60 pass seven hours in bed without requiring to micturate. Dr. Rush regarded the necessity for more frequent micturition the first symptom indicative of a man's years impairing his bodily functions. The pulse feels firmer and fuller; fills quickly after food is taken; but falls in frequency and flags in power in a marked degree after fasting. It is a far less trustworthy indicator of the gravity of any febrile disorder, or of degrees of asthenia, than it was in youth or middle age; and it fails to point to the practitioner the nearness of death, unless he have large experience of it.

There is a default of reaction manifest in advanced life, so that all acute disease is clinically less easy of recognition, and the beginning of the end is therefore apt to pass unobserved. The thermometer warns the doctor of changes which old people do not notice themselves, but which it may be of considerable importance to notice. A slight elevation of temperature means much in old age, and should be heeded accordingly. The slightest change excites a young child; nothing seems to move the old man. In extreme old age life is little more than vegetative existence; the individual eats and sleeps and dreams. The sleep the aged get by night does not satisfy them. Memory is one of the first mental faculties to become impaired, but finally every sense and faculty fail. Up to 75 the strong of both sexes retain their digestive powers, and a fair amount of mental and muscular vigour.

Hygienic Rules.—A prime necessity for old age is warmth; nothing kills the aged so certainly as cold. It is of first hygienic importance after 75 that the individual should be loved and cared for; old people do not, perhaps cannot, take care of themselves.

Those who live longest and enjoy the fullest measure of activity are those who do not overtax their stomachs when their teeth begin to fail them, and who adapt their aliment to their enfeebled powers of mastication by having their food properly cooked for them. Stews, minces, meats boiled and afterwards baked—cooked, that is, twice—are more easily digested than fresh roasts or close-fibred meats. A moderate amount of wine both cheers and comforts old people; a glass or two of good Burgundy or of champagne, and an occasional glass of old port wine, is most beneficial to aged persons, and is better for them than overloading their stomachs with milk and farinaceous foods.

Great attention should be paid to the functions of the bowels and of the skin. Galen pointed out that old people should not suffer their bowels to remain costive beyond two days; on the third they should take some gentle purge, such as by experience they have found adequate to open their bodies. A hot bath once a week, and a hot foot-bath every night, may be advised. A short nap after breakfast and before dinner is the natural habit of the aged. Further, their clothing should be extra warm, and their chambers night and day be heated. They should be encouraged to go out in the open air only in seasonable weather, and when they are equal to it should take a little walk on a dry gravel path in some warm locality, sheltered from north-easterly winds. All change and cheerful society is good for them. If their purses admit of it, they should follow the swallows to warm winter quarters. If they must winter in England, let them shut themselves up throughout it in a well-warmed house.

Summary.—Advice for every age may be thus briefly given: for infancy and childhood—*sustine*; for adult years—*sustine et abstine*; for old age—*sustine* again. There is less need now to enjoin *abstine*.

The hygienist, however, seeks not to lengthen out the days of age and decrepitude; his art is not to prolong life beyond its natural term, though this may come subordinately, but to render its period of activity and utility longer—'*Hic labor hoc opus est.*' Some cynic observes that we have pointed out very few habits as worth cultivating, the truth being we believe what we have insisted on—that most bodily habits need resisting. Individual health is attained by self-denial; habits imply self-indulgence.

Reginald Southey.

PERSPIRATION, Disorders of.—Synon.: Fr. *Troubles de la Sueur*; Ger. *Störungen des Schweisses.*

This subject will be discussed in the following order:—1. Hyperidrosis; 2, Anidrosis; 3, Osmidrosis; 4, Chromidrosis; and 5, Hæmatidrosis.

1. Hyperidrosis.—Definition.—Excess of perspiration.

Ætiology.—The cause of hyperidrosis, though certainly connected with the vaso-motor nerves, is still obscure. Often hyperidrosis seems to be reflex, and excited by irritation of a more or less distant part, such as food in the mouth, by which the muscles of the blood-vessels relax, and admit more blood to the sweat-glands; there being, as far as is known, no direct connection of the sweat-glands with the nerves.

Description.—Hyperidrosis may be either *general* or *local*.

General hyperidrosis occurs in acute rheumatism, gout, intermittent fever, pyæmia, phthisis, general debility, alcoholism, and the defervescence of febricula; in hot weather; in emotional excitement; or after severe exercise. It also follows the use of the vapour or Turkish bath; and is produced by diaphoretics, such as spirit of nitrous æther, opium, antimonials, and especially jaborandi.

Paroxysmal sweating of rapid onset has been seen in one or two cases where the patients still had, or had had, epileptic fits.

Partial hyperidrosis usually occurs on one side of the body, or of the face and head. Numerous cases are recorded where unilateral facial sweating followed cerebral hæmorrhage, and accompanied hemiplegia; or occurred with suppurative parotitis and salivary fistula of the same side. In these the sweating occurs chiefly during mastication, the cheek being also reddened. Hyperidrosis lateralis sometimes occurs on the right or left side when the tongue is touched with salt on the corresponding side. Some cases of lateral hyperidrosis faciei occur without previous assignable cause, and in one the affection was transmitted for three generations. Partial sweating may be limited to the palms or soles, and is sometimes hereditary. The sweat is constant and profuse, and the parts are red, tender, and sodden.

Excessive sweating may cause sudamina and miliaria, and lead to an eczema of considerable severity.

Treatment.—In the treatment of excessive sweating general tonics, sulphuric acid, quinine, iron, or strychnia, may be employed. Flannel should be worn, instead of cotton, on the skin, and woollen socks instead of cotton. The skin may be sponged with very hot water; with vinegar and water (1 to 3); or with lotions, such as one thus prepared—℞ acidi sulphurici diluti ʒij, aquæ Oj.; or ℞ acidi tannici ʒj, spiritus vini rectificati ℥vj. Powdering with talc or violet powder will relieve temporarily some cases of profuse sweating in acute rheumatism. Hyperidrosis in phthisis has been temporarily benefited by zinc, hyoscyamus, or sulphate of atropia ($\frac{1}{70}$ to $\frac{1}{35}$ of a grain *pro die*) administered with care. Belladonna liniment is one of the best remedies in local hyperidrosis of hands and feet.

2. Anidrosis.—Anidrosis, or deficiency of sweat, is merely a symptom in general diseases with a large flow of urine or renal disorder—for example, diabetes insipidus and mellitus, and Bright's disease. It accompanies the earlier stages of fever; and is a constant symptom in skin which is the seat of ichthyosis, psoriasis, or prurigo vera. Some persons habitually sweat little, especially in winter, and the skin is dry and rough, partly from deficient sebaceous secretion (xeroderma).

3. Osmidrosis.—In some persons the sweat, if retained on the skin, has a bad smell, especially that secreted by the armpits, perinæum, genitals, and the feet and toes; and to this disorder the name osmidrosis is given. The smell appears to be due to chemical conversion of the mixed secretion of the sweat and sebaceous glands, under the influence of moisture, and in the presence of macerated epithelium, into the higher fatty acids (caproic, &c.). Removal of the accumulated secretions by thorough washing removes the smell for a time. The underclothes also become saturated with the sweat, and smell badly. This affection is not uncommon in females in the armpits, and it may be a serious affliction from the annoyance it causes to others.

Treatment.—This consists in extreme cleanliness, repeated washing with tar-soap, thorough drying, and frequent change of linen. The parts should be powdered with oxide of zinc and rice-starch (1 to 4), and tincture of belladonna internally should always be tried. Hebra strongly recommends the following ointment (*Unguentum diachyli*) for fœtid sweating of the feet, ℞ Olei olivæ optimæ ℥xv, Lithargyri, ℥iij, ʒvj; Coque; ft. unguentum. The ointment to be applied on strips of linen every twelve hours. Thin and others have had good results from disinfecting the stocking soles with a saturated solution of boracic acid. Cork soles must be worn, and disinfected in like manner. Careful inquiry should be made into the state of the general health.

4. **Chromidrosis.**—This condition, in which there occurs a secretion of coloured matter (indigo) by the skin, is so rare as to be of no clinical importance, though of much physiological interest.

5. **Hæmatidrosis.**—This, the so-called 'bloody sweat,' is also a variety, if it ever really occur. The reported cases are probably due either to rupture of superficial capillaries in the cutis, or to a similar rupture into the duct of a sweat-gland, out of which the blood finally escapes. The mechanism of this rupture, which seems quite unconnected with the secretion of sweat, is very obscure, though the highest authorities are sure that such 'spontaneous' bleedings do occur. A number of cases which have been reported in hysterico-neurotic persons were undoubtedly due to self-inflicted punctures.

Edward J. Sparks.[1]

PERTUSSIS (*per*, signifying excess, and *tussis*, cough).—A synonym for whooping cough. *See* Whooping Cough.

PESTIS (Lat.).—A synonym for plague. *See* Plague.

PETECHIÆ (Ital. *Petecchies*, flea-bites).—Synon.: *Peticulæ*; Fr. *Pétéchies*; Ger. *Petechien.*

Description.—Petechiæ are small crimson and purple spots of the skin, resembling those that result from the bite of a flea. They are circular in figure; are developed around the apertures of the follicles; have an average size of one or two lines in diameter; and are consequent on the transudation of the colouring matters of the blood, through the capillary vessels of the follicles, into the immediately adjacent tissues. They are distinguished from spots resulting from simple hyperæmia by pressure with the finger. Under pressure the hyperæmic spots disappear, but the petechiæ remain permanent. They are differentiated from flea-bites by the presence in these of the puncture, which is always perceptible, and contrasts strongly with the lighter colour of the rest of the disk; although it is to be remembered that the centre of the petechial spot is always deepest in colour, and becomes lighter towards the circumference. Petechiæ vary in tint of colour according to age and the amount of effused blood, being at first brightly crimson, then purple, next almost black, and subsequently fading away through the ordinary colours of a bruise. Hence it is usual to find them scattered over the skin of various shades of colour, ranging through all the tints already mentioned.

Petechiæ are met with on the mucous membranes, as well as on the skin, in purpura, scorbutus, malignant fevers, and in several forms of congestion of the follicles of the skin, associated with constitutional diseases. Petechiæ do not call for special treatment. *See* Purpura.

The term *petechial* is applied to certain varieties of diseases, such as typhus, when petechiæ occur in their course, or the eruption becomes hæmorrhagic. *See* Extravasation; and Typhus.

Erasmus Wilson.

PETIT MAL (Fr.).—A term applied to attacks of epilepsy which are of short duration and slight intensity. *See* Epilepsy.

PFAEFFERS, in Switzerland.—Simple thermal waters. *See* Mineral Waters.

PHAGEDÆNA (φάγω, I eat away).—A form of ulceration, which rapidly destroys the surrounding parts. *See* Bubo; Gangrene; Ulcer; and Venereal Sore.

PHANTOM TUMOUR.—Synon.: Hysterical tympanites; Spurious pregnancy.

Definition.—A peculiar enlargement of the abdomen occurring in females belonging more or less distinctly to the hysterical class. It is supposed by the patient to be a tumour, or to be due to pregnancy, though, in reality, it is nothing of the kind, as its name expresses; and it can be made at once to disappear by placing her under the influence of chloroform.

Description.—The phantom tumour consists in a more or less general prominence of the abdomen forwards, varying in degree. The enlargement may attain a considerable size, but is always quite symmetrical. The projection is most marked in the middle of the abdomen, and usually a depression or constriction is observed below the chest and above the pubes. It is rounded, smooth, and quite regular, presenting a uniform soft feeling, quite distinct from that of gaseous distension, fluid accumulation, or a solid mass. The enlargement is peculiarly movable, as a whole, from side to side. There is no sense of true fluctuation. Percussion yields a resonant note, but not usually excessive, and it may be of a muffled character. On examination *per vaginam* nothing abnormal can be detected, such as would be associated with ovarian or uterine enlargements, or with pregnancy. If there should be any doubt whatever about the nature of the supposed tumour, it will be at once removed by placing the patient under the influence of chloroform or other anæsthetic, when it immediately disappears, the abdomen becoming quite flat; but it gradually returns, even before the patient returns to consciousness, on the removal of the anæsthetic. There is no pain or tenderness in connection with the enlargement; nor are any symptoms due to pressure or other causes observed; while the patient usually presents distinct signs of the hysterical condition. There ought, therefore, to be no difficulty in the diagnosis of a phantom tumour. What is the cause of the enlargement is by no means clear, but most probably it is due to a kind of paralysis of the intestines, depending upon disordered nervous influence.

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[1] Revised by Dr. Alfred Sangster.

TREATMENT.—In a patient having a phantom tumour, the general treatment for hysteria is that principally called for. She should be constantly impressed with the fact that the enlargement is not really a tumour, and is of no consequence. The condition is by no means easy to get rid of, but for this object galvanism may be applied to the abdomen, or in obstinate cases, the patient may be put repeatedly under chloroform. The use of pressure, by means of an abdominal bandage or elastic apparatus, might be serviceable in some cases. The bowels should be kept freely opened.

FREDERICK T. ROBERTS.

PHARYNX, Diseases of.—The pharynx is often involved in acute general diseases which affect the throat, such as scarlatina and diphtheria; or it may be implicated along with other structures in diffused inflammation of the throat, ulceration, gangrene, or morbid growths; but the diseases of practical importance connected with the pharynx itself which need to be discussed here are three, namely, 1. **Acute inflammation**; 2. **Chronic inflammation**; and 3. **Follicular inflammation.**

1. Acute Inflammation of the Pharynx.—SYNON.: Fr. *Pharyngite aiguë*; Ger. *Acute Schlundkopfentzündung.*

DEFINITION.—An affection of the pharyngeal mucous membrane, characterised by a non-exudative catarrhal inflammation.

ÆTIOLOGY.—Some persons, though otherwise robust enough, show a particular predisposition to pharyngeal catarrh; and previous attacks seem to increase the predisposition. The young are, on the whole, more liable to the complaint than those more advanced in age; while all that brings the strength of the individual below par, whether over-work, exposure, or disease, more particularly of a specific nature, acts as a predisposing cause. Two of the most common exciting causes are cold and damp. At other times it may take origin in an extension of the catarrh from other organs, in a blood-poison, or in a direct irritant.

SYMPTOMS.—Most frequently, though not universally, the attack is ushered in by a certain amount of fever. The patient experiences some degree of chilliness, if not actual rigor; is restless; his temperature is exalted; the skin is dry; and languor and stiffness of the body are complained of. This may precede the pharyngeal symptoms by some hours, but soon these begin to arrest attention. The patient discovers in his throat a feeling of soreness or fulness, speedily amounting to pain. This is particularly noticed when an attempt is made to swallow. And yet this very condition of dryness of the throat provokes him to renew the effort to swallow, the unpleasantness of which he manifests to the bystanders by the wry faces thereby induced. This desire to swallow is greatly aggravated if the uvula happens to be involved in the catarrh, as from its swollen condition it suggests the presence of a foreign body, which the patient endeavours to rid himself of by repeated swallowing. Cough is a frequent accompaniment, especially if the inflammation have extended downwards.

The inflammation may not extend into the larynx, but more usually this part is involved, and then the voice is altered in tone, becoming husky or hoarse, and it acquires the well-known 'nasal twang.' On inspecting the throat, it will be observed that the mucous membrane is considerably altered in appearance and colour, being tumefied and redder than in health. At first it is dry, often glistening, and tense. But as the case progresses this condition is altered, a secretion of mucus, more or less abundant, being poured out, bathing the tonsils and posterior parts of the pharynx. This gives rise to repeated hawking and attempts to expectorate. Occasionally this catarrhal inflammation extends into the Eustachian tubes, exciting considerable deafness and pain in the ears. At the same time the oral mucous membrane is affected, as evidenced by the usual symptoms of foul tongue, bad taste in the mouth, accumulation of saliva, and offensive breath. This acute variety, under effective treatment, usually subsides within a week.

TREATMENT.—Dr. Ringer urges the use of tincture of aconite, in drop doses every quarter of an hour for the first two hours, and afterwards hourly, if the angina has been seen at the very commencement. He states that the inflammation rarely fails to succumb to this treatment in twenty-four to forty-eight hours. The patient should be confined to bed; a brisk purgative administered; and bland nourishment allowed, including abundance of milk, ice *ad libitum*, and stimulants if called for. Warm fomentations or poultices may be applied externally, or a wet compress. Steam may be inhaled, and a warm spray, medicated with morphia, thrown into the throat every two hours. When the swelling and redness subside, and the parts no longer present the dry, tense appearance, but are covered with mucus or pus, then is the time to bring in the astringent gargles, or to paint the throat with glycerine of tannin or nitrate of silver. And now, also, tonics will prove useful.

2. Chronic Inflammation of the Pharynx. SYNON.: 'Relaxed throat.'—This is by no means an uncommon affection, and may exist without having passed through the acute form.

SYMPTOMS.—As in the acute variety, so here there is the same difficulty in swallowing, amounting even to pain when irritating substances are attempted to be passed into the gullet, but of course in an infinitely less degree. Persons suffering from this form of sore-throat are specially liable to exacerbations of the catarrh, giving to the affection more of a sub-acute character, and then their usual symptoms are all aggravated. The hawking and expectoration, which habitually go on, more or less, during the whole time of their toilet-making, is increased; and finding some difficulty in removing this tough mucus from the back of the throat, this hawking is continued till the mucous membrane itself is strained, and some of the ramifying vessels give way, and the patient is alarmed to see blood mixed with the expectoration. In some instances, especially in the case of those who are habitual topers, this hawking in the morning is the prelude to the morning vomiting. The voice is apt to be husky, more particularly if the catarrh have at all invaded the larynx. On inspection of the throat, it will be observed that the mucous membrane is more or less reddened; it presents a roughened appearance; and is sometimes puffy-looking, with numerous veinlets running across it, and a quantity of mucus adhering to the posterior part of the throat: this last appearance is more common in the relaxed condition of the throat. This variety is not unfrequently found as an accompaniment of other diseases, as of phthisis, syphilis, disorders of the stomach, gout, and the effects of intemperance. The affection is usually very obstinate.

Treatment.—If the disorder be dependent upon any other affection, then of course the primary disease must be attacked. But in the case of simple chronic pharyngitis it will usually be found that the sufferer is considerably below par in his general health. This indication must be met, and the patient supplied with tonics; his habits of life altered, his business suspended, and much out-of-door exercise enjoined. Good nourishing diet should be ordered. Smoking must either be entirely prohibited, or if this be impossible, it must be much reduced. Locally, the affection is best treated by sprays or swabbing. Gargles seldom reach the parts; but if these are to be used, the best are those of alum, tannin, chlorate of potash, or bromide of ammonium. This latter is especially valuable in relaxed throats, with elongated uvula, and irritable cough. As sprays, many different remedies are employed, the most valuable being solutions of the following in distilled water, in the proportions indicated to the ounce:—Nitrate of silver, 5 to 10 grains; tannin, 5 to 15 grains; alum, 10 to 30 grains; sulphate of zinc, 5 to 10 grains; common salt, 10 to 30 grains; or glycerine diluted with water. In swabbing the throat, glycerine of tannin may be used, Lugol's solution, or the simple tincture of iodine. In some cases mineral waters are prescribed with success.

3. Follicular Inflammation of the Pharynx.—Synon.: Granular pharyngitis; 'clergyman's sore-throat;' Fr. *Angine glanduleuse*; Ger. *Chronischer Pharyngitis*.

This is another, by no means rare, form of chronic pharyngitis. On inspecting the throat of a sufferer from this affection, the posterior wall of the pharynx will be seen to present a mammillated appearance. The mucous follicles are much more prominent than is usual in health, and seem as if distended with their proper secretion. The submucous tissue, in which they are imbedded, is also thickened and hypertrophied. Occasionally these tubercles coalesce, and then a large confluent prominence is observed, studding, here and there, the posterior wall of the pharynx. In addition to the distension of these follicles, in some cases a large secretion of mucus is poured out, which, especially at night, hardens and concretes, and presents a dry, ugly, greenish-coloured crust on the back of the pharynx. At other times there is, on the contrary, a deficiency of mucus, and then there is observed a dry varnished-like appearance on the back of the throat.

Symptoms.—Each of these conditions gives rise to a considerable amount of coughing and hawking; more particularly is this the case when the adherent mucus is tough, tenacious, and difficult of expectoration. The voice becomes hoarse and husky, this being very observable after any continuous effort at speaking or reading. Swallowing is not attended with difficulty or pain. But the presence of these enlarged follicles in the throat suggests to the mind of the patient the necessity of swallowing, and consequently he makes frequent uncalled-for attempts to swallow. At the same time he perceives a sensation of dryness or pricking in the throat. Those who are the subjects of this disorder will generally be found to be over-worked men—often clergymen; and hence the erroneous name for the affection of 'clergyman's sore-throat'—or those whose bodily and nervous energy have been in any way reduced. It is a tedious disorder, often lasting for years. There seems to be small disposition for the disease to extend to the larynx or lungs; but on examination by means of the rhinoscope, the same enlarged appearance of mucous follicles may, in some cases, be seen to extend to the utmost limits of the pharynx, and the mucous membrane is itself tumefied and thickened. If this condition be neglected, it may ultimately proceed a stage further, and the character of the secretion becomes altered, presenting a muco-purulent appearance, while the glands themselves become indurated and, in some cases, ulcerated. Occasionally it will be found that the mucous membrane and the follicles of the larynx take on this same form of chronic inflammation, specially when the disorder is persistently ignored for years. Arrived at this stage, the general symptoms become so aggravated as to forbid the patient, or his friends, any longer to neglect the disease. The hoarseness, always present in a certain degree when speaking or singing, becomes constant and intensified; and if the larynx be considerably affected there may be complete aphonia. And now more decided pain is complained of, and the individual no longer exhibits the same alacrity and interest in the pursuit of his avocations, but becomes indifferent to them, in consequence of the increased debility and general languor which pervades his whole system. Cough, however, is not a striking symptom; for if the disease do not invade the larynx to any great extent (and its tendency is rather to progress upwards than downwards), then the patient may be comparatively free from cough. The other structures in the neighbourhood of the pharynx become implicated, when the disease assumes the ulcerated form; and the uvula, tonsils, and soft palate become tumefied, swollen, elongated, and generally so enlarged as greatly to interfere with the inspection of the parts. The epiglottis also exhibits, in severe cases, a tendency to become crooked and ulcerated.

Treatment.—The general rules already laid down with regard to the treatment of chronic pharyngitis apply equally in this disorder, only, perhaps, with greater force. The constitutional treatment must be more decided. The patient must be absolutely forbidden to prosecute his employment or profession any longer, if he has any respect for his health, be he clergyman, physician, barrister, singer, photographer, or inveterate smoker, for the habits and pursuits of these individuals are the very provocatives of the disease. The constitution must be braced in every possible way, by the use of generous diet, tonics, bathing, travelling. And to further the cure of the affection, attention must be paid to the secretions generally, these being stimulated or altered by the exhibition of small doses of blue pill, podophyllin, and aloes. Iodine in some form should be given. But the local treatment is equally, if not more, important, and to be effective must be regularly and conscientiously persevered in for months. There are various methods of effecting this, as inhalations of medicated fluids, insufflation of various powders, as alum or tannin; but the most certain and efficacious, because at once reaching the affected parts, and producing decided and visible effects, is the direct application of the selected remedy to the diseased parts by means of a large camel's-hair brush. And one of the best of these applications is a strong solution of nitrate of silver, varying in strength from twenty to eighty grains to the ounce of distilled water. If the parts be much ulcerated, a still stronger solution may be employed. Other medicaments which may at a later stage be used are the glycerine of tannin, or a solution of tannin in water (equal quantities of tannin and water), bromide of ammonium, tincture of iodine, or nitrate of uranium. Of course it must be left to the discretion of the practitioner to decide how often he should repeat these strong applications, as it all depends upon the nature of the case; but as a general rule it may be laid down that once every second day will be quite sufficient for the first fortnight, and after that two or three times a week will be often enough. This is to be kept up till the nodulated appearance is got rid of. As soothing applications the glycerine of borax will be found valuable, or glycerine alone, or olive or almond oil. Gargles are useless, as they never reach the affected parts. A course of mineral waters is sometimes of the greatest value. *See* Mineral Waters.

Claud Muirhead.

PHIMOSIS (*φιμόω*, I confine).—Synon.: Fr. and Ger. *Phimosis*.—A morbid condition of the penis, in which the glans cannot be sufficiently uncovered, on account either of congenital smallness of the orifice of the prepuce, or of disturbance of the natural relations between the latter and the glans by disease. *See* Penis, Diseases of.

PHLEBECTASIA (φλὲψ, a vein, and *ἔκτασις*, extension).—Synon.: *Hypertrophia venarum*.

Definition.—An increase or spreading of veins, especially applicable to the minute venules of the cutaneous or mucous surfaces.

Description.—Phlebectasia is sometimes congenital, as when it gives rise to venous nævus; and at other times accidental, proceeding from relaxation of the tissues, or obstruction of the venous circulation. Phlebectasia, from want of tone of the tissues of the skin and weak contractile energy of the vessels, is most frequently met with on the cheeks and nose; whilst that which results from venous obstruction occurs generally upon the lower limbs. On the nose it is associated with small venous trunks which carry the returning blood into the deeper venous plexuses, and are very conspicuous.

Treatment.—The treatment of phlebectasia consists in improving the tone and vigour of the skin, removing palpable causes of obstruction, and applying local astringents. When torpid action is the chief cause, as happens in accidental phlebectasia of the face, daily friction with sulphur ointment is useful in exciting an improved nutritive vigour. Where large venules are present, as on the nose, they may be obliterated by a careful touch with potassa fusa, which forces the blood to seek a deeper channel. In phlebectasia of a nævous character a good treatment consists in painting the surface night and morning with liquor plumbi. But the capillary venous hypertrophy of varicose or obstructed veins is only to be benefited by the removal of the cause.

Erasmus Wilson.

PHLEBITIS (φλὲψ, a vein).—Inflammation of a vein. *See* Phlegmasia Dolens; and Veins, Diseases of

PHLEBOLITH (φλὲψ, a vein, and λίθος, a stone).—A concretion formed in a vein. *See* Veins, Diseases of.

PHLEBOTOMY (φλὲψ, a vein, and *τέμνω*, I cut).—A synonym for venesection. *See* Blood, Abstraction of.

PHLEGM (φλέγω, I burn; I distil).—A popular name for matter expectorated. *See* Expectoration.

PHLEGMASIA DOLENS (*phlegmasia*, inflammation; and *dolens*, painful).—Synon.: *Phlegmasia alba dolens*; Pop. White Leg.; Fr. *Phlegmasia alba dolens*; Ger. *Phlegmasia dolens*.

This is a disease having very distinct characters and easily identified. It has, therefore, been long familiarly known both to the profession and the public. Except in lying-in women, it is uncommon, few medical men seeing well-marked or characteristic cases of it under any other circumstances; and it is for the most part as a disease of the puerperal state that it has been the subject of study and investigation.

Ætiology.—Phlegmasia dolens affects both sexes, and no age is exempt from it. It may attack any part of the body, but one or other of the lower limbs is the ordinary seat of it. Occasionally it seizes one lower limb first and then the other, or the disease may extend from the one to the other. The well-characterised disease, as it affects lying-in women, is an affection of the lower limbs. The left leg is far more frequently affected in the puerperal state than the right; and the left leg is supposed to be more frequently affected than the other under whatever circumstances the disease occurs. In lying-in women the comparative frequency of this affection, and of several other morbid conditions on the left side, is believed to depend on the circumstance that the parts on that side of the pelvis are more frequently subjected to pressure and bruising than the parts on the other side. This probably arises from the comparative frequency of the right lateral obliquity of the uterus throwing the direction of the uterine power of labour across the mesial line to the left side of the pelvis. The disease affects multiparæ more than primiparæ. It is prone to occur in successive confinements.

From the variety of circumstances under which the disease may occur, it will be easily apprehended that it may arise in any period of pregnancy or of the puerperal state, but the time of appearance of the ordinary disease in lying-in women is the second week after delivery. It rarely commences in the first days; generally in the second or third week; seldom subsequently, in the puerperal state.

The special proneness of lying-in women to this disease probably depends on their hydræmic condition.

Besides the puerperal state, other conditions render the body liable to it. Among these are convalescence from fever — especially typhoid, dysentery, disease of the rectum, malignant disease of the uterus, interference with uterine fibroids, arrestment of menses, and malignant and tubercular disease generally. The disease has been frequently observed to affect the leg of the side corresponding with a previously commenced pleurisy. Occurring in connection with any of these conditions, the disease may vary greatly in severity, from being scarcely recognisable to its utmost degree of intensity. But its liability to severity is not the same in all circumstances. For example, in connection with malignant diseases of the womb it is often very slight and chronic.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances referable to phlegmasia dolens vary, especially in the presence or absence of thrombosis of the veins. Phlebitis, periphlebitis, and thrombosis are generally found; but besides these nothing special has been made out. The blood-clots vary in extent, sometimes occurring as high as the vena cava inferior. They vary in appearance, being more or less decolourised, more or less softened, or even diffluent. They may be adherent to the veins, even organised, or separable from them. They may block the veins, or may allow passage of blood through their substance. In recent cases the clot adheres to the internal coat of the vein, which is blood-stained. These coats are thickened and inflamed, and the surrounding cellular tissue is also sometimes specially hardened. In cases complicated with pyæmia there may be found suppuration in the clots, and other appearances observed in that condition.

PATHOLOGY.—Various theories, which reflect the pathology of the times at which they appeared, have been held concerning the nature of phlegmasia dolens. The disease was ascribed to a metastasis of lochia by many pathologists, and by others to a metastasis of milk. These views had no basis of facts, or very little; they rested almost entirely on authority, and disappeared as pathology improved. The discovery of the lymphatics in the last century led to the first attempts of a truly scientific kind to solve the mystery of the nature of this affection, the suggestion being that it arose from their injury and obstruction. But considering how imperfect is our acquaintance even now with the origin and distribution of these vessels, with the circulation through them, and with the effects of their injury or obstruction, we must still seek for information. The next attempt to account for this disease was based on the important discovery of the thrombosis of the veins of the affected limb. This was erroneously assumed to be an invariable or essential condition of the disease, which was accordingly now regarded as phlebitic. But the recurrence of the lesions regarded as essential, the phlebitis and thrombosis, without the development of the characteristic appearances of the affected limb; and, on the other hand, the occurrence of the characteristic appearances without the simultaneous presence of the phlebitis and thrombosis, demonstrated the insufficiency of the phlebitic theory. The next theory to be mentioned is a sort of retrogression to humoral pathology. It alleged, but merely alleged, that a morbid condition of the blood, of undefined nature, is, along with phlebitis and thrombosis, necessary for the production of the disease. This theory is nearly as deficient in basis as the lochia or milk theory. The confirmatory experiments on the lower animals, by injecting lactic acid into the circulation, are in the highest degree insufficient; and it leaves unexplained important points, such as the seat of the affection. The last theory to be mentioned is, perhaps, from its very novelty, likely to get more favour than it as yet deserves. It is that the disease, as it is seen in lying-in women, is essentially a parametritis—that is, an affection of the cellular tissue, commencing, indeed, in the close neighbourhood of the womb, but extending to remote parts; and, it may be, prevailing in them, while the original inflammatory affection of the womb and its immediate neighbourhood has diminished, or even disappeared. Parametric inflammation extends in a similar manner occasionally as far as the cellular tissue around the kidney. When it extends to a limb it is supposed to be the cause of phlegmasia dolens, and to have the phlebitis and thrombosis as concomitants or consequences of it. This theory is to a certain extent an old one in modern habiliments. It is easily applied to all forms of the disease. The most recent observations with a view to the elucidation of the pathology of this disease, are concerned with the thrombosis of uterine sinuses, which goes on in the latter part of natural pregnancy, as well as more extensively, after delivery.

The great barrier to progress in our knowledge of the nature of phlegmasia dolens is the rarity of necropsic investigations, and the sometimes doubtful character of the evidence they afford. Very few unexceptionable *post-mortem* investigations have ever been made in this disease. Such a *post-mortem* inspection must be made in an early stage, and in a patient dying accidentally from some cause unconnected with the disease of the limb. Now, the disease is not only not fatal in an early stage, but it might be asserted that it is not fatal at all—that death, apparently from it, only occurs in complicated cases—in such as run an extraordinary and rare course. In the meantime, then, no theory of the disease can be regarded as established, or as having been shown to be sufficient.

Some modern pathologists believe that there are varieties of phlegmasia dolens dependent on its origin in disease of the lymphatics, in disease of the veins, or in areolar inflammation. This subdivision has strong arguments in its support, but they are far from being conclusive; and it cannot be used in practice, nor made the basis of any separate description of the varieties, which should be held by the advocates of this view to be distinct diseases. Whilst cases of obstruction of the veins with œdema are common, cases of obstruction of the lymphatics with œdema are probably rare; and neither of these obstructions, nor both of them, can as yet be made to account for all the phenomena of phlegmasia dolens. The distinctive characters claimed for the cases of lymphatic obstruction are the absence of pain, absence of lividity or blueness, and the presence of hyaline lines, indicating the course of distended superficial lymphatics. But it requires only a very limited experience in the disease to be convinced of the insufficiency or frequent inapplicability of this distinction during life.

Symptoms.—As a rule phlegmasia dolens is preceded by a slight access of feverish phenomena, seldom by a distinct rigor. The pyrexia soon becomes slight or disappears. It is only in severe cases, while rapidly progressing to a climax, that the temperature of the affected part has been observed to be raised.

Premonitory symptoms.—Premonitory symptoms are frequently absent, indeed generally so; but there is sometimes an indefinite malaise, or even feverishness, for a day or two, before the pain in the limb is complained of. Another premonitory symptom is described, but it also is certainly not always present—namely, pain and tenderness in the region of the womb, especially affecting that side of it corresponding to the limb about to be affected.

Invasion.—The first announcement of the disease is generally pain and tenderness in the groin, along the course of the femoral vein, or in the ham along the course of the external saphena. In these situations the thrombosed vein can frequently be felt, but not invariably, for sometimes the tenderness, sometimes the swelling, prevents its being made out; and sometimes this thrombosis is absent, at least in parts where it can be felt through the skin. Soon the pain and tenderness extend over the whole affected parts, which may be the whole limb, and often a feeling as of aching in the bones is complained of. The pain is sometimes along the internal saphena vein, which may be traced by the finger till it dips to join the femoral.

Simultaneously with the complaint of pain, or within a day or two after it, swelling appears, which gradually spreads and increases in hardness. This swelling is not like ordinary œdematous or anasarcous swelling in the sensation it communicates to the hand of the physician, or in the history of its commencement and progress. When it commences, and again as it disappears, it may be, comparatively to its perfect state, soft, and it may pit on pressure; but when, a few days after its appearance, it is fully developed, it is elastic, and nearly as hard as a solid india-rubber ball, and does not pit on pressure. The swelling may appear at once all over the limb, but frequently it commences above and spreads downwards. Sometimes the inverse course is followed. It not rarely affects only the lower parts of a limb, very rarely the upper parts only. It does not affect the lower more than the upper surface of the limb. It rounds off the figure of the limb, but does not distend the skin or destroy the form so entirely as a huge anasarca. Occasionally there is an erythematous blush over parts of the limb, but this is not common, and it may be confined to a narrow surface along the course of a subcutaneous vein or lymphatic.

In a characteristic and fully developed case, such as is frequently observed in the puerperal state, the limb presents a remarkable appearance. The swelling affects the labium and hip and the whole limb. The form of the limb is partly retained, but its features are all rounded and nearly lost in the swelling. Its colour is pale or sallow, like that of a dead limb, and hence the disease is called 'white leg.' But besides being pale, it is glossy, as if greased over; or, more clearly, its surface resembles that of polished marble, and the disease is sometimes called 'marble leg.' In the milder cases the swelling is less, is softer, and may be confined to a part of the limb.

The limb may be kept in an extended attitude, or it may be slightly flexed at the joints. Movement of it causes much suffering, and the power of voluntary motion is almost completely lost while the disease continues.

After the disease has lasted nine days or thereabouts, it generally makes no further progress, but recedes, the pain and swelling diminishing. The rate of this recession varies very much, being probably more or less directly in proportion to the restored permeability of the vessels. In a favourable case several weeks may elapse before the disease disappears, whilst in others the cure may be further or even indefinitely delayed.

Sequelæ, Complications, and Prognosis.—The most frequent sequela of phlegmasia dolens is persistent aching of the limb, increased by cold and damp weather, and by derangement of the general health, as well as by exercise. Another is a tendency to œdema of the ankles, or a persistent œdema in that situation. Sometimes the limb remains deficient in muscular power. Rarely, the limb is not only powerless but wasted. And in some very uncommon cases it is the subject of a great hypertrophy of the cellular tissue, or elephantiasis, simultaneous with muscular wasting; and the elephantiasis may be complicated with more or less extensive and intractable ulceration. Such cases probably result from permanent destruction of large vascular passages; and, falling into surgical hands, demand occasionally treatment by amputation.

The disease is sometimes, not frequently, complicated by other affections, or by aggravations of some of its conditions. Among such occurrences are inflammation and suppuration of the intrinsic joints of the pelvis, erysipelas, limited abscesses (periphlebitis), diffuse suppuration of cellular tissue, gangrene of any part or of a varying amount of the entire lower portions of the affected limb. These complications or aggravations cause much danger to life, and in this respect their influence varies according to circumstances. But there are other complications or aggravations which are more often fatal. They may be summed up in the terms embolism and pyæmia, and are the consequences of detachment of a thrombus in the femoral, or in still larger veins, or of a more slow breaking up of blood-clots into *débris*, more or less puriform, which enters the circulatory current.

Diagnosis.—The diagnosis of phlegmasia dolens requires no discussion. The disease can scarcely be confounded with any other if its history is taken into consideration: only, it is necessary to remember that œdema with phlebitis or accompanying varicose veins may somewhat resemble it.

Treatment.—The treatment of phlegmasia dolens should be both constitutional and local. The former has no special points, being varied according to the circumstances of the case, and the views of the practitioner. Generally some opiate is required to procure sleep, and Dover's powder is a favourite form for its administration. Local treatment is very important. The limb is to be kept at rest, either in an extended or flexed position, as may prove most comfortable. It should be fomented several times daily, if not constantly. This may be effected by the flannel bandage wrung out of hot water, precautions being taken for the protection of the patient and bed from damp. The fomentations are sometimes made anodyne by using decoctions of poppy-heads or otherwise. Sometimes infusion of chamomile flowers is valued as a fomenting medium. Leeches are sometimes applied along the course of an inflamed vein, but their utility is, to say the least, often doubtful.

After the acute stage of the disease is past the sequelæ have to be dealt with. Of these the most frequent are aches, swelling, œdema, and muscular weakness; and for these the most efficient, but by no means invariably successful, remedies are frictions, bandaging, and faradisation. After all active disease has disappeared, and after danger of the moving of thrombi has passed, the patient should diligently resume the use of the leg. No exact statement can be made of the time at which the danger of embolism is passed. It may prove suddenly fatal thirty-seven days after delivery.

Persistent local hardness and tenderness, probably periphlebitic, may be treated by gentle frictions with a mixture of mercurial and belladonna ointments. In using frictions of all kinds the danger of dislodging a thrombus is not to be overlooked.

J. Matthews Duncan.

PHLEGMATIC TEMPERAMENT. *See* Temperament.

PHLEGMON (*φλεγμαίνω*, I burn—as a medical term, glow, am inflamed).—Synon.: Fr. *Phlegmon*; Ger. *Entzündungsgeschwulst.*—The term phlegmon is almost disused now in English medical literature. It is still employed by the French. Abernethy defines phlegmon as the 'most violent kind of inflammation,' 'attended with heat, redness, throbbing, pain, and swelling,' such as 'generally takes place in a good constitution.' Older writers describe it as a 'tumour or apostume against nature, engendered of defluxion of blood, and of colour red and hard.'

Nélaton describes simple or circumscribed phlegmon and diffuse phlegmon. He says: 'Phlegmon is generally defined as inflammation of the cellular tissue; but surgeons have restricted the sense of the word, and only apply it to inflammation of the free cellular tissue, that is to say, of that which is placed immediately beneath the integuments or which surrounds the different organs.' The diffuse phlegmon of the French writers is the phlegmonous erysipelas of the English. *See* Erysipelas.

Marcus Beck.

PHLEGMONOUS.—A term applied to extremely acute inflammation of the cellular tissue, spreading widely, and accompanied by great exudation, with brawny hardness, intense redness, heat, and pain. If unrelieved by treatment, phlegmonous inflammation tends to terminate in gangrene. *See* Erysipelas.

PHLYCTÆNA (*φλύζειν*, to be hot).—A small vesicle, containing an aqueous or serous fluid, and not exceeding in bulk the diameter of a pea, as in sudamina, miliaria, and herpes. The term is sometimes also used in connexion with ophthalmia.

PHLYCTIS (*φλύζειν*, to be hot).—A vesicle or blister, averaging in size the hemisphere of a hazel-nut or walnut, and filled with serous fluid. Phlyctis is the Greek synonym of bulla, and is applicable to the large vesicles or blisters of pemphigus or pompholyx. *See* Pemphigus.

PHLYZACIUM (*φλύζειν*, to be hot).—A hot or inflammatory pustule. The term phlyzacia is applied to acute pustules with an inflamed base, such as those of ecthyma and smallpox.

PHOSPHATIC DIATHESIS—PHOSPHURIA—PHOSPHATIC CALCULUS.

1. Phosphatic Diathesis.—Ætiology.—Phosphoric acid in the urine is derived directly from the food, and also from oxidation of the waste albuminoid tissues of the body. The daily excretion by the kidneys amounts to about 50 grains, being greatest after the ingestion of food, especially vegetable food.

Characters and Composition.—Phosphoric acid in the urine is always found combined with potash, soda, lime, magnesia, and ammonia. These salts, variously associated, are held in solution by the acidity of healthy urine, and this acidity is probably chiefly due to the acid phosphate of soda. Where this acidity, from any cause, is greatly diminished or destroyed, then a deposit of the phosphates takes place; but this deposit by no means shows that any excess is present. Careful quantitative analysis, under strict precautions as to diet, can alone detect excess or deficiency; but, clinically, this is of less consequence in that no constant symptoms are produced by excess or deficiency, and the real importance to the practitioner lies in the fact of feebly acid or alkaline urine leading to their deposit only.

The two most common forms of phosphatic sediment are—(1) the *triple phosphate of ammonia and magnesia*, and (2) the *amorphous phosphate of lime*.

(1) The *triple phosphate* crystallizes in the

form of transparent triangular prisms with bevelled ends. The deposit has a white appearance, but more frequently it shows as a slight flocculent cloud in the urine, resembling mucus, or as an iridescent pellicle on the surface. The urine is either faintly acid or alkaline; and boiling gives rise to an opaque cloud, which is instantly dissolved by a drop of nitric acid. It not unfrequently co-exists with deposits of uric acid, urates, or oxalate of lime; and also in dense urine with an excess of urea.

(2) *Amorphous phosphate of lime* is only found as a deposit in alkaline urine. Microscopically it shows as pale granules or spheroids, sometimes resembling the dumb-bells of oxalate of lime, sometimes the pale urates.

A third form of phosphatic deposit, the *stellar phosphate of lime*, is but rarely met with. It was first noticed by Dr. Hassall, who considered it to be a biphosphate; it crystallises in minute rods, which are gathered into sheaf-like bundles, or grouped in stars and fans. The clinical importance of this deposit is not well understood. Dr. W. Roberts has met with it in cases of diabetes, phthisis, and chronic rheumatism, and the writer has recently found it in a diabetic patient, and also in one convalescing after ovariotomy.

SYMPTOMS.—Deposit of phosphates takes place in many diseases—diseases often of an opposite character, and having no pathological resemblance—for example, in acute cerebritis; towards the close of cases of pleurisy, pneumonia, and rheumatic fever; in certain periods of typhoid fever; and in acute mania. But it may be taken as proved that there is no morbid condition, characterised by definite and constantly occurring symptoms, and accompanied by the deposit of phosphates in the urine, which can be entitled to the designation of a 'diathesis.' Prout's description of phosphatic diathesis is merely that of ammoniacal urine. Golding Bird associated the deposit with symptoms of irritative dyspepsia, hypochondriasis, and temporary exhaustion of the nervous power; symptoms which are not unlike those said to be characteristic of the so-called oxalic acid diathesis. Remembering, however, that phosphatic deposit does not necessarily or frequently mean excess, but depends on diminished acidity or alkalinity of the urine, it will be more profitable to notice this latter condition.

The urine becomes neutral or alkaline from the presence of either fixed alkali—potash and soda, or of the volatile alkali—ammonia. The continued or frequent presence of alkaline urine from *fixed alkali* denotes grave disorder, generally characterised by debility, anæmia, and nervous dyspepsia; it may and does occur in the course of many, even acute, diseases; it represents an altered condition of blood and nutrition; but it is not typical of any one malady or diathesis, nor, so far as analytical investigations have yet gone, is there any clear evidence of the truth of the theory, that excess or deposit of phosphates, and alkaline urine, are the result of increased cerebral action or of brain-disease.

Urine rendered alkaline from carbonate of *ammonia* is always accompanied by deposit of both forms of the phosphates. The alkalinity is the result of decomposition of the urea; there is the peculiar ammoniacal odour, reaching sometimes to intense putrid fœtor. This decomposition is supposed to be due to the presence of pus or mucus acting as a ferment; but this will not apply to those cases in which no pus or mucus is present, and it is probable that in many instances the putrefaction is produced by germs conveyed into the bladder by the catheter. Ammoniacal urine is always indicative of lowered vitality, either from age or spinal injury or disease; it points to no altered condition of blood or constitution, but is the result of local disease. The phosphates which are so freely thrown down are the triple phosphate and the amorphous phosphate of lime; they are readily deposited on any pre-existing nucleus, whether it be a stone, a clot of blood, a roughened ulcerated portion of bladder, or any foreign body; but without this pre-existing nucleus it but rarely, if ever, happens that concretions form.

TREATMENT.—As there is no real phosphatic diathesis requiring special management, it follows that the treatment should consist in removing the cause of the alkalinity of the urine from *fixed* alkali. The two most common causes are dyspepsia, and nervous and general debility. In those cases of chronic vomiting and irritable dyspepsia in which the urine loses and recovers its acidity several times daily, no special remedies addressed to the state of the urine can be of any avail. The mineral acids have long been relied on for restoring the natural acidity of alkaline urine; it seems certain, however, that they have no special or direct influence, but simply act beneficially by their indirect tonic effect on the system. Phosphoric and benzoic acids may slightly add to the acidity of the urine, and opium and belladonna in certain conditions of nervous irritability are known to have the same effect; but speaking generally, the mineral, vegetable, and acid tonics are required in almost all cases, and with them the usual adjuncts, namely, good air and exercise; the cold sea-water bath; a well-selected generous diet, largely composed of animal food; and relief from anxiety or overwork.

For alkalinity and phosphatic deposit depending on *volatile* alkali, it must be remembered that in this state the urine is almost always secreted acid. The local disease which causes it must, if possible, be remedied—a stone should be removed; an atonic bladder emptied at stated intervals by the catheter, and washed out with disinfectants, if necessary; but the vital strength always needs to be upheld by rest, good diet, and tonics.

2. **Phosphatic Calculus.**—DESCRIPTION.—Phosphate of lime calculi are sometimes formed in the kidney, but much more frequently phosphatic stones are a secondary deposit on some pre-existing nucleus. They form dense or porous white layers, frequently showing the glistening crystals of the triple phosphate on the surface. Such masses are soluble in acids, insoluble in alkalis or water, friable, and fusible. They develop rapidly, and may reach an enormous size.

TREATMENT.—When of moderate dimensions phosphatic calculi may be easily removed by lithotrity; but, as it is often difficult to insure the removal of every minute particle, and as they are often accompanied by chronic cystitis and deficient expelling power of the bladder, recurrence is not infrequent, and the ultimate result unfavourable. William Cadge.

PHOSPHORUS, Poisoning by.—Synon.: Fr. *Intoxication Phosphorée*; Ger. *Phosphorvergiftung*.

Phosphorus acts as a poison only when in the form of yellow, common, or soluble phosphorus; in the allotropic form of red or insoluble phosphorus it is inert, either as a therapeutic or as a toxic agent. Poisoning by phosphorus may be either *acute* or *chronic*.

Acute poisoning by phosphorus has recently become not uncommon in this country. On the Continent phosphorus, in the form of the tips of lucifer matches, is frequently used for suicidal purposes. In England phosphorus is most commonly taken in the form of 'rat paste' or 'phosphorus paste,' a vermin-destroyer composed of butter or other fats and phosphorus, coloured with Prussian blue. Chronic phosphorus-poisoning from the inhalation of phosphorus vapours has long been recognised.

Anatomical Characters. — These are well-marked, and consist of extreme fatty degeneration of the liver, and frequently also of the gastric mucous membrane, kidneys, and cardiac muscular fibre. The liver is also greatly enlarged and white; and the organ frequently takes fire on the mere application of a spirit-lamp flame. On microscopical examination the organs affected are seen to be infiltrated with granular fatty matter, soluble in ether; the gastric tubuli are also filled with granular fat; and the striated muscular fibre has more or less completely lost its normal appearance, and been converted into a similar granular material.

Symptoms.—1. *Acute Phosphorus-Poisoning.*—On swallowing a phosphorus mixture a disagreeable taste is perceived, which is occasionally followed by a burning sensation in the throat, gullet, and stomach; and speedy vomiting. But these signs of the local action of the poison may be either absent, or altogether inconsiderable. At any rate, as a rule, these and the diarrhœa and colicky pains described by some writers, soon pass off, leaving the patient apparently nearly well; though a careful examination may reveal a small, feeble pulse, and when the patient is questioned, the existence of obscure wandering pains may be admitted. In the course of a few days—usually two, three, four, or five—the patient becomes listless, dull, and slightly jaundiced. There is much headache and sleeplessness, together with a general febrile condition, gradually passing into a 'typhoid' state; increasing jaundice; scanty, high-coloured, biliary urine; and a quick and very feeble pulse. Muttering delirium supervenes; there may be violent vomiting of yellow, biliary mucus; and the patient gradually sinks, and dies after a day or two, or perhaps three or more, of acute disease, and usually within a week of the administration of the poison. Death may occur, however, at any period, from one or two to eight or ten days, after a fatal dose of phophorus, which may, perhaps, be taken as half a grain for an adult person.

Variations from the above course of symptoms may be noted. In one class of cases the symptoms betoken a predominance of nervous action. Thus there are cramps and pains in the limbs, great prostration and faintness, convulsions, and, finally, coma. In another class, occasionally observed, hæmorrhagic symptoms are prominent, such as bloody vomits and hæmorrhagic diarrhœa. As an early symptom a phosphorescent condition of the vomited matters, and, more rarely, of the urine, may be noted; and in nearly all cases a peculiar garlicky odour of the breath is perceptible. The phosphorescence or luminosity of the rejected matters is of course best seen in the dark. If the phosphorescent condition of the vomit exist, this permits of no mistake in the diagnosis; but if this condition be absent, the garlicky odour of the breath, and an enlarged condition of the liver, greatly aid in the diagnosis.

2. *Chronic Phosphorus-poisoning.* — Chronic phosphorus-poisoning consists in poisoning by phosphorus vapours. Workers in common or yellow phosphorus exhibit a singular form of disease, from which workers in red or amorphous phosphorus are exempt. This consists in caries of the teeth and necrosis of the lower jaw, which appear to be set up by the direct access of the phosphorus vapours to the part, since those persons only are affected who suffer from decayed teeth.

Prognosis.—This is in all cases very unfavourable, and no general rules can be laid down respecting it.

Treatment.—We know but little respecting this. Good results appear to be obtained from the administration of a magma of magnesia, and the use of mucilaginous drinks. The best results, however, have followed the administration of oil of turpentine, which some regard as a specific antidote to phosphorus. It may be given in doses of 10 to 20 minims, frequently repeated.

The chronic form of the disease, which has led to horrible suffering and deformity, may be prevented by the use of red instead of yellow phosphorus in the making of matches. The use of inhalers, and the impregnation of the atmosphere with the vapour of oil of turpentine, are also preventive measures of great service.

Thomas Stevenson.

PHOTOPHOBIA (φῶς, light, and φόβος, fear).—Dread or intolerance of light; a symptom, more or less constant, of most forms of inflammation of the eye. In its most pronounced character it occurs in what is called 'strumous ophthalmia,' or phlyctenular keratitis. It is, however, present in all forms of inflammation and ulceration of the cornea, in iritis and cyclitis, and more rarely in choroiditis and retinitis. It is also often met with in many diseases of the nervous system, in cerebral irritation, meningitis, cerebritis, &c., and in many pyrexial states. As an ophthalmic symptom, it may occur in eyes perfectly blind, and is probably due to the irritation of the ciliary nerves by light. *See* Eye and its Appendages, Diseases of.

PHOTOPSIA (φῶς, light, and ὄψις, vision).—The subjective sensation of flashes of light, or luminous spectra, due to an abnormal state of some part of the special nervous apparatus of the visual sense. It is a modification of the special sensibility, and, like photophobia, may occur in blind eyes. *See* Vision, Disorders of.

PHRENIC NERVE, Diseases of.—Synon.: Fr. *Maladies du Nerf phrénique*; Ger. *Krankheiten des Nerven phrenicus*.—The principal disorders affecting the phrenic nerve are two, namely, 1. **Paralysis**; and 2. **Spasm**.

1. **Paralysis.**—Ætiology.—Paralysis of the phrenic nerve, that is, of the diaphragm which it supplies, is rarely due to disease of the nerve-trunk. Its common cause is disease at the origin of the phrenic—the anterior grey matter of the spinal cord at the level of the third and fourth cervical nerves. It is commonly part of acute or chronic spinal myo-atrophy. Paralysis has also been observed by Duchenne in lead palsy. In a few cases the paralysis has been apparently due to cold, supposed to have caused a rheumatic inflammation of the nerve-trunk. In a few cases, also, the nerve has lost its function in consequence of compression in the neck.

Anatomical Characters.—Degeneration of the trunk of the nerve, wasting of the nerve-fibres, and increase of connective tissue, have been found in cases of disease of the spinal cord. Of the anatomical changes due to other causes nothing is known.

Symptoms.—The evidence of paralysis of the phrenic is inaction of the diaphragm. When one nerve is diseased there is imperfect action on one side, and this may be conspicuous or indistinct. When both nerves are affected, as is commonly the case in central disease, there is an entire absence of the normal protrusion of the abdominal wall during inspiration; there may even be a recession of the upper part of the abdomen, and a bulging during expiration in the same situation. In ordinary breathing the respiratory actions are not quickened by paralysis of the diaphragm, but if any exertions are made the respirations become more frequent, and the extraordinary muscles of respiration are thrown into action. All spasmodic respiratory actions—sneezing, coughing—are performed with less energy. Little inconvenience is experienced unless bronchitis comes on, and then the lessened respiratory power may place the patient in a condition of great danger.

The phrenic nerve is accessible to direct stimulation in the root of the neck, and when it is paralysed, its irritability is usually lost, and the diaphragm can no longer be made to contract. In rare cases, however, the nerve-trunk retains its irritability.

Diagnosis.—The diagnosis of paralysis of the diaphragm is not always so simple a matter as might be supposed. Its action should be looked for not only in deep breathing, but in ordinary respiration. Many persons, if told to 'take a deep breath,' do not put the diaphragm into action at all. In forced breathing the chief extra action takes place in the upper part of the chest, to which most of the muscles of extraordinary respiration are attached. It is probable that the centres for normal and extraordinary breathing are functionally not identical, and that the diaphragm is chiefly represented in the former, so that it does not necessarily act in deep breathing. There is a mechanical reason for this. In the extreme action of the intercostal muscles the thorax is widened to such a degree, that the diaphragm becomes less curved by the movement outwards and elevation of its points of attachment, so that its contraction does not effect much additional enlargement of the capacity of the thorax. Hence, in many persons, without any paralysis of the diaphragm, if a deep inspiration is taken, the epigastrium does not advance; may even recede, in consequence of the movement of the lower ribs. This is especially the case in women, in whom breathing is always less diaphragmatic than it is in men. In them, too, conscious attention to the act of breathing is apt to arrest the action of the diaphragm. The tendency of voluntary breathing is to be costal rather than diaphragmatic, no doubt because the centre for extraordinary breathing, which is chiefly voluntary, is brought partially into action. In a woman under the writer's care, paralysis of the diaphragm was suspected, and during two separate and prolonged examinations not the slightest action could be observed. On a third examination, however, more normal conditions were obtained, and the action of the diaphragm was natural. This is the condition which has been termed 'hysterical paralysis of the diaphragm.'

It must not be forgotten that immobility of the diaphragm may result from other causes than paralysis of the phrenic nerve. In diaphragmatic pleurisy, for instance, its movement is lessened by a reflex inhibitory effect of the pain. In emphysema of the lungs, in which the thorax is greatly widened, the contraction of the diaphragm produces less effect than in health.

On the other hand, when the diaphragm is really paralysed, a doubt may arise as to whether it moves or not. This is due to the circumstance that the movement of the lower ribs may drag forward the abdominal parietes close to them, and so the protrusion due to descent of the diaphragm may be simulated. This is especially the case when the abdomen is collapsed, so that when the patient is recumbent its level is considerably below that of the ensiform cartilage. This movement may be distinguished from that due to the descent of the diaphragm by a little care: the movement is confined to the proximity of the thorax, and there is not the general movement of the abdominal viscera and parietes which results from the contraction of the diaphragm.

Prognosis.—The prognosis of paralysis of the diaphragm is favourable in the rare instances which are due to exposure to cold; rather less favourable in lead-poisoning. It is unfavourable when part of progressive spinal myo-atrophy. When due to acute spinal myo-atrophy (anterior cornual myelitis) the prognosis will depend on the indication afforded by other symptoms of the position of the chief disease, whether the region from which the phrenic nerve arises is gravely or slightly damaged. When paralysed from compression the prognosis depends on the nature and origin of the pressure.

Treatment.—The treatment of the paralysis, which is part of the spinal myo-atrophy, is that of the central disease. In all cases causal indications must be met. When due to cold, sinapisms should be applied over that part of the phrenic nerve which seems, from any attendant pain, to be chiefly affected. If the nerve has not lost its irritability, it may be faradised systematically. The points to which the rheophores should be applied are one on the neck, just above the scaleni, and one near the diaphragm. A strong current has to be used.

2. **Spasm.**—Spasm of the diaphragm occurs chiefly in the form of hiccup, and as part of the respiratory spasm in hydrophobia, and does not need special description. *See* Diaphragm, Diseases of; Hiccup; and Hydrophobia.

W. R. Gowers.

PHRENITIS (φρὴν, the mind).—An obsolete term, formerly associated with all forms of acute inflammation of the brain or its meninges, but especially the latter.

PHTHIRIASIS (φθεὶρ, a louse).—Synon.: Pediculosis; Fr. *Phthiriase*; Ger. *Läusesucht.*—This disease of the skin bears the same relation to the pediculus that scabies does to the acarus scabiei.

Description. — There are three varieties of phthiriasis, corresponding to the three species of pediculi that infest the human body. *See* Pediculus.

1. **Phthiriasis capitis.**— Phthiriasis affecting the head is met with chiefly in children. The eruption is an artificial pustular eczema, due to the irritation of the insect, and the scratching of the sufferer; in consequence of the sores on the scalp, the superficial lymphatic glands at the back of the neck often become enlarged.

2. **Phthiriasis corporis.**—Phthiriasis of the body is confined to the parts covered by the clothes, and is most developed on the back. It is especially met with in the old and feeble. The lesions of the skin consist of small excoriations and scattered papules, whose tops are seen to be torn and bleeding from the scratching of the sufferer. These bleeding papules give to the eruption its characteristic appearance. In chronic cases the general colour of the skin is darkened from an excessive deposit of pigment.

3. **Phthiriasis pubis.**—This variety of phthiriasis differs little from that of the body, except that it is limited to the regions infested by the crab-louse.

All three varieties of the disease are attended with intolerable itching.

Treatment.—Phthiriasis is easily cured by means of an ointment containing one part of the oil of delphinium staphysagria and seven parts of lard. R. Liveing.

PHTHIRIUM INGUINALE (φθεὶρ, a louse).—One of the synonyms of the *pediculus pubis*, or crab-louse. *See* Pediculi.

PHTHISIS (φθίνομαι, I waste).—Synon.: Consumption; Fr. *Phthisie*; Ger. *Schwindsucht.*

Definition. — Phthisis, or consumption, is the term used to designate a disease characterised by progressive wasting of the body; persistent cough, with expectoration of opaque matter and sometimes of blood; loss of colour and strength, shortness of breath; hectic fever, night sweats, and diarrhœa; these symptoms being associated with certain well-marked pathological changes in the lungs, namely, the formation of consolidations in a granular or diffuse form; which either undergo caseation and disintegration, leaving behind excavations in the lung-tissue; or, becoming indurated and shrinking, cause contraction of the affected organ.

Ætiology.—The conditions which give rise to phthisis are varied and diverse; but by tracing out their mode of action on the individual, we arrive at a twofold arrangement into *general* and *local* causes. In the *general*, the constitution of the individual, and the functions of nutrition and assimilation, appear to be first involved. In the *local*, the lungs are the primary seat of disease, and changes in their epithelium and parenchyma lead to products of a retrograde kind, through which the lymphatic and vascular systems, and the constitution generally, become infected. The general may be called *constitutional*, and the local *inflammatory*. General causes are those which affect the whole system, such, for example, as family predisposition; fevers and exanthemata; syphilis; insufficient food; alcohol; bad ventilation; climatic influences; dampness of soil; infection; &c. Amongst local causes are to be enumerated inflammatory affections of the lungs and pleura; trades and occupations giving rise to a gritty atmosphere; and injuries to the chest. We must bear in mind that a cause may act in two capacities, locally and generally; for instance, scarlatina may cause enlargement of various lymphatic glands throughout the body, and render the individual liable to the formation of tubercle generally; or scarlatina may leave behind it consolidation of portions of the lungs, which may result in caseation, whence may arise tubercular infection of the system.

The most important causes of phthisis will now be individually discussed.

1. **Family predisposition.**—The influence of heredity as a cause of phthisis cannot be doubted; it has been abundantly proved by observation and experiment on both man and the lower animals. The term *family* predisposition is substituted for *hereditary* predisposition, because the latter, from its limitation to direct descent, necessitates the omission of the evidence of disease in collateral relatives. The statistics of the first *Brompton Hospital Report* on this point, as compiled by Dr. Quain, who contrasted them at the same time with the statistics of insanity, and those also of Drs. Cotton and Fuller, show that among the lower classes hereditary predisposition (that is, where one or both parents were affected) was traced in 25 per cent. The writer's researches among 1,000 cases of the upper classes show 12 per cent. of direct hereditary predisposition, and 48 per cent. of family predisposition.

Family predisposition is more common among women than men, in the proportion of 57 to 43, which may be accounted for by the more sedentary and less invigorating life of the former. The transmission of phthisis is more common through the mother than through the father; but where one parent alone is affected, fathers transmit more readily to sons, and mothers to daughters than the converse. Dr. Pollock lays stress on the influence of hereditary predisposition in the acute forms of phthisis, and states that out of 179 cases only 34 could positively declare absence of family taint. The principal effect, however, of family predisposition is to be seen, *not* in any peculiarity of symptoms, but by the influence it exercises over the age of attack. The writer's researches show clearly that this is much earlier in patients so predisposed than in others; and in females this influence is greater than in males.

2. **Local infection.**—Chronic inflammatory affections of organs and textures leading to the formation of caseous centres.—Examples of this class may be found in cases of impetigo in children, leading to enlargement and caseation of the cervical glands; in the so-called scrofulous diseases of the joints; and in psoas and lumbar abscess.

3. **Acute febrile diseases.** — Continued fevers, measles, and scarlatina act partly by exhausting the system, and partly by bequeathing to the individual the legacy of caseous matter either in the lungs or glands, which prove the centres of subsequent tuberculisation.

4. **Syphilis.**—Syphilis, by its debilitating influence, predisposes to phthisis; but it also appears to act as a cause capable of developing two forms of the disease, namely (1) limited consolidation with no great tendency to excavation; and (2) a form of laryngeal phthisis, characterised by ulcers in the larynx and in the pharynx, difficult to heal except by specific treatment. This last has been called syphilitic disease of the larynx; but as in the writer's experience it is always associated with tubercle in the lungs, he thinks that the phthisis is caused by the syphilis, and should be classed accordingly.

5. **Debilitating conditions.**—Miscarriages, unfavourable confinements, over-lactation, insufficient food, and alcoholism are recognised causes; but the cessation of habitual discharges is not so clearly admitted. The stoppage of the discharge of a fistula *in ano*, and the drying up of an old ulcer, are frequently followed by an outbreak of tuberculosis in the lungs.

6. **Mental depression.**—This is often mixed up with other causes, but occasionally acts alone.

7. **Bad ventilation.**—Dr. Guy has shown that consumption is more rife among persons of indoor occupations than among those employed out of doors; this being true not only of the lower classes, as printers, compositors, and tailors, but also of the tradesmen who live in hot gaslit shops, and often sleep in miserably ventilated bedrooms. These are not ill-fed, but are nevertheless twice as liable to consumption as the upper classes. Hawkers and other outdoor trades, though much exposed to catarrh, are shown to be less liable to consumption than indoor workers. Of nearly 6,000 cases of phthisis admitted into the Brompton Hospital during ten years, two-thirds had indoor occupations. Amongst them milliners, sempstresses, and tailors furnish the largest quota, who all live in close rooms, to which they are almost entirely confined.

8. **Climatic influences.** — A moist atmosphere is more favourable to the development of consumption than a dry one; and, while we recognise that the combination of cold and moisture is one of the principal causes of the inflammatory forms of the disease in Great Britain, the testimony of Dr. Guilbert indicates that a combination of heat and moisture, as exemplified in the littoral of Peru, in the West Indies, &c., produces an acute form of consumption, largely prevalent in those districts, attacking the abdominal organs in addition to the lungs.

9. **Dampness of soil.** — The researches of Dr. Buchanan have demonstrated that the death-rates from phthisis in the districts of Surrey, Kent, and Sussex, depend to a great extent on the geological formation of the soil; for while in the light and sandy strata, deaths from phthisis are rare, in the heavy impermeable ones, in which clay predominates, the mortality from this cause is high. The conclusion that wetness of soil is a cause of phthisis to those living on it, has been confirmed by the Registrar-General of Scotland, and by Dr. Bowditch of the United States; the latter testifying that this law holds good, not only as regards villages and towns, but even as regards individual houses—the houses on clay becoming the foci of consumption, while others but slightly removed from them, but on a dry soil, wholly escape.

10. **Inoculation.**—From the time of Laennec until the present, experiments have been carried on by numerous observers to ascertain whether tubercle is, or is not, inoculable; and the results of these experiments prove that in guinea-pigs and rabbits tubercle can be produced artificially by the insertion underneath the skin, not only of tubercle, but of various other materials, such as pus, putrid muscle, and diseased liver, taken from non-tubercular subjects. There was nothing specific in the results of the inoculations, for the materials most efficient in producing artificial tubercle were those taken from low pneumonia, pyæmic abscess, &c.; while human tubercle, phthisical sputa, foul pus, and putrid muscle were less successful. No results were obtained from the material of acute sthenic pneumonia, from pneumonic and bronchitic sputa, healthy abscess, diphtheritic membrane, syphilis, typhoid intestine, and cancer. It was found by Dr. Burdon Sanderson that tuberculosis might be induced in the guinea-pig by the insertion of a cotton thread under the skin, but if the seton was steeped in carbolic acid, no tubercle was produced. To ascertain the results of mechanical injury without exposure to air, the scapulæ of guinea-pigs were fractured subcutaneously. No tuberculosis resulted. It is evident, from these experiments, that tubercle is not so potent for infective purposes as many other materials, and especially those of a septic nature, such as pyæmic pus and putrid muscle; and this is still further borne out by the seton experiments, where the purification of the wound by carbolic acid appears to have prevented the infective process, as also by the cases in which the scapulæ were fractured. These facts warrant the conclusion that tuberculosis is closely associated with pyæmia, and among animals the difference between these two diseases would appear to be one merely of degree; for Dr. Sanderson found that while the injection of pus into rabbits produced death from pyæmic abscesses in forty-eight hours in some, in others the slower results of tuberculosis followed. This process generally consisted in the development of granulations at the seat

of inoculation, from which the neighbouring lymphatics became infected, and this led to a dissemination of the products through both the lymphatic and circulatory systems.

Chauveau found that heifers might be infected by mixing tuberculous matter from their own species with their food. Bollinger confirmed this experiment, but found that carnivora could be fed with impunity on fresh tuberculous matter taken from animals of the bovine species.

11. **Infection.**—The idea of infection being a cause of phthisis still prevails in the South of Europe, and has lately been revived by Dr. Budd in England. The evidence of the Brompton Hospital negatives the idea of a contagion such as is present in small-pox or scarlet fever; for it has been demonstrated that the percentage of acquired phthisis occurring among the resident staff of the institution is less than that of most general hospitals. An infective influence may arise from the expectoration of advanced cases of phthisis or of bronchitis, which should be counteracted by antiseptics and good ventilation. That phthisis may be communicated from husband to wife is strongly maintained by Virchow and many English physicians, and Dr. Hermann Weber has lately indicated by some striking cases the danger of pregnancy to the wife of a consumptive.

Cohnheim, who appears to have confirmed by his own experiments the doctrine of specific infection, holds, in opposition to the above views, that the test of tubercle is its inoculability, and prefers this to any structural test. He considers that tubercular particles are conveyed by means of organisms to the lungs, thus affecting the pleura and bronchial glands, and later the larger bronchi. The infection of the intestinal canal arises from swallowing the sputum. Cohnheim believes strongly in infection through suckling, and states that he has noticed scrofulous inflammation of the mouth and pharynx arise in that way. Weigert maintains that meningitis has been caused by infection through the upper nasal passages.

12. **Local causes.** — The local causes of phthisis are those which injuriously affect the bronchi and air-passages, causing large epithelial proliferation and various inflammatory lesions, followed by thickening and induration of the alveolar walls, and in time caseation or fibrosis.

Bronchitis, or bronchial catarrh, after existing for many years in a person, may extend more deeply into the alveoli and pass into a so-called catarrhal pneumonia, producing consolidation and eventually excavation of the lung. Bronchitis was the origin in nearly 12 per cent. of the writer's 1,000 cases; and a very large number of the poorer classes trace their disease to neglected catarrh.

Pneumonia is a fruitful source of phthisis, though some forms are more capable of giving rise to it than others. In croupous pneumonia, where the exudation is fibrinous, and has but little epithelium or leucocytes intermingled with it, absorption generally follows, if the patient's constitution be in a fair state, and few of these cases go into phthisis; but where leucocytes and epithelial products largely predominate, absorption is slow, the pneumonia becomes chronic, and thickening of the alveolar wall and caseation of the epithelium take place, accompanied sooner or later by the signs and symptoms of consumption. A third form of pneumonia which may originate consumption is pleuropneumonia, or interstitial pneumonia, where the inflammation extends to the pleura, and the interlobular connective tissue is largely increased. Many instances, too, of phthisis have arisen in empyema, through absorption of the purulent fluid, the channels being the elaborate network of lymphatics which the pulmonary pleura has been shown by Dr. Klein and others to contain.

13. **Trades and occupations giving rise to a dusty or gritty atmosphere.**—The constant inhalation of particles of flint, iron, coal, hard clay, and even of cotton, flax, and straw, as is the case in certain trades, such as stonemasons, fork- and needle-grinders, colliers, potters, cotton-carders, chaff-cutters, and others, has been shown by Dr. Greenhow to induce the disease. The various irritating particles have been detected microscopically and chemically in the lungs, where they appear to cause great irritation, followed by thickening of the bronchi and subsequent induration of the lung-tissue, with increase of pigment. Intermingled in the consolidations are found grey and yellow tubercle, and also extensive cavities, proving the identity of the disease with phthisis.

14. **Injuries to the lungs.**—Injuries to the lungs through wounds are somewhat rare causes of phthisis; and their action is chiefly by inducing the inflammatory processes, chronic suppuration and abscess, or induration with shrinking of the lung-tissue.

ANATOMICAL CHARACTERS.—The morbid anatomy of phthisis, acute and chronic, presents considerable difficulties, partly from the variety of pathological products, and partly from the complete disorganisation of the normal structure, and even of the invading growths. It often happens that several processes have been going on in the lungs simultaneously, each of which brings about the work of destruction by a different method and at a different rate, some by obstruction through consolidation, others by caseation and excavation. On the predominance of one or the other depends the future of the lungs, for we sometimes see one pathological element which has invaded a large portion of these organs superseded and gradually destroyed by another of more recent date, but endowed with a higher degree of vitality.

In advanced cases the lungs are for the most part devoid of vesicular tissue, and consolidated by various kinds of growths and exudations. They are also occupied by cavities, varying in size from a microscopic point to one of so large a capacity that the lung is converted into a mere bag of thickened pleura. The cavities are of every conceivable form and shape, sometimes oval and well-defined, lined with a secreting membrane, at other times irregular, sinuous, anfractuous, and presenting on section either an uneven surface, from which portions of the wall stand out like the columnæ carneæ of the heart, or a very rugged surface, on which ulceration and suppuration appear to have done their worst; but, whatever be their shape or their size, they indicate the destructive character of the retrograde processes by which the disease called pulmonary consumption is characterised.

The consolidations vary, but all partake more or less of a tubercular character. In some cases the lungs are disseminated with miliary tubercles from apex to base, the intervening tissue being free from excavation, and either engorged or consolidated with red hepatization, or sometimes apparently healthy; in others no trace of miliary tubercle can be found, but the lungs are consolidated throughout by caseous pneumonia, containing cavities of various sizes. Sometimes there are aggregations of the different forms of tubercles—white, grey, and yellow in the same lung—while the opposite lung may be entirely clear; sometimes a lung may be shrunk to the size of a fist, its pleura thickened, its lobules invaded with white fibrous bands, its tissue converted into an iron-grey structure by fibroid growth. All these, and many other diverse morbid appearances, are found in the lungs of persons dying of phthisis, and we must classify and distinguish them, first describing their naked-eye appearances; secondly, their histological phenomena; thirdly, we must consider the changes which take place in other organs of the body; and fourthly, we must indicate the pathological relation these all bear to one another and to the disease generally.

The principal pathological elements and changes are:—1, grey and dark granulations, or miliary tubercles; 2, white granulations; 3, yellow granulations, or yellow tubercle; 4, caseous masses, or yellow infiltration; 5, grey infiltration, or catarrhal pneumonia; 6, red hepatisation; 7, fibrosis; 8, cretaceous masses; 9, fibrinous nodules (blood-residues); and 10, vesicular emphysema.

1. **Grey granulations, or miliary tubercles.**—These vary in size from a millet-seed (hence the name miliary) to a hemp-seed, scattered throughout the lung-tissue. When first formed they are greyish-white, more or less transparent, and will yield to firm pressure; but after a while they either undergo caseation, being converted into the yellow variety, or losing moisture, become drier and harder, attaining the consistency of cartilage. At the same time pigment is absorbed by them; the colour passes from a light to a dark grey, and to black; the granulations simultaneously drying up and becoming obsolescent. These hard grey granulations are not uncommonly found after death in old persons, and are an evidence of tubercle having appeared at some period of their lives, and of its having afterwards become obsolescent.

More commonly these grey granulations increase in number, and form aggregations or clusters, much resembling bunches of berries, standing out in bold relief against the healthy or congested lung-tissue; their principal locality being the upper lobes of the lungs, and especially the posterior portions. In some instances this aggregation spreads quickly and extensively, and the whole lungs become so densely packed with miliary tubercle that it is difficult to find any portion of the respiratory surface free. This rapid formation of tubercle is sometimes sufficient to cause death by asphyxia, but more commonly the intense crowding of the pathological products gives rise to their destruction. Caseation commences in the centre of the groups, and cavities subsequently form. The discrete form of grey tubercle is generally found in acute miliary tuberculosis, and does not vary much in size with the different organs attacked by tubercle, as the peritoneum, pleura, &c. This identity of form suggests very forcibly the hyperplasia of some normal structure present in all the several organs, rather than an adventitious growth.

2. **White granulations.**—These formations are more opaque, and softer than the grey, and differ from the latter, as we shall hereafter see, in the arrangement of the histological elements, there being more epithelium and less reticular growth in them than in the grey variety.

3. **Yellow granulations.**—Yellow granulations or yellow tubercles exist in greatly varying sizes, from a pin's head to a pea. They are opaque, soft, granular, amorphous, easily separated from the adjoining tissue, and sometimes surrounded by a circle of pearly, transparent material. Dr. Wilson Fox describes a form of yellow tubercle among children dying of acute tuberculosis, which is with difficulty separated from the parenchyma of the lungs; but in adults it is generally easily removed, the grey granulations with which it is so often associated remaining behind.

Yellow granulation is by far the commonest form of tubercle, and its frequent occurrence in phthisis led Laennec not unnaturally to the conclusion that it was a *sui generis* production, essential to the disease. It seldom occurs alone, but is ordinarily associated with the grey and white granulations, sometimes forming with them racemose groups in various parts of the lung, chiefly in the upper lobes. At other times it is the centre of an affected portion, groups of grey granulations apparently radiating from it, thus naturally leading to the supposition that a species of local infection has been set up by the yellow or caseous mass. These groups, as they increase, exercise great pressure on the various granulations composing them and on the intervening lung-tissue, depriving them of nutrition, and thus causing death of the part by caseation. The decayed portion is gradually removed either by absorption by the lymphatics, or by expectoration; in the latter case cavities result. Careful study of one of these tubercular groups will demonstrate that the yellow tubercle is but a later condition of the grey, in which caseation has commenced; and that the cavities, large or small, in its neighbourhood are the result of the softening and removal of the yellow tubercle, and whatever lung-tissue happens to be intermingled with it.

4. **Caseous masses.**—Caseous masses and yellow infiltration are identical in constitution with the yellow tubercle, but differ in size and form, arising sometimes from the aggregation of a number of yellow granulations, but oftener from the rapid caseation of inflammatory exudations; and in this case whole lobes become affected with what is then called yellow infiltration.

5. **Grey infiltration: catarrhal pneumonia.**—This change is identical with the 'gelatinous infiltration' of Laennec. The pressure on the walls of the alveoli caused by the epithelial aggregations, as well as the inflammatory

exudation, gives rise to obliteration of the vessels and consequent caseation, and in this way large tracts of grey pneumonia are converted into yellow masses and subsequently become excavations.

6. **Red hepatization.**—The result of ordinary croupous pneumonia is often found associated with one of the above forms of tubercle, but more commonly occurring in the lower lobes, than in the upper. *See* LUNGS, Inflammation of.

7. **Fibrosis.**—Fibrosis is largely present in phthisis, but preponderates in (1) cases originating in pleuro-pneumonia, pleurisy or pneumonia; and (2) in cases of long duration. Fibrosis is the great element of the contractile process, whereby the lungs are reduced considerably in size, cavities of large capacity are cicatrized, and caseous masses encapsulated; and sometimes grey tubercle is converted into this tissue.

A lung invaded by fibrosis is reduced in size, and presents on section a dense, tough, and very hard structure, resembling cartilage in its resistance to the knife. All traces of the alveoli have disappeared, and nothing remains but a dark grey or black fibrous material, into which run long bands of whitish fibrous tissue, harder than the darker portions. The pleura is generally thickened, and the septa apparently arise from it and from the connective tissue at the root of the lung, which is also largely increased. Fibrosis is found in limited portions of the lung, in nearly all kinds of phthisis, forming the scars of contracted cavities, or tending to isolate caseous masses and tubercular aggregations. When miliary tubercle becomes converted into fibroid growth, the resulting tissue is of short duration, owing to its deficiency of blood and lymph-vessels; caseation consequently takes place at various points, and it thus perishes.

8. **Chalky masses.**—Cretaceous or chalky material is found in chronic cases, lying in small masses in various parts of the lungs, chiefly at the apices, in the neighbourhood of old cavities or caseous tracts, and generally encapsulated by fibroid tissue.

9. **Fibrinous nodules.**—These bodies have been noticed by Dr. Reginald Thompson in cases where large hæmoptysis has occurred. These vary greatly in size, and consist of inhaled blood: they are situated at portions of the lung where inspiratory action is strongest. When first found, they appear as white nodules with a zone of red colouring matter; and even in the old specimens some traces of blood in the form of crystals of hæmatine are to be found. Microscopically they are shown to consist of fibrin and red corpuscles, filling the alveoli and even penetrating the alveolar wall. The masses eventually either (1) separate from the surrounding tissue through contraction of the fibrin, leaving a capsule adherent; or (2), owing to admixture with bronchial secretion or some such septic matter, they soften into a mortar-like material, and are got rid of by expectoration; or (3) if the nodule be sufficiently large, and there be no exit for its contents, the result is the formation in time of a species of cavity filled with glairy yellow fluid, resembling honey.

10. **Vesicular emphysema.**—Two kinds are noted in the lungs of phthisical patients. *Acute vesicular emphysema* is found distributed throughout the lungs of those dying of acute tuberculosis; and *chronic local emphysema* occurs in connection with chronic tubercular masses, and specially in the neighbourhood of cicatrized cavities. The vesicles are few in number, and often as large as a hazel nut, and are generally to be found at the apex, or along the anterior border of the lung.

MICROSCOPICAL CHARACTERS.—In cases of tuberculosis and phthisis, the following histological features (as classified by Dr. Green) are present in the lungs. The amount of importance to be attached to each element has not yet been determined.

1. *Exudation.*—Exudation of fibrin and leucocytes into the alveoli, resembling that of croupous pneumonia, the fibrillation not being quite so distinct, nor the coagulum so abundant. In a large number of cases of phthisis, the lung-consolidation consists of exudatory products mingled with epithelial proliferation; and in some of the most acute instances, these two processes have constituted the only lesion.

2. *Epithelial accumulations.*—An accumulation of large epithelial cells may be found within the alveoli. These are generally large, spheroidal cells, about four or five times the size of a leucocyte, containing granular matter, and a nucleus and nucleolus. Some smaller ones are also observed, indistinguishable from leucocytes. Within the alveoli also are found the so-called 'giant cells,' which are held by Hering to be lymphatics cut across; by Friedländer to be the basis of tubercle; by Klein and Green to be derived from the alveolar epithelium, by fission or excessive development. These appear at first as spheroidal masses of faintly granular protoplasm, reaching $\frac{1}{200}$th inch in diameter, with numerous nuclei—sometimes as many as thirty, and bright nucleoli. After a while they increase in size, and send out branched processes, from which are developed other smaller protoplasmic masses, so that a branched reticulum is formed round the original giant-cell, connecting it with other giant-cells. These branches are often directly continuous with the lymphoid or adenoid network of the alveolar wall, to be presently alluded to, which forms a circle round the giant-cell system. Giant-cells are not found in the earlier stage of tubercle-development, and appear after some of the products of exudation have been absorbed. They are devoid of any vascular supply, and are consequently subject to caseation, having in such cases previously undergone a peculiar transformation into a fibrillar material. Giant-cells are regarded by Green as a product of low vitality, incapable of forming organised tissue; where the protoplasm grows, the nuclei multiply, but the highest manifestation of cell-life—division of the cell—does not take place.

3. *Interalveolar growth.*—This is a thickening of the alveolar wall by a small-celled lymphoid tissue, consisting of minute cells not larger than a leucocyte, separated from each other by a very delicate reticulum. This growth appears to commence in the walls of the alveoli and terminal bronchi, first in the form of a few lymphoid cells, the network appearing later, and has been demonstrated by Sanderson to be a hyperplasia of

the adenoid tissue already existing in the lungs; for it must be borne in mind that lymphatics and lymphoid tissue are largely present in these organs, and that the alveolar wall is considered one of the densest lymphatic plexuses of the whole body.

The small-celled tissue spreads rapidly through the alveoli, invading the walls of the capillaries, the peribronchial and perivascular sheaths, diminishing by pressure the calibre of the vessels, and in time obliterating them, and thus giving rise to necrobiosis by caseation and ulceration of the surrounding tissues. The growth fills up the alveoli, and thus infiltrates whole tracts of the lung, which in time become cut off from both air and blood supply. This either degenerates by caseation, giving rise to the formation of cavities; or the cells become more spindle-shaped and branched; the reticulum more fibrinated; and then gradual fibrosis of the nuclear tissue takes place. Owing, however, to the disappearance and obliteration of the vessels, this tissue is not properly supplied with nourishment, and soon undergoes caseation.

4. *Interlobular growth.*—Increase in the interlobular connective tissue resembles the process prevailing in the liver, kidneys, and other organs during chronic disease, and is not necessarily associated with consumption. This feature is most marked in cases of inflammatory origin, or where the disease is of very long standing; and the result is best seen in the large fibrous septa often accompanying the bronchi and great blood-vessels, as is specially exemplified in fibroid phthisis. Microscopically it is difficult to distinguish between the interlobular tissue and the alveolar adenoid growth in their early stages, both being richly cellular; the main differences being the situation of the former around the lobules, and in the neighbourhood of the great air and blood-vessels, whereas the latter is found in the alveolar wall and smaller bronchioles. The interlobular tissue is not so liable to retrograde changes, owing to the vascular supply being less liable to obstruction and obliteration; and, again, the alveolar growth has a more delicate reticulum of fibres.

Changes in the bronchi, pleuræ, and bronchial glands.—The *bronchi* show, in many cases, catarrh of the mucous membrane, giving rise to a richly cellular secretion, which forms the greater proportion of the expectoration of phthisis, as the principal lesion, and extending in acute cases throughout the whole bronchial tree; but in more chronic forms being limited to the bronchi leading to the affected lobules. A second and more important change is the infiltration, noted by Rindfleisch, of the sub-epithelial connective tissue by large cells characteristic of scrofulous inflammation, and very difficult of absorption. The mucous membrane appears swollen and opaque; the epithelium may be shed; and if the sub-epithelial infiltration disintegrate, small ulcers are formed. A third change is the infiltration of the peribronchial tissue, and the proliferation of lymph-follicles in the walls of the smaller bronchi, owing to transmission of infective substances from the bronchi through the lymphatics. The bronchi from these changes become reduced in calibre, and consequently the adjoining ones, as noticed by Grancher, are often dilated through the action of increased air-pressure on their walls.

In laryngeal phthisis ulceration is to be found in the bronchi, as in the larynx, the changes in which will be presently stated under the head of *Laryngeal phthisis.*

The *pleura* is often adherent over the region of tuberculisation, when the formation has taken place slowly, and is comparatively superficial. It is often considerably thickened, as in fibroid phthisis, to the extent of three quarters or one inch diameter, the layers being sometimes separated, as Dr. Douglas Powell has shown, by a gelatinous material, consisting chiefly of connective tissue.

The pleura, peritoneum, arachnoid, and even the pericardium, may be the seats of miliary tubercle in the most acute form of phthisis, namely, miliary tuberculosis; but it is generally noted that the lungs are the first organs attacked, and it is extremely rare for tubercle to exist in any organ without being also present in the lungs.

The *bronchial*, cervical, mesenteric, and other *glands* undergo various changes. In many, and especially in advanced cases, the bronchial glands enlarge and become deeply pigmented; in others they seem to partake of the changes proceeding in the lungs; they become affected with grey tubercle, and caseate, and occasionally cretify, the cretaceous material being, as a rule, in the centre of the gland, though the reverse is occasionally the case, and the calcareous matter forms a shell over the whole gland (*see* BRONCHIAL GLANDS, Diseases of). The other lymphatic glands, especially the mesenteric, are liable to similar changes.

Other organs.—The stomach and intestines in protracted cases become greatly attenuated, all the coats being thinned and wasted, and in many cases are found to have undergone lardaceous degeneration, which is a common cause of diarrhœa in phthisis. Where the diarrhœa has been very persistent, it is common to find extensive ulceration of the jejunum, ileum, cæcum, and large intestine, extending even to the sigmoid flexure and rectum, the cæcum being earliest attacked, and generally in a more advanced stage than the small intestine. The ulcers vary much in form and extent; in some instances they are circular, clearly cut depressions; in others, and this is the commoner form, they present large, raised, irregular edges, with fæces adherent to their ragged surfaces, and can be often seen through the attenuated external wall of the intestine. The peritoneal coat, as a rule, is thickened in their neighbourhood, and thus perforation of the intestine prevented. The earlier stages of this process appear to be:—miliary tubercles form in the submucous coat, not only in the solitary glands and Peyer's patches, but scattered throughout the submucous layer, appearing as shining granules through the epithelium; yellow points of caseation become visible in some parts, and small abscesses form in others, the latter appearing to have their seat in the solitary and agminate glands; and, later on, these discharge, leaving ulcers of different forms. Ulceration of the large intestine pene trates very deeply, and often resembles that of old dysentery. Perforation rarely occurs, on account of the thickening of the peritoneal coat taking place outside the ulcers, but occasionally it does occur, causing fatal peritonitis.

The liver is rarely normal, but generally undergoes either fatty or lardaceous degeneration. The spleen is softened, and very commonly lardaceous. The kidneys are not generally affected, but where albuminuria has prevailed towards the close of the disease, fatty or lardaceous changes occur. The heart is usually small, and the muscular tissue pale, and very often in a state of fatty degeneration (Quain). Fatty growths may be found on the surface.

PATHOLOGY.—The nature of tubercle has long been a subject of discussion. In the sixteenth century two forms of tubercle (scirrhous and caseose) were recognised, showing that even at this period a distinction had been drawn between grey and yellow tubercle. Later on, the similarity of the changes occurring in the tubercular masses to the softening of scrofulous glands, led Portal to conclude that tubercles were engorged lymphatic glands situated at various parts of the lungs, the engorgement terminating in suppuration. Laennec applied the term tubercle to miliary and yellow granulations, as well as to grey and yellow infiltration, but considered that it was a *sui generis* production, unconnected with inflammation. Broussais, Andral, and Cruveilhier assigned an inflammatory origin to tubercle, the latter considering that tubercle is the result of chronic inflammation of the lymphatics of the lungs. At length Virchow restricted the term 'tubercle' to the grey granulation, which, according to him, originates in the connective tissue, and is of a cellular nature. Rokitansky, Dr. C. J. B. Williams, and others considered that tubercle is principally an exudation from the blood-vessels, the different varieties depending on the kind of exudation, and on the part played by the leucocytes. Dr. Williams does not exclude the additional action of the local tissues, the connective tissue, the epithelium, and the adenoid tissue of the lung; but he assigns the principal part to the exuded materials from the blood-vessels, especially to the leucocytes, regarding the lymphatic cells in the small-celled tissue as identical with leucocytes in their nature and action, and that when increased in their number in denser masses, they constitute grey tubercle. This may pass into the state of yellow tubercle by the process of caseation, which consists of fatty degeneration and disintegration of these masses, entirely destroying their remaining vitality. Drs. Sanderson and Wilson Fox have demonstrated the grey tubercle to consist of the small-celled adenoid tissue with such epithelial accumulations as may be imprisoned in the course of its growth; and the latter holds that this small-celled tissue is to be found in all forms of tubercle and in consumptive infiltrations. Dr. T. H. Green maintains the existence of all four classes of histological elements as enumerated above, in the lesions of phthisis, and that the small-celled tissue is not typical of phthisis, as it may appear in chronic inflammations of various organs, as of the kidney and liver. In some of the most rapid instances of acute phthisis (not acute tuberculosis) he can detect nothing but the products of exudation so closely packed as to cause their own breaking down. At the same time he admits the large part played by the adenoid growth in grey granulations. Charcot, after careful histological study, strongly advocates the unity of phthisis, and affirms that in caseous pneumonia he finds, as in grey granulation, two zones—first, a central region, consisting of little else than exudation-products and caseous *débris*, in which reagents can bring to view fibres of lung-tissue; and, secondly, a peripheral region ('*zone embryonnaire*') made up of adenoid growths and giant-cells. He considers that the last two elements are the basis of tubercle, which is always a peribronchial product, and that caseation does not take place without their being present. Charcot points out that croupous pneumonia occurs in tubercular lungs, and clears up, leaving no residue behind; and argues that pneumonia alone cannot produce the caseous masses.

Though great difference of opinion thus appears to exist as to the relative parts played by exudation and adenoid growth in the pathology of phthisis, it will not be difficult to deduce some general conclusions which may elucidate many of the difficulties.

The part played by inflammation in phthisical lungs, in spite of Charcot's doctrine, is very large, and we may conclude that grey and yellow infiltration are varieties of the pneumonic process, probably of a low type, with, as Dr. Fox remarks, 'that invasion of the alveoli by the small-celled tissue which leads to the obliteration of the capillaries and slow necrobiosis of the part involved.'

Of the inflammatory products found in phthisis, the fibrinous or easily absorbed element is scarce, and the corpuscular, or cellular, which is not easily absorbed, is common; and this last element, in order to be absorbed, has generally to pass through the process of caseation.

The absorption of caseous matter by the lymphatics is attended by a considerable amount of irritation, and thus we get adenoid hyperplasia or tuberculosis. This may be *local*, as when we see a group of miliary nodules surrounding a caseous centre, the rest of the lung being apparently free; or *general*, infecting the lymphatics of the lungs, and it may be of other organs, as is seen in acute tuberculosis. The future of grey tubercle depends to a great extent on its rate of production, and its relation to blood-vessels. When not clustered closely together, and when unaccompanied by inflammation, it may gradually dry up, and even in time be converted into fibrous tissue; but if, as is usually the case, increase of the adenoid growth leads to obliteration of the capillaries, we have caseation and excavation, with fresh local infections.

The two principal factors in the pathology of phthisis then are *irritation* and *infection*:—

Irritation.—Under this term may be included the various inflammatory processes and other local agents, which affect the alveolar wall in proportion to the intensity of their action.

Infection.—Infection is either local, through inflammatory processes, as the result of irritation;

or from general state of system, as in cases from family predisposition, where the lymphatics are primarily affected.

It, therefore, appears most probable that the various pulmonary processes—the exudation of leucocytes, the formation of giant cells, the adenoid hyperplasia, are all indications of some general blood-crasis, manifesting itself chiefly in the lungs, on account of the large circulatory area involved, but not necessarily confined to their limits. We may suppose that under these circumstances the blood has a tendency to form and exude cells, which grow and do not develop into tissue, but die and caseate, and in this state irritate the lymphatic system, and the pulmonary lymphatics in particular. We must bear in mind that the increase of the adenoid tissue takes place *after* the exudation, the epithelial proliferation, and formation of giant-cells. What the irritating quality of the blood is, whether chemical or histological, and why cellular exudations should be less easily absorbed than fibrinous, are problems still to be solved.

SYMPTOMS.—(*a*) *First stage.*—The symptoms of pulmonary phthisis in the first stage may be thus summarised :—Cough, becoming more persistent; mucous expectoration; loss of colour and strength; emaciation; night-sweats; sometimes loss of hair; pulse somewhat quickened, though this is not invariable; and a temperature rising above the normal in the afternoon, and sinking below it in the morning. M. Peter has noted in many cases a rise in temperature on the affected side during this stage; and with regard to the general temperature of the body, though slight pyrexia is often present, tubercle-formation is quite possible without any rise of temperature, or may even be marked by a depression, as Surgeon-Major Alcock and others have shown. Pain in the upper parts of the chest is occasionally present; and the number of respirations are generally increased, though this depends on the amount of tuberculisation proceeding. Some hold that dyspnœa is an early symptom and precedes all others, but the writer has found quite the opposite—that patients do not notice their breath to be short until their lungs are seriously involved. Disturbance of the digestive powers, and considerable irritability of the intestinal mucous membrane, with a red streak on the gums, is noticeable in some, though chiefly in the acute forms. The tongue becomes white, the bowels torpid, and the urine scanty. The most constant of the above symptoms are the persistent cough, with mucous expectoration, and the progressive emaciation; and in many cases so obscure are the beginnings of the disease, that these are the only symptoms discoverable.

Physical signs.—The physical signs, after the first stage, depend to a great extent (1) on the number and aggregation of the miliary tubercles; (2) on the amount of consolidation they give rise to; and (3) on the irritation which their formation causes in the lung.

As a rule tubercle-formation commences at the apex of one lung, and is detected by the presence of certain physical signs in the supra-scapular, supra-clavicular, or sub-clavicular regions, the signs extending downwards at a later date. The signs vary much in particular cases, but consist at the first in an impairment of the ordinary respiratory murmur by a species of crepitation, differing from the pneumonic crepitation chiefly in its more scattered character, in its being audible with both inspiration and expiration, and in its crumpling nature. Many authors, however, maintain that an earlier sign is the 'wavy' breathing (T. Thompson), or '*respiration saccadé*' of the French. Accompanying this is increased vocal resonance and bronchophony, with more distinct conduction of the cardiac sounds; and percussion discovers dulness of varying shades in one of the above-mentioned regions. When a certain definite amount of consolidation has taken place some impairment of the mobility of one side of the chest may be noticed: this is to be detected under the clavicle, where, if any adhesion of the pleura exists, there may be some flattening. Another significant sign is the dry friction-sound, audible generally in the supra-scapular and scapular regions, and indicating limited pleuritis from a nodule of tubercle formed immediately below the membrane. The sub-clavian murmur, much dwelt on by old authors, is too uncertain to be depended on. The dulness usually appears first above the scapula, next over the sternal end of the clavicle, and gradually extends downwards, being limited generally for a considerable period by the third rib.

A careful comparison must be made between the two sides of the chest, and often between different portions of the same side, as otherwise the slighter shades of dulness, and the minor differences in the respiration-sounds, which characterise the presence of tubercle in the lung, will escape notice.

When the crepitation and the wheezing—which may be considered as indicative of irritation in the pulmonary tissue, caused by tuberculosis—have subsided, prolonged expiration, and certain varieties of tubular sound, show condensation of the lung-tissue around the neighbouring bronchi; and a certain amount of dulness is to be detected.

(*b*) *Second and Third stages.*—The symptoms which accompany the second stage, or that of softening of tubercular masses and their subsequent excavation, are by no means uniform. Many authors associate this stage with marked signs of pyrexia, with copious night-sweats, and increase of cough and emaciation; but this is not always the case, for, according to the writer's experience, the process may go on with even subnormal temperatures, and with gain of weight; but as fresh formation of tubercle often accompanies the softening process, some of the above symptoms, which have been assigned to softening, may be due to the tuberculisation and pneumonia accompanying it. The symptoms which should be most depended upon for the detection of softening are—increase of cough, and expectoration of a yellow colour, occasionally streaked with blood. If the expectoration be carefully collected and boiled with an equal volume of caustic soda, of the strength of 20 grains to the ounce, and the sediment then placed under a moderate magnifying power of the microscope, delicate filaments of yellow elastic tissue, of hook-like shape, or else exhibiting the characters of the alveoli, may be detected. The sputum chiefly consists of pus, with 2 to 4 per cent. of albumen, and a large proportion of phosphates. Pouchet found monads and bacteria; and Koch has recently described the peculiar bacilli, believed by him to constitute the virus of tubercle. Dr. Ehrlich has given an elaborate process for showing these bacilli in the sputum. (*Deut. Med. Wochensch.* May 6; and *Med. Times and Gaz.*, May 27, 1882.) *See* BACILLI, in Appendix.

Physical signs.—The signs which these changes give rise to are often obscure. The percussion-sounds vary; sometimes there is an increase of dulness, possibly due to pneumonia of adjacent lobules; at other times, hyper-resonance, as if air had taken the place of the expectorated masses. In all these cases much depends upon the situation of the lesion. The formation of a cavity deep in the lung, and far from the chest-walls, may take place without being detected, except by the expectoration; whereas the formation of a similar one on the surface gives rise to unequivocal signs. Auscultation reveals—where formerly bronchophony and fine crepitus existed—crepitation of a very coarse character, commencing with a *click* sound, and after a while developing into a *croak*. When this last note has been reached, loud tubular sounds become audible on coughing, and we soon get the sounds characteristic of a cavity. The great distinguishing features of these moist sounds of softening are their variety, their short duration, and their concentration over one small portion of the lung. In phthisis, crepitation much more commonly signifies tubercle-formation or pneumonia than it does softening of already formed tubercular masses. The formation of a cavity is generally followed by regular morning expectoration, usually opaque, and nummular in form, and in the majority of cases, unless interfered with by treatment, by the usual consumptive train of symptoms, if these have not already appeared. These are—night-sweats, slightly elevated temperature at night, and rapid loss of flesh, strength, and colour. The drawn look of the face, the hectic spot on the cheek, the pearly white colour of the sclerotic, the clubbing of the fingers, and other signs which mark the confirmed consumptive, generally belong to this stage, and all more or less denote blood-infection from the lung-products, sometimes even simulating pyæmia.

The weakness of voice, so common in chronic phthisis, is distinct from the total aphonia of laryngeal phthisis, and has been shown to be due to granular degeneration of the muscles of the larynx. Marcet has shown that in phthisis the muscles generally undergo degeneration.

The history of a cavity follows one of four courses. *See also* CAVITY; and VOMICA.

1. It may remain patent, secreting pus, like a chronic abscess, but not increasing in size.

2. It may enlarge by caseation and ulceration going on in its walls, by which process blood-vessels may become exposed. In this case the expectoration becomes more nummular and abundant, containing quantities of lung-tissue and remains of bronchi; and excavation may in time convert the lung into a mere pleural bag, devoid of lung-tissue, with what remains of the bronchi opening into it. The physical signs attending this increase in size are amphoric breathing, and often hyper-resonance on percussion, or cracked-pot sound; and the voice and cough may be accompanied by metallic tinkling, especially if the communication with the bronchi is narrow.

3. It may open into the pleura, and cause pneumothorax or pyopneumothorax. That this does not occur oftener is owing to the adhesive pleurisy which so often accompanies the early consolidations of phthisis, especially if the tubercle be superficial. *See* PLEURA, Diseases of.

4. It may contract, and the sides approaching each other form at length a firm, tough cicatrix, causing a stretching of the surrounding tissue, and often considerable displacement of the neighbouring organs. This is the natural cure of the third stage of phthisis, and is evidenced in most cases by a flattening of the chest-wall, chiefly in the infra-clavicular space, a disappearance of the cavernous sounds, and a substitution of deficient or harsh breathing, and sometimes of healthy sounds over the seat of the cavity. Percussion often discovers that the sound lung is drawn across the median line to the affected side; and if the cavity be in the left lung, the heart and stomach may be displaced upwards, the former organ being generally tilted towards the axilla, the apex describing the arc of a circle, of which the centre is the commencement of the aorta. If the cavity be in the right lung, we may expect the liver to be drawn up, and the heart displaced to the right of the median line, reaching occasionally beyond the right nipple. Contraction of a cavity always takes place towards a fixed point, which is sometimes an adhesion of the pleura, but more generally the root of the affected lung; and in this way the remarkable vagrancy of the physical signs is explained; for it is not unusual to find the cavernous sounds audible above the scapula, long after they have ceased to be heard in the sub-clavicular region, and again in the inter-scapular regions after they have ceased to be audible in the supra-scapular fossa.

Of these destinies of a lung-excavation, the two first are undoubtedly the commonest. Where the cavity remains quiescent, and no fresh tubercle-formation takes place, the patient may live on for years, with only the inconvenience of regular expectoration and occasional dyspnœa, and preserve the appearance of actual health. Where a cavity continues to increase by further ulcerative processes, tuberculosis soon attacks the opposite lung; and this organ passing rapidly from consolidation into excavation, the cough and expectoration increase, hectic fever becomes more frequent, the patient reaches an extreme state of emaciation, the adipose tissue disappears from all parts of the body, the temporal and malar bones become prominent, the jaws are sharply defined, the scapulæ, ribs, and sacra all stand out, as if, as is really the case, they were only covered by skin, and the patient becomes to all appearances a mere skeleton. By an all-wise arrangement a kind of balance seems to be maintained between the diminished requirements of the body and the mass of the blood, for this latter is reduced in bulk in proportion to the lessened respiratory surface, and the individual thus gradually dwindles and sinks.

In the last stage of phthisis various symptoms appear indicative of the disorganisation the blood has undergone, and the manifest lowering of the standard of life. Thromboses may arise in the veins of the extremities; œdema of the ankles and feet ensues; bed-sores form on those parts where the pressure is greatest, as, for instance, on the hips, buttocks, and sacrum; and aphthæ appear on the tongue and fauces, and when removed are succeeded by a fresh crop, rapidly spreading round the hard palate, buccal surface, and gums. Ulceration of some part of the mucous membrane of the mouth and pharynx is not uncommon, the part affected being generally the edge of the tongue, or the buccal surface in the region of the back molars. Ulceration of the soft palate rarely occurs except in connection with syphilis. Near the end profuse sweats follow the swallowing of all fluids. The breathing becomes quicker, and expectoration more and more difficult. Diarrhœa prevails at this stage, and often proves fatal before the pulmonary lesions have reached their furthest development.

Death may occur in several ways, either—(1) by apnœa, from inability to expectorate; (2) by thrombosis of the pulmonary artery, inducing lividity and dyspnœa; (3) by pneumothorax; or, (4) by exhaustion, the heart's action gradually failing, the patient being utterly prostrated, either by the wasting course of the disease, or by the attendant diarrhœa. Hæmoptysis may cause death, either by collapse from loss of blood, or by suffocation through the blood rapidly filling the air-cells.

Some of the principal symptoms of phthisis require a fuller description.

Temperature, pulse, and respiration.—The *temperature* of phthisis is both pyrexial and subnormal, its varieties depending partly on the amount of tuberculisation and inflammatory process going on, and partly on the extent to which the constitutional powers are depressed. The high temperatures are due to the former, the low ones to the latter cause. The range extends from 106° F. or 107° F., noted in acute phthisis, down to 90·5° F., observed by Lebert. The writer has seen morning records as low as 91·6° F. In many cases of quiescent phthisis in the first and third stage, the observations are for the greater part of the day subnormal, and only reach the healthy standard in the afternoon. It is even possible for tubercle to form, and for softening and excavation to take place, without any rise of temperature.

Where, however, tubercle-formation is accompanied by elevation of temperature it is postmeridian, and by no means continuous in character, the phenomena being as follows:—The rise commences after 2 P.M. and continues till 8 P.M., when the maximum, which may attain 103° or 104° F., is reached. A fall then begins, and continues till 4 or 5 A.M., when the minimum, which may be as low as 94° F., but is generally about 95° F. or 96° F., is attained. After this a gradual recovery takes place, and by 10 or 11 A.M. normal temperatures are reached. During the process of softening the postmeridian rise appears to be maintained later in the day, the maximum being reached at 10 or 11 P.M. In active cases in the third stage, where excavation is proceeding or extending, and where also fresh tuberculosis may be taking place, the thermic chart approaches more closely to that of suppuration and pyæmia, and shows great extremes, the highest and lowest temperatures of phthisis being noted at this stage. The rise commences soon after noon, and continues till 5 P.M., or even till 10 P.M., when the maximum of 103° to 104° F. is reached, and a fall rapidly follows, 95° F. and 94° F. being very commonly reached before 6 A.M. Then recovery sets in, and normal records are observed about 10 A.M. The chief characteristics of the temperature in phthisis are—(1) the post-meridian form of its pyrexia; and (2) the remarkable fall at night to subnormal figures, showing collapse of the vital powers.

The occurrence of hæmoptysis does not generally affect the temperature, unless a large amount of blood has been inhaled into the air-cells. Under these circumstances catarrhal pneumonia is set up, and the temperature remains elevated until its subsidence; or, if it does not subside, but gives rise to secondary tubercle, the chart will assume the pyrexial character of acute tuberculosis. Night-sweats, as a rule, lower the temperature for the time, but they are not to be regarded as a consequence of the pyrexia, as they are noted sometimes in nonpyrexial cases, but rather as a flux from the skin, due to loss of power in its vaso-motor system. The influence of diarrhœa on the temperature depends entirely on its form and causation. Where it depends on acidity of the primæ viæ and dyspepsia, it exercises no influence; where it arises from lardaceous degeneration of the intestines, and is accompanied by dropsy, a lowering of the standard may be looked for. Where, as is generally the case, it is due to intestinal ulceration, a decided rise of temperature takes place, generally in the evening, succeeded by equally well-marked morning remissions, if the ulceration is extensive. Albuminuria, from whatever cause arising, tends to lower the temperature, and the more so as the kidneys become more deeply involved, the blood is more disorganised, and dropsy supervenes.

The *pulse* varies greatly, according to the form of the disease, and the amount of lung-surface involved. In the greater number of cases of chronic phthisis its character is weak, regular, and little above the normal standard. In cases of acute disease, it has a frequency of 100 to 140, but its rise, as a rule, follows, sometimes after a long interval, that of the temperature. Considerable changes may take place in the lungs without any rise of pulse.

Respiration varies according to the amount of lung-surface involved, being normal in early quiescent stages, and rapid in cases of extensive advanced disease. Nevertheless in acute phthisis and acute tuberculosis, the respirations are generally rapid, even before the lungs are largely obstructed, and in these cases there is a definite pulse-respiration ratio. In phthisis generally this cannot be said to exist, but the observation

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of the number of respirations is of far more importance than that of the pulse.

Diarrhœa.—Diarrhœa has a great influence on the course of the disease, and tends more to weaken and emaciate the patient than the harassing cough, the persistent pyrexia, or the drenching night-sweats. In the first stage an opposite condition, namely, constipation, prevails, but in the third stage it is tolerably common and very obstinate in character. The diarrhœa varies in intensity, according to its cause. Sometimes it proceeds from (1) acidity of the primæ viæ and consequent indigestion, and is trivial in character. Sometimes it is due to (2) atony of the intestines, and partakes of the character of a flux, like night-sweats; (3) in other cases it is due to lardaceous degeneration of the intestines, especially of the small intestine. The diarrhœa is not always very profuse in these last cases, but it is very persistent, and not uncommonly accompanied by vomiting of a very obstinate kind. Lastly (4) it may originate in ulceration of the intestines, as has been described. Here the diarrhœa is very persistent, the stools ochrey and soft, and sometimes streaked with blood; the patient often complains of pain in the abdomen, referred to the seat of ulceration, and experiences tenderness on pressure. This is usually found over the ileo-cæcal valve, but in cases of extensive ulceration the writer has traced it throughout the whole of the ileum, into the colon (ascending, transverse, and descending), and the sigmoid flexure. Flatus and a tympanitic condition of the abdomen is often present in extreme cases, but generally after intestinal perforation. The diarrhœa prevails most at night, but in advanced instances continues day and night, and exhausts the patient greatly.

State of the Blood.—The principal changes in phthisis are a diminution of the red corpuscles (Malassez), and of the hæmoglobulin (Quinquand); and an increase in the number of leucocytes, and in the proportion of fibrin and phosphate of lime. In advanced cases aggregations of granules, varying in size from $\frac{1}{10}$th to $\frac{1}{2}$ a red corpuscle, have been observed. The masses are often large enough in size to occupy a third of the field of the microscope; and when observed for one or two hours at a temperature of 98° or 100° F. these granules appear to develop into organisms, and to move about in the blood. Their nature and function are quite unknown.

VARIETIES.—We have hitherto traced the course of a typical case of consumption in its various stages, and we must now draw attention to the different forms the disease includes, always premising that while they differ in symptoms, in prognosis, and in duration, they cannot be erected into distinct pathological varieties, as they are merely forms of the same disease, and between each is to be found every kind of anatomical and clinical connection.

The following table gives the principal forms:—

I. *Acute.*—1. Acute tuberculosis. 2. Scrofulous pneumonia, or acute phthisis. 3. Acute tuberculo-pneumonic phthisis.

II. *Chronic.*—4. Catarrhal phthisis. 5. Fibroid phthisis. 6. Scrofulous phthisis. 7. Hæmorrhagic phthisis. 8. Laryngeal phthisis. 9. Chronic tubercular phthisis.

1. Acute Tuberculosis.—This term is restricted by the Germans to cases of general tuberculosis where more than one serous membrane is affected with tubercle, in addition to the lung, but it is here used to denote all acute pulmonary cases where miliary tubercle, which has not begun to caseate, is the principal lesion. The history is as follows: a young person of either sex is suddenly attacked with feverish symptoms, pungent heat of body, rapid pulse, extreme oppression, and overwhelming weakness, dry-coated tongue, red at edges, soon becoming brown in the centre, sordes on the teeth and lips, gastric disturbance and diarrhœa, and occasional delirium, the symptoms closely resembling those of enteric fever, for which the disease is often at first mistaken. Cough and slight expectoration come on; fine crepitation and bronchial rhonchus take the place of the ordinary vesicular sounds; and occasionally some dulness is detected over the posterior regions of the chest. The patient wastes rapidly; the breathing becomes more and more embarrassed; the sputum rusty; the crepitation more general and louder. Later on, the symptoms of collapse appear—the pulse becomes more rapid and feeble, the aspect ghastly or livid, cold perspirations appear, and death occurs within a few weeks from the date of the first onset. Or the symptoms may be more cerebral in character, denoting that the meninges are the seat of miliary tubercle. The patient complains of pain in the head, vomiting, and intolerance of light; begins to mutter and to give wrong answers; and then has marked delirium. The aspect is heavy and confused; hyperæsthesia of skin (Empis) appears; and double vision, though squinting is not always noticeable. Granulations can often be detected by the ophthalmoscope in the fundus oculi. Twitchings of the muscles of the extremities and sometimes of the face occur, followed by convulsions, and by paralysis of the sphincters. Dilatation of the pupils and other signs of effusion supervene, and the patient dies comatose. In this variety, as a rule, the temperature remains continuously high (between 100° and 102° F.) but in some instances under the writer's notice it has not risen above 100° F. for the last ten days of the patient's life. After death the lungs are found highly congested and pervaded with miliary tubercle, soft in character, but devoid of caseation; the bronchi full of frothy mucus; and tubercle may also be found in the peritoneum, brain-membranes, or pleura, with effusion into the ventricles. This form is distinguished from capillary bronchitis by the presence of fever; from enteric fever by the different physical signs; from scrofulous pneumonia by the great dyspnœa and scanty expectoration; and by the head symptoms (when present) from all the above.

Acute tuberculosis is the most fatal form of consumption, terminating in a few weeks or even days, and is characterised by gastric disturbance, the presence of family predisposition (Pollock), and the absence of hæmoptysis.

2. Acute phthisis.—Acute phthisis or scrofulous pneumonia, is another very acute variety. The patient, generally young, who may have had cough previously, is attacked with sharp pain in one side of the chest, quick pulse, high temperature, the skin being quite burning to the ear of the auscultator, alternating with night chills and sweats. The general appearance betokens pneumonia, but the crepitation commences at the apices, extending to the whole lungs, and is not so fine and even as in pneumonia. The cough increases; the expectoration becomes opaque and purulent, containing quantities of lung-tissue; and the temperature assumes the intermittent type. The physical signs show at first gradual consolidation of both lungs, but later on declare excavation to have taken place; and this continues, the patient rapidly wasting and dying in a few weeks. Sometimes the cavity opens into the pleura, which in these cases is rarely adherent, and death ensues by pneumothorax. This form is not quite so hopeless as acute tuberculosis, and the disease may stop short of utter lung-destruction, the patient remaining in a state of crippled respiration and of health for months and even years. The writer has notes of one case lasting three and a half years; another sixteen years and still living. After death the lungs are found more or less consolidated, with adherent pleuræ, the indurations consisting of red hepatisation and caseous infiltration, the latter largely predominating. Excavations abound in all directions, and but little or no miliary tubercle is present. The characteristics of this form, are (1) the acuteness of the disorganising processes, excavation quickly succeeding consolidation; (2) the inflammatory nature of the lesions, and the rarity of miliary tubercle; (3) the occurrence of pneumothorax; and (4) the freedom of other organs from tuberculosis.

3. **Acute tuberculo-pneumonic phthisis.** This is a third variety, which constitutes a connecting link between the above forms, scrofulous pneumonia and acute tuberculosis, as it presents some of the clinical and pathological features of each, resembling the latter in so far that the tuberculisation takes place rapidly in the lungs, and often involves other organs, as, for instance, the intestines; and being more akin to the former in the presence of consolidations of a pneumonic origin, yet differing from them both in that the tubercle aggregates, tends to caseate, and thus to form cavities, through the breaking down of tubercular masses, and not of catarrhal pneumonic products, this occurring while rapid tuberculisation is taking place in another part of the lungs.

4. **Catarrhal phthisis.**—Catarrhal phthisis somewhat resembles the last-named variety, and has its origin in bronchitis which has gradually passed into catarrhal pneumonia. The patient has been subject for years, perhaps, to attacks of winter catarrh, which disappear in summer; and at last, owing to a severe season, or from his being in less favorable circumstances than usual, his cough does not cease, as formerly, but remains persistent, and is accompanied by some purulent expectoration, loss of flesh, and night-sweats. The bronchial *râles*, sonorous and liquid, as they disappear from certain parts of the lung, become more prominent and localised in others, especially under the clavicles, and above and between the scapulæ. The *râles* become coarser, and the sonorous rhonchus assumes a croaking character. Signs of consolidation soon appear, but are never so prominent as in other forms, owing to the temporary emphysema accompanying the bronchitis; the dulness appears in patches over the centres of increased rhonchus; the liquid *râles* diminish, owing to increasing obstruction, and give place to a tubular sound conveyed by the extending consolidation from the larger bronchi, and heard best in situations overlying them, as below the clavicle, and above and within the scapula, in the axillary and middle dorsal regions. The tubular sound has a sharp, whiffing character, and is often unaccompanied by bronchophony, from the consolidation being insufficient, and the bronchial tubes too choked to produce it. If the case goes on unfavourably, the expectoration becomes more abundant, and excavation soon takes place, with the usual symptoms; the patient assumes all the appearances of advanced cavity-phthisis, and the case from this date can hardly be distinguished clinically from those of a strictly tubercular origin. After death the lungs are found to be more or less consolidated, the indurations taking the direction of certain lobules and generally not affecting entire lobes. The indurations are of a grey or yellowish tint, with numerous yellow masses of caseation intervening. Portions of the lung may be found in the first stage of catarrhal consolidation, so well described by Dr. Hamilton, with isolated lobules or groups of lobules of a leaden or purple colour, and the adjoining ones may be emphysematous. Wedge-shaped patches of consolidation can be traced on the pleural surface, exuding on section yellow catarrhal fluid similar to that contained in the bronchi. Numerous excavations of irregular form are seen, but in most instances no trace of tubercle is to be found, though it is occasionally present. The bronchi are generally dilated, and full of purulent matter. This form is more common among the young than the old, and arises from whooping-cough, measles, and bronchitis, the pathology being extension of catarrh from the bronchi to the alveoli, implication of the interstitial tissue, large epithelial proliferation, causing pressure and emptying of capillaries, degeneration and caseation of the alveoli and their contents, and consequent excavation, with occasionally lymphatic infection.

5. **Fibroid phthisis.**—This term, introduced by Dr. Andrew Clark, is applied to cases of which fibrosis is the principal feature. While this process accompanies most instances of chronic phthisis, it specially characterises those in which interstitial pneumonia is present, and entirely modifies their history and symptoms. It is generally secondary to attacks of pleurisy and pleuro-pneumonia, or to chronic pneumonia, resulting from long-continued irritation of the lungs, through the inhalation of dust or grit, as prevails among fork and knife grinders, colliers, and button-makers. Taking the pleuritic origin as an example, the following are the symptoms.

A patient has an attack of pleurisy with effusion, from which he recovers with absorption of fluid; but percussion shows dulness over the whole side and somewhat feeble respiration. The patient experiences dragging pains in the side; a dry, hacking cough, somewhat paroxysmal in character, with little expectoration, continues; and the breathing, always short, becomes still more so on exertion. These symptoms increase, and a few months later we find marked immobility of the affected side, dulness throughout, and now considerable shrinking; the circumference of this side, measuring one or two inches less than the healthy side. On auscultation we notice the breathing to be very deficient in some parts, and in others bronchial, and sometimes cavernous in character; but generally there is everywhere absence of true vesicular breathing. Careful percussion of the opposite side of the chest shows the line of resonance to extend beyond the usual limit, passing to the edge of the sternum, and often an inch or two further; demonstrating that the contraction of the affected lung has caused the healthy one to be drawn across, in order to fill up the void. Other organs are likewise displaced. If the left lung be affected, the heart is tilted, not necessarily upwards, as when a cavity is contracting, but outwards. The stomach rises, its note being audible as high as the fourth rib. The heart is not only displaced, but is uncovered by the retreating lung; and the right auricle and ventricle are clearly distinguished by their pulsations, while the right lung is drawn across to the left side to the extent of one or two inches. If the right lung is affected, the left may be drawn over, and the area of resonance may extend as far as the inner half of the right clavicle, and a line drawn thence sloping towards the middle of the sternum. The heart is transposed, and its impulse may be traced in the fourth interspace on the right side. The liver rises up to the fifth rib, and shrinking of the chest-walls takes place, as on the other side. The pulse may be slow; the respiration often rapid, rising to 50 and 60 per minute. The temperature seldom rises above the normal, and is sometimes subnormal. When the temperature rises over 100° F. it signifies that something beyond fibrosis is going on. The cough is troublesome, and often induces vomiting; and the expectoration becomes more and more difficult, and in time, on account of retention, fœtid. Meanwhile the dyspnœa increases, the other lung becoming involved; signs of obstructed circulation appear; dropsy of the extremities takes place and rapidly increases; the urine becomes albuminous; and the patient dies, either of dyspnœa or of blood-poisoning, his death contrasting strongly with the ordinary termination of consumptive disease. The patient may, however, die of apnœa, without albuminuria or dropsy. After death we find a lung contracted to the size of a man's fist, with enormously thickened and adherent pleura and widely dilated bronchi, with interlobular septa much increased in size and encroaching on the lung-structure, which seems to be replaced by a fibrous hard tissue, in parts mottled with grey, deeply pigmented, and resembling cartilage in its resistance to the knife. Imbedded in this structure are found caseous and cretaceous masses, or again, excavations of various sizes; the walls of these and of the dilated bronchi being rigid and inelastic, from the presence of the fibroid material, and thus affording some explanation of the difficult expectoration and consequently troublesome cough. Besides these changes, we may find the other lung the seat of tuberculosis, though this is not constant; but commonly the bronchial glands are hardened and deeply pigmented. There is often amyloid disease of the liver, spleen, and kidneys.

6. **Scrofulous phthisis.**—This is a variety where consumptive disease of the lung is preceded by, or accompanies, scrofulous affections of various joints, caries of the sternum, ribs, and vertebræ, lumbar and psoas abscesses, otorrhœa, fistula in ano, or, as is most common, enlarged and caseating glands, cervical, bronchial, axillary, or mesenteric. Rindfleisch explains the non-absorption of scrofulous matters by the presence in exudations of this character of relatively large cells with glistening protoplasm, and by the fact that the emigrated leucocytes, which pass from the blood-vessels of the inflamed part into the adjoining structures or into the lymphatics, in scrofulous persons tend to grow larger on their way through the connective tissue, by absorption of albuminous substances. The large size of the cells has been verified by Godlee, Schuppel, Green, and others. Cases of scrofulous phthisis show an early infection of the lymphatic system, and a remarkable correlation appears to be established between the external gland or discharging surface and the condition of the lungs. If the glands are suppurating, or if the fistula is open, or it the carious bone freely discharges, the lung-disease will remain quiescent, and progress may be made towards arrest; but if, on the other hand, any of the above discharges should be checked or cease, the lung-disease passes into fresh activity, making considerable advance and extension. The temperature-course in these cases, if active lung-changes are taking place, is remarkably fitful, showing evening exacerbations of 102° F. to 104° F. and morning depressions of 96° F. to 97° F.; and night-sweats are usually very profuse. Patients of this type lose and gain flesh with great rapidity, owing probably to the pyrexia and fitfulness of the appetite.

Scrofulous phthisis is strongly hereditary: it prevails chiefly among children not exceeding fifteen years, as shown by Pollock, many of these presenting the well-known strumous aspect, the clear complexion, enlarged glands, chronic inflammation of the eyelids, or discharging ears. They are attacked early with hæmoptysis, accompanied by cough and wasting. The course of the disease, probably on account of the relief afforded by the various discharges, is slow, and the patient lives on for a considerable period; but, as might be expected, the development of the individual is slow and often stunted. *Post-mortem* examination generally shows the ordinary destructive lung-changes of advanced tubercular phthisis, with considerable enlargement of the various glands—bronchial, mesenteric, cervical, &c.

7. **Hæmorrhagic phthisis.**—This name is intended to designate, not phthisis arising from the results of hæmoptysis (*phthisis ab hæmoptoë* —Niemeyer), but a form recognised by C. J. B. Williams, Peacock, Hughes Bennett, and the writer, in which large and repeated hæmorrhage is the principal feature, associated with a small amount of detectible disease. It is more common among men than women, in the proportion of five to one: and the period of attack is later than in the ordinary forms, possibly owing to the element of heredity being generally absent.

The patient may have had signs of failing health before the hæmoptysis, but often he is apparently in good health when he is suddenly attacked with profuse hæmoptysis, the blood being florid, the hæmorrhage sometimes lasting many days, and always causing a reduction in flesh and strength. Cough and expectoration follow, yet examination of the chest only indicates slight signs, and sometimes none at all. When present they are to be found in the supra- or inter-scapular regions, or below the clavicle. The patient improves, and often entirely loses his cough before the recurrence of the hæmorrhage, which may not take place for days, weeks, months, or even years. If the attacks recur often, the cough becomes persistent; the expectoration, when not sanguinolent, is muco-purulent; wasting and night-sweats appear; and the physical signs now show unmistakable consolidation, which goes on to softening and excavation. In most cases the disease does not extend beyond consolidation, and large quantities of blood are expectorated without fatal results, the patients recovering in the intervals, and sometimes living to a considerable age. Peacock says that in most instances some more or less exciting cause is to be detected, in the form of syphilis, cold, dysentery, bodily strain, exertion of voice; but the writer has often failed to find one. The pathology of this form of phthisis is uncertain, because few of the patients die in the early stage; but it is probable that the hæmorrhage is produced by tubercular formations in the neighbourhood of, and implicating the walls of, some of the larger vessels at the root of the lungs. Though this can be considered only a clinical variety of pulmonary phthisis, the cases are genuine instances of consumption, as is proved by the fact that, if they live long enough, they run the same course of increasing consolidation and excavation as ordinary phthisis.

8. **Laryngeal Phthisis.** *See* LARYNX, Diseases of.

9. **Chronic Tubercular Phthisis.**—This constitutes the ordinary type as sketched under the head of symptoms. In the autopsies of this form are to be found all the pathological elements of phthisis, namely, tubercle—miliary, grey, and white—caseous masses, and infiltration—grey and catarrhal—croupous pneumonia, fibroid tissue, and calcareous deposits,—showing that no abrupt pathological line of demarcation can be drawn between the different varieties of phthisis, whatever clinical peculiarities they may present; and that the appearance of miliary tubercle is a matter of infection of the lymphatics, in which time plays an important part.

DIAGNOSIS.—Phthisis is distinguished from other chest-affections principally on the evidence of physical signs. The evidences of consolidation separate it at once from bronchitis; while the tendency of the signs to become localised in the apices of the lungs, their special characters, and the combination of consumptive symptoms, distinguish it generally from pneumonia.

Of the various forms of phthisis, the most difficult to diagnose from other diseases is acute miliary tuberculosis, which at its onset is sometimes mistaken for acute bronchitis, from the fine *râles* and rhonchi accompanying the miliary formation. It has also been confounded with enteric fever, from the high pyrexia, the depression of the patient, and the occasional diarrhœa accompanying it; but in both cases the rapidly advancing symptoms, and the steadily progressing physical signs, such as increased and scattered crepitation, if proper and frequent examinations be made, ought to leave us in no doubt as to the nature of the case.

The diagnosis between scrofulous pneumonia (acute phthisis) and croupous pneumonia is not easy at the ushering in of these complaints, the physical signs not always sufficing for this purpose. In a short time, however, the detection of lung-tissue in the sputum, and the rapid wasting, make matters quite certain.

The diagnosis of chronic tubercular phthisis from anæmia and chlorosis, sometimes confused with it on account of the amenorrhœa often common to both, is made by the physical signs; by the different kinds of pallor in the two diseases; and lastly, in chlorosis, by the absence of wasting. The diagnosis of excavation in phthisis from bronchiectasis is by no means easy, as the position of the cavernous sounds is not always sufficient to determine the nature of the lesion. Dilated bronchi are found in the subclavicular and interscapular regions, and where ulceration is proceeding in bronchiectasis lung-tissue may be detected in the sputum. The convulsive character of the cough, and the fœtid expectoration, abundant, but mixed largely with air, generally enable us to decide in favour of dilated bronchi.

DURATION AND PROGNOSIS.—Early detection of the disease, and improved treatment have worked a great revolution in our ideas as to the *duration* of phthisis.

The estimates of Laennec, Louis, Bayle, and others assigned two years as the mean duration of life in phthisis generally. Pollock's statistics, founded on between 3,000 and 4,000 hospital cases, give a considerable extension of this, inasmuch as at the end of two years and a half the majority were sufficiently recovered to have a fair expectation of life.

The statistics of C. J. B. Williams and the writer, founded on 1,000 cases among the upper classes, give an average duration in 198 deaths of 7 years 8·72 months; and in 802 living of 8 years 2 months. The fact of these patients having all been one year and upwards under observation necessarily excludes some of the acute cases; but with this limitation these figures, striking though they be, may be taken as a correct average for the duration of the disease among the upper classes under modern treatment, especially as 72 per cent. of the living had recovered sufficiently to pursue their usual avocations, and many among them had already lived upwards of twenty years since their first attack. The duration of the disease is found to be considerably influenced by age; for it is longer in proportion as the age of attack is later, this retarding influence being more conspicuous among males than females. Females are attacked earlier, and the disease in them runs a shorter course by nearly two years than among males.

Of the varieties of phthisis acute tuberculosis is the most rapid in its course, generally terminating in a few weeks, or occasionally in a few days. Scrofulous pneumonia has hardly a less rapid course, though it may occasionally be retarded, the disease becoming chronic, and the patient surviving for many years. Laryngeal phthisis has a short duration, and most unfavourable prognosis. Catarrhal phthisis has an average duration somewhat below the average of eight years of ordinary phthisis. Fibroid phthisis, on the other hand, exceeds the ordinary duration by nearly two years. Hæmorrhagic and scrofulous phthisis are both of long duration. These calculations are based on statistics of patients of the upper classes treated according to the best medical and hygienic treatment known; but if hospital cases are reckoned, the average of duration of phthisis generally, and of its various forms, must be held to be much lower than the above estimate.

The prognosis in phthisis depends chiefly on the extent to which the system is infected, and especially whether or not other organs are the seats of tubercle. Cases of acute tuberculosis resemble closely those of pyæmia in their symptoms and fatal course, and only differ in the nature of the pathological products. Similarly single-cavity cases, where the disease is strictly limited, bear a strong resemblance to chronic abscesses, which go on discharging for long periods, without materially curtailing the life of the patient. The future, therefore, of the patient depends to a great extent on whether the disease may be considered local or general, though of course we admit in both instances a constitutional predisposition, possibly of different degrees of intensity. Where the infection is rapid and complete, as in acute tuberculosis and most instances of scrofulous pneumonia, the prognosis is most unfavourable. Where, again, the disease is limited to one lung, and associated with similar processes in the joints, as in scrofulous phthisis, which act as diverticula to the central disease, the prognosis becomes far more hopeful, and the individual may last on for many years.

The prognosis in laryngeal phthisis is most unfavourable, on account of these cases being always associated with extensive lung-tuberculosis; while in hæmorrhagic phthisis, where the pulmonary mischief is small and limited to the root of the lungs, it is favourable, excepting of course the accident of death during an attack of hæmorrhage. The most favourable prognosis of phthisis must be retained for cases of inflammatory origin, for here the disease often remains limited for considerable periods of time, and the patient may live on, almost unconscious of it, to the natural term of life. If, however, the fibroid element be largely produced, a new danger arises from the obstruction to the circulation, caused by the contraction of the lungs, dropsy, dilatation of the heart, affection of the kidneys, and death.

The influence of *heredity* on prognosis lies in its precipitating the onset of the disease, and not in its curtailing its duration, though, of course, an individual attacked earlier will die at an earlier age, the duration of the disease being the same. The influence of *stage* must be duly taken into account, for statistics show a far more favourable prospect for mere consolidation than when a cavity is formed, and this is obvious from the increase of danger arising from two sources, namely from purulent infection and pulmonary aneurisms.

The grounds for an unfavourable prognosis are:—1, rapid extension of disease or of lung-excavation; 2, persistent afternoon pyrexia; 3, symptoms of great irritability of the gastro-intestinal tract, red tongue, diarrhœa, pain in the abdomen; 4, great wasting with, or without, pyrexia, combined with a good appetite; and 5, strong hereditary predisposition, showing itself in several brothers and sisters being attacked at an early age.

TREATMENT.—The treatment of phthisis may be considered under three heads—1. *medicinal*; 2. *dietetic* and *hygienic*; and 3. *climatic*.

1. *Medicine.*—The medicinal treatment must be directed to three objects: firstly, to raise the standard of nutrition and to counteract the phthisical cachexia; secondly, to reduce and allay the local inflammations and congestions which accompany, and considerably complicate, the tubercular changes; and thirdly, to relieve the various urgent symptoms. The *first* object is carried out by tonics, such as iron, quinine, arsenic, the mineral acids, and, above all, cod-liver oil, which has been shown to be the most effective agent of all in counteracting phthisical disease. Some precautions are, however, necessary to ensure its being tolerated for long periods. The pale oil should be preferred, and ordered in doses of from ʒj to ℥ss shortly before or after meals. The best vehicles for it are the vegetable bitters—such as gentian, calumba, quassia, nux vomica and strychnia, hop, camomile, and cascarilla—combined with an acid or alkali, according to the state of the gastric mucous membrane, and rendered more palatable by the addition of tincture or infusion of orange peel or syrup of ginger. Various other vehicles are used, such as milk, salt and water, lemon-juice, orange wine, and sherry; while many patients, especially children, take it best in an emulsion, composed of cod-liver oil, a few drops of strong liquor potassæ or liquor ammoniæ, with an essential oil, like that of cloves or cinnamon, to cover the taste. In the great majority of cases cod-liver oil is well borne, if exhibited with discretion. Other oils are of use, but few equal the cod-liver oil in efficacy, on account of its great penetrative power, and of its forming with the biliary and pancreatic juices a compound easily absorbed by the lacteals. Malt extract and similar preparations, though of greatly inferior nutritive power to cod-liver oil, often cause increase of weight, chiefly by assisting the patient to digest more starch. Of greatly inferior utility to the oil are the preparations of phosphorus and sulphur, such as the hypophosphites of lime, soda, and iron, sulphurous acid, and the sulphites, all of which have a considerable amount of testimony cited in their favour as tonics and blood-purifiers.

In France the sulphur springs of Eaux Bonnes, Cauterets, Bagnères de Luchon, and Bagnères de Bigorre are largely frequented by consumptives, the ground of this treatment being that the results of Claude Bernard's experiments show that sulphur when absorbed is excreted through the respiratory mucous membrane. Peter considers that any benefit that may accrue is owing to the influence of sulphurous acid on the catarrhal conditions. The arsenical waters of La Bourboule and Royât are strongly recommended by Dr. Noel Gueneau de Mussy.

We may here consider the treatment of the pyrexia of phthisis. In addition to rest in bed, anti-periodics, as quinine in large doses in an effervescing saline, salicine (gr. x), and salicylate of soda (gr. x to xx), may be given every four or six hours, if the pyrexia be considerable. If the temperature only slightly exceed 100° F., and if it be followed by much sweating, then arsenic, in the form of liquor arsenicalis or liquor arsenici hydrochloricus (♏ii to v), three times a day, is indicated. Where these medicines fail, recourse may be had to cold compresses over the chest, to sponging with vinegar and water, and if the patient's strength permit, to the 'wet pack,' swathing the patient in wet sheets; and if the pyrexia be very persistent and tormenting to the sufferer, immersion in a bath of 90° F., lowered gradually to 60° F., may be tried. The reduction of temperature and consequent relief is great, but not always permanent in character, and pyrexia in phthisis may be considered one of its obstinate symptoms.

The *second* object of treatment, the reduction of local inflammation, is best accomplished by mild antiphlogistic means, such as salines, with or without antimony; and counter-irritation to the chest-wall by blisters, iodine, or vesicating liniments, mustard, or the milder but still effectual application of linseed-meal poultices. Steady continuance with these will often render sedatives for the cough unnecessary.

The *third* object, namely, the palliative treatment, includes that of the various urgent symptoms.

The *cough*, when not reduced by the counter-irritation, may be to a certain extent allayed by a combination of sedatives, such as opium and its salts, conium, henbane, hydrocyanic acid, American cherry, with mild expectorants, of which chloric ether, lemon juice, and squills are examples. Where the cough is frequent and the expectoration difficult, and there is proof of active disease, tubercular or pneumonic, proceeding in the lungs, an effervescing saline, containing carbonate of ammonia, with small doses of opium and antimonial wine, taken two or three times at night, will greatly relieve the symptoms, the rule in the treatment of consumption being to restrict the sedatives, as far as possible, to the night, so as not to interfere with the appetite and digestion. The preparations of tar, in the form of capsule, pill, or solution, are useful in reducing profuse expectoration. The inhalations of iodine, compound tincture of benzoin, carbolic acid, creasote, larch and turpentine, are useful if expectoration is offensive or requires stimulating; or again, those of chloroform, conium, hop, when the cough is convulsive and dry.

The *pains* in the chest may be alleviated by painting with tincture of iodine or stimulating liniments, such as turpentine and ammonia; or else on Dr. Roberts's plan, by securing the immobility of the side by strapping.

Night-sweats, when profuse, may be reduced by oxide of zinc (gr. ij to iv), by gallic or sulphuric acids, by sulphate of iron, by arseniate of iron (gr. ⅛ to ⅓), but most effectually of all by the preparations of belladonna, in the form of the extract (gr. ¼ to gr. 1), or as solution of sulphate of atropia (♏j to ij), or used hypodermically. Dover's powder in 10-gr. doses is useful, but Dr. Murrell has lately strongly recommended picrotoxine (gr. $\frac{1}{60}$, in form of a pill), or muscarine (♏v of one per cent. solution), to be taken at bed-time, as more effectual.

Diarrhœa, where due to bilious derangement and an acid state of the primæ viæ, is best treated by mercurial purgatives, combined with carbonate of soda or lime-water. Where it partakes of the nature of a flux, accompanied by a pale tongue and great debility, it may be checked by astringents, such as hæmatoxylon, catechu, krameria, bael, and carbonate or citrate of bismuth. When ulceration of the intestine is proceeding, it is characterised by a red, irritable tongue, pain and tenderness of the abdomen, and persistency of the diarrhœa. Here, as in other forms of ulceration, opium and its salts answer best, and may be given internally with sulphate of copper (grain ¼ to ½) every three or four hours. When the stomach is too irritable to tolerate medicine by the mouth, opium and morphia suppositories are useful, but still better are opiate enemata, which, acting directly on the irritable ulcers, check the pain and diarrhœa, and often afford considerable relief. In very obstinate cases tannic acid (four to five grains), acetate of lead (three to four grains), may be added to the injection. The opposite state of bowels, namely, constipation, is very common in the early stages of phthisis, and is best corrected by changes in diet, such as the use of brown bread and oatmeal, cooked and fresh fruit, regular exercise, and if these prove insufficient, a mild aloetic or rhubarb pill, or the use of some mineral water, as Friedrichshall, Pullna, Carlsbad, Hunyadi Jànos, and others.

The *dyspnœa* of advanced cases generally arises from difficulty of expectoration, and the greatly curtailed respiratory power, and may be relieved by spiritus ætheris, carbonate of ammonia, and other diffusible stimulants. The pain arising from perforation in pneumothorax is best treated by opium, and strapping the side to limit the movements of respiration, and if much liquid effusion or accumulation of air takes place, it is sometimes advisable to tap the chest; but, as a rule, the state of the patient does not allow of very active measures.

Bed-sores should be prevented by the use of a water-bed, and the skin of the dependent parts can be fortified by lotions of spirit and water (one part in four). If a bed-sore has formed, it is best to protect it from friction by the use of circular air or down cushions, or thick felt-plaister, and the raw surface can be painted with collodion, or be regularly dressed.

2. *Diet.*—The great object being to introduce as large a quantity of nutritious food as can be digested, abundance of meat, plainly cooked, with fresh vegetables, and a fair amount of bread and starchy food should be given. Fatty material, if it can be digested, should be largely represented in the dietary, and many physicians

advise large quantities of cream, butter, and suet; but, considering the large amount of fatty matter included in cod-liver oil, which is a severe test at first to the digestive powers, it is not advisable to increase the amount of fat until the oil is well tolerated. Milk (1 to 1½ pints a day), alone or with lime-water, is a staple food for the consumptive; and when cow's milk disagrees, ass's or goat's may often be substituted with advantage. Koumiss and whey are frequently used in Germany and Russia, but they have not become popular in this country. The digestive powers being, as a rule, weakened, much good may be done by the addition of animal ferments, such as liquor pepticus and liquor pancreaticus (Benger) to the food, which, becoming peptonised, is much more easily assimilated (*see* PEPTONISED FOOD). In the early stages stimulants are not largely required, as they increase the cough and lung-irritation; but when the strength fails, and the powers of digestion are weak, they may be given frequently, and advantageously combined with liquid nourishment, such as eggs, soups, various meat-essences and panadas, arrowroot, and jelly. When wine is required, in chronic cases, it will be found that claret, hock, sauterne, and chablis tend to irritate the cough less than the stronger wines.

Hygiene.—The consumptive patient should inhabit a well-ventilated, well-drained house, built on a dry soil, sand or gravel, sheltered from cold winds and well exposed to the south, not hemmed in by trees, the most suitable for the neighbourhood of the house being of the coniferæ order. The bed-room should be lofty, provided with a fireplace for warmth and outlet ventilation; and unless the cubic space be abundant, inlets for the supply of fresh air, in the form of vertical tubes, should supplement the ordinary indraught of the door and window.

Clothing and Exercise.—The underclothing should be woollen, either flannel or lambswool, or perhaps in summer merino may be allowed, the object being to secure a good non-conductor of changes of the temperature which will, at the same time, absorb cutaneous moisture. The rest of the clothes must be adapted to the season, the invalids, male or female, always bearing in mind their greater liability to catarrh than ordinary persons, and using wraps freely, more especially when driving.

Exercise must depend on the stage of the disease, and the strength of the patient. In the first stage, especially when the disease is limited to one lung, and no fever or hæmorrhage is present, active exercise in the form of walking is advisable. Under careful superintendence certain gymnastic exercises may be of benefit, which, by raising the arms, lift the upper ribs, and increase the size of the thoracic cavity, especially in the upper regions, and thus necessitate a larger inspiration of air, and in time this leads to further development, and even to hypertrophy of the healthy lung. Emphysema may be produced in the diseased lung by this means, which is useful in limiting any further advance of infective tubercular disease.

Riding is excellent for a large number of patients, being intermediate between the active and passive varieties of exercise. Where the disease is more extensive and advanced, only the passive forms of driving and sailing are possible.

3. *Climate.*—The main point to be held in view is to give the consumptive a climate in which he can breathe freely, take abundant outdoor exercise, and experience that amount of stimulating influence which, while it improves his appetite and powers of digestion, does not irritate the mucous membrane of the lungs or increase the cough. The selection is generally difficult, and depends not only on the class of cases, but must be sometimes modified by individual peculiarities. *See* CLIMATE, Treatment of Disease by.

The writer's statistics, founded on 251 consumptives, who passed one or more winters out of England, assign the most favourable results to sea-voyages, and the next to Egypt and other dry climates. The Mediterranean basin follows next in point of success; while the moist temperate climates of Pau and Rome give far less good results, and Madeira only slightly surpasses these. The same statistics show the foreign health-stations to be on the whole more successful in prolonging life than the English ones; but we must not forget that the most advanced cases fall to the lot of the latter, on account of the difficulty of travelling; and, on the other hand, a great advantage enjoyed by the home stations is the superiority of the food and appliances for invalids, which may in some degree compensate for the smaller number of days in which exercise can be taken, and the greater vicissitudes of weather. Of the British health-resorts the dryer ones, such as Hastings, Ventnor, and Bournemouth, have afforded more favourable results than Torquay and Penzance. It is impossible in a few sentences to lay down rules for climate-selection, but a few general outlines may be given of the suitability of different groups of agencies.

The British south-coast stations are beneficial in scrofulous phthisis, and in many cases where the appetite is poor, and tendency to catarrh not the prevailing feature. In the catarrhal form of phthisis Madeira, and the West India Islands, especially the Blue Hills of Jamaica, are advisable; the combination of warmth with saline influence, and the absence of stimulating qualities, seeming to answer best.

Dry stimulating marine climates, such as the Riviera, Malaga, and Algiers, are recommended in phthisis of inflammatory origin, and in all cases where it is desirable to combine stimulating influence with a moderate degree of warmth, and decided dryness of atmosphere.

Where the stimulating influence is undesirable, as in patients of excitable temperament, or irritable gastric mucous membrane, the *very dry inland climates*, like those of Egypt or South Africa, are preferred.

Sea-voyages to Australia and New Zealand, or the shorter one to the Cape, are indicated in cases of hæmorrhagic phthisis, in cases of limited first or third stage, where the patient's strength is unequal to much exercise, and where he or she have suffered from close confinement in crowded cities.

High altitudes.—The increasing mass of testimony in favour of this form of climate-treatment for consumption, in both Europe and America, augurs that in a few years it will be used more largely.

At present the Andes, the Rocky Mountains, and the Alps, and even the South African highlands, are frequented by consumptives; but the conditions of temperature and altitude manifestly vary greatly; and while the climates of Quito and Santa Fè di Bogota resemble in temperature that of Malaga, the winter extremes of Davos in the Alps are more nearly akin to those of Canada. In all these places, however, there exists a distinctly specific influence apart from that of heat and moisture, in the form of diminished barometric pressure, which is shown in the patients residing at high altitudes. The chest becomes expanded, and hypertrophy of the healthy lung-tissue takes place, accompanied by vesicular emphysema around the lesions. Patients in the first or third stage of phthisis with only limited lesions, endowed with fair powers of circulation and able to take exercise, are the proper cases for this form of climate, and in many of such complete arrest of the disease may be confidently predicted.

C. Theodore Williams.

PHYSICAL EXAMINATION.—The object of a physical examination is to ascertain the precise seat, limits, and characters of those evidences of disease which are recognisable by our senses, and which are called physical signs. In making such an examination we bring to bear all our senses, with whatever instrumental aids may be available to detect the signs of disease. In the present article a description will be given of the physical examination of—(1) the patient generally; (2) the cerebro-spinal system; (3) the respiratory system; (4) the organs of circulation; (5) the mediastinum; and (6) the abdomen.

1. General Survey.—Our attention will first of all be naturally attracted to the *physiognomy* of the patient, that is to his general appearance and build. We note his apparent *height* and *weight*, and, if possible, correct our observation by scale and measure. We observe the *state of nutrition*, firmness or laxness of muscle, corpulence, thinness, emaciation—atrophy of any particular muscle or group of muscles. The *complexion* of the patient is to be remarked, whether clear, sallow, dark, fair, jaundiced, or pigmented; also lividity or pallor of surface and mucous membranes. The *apparent age* as contrasted with actual years of the patient; elasticity of features, condition of hair, presence of arcus, &c. The *symmetry* and *play of features*, the expression whether of vivacity, despondency, suffering, anxiety, paralysis, or hysteria. *See* Physiognomy.

Whilst making these preliminary observations, a general outline of the history of the patient and of his present illness will have been elicited.

The *pulse* should next be noted (*see* Pulse). We may, in important cases, extend our inquiries or record our observations by means of the sphygmograph. *See* Sphygmograph.

The *respiration* of the patient requires attention as regards rapidity; mechanism, that is, whether abdominal or thoracic in normal proportion; rhythm, regular or irregular, easy or laboured; and freedom or otherwise from pain. The action of the nares, and any recession or otherwise of soft parts during respiration, should be especially observed. *See* Spirometer.

In health and under physiological conditions of age, exercise, emotion, &c., there is a tolerably constant ratio between the respiration and pulse-rate, namely, one respiration to from three to four pulse-beats. In disease this ratio is often much altered. The average respiration-rate in a healthy adult is from 17 to 20 per minute, in the infant about 40 per minute, between one and five years about 26 per minute. In old age the prepirations are very slightly accelerated: in children they are quick and often irregular, being momentarily suspended by anything that excites their wonder or close attention.

The *odour of the breath* may attract attention. It may under morbid conditions be fœtid, urinous, 'mercurial,' alcoholic, or gangrenous. *See* Breath, The.

The condition of the *skin*, whether dry or hot, moist or sweating, and the presence or absence of any eruption, scars, ulcers, or pigmentation, will be duly noted. The presence of *pyrexia* will be exactly ascertained by the use of the clinical thermometer, an instrument which ranks with the stethoscope in value; but the employment of the thermometer does not exclude the necessity of testing the condition of the surface by the hand, whereby we observe the resultant, so to speak, of the bodily heat, tempered it may be by evaporation, or exaggerated by undue dryness in exposed parts. Probably the use of the surface thermometer, in combination with the ordinary clinical instrument, would more exactly give us this information, upon which important therapeutical indications rest; but the hand of the skilled observer fully suffices for the purpose. The surface thermometer is of value in estimating localised elevations of temperature; for example, over the site of an empyema, in peritonitis, and in connection with certain nerve-lesions. *See* Thermometer.

The condition of the *finger-ends*—clubbing, lividity—must be observed. Important information as to previous acute illnesses within the past six months can be obtained by inspecting the nails, a transverse furrow marking the period of defective or arrested nutrition during such illness.

The condition of the *teeth* may indicate previous illness or syphilitic inheritance.

The state of the *eyes*, and especially any irregularity of the *pupils*, requires attention.

The condition of the *tongue* and *gums* furnishes us with valuable information.

The careful superficial inspection of the patient in the manner above sketched will perhaps at once lead to a more minute examination of some one organ or system of organs as the probable seat of disease; and having thus far succeeded in locating the disease, the other organs and functions of the body will of course come under review, but the physician will be more especially inquisitive with regard to such organs or functions as may be in sympathy with those in which disease has been detected.

It may be, however, that on careful examination we fail to find any organic lesion to account for the symptoms present, and for signs of wasting, pyrexia, &c., which notify the illness of the patient. We may then—but not till then—refer the case to one of those blood-conditions which for a time run their course without manifesting any definite lesion.

Again, it may be that certain signs of general illness, and especially pyrexia and wasting, cannot be accounted for sufficiently by the amount of disease discovered. Here we must suspect that the lesion we have ascertained is but an expression of a more general state.

Having made these remarks—relating to orderly measures of inquiry, without a due regard to which no physician or surgeon, however skilful in any one department, can fail to commit the errors of the narrowest specialist—we will proceed to consider the physical examination of those regions of the body, especially the chest and abdomen, in which objective signs can be accurately observed.

2. Cerebro-spinal System, Physical Examination of.—The objective phenomena of disease affecting the nervous system are often very obscure, and it is the more important that they should be sought for in a methodical manner.

(*a*) The Head.—The head should be examined as to size, shape, condition of fontanelles, the presence of wounds, tumours, or depressions.

The *size* of the head varies greatly in different people, without any seemingly corresponding variation in the condition of the brain. It is very difficult to say whether enlargement of head is due to thickening of the skull or enlargement of its contents. In rickets and in hydrocephalus the head is relatively large; in idiocy relatively small.

The *shape* of the head is of more importance than the size. We may recall the long head, with square, high forehead, of rickets; the broad, vaulted skull, with shallow orbits and prominent eyes, of hydrocephalus.

The condition of the anterior fontanelle must be carefully observed in all cases of children with cerebral symptoms—it should be neither tense nor depressed.

The detection of *local changes*, such as thickenings, tumours, scars, or depressions over the skull, will throw much light upon a case presenting cerebral symptoms.

(*b*) The Spinal Column.—The spinal column must be carefully examined for undue prominence or depression of spinous processes, or other tumours, and for lateral or antero-posterior curvature. Kneading and percussion should be employed over each spinous process to elicit any tenderness. The fingers should be passed firmly along the spinal groove on either side to ascertain if there be any painful point, and much care must be taken not to confound such pain (commonly neuralgic) with true spinal tenderness. The application of the hot sponge, or ice-bag, successively to different parts of the spine is a means of eliciting valuable signs of disease.

In all cases of suspected spinal or cerebral disease the *superficial* and *deep reflex actions* should be tested, as affording important indications respecting the integrity of successive portions of the cord, and the condition of the parts above. *See* Spinal Cord, Diseases of.

By the *ophthalmoscope* an example of the cerebral circulation may be observed in the retina, and the condition of vessels noted. Certain lesions of the optic disc correspond also with deeper and more widespread nervous disease (*see* Ophthalmoscope in Medicine). By the use of *graduated compasses* the sensibility of the peripheral nerves may be estimated. *Electricity* enables us to ascertain the irritability of voluntary muscles; and by the *dynamometer* we may compare muscular power on the two sides. *See* Electricity; and Dynamometer.

Further details respecting the diseases of the nervous system, and the methods for their diagnosis, will be found under appropriate headings.

3. Respiratory System, Physical Examination of.—The respiratory system includes the respiratory tract and lungs.

(*a*) Larynx.—The condition of the larynx and trachea is examined into by listening to the voice, whether husky, altered in tone, or suppressed Any tenderness or external deformity is ascertained by careful palpation.

By means of the laryngoscope the condition of the epiglottis, larynx, and trachea can be thoroughly explored. *See* Laryngoscope; and Larynx, Diseases of.

(*b*) Chest.—In making an examination of the chest, the physician should follow a methodical routine of **inspection, palpation, percussion, and auscultation.**

1. **Inspection.**—The *general shape* and *build* of the chest is observed — whether it be the broad, well-formed chest of robust health; or the small, narrow, long chest, with antero-posterior and lateral diameters diminished, costal angle narrow, and ribs oblique and approximated—adapted to small lungs. Or the thorax may be unduly expanded, with wide intercostal spaces, straightened ribs, widened costal angle, and deep antero-posterior diameter, to accommodate large lungs. Again, the thorax may be distorted by various kinds of spinal curvature, or as the result of rickets, or from external pressure, as in the depressed lower sternum of shoemakers (*see* Deformities of the Chest). Lastly, there may be *local* flattenings or bulgings.

The *movements* of the chest are of great importance in diagnosis. We estimate the freedom or otherwise with which air enters the chest during inspiration by the equable expansion of its several parts, or by the immobility or recession of any portion the entry of air into which is retarded or impeded; and this can be accurately done by means of the pneumograph. In cases of general obstruction to entry of air, whether by impediment at the main air-passage or in its entire distribution, there is universal recession of all the soft parts—the supra-clavicular region sinks downwards, the hypochondria recede, and the intercostal spaces deepen during the effort to expand the chest against atmospheric pressure. On the other hand, when the difficulty of expansion, whether from intrinsic disease or obstruction of passages, is restricted to one side of the chest or to a portion of one lung, the restrained expansion during inspiration is limited to that portion. Thus from inspection alone we may often form a shrewd guess as to the seat and even the nature of the disease present.

In estimating local alteration of shape the eye is perhaps more useful than any instrument of measure. *Calipers* of various patterns may be used for taking diameters in different directions. But for *recording* differences of shape on the two sides the *cyrtometer* is very useful. This instrument was originally introduced by M. Woillez, and consisted of two halves of a jointed whalebone measure, connected by a hinge, which could be adapted accurately to the shape of the chest, and after removal the various curves on the two sides could be traced on paper. The cyrtometers now most in use are made of soft metal, two sufficiently long pieces of which are connected by an indiarubber joint or hinge.

Double tape-measures are also used for ascertaining the circumference on the two sides, and by their means the relative expansion during respiration on the two sides can be compared. Various forms of stethometer have been designed for the same purpose. *See* STETHOMETER.

The *vital capacity* of the lungs may be very accurately estimated by means of the spirometer. *See* SPIROMETER.

2. **Palpation.**—Palpation is employed in aid of both inspection and percussion.

a. During preliminary inspection of the chest the *position of the heart's apex-beat* should be invariably, and as a matter of habit, ascertained, and any deviation from its normal seat, namely, the fifth intercostal space one inch to the sternal side of the left nipple line, should be noted.

b. Any local bulging or tumour will naturally be *manipulated* to ascertain its relation with bone, or soft structure, whether it be solid or soft, fluctuating or pulsatile.

c. In connection with percussion, the trained observer will note differences of *resistance*, as well as of sound, over diseased areas.

d. Increase or diminution of *vocal vibration* or *fremitus* will be noted over any spot of altered resonance, by applying the hand and making the patient utter some resonant words, such as 'ninety-nine.'

Vocal fremitus is *increased* by consolidation of lung; *diminished* by much thickening of the pleura, by obstruction to the main bronchus, or by air in the pleura; *annulled* by fluid in the pleura. N.B.—In many cases of fluid in the pleura some vibrations are felt, probably communicated from above. The loudness or feebleness of the voice must of course be taken into account in estimating fremitus, and corresponding parts on the two sides should always be compared.

Loud, coarse, bronchial *râles* may cause the chest-walls perceptibly to vibrate, producing *rhonchal fremitus*. Pleuritic friction may likewise be perceptible to the hand applied—*friction fremitus*. In cases of effusion into the pleural cavity, or in hydatid cysts near the surface, *fluctuation* may be elicited on palpation.

3. **Percussion.**—Percussion is the method of examination by which we detect the various degrees of resonance of different parts of the chest, depending upon the relative amount of air and solid structure.

It is best to use the fingers for percussing, one finger of the left hand being placed firmly over the point to be percussed, and struck with one or two of the fingers of the right hand, semi-flexed, so that the tips of the fingers fall vertically upon the pleximeter finger. Percussion should be made from the wrist, not from the elbow; the stroke should, as a rule, be light, and always perfectly even on the two sides; sometimes a heavier stroke may be needed, but, as a rule, far more information is obtained from light than from heavy percussion. In comparing the percussion note over the two sides of the chest, points exactly corresponding must be taken, and the pleximeter finger must be placed in a corresponding position; for example, it must not be placed parallel with the ribs on one side and across them on the other.

The sense of touch is very valuable in percussion in estimating *resistance* of the part struck. Dulness, and particularly the hardness and want of resilience over thickened adherent pleura, may thus be readily *felt* by the pleximeter finger during percussion. This sense of touch should be carefully cultivated, and its deprivation is a great disadvantage in the use of the artificial pleximeters and percussors first introduced by Piorry, although possibly these may be useful for demonstration to a class. The observer should not be content with comparing corresponding points on the two sides of the chest from above downwards, but he should invariably trace any dulness or resonance from either side across the sternum to ascertain the limits of resonance or dulness in this direction. From neglect of this, important information is often missed. The height to which the pulmonary note extends above the clavicle on the two sides should be compared.

Regions of the Chest.—For convenience in describing the distribution of signs, both of percussion and auscultation, it is customary to divide the chest into regions. The names employed to distinguish these regions sufficiently define their limits, namely, the supra-clavicular, clavicular, infra- or sub-clavicular, mammary, infra-mammary regions on each side in front; the superior and inferior axillary regions; the supra-spinatus, infra-spinatus, interscapular, and infra-scapular regions on each side posteriorly.

(*a*) NORMAL PERCUSSION SIGNS.—There is a certain standard degree of resonance over the lungs, only to be duly estimated by experience, which is known as *normal pulmonary resonance.* In certain regions of the chest the pulmonary resonance is naturally lessened or replaced by dulness. Pulmonary resonance should commence 1½ inch above the level of the clavicle. In the clavicular and sub-clavicular regions, on firm percussion, the note should be even on the two sides, as low as the third rib. Below this level on the *right* side, we still obtain full resonance until we arrive at the fourth space, where in the mammary line the note becomes slightly raised and shortened, becoming dull in the fifth space and downwards to the margin of the cartilages. On very light percussion the pulmonary resonance may be obtained half a space lower, and at least an inch to two inches' difference in level may be obtained between the extreme limits of deep expiration and inspiration. In the lateral (axillary) region the limit of percussion-resonance reaches about an interspace lower. At the sternal margin it is a little higher, from the encroachment of the right side of the heart upon the inferior angle of the lung. Roughly, and for clinical purposes, a line drawn outwards from the base of the xiphoid cartilage may be said to define the upper border of the liver-dulness.

On the *left* side, in the line midway between the sternum and nipple, we already, at the third cartilage, obtain elevation of pitch and shortening of the percussion note; and at the fourth space dulness, from the underlying heart. Between this (mid-sterno-nipple) line and the sternum, and bounded above by the fourth cartilage and below by the level of the apex-beat, is the normal area of superficial cardiac dulness. In the nipple line at the corresponding levels[1] some deadening of percussion note may be obtained, but pulmonary resonance is otherwise clear to the sixth rib; in the lateral axillary region to the seventh. Below the sixth rib in front, and the seventh laterally, stomach resonance is obtained.

Over the *sternum*, percussion is naturally somewhat wooden and resisting, within degrees varying with the condition of the bones. The first piece of the sternum is normally somewhat less resonant than the next two pieces, but it should be, on firm percussion, by no means dull. Below the level of the fourth cartilages the heart and liver cause the note to be dull, although even here a certain degree of resonance is in health communicated from the adjacent right lung.

In the *posterior* regions of the chest the degrees of resonance are almost entirely in accordance with the thickness and character of superjacent tissues. Thus in the scapular and inter-scapular regions increased force of percussion is necessary to elicit pulmonary resonance, whilst in the lateral and infra-scapular region the percussion note is full and low-pitched. On the right side this resonance is replaced by dulness below the tenth rib, and deep percussion will elicit a certain impairment of resonance as high as the ninth rib, in the mid-scapular line. On the left side resonance should be good to the extreme base, except that in the posterior axillary line a small and restricted area of dulness may be sometimes made out, corresponding with the position of the spleen.

(*b*) Morbid Percussion Signs.—Modifications in the distribution of percussion-resonance over the chest may be produced either by general or by local causes.

General causes.—Pulmonary vesicular emphysema, by enlarging the lungs and extending their boundaries, causes encroachment of pulmonary resonance over those regions—the præcordial, right infra-mammary, sternal, and right inferior basic, which are normally dull. In congenital smallness of lungs the boundaries of pulmonary resonance are somewhat retracted, so that liver-dulness in front and behind is slightly higher, and heart-dulness more extensive.

Local causes.—One class of these are encroachments of other organs. Enlargement of the heart will cause increased area of præcordial dulness upwards and to the left, or upwards and to the right, according as the left or right side of the heart is most affected. Effusion into the pericardium will cause similar dulness, extending upwards towards the manubrium sterni, and to the right beyond the sternum. Aneurismal tumours in connection with the heart or great vessels, give rise to dulness, chiefly in the neighbourhood of the sternum above the fourth cartilage, or in one or other inter-scapular region. Enlargement of the liver and spleen will cause them to encroach upon the pulmonary resonance. Effusion into the peritoneum, if extensive, will cause displacement upwards of the abdominal organs and diaphragm, encroaching upon the lower area of pulmonary resonance, and even causing collapse of the lower portion of the lungs, thus giving rise to dulness.

Effusion of fluid into the pleura will give rise to absolute dulness to the level to which the effusion extends upwards. The upper boundary of this dulness, if the lungs be sound, varies slightly with the position of the patient. In order, however, accurately to define the upper margin of dulness from fluid effusion the lightest possible percussion must be employed. In any case of considerable effusion into the pleura the dulness encroaches upon the median line, and towards the opposite side. *See* Pleura, Diseases of.

The chief kinds of morbid percussion signs will now be discussed.

Dulness, hardness, flatness.—These terms are by no means synonymous with regard to percussion sounds. *Dulness* varies infinitely in degree. Thus over a pleuritic effusion the tonelessness is absolute; and to this degree of completeness of dulness the term *flatness* of percussion-note is sometimes applied. There are but a few other chest-conditions in which such absolute dulness is obtained; for example, extensive pericardial effusions, hydatid tumours, extensive malignant growths invading the lungs and infiltrating the bronchi. In inflammatory consolidation of the lung there is always a certain degree of wooden tone in the percussion note. In cases of scattered patches, or nodules, of consolidation in the lungs, with air-containing tissue around, the dulness may be only very slight, amounting to a mere shortening of the note with elevation of pitch. In estimating the slight shades of dulness elevation of pitch is the first point to arrest the attention. *Hardness* of percussion, always more or less appreciable with dulness, is associated especially with consolidations of lung overlaid by thickened adherent pleura.

Skodaic resonance. — In all cases of considerable effusion of fluid into the pleura, in which the lung is not completely collapsed, a peculiar high-pitched tympanitic resonance is found at the sterno-clavicular region on the same side. This resonance, called Skodaic resonance, is a very characteristic sign, and has been attributed to relaxation of lung still in contact with the chest-wall. As the effusion advances to completely fill the chest, this resonance becomes replaced by dulness.

When effusion of fluid follows upon pneumothorax, the lung, unless held above by strong adhesions, is already completely collapsed; and above the level of the dulness caused by fluid there is a tympanitic note, caused by free air in the pleura. In this case the level of the fluid in the pleura shifts with every change in the position of the patient.

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[1] By employing the terms 'lines' and 'levels' to mean the vertical lines and horizontal levels, in connection with definite anatomical points, *e.g.* mid-scapular-, nipple-lines, nipple-, second-, third-, fourth-, &c., rib levels, any portion of the chest-surface may be accurately defined.

Whether the effusion be of serum, pus, or blood, the percussion signs are the same.

Wooden percussion-note is obtained by percussing over thickened pleura with some air-containing tissue beneath. The sense of resistance is marked, the pitch high, and the duration of sound short. This degree of dulness, with increased resistance, is commonly present below the clavicle in cases of phthisis, with thickened pleura, and perhaps small, empty cavities, bounded by hardened lung-tissue.

Amphoric or tubular percussion is the sound elicited by percussing over a superficial empty cavity, connected by adhesions to the chest-wall. The pitch varies with the size of the cavity, but is always somewhat high. The sound can be exactly imitated by percussing the cheek drawn tensely over the teeth, with the mouth slightly open.

Cracked metal sound, or *bruit de pot fêlé*, is obtained by sharp percussion over a cavity such as the above. Sudden displacement of air in the cavity will cause the sound, which somewhat resembles that produced by placing the two hands hollowed in apposition, and striking upon the knee. A little secretion in the cavity will facilitate the production of the sound. This sound may often be appreciated by the touch before it can be heard. It is of little clinical value.

Bell-sound is elicited by combined percussion and auscultation, and *when present* is characteristic of pneumothorax. The stethoscope must be applied over the resonant part of the chest, and at another point within the same area a piece of metal, such as a coin, laid upon the chest, must be smartly struck with a second piece of metal. The auscultator hears a sound of a clear bell-like character within the chest, which is of quite a different quality from that produced by the mere contact of metals. It is essential for the production of this sign that the stethoscope and the struck metal be both within the area of chest-surface corresponding with the air-containing sac of the pleura. If, for instance, either be placed over a point below the level of any fluid effusion present the sound will be lost, to be recovered on altering the position of the patient so as to displace the fluid. By means of this sign, the limits of a pneumothorax may be accurately defined.

Hydatid fremitus is a vibratile sensation, sometimes to be felt on smart percussion over an hydatid effusion. In cases of pyo-pneumothorax a similar sensation may sometimes be felt, on percussing at the exact level of the surface of the effused fluid.

4. Auscultation.—Auscultation simply means the act of listening; but the art of auscultation implies a great deal more than this, namely, the appreciation of the healthy or morbid conditions which produce the sounds heard on applying the ear to the chest or to other parts. If the ear of the observer be directly applied to the chest or part under observation, auscultation is said to be *immediate*. If some substance or instrument be used as a medium between the ear and the part under observation, *mediate* auscultation is said to be practised. Such an instrument is named a stethoscope. *See* STETHOSCOPE.

(*a*) NORMAL RESPIRATORY SOUNDS.—If the stethoscope be applied over the trachea of a healthy person, tubular blowing, or bronchial respiration, is heard—that is, a sound as of air blown to and fro through a tube, and with moderate velocity; the mechanism of the sound being the entrance and outflow of air-currents through the narrowed glottic aperture of the trachea, producing sonorous vibrations within the tube below. As the stethoscope is passed downwards to the first piece of the sternum, the same sound is still heard, but more distant and muffled. In the upper interscapular region, where the great divisions of the bronchi are comparatively superficial, the tracheal sounds may still be indistinctly recognised; but below and aside from these points these sounds are normally obscured by the vesicular pulmonary sounds, into the production of which they, however, necessarily enter.

The *pulmonary vesicular breath-sound* is produced by the friction of air entering the air-sacs from the minute bronchioles, and it is supplemented by the conduction of what remains of the glottic breath-sound, now infinitely subdivided. During calm breathing the sound accompanying *inspiration* should be soft and breezy, giving the idea of innumerable similar and associated sounds. In intensity the sound is even from commencement to near the end, when it fades without perceptible interval into the expiratory sound. The *expiratory* sound commences at the moment inspiration ceases, being continuous with the inspiratory sound, but it rapidly fades in intensity, ceasing to be audible after the first one-fifth or one-third of the expiratory act. Of the time occupied between the commencement of one inspiration and that of the next, the inspiratory act occupies nearly one-half ($\frac{5}{11}$ths), the expiratory act the remainder, with the exception of a very brief interval of pause, between the end of expiration and the commencement of the next inspiration. It may here be observed that when the expiration is said to be *prolonged*, it is meant that the expiratory sound is audible through a longer period of the act than natural.

If the respiration be hurried and forced, the inspiratory sound is coarser and louder, and the expiration more audible, these sounds approximating to the *puerile* breathing which is normal to young children.

In health the vesicular breath-sound should be about equally well heard over the front and back of the chest, allowance being made for additional thickness of covering over certain regions.

(*b*) MORBID RESPIRATORY SOUNDS.—*Puerile, compensatory*, or *supplementary breathing* is characterised by increased loudness of vesicular breath-sound, with some prolongation of expiration. Besides being audible over the chest generally in healthy young children, this exaggerated breath-sound may be heard over certain parts of the chest in persons who have some other part disabled or diseased. Thus, with effusion of fluid into one pleura, the respiratory sounds over the opposite lung are exaggerated or puerile. If one apex be diseased, the breath-sound at the other apex is exaggerated. This increased breath-sound to make up for deficient function elsewhere is called *compensatory or supplementary breathing.*

The breath-sound may be *enfeebled* over the whole chest, as in cases of emphysema or thoracic muscular debility. Localised enfeeblement of breath-sound may be due to several causes—(1) local emphysema; (2) adherent and thickened pleura, as after old pleurisy at the base; (3) blocking of the alveoli by catarrhal products—common in commencing phthisis at one apex; (4) closure of bronchial tubes by plugs of mucus, or from spasm. If the rest of the lungs be free, this local enfeeblement is made up for by compensatory breathing on the opposite side, or in other parts of the same lung.

Suppressed breath-sound signifies removal of lung from the surface by effusion of air or of fluid into the pleura, or occlusion of a main bronchus by compression or morbid growth.

Wavy and *jerking* respiration are terms characterising a kind of respiration, in which the inspiration is either partially or completely interrupted several times. The expiration is rarely thus affected. Wavinees of respiration may be due—(1) to an irregular action of the inspiratory muscles, common in nervous people; (2) to cardiac impulse, in which case these interruptions are rhythmic with the heart's pulsation; (3) unequally distributed impairment of the lung-elasticity, for example in early tubercle-deposits. Dr. Walshe considers that pleuritic adhesions may have the same effect. It will be seen then that waviness of breath-sound is very commonly independent of any organic change, and requires other signs to render it of any value in diagnosis. Jerking respiration or interrupted breath-sound is more commonly due to organic lesions of the third kind mentioned.

Cogged breath-sound is a somewhat clumsy term applied to a form of interrupted respiration in which the interruptions are very even, three or four to each inspiration. Much importance is attached to the sign by some authors. It appears to be due to obstruction in the smallest bronchioles, either by dryish secretion or small nodules of tubercle, requiring some accumulation of inspiratory force to overcome it. The sounds commonly give place to a bubbling *râle.*

Harsh respiration with prolongation of expiration implies a want of vesicularity in the sound. Whilst vesicular breath-sound has been compared to the sound produced by the breeze passing through leaf-laden trees, harsh breathing, on the other hand, resembles a similar breeze traversing their naked branch-tops. Some prolongation of the expiratory sound is inseparable from harshness of breath-sound. Harshness of breath-sound by no means implies increased loudness—rather the contrary. Enfeebled respiratory murmur is commonly harsh—always so when due to alveolar obstruction. The meaning of harshness of breath-sound is simply commencing consolidation; it goes with incipient dulness, and is one of the earliest signs of apex-disease in consumption. There can be little doubt that its real mechanism depends upon the extinction of the vesicular part of the normal breath-sound, and the better conduction of the glottic sounds, which at peripheral parts of the lung are usually muffled and obscured by the vesicular sounds. The prolongation of the expiration is very characteristic of this early alteration of the respiratory sounds; and it may here be observed, in passing, *with regard to morbid breath-sounds, that the expiration is the most important part of the respiratory act to attend to in auscultation.*

Divided respiration, usually described as a separate evidence of disease, is really an inseparable factor of harshness of respiration. Instead of the two component sounds, inspiration and expiration, fading imperceptibly into one another, they are more or less distinctly separate, the more so as the more typical bronchial type of breathing is acquired. Deficiency of elasticity is the cause to which the division is usually ascribed; it is, however, a significant feature of glottic breathing.

Bronchial respiration is most typically heard over simple lung-consolidation, as pneumonia at the base or apex. Skoda well describes the sound as acoustically identical with that produced by placing the mouth in the position to pronounce the guttural *ch* (as in *ch*oir or *ch*ristian), and drawing the breath to and fro. The inspiratory and expiratory sounds are about equal in length, nearly identical in pitch, and distinctly divided from one another. The sound varies in intensity and definition from the most intense *tubular* or *tracheal* breath-sound, to the lower-pitched and more diffuse *blowing respiration* (*diffused bronchial breathing*). Besides hepatisation of lung, this form of respiratory sound may be produced by other condensations of lung, for example, from pressure, or by tumours extending from the neighbourhood of a large bronchus to the surface, such as enlarged bronchial glands, mediastinal growths, and aneurismal tumours. The more diffused blowing sounds are due to less complete consolidation. It is essential that the bronchi be patent, in order that bronchial respiration may be heard; thus, in cases of cancerous growth invading a lung from its root and occluding the bronchi, no respiration is audible. As regards mechanism, however, it can scarcely be maintained that the sound is produced by the passage to and fro of the air in the bronchi of the consolidated lung; for (1) at the period when bronchial breathing is most distinct, the lung is immovably fixed by exudation; (2) the play of the chest-wall on the affected side is almost or quite restrained; (3) the air-cells being occupied, there is no reason why air-currents should penetrate the bronchi. Hence it would seem that bronchial respiration is but the glottic breath-sound reverberating through the bronchial tubes, and well conducted to the surface. A remarkable experiment of MM. Bondet and Chauveau (*Revue Mensuelle,* 1877) strikingly confirms this view. In a horse with hepatisation of the base of one lung and bronchial breath-sound over the part affected, the trachea was incised below the glottis, and the wound held widely open; the bronchial breathing immediately disappeared, all respiratory sounds ceasing over this portion of lung, whilst elsewhere the vesicular breath-sound was unimpaired. A musical reed was now inserted into the wound, and the musical sounds were well-conducted over the consolidation, but little audible over the healthy portion of lung.

Cavernous respiration is a breath-sound in which the inspiration and expiration have both a hollow blowing quality. It is to the expiration that the hollow wavering quality characteristic of this breath-sound is especially attached, and, as pointed out by Dr. R. Thompson, the expiratory sound is lower in pitch than the inspiratory. Cavernous breathing signifies pulmonary cavity usually phthisical,—(1); exceeding in size an unshelled walnut; (2) either empty or at least partially so; and (3) communicating with one or more patent bronchial tubes. Softening of tubercle or caseous pneumonia, pulmonary abscess, or bronchial dilatation of sufficient size, are the most common causes of cavity in the lung. This abnormal sound is formed by—(*a*) the passage to and fro of air into a cavity with the respiratory movements; (*b*) the conduction and modified reinforcement of the glottic respiratory sound within a cavity.

Amphoric breath-sound is a variety of cavernous respiration having the same characters, but on an exaggerated scale; that is, not necessarily exaggerated as regards loudness, but having all the qualities—blowing character and hollowness—intensified. This sound is heard over a large superficial cavity, either in the lung, or in the pleura freely communicating with the lung. Its mechanism is identical with that of cavernous respiration, only that the size of the cavity is large.

(*c*) ADVENTITIOUS AUSCULTATORY SIGNS.—A *râle* or *rhonchus* is a sound produced by impediment to the entry or escape of air within the lungs or bronchial tubes. The impediment may be from narrowing, or secretion within the tubes; from secretion within the alveoli; or from destructive softening or œdema of the lung-tissue. The *râles* that may be audible over the chest, are—*sonorous*, *sibilant*, *crepitant*, *sub-crepitant*, *mucous*, *dry crackling*, *moist crackling*, and *cavernous*.

Sonorous and sibilant râles are noises of a snoring or whistling kind, which are produced in the air-passages. They are audible with both inspiration and expiration (or with either), and are for the most part transitory sounds, being temporarily or permanently removed by cough, or in other cases by the relief of the spasm which has occasioned them. They obscure or altogether mask the normal respiratory sounds. Any narrowing of an air-tube will give rise to a sonorous or sibilant *râle* according to the degree of narrowing and the size of the tube. Thus, if the larger tubes be affected, and the narrowing not great, the coarser sound is produced. If, on the other hand, the finer tubes be partially occluded, or a larger tube be greatly narrowed, the finer sibilus is caused. The *râles* are audible throughout the territory of the tubes affected. Thus if a main bronchus be compressed or narrowed, the sonorous *râle* so occasioned will be heard throughout the lung on that side. Throat-sibilus in croup is conducted all over the chest.

The precise causes of these *râles* are—(1) narrowing of a bronchus from external pressure (uncommon); (2) narrowing from local, cicatricial, thickening and contraction of the fibrous coat of the tube (uncommon); (3) mucous collections in the tubes giving rise to imperfect plugs which vibrate, causing the musical sounds (very common); and (4) spasmodic contraction of the medium-sized tubes (sibilus in asthma).

Dry râles signify—(1) Bronchial catarrh, or bronchitis, local or general, as the case may be, affecting the larger and medium-sized tubes; (2) tumours pressing upon the trachea or one of the main bronchi; (3) numerous minute bronchial obstructions occasioned by pulmonary miliary tuberculosis; or (4) asthma.

Stridor is a variety of sonorous rhonchus, due most generally to pressure of a malignant or aneurismal tumour upon a main bronchus, and heard chiefly over the corresponding side. It is a coarse, vibrating sound, which, however, the trained ear can readily detect to be of distant origin. Paralysis of the vocal cords will, in some cases, lead to stridor.

Crepitant râle, or *fine, dry crepitation*, is a minute dry crackling sound, in which the crackles are infinitely small and even, and occupy chiefly the latter part of inspiration. The sound has been compared to the crackling of salt upon the fire, or that produced by rubbing a pinch of hair between the fingers close to the ear. Probably the exact mechanism of the sound is the abrupt separation of alveolar surfaces, collapsed by inflammatory or other œdema. But there are difficulties in the way of any present explanation of the sound. There are at least four conditions which will give rise to identically the same sound, as far as the ear can appreciate it, namely (1) incipient pneumonic consolidation (inflamed œdema stage); (2) œdema of the lungs when not excessive, as in certain stages of kidney-disease, in obstructive heart-disease, &c.; (3) mere collapse of lung from disease, crepitant *râle* being often temporarily heard from this cause at the extreme posterior bases, to disappear after a few deep inspirations; and (4) certain cases of œdema of the pleura dependent upon old lung-disease. The fine crepitation of pneumonia is peculiar only in being associated with commencing tubular breath-sound, the consolidation associated with which gives an increased intensity and definition to the crepitant *râle*. When associated with acute febrile symptoms, fine crepitation indicates the congestive stage of acute pneumonia. If seated about the base, the pneumonia is most commonly of the typical croupous or exudative variety. If at the apex, or in patches, the disease may be incipient catarrhal or embolic (pyæmic) pneumonia.

Sub-crepitant or *muco-crepitant râle* is a fine bubbling *râle*, of sharp definition, and well-conducted to the ear, audible principally during inspiration, but in less degree also with expiration. This *râle* is produced in the minute bronchioles and alveoli, by the penetration of air through a thin liquid. A certain amount of lung-condensation is necessary to give sharpness of definition to the sound. Sub-crepitant *râle* is most typically heard in the resolution stage of pneumonia. In the second (secretion) stage of broncho-pneumonia it is also heard. There are many *râle* sounds intermediate between true dry crepitation and the sub-crepitant *râle*, which are fairly described by the general term crepitant *râle*, fine or coarse, according to their size. Many degrees of fineness or coarseness may be distinguished in different parts of the same lung in some pneumonic forms of phthisis, and it will be generally found in any such cases that the *râles* increase in coarseness as we ascend from below upwards.

Dry crackle is the term used to describe a *râle* consisting of three or four distinct small crackles heard during inspiration. The crackles are dry in character, and sharply defined. The inspiratory breath-sound attending this rhonchus is usually feeble and harsh, the expiration harsh and prolonged, but unattended with any *râle*, unless it be some sibilus. Dry crackling most commonly signifies commencing softening of 'tubercular' deposits, and the sound may be most frequently recognised in the sub-clavicular region, where this condition is most often found uncomplicated by conditions depending upon other stages of the disease.

Moist crackle, or *humid clicking râle*, consists of a few crackles, heard during the latter part of inspiration and the commencement of expiration, sharply defined, sometimes metallic in quality. The crackles vary in size and in the degree of liquidness, as must be the case from the mechanism by which they are produced. For this *râle* is significant of liquefaction of tubercular or caseous pneumonic nodules in communication with bronchial tubes; and as such adjacent softenings coalesce and increase in size, the crackles become larger, until they develop into the *gurgling* or *cavernous râle*. The moist crackle may be associated with other *râles*, since a softening caseous nodule is often surrounded by congested pulmonary tissue or pneumonia, giving rise to fine crepitant or sub-crepitant sounds. As a rule the breath-sound is more or less masked by the crackling *râle*.

Cavernous and gurgling râles are but larger and more liquid *râles*, produced in a cavity or cavities of moderate dimensions.

Metallic tinkling râle requires for its development a large empty cavity in which it may be produced—(1) by the bursting of one or more air-bubbles through viscid contents; (2) by the impingement of a drop of secretion against the cavern-wall; or (3) by a bubbling *râle* produced in a bronchus near the cavity, and freely communicating with it. In either case the large empty cavity, necessarily near the surface, resonates and re-echoes the sounds, and gives them their peculiar metallic quality, which has been likened to that produced by a pin dropping into a large empty bottle. Metallic tinkling is by no means solely significant of pleuritic cavity, as was supposed by Laennec; it may be most typically heard over a large dense-walled empty pulmonary cavern.

Metallic echo is sometimes confounded with metallic tinkle, with which it is often associated, and, indeed, of which it may be said to form a part. It is really not a *râle* at all, however, but an echo in a large cavity, produced—(1) by air-vibrations caused by cough; (2) by vibrations on the surface of fluid with a large air-space above; or (3) by vocal vibrations reaching through the cavity after true voice-sound has died away.

Hippocratic succussion-sound is the splashing sound heard in a pleura containing both air and fluid, on shaking the patient somewhat vigorously, while the ear is applied to the chest-surface.

Cough-sounds.—A cavernous splash sound may frequently be heard on listening over a cavity, and causing the patient to cough, the forcible entry of air into the cavity in itself largely contributing to the sound, and setting up gurgling and splashing *râles* by the disturbance of contained fluids.

Cough-sounds require no explanation, but they should be invariably tested in chest-examination. Crepitant sounds are often developed after a cough, which are not to be heard either on ordinary or deep inspiration without it. *Cavities* which are not in free communication with bronchial tubes may yield no characteristic breath sounds; but the forcible propulsion of air into them at the moment of chest-compression with closed glottis elicits at once a characteristic localised succussion-sound, attended with more or less coarse gurgling *râle*.

Voice-sounds.—In the ordinary healthy spongy condition of lung, the voice-sounds are heard but distantly and imperfectly, save in certain parts of the chest in the neighbourhood of the trachea and its bifurcation, that is, in the upper sternal and the upper interscapular regions, where the sounds are better conducted.

Bronchophony.—At any portion of the chest where there is consolidation of lung, in association with patent air-tubes, the voice-sound is heard loudly, as though produced near or close, under the stethoscope. Although loudly heard, the sound appears to pass away from under the stethoscope. Any solid medium of conduction between a large bronchus and the stethoscope will give rise to bronchophony, whether by super-position, or by the portion of bronchial tree concerned being imbedded in solid lung, as in lobar pneumonia, of which the sound is most typical. If, however, between the conducting medium and the larynx the bronchial channel be occluded, bronchophony is no longer heard, the voice-sounds being enfeebled or annulled.

Pectoriloquy.—If, on the other hand, a cavity be present beneath the spot auscultated, and in free communication with a bronchus, the voice-sound appears to be concentrated at the end of the stethoscope, and to pass *through* the instrument direct to the ear, with exaggerated and even painful distinctness. It is rather the *noise* of the voice that we hear in bronchophony, but in pectoriloquy the sounds are most distinctly *articulated*. This distinction is even better appreciated by listening to a whisper, which under bronchophonic conditions is merely a conducted hissing sound, whilst in pectoriloquy each syllable penetrates distinctly to the ear. Pectoriloquy may, however, be clearly, although not exactly, imitated by consolidated lung in the neighbourhood of a large bronchus. Hence the diagnosis of a cavity near the root of the lung requires much caution.

Ægophony.—Ægophony is a form of modified bronchophony in which the voice-sound, conducted through condensed lung, has further to penetrate a thin layer of fluid in which the coarser vibrations are lost, a certain quavering nasal quality being given to the sound that reaches the ear. It is significant of effusion into the pleura. The sound is only to be heard near the upper limits of the effusion, where the layer of fluid is thin.

With regard to the mechanism of these three sounds—bronchophony, pectoriloquy, and ægophony — there can be no dispute about their being glottic sounds. In *bronchophony* they are conducted through subdividing tubes of increasing fineness enveloped in solid tissue; hence the sounds, although loudly heard, are not well-defined, being largely converted into the coarser vibrations perceptible to palpation as *fremitus*. In *pectoriloquy*, on the other hand, the glottic sounds are conducted through tubes which, after one or two divisions, terminate in a resonating cavity; hence the vocal vibrations are concentrated and conducted with intensity to the ear as through a speaking-tube. Finally, in *ægophony* one may suppose the bleating character of the sound to be due to secondary, and to a certain extent disturbing vibrations in the fluid medium through which the sounds are conveyed. In ægophony one may commonly note a lisp or whisper-sound in addition to the voice-sound, and better conducted than the voice-sound. And it has been affirmed by Bacelli that in cases of *serous* effusion into the pleura the whisper is heard well-conducted with distinct articulation—*pectoriloquie aphonique*—through the thickness of the fluid, whereas in *purulent* effusion such whisper is not conducted. This statement will be found to apply, however, only in certain cases. The whisper may sometimes be heard well-conducted through purulent fluid.

The voice-sounds are *weakened* or wholly *extinguished* by conditions which—(*a*) shut off the main bronchi from the part auscultated, as in malignant growths invading the bronchus at the root of the lung; (*b*) separate the lung-surface from the thoracic wall, as in pleuritic effusions, œdematous thickening of pleura, &c. (Here, however, we must make exception in certain cases, in which pectoriloquie aphonique is heard); (*c*) in rarefaction of the lung by emphysema the voice-sound is enfeebled; and (*d*) in pneumothorax it is either much enfeebled or annulled. In cases of pneumothorax, however, a faint *metallic echo* may often be heard with, or rather after, the voice-sound. This echo has probably a precisely analogous mechanism to ægophony, save that the medium of secondary conduction is air instead of fluid, and hence the conduction is less distinct.

Autophony.—On listening over a superficial cavity with condensed lung-tissue around, the voice of the auscultator—for example, when requesting the patient to cough or to speak—will be noticed by himself to be intensified. The term *autophony* is applied to this increased resonance, which is a sign of little clinical value.

Pleural sounds.—The sounds originating in diseased conditions of pleura are commonly included under the general term 'friction sounds' —a term, however, very inadequate to describe the varieties.

The *pleuritic rub or dry friction* is a wavy or uneven rubbing sound heard close under the ear with both inspiration and expiration, but chiefly with the former, unmoved by cough, and usually attended with pleuritic pain. We may often fail to obtain this sound, through the patient involuntarily restraining the movement of the affected side on account of the pain. A deep inspiration must, therefore, be always called for. In well-marked cases the friction is very loud and leathery, and may be perceptible to the hand applied—*friction fremitus.*

Pleural creaking is a sound that may be sometimes distinguished over a portion of the chest, when the pleuræ are densely thickened and adherent.

Moist or spongy friction is most difficult to distinguish from fine moist crepitation. It is heard almost entirely at the end of deep inspiration, and closely resembles the crepitation of a moist sponge. The sound is due to the pleura being adherent by moist, recent lymph, as in the early stage of adhesive pleurisy in pleuropneumonia.

In cases of œdema of the pleura a fine crepitating inspiratory sound or *pleural crepitus* may be heard, which it is impossible to distinguish from a pulmonary sound. The diagnosis must rest upon the very superficial character of the sound, and its being unchanged by cough; also upon its being associated with deficient breathing without tubular quality, and with lessened vocal fremitus. It is an inspiratory not an expiratory sound, being engendered by the pulling out of the spongy œdema-tissue during inspiration.

4. Circulatory System, Physical Examination of.—The condition of the heart and circulation may be investigated with great exactness, chiefly by palpation, percussion, and auscultation.

PULSE.—The pulse gives us very important information respecting the state of the circulation. For a full description of the pulse and its different characters in disease, *see* PULSE; and SPHYGMOGRAPH.

HEART.—(*a*) **Inspection.**—In health and during quietude the cardiac impulse is barely perceptible. Under excitement, however, throbbing impulse may be noticed over the præcordia and left epigastrium. In cases of great hypertrophy and dilatation of the heart, especially in children, the præcordial region may be obviously bulged. The impulse of the heart may be observed to be diffused over an increased area, between the nipple-line and sternum, in cases of hypertrophy and dilatation. In cases of dilated hypertrophy of the right ventricle, or in displacement downwards of the heart in emphysema, the impulse is very perceptible at the epigastrium to the left of the ensiform cartilage. A diffused undulating impulse may be observed in some cases of pericardial effusion and in adherent pericardium. The heart is often uncovered, and its impulse revealed on one side or the other by retraction of the lung in contractile or wasting pulmonary diseases.

(*b*) **Palpation.**—The position of the heart's apex should first be ascertained; and the area, force, and rhythm of the cardiac pulsations, and the presence or absence of thrill or other adventitious palpation-signs, should next be noted.

Normally the heart, enclosed in its own pericardial sac, is situated in the anterior and central part of the thoracic cavity, immediately above the diaphragm. Its position may be roughly defined as within the area bounded above by a line drawn across the sternum at the level of the lower border of the second cartilages; on the left by a vertical line passing just within the left nipple; and on the right by a similar line drawn at one-third of the distance between the border of the sternum and the right nipple line. A slanting line from the base of the ensiform cartilage to the upper border of the sixth rib in the left nipple line defines the lower border of the heart. Behind this area the heart lies obliquely, its base directed upwards to the right and backwards, its apex to the left downwards and forwards. The organ, moreover, is so placed that the right auricle and ventricle occupy nearly the whole anterior surface; the left auricle and ventricle the posterior and left surface.

The apex of the heart in the adult impinges in the fifth interspace, one inch within the left nipple line. The aortic and pulmonary valves correspond with the upper border of the third left cartilage at its junction with the sternum, the aortic being on the right of and a little lower than the pulmonary. A line drawn from the middle of the third left cartilage as it joins the sternum, to the upper border of the fifth right cartilage at the sternal margin, would correspond with the mitral valve superficially and above, the tricuspid more deeply and below.

An *altered* position of the apex-beat may arise from congenital displacement of the organ, for example, from transposition of viscera. It may arise from enlargement of the organ by hypertrophy or dilatation, affecting its right or left cavities; or from displacement of the organ, for instance, *downwards*, by emphysema, aneurism, or tumour; *aside*, by pleuritic effusion, malignant disease, or contraction of lung; *upwards*, by abdominal distension, disease in the abdomen, or contraction of lung.

In continuance of palpation, the condition of the arteries and veins at the root of the neck must be observed, whether the arteries unduly pulsate, or the veins on one side or both remain full, or pulsate.

(*c*) **Percussion.**—The præcordial dulness may be enlarged by retraction of the margin of one or both lungs; by effusion of fluid into the pericardium; or by enlargement of the heart itself, either general or restricted to one or more of its divisions. The cardiac dulness may be diminished or obscured by enlargement of the lungs enveloping it, or by air effused into the pericardial sac.

(*d*) **Auscultation.**—By the simultaneous contraction of the ventricles, the closure of the mitral and tricuspid valves, and the impingement of the apex of the left ventricle against the ribs, a single sound is produced, the first sound of the heart. The sudden tense closure of the mitral valve is the principal cause of this sound. The first sound is closely followed by the second sound, which is more tapping in quality, and corresponds with the closure of the aortic and pulmonary valves. Then comes the diastolic pause, which may be said to equal in duration that of the two sounds. The first sound is most loudly heard at the apex, the second at the base of the heart.

The sounds of the heart are subject to considerable variations under varied general conditions of health and disease.

(1) In general debility, anæmia, and wasting diseases, the tendency is for the first and second sounds to approximate to each other in character. As the ventricular wall becomes atrophic or ill-nourished the first sound becomes more purely valvular, and at the same time more feeble and tapping, approaching thus in character to the second sound. Sometimes in cases of anæmia the first sound is peculiarly ringing and hollow in character.

(2) In chronic Bright's disease, with thickened vessels and hypertrophied ventricles, the first sound is peculiarly muffled and indistinct, compared with the recognisable force of the beat.

(3) The rhythm of the heart's sounds may be greatly changed:—(*a*) The first or second, or both first and second sounds, may be reduplicated. This may occur as a temporary phenomenon in apparent health, but it is more commonly traceable to increased resistance either in the pulmonary or systemic circulation. (*b*) Excessive rapidity of action. (*c*) Irregularity in time and force of beats. (*d*) Intermittent action. These several phenomena may be significant of disease of the heart itself; or, as is frequently the case, they may be due to functional disturbance through the nervous apparatus, from dyspepsia; or from excessive smoking, tea-drinking, or venery.

A *murmur* or *bruit* is an abnormal sound, invariably of a blowing character, which may more or less replace or obscure the normal heart's sound. Either of the sounds of the heart may be replaced or attended by a murmur; and in auscultation, with regard to prognosis, it is much more important to note whether a murmur wholly or only partially replaces the normal sound—that is, whether the function of the valve be wholly or only partially disabled—than to be guided by mere loudness of *bruit*. The first sound at the apex may be preceded, or very rarely, succeeded by a murmur. For a description of these murmurs, and of morbid pericardial sounds, *see* Heart, Valves of, Diseases of; Heart, Functional Disorders of; and Pericardium, Diseases of.

5. Mediastinum, Physical Examination of. Having examined the thorax with regard especially to the great organs, the lungs and heart, contained within it, the mediastinal region should next be explored, both anteriorly and posteriorly.

Normal Signs.—The anterior mediastinal region, clinically speaking, corresponds with those portions of the sternum not underlaid by lung, namely, the manubrium and the left half of the body, extending from the fourth cartilage downwards.

The lungs normally approximate beneath the upper portion of the second part of the sternum;

from that point to the lower border of the fourth cartilages hiding the subjacent parts. In the triangular space behind the *upper* sternum, with its apex at the lower border of the manubrium and its base at the episternal notch, lie the inferior extremity of the trachea, covered by the left innominate vein, the summit of the arch of the aorta, and a prolongation of the pericardial sac, with connective tissue, and a few small lymphatic glands. The summit of the arch of the aorta corresponds with the level of the upper border of the second rib-cartilage.

Imperfect percussion-dulness and modified bronchial respiration, with weakly conducted heart-sounds, are usually presented over this region. On deeply depressing the finger behind the sternum in the episternal notch, a slight pulsation, communicated from the aorta—which vessel, however, the fingers cannot reach, is felt. The lower region of mediastinal dulness, that is, below the fourth cartilage level, is continuous on the left of the sternum with the heart's dulness, and indeed, corresponds with the præcordial region.

Morbid Signs.—The *upper* mediastinal dulness may be replaced by resonance—(1) from enlargement of the lungs in emphysema; (2) in cases of contraction of the upper part of one lung, enlargement of the opposite lung wholly occupying the sternal region, and effacing the normal mediastinal dulness. The limits of normal mediastinal dulness may be *extended*, from displacement of the anterior margin of the lungs—(1) by dilatation or aneurism of the aorta; (2) by mediastinal abscess; (3) by simple enlargement of the mediastinal or thymus glands; or (4) by morbid growth, cancer, or lymphoma. For the diagnosis between these several conditions *see* Aorta, Diseases of; and Mediastinum, Diseases of. It must be borne in mind that considerably increased dulness, and even prominence, may be due to intrinsic disease of the sternal bone, or to thickening from periostitis.

Alterations in the boundaries of the *lower* region of mediastinal dulness are most often due to enlargement of the heart, or dilated pericardium. Aneurism of the aorta or the heart, or a growth extending forwards, between the heart and the lung, from the posterior mediastinum, are the other causes of increased inferior mediastinal dulness.

Posteriorly there is no inter-pulmonary space apparent save that occupied by the spinal column. But in disease, and especially in tumour, whether aneurismal or of the nature of morbid growth affecting the root of the lungs, the posterior mediastinal dulness involves the right or left interscapular region, as the case may be.

The bifurcation of the trachea corresponds with the body of the fourth dorsal vertebra. The descending portion of the arch of the aorta corresponds with the left side of the third dorsal vertebra.

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6. Abdomen, Physical Examination of.—The abdomen is that portion of the body included between the diaphragm above and the brim of the true pelvis below; and is usually divided, for convenience of clinical reference, into regions. Two horizontal lines drawn at the level of the ninth ribs, and the highest point of the crest of the ilia respectively, and intersected by vertical lines drawn from the eighth rib on each side down to the centre of Poupart's ligament, divide the abdomen into nine regions, namely, epigastric, umbilical, and hypogastric in the centre; and hypochondriac, lumbar, and iliac on each side, from above downwards.

(*a*) **Inspection.**—When examining a case of abdominal disease the position naturally assumed by the patient should be noticed—whether it be indifferent; or dorsal with the knees drawn up—a position very characteristic of peritonitis; or lateral, with the thighs flexed and the body bent, as in renal or hepatic colic. Sometimes in cases of colic, especially lead-colic, the patient lies on his belly with the arms compressing the part. Frequent changes of posture are also characteristic of colic rather than of peritoneal inflammation. The general size, shape, tenseness, fluidity, or retraction of the abdomen will be next observed. Any alteration from perfect symmetry will be noted, with the region of any swelling. The superficial veins of the abdomen may be enlarged, the internal mammary from above meeting the superficial and deep epigastrics, to secure collateral circulation between the superior and inferior cavæ, when either is from any cause compressed or occluded.

(*b*) **Palpation.**—On placing the hand over the abdomen for the purpose of palpation, the rigidity or otherwise of the muscles, especially of the recti, will be noticed; and the observer will be careful to note whether the muscle becomes contracted during manipulation, or was from the first unduly tense. The muscles of the abdominal walls are rigid, as a rule, in all inflammatory conditions of the peritoneum. In local peritonitis, and over special organs or tissues which are painful, the muscles are also tense; thus it is not uncommon to find one rectus notably more rigid than its fellow.

In order properly to examine the abdomen by palpation, it is necessary to place the patient flat on his back, on a slightly inclined plane, with a round pillow placed under the head, so as to flex the chin upon the sternum. The thighs should be similarly flexed upon the pelvis by means of a second incline, on which the legs should rest, or by placing one pillow beneath the thighs and two pillows beneath the legs. In this manner the muscles of the abdomen will be rendered as lax as possible. The patient should further be held in conversation, or told to breathe deeply but without effort, in order that he may not keep his diaphragm fixed. It is often a good plan, when other efforts fail to prevent the patient from keeping his diaphragm fixed, to make him go on counting 'one,' 'two,' 'three,' up to as high a number as he can possibly reach without drawing breath. In this manner we get the diaphragm thoroughly relaxed; and by keeping the hand on the abdomen, deep palpation can be effected at any period of the counting most suitable for the purpose. The observer should be comfortably placed at about the same level as his patient. The whole hand, previously warmed, should be evenly applied to the surface, and the fingers then depressed in different directions as the hand is smoothly conveyed to different regions. If the patient be poked about with the ends of the fingers by the physician stooping over him he is either tickled or hurt, his muscles contract, and proper examination is impossible.

It is sometimes useful to make the patient change his position first to one side, then to the other. This method is particularly to be adopted in examining tumours which are movable, such as floating kidneys, some uterine tumours, and aneurismal sacs. In the case of tumours lying over the aorta, it may be impossible, without adopting this plan, to be sure whether the pulsation felt over them is communicated or intrinsic.

It is sometimes doubtful whether a tumour is situated within the rectus muscle, or in the abdomen beneath it. By keeping the hand over the tumour and making the patient raise himself half to the sitting posture, so as to cause the recti to start forward in contraction, this point can be cleared up.

The temperature of the surface of the abdomen to the hand applied, and to the surface thermometer, may be distinctly raised above that of the general surface in peritonitis.

It is often difficult to estimate the true degree and nature of pain in the abdomen caused by pressure. In hyperæsthesia of the surface the slightest pressure causes suffering; whilst deep, even palpation gives little inconvenience. If the surface be pinched up the pain is acute. Pain in the abdominal muscles is less acute, and is intensified by bringing these into action. The pain of peritonitis is superficial in so far as it is commonly associated with hyperæsthesia of surface; but gentle, steady pressure is acutely painful, and deep palpation intolerable. The pain of peritonitis may, with the disease, be general or local. There is often some difficulty in differentiating the pain of localised hyperæsthesia—hysterical pains as they are called, from those of inflammatory origin or from tenderness of organs. By holding the patient persistently in conversation respecting symptoms associated altogether with another part, as minute inquiries about headache, cough, &c., and thus keeping off attention whilst the hand is steadily compressing the supposed painful parts, all doubts can be removed. In neuralgic and hysterical pains simulating peritonitis, the tenderness extends beyond the confines of the peritoneum.

Abdominal organs may be tender to palpation.

Fluctuation.—Fluctuation is an important sign of the presence of fluid in the abdomen, whether the fluid be free in the peritoneum or enclosed in a sac. It may be obtained by placing one hand lightly on the abdomen, whilst the fingers of the other hand smartly tap over another part, when a fluid wave will be felt to impinge against the applied hand. In certain tense conditions of the abdomen, a deceptive sense of fluctuation may be obtained from the vibrations of the abdominal walls. To prevent this fallacy the hand of a bystander should be applied edgewise on the abdomen, midway between the two hands of the observer, so as to check superficial vibrations.

Hydatid fremitus.—This is a kind of tense fluctuation appreciable by the pleximeter finger on sharp percussion over certain cysts, more particularly hydatid cysts.

(*c*) and (*d*) **Percussion and Auscultation.**—Percussion and auscultation of the abdomen are adopted in accordance with the methods already described. The distribution of dulness and resonance, varying or not with the position of the patient, affords important evidence respecting fluid collections, whether peritoneal or encysted. *See* ABDOMEN, Diseases of; and ASCITES.

By auscultation friction-sounds may be heard over the seat of peritonitis; vascular, aneurismal, and placental bruits; or the sounds of the fœtal heart may be detected.

PHYSICAL EXAMINATION OF THE LIVER.—In the right mammary line the liver underlies the region from the fifth rib to the costal margin; in the median line from the base of the xiphoid cartilage to an inch and a half below that level. The left extremity of the liver lies just within and behind the apex of the heart. It may, then, be roughly said that a horizontal line drawn from the base of the xiphoid cartilage to the right side of the chest and to the apex of the heart, and a second line slanting from within the apex-beat to the right costal margin in the nipple line, would mark the site of the liver. It has already been observed how this surface is partially covered above by lung. In health the margin of the liver becomes lost to palpation beneath the cartilages in the right nipple line. Its upper margin may be defined, as already shown, by deep percussion, its lower margin by very light percussion.

Displacements.—The liver may be *lowered* in position by certain thoracic conditions, such as emphysema, fluid in the pleura or pericardium, thoracic tumours, or compression by tight-lacing. When the liver is thus lowered, it is somewhat anteverted; and in lax conditions of the abdomen its lower margin may be covered by a coil of intestines, thus requiring somewhat deep palpation in tracing it.

The liver may be *raised* by contractile thoracic diseases, especially on the right side, so that its margin recedes considerably within the costal margin. In cases of doubt as to whether extension of dulness upwards be liver or lung-consolidation, the observer must notice whether the level be shifted by respiratory movements. When the abdomen is distended from any cause, the liver is pushed upwards; and in this case, and also in many instances where the liver is drawn upwards, it becomes also tilted somewhat backwards, so that but little more than the margin presents anteriorly. In this condition there may be but little, if any, liver-dulness discoverable anteriorly, and it may erroneously be concluded that the liver is much diminished in size. In these cases, however, the posterior dulness of the liver is increased in the right lower thoracic region. In cases of enlargement of the liver, therefore, the upper margin must be accurately defined, to see if there be extension upwards, and whether that extension be even or uneven. The lower margin must be traced by palpation; the *mobility* of the organ with respiration estimated; its hardness, softness, sharpness, evenness, or distortion ascertained; and whether it be free or connected with other parts—for example, the spleen, or an abdominal tumour.

The lower margin of the liver, when the organ is enlarged or depressed, very frequently cannot be defined by percussion, being overlapped by intestines. For instance, in cases of lax abdominal parietes, with moderate fluid effusion in the peritoneum, the intestines float up and press between the margin of the liver and the surface. In other cases the front surface may be unduly rounded, and the margin thus incurvated to a certain extent and covered by intestines. The *surface* must be felt—whether smooth, or rough, or nodulated. The *consistence* must be estimated by palpation—whether hard or soft, or fluctuating at any part.

The *gall-bladder* cannot be felt unless it be distended, when it presents as a rounded tumour attached to the margin of the liver in the right nipple line.

Physical Examination of the Spleen.—Normally, splenic dulness may be ascertained on light percussion in an area on the left side extending from the ninth to the eleventh ribs, and between the mid axillary and mid-scapular lines. The shape of the splenic dulness is oval in the slant of the ribs.

In moderate *enlargement* the splenic dulness is increased in all directions; and on placing the hand deeply in the left flank, close under the ribs, the organ may be felt to descend upon it during inspiration. As the organ still enlarges it comes forwards and downwards, raising the apex-beat of the heart, occupying the region in front of the scapular line and below the level of the apex-beat, and projecting downwards beneath the costal margin into the abdomen. As the organ still further enlarges, the anterior margin curves forwards, forming nearly a right angle with the costal margin. It is usually sharply defined, and may extend forwards to the median line, and downwards to the pelvis. The posterior margin of the enlarged spleen is also, in such cases of great enlargement, to be felt thick and rounded immediately in front of the quadratus muscle. An enlarged spleen extending into the abdomen is superficial in its entire area; its anterior and posterior borders are well-defined; and it can usually be moved between the two hands forwards and backwards The notch may be commonly felt. The surface may be quite even or nodulated. Sometimes on auscultation a bruit may be audible over an enlarged spleen. Friction-sound may also sometimes be heard. Certain alterations in the constitution of the blood and in the temperature of the body are intimately associated with diseases of the spleen, and the examination of these conditions forms an important item in their diagnosis.

Diminution in the size of the spleen cannot be accurately estimated, and is of little clinical moment.

Physical Examination of the Kidneys.—The kidneys, when of normal dimensions, cannot, as a rule, be felt, especially in fat people, or when the abdomen is enlarged. They lie one on either side near the spinal column, between the level of the spinous process of the eleventh dorsal and of the second lumbar vertebræ, and in the mid-line between these spinous processes and the outer margin of the flank. Imbedded in fat, they rest on the lumbar muscles. The right kidney is overlain in part by the liver, colon, and intestines; the left by the stomach, colon, and intestines.

In order to feel for the kidney, the patient should be placed in the position for abdominal examination. The observer, standing on the side opposite that of the kidney under examination, then places one hand along the mid-flank behind, immediately below the last rib; the other hand should rest upon the corresponding part of the abdomen in front, firmly depressing and manipulating deeply, so as to bring the site of the kidney between the phalangeal portions of the two hands. At the same time the patient should be made to inspire and expire deeply; and it is during the stage of moderately deep expiration that the organ will usually be felt.

Tenderness of the kidney, if present, may thus be estimated with certainty. Undue rigidity of the muscles on one side may be observed.

If the kidney be *uniformly enlarged* it simply extends downwards, and comes more readily under observation. In great enlargement of the kidney, as in cancerous tumour, or of its pelvis, as in pyelitis, the organ forms a tumour occupying the flank, and coming forwards from behind the colon towards the front of the abdomen. Such a tumour is more or less pyramidal or rounded in form, with a distinct band of resonance corresponding with the superior flexure of the colon extending across it. The tumour may be solid or fluctuating, according to its nature. Renal tumours are most common on the left side. The pelvis of the kidney, except when considerably dilated, does not come under palpation. *See* Kidneys, Diseases of.

Movable kidneys.—The mobility of the kidneys varies much, from mere laxness to complete dislocation. *See* Kidneys, Diseases of.

The examination of the urine forms the most important part of the physical diagnosis of kidney-diseases. *See* Urine, Morbid Conditions of.

Physical Examination of the Pancreas.—In thin subjects with retracted abdomen, the head of the pancreas may be felt as a small, somewhat angular, tumour to the right of the median line, above the level of the umbilicus, in the region, in fact, of the pylorus, with thickening of which it may readily be confounded.

Cancerous enlargement of the pancreas extends forwards, in or near the middle line, above the umbilicus, presenting a tumour difficult to diagnose. *See* Pancreas, Diseases of.

Physical Examination of other Abdominal Viscera.—Diseases of the *stomach* and *intestines* yield their proper signs, requiring no separate description here. Tumours of the *omentum* have to be distinguished, by the method of exclusion, from affections of the solid organs of the abdomen.

The *pelvic organs*—uterus, and ovaries, and bladder, under certain conditions of enlargement—present themselves for diagnosis as abdominal tumours.

When distended, the *bladder* gives rise to a pyramidal area of dulness extending in the median line from the pubes, broadening upwards, towards or even beyond the umbilicus. The tumour is firm but elastic, on palpation tender, and is at once removed by successful catheterisation.

In pregnancy at the fourth month the *uterus* becomes perceptible to deep palpation in the pelvic basin in the pubic region. At and beyond the fifth month a tumour of growing dimensions extends from out of the pelvis towards and beyond the umbilicus. Dulness on percussion extends from the pubes over the whole front of the tumour, whilst above and in the flanks a resonant intestinal note is obtained. The relations of dulness and resonance are not appreciably changed by position. The tumour is elastic, and in the advanced stages obscurely fluctuating. On deep palpation, an irregular resisting lobulated mass is to be felt, and on keeping the hand steadily applied, undulating movements, or a distinct shock or jerking movement, may from time to time be felt. On applying the stethoscope with somewhat deep pressure, half-way between umbilicus and pubes and a little on one or other side, the rapid beat of the fœtal heart may be distinctly heard, closely resembling the tick of a watch under the pillow. On bringing the stethoscope nearer the inguinal region (usually on the right side), the soft low-pitched placental *souffle*, synchronous with the maternal pulse, is to be heard. Enlargement of the uterus from other causes, especially fibroid and fibro-cystic growths, may lead to abdominal tumours, which are diagnosed by combined vaginal and abdominal examination. *See* WOMB, Diseases of.

Ovarian tumours also present in the abdomen, extending upwards from one or other side of the pelvic region, and with a disposition as they extend to become central. They are most commonly cystic, and—especially in the later stages—sometimes present difficulties in diagnosis from pregnancy or peritoneal dropsy. *See* ABDOMEN, Diseases of; ABDOMINAL ANEURISM; AORTA, Diseases of; OVARIES, Diseases of; and other appropriate headings.

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PHYSIOGNOMY (*φύσις*, nature, and *γνώμη*, judgment).

DEFINITION.—Physiognomy originally meant the interpretation of the nature of an individual, by the light of the indications afforded by his countenance, conformation, and movements; but the term is frequently used for the indications themselves.

PHYSIOGNOMY IN DIAGNOSIS. — In the early ages of medical science the doctrine of physiognomy formed an important part of all systematic teaching. In proportion as the means and practice of physical diagnosis have been developed, physiognomy, being insusceptible of exact treatment, has fallen into the background, and is seldom assigned a definite place among methods of investigation. Yet in every description of disease the indications yielded to inspection have their place; and practically it is no small part of the accomplishment of a skilful physician to be able to recognise readily in any sick person the outward signs which may be characteristic of his malady.

The authors who have treated systematically of physiognomy make it, in the first place, subservient to the definition of certain morbid temperaments, to which the name of *diatheses* has been given. When in any case the tendency belonging to a diathesis has gone on to the production of an actual diseased state, the word *cachexia* has been commonly adopted to express the fulfilment of the first physiognomical prophecy, with an extension of application to diseased states produced by accident, or without precedent sign of the existence of the corresponding diathesis. Among modern English authors on medicine, Dr. Laycock was conspicuous in allotting an important place to the 'physiognomical diagnosis of morbid constitutional states.'

ELEMENTS OF PHYSIOGNOMY.—Besides such larger groups of physiognomical indications, there are smaller groups, and even single features, which relate to particular systems of organs, or to individual parts, and which, in proportion to their limitation, have mostly a more precise meaning. Before enumerating some of these, it may be of advantage to review the elements of physiognomy. These are, in the main, four:—1, *tegumentary*—skin, with glands and blood-vessels, mucous membrane of mouth and throat; 2, *muscular*; 3, *skeletal*; 4, *attitudes* and *movements*, including those of speech.

The *skin* presents a large number of points for observation; for example, its colour, as regards pigmentation, and as regards vascularity; its texture, as regards softness or hardness, smoothness or roughnesss, thickness or fineness, toughness or flexibility, dryness or moisture; the development and distribution of glands and hairs; œdema; tumours, such as warts; and eruptions. Besides these, in the face lines, furrows, and ridges mark the excessive or defective action of particular muscles, whether determined by habit or disease, causes which also determine the shape of the orifices and skin-prominence of the face.

As regards *muscular* variations there may be noted protective contractions, to which Mr. Darwin has drawn attention as part of the basis of the expression of the emotions, protective relaxation, reflex contractions, spasmodic contractions, and paralysis. With the conformation of the *bones*, which form the framework upon which the skin and muscles are moulded, must be associated the teeth, organs rich in information touching the health of the mucous membranes during childhood, and of the system at large throughout life.

APPLICATIONS OF PHYSIOGNOMY.—Many of the correlations between physiognomy and disease are fully discussed in other parts of this work. A few illustrations of the use of the method may, however, be cited in this article.

The *skin*, alone, may yield indications suggestive, pathognomonic, or diagnostic, as the case may be. Of the first kind are the staining of jaundice, the contrasted tints of hectic, the alterations of the hair in various diseases; of the second kind are the eruptions of exanthematous fevers and syphilis; of the third kind is the observation of Mr. Spencer Wells, in dealing with the diagnosis of ovarian and uterine tumours, that 'there is a facial expression common to women suffering from both classes of disease, associated with a very florid complexion when the tumour is uterine, whereas in the majority of ovarian cases the complexion is pallid.' In the mucous membrane of the mouth the blue line on the gums in chronic lead-poisoning, the spongy gums of mercurial-poisoning and of scurvy, and the pigmentation of Addison's disease are, approximately, instances of the three kinds of signs.

In the *muscles*, independently of the various evidences of paralysis, we may refer to the 'risus sardonicus'; to the tumid, expressionless upper lip of progressive muscular atrophy (Duchenne); to the fixed bent attitude of the head, and rigid, imperturbed features and unaltered articulation of paralysis agitans, as compared with the shaking head and scanning articulation of disseminated sclerosis, or the fatuous look which accompanies the irregular movements of chorea. The physiognomy in plague is said to be highly characteristic. *See* Plague.

The *bones* contribute also to our information. They present definite changes of form in rickets, the projecting under-jaw which in many women is associated with pelvic deformity, the enlargement of the cranium in hydrocephalus, and the hour-glass head and altered teeth of inherited syphilis.

As in the diatheses all the four systems cooperate to form a characteristic physiognomy, so in many actual diseases complex manifestations are abundantly presented. The changes observed in the face and neck in association with certain affections of the chest may be selected as illustrating well this kind of grouping. Thus in severe cases of chronic bronchitis, with emphysema, the skin is turgid, blue, purple, or livid, the lower lip especially being discoloured, enlarged, and everted; the veins, particularly in the neck, are full and prominent; the brows are knitted, the eyeballs projected, the eyelids swollen and partly contracted; the lower jaw, if not closed, is rigidly set in a way to give full effect to the action of the central muscles raising the sternum, which, with the sterno-cleido-mastoids, are prominent and strong; the head is bent forward, the shoulders raised, the nostrils expanded and thickened. The entire expression is one of strain and anxiety. If there be, as is often the case, tricuspid regurgitation, the veins of the neck may be seen filled during every pulsation of the heart.

In certain forms of advanced disease of the heart there is the same swelling and discolouration. But there is usually some icteric tinging of the skin and conjunctivæ, and much weaker signs of muscular strain, which in emphysema are brought about by the constant inspiratory effort. The face is generally calmer in expression, and the head rather thrown back than drawn forward.

When an aneurism or intrathoracic growth presses on the structures in the upper part of the chest, the face often presents enormous venous turgidity, and the veins at the root of the neck are often permanently distended, and unaffected by the movements of respiration, sometimes on one side, sometimes on both. If there be pressure on the trachea or large bronchi, or if there be paralysis of the recurrent laryngeal nerve, many of the muscular strains already noticed may be present; if there be paralysing pressure on the sympathetic, the pupil on the same side will be comparatively contracted, all the tissues on the side more swollen, and the secretions increased. If with aneurism there be aortic regurgitation, violent pulsation of all the arteries will usually be noticed, bringing into strong relief arteries generally quite unseen.

In these illustrations the appearances seen in the head and neck only are considered. If the modification of bodily conformation, movements, and attitudes which go to make up the full physiognomical picture were also detailed, a large addition, exceeding the limits of this article, would be involved. But even so much as is here portrayed will serve to remind us of the large amount of suggestive information which may be gleaned by the observer before proceeding to actual physical examination of the patient, and may stand for an example of the process which, under careful training and practice, is at last performed almost unconsciously by the experienced physician.

William M. Ord.

PHYSOMETRA (φῦσα, air, and μήτρα, the womb).—A condition in which a collection of gas or air is formed in the uterus. *See* Womb, Diseases of.

PHYTOSIS (φυτὸν, a plant).—A generic term for plant-formation, applicable to epiphytic, phytiform, or parasitic diseases of the skin, of which there may be enumerated the following species:—*Phytosis* or *tinea tonsurans; phytosis* or *tinea circinata; phytosis favosa* or *favus*; and *phytosis versicolor*. *See* Favus; Nosophyta; Ringworm; and Tinea.

PHYTOSIS VERSICOLOR.—Synon.: Willan, Fr., and Ger. *Pityriasis versicolor*.

Definition.—A disease of the epidermis, rete mucosum, and follicular epithelium, characterised by the development on the skin of a yellowish-brown discolouration, sometimes tawny and sometimes olive; consisting of small, irregularly-shaped patches and blotches of considerable extent, which give to the integument a variegated or mottled appearance.

Ætiology.—The presence of phytosis versicolor indicates defective nutritive power of the skin, which is not infrequently associated with general debility, and sometimes defect of sanguification—with such symptoms, in fact, as are present in melasma; but these symptoms are rarely very prominent, and the general inference may be that the health is unaffected.

Description.—The most common seat of phytosis versicolor is the trunk of the body, where it assumes a symmetrical distribution, sometimes spreading down the flanks from the axillæ, sometimes occupying the middle line, and sometimes the whole surface of the abdomen, or descending from the groins upon the upper part of the thighs, like an apron. It is found similarly disposed on the back of the trunk, or it surrounds the neck, blending with a general swarthiness of the face; and it is likewise met with on the upper arms, the flexures of the elbows, and those of the knees.

When closely examined, it may be seen that the discoloured skin is punctated by the apertures of the follicles, which are deeper tinted than the rest of the surface, and seem to perform the office of centres, from which the pigment spreads around, involving other follicles similarly affected. This inspection tends to satisfy us that the follicles are the origin of the morbid process and discolouration. Another observation, derived from close inspection, is that the patches are slightly elevated, and that they present evidence of hyperæmia; and, further, we discover that they are very apt to take on a ragged kind of exfoliation, which has gained for the disease the synonym of *pityriasis*.

Therefore, the distinguishing characters of this affection are its colour; its patchy distribution; its exfoliation, from the breaking up or crumbling of the morbid epidermis; and the subjective symptom of itching. These characters present considerable variety. In some instances the colour of the disease predominates so considerably as to suggest a pigmentary affection simply; in others the exfoliation is so remarkable that the term pityriasis would seem to be fairly warranted; while in others, again, the itching may be either almost absent or insufferable.

When a portion of the exfoliating epidermis is submitted to the microscope, it is found to be largely composed of minute globular bodies or cells, which are rendered transparent by the addition of a solution of potash. These are presumed to be a fungous vegetation, and to the individual globules the term *microsporon* has been applied.

Phytosis versicolor is a malady which is chiefly inconvenient from its appearance, and may exist for years without giving rise to any disagreeable symptoms. Sometimes there is a little pruritus, when the patient becomes warmed by exercise; but occasionally the itching has been found so troublesome and unbearable as to be a source of considerable suffering.

Although, in consequence of being considered one of the parasitic diseases, phytosis versicolor has been credited with the reputation of being contagious, it is very rarely met with in both husband and wife, however long it may have been present in either. Unlike tinea, it is a disease of the adult; and tinea is never attended by pigmentation.

Sometimes it exists for years without attracting the attention of the patient further than the inconvenience of its appearance, and it rarely gets well without treatment.

Diagnosis.—The diseases with which phytosis versicolor is liable to be confounded are the pigmentary affections, melasma and chloasma, and pityriasis. The presence of slight elevation, exfoliation, and its flecked appearance, as well as its symmetrical distribution, will distinguish it from the smooth stains of the former; and the absence of inflammation, with exfoliation rather than desquamation, from the latter.

Treatment.—In the treatment of phytosis versicolor, tonic remedies and a tonic regimen are generally indicated. Locally, it yields very quickly to the sulphuret of potassium ointment, to all the mercurial ointments, or to a lotion of perchloride of mercury ointment in almond emulsion. The use of sulphur soap is also valuable, and by keeping up a moderate stimulation of the skin, it tends to check the return of the disease. *See* Tinea.

Erasmus Wilson.

PIA MATER, Diseases of. *See* Meninges, Diseases of.

PIARHÆMIA (πῖαρ, fat, and αἷμα, blood).—A morbid condition of the blood, in which it contains free fat. *See* Blood, Morbid Conditions of.

PICA (*pica*, a magpie).—A perversion of appetite, characterised by a craving for various substances unfitted for, or incapable of digestion. *See* Appetite, Disorders of.

PIGEON-BREAST.—A deformity of the chest, in which the ribs are flattened laterally and the sternum thrust forward, so that the chest assumes somewhat the shape of the breast of a pigeon. *See* Deformities of Chest.

PIGMENTARY SKIN-DISEASES.—Synon.: *Chromatopathia*; Chromatopathic affections.

These affections may be arranged under four heads, namely:—1, *defect*; 2, *excess*; and 3, *alteration* of colour: and 4, *artificial colouring* of the skin.

1. **Defect of Colour.**—Defect of colour of the skin is due to absence of pigment; it occurs both in the rete mucosum and hair, and is either general or partial. As a general affection it is known by the name of *albinism*, the subject of the defect being called an *albino*. Considered as a disease it is termed *leucopathia* and its examples are achroma, leuce, and leucasmus. *See* Albinism.

2. **Excess of Colour.**—Excess of colour is represented by increase in quantity of the normal pigment of the skin, giving rise to a series of shades of hue, ranging from the lighter tints of olive and brown to the deepest tints of black; and, like the preceding, may be general or partial. As a morbid process it is denominated *melanopathia*, and its examples *chloasma* and *melasma*.

3. **Alteration of Colour.**—Alteration of colour of the skin is manifested by a variation in hue of the pigmentary matter, arising from an excess of one of the primitive elements which enter into the composition of the normal brown or black. Thus it may be yellow or olive, as in the two principal members of this group, ephelis and lentigo, the general term for the affection being *xanthochroia*; whilst the term *cyanochroia* has been applied to a rare example of blue pigmentation of the skin.

4. **Artificial Colouring of the Skin.**—This is shown in the leaden or slate-coloured hue resulting from a prolonged use of the salts of silver as an internal remedy. The seat of the discolouration is the papillary layer of the corium, and not the rete mucosum; and the affection is termed *argyria* or *melasma tinctum*. Here also may be mentioned the yellow and green pigmentation of the skin of jaundice, and the blue, green, and yellow stains of a bruise; with the reservation, that they are temporary, being due to bile or the extravasation of blood, whilst the colour produced by the oxidation of silver in the tissue of the derma is permanent

ÆTIOLOGY AND PATHOLOGY.—Pigmentary affections may be said to be due to derangement of function of the integument consequent on disturbance of nutrition. Thus, in natives of tropical countries a slight functional disorder may occasion arrest of pigment-formation of varied extent, and become the cause of *achroma*, as we see illustrated in the instance of the pied negro. Similar effects may be produced by hyperæmia of the skin, as in the case of varicose veins; and again by deranged innervation, as in nervous shock and prurigo. And to these several causes, namely, deranged nutrition, hyperæmia, and altered innervation, all the known examples of melanopathia and leucopathia may be traced.

One of the commonest forms of *melasma* is a natural concomitant of a delicate skin—for instance, lentigo, which, when it appears on the face, may be attributed to the sun and light, but occurs on the covered parts of the body as well. *Ephelis solaris* and *ephelis ignealis* result from the action of heat; a pigmentary stain not infrequently follows the use of a blister; and melasma is a common consequence of varicose veins. Associated with a slight inflammation of the papillary layer of the derma we have pityriasis versicolor, and with the more extensively deranged nutrition of the integument in syphilis, the form of melasma termed 'copper colour.' Morphœa and scleriasis are accompanied with achroma, as well as with melasma; and elephantiasis in even a greater degree. Arsenic, when prolonged in its use for a considerable time, is a cause of melasma; and several chronic diseases of the skin are succeeded by a melasmic stain.

Another series of cases derive their origin by reflex action, or directly, from the nervous system. The *melasma palpebrarum*, which in some females accompanies every menstrual period, is often exaggerated in dysmenorrhœa. In pregnancy, melasma of the areola of the nipples is a normal occurrence, but there are often, superadded to this, *chloasma* or *melasma frontis* or *faciale*. Melasma, again, with achroma, is not infrequently associated with hysteria, nervous shock, and notably with Addison's disease, the so-called 'bronzed skin:' and melasma is a constant attendant on prurigo.

As an aberration of function melasma and achroma indicate a feebleness of skin, as well as more or less constitutional debility; and, as such, they are occasionally associated with grave disorder of the general health. Lentigo, ephelis, and chloasma may be of trifling portent, but *melasma faciale* often indicates a wearying disturbance of the uterine system; the melasma of prurigo a troublesome derangement of the peripheral nervous system; the melasma and achroma of syphilis and elephantiasis a serious dyscrasia; and the melasma of Addison's disease a dangerous and often fatal state of disease.

PROGNOSIS.—The prognosis of a return of the skin to its normal state is decidedly unfavourable, and these discolourations will often endure for a lifetime.

TREATMENT.—As the greater proportion of pigmentary affections are symptomatic of constitutional disorder, the latter will demand an appropriate treatment, whilst the discolouration is dealt with by local remedies. Addison's disease, the neuroses, the dystrophic affections—morphœa and scleriasis, and the dyscrasic affections—syphilis and elephantiasis, require a treatment suited to their respective nature. Parturition and cessation in the use of arsenic withdraw the constitutional cause of chloasma and *melasma arsenicale*, and the removal of local irritants, as in ephelis, tends to their cure. But as the local effect will frequently continue even after the constitutional or exciting cause is withdrawn, we are led to consider the best form of local treatment. Our most trustworthy remedies for the purpose of removing pigmentary stains are alkaline lotions and ointments, headed by soap; lotions of acetic and hydrochloric acid; iodine and iodide of potassium. A lotion of perchloride of mercury in almond emulsion is commonly resorted to for freckles and the slighter forms of discolouration. The pigment is invited to return in achromatous spots by the stimulation of cantharides. In every form of pigmentary discolouration stimulation by friction is also serviceable. ERASMUS WILSON.

PIGMENTATION, Morbid.—DEFINITION. A morbid process, consisting in the deposition of colouring matter in situations where it does not normally occur, or in excess in usual localities.

DESCRIPTION.—The abnormal deposition of pigment may take the form of an uniform staining of the tissues, as in icterus; or it may occur in patches, varying from mere specks up to a very considerable size. The colouration may affect the skin (*see* PIGMENTARY SKIN-DISEASES), or the mucous membrane, as in Addison's disease, where patches of pigmentation are frequently seen on the palate and inside of the cheeks; or the pigment may be deposited in granular masses in the substance of organs, such as the liver, brain, spleen, kidneys, lymphatic glands, and medulla of bones. New growths, both of the epithelial and connective-tissue type, may be the seat of extensive pigmentation, especially if the tissues with which they are connected be normally the repositories of colouring matter (*see* MELANOSIS); but the change is by no means limited to such situations. Considerable variety is presented in colour. The various shades of black and brown are usually attributed to the existence of a substance called 'melanin,' though there is reason to believe that several different pigments are included under this term. In chemical composition melanin contains carbon, oxygen, hydrogen, nitrogen, and iron; in this latter respect resembling hæmatin. 'It is soluble in ether, alcohol, water, and acids; also in boiling caustic alkalies, thus distinguishing it from particles of carbon' (Gamgee).

The bile-pigments are obviously the cause of icteric staining. The very exceptional and remarkable condition of *cyanoderma* is attributed to the presence of indigo; whilst the excessive ingestion of such minerals as lead and silver is liable to be followed by a bluish line around the gums, or a purple colouration of the skin. As in the retina, choroid, and Malpighian layer of the skin, pigment most frequently occurs in epithelial cells, though not unusually in free granules and flakes.

PATHOLOGY.—Excepting when the colouring

matters are obviously introduced from without, the morbid, like the normal pigments, are derived more or less directly from the hæmatin of the blood, itself a reddish-brown substance. Their presence is associated with two very opposite conditions of nutrition, being sometimes an accompaniment of tissue-degeneration and diminished function, at other times connected with extremely active trophic changes. It is noticeable that the chlorophyl of plants and hæmoglobin of blood are amongst the earliest differentiated and most widely distributed proximate principles, intimately dependent upon which are the respiratory changes of plants and animals. The pigmentary layer of the retina, the visual purple, and the wide-spread occurrence of pigment in the nerve-centres, are among the most striking examples of the connection of colouring matter with normal functional changes. Melanotic growths, which are usually of remarkable activity, the temporary brown patches on the skin (*melasma*) in the neighbourhood of painful spots in neuralgia and some uterine states, and the occasional sudden loss of colour in the hair from mental disturbance, are illustrations of morbid nutrition in the same direction. In the majority of cases where pigment is met with, some coincident blood-change is to be found. Thus in the class of malarial diseases, masses of black material are formed in the blood (*melanæmia*), from destruction of the red corpuscles during the pyrexial state, and are liable to be deposited, it is said, by the white corpuscles, in certain organs, especially the spleen. In Addison's disease, purpura, syphilis, &c., characterised by pigmentation, the red corpuscles are obviously affected. The deposition of pigment appears without doubt to be somehow under the control of the sympathetic centres.

Dr. Laycock observes:—'Fundamentally the entire series of phenomena in which pigmentation is a leading characteristic, may be regarded as having reference to the excretion of carbon after it has served its purpose in the economy; and, pathologically, the production of pigments may be taken as the expression of—(*a*) imperfect oxidation of carbon, so that it is not eliminated as carbonic or lactic acids, &c.; (*b*) imperfect elimination of carbon proper; and (*c*) excessive production of carbon from highly carbonaceous foods. In all these there is a close analogy between the carbonaceous excreta as morbid pigments, and the nitrogenous excreta as morbid deposits of urates, &c.' However, all diseases in which the red corpuscles are altered, and their oxygen-carrying power diminished, tend to be associated with pigmentation, from imperfect oxidation of the carbon-waste.

A spurious pigmentation or blackish colouration by sulphide of iron is to be met with *post mortem*, or in gangrenous areas, from the union of sulphuretted hydrogen with the iron of the blood. W. H. Allchin.

PILES.—A popular name for hæmorrhoids. *See* Hæmorrhoids.

PIMPLES.—A popular name for papules. *See* Papula.

PISA, in Central Italy.—Rather moist, mild, equable, calm, and relaxing climate. Mean temperature, winter, 44° Fahr. East prevailing wind. *See* Climate, Treatment of Disease by.

PITTING.—The formation of pits or hollow cicatrices in the skin, resulting from ulceration, as in small-pox; or from disorganisation of tissue and absorption of the papillary layer of the skin, as in syphilis and lupus. Also, the depression produced by pressure on an œdematous part.

PITUITOUS (*πήττω*, I congeal).—A term associated with phlegm or expectoration, when this is of the nature of thick and adhesive mucus. *See* Expectoration.

PITYRIASIS (*πίτυρον*, bran).—Synon.: Furfur; Porrigo; Fr. *Pityriasis*; Ger. *Kleiengrind.*

Definition.—A branny exfoliation of the skin; giving rise to scurfiness or scaliness of the epidermis; and accompanied with heat, dryness, redness, and pruritus.

Ætiology.—The cause of pityriasis must be regarded as a feeble state of the skin, probably dependent on a low condition of the general system. In a symptomatic form, however, it may be due to the causes which control the parent disease, as in the case of eczema.

Anatomical Characters.—Pityriasis is a superficial chronic inflammation of the skin, without exudation or swelling, but especially characterised by disturbed nutrition of the epidermis and its desquamation in minute scales. Essentially it is a mild manifestation of eczema, and must be regarded as one of the forms of dry eczema.

Description.—The most common seat of pityriasis is the scalp—for example, *P. capitis*; and in that situation it may present several degrees of severity, ranging between the pityriasis with silvery scales of elderly persons (*xerasia*), or the mere accumulation of epidermic exuviæ in children and young persons, called 'dandruff,' and the more extensive desquamation, attended with chronic inflammation, of a declining eczema or even of psoriasis.

On the sensitive skin of children, particularly those of light complexion, it is apt to appear on the face in the form of small, circular, reddish discs, coated over with a fine furfur; and occasionally it is met with in patches on the body and limbs, and always maintaining the same characters, namely, heat, redness, and pruritus, but a total absence of serous exudation.

The term pityriasis, whilst strictly signifying an exfoliation of fine scales upon a skin which is more or less congested, yet falls short of the activity of eczema, has also been applied to a furfuraceous state of the skin accompanying other morbid affections of the texture; for example, *elephantiasis Græcorum*, and especially *xeroderma* in its transition to ichthyosis. Another form of exfoliation of the epidermis associated with a yellowish pigmentation of the skin, received from Willan the name of *pityriasis versicolor*; but as the pathological conditions of the latter are totally different from ordinary pityriasis, and are identical with the phytiform or so-called parasitic diseases, this affection will be found treated of under the head of Phytosis versicolor.

Diagnosis.—The description of the physical signs and the pathological condition of this affection will sufficiently distinguish it from other diseases; although, as will be perceived, it may be an accidental accompaniment of a variety of cutaneous affections, such as dry, chronic eczema. Indeed, its idiopathic form is its rarest manifestation.

Prognosis.—Taken by itself, pityriasis must be regarded as a trivial affection, and one which will speedily yield to appropriate treatment.

Treatment.—Our efforts in this direction should be aimed at the improvement of the nutritive function of the skin, and the relief of local inconvenience or suffering. The first indication is to be met by general tonics, and by the exhibition of small doses of some arsenical preparation; and the second by the application of the red oxide of mercury ointment in a diluted form (one part to three), or the oxide of zinc ointment. The former remedy is the more suitable for the scalp or hairy regions of the body; and the latter for the unprotected surface of the face and trunk. Erasmus Wilson.

PITYRIASIS VERSICOLOR (*πίτυρον*, bran, and *versicolor*, of changing colour).—A synonym for phytosis versicolor. *See* Phytosis Versicolor.

PLACENTA, Diseases of.—Synon.: Fr. *Maladies du Placenta*; Ger. *Krankheiten des Mutterkuchens*.—The frequency and importance of placental disease is hardly yet sufficiently recognised; and forty years ago, when the late Sir James Simpson published his memoir *On Congestion and Inflammation of the Placenta*, almost nothing was known on this subject.

The placenta being the sole medium of vital communication between the fœtus and mother, any deviation from its normal condition, by which its development may be arrested, and its physiological action impaired, must be of serious consequence.

The principal diseases to which the placenta is subject are:—1. Inflammation; 2. Congestion; 3. Hæmorrhage; 4. Hydatidinous degeneration; 5. Fatty degeneration; 6. Atrophy; 7. Hypertrophy; 8. Œdema; and 9. Calcareous deposits.

1. Placenta, Inflammation of.—Synon.: Placentitis.—Acute inflammation of the afterbirth is the sole cause of those morbid adhesions that occasion the most serious dangers of parturition, namely, *post-partum* hæmorrhage and inversion of the uterus. Moreover, it sometimes causes the death of the fœtus by destroying the structural integrity of the placenta. The disease is generally syphilitic in its origin.

Symptoms.—The symptoms of placentitis are so obscure that it is seldom detected until after the birth of the child, when we find the placenta adherent.

In many cases, however, this disease is attended by constitutional irritation or febrile disturbance of a remittent character. A very usual symptom of placentitis is the return of morning sickness in the later months of pregnancy, together with a dull aching pain, or a sensation of weight and fulness, over the hypogastric or iliac regions. The placental souffle will also be found intensified in sound, or abnormal in some other respect.

Treatment.—The treatment most in use for placentitis is a mild alterative course of mercury conjoined with tonics, and followed by iodide of potassium. Severe local pain may be relieved by leeching, or by the application of oleate of mercury with morphia, or by iodated liniments.

2. Placenta, Congestion of.—This condition is occasionally met with after a protracted labour, the placenta being then found engorged with blood, hard and tumefied, its external surface of a deep purple colour, and covered with a raised network of tortuous and congested vessels. Acute congestion, from the sudden engorgement of the placental vessels, may also arise at any period of pregnancy, from general plethora, or the recession of some acute inflammatory disease. It may also be occasioned by the sudden check to the placental circulation from the death of the embryo.

The *diagnosis* between congestion and inflammation of the placenta is impossible; and the *treatment* is the same in both cases.

3. Placenta, Hæmorrhage into.—Acute congestion of the placenta generally terminates by hæmorrhage into either the deciduous or cellular (maternal) portion; into the villous or vascular (fœtal) part of this organ; or in some cases into the cellular interspace between these, thus constituting what Cruveilhier described as 'apoplexy of the placenta.' Hæmorrhagic effusions of this kind are a frequent cause of miscarriage.

Occasionally, especially amongst the ill-treated wives of the labouring classes, placental hæmorrhage is the result of external violence or shock. The effusion then generally takes place from the central external surface of the placenta, which is thus partially separated from the uterus; but if the effusion be limited to a few ounces, gestation may go on undisturbed.

4. Placenta, Hydatidinous Disease of.—This consists in degeneration and abnormal development of the placental villi of the chorion, usually following, although occasionally producing, the death of the fœtus. In the *Dublin Obstetrical Transactions* for 1874–9, the writer has related several instances of this comparatively rare disease. In most of these cases the hydatidiform mass was expelled from the uterus at the fifth month.' *See* Mole.

Symptoms.—The symptoms of this disease can at first hardly be distinguished from those of ordinary pregnancy. If, however, in addition to the signs that usually denote the death of the fœtus *in utero*, the patient experiences occasional gushes of water, together with slight hæmorrhage from the uterus, lasting for a short time, and recurring at irregular intervals, we may suspect the existence of hydatidiform disease in the placenta of a blighted fœtus.

The expulsion of these growths from the uterus is generally attended by severe hæmorrhage.

Treatment.—In the way of treatment, nothing can be done to arrest the progress of the disease, although chlorate of potash has been suggested for the purpose. But an attempt should always be made to prevent its recurrence by improving the general health of the patient by alteratives and ferruginous tonics, especially any of the milder saline chalybeate waters, such as Ems, Kissingen, or Schwalbach.

It has been recommended that we should bring on the expulsion of hydatidiform moles as soon as they are discovered. This, however, is inadvisable. Only a portion of the placenta may be affected; or, as the writer has seen, the birth of a healthy living child may be immediately followed by the hydatidinous placenta of a blighted twin conception. Hence, we should let nature take her course, for in due time the morbid growth will be surely expelled from the uterus, rather than by unnecessary interference run the risk of destroying a living fœtus.

5. Placenta, Fatty Degeneration of.—This is a common disease. The late Sir James Simpson, Virchow, and Dr. Druitt, as well as some earlier writers, have discussed the nature of the affection, on which more light has been since thrown by Dr. Barnes's papers in the 34th and 36th volumes of the *Medico-Chirurgical Transactions*, and by Dr. Braxton Hicks' researches in the 14th volume of the *Obstetrical Transactions*. The symptoms and treatment of this condition are so obscure, however, that it will be unnecessary to dwell on it in the present work.

6. Placenta, Atrophy of.—Atrophy of the placenta is an occasional cause of the death of the fœtus between the sixth and ninth months of gestation. The uterine placental villi in such cases are arrested in their development, undergoing a retrograde metamorphosis into an opaque molecular substance, generally accompanied by fatty deposits in the umbilical terminal vessels of the fœtal portions of the blighted organ.

7. Placenta, Hypertrophy of.—This is a much more rare pathological condition than that last mentioned. We sometimes, however, find the placenta greatly enlarged without any other apparent alteration in its structure, and in such cases the child, if alive, is usually diminutive and puny, being stunted not only by the blood having been diverted from its nutrition, but still more by the compression of the terminal umbilical vessels.

8. Placenta, Œdema of.—Effusion of serum is another consequence of placentitis. In the few cases of this kind that the writer has seen, abortion occurred, and the placental villi were enormously distended and bloodless, being filled with a serous fluid. In one instance, in addition to the dropsy of the placenta, the umbilical cord was œdematous to an extraordinary extent.

9. Placenta, Calcareous Deposits in.—Calcareous deposits are sometimes met with in cases of adherent placenta, being usually situated in the external or uterine surface, and in the decidual vessels. In some instances, however, the writer has found these deposits scattered throughout the whole substance of the afterbirth.

Thos. More Madden.

PLAGUE (πληγή, *plaga*, a stroke).—Synon.: The Pest; Inguinal, Bubonic, Glandular, Oriental, Indian, Pali, and Levantine Plague, Oriental Typhus; Septic Pestilence; Fr. *la Peste*; Ger. *die Pest*.

Definition.—A specific fever, attended by bubo of the inguinal or other glands, and occasionally by carbuncles.

History.—The term *plague* is used by the older historians in two senses, (1) in a general sense, as applicable to the prevalence of diseases accompanied by great mortality, irrespective of their nature; and (2) in a limited sense, as indicating the particular malady defined above. The earliest notice of the disease now designated *plague* is found in a work of Oribasius, the physician to the Emperor Julian (A.D. 361–363). He quotes from Rufus (Alexander) of Ephesus, a writer who lived in the reign of the Emperor Trajan (A.D. 98–117), a passage from which it would appear that plague had been known as an endemic, and occasionally as an epidemic, in Libya (North Africa), Egypt, and Syria, from the end of the third or beginning of the second century before Christ. The first appearance of plague in Europe is referred to the 6th century of the Christian era. In the reign of the Emperor Justinian (A.D. 527–565) the disease underwent a development previously unknown. According to contemporary historians, it broke out in Egypt, explosively, and presently spread thence to the neighbouring countries of Africa and Asia; invaded and extended over the whole of Europe; and generally became disseminated throughout the then known world, causing frightful mortality wherever it showed itself. From this period, it is inferred, plague became established in Europe, being sometimes more, sometimes less prevalent, for the 1,300 years following—indeed, until the ninth lustrum of the present century.

The great pestilence, most familiarly known as the *black-death*, which swept over the western hemisphere in the 14th century, causing an inconceivable mortality, and which has been designated *black plague*, although presenting several of the symptoms of bubonic plague, is held by some epidemiologists to have differed essentially from that disease. The *black-death*, according to these writers, was particularly characterised by a gangrenous inflammation of the respiratory organs, violent fixed pains in the chest, vomiting and spitting of blood, and a horribly offensive and pestiferous breath, which could be perceived at a considerable distance from the patient. Such symptoms distinguished, these writers think, the disease from bubonic plague. Moreover, it is noted that while bubonic plague had had its apparent source in Egypt seven centuries before, black-death, according to contemporary writers, had its origin in Cathay (Northern China), and issued thence to devastate the world. Writers who regard black-death as a different malady from plague, hold that the pestilential manifestation of the disease began and ended with the dreadful outbreak of the 14th century, and that the malady has long been extinct.

Other writers consider black-death to have been a modification of bubonic plague. But if this view be accepted, the extraordinary development and remarkable modification which the dis ease underwent in the 14th century, stand quite alone in the history of the affection, and constitute phenomena which would have to be regarded as indicative of a secular evolution of morbid changes (*see* PERIODICITY IN DISEASE). This last-named view of the relation between black-death and bubonic plague is not without a present interest. For Hirsch and others believe that the *Máhámari* of Northern India—the *Pali*, or *Indian plague*, as the disease is also termed—which has several times prevailed as a local epidemic since the commencement of the present century, is a disease analogous to the *black-death* of the 14th century. Probably these writers would now include the more recently known *Yunnan plague* in the same category.

In the 15th century the countries in which plague was habitually present or recurred at intervals, included Northern Africa, Egypt, Western Arabia, Syria and Palestine, Asia Minor and Mesopotamia, Persia, probably India and China, and Europe generally. Throughout the 16th and 17th centuries there are almost continuous records, from year to year, of the presence of the disease, in greater or less activity, within this area of prevalence (Carl Martin, *Petermann's Mittheilungen*, Juli, 1879). During the latter half of the 17th century a remarkable lessening of the area of prevalence of the disease began to take place. As regards Europe, in the course of the twenty years 1661–1681 plague disappeared from Italy, England, Western Germany, Switzerland, the Netherlands, and Spain. This lessening of area continued throughout the 18th century, the number of serious outbreaks of plague also diminishing, two only having occurred in that century, namely, (1) in 1703–13, (involving Turkey, Hungary, Russia, Poland, Austria, Bohemia, and Eastern Germany), and (2) in 1720–22 (Provence). At the close of the first third of the 19th century, the area of prevalence of the disease had shrunk to the easternmost part of the Turkish Empire in Europe; and in the year 1841 plague ceased on the Continent altogether.

While this change had been taking place in Europe, a corresponding change had been manifested in the prevalence of the disease in its habitats elsewhere. Before its complete cessation in Europe, plague would appear to have disappeared from Northern Africa (except Egypt), from Mesopotamia, and from Persia; the existence of the disease in Asia Minor, Syria, and Palestine came to an end in 1843; and in the year 1844, with the cessation of the malady in Egypt, plague seemed to have become wholly extinct, and Europe to have got rid of a terror which had harassed it for ages.

It is noteworthy that during the period of the progressive narrowing of the limits within which plague prevailed, and until its disappearance, the disease manifested no abatement of those characteristics, as well in respect to rapidity of course, to the nature of the symptoms, and to its fatality, which had made it the dread of Europe and the Levant. The outbreak of 1665 in London, which preceded the disappearance of the disease from England, and which is known as *The Great Plague of London*; also the outbreak of 1720 in Marseilles, which preceded the disappearance of the disease from France, have become historical from the fatality which accompanied them. Hardly, if at all, less terrible was the outbreak in Moscow in 1770, and the later outbreaks in Turkey, in Syria, and in Egypt. Even at the present day the traveller in Persia and Kurdistan comes upon communities the growth of which has been arrested, and the ruins of villages which have been depopulated, by the ravages of plague earlier in the century.

Notwithstanding the disappearance of plague from its last-frequented haunts, certain epidemiologists, and notably Gavin Milroy in this country, having regard to the long intervals which had occasionally been observed between recurring epidemics of the disease, doubted its cessation. Their doubts were presently confirmed by the re-appearance of the plague in the Levant. This happened in 1853 (nine years after the presumed cessation of the disease in Egypt) in the Assyr country, Western Arabia, where a circumscribed outbreak occurred. Other local outbreaks followed at intervals in different places, in the order and countries here noted:—

1853, the Assyr district, Yemen, Western Arabia; 1858–59, province of Bengazi, Regency of Tripoli, North Africa; 1863, district of Maku, Persian Kurdistan; 1867, the marsh district on the right bank of the Euphrates, south and west of Hillah; 1870–71, Persian Kurdistan, in the district south-east of Lake Urumiah; 1871–73, Yunnan province, Western China; 1873–74, the marsh district on the left bank of the Euphrates, south of Hillah and the position of ancient Babylon. This outbreak proved to be the beginning of a manifestation of the disease, which in the course of the years 1874–75, 1875–76, and 1876–77, showed itself over an area extending from Bagdad on the north, to Suk-e-Sheyukh on the south, and from the banks of the Tigris and Shat-el-Hai on the East to the borders of the Syrian desert on the west. Hillah suffered from this outbreak in 1876 (recorded deaths 1,007), and Bagdad, both in 1876 (recorded deaths 2,611) and 1877 (recorded deaths 1,672). The outbreak of 1873–74 on the Lower Euphrates was not the only appearance of plague at that period. Two other outbreaks occurred in 1874, one in the Assyr district, Western Arabia (the scene of the outbreak of 1853), and another in the province of Bengazi, Regency of Tripoli (the scene of the outbreak of 1858–59). In 1876, in addition to the then prevalence of the disease in the district south of Bagdad and on the Lower Euphrates, plague broke out in the Shuster-Dizful district, Khuzistan, south-eastern Persia; and before the close of the year it had shown itself also in two villages of northern Persia, situated about twenty-five leagues from the south-eastern angle of the Caspian Sea. The same year also there was an outbreak of *Máhámari*, in the mountainous district of Kumaun, North-western India, which did not terminate until the following year. In 1877 an outbreak occurred at Resht, the capital of the province of Ghilan, Persia, and in the surrounding district. Ghilan lies at the south-west angle of the Caspian Sea. The same year cases of a fatal bubonic febrile malady occurred in the district of Baku, on the Caspian shore of Transcaucasia; and an outbreak of a non-fatal bubonic affection took place in Astrakhan and its vicinage, since recognised as a form of plague. At the beginning of 1878 plague was reported in the district of Souj-Bulak, Persian Kurdistan; and in October the disease broke out at Vetliacka, a Cossack settlement on the Lower Volga, in the province of Astrakhan, Russia in Europe, and prevailed there and in the adjacent districts on both banks of the river, until February, 1879, with the exception of an isolated case, or more than one, which was observed in the following month.

Since this outbreak, when, after thirty-seven years' absence, plague re-appeared on European soil, the disease has shown itself again (February–June 1879) in the Assyr district, Western Arabia, and there have been doubtful rumours of its presence in Persian Kurdistan.

ÆTIOLOGY.—Plague is observed to be developed under two principal sets of conditions, namely, (*a*) certain *local states*, physical or social, or both, as the case may be, affecting communities; and (*b*) certain *relations between persons* sick of the disease and healthy persons. To these must be added (*c*) particular *seasonal influences*.

(*a*) The *local conditions* which favour the development of plague were made the subject of careful study by a commission of the French Academy of Medicine, in 1844. The report of this commission, prepared by Prus, sums up and represents the then existing knowledge on the subject. According to the commission, plague was a product of Egypt (where it was held to be endemic), Syria, the two Turkeys (Turkey in Europe and Turkey in Asia), and many other countries of Asia, Africa, and Europe; and the conditions 'which determined and favoured' the development (birth) of the disease among communities there, were:—dwelling upon alluvial and marshy soils, notably such as were found near the shores of the Mediterranean, and on the banks of certain great rivers, the Nile, the Euphrates, and the Danube being specified; a warm and humid atmosphere; low, badly ventilated and crowded houses; great accumulations of putrefying animal and vegetable matters in the vicinity of dwellings; unwholesome and insufficient food; excessive physical and moral misery; and neglect of the laws of health, as well public as private.

The recent appearances of plague have served to correct some, and to confirm others of these conclusions of the commission. Plague is no longer endemic in Egypt; but of late years, as already stated, it has broken out in several widely separated places of Africa and Asia. In these outbreaks (excluding from consideration for the present the outbreak in Astrakhan province), the disease appears to have been a local product determined by as yet entirely unknown conditions. The term 'spontaneous' is frequently applied to such developments of disease, but is best avoided as implying more than is warranted by our present knowledge. Again, the recent outbreaks have shown (and Tholozan has particularly dwelt on this subject) that plague is, perhaps, as much a disease of the highlands as the lowlands. This is evidenced by its persistence, in Kumaun, on the Himalayan mountains, and among the mountains in Western Arabia and in Yunnan. The outbreaks in Persian Kurdistan in 1870–71, and in the province of Bengazi in 1873-74, took place on elevated tablelands. The outbreaks also of 1853 and 1874 in Western Arabia took place among the highlands. But, if a less restricted topography must be assigned wherein plague may manifest itself as a local product, so to speak, the later prevalences of the disease confirm fully the conclusions of the Commission of 1844 regarding other conditions of development which are not peculiar to any country or locality. The outbreak of 1858–59 in the province of Bengazi followed upon four years' drought and failure of crops, at a time when the greater part of the flocks and herds had been destroyed from want of food, and by a fatal epizootic which prevailed among them, plague breaking out when the population was suffering most from famine, and when the physical and social misery resulting from destitution was greatest. The same was, in effect, the state of things when plague appeared in Maku, in Persian Kurdistan, in 1863; but here it is noted also that the infected district was pervaded with the putrid emanations from the unburied bodies of cattle which had died from murrain. The outbreak of 1867 on the Lower Euphrates was confined to marsh-villages on the right bank of the river; and that of 1873-74, in the same district (the beginning of the greater development of 1874–77), began in marsh-villages on the left bank of the river. The huts of the particular class of villages affected, writes W. H. Colvill, 'are on ground which is a foot or two lower than the surface of the water in spring; and the ground is so saturated with water, that the refuse of the village is neither absorbed nor can it be evaporated, for it acquires fresh moisture from the ground, and this refuse acquires the form of a bluish-black oily fluid which surrounds the huts and covers the paths, and stains the walls two feet from the ground; and, in fact, the village is in such a state of filth that it requires to be seen to be believed.' The outbreaks of 1867 and 1873–74 had been preceded, according to Colvill, by the only two great inundations of the Euphrates which had occurred since 1831, the year of the then latest outbreak of plague in Bagdad. The outbreak of 1870–71 among the highlands of Persian Kurdistan, had been preceded by a fatal epizootic among sheep, and ergotism among the people. Writing of one of these mountain-villages—and the account serves for all—Castaldi says: 'Whatever is most afflicting in poverty, whatever is most revolting in filthiness, is accumulated, as if designedly, around these infected dens, in the interior of which live, or rather vegetate, from fifty to sixty men, women, and children. The cultivation of some plots of ground in the neighbourhood furnishes these unfortunates with insufficient nourishment.' The infected district escaped the famine which at this time prevailed in Persia, but it may be a question if the inhabitants escaped severe privation during the winter in which plague first appeared. The outbreak of 1874, in the province of Bengazi, North Africa, occurred among the nomadic tribes occupying the Cyrenaic plateau at a time when some of the favourite Arab camping grounds had been converted into vast swamps from heavy and protracted rains, and when the people were reduced to the most abject misery and were suffering from an extremity of famine, the result of failure of their crops for three years in succession, consequent on drought. The outbreak of 1876–77 in the mountain-villages of Kumaun took place among communities who are described as occupying houses in which cattle, grain, and families are packed together under conditions of filth not unlike those observed in the mountain-villages of Kurdistan. Of the conditions under which plague was observed in the great towns, as in Bagdad and in Resht, as also on the Volga, they were states of filth, in and about dwellings, such as might be anticipated where no organised scavenging had ever existed, and of crowded and badly-ventilated houses. But in Bagdad and the Mesopotamian towns generally, the most influential condition in promoting plague was, according to Colvill and Cabiadis, *poverty*. Cabiadis, indeed, styles the disease, *miseriæ morbus*, thus reproducing, in 1878, a name by which plague was designated by some in the 'Great Visitation' of London, 1665, namely, 'the *Poor's Plague*.' On the other hand, the communities which suffered on the Volga were prosperous and believed to have plenty (on somewhat doubtful evidence, it must be confessed); but at the time of the appearance of plague among them, they were living under almost indescribable conditions of filth accumulated about their houses, and from which the interiors were not free.

The local conditions which have been observed to be favourable to the development of plague since the reappearance of the disease in 1853, it will thus be seen, are similar to those which were observed before its disappearance from Europe and the Levant in 1844.

(*b*) That the kind of *relations maintained between persons* sick of plague and the healthy exercised an important influence upon the propagation of the disease, has been made clearly manifest in the recent outbreaks. The more closely and continuously the healthy were brought into association with the sick, the more certain were the former to suffer from the disease. Thus persons living in the same house with the patient were peculiarly liable to suffer, while those who were brought only occasionally into contact with him (as the physician) were rarely affected. And here, again, a difference was noted between the liability of the physicians and of the surgeons and their assistants to be attacked by the disease, the duties of the latter calling for more frequent and protracted visits to the patients than the duties of the former, and they suffered to a greater extent. No doubt was entertained that the disease was, in ordinary phrase, *caught* from the sick by the healthy brought into association with them; but there was no certain evidence that actual *contact* with the sick person was necessary to the transmission, as the older doctrine of contagion maintained. On the contrary, the evidence indicated that the transmission was chiefly effected through the healthy breathing the same atmosphere as the sick, that is to say, the atmosphere surrounding the sick person. There would appear to be, in addition, evidence of transmission of the malady by the agency of *clothes and bedding* which had been used by the sick. The newer information obtained on this subject of the transmissibility of plague from those sick of the disease to the healthy, corresponds with the results obtained on the same subject by the commission of the French Academy in 1844, and both point to a close analogy between the modes of transmission of plague and of typhus, and between the habits of the two infections. In plague, as in typhus, the liability of the healthy to contract the disease is mainly dependent on the constancy and intimacy of communication with the sick. In plague, as in typhus, the danger of infection appears to be principally proportionate to the fouling of the atmosphere surrounding the sick by the effluvium from his body and breath; and in like manner either infection would seem to be peculiarly easy of destruction by free dilution with air. Again, there seems to be no trustworthy evidence to show that the danger of the propagation of plague by *fomites* (as the older writers have it), that is to say, by articles carrying the infection of the disease—such as clothing and bedding—is greater in plague than in typhus. The condition for infection of articles of clothing and bedding was their very intimate use by, or association with, the sick. Evidence was entirely wanting of articles other than those mentioned, and under other conditions, being capable of communicating the disease to the healthy; nor was there anything to confirm the assumption that the long array of articles contained in quarantine-regulations regarding plague were capable of retaining and conveying the infection.

(*c*) Both the sets of conditions here noted as affecting the development of plague appear to be influenced by *seasonal* changes. In Mesopotamia the disease, during its prevalence there, rapidly declines, and becomes dormant, with the setting-in of the hot weather in June (beginning to fall when the temperature reaches 86° F., and ceasing abruptly at 113° F.), its activity re-awakening in winter, and gathering force with the advancing spring. Similar phenomena were observed in Egypt, whilst the disease prevailed in that country. In Constantinople, on the contrary, the disease was dormant during the colder months of the year, and became active during the hotter. The same was true of this country when the disease existed here, as is particularly observed in the season of prevalence of the epidemics which have ravaged the metropolis. Here, as Wm. Farr, Ed. Smith, and, more recently, Buchan and Mitchell have shown, from the records of mortality, September was the month of greatest prevalence, the disease rising throughout July and August and falling throughout October and November. Further north (in Moscow, for example) the disease has prevailed as severely in the depth of winter as in the height of summer.

Incubation.—The recent outbreaks have not furnished much additional information on this subject, but, such as it is, it tends to confirm the conclusion of the commission of the French Academy. This was to the effect that the disease had never shown itself among compromised persons after an isolation of eight days. L. Arnaud carefully studied the question in the outbreak of

1874, in the province of Bengazi, and from the facts he then collected concluded that the mean time of incubation of plague was five or six days, and that the maximum duration did not exceed eight days. Hirsch, from the information he obtained at Vetlianka, relating to the recent outbreak in the province of Astrakhan, concluded that the minimum period of incubation observed there was from two to three days, the maximum exceeding eight days, and that the average might be set down at five days. He notes, however, that very short or very long periods of incubation were seldom observed.

SYMPTOMS.—These are summarised here wholly from the writings of recent observers: W. H. Colvill and Giovanni Cabiadis (as made known by E. D. Dickson) in regard to plague in Mesopotamia; Castaldi, in regard to plague in Mesopotamia, Persian Kurdistan, and Resht; L. Arnaud, in regard to plague in Bengazi (*see* Blue Book, 'Plague,' 1879); Döppner (official report); Hirsch (*Practitioner*, ii. 1879); and W. H. Colvill and Payne (official report), in regard to plague in the province of Astrakhan. This course is taken, first, because the disease, as they describe it, is that which the present generation is called upon to consider; and, secondly, because, generally speaking, the symptoms observed by them are similar to those described by the earlier writers on the subject.

Plague occurred in three forms in the recent outbreaks, namely (1), an *abortive* or *larval*; (2), a *grave* (*plague*, as usually understood); and (3), a *fulminant* form.

1. **Abortive (larval) Plague.**—This form is characterised by the appearance of buboes in the groins, armpits, and neck, as a rule painless, and unaccompanied by feverishness. At times, but rarely, the manifestation of the buboes is preceded and accompanied by a general febrile disturbance of the system, so slight as not to preclude the patient from moving about (*ambulatory plague*). At times also, a bubo suppurates; but more commonly these swellings disperse in about fourteen days. The buboes are clearly distinguishable from the chronic glandular swellings observed in persons of a scrofulous tendency, or affected with any special diathesis. Cases of abortive plague were recorded in the greater number of the recent outbreaks of the disease of which we have detailed accounts, and were particularly observed preceding and following the outbreak in Mesopotamia in 1873–77, and preceding the outbreak in the province of Astrakhan in 1878–79. It is questionable whether this form of the disease, unaccompanied by any marked febrile disturbance, is infectious.

2. **Plague in its usual form.**—The onset and progress of plague differ much in different cases, and at different periods of an epidemic. Most frequently, after a brief time of lassitude, aching in the limbs and loins (sometimes a very painful aching), and shiverings, a febrile state commences; and concurrently with this, or from the second to the fourth day of its duration, buboes appear in the groins, the armpits, or beneath the angle of the jaw. The febrile state is usually acute, and accompanied with much, often severe, headache, and delirium or stupor; the face being flushed; the eyes red and turbid; the skin hot; the tongue black, dry and fissured, or coated as with cotton wool, or pointed at the tip, with red edges and thickly furred in the centre; the teeth and gums covered with sordes; and the thirst intense. The swelling of the glands increases, and is accompanied by much, sometimes acute pain; and if the patient have lived on, suppuration may take place about the seventh day, at which time, if not earlier, carbuncles or boils may appear. Of these symptoms, or groups of symptoms, it may be noted more particularly, that the disease is sometimes ushered in by vertigo, or convulsive tremor, or a peculiar, absent, 'lost' state, when the patient, if he be seized from home, will be observed to make his way thither in a quasi-automatic fashion, with a strange staggering gait; or else the patient, whilst going about his ordinary avocations, is seen to become distracted, as if impressed with some indefinable fear, which prompts him, if away from his house, to rush wildly through the streets until he reaches it, and then throw himself on the bed in a state of extreme restlessness; while, in the gravest cases, the patient is attacked at the same period with vomiting of blood and a high febrile state. Cabiadis describes cases ushered in by a *prolonged regular shake*, which persists from six hours to three days, the temperature of the body remaining nearly normal, and the patient not complaining of cold. This *shake* was invariably followed by coma, during which the patient sank rapidly. The pulse, in the febrile state, runs quickly up to 100–130; and the temperature of the body to 102–104°, and in the acutest cases to 107·6° Fahr. The end of the febrile state is marked by a sudden fall of temperature, the thermometer descending sometimes as low as 93·2° Fahr.; at the same time a profuse perspiration often occurs. Heat in the throat and in the epigastrium (in the latter, as of burning charcoal there) was a not unfrequent complaint of the patients; and at times a sensation likened to being stabbed by a knife in the breast has occurred. Nausea and vomiting of bilious matters were not uncommon (Arnaud); and vomiting of coffee-ground-looking matter was frequent at the beginning of the outbreak of 1873–74 on the river Euphrates. Constipation is the rule in the acute stages of the disease. It is sometimes followed by diarrhœa, which has been regarded as a favourable sign. No noteworthy change appears to have been observed in the urine, either as to general appearance or quantity, unless it were mingled with blood; but Döppner describes its diminution and even suppression in severe cases at Vetlianka. *Hæmorrhages* were observed from the nose, the lungs, the stomach, the bowels, the vagina, and the urethra; and the cases in which they occurred all ended fatally. Occasionally the respiration is much hurried, but Arnaud states that such disturbances of the respiration as he witnessed in Bengazi were of nervous origin—a nervous dyspnœa preceding death. The prostration is extreme in some cases, and in a few instances in which this was observed consciousness was maintained until just before the patient expired.

Of the *local signs*, the appearance of the *buboes* not unfrequently precedes the symptoms of general disturbance. In some cases they are first observed within seven or eight hours after the febrile state has set in; in other and more numerous cases they show themselves on the second, third, and fourth days of the attack, and rarely on the fifth. When the buboes appear first they are sometimes accidentally discovered, the patient having no previous suspicion that he is affected; but more generally their appearance is preceded by pain in the glandular organs, at times sudden in accession, the patient exclaiming he has been stabbed in the groin, armpit, or elsewhere, as the case might be. The enlarged glands forming buboes are rarely numerous, and of a group only one is, as a rule, conspicuously enlarged, sometimes attaining a size equal to a turkey's egg or an orange, while the others are but little enlarged. The swelling at times is very rapid. Suppuration is not often observed in the fatal cases, and so it happened that suppuration came to be regarded by the inhabitants of the localities where plague prevailed as a favourable sign; while on the other hand, 'flattening' or subsidence of the swollen glands in the early days of attack was held as indicative of a fatal result. *Boils* and *carbuncles* occur, but not very frequently. *Petechiæ* are often observed, most usually preceding a fatal issue; at times occurring comparatively early in the progress of the disease. Sometimes they are distributed generally over the body, at other times they are chiefly localised in the vicinity of the enlarged glands. They vary in size from the dimensions of a grain of millet to those of a lentil. They are at times so numerous that the skin assumes a livid hue, and the corpse has a blackened appearance after death. This appearance is so characteristic of the disease, says Cabiadis, that the malady might properly have been called, even in this day, *black-death*.

The plague has a special *physiognomy*, having nothing in common with either typhus or pernicious fever in any of its forms, or with relapsing fever. 'The eyes are retracted within the orbits, but not surrounded with the blue circle which is seen in cholera; the aspect is haggard, but without the fixity seen in typhous cases; the facial muscles are relaxed as other muscles of the patient, and do not present the wrinkles and contractions observed in a patient attacked with typhus or cerebral maladies; the countenance of the plague-stricken expresses apathy' (Castaldi). 'On coming up to a patient suffering from an attack of pernicious fever, you are struck with the gravity of his case and the danger threatening his life. The very reverse of this meets your eye when you see for the first time a case of plague. Even the worst instances of this malady are apt to deceive an inexperienced physician, and make him fancy that the case is free from danger, when in reality the patient has only a few hours to live. The first instance of plague seen by Dr. Cabiadis did not seem to him to be one of an alarming nature. The patient looked stupified, as if intoxicated, and did not answer readily the questions put to him. He vomited blood, and had a small bubo in the right axilla, but the pulse and temperature were normal. The patient died a few hours after Dr. Cabiadis' visit' (E. D. Dickson).

3. **Fulminant Plague.**—Cases to which this term is applied have been observed more particularly at the commencement of plague epidemics, but also during their course and towards their termination. These were cases which were struck down suddenly with illness and died in a few hours, without any of the characteristic indications of the disease—buboes and carbuncles, for example—having shown themselves. The conclusion that they were part of the prevailing epidemic—the infection having overwhelmed at once, as it were, the sufferers—appears justified by the prevalence, at the same time, of an intermediate class of cases, also very quickly ending in death, in which some traces of glandular swellings were observed, with profound disturbance of the nervous centres, convulsion or coma, and rapid formation of vibices and purpuric spots. The cases of the fulminant class which occurred at the beginning of the outbreak on the Lower Euphrates, 1873–74, were chiefly marked by vomiting of blood and setting in of a high febrile state concurrently. The natives had named these cases 'black-vomit' before the actual nature of the disease became apparent (Castaldi).

Máhámari (Pali or Indian plague); *Yunnan Plague.*—The recent descriptions of these forms of plague by Planck, Francis, Rocher, and Baber, do not present any such differences in the character of the disease as above described as to call for a separate account.

THE PLAGUE ON THE VOLGA, 1878–79.—Only one account of this outbreak has come into the hands of the writer from the pen of an actual observer, and it merits a separate notice. It is contained in a report of Dr. Döppner, principal medical officer of the Cossack troops in the province of Astrakhan at the time, and is founded on personal observation of twenty-three cases seen by him when the outbreak was approaching its greatest intensity. His description of the symptoms presents them as forming two groups:—1. Violent headache (forehead and temples), pains in the limbs, slight shivering, followed by high fever, pulse from 100 to 120, sense of burning in the body and eyes, distension of the abdomen, and enlargement of the liver. These symptoms lasted two or three days, and were in favourable cases followed by perspiration and recovery with general debility; but in the greater number, after an interval of two or three days, the fever returned, accompanied by delirium, sleeplessness, restlessness, a temperature of 107·6° Fahr., dryness of tongue, frequent involuntary dejections, urine scanty and reddish. Death usually occurred in the second paroxysm (sometimes, but rarely, after a third) preceded by convulsions and a general prostration of the vital powers.—2. In other cases the patient was attacked suddenly with palpitation of the heart, irregularity of pulse, vomiting, vertigo, oppression of the chest, spitting of clear blood, pallor, an apathetic expression, with dulled eyes and dilated pupils. The patient then remained for two or three hours in a state of extreme feebleness, followed by violent feverishness and delirium, suppression of the urine, and constipation. Maculæ appeared upon the body;

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it exhaled a peculiar odour, something like that of honey; and death supervened in a state of lethargy, with complete prostration of the vital powers.

In neither form of the disease, at this stage of the outbreak, were buboes a conspicuous symptom, and in the latter form they were rarely observed; but buboes (inguinal and other) had characterised a series of non-fatal cases of abortive plague which had preceded the cases described, and during the decline of the outbreak buboes were again observed. Death in the cases described occurred in from twelve hours to three days. Decomposition of the body always set in rapidly.

[Dr. Z. Petresco, of Bucharest, who, under instructions from the Roumanian Government, visited the seat of plague on the Volga, and reached the infected locality early in February 1879, received accounts of the disease from physicians who had witnessed it at Vetlianka subsequent to the period of time to which Dr. Döppner refers (November 17 (29) to December 4 (16) 1878). He states that the predominant symptoms were intense headache, an acute febrile state (very rarely accompanied by delirium), and excessive prostration of vital force—these symptoms forming a 'triade séméiotique pathognomonique de la peste.' He also states that, at the beginning of the outbreak at Vetlianka, cerebral and lymphatico-glandular disturbances were chiefly noted, the latter manifested by submaxillary, axillary, and inguinal buboes; afterwards, at the height of the epidemic, graver indications of disorder of the nervous centres were observed, manifested especially by the headache, vertigo, feverishness, and collapse, the cases at times ending fatally in twelve hours; lastly, during the decline of the epidemic pulmonary disturbance predominated (hæmoptysis with symptoms of catarrhal pneumonia), inducing the medical men to diagnose the malady at this time as a croupal pneumonia, pneumotyphus, or malignant typhus.—February 1880.]

DIAGNOSIS.—'No other idiopathic fever, attacking a multitude of persons at the same time, is characterised by glandular swellings, by carbuncles, and by those severe manifestations of the nervous, sanguineous, and biliary systems which declare themselves in an attack of plague.' —(Cabiadis, according to E. D. Dickson.) As regards *pernicious fever*, with which the disease was confounded by some medical men in Mesopotamia, Cabiadis says no *intermission* has ever been observed in plague; no attack of plague has ever been cut short by the administration of *sulphate of quinine*; and the *expression of countenance* (see above), and *general aspect* of a plague patient are strikingly different from those of a patient affected with pernicious fever. At Vetlianka, intermissions, according to Döppner, were observed.

PROGNOSIS.—'Rapid suppuration of the buboes, even when accompanied with high fever, indicates a favourable termination; all cases complicated with nervous, hæmorrhagic, or bilious manifestations end fatally' (Cabiadis). Colvill is of opinion that the occurrence of diarrhœa in the course of plague, as seen in Mesopotamia, was a favourable sign.

RELAPSES AND SECOND ATTACKS. — Arnaud notes both relapses and second attacks in his account of the Bengazi outbreak, 1873–74.

AGE, DURATION, &c.—Cabiadis and Colvill made an analysis of numerous cases of plague which came under their observation, from which the following particulars are taken in illustration of the foregoing symptoms, and as elucidating other questions.

Age.—Dr. Cabiadis noted the ages of 1,826 cases of plague observed at Hillah, in 1876, with the following result:—

From 2 months to 9 years	277
„ 10 years to 19 „	617
„ 20 „ 29 „	432
„ 30 „ 39 „	292
„ 40 „ 49 „	123
„ 50 „ 59 „	52
„ 60 „ 69 „	18
„ 70 79 „	11
„ 80 „ 89 „	3
An old man of 113(?)„	1
Total	1,826

Buboes and Carbuncles.

	CABIADIS 1,826 cases	COLVILL 402 cases
Buboes:—		
In the Groin	710 „	128 „
„ Axilla	466 „	109 „
„ Neck	98 „	19 „
„ Crural region	— „	2 „
„ Several places	122 „	8 „
„ not recorded	— „	9 „
Carbuncles	36 „	9 „

Other manifestations.—Cabiadis, with respect to the 1,826 cases mentioned above, gives the following numerical statement of the numbers in which noteworthy special symptoms were observed:—

Dependent on the nervous centres	Coma in	28
	Convulsive shake	9
Dependent on the circulatory system.	Petechiæ	120
	Epistaxis	2
	Hæmoptysis	6
	Hæmatemesis	27
	Sanguineous diarrhœa	14
	Menorrhagia	2
Dependent on the assimilative organs.	Bilious vomiting	32
	Bilious diarrhœa	16
	Jaundice	2

Duration.—Colvill shows the duration of 534 fatal cases of plague as follows:—

Days after attack	Number of Deaths
One day	126
Two days	80
Three „	105
Four „	76
Five „	60
Six „	26
Seven „	12
Eight „	14
Ten „	14
Twelve days	9
Sixteen „	1
Twenty „	11

Mortality.—The mortality appears to have differed much in different places and at different periods of an epidemic. Colvill states, of the outbreak of 1874-75 in Mesopotamia, that the mortality in the first half of the epidemic in a village, was from 93 to 95 per cent. of those attacked, but that during the latter half of the epidemic the greater number of the attacked recovered. The mortality in Bagdad throughout the outbreak in 1876 was, he states, 55·7 per cent. of the attacks (cases 4,585, deaths 2,556). Arnaud gives the mortality during the outbreak in Bengazi, 1874, at 39 per cent. of the attacks (cases 533, deaths 208). According to Cabiadis, the mortality at Hillah in 1876 was 52·6 per cent. of the attacks (cases 1,826, deaths 961). Hirsch estimates the mortality at Vetlianka, on the Volga (Astrakhan) at 82 per cent of the attacks (cases 439, deaths 358); and Döppner states that at one period of the outbreak there was a mortality of 100 per cent. (in other words all who were then attacked died), and at another, and later period, of 43 per cent.

Anatomical Characters.—The recent outbreaks of plague have added nothing to our knowledge of the anatomical characters of the disease. The outbreaks occurred under circumstances where anatomical investigation was out of the question. The information existing on this subject was obtained almost solely at the time of the French expedition into Egypt at the close of the last century and the beginning of the present; during the outbreaks of plague in Bessarabia, 1825, and in Moldavia and Wallachia (1828-29); and again in the outbreak of 1834-35 in Egypt. The morbid alterations noted were ecchymoses of the coverings of the nervous centres, of the pericardium, the omentum, and the peritoneum; enlargement and softening of the spleen; punctated extravasations of blood in the mucous membrane of the stomach; ecchymotic spots in the mucous membrane of the intestines; reddish-black injection of the mesenteric glands; extravasation of blood—sometimes considerable—into the cellular tissue about the kidneys, the kidneys themselves being tumefied and presenting extravasation of blood in their tissue and in their pelves. The most constant and characteristic changes were observed in the lymphatic glands. When buboes had been formed, the glands presented manifest signs of inflammatory action in various degrees, as also at times the surrounding cellular tissue, which was, moreover, frequently the seat of bloody extravasations. The glands of the several cavities were more or less involved in or partook of the morbid action conspicuously observed in the buboes; and even where no buboes had formed, indications of considerable changes were found in the internal lymphatic glands. In some instances the affection of the glands would appear to have been general throughout the body; in others it would be limited to one or more of certain groups, in addition to the more superficial groups, as the bronchial, the mediastinal, the mesenteric, the lumbar, &c. The glands, as a rule, were found more or less enlarged, injected, and infiltrated with sanguineous fluid.

Treatment.—(a) *Curative.*—The recent outbreaks of plague have thrown no positive light upon its curative treatment. In Bagdad and Hillah the plan of treatment mainly followed was the internal administration of carbolic acid or of quinine, and the use of leeches and mercurial frictions to the buboes before suppuration. In some instances this plan was thought to have done good, in others it was useless, if not detrimental. In regard to plague, as to other grave general maladies, except those arising from paludal poisoning, curative treatment is at present only possible on general principles, both as regards the systemic and the local symptoms. The practice would appear to be the same in respect to the general symptoms as would guide the physician in the treatment of *typhus*; in respect to the local symptoms, such as would apply to ordinary phlegmon.—(β) *Hygienic.*—In the present state of our knowledge, more importance is perhaps to be attached to the hygienic treatment of the disease than to the curative. Most important of all, perhaps, is the exposure of the patient to abundant, freely changing air; next is the use of cold or tepid sponging, as the temperature of the body and the state of the skin (as well as the sensations of the patient, if he be sensible) may seem to call for; together with the large administration of drinks (acid—?mineral, or other) to combat the thirst, the judicious use of liquid food, and especially of stimulants when the dropping of the pulse, the coolness of the skin, and the ataxic condition of the patient call for them.

Prevention.—The prevention of plague involves two sorts of considerations, the one relating to the removal of the conditions which favour the development of the disease; the other to the limitation of the spread of the disease, the malady existing. (*a*) The conditions favourable to the development of plague have been already enumerated, and include all those insanitary states of houses, their sites and surroundings, which form the subject of public-health administration; also those states of poverty which have to be dealt with, not only as an economic but as a public-health question. Of these several conditions, the three which would seem most to call for special attention in this country, in view of impending plague, whether as regards private individuals or as regards local authorities representing communities, are *over-crowding*, *defective ventilation of houses*, and *impoverishment*. (*b*) In respect to the limitation of the disease, the malady being present, the first and most important consideration is the *isolation* of the patient under such circumstances of aëration as are stated above, as well in the interest of the patient himself as of the community; and the *disinfection* of articles of clothing, or bedding, used by him, and of the room he may have occupied. Local authorities have large powers enabling them to provide beforehand, in a mode available for the use of the whole community, (Public Health Act, 1875, and the Metropolis Management Act, 1858, together with the Sanitary and Poor Law Acts relating to the Metropolis), hospitals for the isolation of cases of infectious diseases, such as plague, and apparatus and materials for disinfection; and many authorities have already exercised these powers. *See* Public Health.

But *plague* is the subject of special measures in this country, as in every country on the Continent and Mediterranean littoral, to wit, measures of *quarantine*. Quarantine aims at preventing both the introduction of the disease into a country, and the spread of the disease, if by accident it should happen to have been introduced, by the isolation for a longer or shorter period, not only of persons *sick* of plague, but, in addition, of *all healthy persons* who may have been exposed, directly or indirectly, to the infection of plague; also by the isolation and disinfection of articles, described under the quarantine law, as susceptible of conveying plague-infection, coming from an infected district. Experience has shown that measures of quarantine against infectious disease are futile, if not impracticable for this country, from the impossibility of closing all channels of introduction, in consequence of the activity and magnitude of our commerce. But quarantine is retained in regard to plague and yellow fever, and has occasionally to be made use of to meet the requirements of other nations, who, failing the adoption of this system here, would be likely to impose disabilities on our shipping with reference to the diseases named. Thus quarantine was revived in respect to plague, at the time of the recent alarm of the disease on the Continent. The doctrine of plague upon which the English Quarantine Act of 1825 is based, as well as the laws of foreign countries relating to the subject, is a traditional one, inconsistent in many respects with the later and more accurate observations which have been made on the mode of spread of the disease.

J. Netten Radcliffe.

PLESSER PLESSOR (πλήσσω, I strike).—A hammer-like instrument used in percussion, for striking the surface of the body, either directly or indirectly. *See* Physical Examination.

PLESSIMETER PLEXIMETER (πλήσσω, I strike, and μέτρον, a measure).—A flat instrument used in mediate percussion, by being applied to the surface of the body to receive the stroke of the plessor. *See* Physical Examination.

PLETHORA (πλήθω, I fill).—Fulness of blood. A condition in which the vessels of the body generally, or of any part, are over-distended with blood. *See* Blood, Morbid Conditions of; and Circulation, Disorders of.

PLEURA, Diseases of.—The serous membrane which lines each cavity of the chest, and is so reflected as to cover the lung, is not unfrequently the seat of disease. As in its anatomical and physiological relations, so also in its diseases, it presents analogies to the lining membrane of a joint. Its diseases may be of external or of internal causation. They may be considered under the following headings.

1. Pleura, Injuries of.—These may be caused in several ways: (1) by violent blows upon the chest, and in this case there is usually at the same time an injury to the lung-tissue, the effects of which to some extent overshadow the pleural lesion and its results; (2) by direct wounds with a knife or blunter instrument, or a bullet; and (3) by fractured ribs. In each case inflammation of the pleura may occur. With the surgical aspect of these cases we here have no concern, and the pleural consequences may be sufficiently gathered from the following paragraphs.

2. Pleura, Inflammation of. — Synon.:— Pleurisy; Fr. *Pleurésie*; Ger. *Pleuritis*.

Definition.—Pleurisy is defined as an inflammation of the pleura, of whatever nature and extent. Clinically and pathologically, pleurisy differs only in its accidents from inflammation of serous membranes elsewhere, and is the most common of the serous inflammations.

Ætiology.—The causes of pleurisy, if local, may be obvious enough; if general, not so obvious. Of local causes the chief are wounds or bruises of the chest-wall; fracture of the ribs; caries of the spine; escape of irritating matter into the pleural cavity, whether from the costal side, as in periostitis or osteitis, from the pulmonary side, as in phthisical excavation, from disease of the bronchial glands, or from the side of the abdomen, as in gallstone, hydatid, subphrenic abscess and the like. Foreign bodies, again, such as bones or coins from the œsophagus or larynx, have been known to find their way into the pleural cavity, and thus set up mischief. Acute pleurisy, the result of local causes, is usually more or less proportioned to these in its severity and duration; pleurisy of general or systemic causation, on the other hand, though less regular in its career than pneumonia, has yet a certain character of uniformity. The general or systemic causes of this form of pleurisy are very obscure, and none of them are accurately known. There are some grounds for suspecting that a chill alone may be a cause of acute pleurisy; but more probably we have to learn that chill must be associated with other factors. A rheumatic or gouty habit is suspected to be a disposing condition by many, and probably with good reason. The depression of overwork or harass, the debility of former illness or of convalescence, and the poison of malaria are among the more common disposing causes. Acute pleurisy again often occurs as a part, or as a complication, of other diseases. Thus it is rarely absent in acute pneumonia; and it occurs, as cardiac valvulitis and pericarditis occur, in acute rheumatism, but less frequently. Acute pleurisy following scarlatina is probably dependent upon a rheumatic or nephritic sequel; if it arises otherwise in the malady the pleurisy is more often of the profuser kind and tends quickly to empyema. Pleurisy arises sometimes after measles, when it is probably due to pneumonic irritation. It is also a common consequence of diseases of the kidney, in which maladies hydrothorax may be simply dropsical or the product of pleuritis. In septicæmia and in pyæmia, again, a low pyogenic pleurisy often arises as like effusions arise in the joints, and may be equally or more latent; or it may be caused by the rupture of a pyæmic abscess of the lung into the pleural cavity.[1] Acute pleurisy, when 'idiopathic,' is more often on the left side (3 to 2) and is rarely bilateral. When due to more specific causes, such as acute rheumatism or nephritis, it is often bilateral, though rarely of equal severity on the two sides. Acute pleurisy is common at all ages; it is recorded often within the first six months of life; in babies it is readily overlooked unless there be abundant effusion, and not rarely even then. In children the symptoms are often very latent, neither cough nor pain is manifest, and there is little displacement of viscera; yet it is really more common under one year than between the ages of two and five years. At the age of five it is frequent, but it reaches its maximum frequency in middle life (æt. 35–45). The younger the child the more readily the effusion becomes purulent, and in such cases the mischief often extends to the pericardium. Cases of simple inflammatory pleurisy have been recorded in persons beyond threescore years of age; but in aged persons it is rare, and presents little reaction or pain. The male sex is more often affected than the female, in the ratio of about seven to five, the difference being probably due to the class of cases which owe their origin to weather. It does not appear, however, that pleurisy varies in prevalence with the change of the season. Pleurisy, under one form or other, is credited with about 2 per cent. of the deaths in England, and with about 1 per cent. of the deaths of patients in public hospitals.

Anatomical Characters.—The morbid anatomy of pleurisies differs but little from that of serous inflammations elsewhere. The costal membrane generally suffers the sooner and the more severely. The vessels become injected and even yield in places, giving rise to small irregular ecchymoses. Effusion of a sero-fibrinous and proliferative kind quickly infiltrates the tissue, and the natural gloss of the membrane gives place to opacity. The superficial epithelium also strips off and papillæ appear, at first isolated, but soon communicating together by networks of vascular formation. At this point all may clear up, or effusion may escape from the surface. In dry pleurisy the products are chiefly new-tissue elements, without much interstitial effusion. In active cases the effusion is not very voluminous, but is very rich in fibrin; and false-membrane, often of great thickness, forms upon the pleura, and sits tightly. Some of this loose or adherent gluey effusion degenerates, and is absorbed on resolution; some of it organises, and forms more permanent false-membrane or bands of connection and adhesion. Into these enter blood-vessels, elastic fibre, lymph-channels and even nerves (Virchow). Clots of fibrin float freely and abundantly in the effused serum, and contain a great abundance of imprisoned cells. In the fluid itself the cells are fewer, clear, granular or multinuclear. The more of these cells the greater the fear of a purulent transformation. There are also found abundant free nuclei and a quantity of red blood-corpuscles, varying with the vascularity of the new growths. If the exudation be less actively inflammatory and more serous, it is also more abundant, and may amount to 100–150 ounces. It is less disposed to form firm membranes or adhesions. This fluid is of a greenish straw-colour, like synovia, and is thin, with flocculent lymph in it. It partially coagulates when exposed to the air, and is found to contain more degenerated cell-elements, tending towards a sero-purulent character. In scurvy, tuberculosis, carcinoma and other cachexias, and even in rare cases of simple pleurisy, the effusions may be highly sanguineous, and blood may be found alike in the coagula, in the free and in the attached false-membranes.

When the contents of the pleura are purulent, much of the new membrane has broken up, though even here false membranes are far from being absent, and fibrinous clots are at times discovered. In cases of large effusion the lung is found compressed, and often bound down by false-membranes extending from the walls of the cavity. In adults the lung is usually found in the vertebra-scapular space, being thrust upwards, inwards, and backwards. It may be compressed from one-quarter to one-eighth of its normal volume; is flattened, leathery, bloodless, and airless; and will sink in water. As the pressure subsides the lung may, and generally does, recover more or less of its former volume. It is surprising to see how successfully re-expansion may take place in spite of false-membranes, bands, and prolonged compression. Nevertheless either complete or partial adhesions or bands of connective tissue generally remain indefinitely after acute pleurisy; and happily for the most part do little harm. If the lung fail to re-expand to any extent, its deficiency is made up by the inward pressure, partly of neighbouring soft parts, and partly of the chest-wall. Pleuritic adhesions are very commonly found after death from other diseases, the origin of them being unknown or forgotten. On the other hand, false membranes and bands may become the seat of degenerative processes; and pus, cretified pus, tubercle and the like may be found in them, with or without secondary abscesses elsewhere. A pleural cavity which has thus suffered is more liable to subsequent inflammations. The compressed lung in like manner is liable to become the seat of degenerative disease, and in empyema the contact of pus promotes ulcerative and septic changes in the lung, as it does likewise in the vertebræ, ribs, and other neighbouring parts. In this way the pus, finding for itself a passage in the direction of least resistance, pierces through lung or thorax, and establishes a pulmonary or costal fistula. Sometimes the pulmonary fistula is a simple one, and communicates at once by a free or a valvular opening with a bronchial tube, or may have so communicated by an opening afterwards closed; at other times the pus finds a less direct route, and either by a transference like filtration, or by way of a number of lesser ulcerating channels, it reaches the more open passages of the lung.

Subpleural ecchymoses, though often accompanying evidences of inflammation, are not always caused by pleurisies. They occur in deaths of children after broncho-pneumonia and diphtheria, but there is usually a patch of pleuritic inflammation upon and co-extensive with them. They are not uncommonly found in other deaths also, but are probably always associated with obstruction to the entrance of air into the lung.

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[1] The origin of the pleurisy which may accompany puerperal and other diffuse peritonitis is explained by Von Recklinghausen's demonstration of lymph-canals between the diaphragm and the pleura; and its supervention in cases of abscess of the liver may receive a like explanation. Reversely septic pleurisies spread themselves sometimes from the pleural to the peritoneal cavity.

In all cases the position of the heart and other viscera must be observed, and the chambers of the heart, the pulmonary veins, and other vessels examined for clots. In empyema a careful examination of the body for secondary abscesses must be made, not forgetting the brain.

CLINICAL CHARACTERS AND VARIETIES. — Pleurisy may be conveniently divided into kinds, according to certain pathological and clinical differences, as follows:—(α) *Dry*; (β) *Acute*; (γ) *Diaphragmatic*; (δ) *Quiet, with large effusion*; (ε) *Tubercular*; (ζ) *Fibroid.* Each of these requires separate consideration.

(α) *Dry Pleurisy.*—This is so called because it is attended with no effusion, or with effusion so slight as to escape notice. Usually, if not always, it results in an adhesion of the opposite surfaces of the membrane. It may not be revealed by any sign or symptom during life. Adhesions, more or less extensive, due to this process, are very often found after death. Dry pleurisy may occur alone, or as a complication of irritative changes in neighbouring tissues, as in the lung or chest-wall. Pain or pyrexia, more or less fugitive, may accompany dry pleurisy, but in many cases if present they pass unnoticed. Should attention be drawn to the chest, friction may generally be detected. An obscure pain in the chest or loin, or a frequent teasing dry cough, may at times be traced by the close observer to a patch of dry pleurisy in some part of the chest. A friction-sound due to such a patch may be transient, or may be audible for many weeks. Recovery follows adhesion. It is supposed that some of the pains in the chest which accompany phthisis are due to the intercurrence of dry pleurisy; probably, however, they are as frequently myalgic or neuralgic. Dry pleurisy, with its resulting adhesions, is rarely injurious. Indeed, it is rather a safeguard when any destructive process, such as phthisical ulceration, threatens to bore into the pleural cavity. If it fail, and morbid matters escape into the cavity, acute pleurisy is the probable consequence. Dry pleurisy often ends in but slight thickening, the two pleural surfaces adhering without much increase of substance. In other cases the thickening may be considerable, but this probably indicates some more persistent irritation, such as we find, for example, in those dense coverings which often surround the apex of a lung in chronic phthisis. The remoter consequences of dry pleurisy are for the most part without importance. In some instances it may limit the chest-movements, or, more rarely still, may so tie the parts as to cause abiding pains, described as dragging or tightening. Such pains are usually referred to the sub-axillary or sub-mammary regions, and may be really annoying. More often they do harm by ministering to needless fears. It is said that in rare cases hypertrophy of the heart has resulted from the embarrassment of its action by pleural bands. Dr. Bowditch tells the writer that he has seen this twice at least. It is useless to prescribe treatment for a disease which escapes observation, or is but a secondary event in the course of more serious processes. Where dry pleurisy is found, and is doing harm by exciting cough or otherwise, the best practice is to place several light blisters in succession over the affected part.

(β) *Acute pleurisy.*—Acute pleurisy, though less serious than chronic dropsical pleurisy, is far more serious than dry pleurisy, and generally appears as an important illness. It sets in with fever, pain, embarrassment of the breathing and cough, sometimes catarrhal, mostly reflex. These symptoms bear no certain proportion to each other. The fever has no very characteristic type, but is rather what is known as a symptomatic pyrexia. Thus there is not a sharp rigor of onset, as in pleuro-pneumonia, but there is often a succession of chills. Nor are there any very definite stages of increment and acme, but rather a daily fluctuation of remittent, more rarely of intermittent type, with evening rise, the elevations not often reaching and rarely exceeding 40° C. (104° F.) At first the arterial tension is high, the pulse being small and hard; after the first onset the tension falls, and the pulse becomes dicrotic. As the effusion reaches its height the fever in acute pleurisy gradually recedes, unless the case approaches to the form δ, when the effusion is indeterminate, and the fever may subside, may fluctuate, or may drift into hectic. The pain is often very characteristic, but at other times is variable, and even delusive. Most commonly it appears as a stitch in the side, about the level of the false ribs, which is intensified by inspiration and cough. The deep breath when partly drawn is cut short, as if with a stab, while the face of the patient is wrung with an expression of sudden distress. Such inspirations are, however, instinctively avoided, and may have to be called for by the physician, so that the face may speak rather of apprehended than of actual suffering; in either case the expression is a telling one to the practised observer. The fixed alæ nasi, which are dilated but do not oscillate, as in some other kinds of dyspnœa, the parted lips, the bright eye of fresh fever, the cheeks flushed, but not congested as in pleuropneumonia, the preoccupied and apprehensive expression, the posture semi-erect, slightly bent forward and toward the affected side, the shallow breathing, the fixed chest, the hand on the side, the curt speech, the stifled cough, make up a clinical picture often seen, and easy of recognition. It is a curious fact that these symptoms of distress are generally more marked in a robust patient, or one previously healthy, than in the ailing, weakly or cachectic. The pain, however, may wander from the lateral or ante-lateral aspect of the lower ribs, and appear in the hypochondrium, or even on the opposite side. At other times it may become more diffused, and play upon the brachial plexus, darting from the clavicular and scapular districts to the upper chest, shoulder or arm. This is, perhaps, more common in the diaphragmatic variety (γ). In some bad cases, in which pus forms from the beginning or almost from the beginning, the pain is very distressing and prolonged, and the rigor very strong. Whatever be the treatment, we look for some relief of pain, cough and conscious dyspnœa on the third or fourth day.[1] The respirations, however, may still range above the normal rate, from the mechanical interference of increasing effusion, or of this increase combined with œdema of the open parts of the embarrassed lung, and perhaps of its overworked fellow. About the end of the week, be it more or less, the pleurisy has run its course, and the effusion has, in favourable cases, attained its maximum; the urinary, gastric, and other glands regain their normal activity; and convalescence, with absorption of the exudations, is to be looked for. Thus far, then, the disease is painful rather than dangerous, death in the first week of ordinary acute pleurisy being practically out of the question.[2] By certain signs in the chest we know the height to which the fluid has flowed in the cavity, and we await its ebb. Usually, in a day or two, some fall is noted, and in favourable cases this ebb runs quickly at first, and afterwards more slowly as the products become denser. Some remnant is usually to be detected after the patient is about; and months, or even years, may elapse before the parts become normally clear. Indeed, the signs of an old pleurisy may be carried to the grave. Likely as is this favourable result in strong persons, yet it is not to be too lightly promised even to these. Too often when we are awaiting the ebb we find a new flood, the level of the fluid rises into the upper chest, and the patient, who hitherto has lain on the sound side to avoid pain, now turns on the affected side to give full play to the open lung. This flow may recur with or without renewed fever, but is generally attended with a proportionate increase of pulse-rate, and diminution of pulse in volume and tension. Coincident with the diminution of arterial tension, which in its turn is due to the pulmonary obstruction, is a diminution of the urine, which, probably, had become more abundant as the fever ceased. That the changes, both of pulse and urine, depend upon the effusion, is shown by the rapid recovery of both when fluid is artificially let out from the pleura: the pulse then falls in rate and increases in tone under the finger, and the urine soon becomes more abundant. A little albumen is sometimes present during the time of pulmonary obstruction. Under ordinary circumstances a renewed flow of urine may be indicative of pleural re-absorption, or the case may pass on into the form γ, or into an empyema. Neither event is common, however, except as a consequence of neglect, the symptoms preceding these events being generally of a quieter character. It is hard to tell when the full chest contains *serum*, and when *pus*. Marked hectic may exist with serum, but if this be associated with increased temperature of the affected side, with change of countenance, loss of appetite, wasting of flesh, failure of strength, thrush, diarrhœa, or with any of them, and the more if there be any inherent constitutional frailty, or a septic element present, we must fear that the fluid is turning to pus. In the later weeks or months of an acute pleurisy which has not ended in resolution, death may threaten and may not be averted. In some cases, as after scarlatina, the effusion may be purulent from the beginning, and a fatal result may be feared even in the earlier days of the malady. Under ordinary circumstances, however, in healthy persons who have been carefully treated from the outset, and who have not been exposed to septic or malarious influences, we expect to have to deal with effusions moderate in quantity and stable in quality. The effusion in such cases rarely remains at its height more than two or three days; and in three weeks at farthest absorption should be tolerably complete. In other cases, fortunately rare, acute pleurisy, with remittent fever, continues for many weeks. Effusion in these cases may not be very rapid, but recurs gradually after the removal of moderate quantities; or it may be so moderate, indeed, as scarcely to need removal. The signs are simply those of acute pleurisy, but resolution does not take place, or is indefinitely deferred. Death may result in such cases, or the patient may slowly recover. After death are found evidences of active simple inflammation, partial or complete obliteration of the lung, and sero-fibrinous exudation. The other side, and the rest of the body, may be quite healthy. The name *relapsing pleurisy* might be given to these cases. When inflammation falls upon both pleuræ, it generally falls also upon the pericardium, and such cases are terribly dangerous. Even if moderate in degree in each, yet taken together the embarrassment of the patient becomes very grave, and death imminently threatens. It is important to give relief by puncture as early as possible.

(γ) *Diaphragmatic pleurisy.*—Diaphragmatic pleurisy is not essentially different from the preceding, but the symptoms are peculiar.[1] If the inflammation be, as it may be, exclusively diaphragmatic, and not costo-pulmonary, then the ordinary physical signs of pleurisy with effusion are either absent, or so ill-marked as to puzzle the inexperienced practitioner. In diaphragmatic pleurisy the patient is taken as acutely as in ordinary pleurisy, or the fever may even be higher; but his distress is different, greater, and more serious. The practitioner is surprised and perplexed to find a person, in whom he can discover no important organic defect, in an agony almost mortal. The presence of pain shooting from the lower ribs of one side suggests pleurisy; but the ribs of both sides play with perhaps more than normal freedom, and no physical signs are audible, unless it be that the practised ear may detect a want of breath-murmur at the base of one lung, and, after the first day or two. it may be, two finger-breadths of dulness there. Still no friction may be heard, and it seems impossible at first sight to credit signs so slight with clinical phenomena so alarming. For the patient is as one having a clot in the heart, or a sudden perforation of the pleura, so terrible and so absorbing is the strife for inspirations which never satisfy, so keen the dread of any handling which may interfere with the one permanent need of sitting erect, and of keeping every respiratory muscle in full play. These inspirations may range from forty to fifty in the minute, or may even run with the seconds, except only when cut by a hiccup or a heaving of the stomach. To this are added the suffering of pain which shoots through the waist to the back, or darts round the shoulder-blade and collar into the shoulder, and an impending sense of dissolution. The fever is perhaps not actually higher than in ordinary acute pleurisy, and the normal character of the heart-sounds gives great confidence to the physician. Abdominal breathing, however, rather than thoracic is instinctively lessened, and any pressure upwards upon the diaphragm is resented. All these things finally lead to the conclusion that acute inflammation has partially attacked and so far paralysed the diaphragm, without extending far upon the pleura above; and the diagnosis is of course the easier if pleurisy is discovered elsewhere in the chest. A patient thus attacked seems to be in no little danger, but recovery may be anticipated. Fortunately the malady is far less common than ordinary pleurisy, and indeed may be called rare. As stated above, however, inflammation of the diaphragm may complicate ordinary pleurisy, and introduce both the pains in the brachial plexus, and the excessive and paroxysmal dyspnœa.

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[1] Writers are not yet agreed whether there be any local elevation of temperature in the affected side or not. Still less can it be said whether such local temperature runs any definite course of change.

[2] Malignant cases are related of pleurisy, in which the temperature remains at 40° or 41° C. (104°, 105·4° F.), the pulse reaches 140, the tongue becomes dry and brown and prostration excessive, and the exudation runs promptly to pus. Such cases are rare, except as complications of septic and other diseases, and they are almost surely fatal, even after free evacuation of pus by incision.

[1] Wintrich is indisposed to admit that the symptoms of diaphragmatic pleurisy are as characteristic as herein described. Diaphragmatic pleurisy may perhaps exist without setting up such marked and special symptoms.

(5) *Quiet pleurisy with effusion.*—This form of pleurisy is commonly said to be the sequel of acute pleurisy; but if we except a few cases in which pleurisy, at first sthenic, afterwards follows the asthenic tendencies of the patient, and those in which acute pleurisy has been treated with neglect, we shall find that in the large majority of the remainder this form begins not sharply but quietly, and indeed is often unnoticed until the chest is laden with fluid. If the patient suffered pain it was too slight or too indefinite to ensure attention; the low fever, unmeasured by the thermometer, escaped observation; the chest, slowly invaded, accommodated itself to circumstances until the fluid had nearly filled the cavity; and even then the patient may be brought to the doctor only by a sense of dyspnœa on ascending hills or stairs. A quick eye may detect in him an expansion of the alæ nasi; or, indeed, may see that the patient—almost unknown to himself—is breathing at double, or nearly double, the normal rate; or, again, a sensitive patient and a vigilant physician may fully perceive the remittent—almost intermittent—fever, the indefinite pain and the encroaching effusion, and may lessen the evil by timely interference. As a rule, where effusion is large the patient lies on the affected side, thereby escaping the pressure of the fluid upon the mediastinum, and enabling the sound lung to have free play. This decubitus is not, however, invariable, and is avoided if the affected side be painful. With pyogenic change in the effusion the patient may turn off the affected side, as this change sometimes is accompanied by a renewal of tenderness to pressure. When the effusion has come on very gradually, the patient may be able even to lie on either side indifferently. In a few cases a large pleural effusion may cause some difficulty of swallowing, but this is rare. Let the reader then remember that pleurisy running to large serous effusion not only may be, but generally is, quiet; and not only may be, but not uncommonly is overlooked until matters come to an extremity. In like manner, if the effusion be purulent its accumulation may be equally rapid or equally silent; being silent when it is the further change of a serous effusion, being silent and rapid when it comes as pus almost, if not quite, from the outset, as in septic and infectious diseases, and in children. If acute pleurisy drifts into chronic pleurisy, the fever, which may have vanished for a time, lights up again fitfully, and fresh brushes of inflammation take place in the pleura and in the new membranes. With this there are also renewed outpourings of serum, and these sometimes increase so rapidly as to put the patient in imminent danger of death by syncope. The fever in these stages is often hectic in character, so that the presence of hectic alone does not prove the effusion to be purulent. Quiet dropsical pleurisy is very uncertain in duration. Should the effusion be not excessive, and remain serous, months may elapse—nay, even years—before it is absorbed; and the absorption may be gradual, or may be deferred for awhile, and then completed more quickly. It is needless to say that even so favourable a result as this cannot do away with the injury which the chest must suffer from being water-logged for so long a time. Very frequently, however, the effusion becomes sero-purulent or purulent; and if left to itself finds an exit gradually by many little ulcerated spots through the filtering lung, and so is gradually expectorated; or by an opening into a bronchial tube, rushes with a sudden and copious discharge into the mouth. The expectoration in the former case is usually profuse, inoffensive, and muco-purulent; in the latter, the gush of pure and often stinking pus is sometimes so great and so sudden as to swamp the lungs and threaten suffocation, especially if it occur during sleep. In either case we have to deal with a subsequent pyopneumothorax, which, if left to itself, will probably end in death by slow hectic and marasmus. The issue is more promising if the pus find its way outwards between the ribs, and this it may do by a direct opening or a sinuous opening; or it may gather between the ribs and skin, forming there a large superficial abscess—'*empyema necessitatis,*' the tension of which varies with respiration and increases with cough, and these of course more or less readily as the communication is more or less direct. These changes in tension aid in distinguishing such issues from the pleural cavity and local abscesses of the chest-walls. In these cases, however, the chest is imperfectly emptied; septic poisoning is but partially prevented; and a lingering illness is only to be

cut short by operation. Again, the pus may find its way into the opposite pleura, thus doubling the empyema, and such cases have recovered; or into the pericardial or peritoneal cavities, though such terrible events are fortunately rare; or it may burrow between the tissues and appear at distant places, and thus may mimic psoas or other sinuous abscess. A cure of empyema by resorption is said to be possible, but the possibility must be a bare one.

In some cases the fluid may rise in twenty-four hours from the angle of the scapula to the clavicle—an obliteration of breathing space far more terrible in its rapidity than a more gradual one to which the system slowly adapts itself. This affection has no definite course, for absorption is difficult, and so far as it occurs is too often compensated by renewed febrile movements, with renewed effusions. The lower character of the new-formations, their lack of vessels, and the compression of those which exist, hinder such absorption as may be possible in weakly persons. The fluid sooner or later becomes purulent, and makes for itself an outlet.

(ε) *Tubercular Pleurisy.*—In considering the relations of pleurisy to tubercle we have to deal with four classes of cases:—1. Those in which one or more attacks of pleurisy, not apparently itself tubercular, have preceded phthisis. 2. Those in which tubercle arises in the exudations of a pleurisy thitherto simply inflammatory. 3. Those in which pleurisies spring up here and there in the course of pulmonary phthisis. 4. Those in which the pleurisy is tubercular in its origin and development.

These states will be best considered reversely, beginning with the last. True tubercular pleurisy is not uncommon, but, apart from tubercle in other parts, rarely or never destroys life, and, being a part of general tuberculosis, is not therefore found alone upon the *post-mortem* table. Tubercle, however, sometimes betrays its presence in the pleura before it manifests itself elsewhere, so that the occurrence of pleurisy without definite cause in a delicate person should always excite suspicion, and this the more if patches of inflammation spring up here and there in the membranes of the two sides without much resulting effusion. For the fluxion of tubercles is rarely sufficient in degree or kind to produce much effusion. No great difficulty arises in deciding upon the nature of those intercurrent pleurisies which are coincident with, and so often caused by, pulmonary phthisis in the neighbourhood. These very commonly are not tubercular in a strict sense. More difficulty will be found in foreseeing or detecting the birth of tubercle in the false membrane of a pleurisy apparently simple. Tuberculous pleurisies of this second class are not uncommonly met with in practice, and followed to the *post-mortem* table. A pleurisy, severe or not, but seemingly of simple nature, progresses towards recovery, and perhaps, indeed, reaches apparent recovery. The temperature, however, if it has fallen, fitfully rises again and the pulse quickens, yet without much evidence of empyema or of any returning effusion. Presently a patch of pleurisy on the other side, or a sign of mischief at the apex of a lung, betrays the character of the relapse. These cases end as more or less generalised tuberculosis, and in the old false-membranes are found the caseous or softened residue of the first crop. Most difficult of forecast are the pleurisies of the first class, which, however painful or profuse, end in recovery which seems complete. The patient, who has returned to the labours and delights of life, begins, however, to be hectic and to cough shortly and drily; signs of phthisis are detected in the lung; and the end comes in the too familiar way. There is little more to be said under this head, but to urge the physician to look upon all pleurisies jealously, and to regard with positive anxiety all pleurisies, however frank they may seem, or however happy in their resolution, which arise in delicate subjects, or in the members of families tainted with consumption.

(ζ) *Fibroid Pleurisy.*—Sometimes as a primary affection, but more often as an ultimate consequence of ordinary or of latent pleurisy, the membrane slowly thickens, and allying itself with a like irritation of the connective elements of the lung, increases at the expense of the proper tissue of the lung, and gradually contracting after its kind, stifles and destroys a great part of that organ. Fibroid pleurisy generally begins at the base of the lung, and the pulmonary membrane may increase until it forms a dense leathery covering of perhaps one-third of an inch in thickness. The disease is very chronic, and as the irritative overgrowth of the connective elements slowly advances into the lung, and is chiefly important as affecting the lung, little more need be said about it in this place. Fortunately the affection is rare, and it has not therefore received the attention it deserves. Commonly it ends in fibroid pneumonia. Cough and dyspnœa, abiding dulness on percussion, with lack of expansion, symptoms of pulmonary irritation and bronchiectasis, all following a known attack of pleurisy, should excite suspicion of fibroid hyperplasia. The causes of this abiding irritation are very obscure; the abuse of alcohol seems to be among them.

Pleurisy may be attended with other peculiar features of not sufficient importance to justify its division into further varieties. For instance, it may be attended with *hæmorrhagic exudation*—that is, with exudation mixed with more or less blood. These cases, though sometimes very acute, are usually chronic; and the hæmorrhage depends on bleeding of the new vascular tissues, which partake of some further abnormal state of the patient, such as scurvy, carcinoma, or even phthisis.

PHYSICAL SIGNS.—These are to be detected by the usual methods. Throughout the stages of the disease *inspection* will tell us that the movements of the affected side are lessened either by the warning of pain indirectly, or directly by effusion which stops the play of the lung. This diminution of movement is often to be noted also in the abdomen on the same side, especially in diaphragmatic pleurisy. If the effusion greatly increase, the chest may or may not be seen to bulge beyond its true lines; the intercostal spaces are usually flattened up to the level of the ribs, and the form of the affected moiety of the chest becomes more cylindrical, as is best shown by the cyrtometer. The diaphragm may be so thrust down and forward as to cause a fulness in the epigastrium; in large effusions there may be bulging even of the supraclavicular space; and the outline of the affected side measured in the transverse submammary line will usually measure more than on the healthy side. Half-an-inch is an important difference, seeing that the other and healthy side in overwork expands in a young adult about half-an-inch or more beyond the normal, and falls again as the compressed lung expands after paracentesis. In recent effusions the skin is often obviously stretched. Œdema of the skin on the affected side may be present, and, though not decisive of pus, is less common in serous effusions. Though confined to the affected side, it sometimes extends far beyond the chest-wall. The state of the veins of the neck must also be noted, and of those upon the chest, as much enlargement of these would suggest intrathoracic tumour rather than fluid, as in like manner would inequality of the pupils, or other evidence of solid pressure within. Clubbing of the fingers may be seen in old cases of pleuritic effusion not necessarily phthisical. The presence or absence of a heart-beat, and its position if present, must be noted. If fluid be in the left chest a diffused pulsation in a tumid epigastrium often replaces the proper apex-beat, or the heart-beat may be felt or heard towards the right breast; if in the right chest this beat may be detected towards or upon the left axillary line. In some cases of limited but complete dulness in the anterior and inferior region of the left chest, it may be difficult to decide between fluid and pleuro-diaphragmatic adhesions. In the latter case tapping might be attended with some risk of perforating the diaphragm. M. Jaccoud says the distinction may be made in some cases of adhesion by observing traction upon the lower ribs and spaces in forced breathing, so that the spaces are drawn in on inspiration, and the ribs drawn towards the median line. But puncture in so dangerous a situation could never be desired. In some rare cases of empyema the whole of the affected side so pulsates as to simulate a large aneurism, a phenomenon which has not yet received a satisfactory explanation. Finally, in large effusions there is often some prominence in the hypochondrium of the same side; the nipple drifts farther from the sternum, and the shoulder-blade is thrust somewhat out and away from the spine. All these displacements and changes of shape are of course more readily brought about in young subjects, and in women more readily than in men. In children, also, we find proportionately less visceral displacement. The female diaphragm is more readily depressed than the male, and the right side of it more readily than the left. In neglected cases absorptive and atrophic changes tend to bring about a retraction of the affected side, the thoracic and intercostal muscles wasting, and the ribs falling together, with corresponding flexure of the spine, and great elevation of the heart or liver. Such a deformity may, indeed, be permanent if the lung be obliterated; happily this is not generally the case.

Palpation will help us to find the heart's beat; and to ascertain if the liver or the spleen be displaced. By the hand we may sometimes detect the creaking of friction; and we may verify the imperfect expansion of the side or abdomen, the levelling of the intercostal spaces up to the ribs, and possibly make out fluctuation in the former. The most distinctive sign to the hand, however, is the loss of the vocal thrill, which is arrested by fluid effusion. This is normally more distinct over the lower two-thirds of the chest. Here effusions usually first accumulate, and loss of this thrill is almost pathognomonic of them; for it occurs besides only with those intrathoracic growths which by their size or position close the bronchial tubes. Unfortunately sometimes, when most wanted, the voice fails to awaken a thrill in normal parts. Sometimes the limits of the thrill may give a gauge of the height of the effusion. Above the limits of the effusion the thrill is often more distinct than it is over the corresponding part of the sound lung. It must be remembered if compressed lung lie between the hand and fluid, that the vocal fremitus is none the less diminished.

Percussion of course reveals to us a higher or duller note over the whole extent of the fluid. But it cannot always tell us the amount of fluid present, as the level of this depends on the state of the lung, and of intrathoracic tension. Moreover, during absorption dulness depending upon thick false-membranes cannot be easily distinguished from that due to fluid. Such membranes may diminish vocal fremitus also. When fluid is present in quantity the note struck is dull, as if struck upon the thigh, and the stricken finger receives a peculiar sense of dead opposition, owing to the loss of resilience or vibration in the chest-wall. Extreme degrees of lung-consolidation, however, may rival fluid in these particulars. On the other hand, in effusion the level of the dulness may vary with the position of the patient, if its quantity be moderate, and it be unconfined by adhesions. Gravitation, however, helps us less in pleuritic effusions than in pleural and other dropsies, as in the former case the fluid is more liable to be sacculated, and may often be suspended by adhesion above the base line of the cavity. If the pleura seem full of fluid, but the lung be not much compressed, direct percussion by the finger-tips will give a very dull note and the sense of resistance, while stronger mediate percussion will bring out a note of somewhat lower pitch. Usually the level of the fluid is a little lower in front than laterally and behind, and the lung if free from much adhesion is usually pushed upwards, inwards and backwards, so that it may be detected by a clearer percussion-sound at the corresponding side of the four or five upper dorsal vertebræ. In acute pleurisy the fluid rarely rises above the third rib in front, but in quiet effusive pleurisy the whole moiety of the chest may become very dull upwards, and across to the opposite parasternal line, and there may be dulness and actual bulging in the supraclavicular space. When the chest contains a good deal of fluid, but is not full, percussion over certain areas may actually give a low or tympanitic percussion-note. These tympanitic areas may be of three kinds—1, where a thin layer of fluid lies over expanded lung; 2, where distended air-cells compensate cells closed in another part; 3, where, the chest being full of fluid and the lung compressed and empty, percussion in the neighbourhood of the trachea and large bronchi causes vibration therein. Tympany when present is nearly always immediately under the clavicle. If the tympany be due to the third cause, it may have something of the cracked-pot quality. In some cases the tympany is decreased on inspiration and increased on expiration. The detection of tympany under the clavicle may mislead the unwary into a belief that the healthy side is morbidly dull, but on the other hand it is an invaluable help to the physician who takes it as a hint to look for fluid below. Dulness due to a displaced liver may be distinguished by the removal of its boundaries on inspiration, and by its anterior rather than posterior disposition. In mere hydrothorax the lung generally floats more readily, and the diaphragm and other structures can usually be made to move in respiration.

Auscultation, before any dulness appears, usually reveals the respiration at the part to be defective in quantity, rhythm, or quality; and there a friction-sound may be audible. Defective inspiration at the outset is due to arrest of that act; afterwards it is due to the false-membranes and effusion which hinder conduction of sound, compress the lung, and ultimately silence it. A friction-sound, if ever generated, may be fugitive and escape the observer, or the embarrassed chest-movements may fail to give it distinctness. When present it appears at the outset, and disappears as effusion separates the surfaces; it may reappear as the fluid is absorbed. The friction of outset may last but a few hours, and, except in dry pleurisy, is rarely abiding; returning friction, however, may continue for a longer time, even for weeks. In those cases in which the surfaces do not separate, and friction continues for many days without a break, we have to deal most frequently with the drier pleurisies of some cachexias or of septicæmia. Diminished breathing and friction, if effusion gathers, are followed by intermediate phenomena due to thin layers of fluid. These are bronchial breathing, bronchophony, and ægophony. Ægophony is nearly always heard near the root of the lung under the scapula; it has the character of a bleat, and when once heard is not easily forgotten. Its presence is pathognomonic of fluid;[1] but it is so often absent that it is of little practical value. As fluid increases these phenomena give place to silence, and as fluid gathers first at the bottom we often find silence at the base; bronchial resonance amounting, it may be, to ægophony at mid-lung; and defective or compensatory breathing at the apex. We may also meet with curious inverse changes in the physical signs, notwithstanding an increase of fluid, if at first this be spread over a partially expanded lung, and afterwards accumulate below it as the lung floats upwards, or as intrathoracic tension tells on the other side. Thus dulness may actually recede with an increase of fluid, and on the other hand it may rise upwards as with a diminution of fluid the re-inflated lung descends. For these and other reasons it is very difficult to gauge the ebb of intrathoracic effusions, or accurately to ascertain their behaviour after tapping. In children, bronchial breathing and bronchophony often persist throughout. Dr. Bowditch says that he has been occasionally greatly embarrassed in deciding about reaccumulations. 'At times after the effusion has been withdrawn the chest remains as flat as ever, and often it never clears up in the lower part of the affected side; but if it remains in this state without producing untoward symptoms, I have not tapped again, though a tentative aspiration could do no harm.' In cases where the lung is unbound, gauging is of course the more easy. When the chest is quite full of fluid there may be silence throughout to ear and hand; but even in such cases a faint or distant respiratory souffle is sometimes audible almost down to the base. Moreover, in most cases breathing more or less tubular, and some resonance on percussion, are to be heard over the root of the lung in the vertebra-scapular space. As air re-enters the lung, respiration is at first defective, and accompanied by crepitant *râles*, but it improves gradually, and reinforces itself as the lung expands and clears. In children silence on the affected side is less common, bronchial breathing and bronchophony persisting in them far more than in older persons; but it is not by any means correct to say that bronchial breathing and bronchophony always persist in the pleuritic effusions of children. Yet the pneumonia of children being mostly lobular the discovery in them of bronchial breathing and bronchophony is highly suggestive of fluid. In the other lung there is usually a slight general lowering of the percussion-note and compensatory breathing; if the effusion be large enough to compress the opposite lung, the percussion-note may be very markedly lowered. At times morbid sounds may be heard, even in the lung of the affected side. The gradual formation of a pulmonary fistula may in some cases be revealed some days or hours before evacuation, by the presence of liquid *râles* in the upper third of the affected side.

Physical examination must be applied not only to the investigation of the lung and of the contents of the pleura, but also to determine the position of those neighbouring parts which may be displaced, such as the liver, heart, spleen, mediastinum, and so forth.

Pyopneumothorax.—This is a term applied to that condition in which, on perforation into some open channel, air finds entrance into an empyematous cavity. At the same time pus is evacuated. The lung may in a measure expand, or in neglected cases may be irrecoverable; and the chest-wall falls in more or less, according to the rigidity of the ribs in the individual. Dulness now gives way to clearer and lower notes, except in such dependent parts as may still be occupied by effusion, and their pitch will vary according to the thickness and density of the false membranes within, and to the degree of pulmonary expansion. If the fistula be moderate in size, little or no blowing sound will be heard, but two additional auscultatory signs may be obtained, which are alike in nature, but are distinguishable as *succussion* and *metallic* tinkling. *See* **Pneumothorax**.

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[1] Several modifications of pectoriloquy have been relied upon by Bacilli and other writers as means of distinguishing between pus and serum in the pleura. Dr. Bowditch informs the writer that the signs in question do not bear out the value which has been claimed for them; the phenomena probably vary, not with the density of the effusion, but with states of the lung.

Diagnosis.—The difficulties of diagnosis in pleurisy belong chiefly to the earliest and to the latest stages of the malady. In the earliest stage the pleurisy may be latent, and so beyond the possibility of diagnosis; or a pain may be felt, and this pain may be due to pleurisy, pleurodynia, or other causes. The pain is often referred to the loin or abdomen, thus leading to suspicion of mischief elsewhere. In the previous history a catching of cold, and the arthritic diathesis, would tell equally in favour of either view; while prolonged anæmia and leucorrhœa would lead us to think of the latter. Unfortunately a comparison of local temperature in the two sides seems untrustworthy, but the presence of fever would make us strongly suspicious of pleurisy. It must not be supposed that diagnosis in this early stage is unimportant. Few errors are more common than the attribution of pleuritic pains to pleurodynia; the pain disappears as an effusion slowly accumulates, and mischief and peril, perhaps hardly remediable, may be the consequence. The careful observer will listen anxiously to the chest day by day, or more than daily, until a friction-sound be audible, and this once heard further mistake is impossible. Fever of course may be present with pleurodynia, and an immediate diagnosis would then be impossible, unless something characteristic in the stitch and start on deep inspiration betray the real state of things to the practised observer. Neuralgic and inflammatory diseases of the walls of the chest are not likely to give rise to any permanent misunderstanding. It is said that a pericardial may be mistaken for a pleuritic friction-sound, but the distinction can rarely be difficult. A difficulty is more likely to arise in distinguishing between a pericardial and a localised pleuritic effusion. Still this can hardly be insuperable. In rheumatic fever and in some other diseases pericardial may accompany or ensue upon pleuritic effusion, and when the latter is on the left side, and is abundant, the limit between the two may be beyond definition. The practical lesson is to remember the likelihood of pericardial effusion, and not to overlook it if it comes.

In the later stages of pleurisy, when effusion is abundant, its diagnosis may be very difficult. Under ordinary circumstances complete and extensive dulness with loss of all elasticity in the chest-wall, of respiratory sound, and of vocal thrill, make diagnosis easy; and if there be resonance below the clavicle, its high-pitched character is very characteristic of fluid below. But there may be no such resonance, and the voice may fail, or fail to set up thoracic thrill. Moreover, vocal thrill and respiratory murmurs may vanish likewise in intrathoracic tumours. Thus the diagnosis between exudations and pulmonary consolidations is sometimes difficult. In acute pneumonia the course of the fever, the expectoration, and other symptoms, help us to a decision. In pleurisy with moderate effusion, on the other hand, the limits of posterior dulness might be changed by a few forcible inspirations, such changes being probably due to a re-expansion of collapsed lung. Consolidated lung could not, of course, be thus altered. In both there may be tubular characters of respiration, which are more easily distinguished in print than at times they may be in the patient. If ægophonic we decide upon fluid, but if bronchophonic we have to distinguish as well as we can between the 'sniffling and metallic' bronchophony (Walshe) of consolidation, and the duller and more diffused bronchial sound of pleuritic effusion. If the dulness and breath-sounds vary with the position of the patient, fluid is clearly present. Limited effusions, such as an encysted empyema, not large enough to bulge the intercostal spaces, to crush up the lung, or to displace other organs, are at times quite indistinguishable from a like extent of chronic consolidation, or of abscess in the lower lobe of the lung; such collections, though usually basic, are by no means always so, but, retained by adhesions, may occupy the upper and anterior region, any part of the middle region, or strips, or irregular districts in any direction. It may be said in general terms that a permanent *very dull* area remaining after an acute pleurisy or pleuropneumonia most probably corresponds to an encysted empyema, but not always. In such cases fever may be entirely absent, and the general condition of the patient may not suggest disease. Still, such a collection of pus is pretty sure to work mischief sooner or later—years later, it may be—but the patient rarely escapes with impunity at last. The difficulties of distinguishing bulky effusions from pulmonary consolidations are not often great. In the former the intercostal spaces may be bulged, and the moiety of the chest enlarged; on the other hand it but very rarely happens that consolidation reduces the lung to silence, though this may be the case; in such a case the bulk of the half-chest would in all probability be lessened, but so, on the other hand, may it be in a chronic pleurisy. The fact is, many chronic cases can be diagnosed by the needle alone; and it should be noted that even with the needle more than one puncture or two should be made before deciding against fluid. Between intrathoracic tumours and large pleuritic effusions a difficulty is found only in those cases in which the tumour occupies precisely the half of the chest, but this is not very uncommon, especially in cases of aneurism. It must not be forgotten too that fluid effusion may accompany tumour, in which case there may be subtympanitic resonance under the clavicle. In favour of fluid alone are the absence of enlarged veins; the equality of hydrostatic displacement of organs; the absence of signs of localised pressure, of pulse-retardation, of inequality of pupils, and of peculiar sputa. A curious pulsation, of uncertain explanation, is sometimes seen in empyema, and must not be mistaken for an aneurismal throb. If fluctuation be certainly felt in the intercostal spaces, the disease, in part at any rate, is a fluid effusion. Sometimes a hepatic, biliary, renal, or other subphrenic abscess, making its way by a sinus, occupies also some part of the pleural cavity. Here it may encyst itself, and remain latent or quiescent for months or years; or it may excite an effusive pleurisy in the remainder of the cavity, so that two effusions co-exist in one pleura. Such collections may of course form pulmonary fistulæ, and pus from the same central source may in part issue from the urethra or rectum, and in part issue from the mouth. Such cases are often easy of diagnosis; at other times they are more difficult, especially if there be no fistula in any direction. When such pyogenic cysts contain air, but not by way of the lung, it may be supposed that they have originated in some perforative disease of stomach or bowel. It is obvious that in these cases there will be little evidence of increased intra-thoracic tension. Dulness from disease below the diaphragm, but encroaching on the thoracic space, can often be displaced downwards by a deep inspiration. It is stated that in puncture, combined with the use of the manometer, when the canula is in a cavity beneath the diaphragm, inspiration is attended with an increase and expiration with a decrease of pressure, being the reverse of that which occurs when the canula lies in the pleura. In peripleuritic abscess tension is of course low and there is no pressure on neighbouring organs; percussion-dulness is also less profound. It is said that pus from cellular abscesses is of higher specific gravity (1040) than from large cavities 1028–1030).

A hæmorrhage into the pleura can be distinguished from a serous or purulent effusion, only by a careful survey of all the history and symptoms; the direct physical signs helping us but little. Large pulmonary cavities may be taken for encysted empyema with fistulous opening into a bronchus; and here again, although a pulmonary fistula rarely gives rise to tubular breathing, unless the opening be very large, or communicate with a secondary cavity, yet diagnosis by the direct signs alone might be impossible. The history of the case, and the state of the other lung would be important factors in decision. In another class of cases the distinction between chronic phthisis and pleurisy may be difficult—in those, that is, in which there is some old dulness and retraction of a part of the side, with weak respiration and indefinite *râles*, and more or less fever. The absence of lung-tissue in the expectoration, and the health of the other side, help to exclude phthisis. Fibroid phthisis, however, is not even thus excluded, and is usually pleuritic in origin. In children enlargement of the spleen, with extension upwards and backwards, has not infrequently simulated effusion at the base of the left lung. Finally, the intense distress and orthopnœa of very painful pleurisies—of diaphragmatic pleurisy more especially—may simulate cardiac thrombosis. The state of the pulse alone is usually sufficient to lessen the fears of the physician.

Prognosis.—The prognosis of simple pleurisy, apart from tubercle or carcinoma, is generally favourable, unless the degree or kind of effusion in the chest endanger life. If not always favourable, it is because simple inflammatory pleurisies seem sometimes to originate a process of chronic fibrosis, which thence invades the lung. Happily such instances are rare, and in an individual case the chance of such an event almost vanishes. In ordinary inflammatory pleurisies, then, prognosis is quite favourable; in cases of effusion, where the effusion is moderate, it is favourable; where the effusion is large, it is the less favourable the greater the quantity and the slower the absorption. Signs of hyperæmia and œdema in the working lung must be anxiously watched, especially if an empty radial, scanty urine, and other evidences of venous stasis be added. When the chest is full, prognosis is unfavourable apart from operation. In severe and acute cases the other lung becomes œdematous and congested, bloody and frothy sputa may appear, carbonic-acid-poisoning will become evident in the blue lips and lethargic brain, the pulse will slip away, the heart fail, and the extremities grow chill; or, again, dislocation of the heart and arrest of the pulmonary circulation may cause syncope by asystole or thrombosis. Operation, however, raises the hope of recovery greatly—so much so as to put the chances largely in favour of rapid recovery in good subjects. The earlier the relief, the less the probability of refilling, the less the damage to the lung, and the better the hope of rapid amendment. In bad subjects prognosis will be the less favourable the more potent the adverse conditions; and in pleurisies secondary to other diseases the prognosis will depend but partially upon any one element in the case. In old people operation is still useful, but especial care must be taken to draw off the fluid very slowly, and to watch the circulation. The conditions in them unfavourable to operation are still more unfavourable to absorption, or to any kind of delay. In empyema the prognosis is grave; unless operation be performed death is very probable, either by syncope before the matter escapes, or by exhaustion, chronic septicæmia or secondary abscesses, during a long period of incomplete drainage of the chest. If operation be submitted to, the prognosis is favourable, though a vast internal abscess with rigid walls cannot be but a fearful thing, and the illness will still be a long and an anxious one. Death can scarcely be said ever to be due simply to the operation, if carefully performed; and death, during or directly following the operation, though not unknown, is too rare to be an important factor in our decisions or forecasts. On the whole, the earlier the operation is performed, after it is fairly indicated, the better the prognosis. Among the deferred dangers are amyloid disease, a rare event, but possible in cases of necrosed rib or other bone, or of very long and exhausting drain; and phthisis or septic tuberculosis, happily made also rare by the density of the false-membranes. The presence of albumen in the urine alone does not necessarily preclude complete recovery, nor forbid prompt operation. The bearing of age and sex upon prognosis cannot as yet be decided. Experience indicates that it is more hopeful in cases under ten years of age and above twenty years. Dr. Bowditch says that full pregnancy is no bar to thoracentesis. The influence of diathesis on the progress of local diseases must be estimated in all cases on general principles.

As regards duration, an ordinary case of inflammatory pleurisy will last from ten days to a month, according to the degree of effusion and the rate of re-absorption. Chronic cases with large effusions may last any length of time, rarely less than three months. If tapped the fluid may, and very often does not return, or may not return after a second tapping; in such a case recovery will be prompt. Empyemas, opened under the most favourable conditions, are often months and sometimes years before final closure, though it seems that the antiseptic operation and dressings will much shorten the average duration. If left to itself an empyema usually opens through the lung or externally. In the latter case the issue is most commonly about the fifth interspace anteriorly. Drainage is thus very incomplete, and although some relief is attained, the patient nevertheless drags on with a permanent fistulous discharge, it may be for years, but recovery without operation is scarcely to be hoped for.

Finally, it must not be forgotten that simple pleurisies may be the forerunners of phthisis. The occurrence or repetition of a pleurisy in a young person of delicate habit or origin is always an alarming thing, and the more so if not due to obvious causes. The experienced physician will call to mind many cases in which a pleurisy to all appearance wholly recovered from at the time, was followed before many months had passed by definite signs of phthisis. There is no evidence to show that all such pleurisies are tubercular in nature. Lastly, a decided attack of pleurisy, occurring in the course of pulmonary phthisis, always means or makes mischief, even if quickly got under.

Treatment.—1. *Medicinal.*—Dry pleurisy requires little or no treatment. In some cases, indeed, it may cause distress, as in chronic phthisis; and if so, may be relieved by spongiopiline and laudanum, or by any similar soothing measures. In the cases in which a troublesome cough is caused by a patch of chronic dry pleurisy, the cough and pleurisy alike may be removed by the application of blisters. In acute pleurisy, however, much depends upon active treatment at the outset; in few maladies is early attention better rewarded, and in few is neglect more surely punished. Our great aim in the beginning is to diminish the pain, the inflammation, the fever, and the tendency to excessive exudation. With or without treatment, as we have seen, the pain usually passes off in forty-eight hours, or thereabouts; nevertheless it is very acute while it lasts. In sharp cases, occurring in healthy persons, we may put on six to twelve leeches according to the age, sex, or condition of the patient, and these may bleed freely into a large poultice. This measure, if adopted at the very outset, diminishes the pain, the fever, the exudation, and the duration of the case. When the bleeding has ceased the chest should be firmly bandaged, and as soon as the state of the leech-bites will allow of it, the affected side should be firmly strapped. This, by giving rest to the part, will favour resolution and resorption. Constant respiration, on the other hand, favours effusion, as exercise favours it in inflammation of a joint. If called to a case after the first brunt is over—say after a lapse of forty hours—it is better to omit the leeching, in order that the strapping may be applied at once. It must be carried out on the following plan, as laid down by Dr. Roberts, of University College Hospital:—

Strips of a properly-adherent plaster spread on some thick material, from three to four inches wide and of sufficient length, are applied round the affected side from mid-spine to mid-sternum, or a little beyond. These are laid on over a variable extent of the chest, according to the requirements of the case, it being sometimes necessary to include the whole side. It is best to make the application from below upwards, and to fix the strips of plaster in an oblique direction rather than horizontally. The patient being directed to expire deeply, a strip is fixed at mid-spine and drawn tightly, firmly, and evenly round the side in the direction of the ribs, that is, a little obliquely from above downwards and forwards; then another strip is laid on over this, also extending from mid-spine to mid-sternum, but in the opposite direction to the first, that is, obliquely upwards and forwards across the course of the ribs; the third should follow the direction of the first, overlapping about half its width, the fourth that of the second, and so on in alternate directions, until the entire side is included if required. Finally, it is often desirable to apply over the whole two or three strips horizontally, so as to form a superficial layer; and, if necessary, one or two may also be passed from behind forwards over the shoulder, these being kept down by another strip fixed round the side across their ends. Dr. Roberts applies the strapping in all cases from the outset. The writer's experience is in favour of early leeching in suitable cases, but it may be possible to combine the two remedies. This at the outset is far from easy, as a large poultice is almost an essential part of the leeching. Some physicians recommend that an attempt be made to subdue the local inflammation by the application of ice, but the results of this method are not satisfactory. In addition to local measures, such medicines as the following are required:—A powder consisting of Pulveris ipecacuanhæ compositi gr. v, and Pulveris antimonialis (James's) gr. iij, is to be given every six or eight hours, for two or three days. In diaphragmatic and in other cases, in which pain is a marked feature, the subcutaneous use of morphia is also to be recommended, in doses of one-eighth to one-fourth of a grain, or possibly more. The fever is rarely severe or protracted enough to require such vigorous antipyretics as quinine, nor is aconite a very safe remedy. It is better to give, in addition to the powder, full doses of Liquor ammoniæ acetatis (ʒij–ʒiv for an adult) every four hours, covered with a little milk; an alkaline effervescent being freely used also as a drink. Thus vascular tension is lessened, and activity of the skin and kidneys is promoted. In the earlier stages free purgation should be avoided, but it is well to call gently upon the alvine excretion by the use of mercurials and salines. All solids must be withdrawn from the dietary, and stimulants, as a rule, forbidden. The alkaline effervescent or a cream of tartar drink, with acetate of ammonia mixture, are to be continued after the powders are withdrawn, so as to keep up free excretion: for the same purpose, and also to lessen chest-movements, the patient must be kept closely to bed. For some days after the subsidence of the fever the appetite for highly nitrogenous diet must be held in check, and it is desirable at this stage to lessen the amount of fluid in the dietary. Thus it is to be hoped that, as the patient's general condition improves, the effusion in the chest may likewise fall. If this be not the case other remedies must be brought forward. Among the chief of these are blisters, which, if not pushed to full vesication, may be repeated frequently; or the chest may be kept continuously under the effects of iodine, though this method is less successful than the blisters. At the same time, or soon after, a pill may be administered twice daily, containing a grain each of digitalis (fresh leaf) and blue pill. A grain of squill may be added, but squill has some tendency to disorder the stomach. The use of both blisters and mercury must, of course, be avoided if the kidneys be not sound, and mercury should be avoided in any case where a phthisical tendency is suspected. Dr. Bowditch applies a solution of iodine (ʒss in Spiritus etheris sulphurici ℥j), painting it on twice or thrice, or till burning is produced, and then reapplies it intermittently. He also administers iodide of potassium gr. v, thrice daily internally, and finds much help from this treatment. In vigorous patients free and repeated doses of some hydragogue purgative—such as Hunyadi water—may be tried before beginning the more tedious pills. Or the ointment of oleate of mercury may be rubbed freely into the chest, and this may be used even in delicate persons, without fear, and in those whose sensitive skins are intolerant of blisters. Quinine may be added to the mixture containing iodide of potassium, or may well accompany the mercurial course. But when a brief and gentle eliminative course of this kind is ended, it is well at once to turn to the full tonic treatment, with such drugs as iron and quinine. Less active effusions in delicate and anæmic subjects may need iron and bitters, cod-liver oil, and liberal diet from a very early stage, and such cases are common. At the same time such measures are not to be used while the acuter stages are present—a precaution too often forgotten; for even in phthisis a sharp intercurrent pleurisy must often be treated by salines, and perhaps a leech or two at first. These measures will generally succeed, in reducing not only an acute effusion of moderate extent, but also many effusions of a more obstinate kind. If, however, the case resist the means prescribed, the effusion will probably increase, and may need operative interference, as is so commonly the case in latent pleurisy. As a general rule, if an effusion rises above the angle of the scapula, and abides in this quantity or more for two or three weeks in spite of adequate treatment, it must be drawn off, whether the patient be embarrassed by it or not. In cases where treatment by medicines has not been fairly tried, where the patient is in comparative ease, where the effusion is not above the spine of the scapula behind nor above the mamma before, and where the neighbouring organs are not seriously displaced, these operations may give place to medicine for two or three weeks longer if desired. The writer, however, would advise the withdrawal even of a pint of fluid which had lain in the cavity for a month, as its continued presence, by soaking and compressing the lung, injures it, and destroys the absorbent power of the pleura and of its granulations. It is needless to add that if there be effusion in both pleural cavities, the amount in both must be considered as one quantity. Before resorting to operation, however, it is well to say that two more methods remain—the so-called 'thirst cure,' which has some good effect in the treatment of serous effusion; and the jaborandi cure. The first method consists in the withdrawal of fluid from the diet, which should be as dry as possible, and consist of lean cold meat, stale bread and the like. All fluids are forbidden, except half a pint on the third day, and a pint on the seventh and eighth days. The effusion is said under this method to decrease daily; the method, however, is more painful than tapping, and could not be borne by all patients without injury. The second plan consists in the promotion of profuse sweating, by means of jaborandi. Excellent results are said to have followed this method. The drug is administered as a liquid extract, ʒj being given every three hours. If medicinal and dietetic means fail to remove a moderate effusion, or if the effusion already occupy the whole or a great part of the pleural cavity, the cavity must be tapped without further delay. There should be no hesitation in tapping instantly any chest which is dull up to the clavicle, or which presents a small tympanitic space under the clavicle. The operation of removing fluid from the chest by tapping (paracentesis thoracis), seems to have been practised in early times, but has scarcely become familiar to us until the last quarter of a century. To Trousseau, of Paris, and to Dr. Bowditch, of Boston, the profession is chiefly indebted for anything like doctrine in this matter. Trousseau was probably the first physician to recognise the means, and the propriety of tapping in *serous* effusions.

2. *Paracentesis thoracis.*—Taking the operation as agreed upon, we will now lay down the precise method of it. It may be a matter of doubt whether the fluid contents of the chest be serous, sero-purulent, or purulent. To ascertain this a hypodermic syringe may be passed through the wall of the chest, and a sample of the fluid drawn away. In this way information is obtained as to the nature of the fluid, and its accessibility. Should the tap be dry, it can be repeated elsewhere more readily, and with less sense of failure, than the greater operation. The precise place of operation must, of course, be chosen with great care; but, happily, there is plenty of margin for error. In an encysted empyema with thickened walls four or five punctures may be needed before pus be reached. If the issue be purulent two openings will be needed, when, after choosing the second with the greatest care, the first may be closed; if the issue be serous, the complete emptying of the cavity is not necessary, and not always desirable. In cases of multilocular pleuritic effusion the emptying of one cavity only is of course an incomplete measure. Such cases are unsatisfactory

at best, and can only be tested by repeated puncture.

If there be no special reason to the contrary, the chest will be tapped on the lateral or posterior aspect, as there is thus less danger of interference with other organs. Reasons to the contrary may present themselves in the case of adhesions tying the lung to the side or back of the cavity, of lateral displacement of the heart in left-side effusions, of deformities in the individual, and so forth. The pointing of an empyema forward, however well-marked, is no indication for an anterior opening, as this pointing will recede when a posterior opening has been made; nor is the faintly audible sound of respiration over the back of the affected side a reason for declining to operate posteriorly, for, such faint sounds are often conveyed to the ear when the cavity is full of fluid. Let a minute scrutiny then be made of the lateral and posterior aspects of the chest. Let any bulging of intercostal spaces be looked for, as at such a spot false-membranes are probably scanty or thin, and let the ribs be minutely examined, in order to ascertain that there is room enough between them for the insertion of a finger into the cavity, if this prove to be needful; or that, in any case, resection of a rib may, if possible, be avoided. The axillary line should be chosen in all cases in which the effusion is believed to be serous. If it should appear that the fluid is so limited or encysted that it does not gravitate to the bottom of the cavity, a tentative puncture must be made at the dullest spot, regard being had of course, to the position of neighbouring organs. If there be no indication to the contrary, we shall select the fifth intercostal space, a little in front of the axillary line, as our point of entrance, or the fourth space on the right side.

The needle must now be gently forced through the skin, and then shot with a sharp sudden thrust through the remaining tissues into the cavity, the operator being careful to take the mid space, and thus to avoid the periosteum of either rib, and the intercostal artery. If the skin be thick it is well to incise it with a bistoury before inserting the needle. There is no objection to freezing the skin beforehand, but it is rarely desirable. If the fluid drawn be clearly serous, and the patient be a child, or, the syringe capacious, it may be well, if time press not, to wait a day or two to see whether this small draught will set up absorption of the rest. Many such cases are on record. As a rule, however, it will be needful to proceed to a further evacuation of the cavity. For this a special instrument will be needed.

We cannot enter into an account of the many instruments sold for paracentesis thoracis; almost any one of them is satisfactory. They all consist in a fine trochar or perforated lance-headed needle, with an exhausting apparatus attached thereto.[1] Pumps of various makes are therefore adapted to the trochars, by which the pressure of the atmosphere or the choking by clots may be counteracted. These pumps are rather cumbrous, and they are liable to be worked at an excessive pressure. The best exhaust in ordinary cases is a column of the fluid itself, which can be made longer or shorter, as the run of the fluid seems to indicate. This column is formed by attaching a long, fine india-rubber tube, at least four feet long, to the collar of the trochar, and its length is varied by elevation or subsidence of the basin of water in which its distal end is placed. This tube has, of course, the action of a syphon, and by it alone, in the vast majority of cases, we can overcome the resistance of the atmosphere. The diameter of the tube should be small, or the fine canulas now in use for paracentesis will not feed it; moreover, the slower the issue of the fluid the better. It is well to attach the tube to a short branch of the canula issuing at a small angle from the side of the latter, and containing a stopcock; in such an instrument the trochar works like a piston in the canula, and can only be withdrawn to a point immediately beyond the opening of the lateral channel. The advantage of this arrangement is that on stoppage of the canula the trochar can at once be so pushed up as to clear it. If there be no piston-trochar the canula has to be cleared by wires—a fidgety process, and too often insefficient. It may be better indeed under such circumstances to close the wound and reintroduce it elsewhere; thus less pain and annoyance is felt in the end, and a better result obtained. As inflammatory serous effusions are certainly liable to turn into pus if septic elements be admitted to them in the smallest quantity, the instruments used must be scrupulously disinfected and air excluded. If the distal end of the delivery tube be placed in water, and the tube be emptied by running the finger down it, any bubbling will almost certainly point to wound of the lung. The cock should be turned when the patient is quiet and at the beginning of his expiration. The fluid will run at first in a steady stream, afterwards in gushes corresponding to the inspirations. When the fluid ceases to run, or coughing grows troublesome, the tube may be withdrawn; for if the fluid be serous the presence of a remnant, or more than a remnant, of the effusion in the cavity is of no disadvantage; if it be seropurulent the cavity is certain to refill, and if it be laudable pus it will in all probability refill. On the other hand, when the lung expands imperfectly, to exercise strong suction upon the mediastinum or on the abnormally vascular pleura is to run the risk of doing harm. The patient must neither lie nor sit erect, but a semi-recumbent position should be taken, with the shoulders raised upon pillows. If there be any tendency to syncope, an erect position will favour it, and a recumbent position is unfavourable to operation and to escape of fluid. The patient must be closely watched, and the stopcock turned on the least sign of faintness, but, happily, this is rarely seen. Cases are reported in which sudden death has occurred during paracentesis, or about the time of it, but cases of sudden death are not uncommon in pleuritic effusion, whether punctured or not. An anæsthetic is scarcely required for simple paracentesis. If the edge of the canula present no harsh ridge upon the trochar the stab is but little painful.

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[1] The hollow needles sometimes used have many drawbacks. They may prick the lung and cause cough or even let air into the pleural cavity, which, though not septic, prevents expansion of the lung. This, though not the only one, is a sufficient objection.

It is well, if there be no indication to the contrary, to inject one-fifth of a grain of morphia beneath the skin after the operation, to relieve any irritation either by cough or otherwise, and to secure subsequent rest. The stopcock of the instrument will, of course, be shut when the trochar is withdrawn, and the puncture promptly closed on withdrawal by the finger. It is well to keep the finger in apposition for a few minutes, and then to apply a simple lint-pad with short strips of plaster. In favourable cases no second tapping is needed, and the heart tends to recover its position on the completion of the operation, moving three inches perhaps in the course of it; in other cases, even of serous effusion, the severity of the pleurisy may have so fettered the lung that the readjustment of the parts is much more gradual, and the space of the effusion is reoccupied but slowly by the unfolding lung and the yielding of the chest-wall and mediastinum. In this respect there is not much difference between serous and purulent formations, save, of course, that neglected cases are more likely to have become purulent. A rapid return to the normal of the physical signs is a very good omen, and in cases promptly dealt with is now happily our common experience. In cases which recover more slowly we get less help from the physical signs, the conditions within the chest being in a more stable state of perversion. In pleuro-pneumonia the lung may not be able to expand any more in cases of paracentesis for the pleurisy, so that only some ten ounces or so may be obtainable by falling in of the ribs. In two cases in which the present writer noted reduplication of the second cardiac sound before tapping, this sign ceased at once on the emptying of the cavity. It is rather the rule than the exception for some dulness to remain below the scapula, and this alone is no indication for repeating the operation.

If there be any subsequent pain or elevation of temperature, these, under ordinary circumstances, will prove to be transient. If the rise of temperature continue after the first day or two, the formation of pus is to be feared. The formation of pus, moreover, is not infrequently attended with a re-awakening of pain. If pus form, the cavity in all likelihood will soon refill, and pus will be detected on puncture. It is desirable, however, to draw off a considerable quantity of a purulent effusion by ordinary tapping before proceeding to any further operation, as in this way any danger due to the sudden emptying of the whole cavity by the radical operation is avoided. Soon after, or in one or two days, according to the state of the patient, an opening must be made sufficiently large to permit of the introduction of a sound. By means of the sound the extent and depth of the cavity will be gauged, and the sound being directed to the lowest point in the axillary or infra-scapular line an opening must be made upon it into the cavity, through which the latter will be drained to the last drop. It is impossible to take too much pains to secure the perfect freedom of this opening, or to place it at the lowest point in the cavity. For this reason it is desirable to give an anæsthetic, that the operation may be deliberately performed. Chloroform seems to put less strain upon the limited breathing powers than ether in these cases. If the patient be of spare body, let the opening be taken below the spine of the scapula; if stout and muscular, a more lateral operation will probably be preferred, though drainage is more continuous and thorough by a posterior opening, and the ribs are there less liable to fall together. After the pus has run out, the upper opening may be closed in the usual way. On no account let a drainage-tube be run through both openings, or it will act as a seton.

It is of the greatest possible importance that all the instruments in use be disinfected, and it is desirable, if possible, to do the whole operation and dressings by the antiseptic method; and this is to be followed up by dressing under the spray. From the time of the operation, it has been stated, the temperature will fall rapidly to the normal; if it rise again during convalescence the rise will be almost surely due to occlusion of the opening. To prevent this we insert a drainage-tube. False-membranes as thick as wash-leather may oppose themselves at first, and the tube therefore, at first, should be proportionately large; but these soon break down into curdy shreds, and the tube may be reduced in diameter, and must be gradually cut away, as secretion of pus diminishes. Injections of a simple or antiseptic character, into the cavity of empyema, are in the writer's opinion to be avoided. They are rarely of use, they often increase irritation, and are sometimes attended with distressing or alarming general symptoms. The great secret is to secure free and complete drainage; if this be attained the cavity will purify itself. This is as true of closing cavities as of freshly-opened cavities; for to inject sinuses, in the hope of procuring adhesion and closure, rarely succeeds and often does harm. In like manner to probe the opening of an empyema is generally a mistake. If the opening discharge for a long period, it may be well once for all to ascertain the length and direction of the sinus, but it is better to enlarge the opening if necessary, or even to make another, than to fret the part by repeated explorations. Resection of a portion of a rib has been recommended by some surgeons, even as a part of the ordinary operation. If a neglected empyema have shrunk or discharged spontaneously, or if, after opening, the continuance of the discharge seem to depend on rigidity of the chest-wall and arrest of lung, then resection of a considerable portion of two or three ribs may carefully be considered. In this way closure of the cavity may be obtained, the spine and shoulders becoming distorted; but such cases will become very rare as diagnosis and early operative relief are more generally understood.

In the exudations of tuberculous or carcinomatous disease, operation is often more than justified by the temporary relief given to the sufferer. If after the removal of a collection of pus and the establishment of free drainage the discharge becomes more offensive and the fever remains, the disease is probably tubercular and the forecast of the worst.

Sometimes empyemas have been treated by repeated aspirations, instead of by incision and continuous drainage. It is hopeless to attempt the cure of a sero-purulent discharge by this method, but a collection of laudable pus once removed by the aspirator has in rare cases failed to return. The chance of success by this method is too slight to be looked for with any confidence, and the repetition of these aspirations does not prevent the gradual condensation of the lung, nor the formation of a pulmonary fistula. There is no difference in method between the performances of these operations in childhood and in age, but in childhood recovery is generally more rapid and sure. Nor is there any difference of method in operating upon a case in which a pulmonary or other ill-placed fistula has already formed, nor is the performance of the operation much the less urgent in such cases, even if the bronchial opening be free and not valvular.

It is desirable that after each or any removal of fluid from the chest the re-expansion be assisted by respiratory gymnastics. The best method of obtaining this end is by graduated exercise; by the inhalation of compressed air from one of the apparatus constructed for this purpose; or by residence at high elevations.

Means have been proposed by which the entrance of air into an empyematous cavity under drainage might be prevented, and the lung thus helped to expand under inspiration. The permanent need of absolute freedom in draining and dressing, however, must discourage the use of all complex apparatus, and if the operation be performed early and antiseptically it is marvellous how well the lung will recover itself.

3. Pleura, Air in.—Synon.: Pneumothorax; Fr. *Pneumothorax*; Ger. *Luftbrust.*

Definition.—Pneumothorax, as its name imports, is the state in which the pleural cavity, normally vacuous, or rather non-existent as a space, contains air or other gas without intermixture of liquid. If air or gas be present, together with pus, blood, or a watery fluid, we give to the resulting state the compound names *Pyopneumothorax*, *Hæmatopneumothorax*, and *Hydropneumothorax* respectively. The gaseous contents in these cases may precede the entry of the fluid or succeed it, and in the latter case it may perhaps be developed as a product of decomposition. These conditions, though not wholly unknown to the predecessors of Laennec, nevertheless were first adequately distinguished and clinically demonstrated by him.

Ætiology.—Pneumothorax is a commoner event than would be supposed, were we to confine our attention to the cases which have received this name. It is often an incident in the course of other diseases, and of none more often than phthisis. Pneumothorax sometimes, but rarely, appears as a primary event and disappears again without further complication; more usually it occurs as one result of wounds of the chest, of purulent pleuritis, of phthisis, or of some rarer disease, such as ulceration of the œsophagus or stomach, carcinoma and the like, which effects an opening into the cavity. If air be mechanically admitted to the cavity, decomposition of its contents may add to the volume of that which was admitted. Even in those few cases in which pneumothorax seems 'idiopathic'—in which, that is, we find pneumothorax to be the first, the sole, and the last morbid state—we are almost bound to assume that this state is, in fact, secondary, and due to some perforation the cause and place of which escape our search. That such cases do occur is unquestionable; the most frequent cause being a strain, noticed or unnoticed at the moment. In passing to the cases of more obvious causation, those due to wounds of the chest are the first to meet us, and need not detain us. That any wound perforating the wall of the chest and the pleura will permit air to be drawn by suction into the pleural cavity is obvious.

Of the same kind, but of natural origin, is the pneumothorax which in empyema follows perforation of the lung with ejection of the pus upwards, or perforation of the chest-wall by natural ulceration outwards. In these cases of pyopneumothorax we have to deal, of course, with the presence both of pus and of air in the pleura. Pneumothorax, though occurring but in a minority even of the ulcerative cases of phthisis, yet is frequently met with as a complication. It occurs for the most part in the later stages of the disease, and often escapes observation; less frequently it is met with in the earlier stages, and is then betrayed at once by its symptoms. Its occurrence may be aided or not by such a strain as a fit of coughing. That pneumothorax is not a more uniform result of ulcerative processes in the lung is due, of course, to the anticipation of a breach of surface by previous adhesive inflammation. In phthisis, happily, the perforation as a rule is minute, and the quantity of matter escaping into the cavity small—so small as to be generally inadequate to produce the physical signs of fluid contents. In other cases the escape is more abundant, or a more abundant effusion comes from the pleura itself, as a consequence of the resulting irritation. We then have to deal with an obvious hydropneumothorax, or pyopneumothorax. The opening by which air escapes into the pleural cavity may be, and often is, valvular, so that its entry during inspiration may not be balanced by its exit. In this way air may accumulate under pressure. If, as in empyema, the lung be already collapsed, this pressure is the less distressing; if the lung be wholly or in part open, the pressure adds to the degree of the sudden embarrassment due to rapid collapse of lung, and to encroachment upon the surrounding parts, including the opposite lung. Air thus entering the pleural cavity is often purified from septic elements by its filtration through the lung, unless it pass through cavities and alveoli already charged with septic matters. In puncturing the chest-wall with a fine trochar, in cases of serous effusion, the lung is sometimes wounded, and air escapes into the pleura. The accident is an untoward one; but the air which thus escapes into the pleura is so cleansed by its passage through a healthy lung that, as a rule, it sets up no putrefaction, and is itself quickly absorbed. The puncture heals too rapidly to permit of any continuous transpiration, but the quantity suddenly admitted may add a good deal to the suffocative distress of the patient. A similar state of things is not uncommonly seen in the practice of the surgeon, when an injury which breaks a rib also drives its broken point or points through the costal and pulmonary pleuræ.

It is said that in emphysema the bursting of dilated lobules may set up pneumothorax, and we may wonder that this event should be so rare. Perforation into the pleural cavity by cancerous or other destructive changes, either in the lung itself or such neighbouring organs as the œsophagus, the stomach, the bowel or connected ducts, is not very rare in cases of malignant disease; and the entry of air and food into the pleura sets up suffocative and inflammatory symptoms, which add greatly to the miseries of the last days of life. There are, no doubt, other ways of disease by which air may find its way into the pleural cavity; but the above description, with little or no essential difference, will apply to all.

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ANATOMICAL CHARACTERS.—Under this head we have little to say in respect of pneumothorax, and we have not here to deal with the further appearances of hydrothorax or empyema. A patient would rarely die of simple pneumothorax; for if death be mainly due to this, yet unless it occurred within the first few days it is probable that some degree of inflammation would follow the disturbance. In the vast majority of cases, of course, the pneumothorax is secondary to some other disease, and any fluid or other products found with the air in the chest may be due—not to the mere admission of septic air into the cavity, but to the admission of decomposing tissue-elements into it. As concerns the presence of air alone, we have only to say that in most cases—especially in the cases in which air has reached the pleura by a valvular opening—the affected side of the chest may be visibly distended. In such a chest the pressure of the contained air may well have been not passive only but active, and on puncture the imprisoned air may escape with a hissing noise; if the lung be wholly retracted, and the air contained under high pressure, the out-rush may be very strong—strong enough to blow out a candle. This air is usually deoxidised, and rich in carbonic acid; if there be decomposing matters in the cavity, it is likely also to contain sulphuretted hydrogen. Neighbouring parts will be found more or less dislocated directly as the degree of compression of the contained air, and inversely as the amount of adhesion limiting its extent. Bilateral pneumothorax is, of course, incompatible with life; if it be found double we may be sure that one side of it came on at the moment of death.

SYMPTOMS.—The symptoms of pneumothorax are of course the more distinct, the less the symptoms of the primary malady. In those rare cases in which pneumothorax comes on apparently as a primary disease—that is, in which the mode of entrance of air into the pleural cavity is most obscure—we find the chief symptoms to be dyspnœa and a sense of faintness, pain being a less uniform symptom, and present only when the entrance of air is followed by irritation and inflammation from the fluid or solid matters which accompany the gaseous. Aseptic air alone does not set up inflammation, nor much irritation. Fever, in like manner, depends not upon the entrance of air, but of the irritating matters accompanying the air, and exciting inflammation. It may, like the pain, be considerable; it may not be present at all; or, again, it may be lost in the fever of the primary malady, or show itself as a slight exacerbation of that fever. The dyspnœa, in part mechanical, in part probably reflex, is necessarily attended by increase of pulse-rate; the two events being but different aspects of the same machinery. The degree of these accelerations, as has been hinted, depends upon the amount of previous accommodation in the chest, and upon the amount, if any, of fluid and solid concurring with the gaseous escape. The escape of air with irritating matters suddenly into the pleural cavity of a person suffering but little from a phthisical ulceration, or of one surprised by an accident in the midst of health, will cause dyspnœa almost suffocative in degree, faintness, great acceleration of the pulse, and intense pain. If the affair be more serious there may also be symptoms of collapse, including a fall of temperature, cold extremities, ashen face, colliquative sweats and chill breath. On the other hand, in pneumothorax occurring towards the end of phthisis, when a pulmonary ulcer breaks into the pleura widely-adherent about a lung already half-obliterated, an attack of chest-pain may follow a bad fit of coughing, and be often put down, like the dyspnœa and the pulse-rate, to the fatigues and distress of a restless night. The patient's general condition is not very markedly altered in such cases, and the pneumothorax is often overlooked. Cough and expectoration of course assume no proportions in simple pneumothorax; but if pneumothorax be established on the bursting of an empyema into a bronchus, it is obvious that cough and expectoration will be the most prominent of the symptoms. It is well to remind the reader that emphysema of the skin may result from the same breach which causes the pneumothorax.

The *physical signs* are as follows:—The affected side, in well-marked cases, may be enlarged in girth and of a rounder form. It is, moreover, still in respiration, the half of the chest being fixed in the inspiratory position, or only dragged a little by the efforts of the accessory muscles. Air, like fluid, may press down the diaphragm, thrust the mediastinum aside, and change the place of the heart. And even if the admission of air be not through a valvular opening, and the admitted air be passive, yet, as Dr. Douglas Powell has shown, the elasticity of the opposite lung will dislocate the parts to some extent. In other cases, as in pyopneumothorax with retraction, the affected side often falls in so as to be of less girth than the sound side. In such a case, of course, there is no tension of the contained air. Vocal fremitus must be absent if the lung be wholly collapsed, or far removed from the wall of the chest; if the lung be adherent in part to the chest-wall, vocal fremitus may be proportionally perceptible, and it may be possible to ascertain by other methods how far, if at all, the lung is adherent. Decubitus is usually on the affected side.

Percussion gives us great assistance in the detection of pneumothorax, the sound being tympanitic everywhere where lung is not, by adhesion or repression, kept in contact with the chest-wall, and often extending beyond the normal boundaries of the affected side. There is something about the loud, low-pitched and extensive (tympanitic) vibrations of the stricken chest in pneumothorax which is very characteristic. On the other hand, it is said that if the pleura be tightly distended by air under high pressure the percussion note may rise to positive dulness, and the presence of fluid will dull the percussion considerably or altogether, in districts which will vary with the quantity of fluid and the position of the patient. In pyopneumothorax, with a bronchial fistula, the sharp line between hyper-resonance and dulness may be changed after a profuse expectoration. By percussion with palpation the dislocation of neighbouring parts and organs may be ascertained. The auscultatory phenomena of pneumothorax are curious, and were known even to Hippocrates. If we confine ourselves to pneumothorax pure and simple, auscultation is generally almost negative; in rare cases we may detect by a blowing sound the entrance and exit of air by a free opening, but in such cases fluid is always present as well. In them there may be faint amphoric breathing and a few resonant *râles*, especially near the shoulder-blade. The voice sounds in like manner; and the cough may be more or less amphoric. Vesicular breathing is never heard. In pneumothorax, there is often present the peculiar phenomenon called the *metallic ring*. After death this metallic echo is always to be obtained, but during life the increased tension of the gas at the higher temperature may prevent it. In addition to this a very clear cracked-pot sound may be heard in some cases of pyopneumothorax with a wide fistula. The metallic tinkle of succussion, which was known to Hippocrates, consists in the echo of splashing or dripping fluid in the air-containing pleural cavity; and indeed other sounds generated inside the patient, such as the heart-beat, cough, &c., may take this metallic resonance from the chest-cavity, and may betray pneumothorax or illustrate it. In the same case, at different times, such sounds may be heard, or may be inaudible—changes which are, perhaps, due either to mechanical conditions dependent upon adhesions, the formation of false-membranes, the shape of the cavity, or the tension of the contained gases. *See* PHYSICAL EXAMINATION.

DIAGNOSIS.—The diagnosis of pneumothorax by the signs and symptoms above named is not difficult, if the occurrence of it be sudden and the patient not too ill to resent examination. If the presence of adhesions prevent the development of these symptoms, the case may be more obscure, but by so much the less serious. As, on the one hand, in an enormous moist cavity it is conceivable that metallic and succussion sounds may be heard, so, on the other hand, pyopneumothorax, restricted by adhesions to small dimensions, might simulate a cavity. Indeed, diagnosis might be impossible in such cases, but speaking generally, the dulness and retraction of the chest-wall over a cavity would assist the diagnosis. Distension of the stomach, with elevation of the diaphragm, or diaphragmatic hernia, could scarcely be mistaken for pneumothorax by anyone who fairly took into consideration all the facts and history of the case. As empyema, especially in children, is liable to lead to purulent pericarditis, so may pyopneumothorax by perforative process have pyopneumopericardium added to it. Emphysema of the lungs gives rise to tympany sometimes as great as of pneumothorax. Emphysema, however, is always two-sided, and rarely dissociated from sibilus or other sign of open bronchial tubes. In cases of pyo- or sero-pneumothorax there may be great difficulty in determining the quantities of fluid and of gas respectively in the cavity; as much as three quarts of fluid may co-exist with a great deal of resonance above it. Tapping alone could decide the matter, and in such a case would probably be indicated.

PROGNOSIS.—This obviously depends so largely upon the causes and concomitants of the pneumothorax, that any general estimate of it is impossible. The tendency of air in the pleura is to absorption. The prognosis of chest-wounds, of phthisis, of empyema, contains differences too wide for formulation. It is asserted that pneumothorax, by the sudden oppression of the lung, through the in-rushing air, may cause rapid and even sudden death.

TREATMENT.—The treatment of pneumothorax in like manner must depend greatly upon the nature of the primary malady. In pyopneumothorax from empyema operation is the first necessity in a patient of sound constitution. Whether in any given case of phthisis pyopneumothorax should be dealt with by operation may become a question—but a question usually, of course, to be decided in the negative. In such cases opiates alone are our resource. Still, a case may be imagined in which the urgency of operation may outweigh its risks. In wounds of the chest-wall, or of the pulmonary pleura, the puncture rarely closes so soon as to imprison the air in a state of higher tension than the atmosphere. Such a thing may occur, however, and the displacement of organs and respiratory distress may indicate that relief is urgently needed. If it be, a fine trochar may be inserted into the chest, and by means of a tube air may be permitted to escape through water until equilibrium is re-established. The hypodermic use of morphia is as valuable in soothing the pain and distress of pneumothorax as of like suffering elsewhere. Walshe recommends general bleeding, if admissible, or in any case free dry-cupping of the affected side. Among drugs he chiefly recommends musk, in five-grain doses, and very small inhalations of chloroform.

4. Pleura, Dropsy of.—SYNON.: Hydrothorax; Fr. *Hydrothorax*; Ger. *Brustwassersucht*.

DEFINITION.—As the word implies, this is the term given to simple aqueous effusions into the thoracic cavity.

DESCRIPTION.—Hydrothorax is not to be classed with the effects of inflammation, but with dropsies elsewhere, and is the companion in many cases of ascites and anasarca. In other cases it exists alone, but is rarely confined to one side of the thorax, and perhaps never exists as a sole malady. We may say generally that it is liable to arise under the following circumstances:—when the whole circulation is so impeded that venous pressure is increased—as, for instance, in disease of the mitral valve or its orifice; when venous arrest is due to some local causes, as for instance, to the pressure of localised swellings upon veins, or to venous thrombosis; when the bronchial glands are enlarged; when in renal disease the removal of water from the system is checked; or, finally, when the quality of the whole blood is so deteriorated by disease, or the circulation is so changed by cold, or other such general influence, that its serum tends to exude passively from the vessels. In the first and third cases we should expect to find dropsy in both pleural cavities, in the second case the transudation might be limited to one of them. On the other hand it is to be remarked that such transudations rarely stand at the same height in the two cavities, and indeed the contents of one of them is often so small in volume that the hydrothorax may seem to be unilateral. As a matter of experience hydrothorax is chiefly seen in diseases of the heart and kidneys, in scarlet fever, in septic and other diseases of the blood, and in the cancerous and other cachexias, whether there be local disease of the pleura or not.

Diagnosis.—The diagnosis of hydrothorax and its measure are easy, except in a few cases where the effusions are restrained by adhesions. The lung floats more readily than in pleuritic effusion, and the diaphragm often retains its normal relations.

Treatment.—Hydrothorax in the majority of cases is not formidable in itself, and (being not uncommonly an event of the last days of life) is perhaps only noticed at the autopsy. Diuretics and hydragogue purgatives act more readily in hydrothorax than in inflammatory serous effusions. Still, if it increase so far as to harass the breathing or to add to the dangers of the disease, the fluid may be drawn away by a fine trochar without any fear of purulent change. It is well, however, to prevent the entrance of air into the chest, lest the fluid have in any degree an inflammatory nature, as it may well have in scarlatina or nephritis, for instance. The operation may be repeated a great number of times if re-accumulations make it necessary. The fluid, if wholly non-inflammatory, will appear as a greenish or yellowish transparent water, containing no clots nor coagulating in the vessel; it will not contain corpuscular elements. The presence of a corpuscular precipitate, or any troubling of the fluid, will at once suggest a degree of pleuritis. In heart-disease with much venous stasis the effusion is not rarely tinged with blood. If there be coagulation, however, the effusion is probably inflammatory.

5. **Pleura, Hæmorrhage into.**—Synon.: *Hæmothorax.*—Bloodstained effusions may occur, as we have said, even in simple pleurisy, but more commonly in such conditions as scurvy, tubercle, cancers, and the like. A purely sanguineous effusion is generally the result of wounds of the chest or its viscera; but it may also arise from within, as from rupture of the heart or of an aneurism, or from a bleeding cancer. The means of examination or treatment of such cases, in so far as these are possible, may be gathered from the preceding sections. Hæmorrhage into the pleura from direct extravasation may be left awhile, on the chance of reabsorption. If this does not seem on the way, a tentative puncture may be made. If the issue be ichorous, the patient will probably become febrile, and the major operation be needed sooner or later.

6. **Pleura, Morbid Growths in.**—The pleura enjoys no complete freedom from the invasion of sarcomatous or carcinomatous growths; but the former class of growths are very rare, except as intrusions from neighbouring parts. Cancer is found less rarely. The frequency of mammary cancer and the neighbourhood of the pleura to the breasts increases the danger of secondary mischief in the former part. Pleural mischief is, indeed, a common consequence of mammary cancer, and may be the fatal conclusion of a case. It occurs after or before operations of excision. From the cancer in the wall of the chest simple inflammation often extends to the pleura, and produces the usual results. In other cases the cancerous growth is itself propagated to the costal pleura, and spreads from thence. The cancer is usually seen in the form of small flattened or rounded elevations, rich in bloodvessels. If septic matters escape into the pleural cavity its effusions may soon become putrid. It is said that a rapid degeneration of cells, either cancerous or tubercular, may give rise to a quantity of fat-droplets so great that a layer of fat may be seen to stand on the top of the serosity withdrawn by tapping. Blood, too, easily issues from highly vascular formations—whether cancerous, tubercular, or simply inflammatory; and may be seen in the fluids after withdrawal.

There is little to be said of the symptoms and signs of such cases that has not been said already under the more general heads of Lungs, Morbid Growths in; Mediastinum, Diseases of; and Pleurisy. The diagnosis of cancerous or other such masses from their own effusions or from simple effusions, let it be frankly repeated, is sometimes impossible without the needle. The prognosis in such cases will not depend upon the pleuritic changes alone; and the only remark to be made on their treatment is that paracentesis, in the secondary effusions, is not wholly to be declined. Some such patients have obtained from repeated puncture not only a prolongation of life, but also great relief of suffering.

T. Clifford Allbutt.

PLEURODYNIA (πλευρὰ, the side, and ὀδύνη, pain).—Synon.: Intercostal myalgia; Fr. *Pleurodynie*; Ger. *Seitenschmerz.*—A name for muscular rheumatism or cramp affecting the chest-wall. *See* Cramp; and Rheumatism, Muscular.

PLEURO-PNEUMONIA.—This compound word signifies a combination of inflammation of the pleura and of the lung itself. In all cases of acute pneumonia there is a certain degree of pleurisy corresponding to the inflamed lung; but it is of little or no practical significance, there being only some exudation on the pleural surfaces. Pleuro-pneumonia implies that the two morbid conditions are actually associated in various degrees, giving rise to their respective pathological changes, and each thus influencing the symptoms and physical signs. Individual cases, therefore, present many diversities, in accordance with the different ways and degrees in which the two diseases are combined. It may happen that they are associated from the first; or one may supervene during the progress of the other, in this way modifying its course, and not uncommonly rendering the diagnosis more or less obscure and difficult. It may be affirmed that the exact conditions present in the chest under such circumstances can only be positively determined by adequate physical examination; and it must be remembered that the pleuritic and pulmonary conditions will each tend to modify the signs produced by the other. No general rules can be laid down as to prognosis or treatment, but every case must be regarded on its own merits, in accordance with the principles laid down in the articles which treat of pneumonia and pleurisy respectively. *See* Lungs, Diseases of; and Pleura, Diseases of.

Frederick T. Roberts.

PLEUROTHOTONOS (*πλευρόθεν*, laterally, and *τόνος*, tension).—A form of tetanic spasm, in which the body is bent towards one side. *See* Tetanus.

PLICA POLONICA (base Latin).—Synon.: Fr. *la Plique*; Ger. *Weichselzopf*.—An alteration in the direction of the hair, attended with matting or felting, and resulting from neglect. *See* Hair, Diseases of.

PLOMBIÈRES, in France.—Simple thermal waters. *See* Mineral Waters.

PNEUMATOCELE (*πνεύμων*, the lung, and *κήλη*, a tumour).—Hernia of the lung. *See* Lungs, Malpositions of.

PNEUMOGASTRIC NERVE, Diseases of.—Synon.: Fr. *Maladies du Nerf Pneumogastrique*; Ger. *Krankheiten des Vagus*.—Of all the cranial nerves, the pneumogastric has the most extensive distribution, supplying the pharynx, larynx, lungs, heart, œsophagus, and stomach, and even, in part, the intestines and the spleen. In some of the so-called functional diseases of the organs which it supplies, its action is conspicuously deranged. The symptoms of its disease are thus very extensive, and it will be well first to describe them generally, and afterwards to consider in detail those which merit separate description.

Some of the functions of the vagus depend upon fibres of the spinal accessory which join it, but it is convenient to consider these in this article.

The pneumogastric, it will be remembered, arises from the side of the medulla, between the glosso-pharyngeal above, and the spinal accessory below, and to the outer side of the hypoglossal. The fibres of origin come from a tract of grey matter which is continuous below with the nucleus of the spinal accessory, and above lies, in the calamus scriptorius, between the hypoglossal and internal auditory nuclei, while to the outer side of the upper extremity, and more deeply seated, is the nucleus of the glosso-pharyngeal. The trunk of the nerve, after receiving fibres from the spinal accessory, and giving off some small branches (of which the most important is one to the external ear), passes down the neck, behind, and in the same sheath with, the carotid artery; enters the thorax on the right side, over the subclavian artery, and, on the left, between the subclavian and the carotid; passes through the thorax beside the œsophagus; and ends in branches to the stomach, spleen, and intestines. The most important branches are the pharyngeal, which, with the glosso-pharyngeal, forms the plexus of the same name; the superior laryngeal; the recurrent laryngeal, which passes back, the left around the arch of the aorta, the right around the subclavian artery; branches to the œsophagus; pulmonary branches which, by means of the pulmonary plexus, supply the lung; and branches which form the cardiac plexus for the heart.

Ætiology.—The deep position of the pneumogastric and its branches preserves it from some forms of damage, although its extensive course renders it liable to suffer from many causes. The nucleus in the medulla may be damaged by local softening, hæmorrhage, or slow degeneration; but in all these cases other, adjacent, nuclei suffer (*see* Labio-glosso-laryngeal Paralysis). The nerve, at its origin from the medulla, may be compressed by thickening of the meninges, growths from the meninges or bones, or aneurism of the vertebral artery. Affections of the nerve due to syphilis are almost always the result of meningeal disease in this situation. Other adjacent nerves commonly suffer at the same time. The trunk of the nerve is sometimes, but rarely, implicated in punctured or gunshot wounds; incised and lacerated wounds damaging it are usually immediately fatal from lesion of the large blood-vessels to which it is contiguous. In surgical operations the trunk and branches of the nerve are occasionally injured. The trunk has been tied in ligature of the carotid, and divided in the removal of deep-seated tumours. In such operations in the lower part of the neck it is often also difficult to avoid injury to the recurrent laryngeal. In excision of an enlarged thyroid both recurrent laryngeals have been repeatedly excised, from the time of Galen down to the present. Sarcomatous and other tumours, and enlarged glands, may compress or involve the nerve in almost any part of its course; and interference with its function especially occurs from such disease in regions limited by rigid structures, as in the upper part of the neck, near the skull, and in the upper part of the thorax. Aneurisms may compress the nerve or its branches; and the recurrent laryngeals suffer from this cause with especial frequency, because they pass round large blood-vessels. The left suffers much more frequently than the right, because the arch of the aorta is more frequently affected by aneurism than the subclavian. An enlarged thyroid may compress the recurrent laryngeal nerves, and symptoms due to such compression may vary with the varying size of the tumour. The nerve is, in rare cases, the seat of neuromata. Neuritis of the trunk of the nerve, due to cold, is supposed to be an occasional cause of symptoms, but such cases are extremely rare.

Some toxic influences, and especially the poisons of diphtheria and lead, may affect it, probably by acting on its central origin.

Symptoms.—It must be remembered that the vagus nerve, besides containing motor fibres for the pharynx and larynx, is the chief afferent nerve for the respiratory centre. It contains accelerating and inhibitory fibres for this centre, but the former preponderate, so that experimental division of the nerve in an animal renders the respirations less frequent, but deeper, while stimulation of the divided (central) end quickens the respiration, and may even arrest it in tetanic standstill. The inhibitory fibres are contained chiefly in the superior laryngeal nerve, and their stimulation arrests the respiration in muscular relaxation. It is the inhibitory nerve of the heart; slight stimulation increasing the diastolic periods, and stronger stimulation arresting the action of that organ. On division of the nerve the cardiac contractions are accelerated. It has been said to contain trophic fibres for the heart and lungs, but this is not certain. The pneumogastric is an afferent nerve for the vaso-motor centre, the action of which is lowered by its stimulation, so that the arteries throughout the body are relaxed. It is the motor and sensory nerve for the œsophagus; the sensory nerve for the stomach; and partly also the motor nerve for the stomach and intestines.

Symptoms due to paralysis of the vagus are more frequently met with than those which result from its irritation. Occasionally both are combined. Laryngeal spasm and vomiting are the irritative symptoms most commonly met with, but occasionally cardiac inhibition occurs. Czermak, for instance, was able to arrest his heart for a few beats at will, by pressing a small tumour of the neck against his pneumogastric. Concato had a patient in whom a similar inhibition could be caused by pressure on the right nerve. The increased frequency of pulse which corresponds to its paralysis has been several times noted, and has occasionally been associated with diminished frequency of respiration, although the laryngeal paralysis, also resulting, has often obscured the effect on the respiratory movements. Roux tied the trunk of the vagus with the left carotid; instantly respiration was arrested, but the pulse was also retarded. The ligature was immediately relaxed, but the patient died in half an hour. Robert also tied the nerve with the carotid; the patient, who was conscious, immediately called out, 'I am suffocated!' and his voice became hoarse. He recovered, but the hoarseness continued for six months. A good example of interference with the functions of the vagus has been recorded by Guttmann. A lad, after diphtheria, presented paralysis of the palate and of one sternomastoid. His respiration quickly became reduced to twelve per minute, and very laboured, while his pulse rose to 120, and he died in a few hours. In many other cases a similar change in the pulse and respiration has been noted, and even a pulse-ratio of 160–200. In the face of these observations, and of experiments on animals, it is not easy to understand a fact said to have been observed by Billroth, who excised half an inch of one pneumogastric, which was implicated in a tumour, without any resulting symptoms.

The important central relations of the vagus above alluded to cause derangement of its function to form part of many so-called functional disorders of the central nervous system. Its nucleus forms part of, or is connected with, the respiratory centre, which is conspicuously disturbed in hydrophobia and some other diseases. The phenomena of 'Cheyne-Stokes breathing,' or 'respiration of ascending and descending rhythm,' are probably the result of lowered action of the respiratory or pneumogastric centre (*see* Respiration, Disorders of). This symptom is met with in cerebral hæmorrhage, uræmia, meningitis, and in some cardiac diseases. The central connections of the vagus, in the hemispheres, extend to, or are connected with, those parts which are concerned in emotion, and it is probably through the agency of this nerve that the heart's action is affected in excitement and fear. In many epileptic fits the central representations of the nerve are the parts through which the consciousness is first affected, and hence the so-called 'epigastric aura.'

A similar disturbance seems to be the cause of the globus hystericus and of the laryngeal spasm, which are conspicuous in some epileptic and hysteroid seizures. The nerve is closely connected with the centre or nerves for equilibration, so that severe vertigo, on whatever dependent, is often followed by vomiting. The pneumogastric nucleus is contiguous to the internal auditory nucleus, and part of the auditory nerve, that which comes from the semicircular canals (the space-nerve of Cyon) is known to be concerned in equilibration. In the vertigo which results from disease of this nerve, or of the canals (labyrinthine or auditory vertigo) vomiting is very common, and the nausea and retching of sea-sickness are probably due to the deranged action of the semicircular canals, in consequence of the motion affecting the pneumogastric centre. It is possible that the connection of the vagus with the equilibrial nerves is by means of the cerebellum, disease of which so constantly causes vomiting, although this connection has not yet been traced. Conversely, gastric disturbance of the vagus is often accompanied by vertigo, especially when combined with pre-existent imperfect action of the auditory nerve.

1. **Pharyngeal Branches.**—The branches of the pneumogastric which enter the pharyngeal plexus supply the constrictors of the pharynx and the soft palate. Some have asserted that all the pharyngeal branches are derived from the spinal accessory; the pathological evidence that the branches to the soft palate are derived from this source is very strong, since when one vocal cord is paralysed from disease of the roots of the spinal accessory, the levator palati on the same side is always paralysed, and very often the tongue. *See* Palate, Paralysis of.

(1) *Paralysis.*—Ætiology.—The most common cause of paralysis of the pharynx is disease of the origin of the nerve in the medulla; such disease commonly also involves adjacent nuclei (*see* Labio-glosso-laryngeal Paralysis). Paralysis may, however, result from meningeal disease outside the medulla, from disease of the bones of the base of the skull, but scarcely ever from disease outside the skull. It occasionally forms part of diphtheritic paralysis.

Symptoms.—The chief symptom is difficulty in swallowing. Food lodges in the pharynx about the epiglottis, and small particles and liquids may enter the larynx. If the paralysis is limited to the superior constrictor, liquids may, it is said, be forced up into the nose by the contraction of the middle constrictor; but it is doubtful whether this occurs unless the palate also is paralysed. The affection of one nerve causes only slight trouble in deglutition, no doubt because of the circular arrangement of the muscular fibres.

Diagnosis.—The only conditions with which paralysis of the pharynx can be confounded are spasm and organic disease. The writer once saw an elderly man with distinct pharyngeal paralysis, who had been sent to an eminent surgeon because the difficulty in swallowing was supposed to indicate cancer of the throat. A careful examination is usually sufficient for the distinction.

(2) *Spasm.*—Spasm of the pharynx may be recognised by its paroxysmal character, and is almost always part of 'functional' nervous disease. It forms part of the spasm of hydrophobia; and occurs in hysteria, and in some other allied states. Individuals are sometimes met with who are unable to take food except when alone, so great is the amount of pharyngeal spasm which the presence of others induces.

2. **Laryngeal Branches.**—It will be remembered that, of the two laryngeal nerves, the superior is the sensory nerve for the larynx, and also supplies motor power to the crico-thyroid muscle, which is the tensor of the cords; while the recurrent laryngeal is purely motor, and supplies the other muscles. The motor fibres of both are derived from the spinal accessory. Of the muscles, the most important in regard to paralysis are the chief abductor, the posterior crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage backwards, and so moves the processus vocalis outwards); the chief adductor, the lateral crico-arytænoideus (which draws the postero-external angle of the arytenoid cartilage outwards, and thus the processus vocalis inwards); and the arytænoideus (which approximates the two arytenoid cartilages). Other muscles, acting at the same time, increase the power of closure.

(1) *Paralysis.*—Only paralysis of the abductors and adductors need be discussed in this article. That of the tensors and laxors of the vocal cords, although very important among laryngeal diseases, is always the result of local conditions, not of lesions of the pneumogastric nerve.

Ætiology.—Almost all diseases of the nerve-trunk affect the fibres to the larynx, the only exception being the diseases of the trunk below the origin of the recurrent laryngeal. Syphilitic and other intracranial disease, injuries, and pressure by tumours, all have this consequence; and the motor paralysis is, necessarily, almost as complete in disease of the recurrent laryngeal as in that of any part of the trunk of the pneumogastric. In diphtheria the larynx is also sometimes paralysed. Rheumatic paralysis is probably always local. Diseases affecting the fibres of origin of the spinal accessory at the medulla, or its trunk in the neck, or the recurrent nerve, usually, and diphtheria occasionally, cause paralysis on one side only. Affections of the nucleus of origin of the nerve are usually bilateral; and the other common cause of bilateral paralysis is the implication of both recurrents in growths in the upper part of the thorax. Diphtheria also sometimes causes paralysis of both nerves.

Symptoms.—In complete *unilateral* paralysis the affected vocal cord is usually in half-abduction, in the position assumed after death. Although there is loss of all movement, that of adduction is the obtrusive defect. In phonation the unaffected cord moves up to or beyond the middle line, while the paralysed cord remains motionless; and the movements outwards in inspiration and inwards in expiration, are performed only by the healthy cord. The voice, under these circumstances, may be hoarse, or it may be little altered, the healthy cord being moved beyond the middle line into sufficient proximity to the other to permit phonation. Complete approximation, such as is necessary for a cough, is impossible; and in the attempt to cough the patient only succeeds in driving air quickly through the open glottis, and no sudden explosive cough is possible. Sometimes, in complete unilateral paralysis, the affected cord is not in semi-abduction, but is nearly up to the middle line. It is in the position for phonation, and so there is no defective approximation in uttering vowel-sounds; but when phonation is over, and especially during inspiration, the healthy cord is abducted, while the paralysed cord remains motionless. Thus the loss of abduction is the conspicuous defect. On what the difference in the position of the paralysed cord depends, whether it is in abduction or in adduction, is not quite certain. The position of adduction is seen especially in paralysis of the recurrent nerve. A plausible explanation, which has been suggested to the writer by Dr. Poore, is that the position of abduction is the early state, and that after a time, in some cases, the unopposed crico-thyroid over-extends the cord, and so brings it into the middle line, just as in other organs, muscles, the opponents of which are paralysed, gradually, by their tonic shortening, alter the position of parts to which they are attached. In paralysis from disease of the roots of the spinal accessory at the medulla, the affected cord is always, as far as the writer has seen, in a state of partial abduction, a fact which harmonises with Dr. Poore's explanation, since, in this case, the crico-thyroid will also be paralysed. When the cord is in the position of adduction, the voice is high-pitched. At rest there is no dyspnœa, but on exertion the unabducted cord interferes with the entrance of sufficient air, and respiration becomes stridulous and short; but there is rarely, if ever, sufficient dyspnœa to render tracheotomy necessary.

Bilateral paralysis is much less common. It may be due to central disease; to diphtheria; to pressure on both recurrent laryngeal nerves from tumours in the upper part of the thorax; or to the injury of these nerves in the excision of enlarged thyroid. Two remarkable cases have been recorded (Baümler, Johnson), in which pressure on one recurrent laryngeal and vagus has caused paralysis of both vocal cords, in one case equally, in the other less on the side opposite to the tumour than on the same side. Dr. Johnson suggests that the mechanism is probably an inhibition of the central nucleus on both sides, by the pressure of the afferent fibres in the vagus. In bilateral paralysis the same difference in the position of the cords is met with as in unilateral paralysis. Sometimes they are apart, in half-abduction, and sometimes approximated in adduction. In each case they are motionless. In the first instance the absence of the adduction for phonation is more conspicuous than the want of respiratory movement, and leads to the condition being designated *paralysis of the adductors*; in the latter the absence of the normal abduction on inspiration attracts chief attention, and there is said to be *paralysis of the abductors*. It is probable that Dr. Poore's explanation applies to these cases also. The difference between the two in their symptoms is very great. When the vocal cords are in abduction phonation is almost, or quite, impossible, and there is no closure of the glottis in cough. There may be no dyspnœa unless on very active exercise. When, however, the cords are near the middle line, the patient's condition is very different. He is able to speak, but only in a high, stridulous voice. The most urgent symptoms arise from the absence of the normal respiratory movements. Instead of being abducted in inspiration, the pressure of the air brings the cords closer together, while the current, in expiration, separates them. This inspiratory approximation of the cords constitutes a source of the gravest danger. When the patient is at rest enough air may enter to prevent dyspnœa, but exertion brings on stridor and intense difficulty of breathing. The least swelling of the cords occludes the glottis entirely. This condition is one of great rarity, and is most commonly due to central disease.

Slight impairment of adduction of the cords is a very common and much less grave affection, met with in general weakness, hysteria, and local inflammatory diseases. It has been termed 'phonic paralysis,' because in the slight effort of speaking the cords are not approximated, while in the stronger effort of the cough they are brought together perfectly. It does not result from nerve-lesions.

Anæsthesia of the larynx may result from disease of the superior laryngeal nerve, but is extremely rare from this cause. Lessened sensibility, bilateral, is not uncommon in central disease of the medulla.

(2) *Spasm.*—The common form of spasm of the laryngeal muscles is that of the adductors. The muscles which close the glottis are far more powerful than those which open it, hence any irritation of the nerves—direct, central, or reflex—causes closure. For this closure, since it plays an important part in many physiological processes, a central mechanism is provided, which is readily excited by various means. In cough, for instance, it may be excited, not only from the special afferent nerves of the throat, larynx, and lungs, but also by those of the stomach, and even, it is believed, by the branch of the vagus which goes to the external auditory meatus. Spasmodic cough may result from the simple irritability of the centre, as in hysteria; and a peculiar barking cough is occasionally the result of masturbation in boys. In whooping cough, again, the glottis, after being closed, is imperfectly relaxed, so that a sound accompanies the next inspiration. Simple laryngeal spasm, without implication of the expiratory muscles (laryngismus stridulus), occurs in children, in whom, in consequence of the constitutional condition known as rickets, the central nervous system is in a state of undue irritability. In this the vaso-motor centre seems to participate; a child, on some exciting cause, as a start, a reflex impression, or on none, suddenly turns pale, is unable to get its breath for a few seconds, and then, the spasm relaxing, air is drawn through the slowly opening glottis with a crowing noise. Quite similar attacks may occur in adults. It may be accompanied by distinct convulsive action elsewhere. In the paroxysms of epilepsy a similar combination is seen; the epileptic cry is the result of laryngeal spasm. Hydrophobia also is attended with a paroxysmal closure of the glottis.

Since the closure of the glottis is the physiological effect of irritation of the afferent laryngeal nerves, it is not surprising that spasm accompanies a large number of laryngeal diseases, varying in its prominence according to the irritative nature of the disease, and the irritability of the reflex mechanism; and, since the latter is most intense in children, we have in them a condition in which the slightest local catarrh gives rise to spasm. The attacks tend to occur especially at night, when the reflex centres, released by sleep from the control of the higher, are in their most active state. Spasm may occur, not merely from irritation of the laryngeal nerve, but from that of the vagus below (or by compression by tumour), the afferent nerves from the lungs being sufficient to generate it. Reflex spasm is always bilateral in character. Direct spasm by irritation of the recurrent laryngeal usually involves only one vocal cord; but in a few cases spasm so excited has been bilateral. This result can only be explained either by assuming the irritation of some afferent fibres, or by ascribing it to the spasm of the arytænoideus, which is a bilateral muscle (Krishaber).

A very rare condition of 'functional spasm' has been described, in which spasm is excited by attempts to speak. It has been thought to be similar in its nature to writer's cramp.

3. **Pulmonary Branches.**—The effect of disturbance of the pneumogastric on the respiratory movements, and the reflex effect of disturbances of the afferent pulmonary branches, have been already described. The muscular fibres of the bronchi are innervated by the nerve, and their paroxysmal contraction in asthma is thought to be produced through its agency. It has been asserted that the plain muscular fibres, said to exist throughout the lung-tissue, are supplied by it (Gerlach), and their contraction has been assumed to explain a peculiar form of emphysema, which has been observed in compression of the pneumogastric (Tuczek); but, since deep breathing of a costo-superior type was observed, it is possible that the effect is the result of the energetic respiration from the disturbance of the centre. The pneumogastric is commonly believed to contain vaso-motor fibres for the vessels of the lungs, but Brown-Séquard and Franck have separately shown that these fibres

are contained, not in the vagus, but in the sympathetic. Vascular lesions of the lungs have, however, been observed after section of the vagus. Michaelson noted rapid congestion and hæmorrhage. It is possible that this may be of reflex origin. The congestion noted after lesion of the pons may also be produced through the agency of the sympathetic. In a case of hæmorrhage into the pons, fatal in two hours, the writer found intense congestion with extravasation into the left lung, and hæmorrhages in the left extremity of the stomach.

After section of the vagus, animals die from chronic pneumonia, and hence the vagus has been supposed to be a trophic nerve for the lungs. But the changes have been accounted for by the entrance into the bronchi of food from the pharynx, in consequence of the obstructive paralysis of the œsophagus, and the paralysis of the larynx (Traube, Steiner). All admit that this is one cause of the pulmonary affection, but differ as to its adequacy in all cases. The question is still undecided.

4. **Cardiac Branches.**—The inhibitory effect of irritation, and acceleration of the heart's action, which results from lessened action of the vagus, have been before alluded to. The increased frequency has been several times observed in cases of local disease of the vagus in the thorax, compression by mediastinal tumours, &c. In a case of phthisis, for instance, in which the pulse was at first occasionally, and afterwards constantly, frequent (130–148), Meixner found the left vagus enclosed in a mass of enlarged glands in the upper opening of the thorax. The vagus is also the afferent nerve from the heart, and although we are normally unconscious of the cardiac action, some of the disordered sensations of disease are apparently produced through its agency. The subject of angina pectoris, and its relation to the vagus, are discussed in a separate article, but it may be here noted that in some anginal attacks the heart's action is, for a time, arrested or retarded, and that in a few cases these symptoms have been found associated with organic disease of the cardiac plexus. Thus in a case in which, during paroxysms of intense anginal anguish, the heart's action was arrested for four or six pulsations, Heine found a tumour involving the cardiac plexus. In a case recorded by Blandin, anginal attacks were associated with a small tumour of the vagus. Further, there are afferent fibres from the heart inhibiting the action of the vaso-motor centre, and these are probably stimulated in some anginal seizures.

After disease or injury of the vagus, the heart has been found in a state of fatty degeneration, and hence it has been thought that the vagus contains trophic fibres for the cardiac substance.

5. **Branches to the Alimentary Canal.**—The branches to the œsophagus are rarely diseased except in cases of affection of the nerve-trunk or of the centre. In very rare cases such disease has caused difficulty in swallowing, simulating stricture. Spasm of the œsophagus is more frequent. The vagus is the sensory, and in part the motor nerve for the stomach. Its fibres are very sensitive to any local irritation, and not rarely the seat of spontaneous neuralgia. Hunger is generally believed to be a pneumogastric sensation, and complete loss of the sensations of hunger and thirst were noted in a case of softening of the root of the vagus from an aneurism of the vertebral artery (Johnson). Appetite, however, is not always lost in animals when the pneumogastrics have been divided (Reid). In some cases of disease of the nerve, excessive appetite has been noted. This symptom, for instance, was noted in one case, in conjunction with dyspnœa, noisy breathing, and vomiting of unaltered food: *post mortem*, both pneumogastrics were found atrophied (Swan). In another case of insatiable appetite, small neuromata were found on the nerve. It is possible that the polyphagia may be in part the result of the defective digestion of food.

The pneumogastric is also in part the motor nerve of the stomach; after its section the contractions of the organ are lessened, although not altogether arrested. Vomiting is probably produced through its agency, by varied reflex and central irritation. In the latter case (as in meningitis) the vomiting is sometimes extremely rapid. The writer has known paroxysmal vomiting to result from the intermitting pressure of a tumour on the vagus; and Boinet, having exposed the vagus in an operation in the neck, noted that whenever he touched the nerve the patient vomited.

The vagus accelerates the contraction of the intestines, but no intestinal symptoms have been noted from its disease.

General Diagnosis.—The chief symptoms on which the diagnosis of disease of the vagus, in any given case, would rest, are the laryngeal paralysis; retarded respiration; accelerated or retarded heart; and vomiting. The diagnosis of the seat of the disease rests upon the range of the symptoms, and associated morbid processes. Disease of the trunk of the vagus is much less common than disease of its branches or roots. Paralysis of one vocal cord, for instance, is almost always the result of pressure, either on the recurrent laryngeal, or on the roots of the spinal accessory at the medulla. Bilateral symptoms are usually due to central disease, or else (if slight) are of merely local origin. In most cases of pressure on the trunk and branches of the vagus the cause of the symptoms is distinct, the only exception being deep-seated tumours in the thorax.

Prognosis.—The prognosis is that of the cause of the disease, and is sufficiently discussed in other articles.

Treatment.—Little can be said on the general treatment of the diseases of the pneumogastric, since it depends on the different conditions to which the symptoms are due, and which are described elsewhere. Central disease, and causes of pressure on the nerve are, as a rule, beyond the range of treatment. Whenever there is reason to suspect pressure on the nerve-roots (from the combination of paralysis of the tongue, palate, and one vocal cord), iodide of potassium should be given, since this is more frequently due to syphilis than to any other cause. In laryngeal paralysis the local application of electricity is sometimes useful, but more so in the weakness which depends on local causes than in that which is due to nerve-lesions. Injections of strychnine are also sometimes useful, even, it is said, when its administration by the mouth is without effect. In central paralysis the treatment will depend on the indication given by the mode of onset regarding the nature of the lesion, whether softening or degeneration. In all spasmodic affections, sedative inhalations, especially chloroform, are useful; and bromides will lessen the irritability of the nerve-centre.

W. R. Gowers.

PNEUMOGRAPH (πνεύμων, the lungs, and γράφω, I write).—An instrument for recording the movements of respiration. *See* Physical Examination.

PNEUMONIA (πνεύμων, the lungs).—Inflammation of the substance of the lungs. *See* Lungs, Inflammation of.

PNEUMO-PERICARDIUM (πνεῦμα, air, and περικάρδιον, the pericardium).—A collection of gas in the pericardium. *See* Pericardium, Diseases of.

PNEUMOTHORAX (πνεῦμα, air, and θώραξ, the chest).—A collection of gas in the cavity of the pleura. *See* Pleura, Diseases of.

POCK.—A popular term for pustule, as though a pocket or pouch in the skin filled with pus. From the plural of pock is derived *pox*; hence, *small-pox*, *chicken-pox*, the *great pox* or *venereal pox*, and so forth.

PODAGRA (πούς, the foot, and ἄγρα, a seizure).—A common synonym for gout, as it usually attacks the foot. *See* Gout.

PODALGIA (πούς, the foot, and ἄλγος, pain).—A name for pain in the foot, due to any cause, such as gout, rheumatism, &c.

POINTS DOULOUREUX (Fr.)—Tender points in connection with the affected nerves in neuralgia. *See* Neuralgia.

POISONOUS ANIMALS. *See* Venomous Animals.

POISONOUS FOOD.—Under certain conditions, various articles of diet, especially meat, eggs, milk, butter, cheese, and honey, may become possessed of poisonous properties, and this may arise from a variety of causes, besides the introduction of known and specific poisons. Moreover, certain kinds of animal food—fish chiefly—may be possessed of definite toxic properties.

Food may be more or less poisonous—(1) from *unsoundness*, either from putridity or decomposition, and from disease; (2) from the presence of *parasites*; (3) from *mouldiness*, or presence of deleterious fungi; and (4) where the *flesh* is that of animals which have *fed on noxious or poisonous plants*; and under this head may also be classed poisonous honey, which bees have gathered from poisonous plants. (5) It may be of the nature of *poisonous fish*, using the term fish in the popular sense. Parasitic diseases might strictly be said to come under head (1); but as they are discussed in separate articles, the preventive measures to be adopted in the use of food infested with parasites will alone be treated of in this place. *See* Cysticerci; Tænia; and Trichina.

Poisonous Vegetables.—Unsound or even rotten vegetables and fruits may be consumed, especially in hot summers, and become fertile sources of varied forms of poisoning. The symptoms produced by the ingestion of large quantities of unsound fruit and vegetables are usually of a diarrhœal character, not often of an alarming severity, except in the cases of the young and feeble. They may, however, sometimes attain a fatal severity. The cause is usually obvious, and the treatment is simple—mild purgatives, as rhubarb or castor oil, with or followed by opiates, to remove peccant matters from the intestines; and stimulants, as ammonia or alcohol, if there be much collapse.

Poisonous Meat.—*Tainted or putrid Meat.* The obvious characteristics of good, sound flesh meat are that its colour is red—neither pale pink nor deep purple; that it is marbled in appearance; firm and elastic to the touch, scarcely moistening the fingers; having a slight and not unpleasant odour; and that when exposed to the air for a day or two, it should neither become dry on the surface, nor wet and sodden. Sound meat is *acid* to litmus paper; unsound meat may be neutral or alkaline. Meat may be tainted with physic administered to the animal. It is a common practice when a fat and valuable animal is unwell, to physic it, and if its recovery be not speedy to slaughter it. The meat of such animals may often be met with in our markets, and may induce illness from the physic with which it is contaminated. The effects of simple putridity are most varied. It is well known that some nations habitually eat, and even prefer, putrid in preference to fresh meat; and the development of rottenness in eggs for the epicure is an art in China. There is no doubt that habit has much to do with the tolerance of putrid meat—whether cooked or only partially cooked—by the stomach. But tainted game, and indeed all kinds of meat in which putrefaction has commenced, may, when taken, indubitably produce disease. This is chiefly of a diarrhœal character, preceded by rigors, and attended with collapse, and it may be convulsions and other signs of a profound affection of the nervous system.

The effects of such tainted meat are slight as compared with those which are produced by the sausage-poison, developed by a sort of modified putrefaction in certain German sausages. These sausages, when they become musty and soft in their interior, nauseous in odour and flavour, and acid to test-paper, acquire a highly poisonous character, and are frequently fatal in their effects. The symptoms produced by their use are gastric pain, vomiting, diarrhœa, depression, coldness of the limbs, and weak, irregular cardiac action. Fatal cases end in convulsions and oppressed respiration, death ensuing from the third to the eighth day. The nature of the sausage-poison, which is probably akin to that of putrid, and indeed all non-specifically tainted meats, has been a matter of considerable controversy. Some have held that the toxic action is due to the development of rancid fatty acids; others believe that a so-called catalytic body is produced, capable of setting up by contact a similar catalytic action. Others have regarded the sausage-poison as due to the formation of pyrogenous acids during the process of drying or smoking the sausages. The recent discovery by Selmi of a class of poisonous alkaloids, termed *ptomaines*, developed during putrefaction of animal matters, on the one hand; and the discovery by Ballard and Klein, still more recently, that the fatally poisonous properties of ham prepared according to the American method, may be due to the presence of a parasitic bacillus, point to one or other of these two latter causes as the source of the effects of sausage-poison. Others have referred the effects to the presence of a microscopic fungus—*sarcina botulina.*

Poisoned Meat.—The poisonous nature of the flesh of animals which have fed on certain plants, for example, hares which have fed on certain species of rhododendron, pheasants on the calmia, &c., has been abundantly demonstrated, and need only be referred to here. The honey from bees which have garnered on poisonous plants, as the azalea, may likewise be deleterious; and the fact is of classical interest. The milk even of goats and other mammalia which have browsed on poisonous herbs has also proved poisonous.

Diseased Meat.—The poisonous effects of meat affected with certain parasites—trichina, cysticerci, trematodes, &c., are referred to in the articles bearing these names. Great quantities of meat pass through our markets which is undoubtedly the flesh of animals affected with disease—foot-and-mouth disease, pleuro-pneumonia, pig typhoid, the so-called scarlatina of swine, sheep-pox, &c.; and it is a quite undecided point as to whether such flesh produces any injurious effects. To stop the sale of such meat would undoubtedly be to cut off large sources of our meat supplies. The evils attending the use of such diseased meat, when well cooked, have undoubtedly been exaggerated; but, on the other hand, there is enough evidence to show that the use of certain kinds of diseased meat is followed by serious results. Thus it is generally admitted that the flesh of animals which have suffered from pleuro-pneumonia and murrain, will give rise to boils and carbuncles. Braxy mutton may also produce disease when eaten. Trichina will produce trichinosis; hydatids the tape-worm; &c.

Poisonous Fish, Crustacea, and Mollusks.—Cases of poisoning by fish, crustacea, and the so-called shell-fish of our islands are not unfrequently met with. Generally it is the ingestion of crabs, lobsters, and mussels which produces such results. These are usually of a distressing, rather than of a serious character, nettle-rash being a common symptom. Occasionally, however, fatal results have ensued from the use of mussels. In tropical seas poisonous fish are more plentiful—the golden sardine, the bladder-fish, the grey snapper, &c.; and these being eaten by larger fish, as the baracosta, perch, globe-fish, conger-eels, &c., the latter may become in turn poisonous.

Preventive and Curative Measures.—Good cookery, that is, exposure to a sufficiently high temperature for a sufficiently lengthened time, is undoubtedly the best treatment, short of absolute destruction, of unsound and diseased meat. So long as meat is high-priced, and the effects of diseased meat so little understood and so undefined, it will be impossible to induce medical officers of health and sanitary inspectors to seize all the diseased and unsound meat which is daily offered for sale. Notwithstanding all that has been said to the contrary, experienced observers are agreed that thorough exposure of the meat throughout to the temperature (140° Fah.) at which albumen is coagulated, is destructive to the parasites of flesh. Smoking is less effective. Salting is more effective than smoking; but there is some evidence to show that salting may merely hold the life of organisms in suspense without entirely destroying their vitality; and thus in the conversion of American salted pork into American hams in this country—a process of re-salting and subsequent drying—the specific germ (a bacillus) has been known to be again rendered harmful. It is not known whether efficient cooking entirely removes the deleterious effects of flesh affected with other than parasitic disease, as, for example, pleuro-pneumonia.

The curative measures for the results of eating poisonous food cannot be specifically described. They are those which must be arrived at on general principles. Symptoms are to be treated, and the powers of the patient sustained, until the deleterious matter is removed by excretion, or the trichina, *e.g.*, has become encysted.

Thomas Stevenson.

POISONOUS GASES. *See* Carbonic Acid; Carbonic Oxide; Prussic Acid; &c.

POISONS.—Synon.: Fr. *Poisons*; Ger. *Gifte.*

Definition.—There is no legal definition of the word *poison*, and the definitions usually proposed are apt to include either too much or too little. Generally, a poison may be defined as a substance having an inherent deleterious property, which renders it capable of destroying life by whatever avenue it is taken into the system. Substances which act only mechanically, such as powdered glass, are not poisons. In popular language, a poison is a substance capable of destroying life when taken in small quantities. A poison, then, may be defined as any substance which when introduced into the system, or applied externally, injures health or destroys life irrespective of mechanical means or direct thermal changes. *See* Poisonous Food.

Action.—Poisons may exert a twofold action. Their action is either local or remote, or both local and remote. The local action of a poison is usually one of corrosion, inflammation, or an effect on the nerves of sensation or of motion. The remote actions of a poison are usually of a specific character, though some writers group the remote effects of poisons under two heads, and speak of the common and specific remote effects of a poison. The local actions of a poison of the corrosive class are usually so well marked and so easily recognised, that the fact of its administration is obvious. The same may be said, in a lesser degree, of the irritant poisons, especially the mineral irritants; but here the symptoms often so closely simulate those of natural disease as to render the diagnosis a matter of great difficulty. An accurate acquaintance with the remote specific effects of the various common poisons is indispensable to the medical practitioner. The class of poison which has been administered or taken will thus be suggested to his mind by the symptoms observed, and not unfrequently the specific poison will be suspected.

In this way the physician may often be at once able to diagnose, from the symptoms alone, the administration of strychnia, henbane, or cantharides. Great care must be taken, however, not to draw a rash conclusion from the one symptom alone; as, for instance, from the tetanic spasms which are so marked a feature in strychnia-poisoning.

It is generally, but not universally, held that absorption is necessary in order that a poison should be able to exert its specific effect. Some, nevertheless, are of opinion that a poison may destroy life by an action on the nervous system before absorption has had time to take place. The facts in support of this view are, however, few, and open to doubt.

Modifying Circumstances.—The usual action of poisons may be greatly modified—(1) by the largeness of the dose, and the state of aggregation, admixture, or chemical combination of the poisons themselves; (2), by the part or membrane to which they are applied; and (3), by the condition of the patient. Thus, for example, opium may be a medicament or a poison, according to the dose in which it is given; and a dose of opium which may be beneficial to an adult in certain states of the system may be fatal to a young child, or to the adult when suffering, for example, from Bright's disease. All barium salts are poisonous, except the sulphate, which is one of the most insoluble of all mineral substances. The simple cyanides are highly poisonous, and the same may be said of many double cyanides. But the double cyanide of iron and potassium (potassium ferrocyanide) is almost without action on the system. The part or tissue to which a poison is applied must obviously greatly affect the activity of a poison, owing to the varying rapidity with which absorption takes place through the cutaneous, mucous, serous, and other surfaces of the body. Curare may be swallowed in a considerable dose, without producing any appreciable effect, whilst a small quantity of the same substance introduced into a wound will speedily prove fatal. It has been found that when a poison is slowly absorbed, so that it can be either disposed of in the system or again excreted more rapidly than it is absorbed, no poisonous results ensue; but when absorption occurs so quickly that the poison can neither be excreted nor destroyed in the system as rapidly as it is absorbed, the specific effects of the poison are developed. Curare, for instance, is absorbed by the gastric mucous membrane more slowly than it is excreted through the kidneys. But if the renal arteries be ligatured, the poison accumulates in the blood, and the specific effects of the poison are developed, just as when curare is introduced into a wound.

Idiosyncrasy has much to do with the poisonous or hurtful character of a substance. Thus pork, mutton, certain kinds of fish (notably shell-fish), and fungi (*see* Mushrooms, Poisoning by), have, under certain circumstances, and in certain persons, produced all the symptoms of violent irritant poisoning; whilst others, who have partaken of the same food at the same time, have enjoyed perfect immunity. More commonly all who partake are affected, but with varying degrees of severity. Some persons are said, on good authority, to be capable of taking with impunity such violent poisons as corrosive sublimate or opium, in enormous doses, and this independently of habit, which is known to have such a large influence in modifying the effects of some poisons, notably of the narcotics. A tolerance of poisons is sometimes engendered by disease, so that a poison may from this cause fail to produce its accustomed effect. Thus opium is largely tolerated in tetanus, and in mania from drink; and mercurial compounds may in severe febrile affections fail to produce the usual constitutional effects of the metal. On the other hand, kidney-disease, by impeding elimination, may intensify the ordinary effects of a poison, and the like is observed when opiates are given where there is a tendency to cerebral congestion.

Evidence.—In order to raise a valid inference in the mind of the medical attendant that poison has been administered to a patient, certain facts must be brought under his notice; and without the concurrence of at least two or more of these, the actuality of poisoning cannot be maintained. The sources of evidence in cases of suspected poisoning are the *symptoms*, the *post-mortem appearances*; *chemical analysis* of articles of food or drink, or of the body and the excretions; and *experiments upon animals*. The evidence derived from these sources being compared with the known properties and effects of various poisons in authenticated cases, will enable the physician to form a correct opinion as to the probable administration or not of a poison. The poisons most commonly administered are opium, prussic acid, arsenic in various forms, phosphorus, oil of vitriol, and oxalic acid.

It is rarely that the *symptoms* exhibited during life do not afford some clue to the cause of illness; and most frequently the symptoms are all that the medical attendant has to guide him to a diagnosis of the nature of the case, during the lifetime of the patient. Sometimes, however, persons are found dead as the result of poison, concerning the manner of whose death nothing whatever can be learned; a suspicion of poisoning arising from the circumstances under which the corpse is found. Here the aid of chemical analysis ought invariably to be invoked; and fortunately in these cases the delay involved in making an analysis is of comparatively little moment. The effects may in the case of many persons be either suddenly or slowly manifested; hence we have *acute* and *chronic* poisoning. Cases of chronic poisoning are usually the result of the repeated administration of small doses of lead, copper, mercury, phosphorus, or arsenic. All of these poisons are treated of in separate articles. The general conditions which should excite a suspicion of poisoning are the sudden onset of serious and increasingly alarming symptoms, in a person previously in good health, especially if a prominent symptom be epigastric pain; or where there is complete prostration of the vital powers, a cadaverous expression of the countenance, an abundant perspiration, and speedy death. In all such cases the aid of the chemist is required, either to confirm well-founded, or to rebut ill-founded, suspicions.

Classification.—Various attempts have been made to classify poisons rationally. Perhaps the best classification, for the purposes of the medical practitioner, is that which groups poisons according to the more obvious symptoms which they produce. Our knowledge of the more intimate action of many poisons is still too slight to admit of any useful classification according to the manner in which they specifically affect the vital organs.

Poisons may in the manner indicated be classified as:—1. **Corrosives**; 2. **Irritants**; and 3. **Neurotics**. It is perhaps at present premature to attempt a systematic division of the last class. The class of neurotics embraces poisons so widely different in their action as opium and strychnine.

1. **Corrosive Poisons.**—Enumeration.—The action of one of the most typical of these poisons, corrosive sublimate, is fully considered under a special head (*see* Mercury, Poisoning by). The most commonly administered corrosives are the mineral acids—sulphuric, nitric, hydrochloric, and oxalic acid; the alkalies—potash, soda, and ammonia; acid, alkaline, and corrosive salts—such as potassium bisulphate, potassium carbonate, zinc, tin, and antimony chlorides, and silver nitrate.

Symptoms.—The mineral acids and the alkalies have scarcely any remote effects on the system, their action being almost purely local. Some of the other corrosives enumerated may have, besides their local effects, a remote and constitutional action. The symptoms of corrosive poisoning are marked and unmistakable, except when the patient is an infant. Immediately after swallowing the corrosive substance, there is an acid, caustic, or metallic, burning sensation felt in the mouth, fauces, gullet, and stomach; and this speedily extends over the whole abdominal region. Vomiting is speedy, or may, rarely, be altogether absent. The vomited matters consist at first of the ordinary contents of the stomach, more or less altered by the action of the poison. In the case of *mineral acids* they are intensely acid, and cause copious effervescence when they fall upon limestone or marble. No relief is afforded by the evacuation of the stomach; and later the vomits may be more or less mingled with altered blood, which may be dark, or even black; shreddy mucus, casts of the gullet or stomach formed by the shedding of the mucous membrane, and sometimes even the muscular wall of the œsophagus, are rejected. The abdominal pain is not relieved, but greatly aggravated, by pressure. The whole abdomen becomes distended, owing to the gases evolved by the action of the poison; the diaphragm is pressed upon; and intense dyspnœa may result, owing to pressure upon the thoracic viscera. When a mineral acid has been administered, there is little or no bowel action, and the urine may be suppressed; but in poisoning by the *alkalies*, and by the *alkaline carbonates* and *sulphides*, there may be purging. The mouth, tongue, and fauces exhibit the local effects of the corrosive; a yellow coating in the case of nitric acid; white at first, and as if covered with white paint, from sulphuric acid; and whitish or brown and less thickly coated from hydrochloric acid. Yellow or brown stains may be observed on the skin, extending downwards from the angles of the mouth, and caused by the trickling of acid or other corrosive fluid from the mouth. Meantime the symptoms develop rapidly. The pain, thirst, dyspnœa, and dysphagia increase. The patient, at first excited, with rapid, bounding pulse, becomes bathed in cold perspiration, the countenance becomes pinched, the pulse more rapid and thready. Enormous eructations of gas take place, but these afford no relief. The patient may become more or less cyanosed; but this will depend upon the amount of dyspnœa. The intellect is usually clear to the last. Signs of collapse come on, and the patient may sink within a period varying from six to twenty-four hours. If recovery does not take place, death usually supervenes within a period of twelve to twenty-four hours. Very frequently, and more especially in poisoning by oil of vitriol, the patient survives the first acute symptoms only to perish months after, should not the aid of the surgeon be invoked and gastrotomy be performed, by slow starvation, due to local injury to, and subsequent stricture of, the œsophagus. The use of bougies in these cases, to keep the gullet patent, seldom affords permanent relief.

When *nitric acid*, or *ammonia*, is the poison taken, the vapours of the acid or of the ammonia may gain access to the air-passages and lungs, provoking inflammation, which is commonly fatal. The dyspnœa and chest-symptoms will be greatly aggravated in these cases, and may overshadow the more usual symptoms due to local action on the digestive canal. In poisoning by the *caustic alkalies* (potash and soda lyes) diarrhœa, with discharge of blood, is more common than the constipation observed in poisoning by the mineral acids. Entire suppression of urine, or anuria, is the rule in poisoning by corrosive sublimate.

Oxalic acid in concentrated solution is undoubtedly a corrosive and irritant poison. Very commonly, however, it kills by its depressing action upon the heart before symptoms of corrosion have become prominent; or the vomiting, pain, and other more immediate symptoms of corrosive poison, are associated with a feeble pulse, clammy skin, nervous symptoms, aphonia, and speedy death, even within ten minutes of the administration of the poison. To quote Christison's language:—'If a person, immediately after swallowing a solution of a crystalline salt, which tasted purely and strongly acid, is attacked with burning in the throat, then with burning in the stomach, vomiting, particularly of bloody matter, imperceptible pulse, and excessive languor, and dies in half an hour, or still more in twenty, fifteen, or ten minutes, I do not know any fallacy which can interfere with the conclusion that oxalic acid was the cause of death. No parallel disease begins so abruptly and terminates so soon, and no other crystalline poison has the same effects.' It must be added that binoxalate of potash, and the soluble oxalates generally, are as poisonous as the acid itself.

Anatomical Characters.—The distinction between corrosive and irritant poisons is by no means well-marked; and indeed corrosive poisons, when diluted, act as irritants. Hence we shall describe the *post-mortem* appearances of corrosive poisoning under the head of irritants.

Diagnosis.—The diagnosis of corrosive poisoning rarely admits of difficulty; and in any doubtful case analysis will remove all doubt.

2. Irritant Poisons.—Irritant poisons are of two classes—*metallic irritants*, and *vegetable* and *animal irritants*, these latter being grouped together. Perhaps none of them, however, act as pure irritants; and the irritant symptoms which they produce are most commonly accompanied by a well-marked effect upon the nervous system also. An irritant is a poison which causes inflammation of the parts to which it is applied, usually the alimentary canal. By far the most important of the metallic irritant poisons is arsenic (*see* Arsenic, Poisoning by). Other metallic irritants are the salts of antimony, zinc, and other metals. Elaterium, essential oils, and gamboge may be cited as examples of vegetable irritants; and cantharides of animal irritants. Irritant animal and vegetable foods are separately described. *See* Poisonous Food.

Symptoms.—Irritants differ as a rule from corrosive poisons in the greater slowness with which the symptoms are developed. Usually when an irritant is swallowed, after an interval—greater or less according to the specific character of the poison—a burning pain is felt, and sense of constriction of the mouth, throat, and gullet, speedily followed by sharp burning pain in the epigastrium; and this is increased by pressure—a mark which serves to distinguish the attack from one of ordinary colic. Nausea, vomiting, and great thirst ensue; speedily followed by pain and sense of distension of the whole abdomen, which is exceedingly tender, and perhaps visibly distended. Most commonly the vomiting is followed by purging, tenesmus, dysenteric stools, and often by dysuria. Should the poison not be speedily removed from the system by vomiting and purging, these continue unrelieved, and increase in severity; and symptoms of inflammatory fever, or it may be of collapse, supervene. The pulse becomes rapid, small, and thready; the countenance is anxious; the skin is bathed in perspiration, now warm, and again cold and clammy. The patient may never rally from the first shock to the nervous system; more rarely, having survived this, he dies in convulsions; or he may perish of inanition after more protracted sufferings. It must be borne in mind that those irritant poisons—such as diluted sulphuric acid—which, when taken in a more concentrated form, act as corrosives, may bring about starvation, necessitating such operative procedure as gastrotomy, by the injury which they inflict upon the œsophagus and stomach. Death after the administration of an irritant poison may, it is obvious, occur at very varying periods after the ingestion of the poison.

Diagnosis.—Irritant poisoning may be mistaken for various forms of natural disease. The diseases with which it is most apt to be confounded are—gastritis; gastric ulcer, with or without perforation; peritonitis; severe colic; sporadic and Asiatic cholera; and rupture of the stomach or intestines. A careful examination of the patient, and the history of the case, will often remove any doubt which may be entertained; but a microscopic examination and chemical analysis of the ejecta of the patient will frequently afford the only means of clearing up the case during life. Too frequently irritant poison is not suspected until a *post-mortem* examination is made. In every case where a possibility of irritant poisoning is suggested, the aid of analysis should be invoked. For the diagnostic differences—so far as differences in symptoms are diagnostic—between irritant poisoning and the special diseases above mentioned, the reader is referred to the special articles in this dictionary.

Anatomical Characters.—The *post-mortem* appearances in irritant and corrosive poisoning are corrosion of the mouth, fauces, gullet, and stomach, the mucous membrane being shrivelled, altered in consistence and colour, and more or less detached; irritation and inflammation of the stomach and first portion of the small intestines; ulceration; and erosion. In corrosive poisoning the stomach may be perforated, the edges of the aperture being shreddy; and in the case of sulphuric acid the viscera may be blackened (altered blood) from the action of the acid upon the blood-pigment. The small intestines are implicated to a varying extent, or may altogether escape. The large intestine may be attacked, and this is more especially the case in poisoning by mercurial preparations. Arsenic exerts a specific effect upon the gastric mucous membrane. Remains of irritants may be detected in the intestinal canal, and be recognised by their physical, microscopical, and chemical characters.

3. Neurotic Poisons. — Enumeration. — Under this head may be ranged a great number of poisons, having this in common, that the symptoms produced by them are more or less prominently affections of the nervous system. The class embraces pure narcotics, such as morphia; chloral hydrate; hyoscyamus; digitalis; strychnia; prussic acid; nitro-benzol; phenol (carbolic acid); alcohol; aconite; belladonna, and many others.

Symptoms.—These are necessarily of the most varied character. All that has been said already about the onset of symptoms, their character, and the circumstances under which they have appeared, must be borne in mind in arriving at a diagnosis.

Prussic acid produces its effects in the course of a few minutes; or, it may be, seconds. The course of symptoms is very rapid; and death may be well-nigh instantaneous. The symptoms are convulsions, great disturbance of respiration, with prolonged expiration, dilated pupils, and cyanosis. *See* Prussic Acid, Poisoning by.

Morphia and *opium*, after a stage of excitement, produce deep comatose sleep, with slow stertorous breathing; contracted pupils; and clammy, perspiring skin; all the other secretions being more or less suppressed. *See* Opium, Poisoning by.

Aconite is diagnosed by the peculiar numbness and tingling of the skin which it produces.

Belladonna, and its alkaloid atropine, widely dilate the pupils, and cause intense thirst, with mirthful delirium and spectral illusions.

Alcohol in toxic doses produces profound insensibility; and there is, moreover, always more or less recognisable by circumstances which will be found described under Alcoholism.

Nitrobenzol causes symptoms often undistinguishable from those of prussic acid; but in consequence of its insolubility, and the slowness with which the liquid poison is absorbed by the gastro-intestinal mucous membrane, there is often a prolonged interval between the administration of the poison and the onset of alarming symptoms.

Chloral hydrate causes death after a stage of unconsciousness; and there is scarcely any difficulty in ascertaining the nature of the case by the aid of the surroundings of the patient.

Carbolic acid or *phenol* whitens and shrivels the membranes with which it comes in contact, and not only acts as a corrosive, but produces speedy narcosis, and greenish or black urine. The peculiar odour of phenol is always perceptible, though not infrequently overlooked.

Diagnosis.—It is impossible to enter fully into the diagnosis of each individual neurotic poison. The most frequent and important diagnoses have to be made in supposed cases of poisoning by opium, alcohol, and strychnia respectively.

In opium-poisoning the equally contracted pupils; the possibility of rousing the patient by means of external stimuli in all except the later stages—as, for instance, by flicking the feet, the application of the electric current, &c.; and the moist clammy skin, may serve to prevent the case being confounded with one of apoplexy. In alcoholic coma there is great danger of mistaking the nature of the case, in consequence of the frequency with which the alcoholic odour may be met with in cases where alcohol has been taken, either dietetically or medicinally, in moderate or somewhat immoderate doses. The very careful use of the stomach-pump can do no harm, and may not only save the patient if the case be one of alcoholic poisoning, but also serve to clear up the diagnosis. The tetanic spasms of strychnia will have to be differentiated from those of true (traumatic) tetanus. In this there is not usually any insuperable difficulty. Strychnia convulsions are intermittent; do not begin in the lower jaw; are, as a rule, opisthotonic in character; and do not affect the same groups of muscles as are implicated in true tetanus. *See* Opium, Poisoning by; and Strychnia, Poisoning by.

Treatment.—Only the general principles of the treatment of poisoning can be indicated here. The treatment in poisoning by the most important special poisons is described in separate articles. The question of the use or non-use of the stomach-pump must be decided by the nature of the poison administered. Where one of the concentrated mineral acids, a caustic alkali, or other corrosive salt, oxalic acid in concentrated solution, or carbolic acid, has been swallowed, it is generally held that the stomach-pump should not be used, the danger of perforation of the gullet or stomach being considerable. In all cases where a non-corrosive poison has been taken, except in the case of prussic acid, where the course of the poisoning is too rapid to permit of the use of the instrument, the application of the pump is advisable and can do no harm. In cases of poisoning by opium and alcohol, the greatest reliance must be placed on evacuation of the stomach by its aid. The corroding acids may be neutralised by the administration of lime-water, or, still better, saccharated lime-water; highly diluted solutions of the caustic alkalies; or, failing these, the continuous use, in frequently repeated doses, of chalk, whiting, or the alkaline carbonates—so as to avoid dangerous distension of the abdomen with carbonic acid gas. On the contrary, the caustic alkalies may be neutralised by the copious imbibition of highly diluted acid liquids. Failing the use of the stomach-pump, or even after the use of this, emetics may be administered to relieve the stomach of irritants. The prompt administration of an emetic is perhaps never inadmissible. The effects of corrosives and irritants must afterwards be met by general remedies, such as demulcents and oil to sheathe the mucous membranes, opiates to relieve pain, &c. The effects of oxalic acid cannot be avoided by the administration of alkalies and alkaline carbonates, for the alkaline oxalates are themselves highly poisonous. Chalk, whiting, and soluble lime-salts precipitate oxalic acid as an insoluble calcium oxalate, and form the best remedies. No safe antidote is known for carbolic acid. Oil greatly allays the intolerable pain attending the local action of this acid. In prussic acid poisoning artificial respiration, persistently used, is our sheet-anchor, and may be supplemented by galvanism, alternate douches of warm and cold water, and other measures. After the use of the stomach-pump to remove unabsorbed opiates, stimulating liquids containing tannin, such as strong black coffee, may be given; the patient must be kept awake by walking him about, flicking the feet with towels, the application of the Faradic current, &c. Belladonna in full doses is in some respects antagonistic in its physiological action to opium. Conversely opiates are regarded as direct antidotes to belladonna. On the same principle of counteracting effects, digitalis and aconite are counter-poisons, and hence antidotes the one to the other. The happiest results have followed the use of full doses of chloral-hydrate in strychnia-poisoning; and chloroform may be freely inhaled to allay the tetanic spasms. In alkaloidal poisoning, except where a tetanising poison, such as strychnia or brucia, has been given, the stomach-pump must be employed; and emetics and tannin, in the form of tincture of galls, strong black coffee, or strong tea, should also be given, with the object of precipitating the alkaloid as an insoluble tannate.

Thomas Stevenson.

POLYDIPSIA (πολὺς, much, and δίψα, thirst).—A synonym for excessive thirst; sometimes used for diabetes. *See* Polyuria; and Thirst.

POLYPHAGIA (πολὺς, much, and φάγω, I eat).—A synonym for excessive hunger. *See* Appetite; and Pneumogastric Nerve, Diseases of.

POLYPUS (πολὺς, many, and ποῦς, a foot). Synon.: Fr. *Polype*; Ger. *Polyp*.

Definition.—This term is generally applied to any simple pedunculated growth, springing from a mucous surface; but it is sometimes extended so as to include malignant pedunculated growths in similar situations.

Varieties.—It is clear that no single description will apply to each member of the class. Hence it will be sufficient to enumerate the principal varieties of polypus, a fuller account of most of which will be found in the article Tumours, and also in connection with the diseases of the several organs which they affect.

1. **Polypi of the Nose.**—These are of two varieties—the *mucous* and the *fibrous*; both are classed among the fibromata. Both are covered with ciliated epithelium; the fibrous variety often involve the structures at the back of the pharynx, forming the so-called *naso-pharyngeal polypus*.

2. **Polypi of the Ear.**—Polypi of the ear resemble those of the nose, but present a variety of structure, as some spring from the membrana tympani, others from the interior of the tympanum.

3. **Polypi of the Intestines.**—These polypi are of much more frequent occurrence in the rectum than in any other portion of the intestinal tract. They are composed of tissue resembling that of the mucous membrane of the part, and are described amongst the adenomata.

4. **Polypi of the Uterus.**—These growths are of three kinds, namely:—(*a*) *Cystic*, which are derived from the ovules of Naboth; (*b*) *mucous* or *soft*, resembling the polypi of the rectum; (*c*) *hard* or *fibrous*, the so-called fibrous polypus of the uterus.

5. **Polypi in other situations.**—Less common forms of polypi, consisting of some modification of the mucous membrane from which they are derived, are found in the *bladder*, the *larynx*, on the *gums*, or sometimes in the *sinuses communicating with the nose*.

Malignant polypi present no special features which would enable them to be described as a class.

Treatment.—Though polypi differ somewhat in structure, the treatment of the simple varieties of the class is the same—that is, if removal be considered advisable. Either the pedicle may be grasped and the tumour removed by avulsion; or it may be divided at a stroke by some sharp instrument, or cut through slowly or rapidly by some form of écraseur or ligature.

In removing a malignant polypus a wide margin of healthy tissue must be taken away from around the pedicle. R. J. Godlee.

POLYSARCIA (πολύς, much, and σάρξ, flesh).—A term for excessive corpulence or obesity. *See* Obesity.

POLYURIA (πολύς, much, and οὖρον, urine). Synon.: *Diabetes Insipidus*; Fr. *Polyurie*; *Diabète Insipide*; Ger. *Zuckerlose Harnruhr*.

Definition.—A malady or group of maladies, characterised by thirst, and a persistently excessive flow of watery urine, which has a low specific gravity, and contains no albumin or sugar.

Attempts have been made to subdivide this group into smaller sections. One such section is *polydipsia* or *hydruria*, having the characters above specified as those of polyuria; another is *azoturia*, where the solids, especially urea, are in excess of the normal amount; and a third, *anazoturia*, where these are markedly deficient. The term *polydipsia*, referring as it does specially to the symptom thirst, often used, puts the cart before the horse. *Hydruria* points to the dilute character of the urine rather than to its excessive quantity. *Azoturia* has been made to include all cases where urea is unusually abundant, even where the urine is scanty, as in fevers; a condition totally averse from our notions of diabetes. *Anazoturia* very rarely occurs; for, notwithstanding the low specific gravity of the urine in polyuria, owing to the large amount passed, the quantity of urea may, and often does, exceed that excreted in health. A form of polyuria, often slightly marked, has been described as 'phosphatic diabetes,' on account of the excess of phosphates passed. The separation of these cases into a distinct group is hardly necessary. Certain factors in the above definition require special attention, the better to mark off the malady so defined from other pathological states. Thus the flow must not only be excessive, but persistently so. This separates polyuria from conditions where there exists a merely temporary flow of an unusual amount.

Ætiology.—Polyuria is limited neither by age nor by sex. It may exist in the new-born infant, and it may be found in the patient of seventy, but on the whole it is a disease of early rather than advanced life, whilst it is about twice as frequent in males as in females. Nothing is more marked in connection with the causation of polyuria than heredity. Perhaps the most extraordinary example of this is recorded by Dr. Gee, where the disease was directly transmitted through four generations. Sometimes one member of the family escaped, but the children were sure to be attacked. A newly-born infant, a member of this family, suffered from unusual thirst, so much so that water had to be given to still it.

Beyond inheritance, nothing very definite can be said as to the cause and origin of polyuria. It is often connected with nervous affections or nervous excitement, and sometimes follows upon injuries to the head or disease of the brain. Drinking bouts too have been credited with giving rise to the disease, as have drinking cold fluids, and sudden exposure to cold. Beyond these, no cause of any value can be assigned; often indeed the disease comes on without even such insufficient reasons as those given above, some of which have doubtless been assigned on the *post hoc* principle.

Symptoms.—Not much need be said regarding the clinical history of polyuria. When the result of accident or mental emotion, its onset is usually abrupt, and it may end in like manner; sometimes as the result of intercurrent disease of a febrile kind. During its continuance thirst and watery urine are the two prime symptoms, for there may be little wasting, and the general health may be good. Occasionally there is increased appetite, as in one of Trousseau's patients, whom *restaurateurs* would pay to stop away. In this patient, too, there was great tolerance of intoxicating liquors, whilst in others the opposite condition has been noted. Usually the bowels are confined, and the skin dry, though neither happens invariably. Boils, so common in diabetes, are rarely seen; but purpuric spots sometimes occur, as does œdema, or that laxness of subcutaneous tissue which often passes for œdema, in the later stages. As long as drink is supplied in plenty, the condition of the patient is very tolerable, were it not for the broken sleep caused by the incessant thirst and the desire to pass water; but any attempt to restrict the quantity of fluid gives rise to intense discomfort, even causing the patient to drink his own urine. Ultimately this constant strain wears out the patient, and leads to death, if intercurrent disease do not carry him off.

Of the phenomena of polyuria, the urine alone requires special notice. It is inordinate in its quantity, and of a specific gravity little above that of spring water. In a case under the care of the writer, it remained persistently at 1,001; but it may rise to as much as 1,008 or 1,010. It is transparent; almost like water; of a faint greenish-yellow tint; and with little taste, smell, or acid reaction. In quantity it varies with the amount of water consumed. If the patient is allowed to drink at will, the quantity passed roughly corresponds with that drunk, allowance being made for the watery vapour passing away by the lungs, and perhaps also by the skin. If the drink be restricted, more will be passed than is consumed, by the abstraction of water from the body. On the whole the quantity passed is greater than in ordinary diabetes, and may sometimes be measured by the pailful. Of the normal constituents of urine, urea, though relatively deficient in any specimen examined, is upon the whole in excess, sometimes enormously so. On the other hand, uric acid seems diminished, but this may depend on the difficulty of estimating it in urine so greatly diluted. Sulphates and phosphates, especially the earthy salts of the latter, are usually increased, whilst the only abnormal constituent, if such it can be called, commonly found is inosite.

Pathology.—As in the case of saccharine diabetes, our insight into the morbid processes concerned in the production of polyuria has been greatly aided by direct experiment. Bernard found that by pricking the floor of the fourth ventricle above the level of the 'sugar puncture' he could produce copious diuresis; and in certain animals injuries to the central lobe of the cerebellum (the vermiform process of human anatomy) are followed by a like result. From this part of the nervous system the nervous influence seems propagated to the kidneys both by the splanchnics and spinal cord, but the exact course of the fibres has not yet been clearly demonstrated. Whether the nerves are merely vaso-motor fibres, section or paralysis of which would produce turgescence of the vessels of the kidneys, or trophic fibres, irritation of which would increase the activity of these organs, is not yet determined; but in all probability paralysis of the vaso-motor fibres is the main factor in the production of hydruria.

In the definition of polyuria given above disease of the kidneys was expressly excluded; and after death, as far as the malady itself is concerned, nothing is to be found except increased vascularity. As a consequence of the disease, however, persisting over many years, and giving rise to frequent and severe distension of the bladder, when circumstances may prevent its being emptied with sufficient frequency, thickening of the walls of the bladder, dilatation of the ureters, and sacculation of the kidney have been described; but the accuracy of such observations as the results of simple polyuria have been questioned. Undoubtedly the most important lesions which bear on the disease are those which have been found in the brain, especially in the neighbourhood of the fourth ventricle. These, besides the injuries already alluded to, comprehend tubercular and other forms of inflammation, tumours of various kinds—gliomatous and syphilitic, together with other local changes of different kinds.

Diagnosis.—The diagnosis of polyuria, according to the definition already given, is easy. It rests on these factors—thirst, and persistent excess of urine, coupled with the absence of sugar and albumin. It has further to be carefully distinguished from mere temporary excess of watery urine. Such an excess may occur where a large quantity of fluid of a diuretic kind has been swallowed, especially when there is little or no cutaneous transpiration. Again sudden flows of urine may occur about the period of early convalescence from fever, or yet again when a hydronephrosis suddenly empties itself. All these are merely temporary and evanescent states. The total absence of sugar distinguishes polyuria from diabetes, though it is well known that the one state may pass into the other. In certain forms of Bright's disease, especially those characterised by contracted kidney, the urine may be excessive and of low specific gravity; but in all of these albumin will be at least now and again found. Finally, polyuria is not to be confounded with such abnormal discharges of urine as may occur from time to time in what we call hysteria and its allies. Here the nervous symptoms give a special feature to the malady; nevertheless polyuria has strongly marked nervous affinities.

Prognosis.—This cannot be called favourable, for, whilst few actually perish from the uncomplicated disease, still fewer are cured of it, though a good many get well. For some unaccountable reason, Trousseau looked upon polyuria as more dangerous than diabetes; but ordinary experience cannot bear out this view. Probably its connection with tubercular disease in many cases misled him. Under such circumstances the tubercular disease would run its course just as disease of the nerve-centres would, altogether independent of the polyuria.

Treatment.—As might be inferred from the account of the disease given above, the treatment of polyuria is far from satisfactory. If the disease can be assigned to any definite cause, we must look to that and deal with it, rather than with the excessive urination; if not, it must be our endeavour to counterbalance the draining of the tissues, and the corresponding waste, by a plentiful supply of fluid and good nourishing diet. To relieve the kidneys from the unusual stress thrown upon them, diaphoretics have been recommended; at all events great care should be taken of the clothing so as to secure the patient from any risk from cold. Of medicinal remedies, that which has been most lauded is valerian, especially by Trousseau, who gave it in enormous doses. Probably it, like other antispasmodic remedies, would be found of most service in cases allied to hysteria or similar neuroses. In one case under his care, the writer tried the whole range of antispasmodic remedies without effect. Opium and its alkaloids, though so serviceable in diabetes, are worse than useless in polyuria. They diminish the thirst and the urine, but they greatly increase the patient's discomfort. Tonics, especially strychnine and iron, do good by improving the general health. In another case under the care of the writer, in a highly scrofulous subject, after every medicinal remedy had been tried in vain, change of air at the seaside was followed by almost complete disappearance of the polyuria. The importance of attending to the constitutional state is strikingly indicated in this case. Finally, in the hands of some the constant electric current has done good, whilst it has equally failed in the experience of others.

Alexander Silver.

POMPHOLYX (πομφὸς, a bulla or bladder). This term is applicable to the bullous affection of the skin more commonly denominated pemphigus, of which it is, in fact, a synonym. *See* Pemphigus.

PONS VAROLII, Lesions of.—Synon.: Fr. *Maladies de la Mésocéphale*; Ger. *Krankheiten der Brücke*.

Introduction.—The pons is liable to a variety of affections, either by morbid processes having their primary seat here, or by secondary implication from disease originating elsewhere, as by tumours of the cerebellum or base of the skull, or aneurism of the basilar artery.

The position of the pons, its close relation to the vital centres of the medulla oblongata, the connection of the sensory and motor paths with the cerebrum and spinal cord on the one hand, and the cerebellum on the other, and the transit through it of many of the cranial nerves, render the symptomatology of pontine affections highly complex and diversified.

Summary of Pathological Conditions.—*Hæmorrhage* in the substance of the pons is by no means uncommon, and may vary from a minute focus up to a complete disorganisation and rupture into the fourth ventricle. *Embolism* is not common; but *thrombosis*, from *syphilitic* or *atheromatous degeneration* of the basilar artery, is frequent, and is the origin of necrotic *softening* of an acute or chronic character.

Hæmorrhage.—Hæmorrhage into the substance of the pons, if of small extent, is not necessarily fatal; but if it be of large amount, death occurs suddenly, or within a very few hours. Sometimes there is a sudden onset of coma, with complete relaxation of the whole muscular system. The pupils are, as a rule, minutely contracted, and the condition resembles profound narcotic poisoning. The temperature may rise to as much as 105° Fahr. or more. Deglutition is difficult or impossible; and death ensues from cardiac and respiratory paralysis, irregularity in the rhythm preceding the fatal issue. At other times, and of great signification in a diagnostic point of view, muscular spasms occur, either general or affecting one side more than the other, with distortion of the face, either from paralysis of one side, or this combined with active spasm of the other.

The occurrence of paralysis of one side of the face and of the limbs of the other side, so-called 'alternate' paralysis, is pathognomonic of the pontine seat of the lesion.

Softening.—Acute embolic or thrombotic softening of the pons, with or without loss of consciousness, may lead to death rapidly, with similar paralytic symptoms; but days may elapse, or even months, after the first onset, with characteristic symptoms indicative of the position of the lesion, and death ensue either from gradual implication of the vital centres, or quite suddenly.

Localising Phenomena.—The symptoms most characteristic of lesions of the pons are a combination of paralysis of certain cranial nerves on the one side, and of the limbs on the other. The most common combination is paralysis on one side of the face and of the limbs on the opposite, the face being paralysed on the side of the lesion. The facial paralysis in this case resembles peripheral facial paralysis, both in the implication of the orbicularis oculi and degenerative changes in the muscles. The limbs may be paralysed as to motion only, or there may be a combination both of sensory and motor paralysis. Sometimes the motor paralysis affects one limb more than the other, and there may be a similar distribution of the anæsthesia.

The alternate paralysis of the face on one side, and of the limbs on the opposite, occurs more particularly with lesions of the pons situated towards the pyramids, at a point where the facial roots have not crossed over to pass on to the opposite hemisphere. If the lesion be higher up, near the crus cerebri, the face and limbs may both be paralysed on the side opposite the lesion. Amongst other varieties the face alone may be paralysed, without affection of the limbs; or one side of the face may be paralysed, and the other in a state of spasm; or both sides of the face may be paralysed; or one side of the face may be paralysed, and the limbs on both sides; or both sides of the face, and the limbs on one side. Spasms in the limbs paralysed or in the others may occur; and similar irritation of the sensory strands may be indicated by excentric hyperæsthesia and paræsthesia.

Along with the motor paralysis of the limbs, there is also a varying degree of vaso-motor paralysis, and a difference in temperature of the limbs of one degree or more.

Next in frequency to affections of the facial nerve, with or without affections of the limbs of the variable character above mentioned, comes affection of the abducens or sixth cranial nerve. This gives rise to an internal strabismus, and usually of the eye on the same side as the lesion. There may be, therefore, paralysis of the face and abducens on the side of lesion, and of the extremities on the opposite side; but cases have been recorded of paralysis of the abducens on one side, and of the face and limbs on the opposite;

and also of paralysis of the face, abducens nerve, and limbs on the same side as the lesion.

Defects in articulation are not unfrequently observed, depending on impaired mobility of the tongue, usually on the side of the motor paralysis of the limbs, but apparently sometimes on the other side. The fifth cranial nerve is also not unfrequently implicated. The sensory portion seems to suffer more than the motor. But cases have been recorded in which the motor portion of the fifth has been specially affected, leading to paralysis and degeneration of the muscles of mastication.

The affection of the sensory division shows itself in more or less marked anæsthesia of the face, which may be general or limited to the area of distribution of some of the branches only. The tongue is not unfrequently affected on the same side, and tactile and gustatory sensibility impaired or abolished on the anterior two-thirds. The affection of the fifth may occur on the same side as the lesion, with or without affection of the limbs, but it would appear also that anæsthesia of the face may occur, with implication of the extremities on the side opposite the lesion.

There is thus an extraordinary complexity and variability in the symptoms which may be met with in connection with pontine lesions. Those which have been mentioned are the most common and most significant, especially if they occur in combination. Singly they have less value, and some of them, particularly defects in articulation, are not specially characteristic. But a combination of paralysis of the limbs on one side, either motor alone, or of motility and sensibility, and of the face on the other, is significant of pontine lesion. The addition of paralysis of the abducens adds to the certainty.

Many other symptoms might be mentioned which have been noted in connection with lesions of the pons, especially tumours, which ought perhaps to be ascribed to interference with the functions of neighbouring structures. As in other parts, however, tumours have been found invading or pressing on the pons without having given rise to any marked symptoms during life. But at other times, along with one or more of the previously mentioned symptoms, impairment of deglutition has been observed, due without doubt to pressure on the medulla oblongata. To pressure on the medulla oblongata should also be ascribed the irregularity and ultimate paralysis of the cardiac and respiratory movements, in connection either with tumours or with hæmorrhagic effusions into the pons itself.

When a tumour presses forward in the direction of the crura cerebri, the third cranial nerves may be implicated. Ptosis has been observed in such cases; and external strabismus, from paralysis of the internal rectus, has also occurred, but comparatively rarely.

Vertigo and disorders of equilibration have also been observed, but these may be attributed to an implication of the cerebellum or of its peduncles. Ataxic symptoms have, however, been described by Leyden as occurring in pontine lesions, without affection either of the cerebellum or of its peduncles. The writer has seen a case of very marked ataxy associated with anæsthesia of one side of the face, and of the limbs and trunk on the opposite side, due probably to lesion on the right side of the pons. But the cases which have been recorded are not yet sufficient to establish any very definite propositions in regard to the exact causation or special characteristics of the ataxic disorders in question. In connection with tumours pressing on the pons, hearing may also be impaired or abolished in one or both ears. Impairment of smell has been observed on one side, when there has been anæsthesia of the face. This is probably due to the impairment of common sensibility in the nostril, intensified in some cases by the defective power of sniffing if the facial nerve is also paralysed.

Albuminuria and glycosuria have occasionally been found in connection with diseases of the pons. It is very doubtful if any causal relationship has been at all satisfactorily established. Very often when albumin has been found, there is good reason to believe that it has been preexisting, for lesions of the pons frequently occur in connection with chronic renal disease. Sugar has been found sometimes, and in other cases not. The same has been found in connection with lesions of other nerve-centres. So far, therefore, as facts go, the evidence in favour of a direct relationship between pontine lesions and glycosuria is at present extremely slender, and in need of further investigation.

Diseases which encroach on the intracranial space produce the general symptoms of intracranial tumour, in addition to the special symptoms indicative of their invasion of the pons.

D. FERRIER.

PORRIGO LARVALIS (*porrigo*, scurf, and *larva*, a mask).—*Porrigo* is an old-fashioned term, applied generally to eruptions on the scalp and face, whether exudative or desquamative; *larvalis*, masked, alludes to the covering of the face with an incrustation which conceals the features like a mask, such as is seen in a neglected exudative eczema of the face, an eczema pustulosum or impetiginodes. Pathologically, porrigo is an eczema. *See* ECZEMA.

PORTAL OBSTRUCTION.—This is a condition of not uncommon occurrence, and calls for brief general discussion. Strictly speaking, portal obstruction implies that there is some direct impediment to the flow of blood in the portal circulation, either affecting the trunk of the vein before it enters the liver, or its branches in the substance of this organ. It must be remembered, however, that any condition that interferes with the circulation beyond the portal divisions, whether in the hepatic vein, inferior vena cava, right side of the heart, or lungs, will retard more or less the flow of blood through the portal system; and also that either of the tributary branches of the portal vein may be affected alone. The portal trunk may be obstructed by direct pressure upon it, as by enlarged glands, a growth projecting from the liver, or a neighbouring tumour; by changes in its walls, leading to constriction or complete closure; or by blocking-up of its channel, as by a thrombus (*see* PORTAL THROMBOSIS). Cirrhosis is the most important disease which obstructs the portal circulation within the liver; but this result may also arise from accumulation of pigment and other causes.

Effects.—The effects of portal obstruction will depend on its seat, its degree, and the rapidity with which it is set up. They are merely those which necessarily follow mechanical venous congestion, namely, distension of the small vessels, which may end in changes in their walls and varicosity; escape of serum; a catarrhal condition of mucous surfaces; hæmorrhages; and, in course of time, permanent changes in organs and structures which are congested. Their localisation in this case will correspond to the structures from which the portal vein receives its tributary branches. Hence any of the following conditions may result in various degrees from portal obstruction:—(1) Congestion and catarrh of the mucous membrane lining the stomach and intestines, with consequent disorder of the secretions; dilatation and varicosity of the small vessels; or hæmorrhage into the alimentary canal. (2) Ascites, one of the most frequent and evident phenomena. (3) Enlargement of the spleen, either from mere accumulation of blood, or in chronic cases with permanent increase and alteration in the splenic structure. (4) Congestion, followed by fibroid changes in the pancreas. (5) Hæmorrhoids, it is generally believed. (6) After a while enlargement of the superficial veins of the abdominal wall, owing to their communications with the portal vein; as well as of the veins within the abdomen, which are tributary to it.

Several of the conditions mentioned are obvious on clinical examination during life; others are only evident on *post-mortem* examination, although they assist in originating symptoms, especially in connection with the alimentary canal, such as those of dyspepsia, flatulence, and disordered bowels. Hæmorrhage into the stomach or bowels is usually revealed by the occurrence of hæmatemesis or melæna, but it may prove fatal without any discharge of blood externally. It must necessarily happen that if the portal circulation is not properly carried on, the functions of the liver are proportionately disturbed.

The signs of portal obstruction may set in with great acuteness, or very gradually. Those indicative of acute obstruction are the rapid development of ascites, returning speedily after paracentesis; enlargement of the spleen; and hæmorrhage into the alimentary canal. It must be remarked that the most striking phenomena may disappear in chronic cases, after a time, without the removal of the obstruction, probably owing to the development of new channels, by which the blood is returned to the heart without passing through the liver.

Diagnosis.—There ought to be no difficulty in recognising the signs of portal obstruction in marked cases; and it might even be suspected before these signs are well-developed under certain conditions. The cause of the obstruction can only be made out by a consideration of each case in all its features.

Treatment.—Rarely can anything be done directly to remove portal obstruction. The circulation may often be relieved to some extent by acting freely upon the bowels, especially by means of saline and hydragogue purgatives. Treatment directed to the effects of portal obstruction is frequently highly efficacious, and the most important of these may be cured or relieved, even though their cause remain unaffected. The special treatment of these symptoms, and also of the conditions upon which portal obstruction depends, is described in other articles.

Frederick T. Roberts.

PORTAL THROMBOSIS.—Synon.: Portal Phlebitis; Pylephlebitis; Fr. *Pyléphlébite*; Ger. *Pylephlebitis*.

Portal thrombosis may be divided into two kinds: (*A*) the **Adhesive**; and (*B*) the **Suppurative**.

(*A*) **Adhesive Portal Thrombosis.**—Adhesive portal thrombosis is seen most commonly in cirrhosis of the liver, rarely as a cause of the cirrhosis itself. In the first case, it arises, not from an inflammation of the walls of the vessel, but from obstruction to the circulation. The thrombus itself is usually firmly adherent to the walls, tough, and of a red-brown colour, the vein being dilated.

Symptoms.—The symptoms of portal thrombosis are those of intense portal obstruction. There is ascites, rapidly developing itself, and, according to Frerichs, returning rapidly after removal by tapping. The veins of the walls of the belly become dilated. There may be hæmatemesis or a bloody diarrhœa. The spleen is greatly enlarged. Jaundice may or may not be present.

Diagnosis.—The diagnosis of portal thrombosis is a matter of great difficulty, the symptoms being very like those of cirrhosis, of which, indeed, it is often a mere complication.

Prognosis and Treatment.—The prognosis is always bad, no instance of recovery being known, and the treatment must be the same as for cirrhosis.

(*B*) **Suppurative Portal Thrombosis.**—Suppurative portal thrombosis is commonly met with in connection with some morbid process, most often suppuration, in the parts from which the branches of the portal vein arise, as the intestines, of which very often the cæcum is the seat, next the stomach, and the spleen. The vein is found greatly dilated, and filled with a dirty grey or reddish pulp, which, under the microscope, shows small round nucleated cells like pus-corpuscles. The liver itself shows, on section, the branches of the portal vein filled with a diffluent thrombus, so that the organ looks as if pervaded with abscesses.

Symptoms.—The symptoms closely resemble those of abscess of the liver or of pyæmia. Traube thinks the diagnosis may be made if the liver and spleen be much enlarged, and if there be returning attacks of rigors with raised temperature, while between the attacks the temperature is natural or only slightly raised. There must be also evidence of some suppuration, which may involve the branches of the portal vein; and pyæmia and endocarditis must be excluded. Often, however, all these signs fail.

Prognosis and Treatment.—The prognosis is always bad; the treatment must be the same as for abscess of the liver or pyæmia.

J. Wickham Legg.

POST-MORTEM EXAMINATION. *See* Necropsy.

POST-MORTEM WOUNDS.—Synon.: Dissection-wounds; Fr. *Blessures anatomiques*; Ger. *Sectionwunden*.

Definition.—A variety of poisoned wounds, arising from the inoculation of a virus derived from the dead bodies of men or animals.

Similar consequences may result from the inoculation of the discharges from unhealthy inflammations in living bodies, especially those arising from *post-mortem* poisoning. The conditions necessary for the production of a dissection-wound are the virus, a means of entrance of the virus into the system, and a condition of body favourable to the development of the effects of the virus.

Pathology.—*The Virus.* Of the exact nature of the poison which gives rise to *post-mortem* wounds we know but little. The products of ordinary decomposition may cause local troubles, to be mentioned hereafter, but they never give rise to the graver forms of dissection-wound. The poison is present in greatest intensity in fresh bodies, and its virulence diminishes as decomposition advances. We have no evidence that it is the same in all cases, and as the effects vary greatly, we are justified in assuming that the poison also varies. The chief views held as to its nature are, that it is a product of a certain stage of ordinary decomposition; that it is the product of some special non-organised ferment; and that it is of the nature of a minute organism, which has the power of propagating itself in the living body. The first view is probably untrue, as the poison which gives rise to serious dissection-wounds is only found in the bodies of patients who have died from some unhealthy inflammatory (infective) process. It is most marked in cases of septic peritonitis or pleurisy, pyæmia, septicæmia, puerperal fever, diffuse cellulitis, erysipelas, or spreading gangrene. The diminution of the intensity of the poison with decomposition is accounted for on the second theory, by supposing that the peculiar ferment is destroyed by putrefaction; and on the third theory, by the specific organism being destroyed by the growth of the ordinary bacteria of decomposition, it being a well-known fact that when two organisms are growing together in the same fluid, the stronger seems to overpower the weaker, to check its growth, and finally to lead to its destruction.

Certain specific diseases, as glanders and splenic fever (malignant pustule), may be communicated by inoculation from the dead body, but these accidents are not classed with ordinary dissection-wounds.

Mode of entrance of the poison into the system. Whatever the virus may be, it only acts by direct inoculation. This most commonly occurs through an accidental wound or scratch during the *post-mortem* examination; but a raw surface partly healed, or the fissures in chapped hands, or the small fissures so common at the margin of the nail, may equally serve as points of inoculation. In rare cases infection takes place through the unbroken skin, the hair-follicles seeming then to serve as the points of entrance. The further progress of the poison takes place either by soaking amongst the lymph-spaces of the cellular tissue, as shown by diffuse spreading cellulitis; or by being carried with the stream in the lymphatic vessels, as in those cases in which the local affection is slight, and the first trouble is in the lymphatic glands.

Prevention.—In order to prevent inoculation the following points should be attended to. Before making a *post-mortem* examination of a dangerous case the hands should be carefully looked over. If any spot denuded of cuticle is found on the fingers, an india-rubber cot should be applied, its base being bound round with string. If the whole hands are sore and chapped an india-rubber glove may be used. If no india-rubber cot for a finger is to be found, an efficient waterproof covering may be made at once with gutta-percha tissue and chloroform. If the hands are sound they may be well greased with carbolic oil (1 to 10), but, as this soon wipes off, the application must be repeated several times during the *post-mortem* examination. Accidental wounds arise almost invariably from carelessness—the assistant being as often wounded as the operator. There is scarcely any operation in a *post-mortem* which requires two to perform it, and an assistant should therefore be dispensed with. The most common acts of carelessness are—cutting towards instead of away from the left hand; and letting the knife fall unobserved into one of the cavities, where it is concealed by blood or the viscera, and wounds the hands when next introduced. Wounds from ribs are amongst the most dangerous, as they bleed but little. To avoid these, when the bone-forceps has to be used, in cases of ossification of the cartilages, the ribs should be cut near the nipple line, and the skin folded over them whilst the viscera are being examined. In opening the head the saw is apt to slip, and to injure the hand holding the vault. To avoid this, either wrap the hand in a thick cloth, or hold the head with the left hand on the face, where it will be out of danger. Punctures during the sewing-up of the body have caused many deaths. These injuries are usually due to using too small a needle, which cannot be kept properly under control. A common packing needle sharpened is by far the safest instrument that can be used. In whatever way the wound is made the first essential of treatment is to make it bleed freely. If it is on the finger this may be done by winding a piece of string round it from the root to the tip; then wash it thoroughly under a tap and suck it. Caustics are quite unnecessary if these directions are carried out. After a *post-mortem* examination the hands should always be well washed in some strong antiseptic solution.

The condition of body favourable to the development of the effects of the poison.—Nothing is more common than for two persons to be wounded at the same *post-mortem* examination, and only one to suffer from it. Sir James Paget has brought forward strong evidence for believing that constant exposure to the poison gives a certain degree of 'immunity from the worse influences of the virus,' and that one dissection-wound protects the sufferer from another, at least for some time. Anything which causes a depressed state of health favours the occurrence of *post-mortem* poisoning. Thus, we see it in students who have been some months resident in hospital, in nurses who are worn out with attending a bad case, and in dissecting porters or others who indulge too freely in alcohol. Beyond these no special predisposing conditions are known. *See* PREDISPOSITION TO DISEASE.

VARIETIES.—It will be convenient to discuss the several forms of *post-mortem* wounds under distinct headings according to the following arrangement:—

1. Purely Local Affections.

(*a*) *Dissecting-porter's wart*, or *anatomical tubercle.*—Although not exactly a *post-mortem* wound, this affection must be mentioned here as being one of the effects of the irritation caused by the repeated application of putrid matter to the skin. It is seen only in those whose occupation brings them much in contact with decomposing animal matter, and is of very rare occurrence. Its seat is always at the back of the hand over the knuckles, or the joints of the fingers. It is characterised by a warty thickening of the skin, which may in some cases resemble epithelioma. In other cases the thickening of the cuticle may give the skin an ichthyotic appearance. The enlarged papillæ are set closely together, and there is no true ulceration, but cracks and fissures may exist in parts, from which a serous discharge escapes. The growth tends slowly to spread. These warty growths are usually multiple, and this, together with the want of any tendency to ulceration, will serve to distinguish them from epithelioma.

TREATMENT.—In some cases a cure can be effected by the constant use of wet dressing to soften the epithelium, combined with the application of a mixture of equal parts of glycerine and extract of belladonna. Should this fail, painting with strong tincture of iodine may be tried, or, as a last resource, the application of some strong caustic.

(*b*) *The dissecting-room pustule.*—This is always the result of the inoculation of some poisonous matter into a slight abrasion or puncture. About twenty-four hours after inoculation the spot becomes red and itches. In another twenty-four hours a small drop of pus is seen raising the cuticle, and the part is intensely tender. If the drop of pus be let out the pain is at once relieved. If no treatment be now adopted to prevent it, a small scab forms, under which pus again forms, and the redness and pain return as before. Each time that this happens the sore increases in size, till it may reach about one-eighth of an inch in diameter, and it then closely resembles in appearance a small soft chancre. Without treatment the condition may continue indefinitely. It is very seldom accompanied by any constitutional disturbance. The axillary glands may be tender, but suppuration is rare, except in unhealthy subjects.

TREATMENT.—The small pustules can usually be cured simply by the application of water-dressing, so as to prevent the formation of a scab, and the shutting in of the pus. The treatment must be continued until it is soundly healed. If the smallest speck is unhealed it will relapse as soon as the dressing is removed. If, in spite of water-dressing it refuses to heal, nitrate of silver may be applied, or the ulcerated surface may be covered with iodoform.

(*c*) *Suppuration of the matrix of the nail.*—This arises from inoculation through one of those small fissures at the side of the nail popularly known as 'agnail' or 'hangnail.' The inflammation extends rapidly to the matrix at the root of the nail. The dorsal aspect of the finger for half-an-inch below the nail is swollen, red, and acutely tender, and on pressing over this area pus oozes out over the nail. The inflammation rarely extends over the whole matrix, so that the distal part of the nail is usually unaffected and firmly attached, while the root is softened and loosened by the suppuration beneath it. The discharge has a strong, offensive odour of decomposition. This condition is extremely chronic, the irritation being kept up almost indefinitely by the putrid discharge, which is more or less pent up beneath the nail. When recovery takes place the nail usually separates.

TREATMENT.—The first essential of treatment is, if possible, to render the discharges aseptic. For this purpose the finger may be soaked in a concentrated solution of boracic acid, and dressed with boracic acid lint; or powdered iodoform may be pushed with a piece of card beneath the swollen skin over the root of the nail. If these fail a strong solution of subacetate of lead (liquoris plumbi subacetatis, 1 part, spiritûs rectificati 1, aquæ 6) may be tried. If all these simpler means fail, the nail must be removed, and the raw surface, dressed with some mild antiseptic lotion, will quickly heal.

(*d*) *Suppuration of the hair-follicles.*—This is a somewhat rare effect of *post-mortem* poisoning. About forty-eight hours after exposure to infection a varying number of small pustules, each surrounded by a red areola, form on the hairy parts of the hands and wrists. On careful examination each pustule will be seen to have a hair passing through it. As a rule these pustules discharge and dry up without causing further trouble, but in some exceptional cases they may be followed by constitutional symptoms or lymphatic inflammations.

TREATMENT.—All that is necessary is to cover the part with cotton-wool, to hasten the drying of the pustules.

(*e*) *Boils.*—Boils, which differ in no respect from those arising without known cause, may form as a consequence of exposure to *post-mortem* poisons. They probably start from inflammation of the hair-follicles.

TREATMENT.—This presents nothing special.

(*f*) *Ordinary Whitlow.*—Although whitlow is common amongst nurses and others whose duties oblige them to dress foul wounds, it is a very rare consequence of *post-mortem* wounds. It may, however, occasionally be met with, and then present nothing special. *See* WHITLOW.

2. Diffuse Inflammation of the Cellular Tissue, spreading from the point of inoculation.

(*a*) *Diffuse Cellulitis.*—The seat of inoculation becomes in from twelve to twenty-four hours more or less red and irritable, and in this state it may remain for another day, at the end of which time a brawny swelling of a dusky red colour forms round it, and rapidly extends in all directions, but chiefly in the line of the lymph-stream. At the same time there is intense tension, burning pain, and severe constitutional disturbance, high temperature, total loss of appetite, and possibly delirium. Red lines of inflamed lymphatic vessels may or may not be seen extending upwards, but glandular abscesses are rare, as in ordinary cellulitis. If unrelieved by treatment, sloughing rapidly follows the brawny swelling, first of the subcutaneous tissue, and afterwards of the skin.

Treatment.—The only treatment in such case is free and early incision into the affected part. In one case which came under the observation of the writer the inoculation took place from a scratch from a broken rib which had penetrated a consolidated lung, and caused the formation of a foul abscess. Swelling in the finger commenced on the second day, about 10 p.m., and at 11 a.m. on the following morning it had involved the whole finger and part of the back of the hand. Red lines extended from it a little way above the wrist. Two incisions were immediately made in the palmar aspect of the finger, and one on the dorsum of the hand, with the effect of at once arresting the extension of the process. In this case the attack commenced with slight nausea, but no chilliness or rigor; there was high fever and delirium on the third and fourth days. The constitutional treatment must be the same as in other cases of diffuse cellulitis. *See* Erysipelas.

(*b*) *Spreading Gangrene.*—This is an intensification of the preceding variety. A red, brawny swelling advances rapidly up the arm, quickly followed by gangrene of the subcutaneous cellular tissue and skin. This condition is extremely rare as a consequence of dissection-wounds. A case occurred in 1880, at University College Hospital, under the care of Mr. Heath, in which the patient's life was only saved by amputation at the shoulder-joint. It happened to a nurse from an accidental wound received whilst laying out the body of a patient who had died of puerperal fever.

Treatment.—The treatment is the same as in other cases of spreading gangrene.

3. Inflammations chiefly affecting the Lymphatics.

(*a*) *Inflammation of the Lymphatic Vessels.*—This usually commences from twenty-four to forty-eight hours after inoculation. The seat of inoculation may show scarcely any signs of inflammation, or it may have developed into a small suppurating sore. The invasion of the lymphatic inflammation is marked by elevation of temperature, chilliness, or possibly a rigor. There is malaise and often nausea, with headache. Red lines are soon after observed running upwards from the seat of inoculation in the course of the lymphatic vessels. These lines are about one-eighth to one-quarter of an inch in width, and clearly defined. They are acutely tender. The lymphatic glands to which they lead are swollen and painful. If unrelieved by treatment suppuration frequently occurs in the lymphatic glands, or sometimes in the course of the vessels. Occasionally several lines may fuse together, giving the appearance of a band of cutaneous erysipelas.

Treatment.—The bowels should be well opened. Stimulants in moderate quantities may be taken, good port wine being especially useful, with strong beef-tea, milk, and eggs. If there is much fever quinine may be of use in reducing the temperature. Locally, the whole course of the inflamed vessels is to be painted with a mixture of glycerine and extract of belladonna in equal parts, and the whole arm wrapped in hot fomentations, which must be frequently renewed. This treatment seldom fails to arrest the progress of the inflammation, and ward off suppuration. If pus forms, either in the course of the vessels or in the glands, it must be let out as soon as it is recognised.

(*b*) *Abscess in the Lymphatic Glands.*—This occurs either as a consequence of the previous condition or without any evident inflammation of the lymphatic vessels. It is frequently a complication of one of the local forms first described. The abscess forms either in the gland at the bend of the elbow or in the axilla, and presents no special features requiring description. The prognosis is not grave.

Treatment.—The abscesses must be opened as soon as recognised, and, if possible, treated antiseptically.

(*c*) *Axillary Cellulitis.*—This is one of the gravest effects of *post-mortem* wound. It frequently occurs in cases in which the local affection at the seat of inoculation is so slight as to be scarcely recognisable. From twenty-four to forty-eight hours after inoculation the patient is seized with chilliness, and frequently a rigor; there is great depression; with nausea, or even vomiting, and headache. The temperature rapidly rises, reaching 104° or 105°, and there is frequently delirium. On examining the axilla some fulness, with acute tenderness, is recognised, and there is pain in moving the arm. The fulness soon extends to the front of the chest, in the region of the pectoralis major, and the veins of the region may become more clearly visible than natural. Later on there may be a blush of redness over the pectoral region, and with this there is œdema. If not relieved the swelling and redness may extend down the side of the chest, and show above the clavicle at the root of the neck. The constitutional condition assumes the ordinary characters of septicæmia. There is muttering delirium, rapidly failing pulse, dry tongue, with sordes on the lips and teeth, possibly diarrhœa, and the patient sinks into a comatose condition and dies. Sir James Paget, in his well-known lecture on his own case, explains this condition by supposing that the lymphatic glands are first swollen, and the flow of lymph through them obstructed, and that the poison then extends backwards in the distended lymphatics till it reaches the cellular tissue in which they arise, thus causing diffuse cellulitis, which, if not relieved, or if not speedily fatal, may extend to the whole area which sends lymph to the affected glands. If an incision be made early into the affected cellular tissue it will be found merely infiltrated with serum; later on the serum is turbid; still later the whole areolar tissue would be found in a sloughy condition, soaked in pus.

Treatment.—The blood-poisoning accompanying this condition is frequently fatal in spite of any treatment. The only hope for the patient lies in early recognition of the state of the part, and in making free incisions. These incisions must thoroughly open up the axillary fascia, and if there is any suspicion of extension beneath the pectoralis major, another incision must be made two, or even three, inches in length, through the muscle. This is best made in the interval between the sternal and clavicular portions. The skin and fat only need be divided with the knife, the muscular fibres being separated with the handle of the scalpel to avoid hæmorrhage. If these incisions are made with all antiseptic precautions and the antiseptic dressing adopted, the patient's chance of life is greatly increased. The constitutional treatment consists in free stimulation and abundant nourishment. Quinine may possibly be useful in large doses.

4. **Septicæmia.**—In some cases, which, fortunately, are very rare, *post-mortem* wounds prove speedily fatal, with the ordinary symptoms of acute septicæmia. Local changes at the seat of inoculation may be entirely wanting.

5. **Pyæmia.**—Pyæmia may occur as a secondary complication of the forms of *post-mortem* wound which are accompanied by suppuration and sloughing; but it presents nothing special in such cases. *See* PYÆMIA.

MARCUS BECK.

POST-PHARYNGEAL ABSCESS. *See* RETRO-PHARYNGEAL ABSCESS.

POSTURE.—In this article it is intended to point out the main practical relations of posture to the ætiology, diagnosis, and treatment of various diseases. It not uncommonly happens that a patient assumes instinctively a posture by which his condition may be at once recognised, or which gives indications of importance as to his management. In other cases the practitioner makes systematic use of posture to assist him in his diagnosis, or to aid him in treatment. It should be mentioned at the outset that persons often present peculiarities with reference to posture, which are of no practical significance, and are the result either of natural differences in individuals, or of habit. For instance, some people can only sleep with the head raised very high, in an almost semi-recumbent position; others lie with the head very low, even level with or below the body. Many are unable to sleep on the back, or on one or other side, and especially the left side. The subject will be further discussed in its relations to the points mentioned above.

1. **Ætiology of Posture.**—As an immediate cause of disease, posture is chiefly important in connection with occupation. For instance, many persons suffer from long-continued standing; or, on the other hand, from sedentary occupations. The evil effects of the erect posture are evidenced by the development of varicose veins in the legs, and also by the occurrence of general fatigue and debility, displacement of the uterus, and other conditions, especially in young women; and this subject has of late received considerable attention in relation to those employed in drapers' shops. Those callings which entail constant or frequent bending forward of the body are often very injurious, and this may be aggravated by carrying burdens on the back and shoulders. Not uncommonly persons injure themselves by habitually bending forward while sitting, quite apart from occupation. Another illustration of the influence of posture in causing disease is where individuals have to work in constrained positions, such as colliers and mine-workers. The conditions thus induced are chiefly deformities of the chest, and certain diseases of the lungs, heart, and vessels. Posture is also of consequence in predisposing to certain affections under particular circumstances, or in modifying their effects. Thus the recumbent posture in low febrile and other conditions aids in the causation of hypostatic congestion and its consequences; a similar position promotes the accumulation of morbid products in the bronchi in cases of acute bronchitis, which may cause further mischief; and if an attack of pleurisy should supervene when a patient is obliged to lie on his back, this will materially modify the way in which the fluid accumulates, for it tends then to collect posteriorly, and may cover the whole area of the chest in this aspect, while there is no sign of any fluid in front. Lastly, a peculiar posture in performing certain acts, such as writing, may have some influence in originating affections of the type of writer's cramp.

2. **Posture in Diagnosis.**—As examples of postures spontaneously adopted by patients, which may give useful information in diagnosis, the following are the most striking. In many cases the posture indicates great debility, helplessness, or prostration, and may thus afford important information as to the general condition of a patient. An inability to lie down constitutes a prominent feature in certain forms of cardiac and pulmonary disease, in consequence of interference with the respiratory functions, so that the patient is obliged to sit or to be propped up in bed, or sometimes even to sit up in a chair, to assume the erect posture, or to bend forward. Again, when anything is pressing upon the main air-tube—such as an aneurism—causing obstructive dyspnœa, the patient may instinctively lean forward, so as to take off the pressure as much as possible. In cases of unilateral lung-disease or pleurisy, the patient is often unable to lie on one or other side, especially the affected one; while in affections of the heart it is frequently impossible for him to rest on the left side. As regards abdominal diseases, acute peritonitis is usually characterised by a very striking posture, the patient lying on his back, with the knees well drawn up and bent, in order to relax the abdominal muscles. He may also assume certain positions in other abdominal affections, on account of their influence upon symptoms, such as pain or vomiting. In spasmodic painful attacks connected with this region, it is very common to see the patient bending forwards in a doubled-up position, and pressing upon the abdomen. In nervous diseases posture may be of value in diagnosis. Thus, it may reveal paralysis of different parts; in cerebral meningitis the patient often lies in a curled-up position, all the limbs being bent towards the body; in spinal meningitis the head may be involuntarily drawn backwards, in order to try to relax the muscles behind; in cataleptic conditions any posture that is assumed is retained for a considerable or an unlimited time; while in wry-neck the head is

turned to one side. Lastly, the position voluntarily assumed by a limb may give important information as to local diseases likely to influence it in this respect, such as those of the joints. The whole body may be distorted, as well as the limbs, in connection with diseases of the articulations.

What has just been stated will supply hints as to how the practitioner might avail himself of alterations in posture in aiding him towards a diagnosis in certain cases. For instance, observing the effect of such changes often gives valuable information in connection with pulmonary and cardiac diseases, as evidenced by the influence of the respective positions upon breathing, cough, the heart's action, and other symptoms; and the same may be the case in some abdominal diseases, as well as in nervous affections or in local diseases. Change of posture is most useful, however, in connection with physical examination, the effects it produces upon certain physical signs being noted. In this way it is of essential aid in determining the presence of fluid in cavities, such as the pleura or peritoneum; in distinguishing an internal aneurism from conditions simulating this lesion; in detecting certain solid formations in the abdominal cavity; and for other purposes. Details on these points are given in other appropriate articles. It is also of importance to study the position of the patient in examining the chest; and to remember that posture may materially influence physical signs connected with the heart.

3. **Posture in Treatment.**—Many of the preceding remarks will afford suggestions as to the value of paying attention to posture as a therapeutic measure, and it will at once be evident that if a wrong posture is the cause of any morbid condition, the first principle in treatment should be to rectify it. Besides, it will not uncommonly be found advantageous to watch patients, and to allow them to adopt, or assist them in adopting, such a position as their own sensations dictate to be the most suitable for their condition. In order to illustrate further, however, the benefits to be derived from posture, it may be well to point out some of the diseases in which its value is most strikingly exhibited.

(*a*) Posture is of great importance when general rest of the body is required, or when there is general exhaustion or prostration of the system. The recumbent posture is clearly indicated under these circumstances, for it is the most restful of all, and involves little or no expenditure of muscular force. Hence in acute febrile diseases of all kinds, one of the first indications in treatment is to keep the patient absolutely in bed. This is also desirable where there is excessive fatigue or prostration from any cause.

(*b*) In the management of affections connected with the respiratory organs, attention to posture is frequently of service. Here its influence as regards rest again comes in, for it may be of much consequence to make as little call as possible upon the respiratory functions. Moreover, symptoms associated with the breathing apparatus are in many cases strikingly influenced by posture, such as pain, dyspnœa, or cough; and the act of coughing may be materially assisted, and made more effectual as regards expectoration, by the patient assuming a sitting or erect position. The importance of the prone posture, or of bending forwards, must be remembered when there is anything pressing on the main air-tube.

(*c*) Posture often requires particular consideration in relation to disorders of the cardiac action, or to actual disease of the heart. Thus, in the syncopal state the patient should be placed horizontally, or even with the head at a lower level than the body, so that the blood may more readily reach the brain, and thus life may be sustained. In this state, or when the heart is acting with extreme feebleness from any cause, raising the patient into a sitting posture has been known to cause a fatal result, and should be carefully avoided. On the other hand, there are conditions of the heart in which the patient cannot possibly lie down, and especially where there is much dilatation; under these circumstances it may be of the greatest service to have him constantly sitting up in a properly-constructed chair, and the beneficial effects thus produced are sometimes almost marvellous.

(*d*) In the treatment of aneurisms, whether internal or external, posture is frequently made use of with advantage. In the cure of this lesion in the chest or abdomen, rest is often an important agent, and on this account patients are kept in the recumbent posture for weeks or months, so as to keep the heart as quiet as possible, and also to limit the demand of the system for food, which is only given in a restricted quantity. Aneurism in the chest is one of the causes which may originate pressure on the air-tube, and on this account attention to posture may be required in connection with it. In the case of aneurism in the limbs, posture is sometimes made use of to cure them, by causing pressure, as flexion of the knee for the cure of popliteal aneurism.

(*e*) The influence of posture with respect to gravitation may often be recognised with advantage in the treatment of certain conditions. This is well exemplified by its effects on dropsical accumulations in the legs and scrotum. Abundant anasarca may frequently be got rid of completely in a short time by keeping the legs in a horizontal position; and œdema of the scrotum likewise may soon disappear when this part is propped up. The same principle is of essential importance in checking hæmorrhage from a ruptured varicose vein in the leg; and may also be made use of in the cure of varicose veins. The influence of posture upon dropsy may give useful information as to its cause, and as to the exact conditions upon which it depends.

(*f*) As miscellaneous illustrations of the employment of posture in treatment may be mentioned the value of the recumbent position in sea-sickness, attacks of giddiness, megrim, and neuralgic affections about the head; raising the head in comatose conditions; the prone posture in the treatment of certain forms of spinal disease; prolonged decumbency to restore a displaced uterus; and various positions in which limbs are placed on account of local diseases, to relieve pain, to prevent muscular tension, to promote the escape of pus, or for other purposes.

(*g*) Lastly, it must be remembered that it is not uncommonly requisite to change the position of a patient more or less frequently, if he should be confined to his bed. For instance, it may be necessary to do this in low febrile diseases, in order to prevent the occurrence of hypostasis at the bases of the lungs, or the formation of bed-sores on parts subjected to pressure. This is also necessary in many cases of spinal or cerebral disease, and in very emaciated patients (*see* ULCER). Change of posture is further useful in assisting the escape or expulsion of morbid secretions from the air-passages when they tend to accumulate there. FREDERICK T. ROBERTS.

POUGUES, in Loire, France.—Alkaline chalybeate waters. *See* MINERAL WATERS.

POULTICE.—SYNON.: Cataplasm; Fr. *Cataplasme*; Ger. *Breiumschlag*.—Poultices are soft moist applications, usually applied hot, but occasionally cold. They may be used merely as a means of applying heat and moisture; or may contain some drug intended to exert a specific effect. Of the innumerable poultices formerly in use, only six are now officinal.

Poultices may be arranged thus: 1.—The *simple* poultice, composed of linseed meal. The practice of using bread soaked in hot water as a poultice has deservedly fallen into disrepute, as it soon becomes sour and offensive. 2. *Disinfecting* poultices, namely, cataplasma carbonis, and cataplasma sodæ chloratæ. 3. *Sedative* poultices, such as cataplasma fermenti, and cataplasma conii. 4. The *counter-irritant* poultice—for example, cataplasma sinapis.

1. **Simple Poultice.**—The simple poultice, by its heat, causes a dilatation of the vessels of the part to which it is applied, and thus hastens the progress of inflammation, either towards resolution or suppuration. It softens the cuticle, and relaxes the skin by its moisture, and thus favours swelling, and lessens tension and pain. In internal affections, such as bronchitis, pleurisy, or pericarditis, large poultices are frequently applied to the skin over the inflamed part. They benefit the patient, partly by their warmth, and partly by exerting an extremely mild counter-irritant effect, consequent upon the redness and congestion of the skin which they produce. They are, however, somewhat troublesome; they soon become cold and hard; and if the patient be restless their weight causes them to shift, and fragments break off and drop into the bed, and there drying they cause considerable discomfort. For application to external inflammations a few folds of lint, soaked in hot water or any appropriate lotion (sedative, stimulant, or antiseptic), covered with oil-silk, and afterwards with a thick layer of cotton wool, will be found to answer every purpose of a poultice, and to be much more cleanly and less troublesome.

Linseed-meal poultices applied to boils usually cause a fresh crop to spring up round the original boil, from the irritation they give rise to. They should consequently never be used, wet boracic lint being always substituted. In internal inflammations a poultice may often be advantageously replaced by cotton-wool only, covered with oil-silk and secured by a bandage. If any counter-irritant action is required a few drops of chloroform or turpentine may be sprinkled on the wool.

Linseed-meal poultices are best made from meal from which the oil has been expressed, as the pure meal becomes rapidly rancid. The *British Pharmacopœia* recommends the addition of a little olive oil. The following is a useful method of making a linseed-meal poultice:—Heat the basin in which the poultice is to be made with boiling water; then empty it and put into it again as much boiling water as may be necessary to make the required poultice; sprinkle the meal into the water, stirring vigorously, till the proper consistence is attained; lastly, stir in a small quantity of olive oil. By adopting this plan the poultice will be free from lumps. The poultice should then be spread with a broad spatula on a piece of rag. It must be of a uniform thickness, and neither so thick as to be too heavy, nor so thin as to cool and dry too rapidly. A poultice should be changed every two or three hours by day, and every four at night, if the patient is sleeping. In all cases where there is free suppuration, a poultice is the dirtiest application that can be made to the wound. Wet boracic lint should always be used instead.

2. **Disinfecting Poultices.**—*Cataplasma carbonis* is a horrible compound of wood-charcoal, linseed meal, and bread, and was formerly supposed to have some disinfectant properties. Both this and the *cataplasma sodæ chloratæ* have been entirely replaced by more cleanly or efficient antiseptic applications. The best of these are boracic acid lint and carded oakum. If carded oakum be used it must be made into a soft and even pad, and may be dipped in hot water before being applied. It is a most powerful antiseptic, and very cheap, but it has the disadvantage of blackening the skin with the tar it contains, and sometimes causes considerable irritation. Both these inconveniences may be overcome to a certain extent by greasing the skin with carbolic oil (1 to 10).

3. **Sedative Poultices.**—*Cataplasma fermenti* is composed of beer yeast, 6; flour, 14; water (100° F.), 6. After mixing it is to be placed near the fire till it rises. The carbonic acid was credited with both sedative and antiseptic properties. It was chiefly used in boils, but from personal experience the writer can state that it has none of the virtues attributed to it. *Cataplasma conii* is composed of hemlock leaf, 1 ounce; linseed meal, 3 ounces; and boiling water, 10 ounces. Mix the ingredients and add them to the water gradually, constantly stirring. It has been chiefly used in cases of cancer to relieve pain. Its dirtiness and weight are, however, strong objections to it.

4. **Counter-irritant Poultice.**—*Cataplasma sinapis*, the ordinary mustard poultice, is an invaluable counter-irritant. It is composed of mustard in powder, 2½; linseed meal, 2½; boiling water, 10. The linseed meal is to be mixed with the water, and the mustard added, constantly stirring. It must be remembered that mustard varies much in strength, and that since it has been made the object of the special attention of the authorities engaged in carrying out the Adulteration Act, its strength has consider-

ably increased. Its action should extend only to producing redness of the skin, but if kept on too long it will cause vesication, and has even been known to give rise to sloughing. The time a mustard poultice can be kept on varies from ten minutes to half an hour or more, according to the strength of the mustard. The guide most usually relied upon is the sensations of the patient. An ordinary patient is not likely to keep it on too long, as the smarting soon becomes unbearable. Patients who are much in the habit of applying mustard poultices to the same part —as, for instance, the front of the chest—acquire a singular power of resistance to the irritative action of the mustard. The mustard poultice is indicated whenever mild and rapid counter-irritation is desired. It is especially useful in bronchitis, and in muscular rheumatism, as lumbago, or pleurodynia. Rigollot's mustard-leaves, or the Chartæ Sinapis of the *Pharmacopœia*, are an excellent substitute for the mustard poultice. They are cleaner, more easily applied, and can be more accurately adapted to the spot required. They should always be used in preference when obtainable. Marcus Beck.

PRÆCORDIAL ANXIETY or OPPRESSION.—Synon.: Fr. *Angoisse*; Ger. *Präcordialangst*.

Definition.—A paroxysmal sensation of constriction, attended with anxiety, referred to the præcordium.

Description.—Præcordial anxiety is a distressing sensation in the region of the heart, characterised by an irregular, rolling, tumbling, or falling motion, supervening on a feeling of constriction. It is accompanied by feelings of anxiety; by restlessness, which may pass into a state of extreme agitation; by a sensation of approaching syncope, with fear of death; and by chilliness passing into a cold clammy perspiration. Though there may be a soreness or dull aching, there is neither pain nor palpitation. The urine is not increased, but rather diminished. Sleep is impossible. The attack often comes on during sleep, and soon, perhaps, the restless anxiety necessitates rising from the couch and walking about; often flatulence oppresses, and gas is evolved, with relief to the symptoms. The attacks are paroxysmal, of varying duration. Præcordial anxiety appears to have no alliance with præcordial pain; it does not appear to be a simple neurosis, but dependent on some abnormal muscular condition, whereby the irritability of the heart is disturbed, caused, it may be, by deficient innervation, or by an impure blood failing to stimulate it to due expansion and contraction. The heart may not be altogether free from indications of more than functional disease.

Treatment.—During the paroxysm relief is generally obtained in locomotion, and in occasionally administering small amounts of some diffusible stimulant or warm carminative. In the intervals fresh air, attention to dietetic rules, the free evacuation of the bowels without purging, and light nervine bitters, will be found useful.

T. Shapter.

PRÆCORDIAL PAIN.—Synon.: Heartburn; Fr. *Cardialgie*; Ger. *Magenschmerz*.

Definition.—By præcordial pain it is intended in this article to signify pain referred to the region of, but not originating in, the heart.

Description.—Spasmodic, not paroxysmal, præcordial pain may vary from a slight uneasiness to an intense anguish. It may have different characters; it may be sharp and lancinating, dull and heavy, twisting, or grinding. Its seat may be defined, or it may be diffused over a large surface. It is met with mainly in persons of a nervous temperament, in the gouty and dyspeptic, in the course of certain of the blood-diseases, and as an accompaniment of special female disorders. A common seat of this pain is the left fourth intercostal space below, or, rather, outside, the line of the nipples. The patient associates it with the heart; and yet describes it as not so deeply seated, nor in any respect influenced by its action—having no rhythmical exacerbations; generally it is confined to this spot, but may be diffused over the chest. A severe form of this pain, though for the most part confined to the region of the heart, often extends from the præcordium to the left shoulder, the neck, and the stomach; sometimes, though rarely, to the arms. These several forms of pain have analogies with each other, their differences being mainly in seat, in intensity, and in their complications with other disorders; they are irregularly remittent; they do not partake of the nature of cramp, or spasmodic constriction; and apparently they have little or no influence on the heart's action, or on that of the respiratory organs. For the most part, though their manifestation may be severe, and therefore alarming to the patient, they do not, simply and unassociated, indicate the presence of disease of a fatal tendency. They are to be esteemed as capable of alleviation, and generally of cure. If there be danger, it is chiefly due to complications with organic disease of the heart, or other contiguous organs; they partake of the nature, and obey the laws, indications, and phenomena, of ordinary nerve-pains, such as tic-douloureux, or those of sciatica or lumbago; and they have their seat primarily in the pneumogastric or cardiac nerves, and, secondarily, in the nerves of the brachial plexus, and the cerebro-spinal nerves supplying the front of the thorax.

Prognosis and Treatment.—The prognosis and the treatment of these affections require that their origin, seat, intensity, persistency, and complications should be well considered; each being a measure of disorder, and a guide to the means of alleviation.

The severe paroxysmal or recurrent pain, which appears to have its seat mainly in the branches of the vagus nerve, is essentially of dyspeptic origin, and requires, with well-regulated diet and exercise, very careful medical management. The indications for the most part are to correct an acid or gouty diathesis. Alkalies, and the alkaline mineral waters, light bitter infusions, and warm alterative aperients, are often most useful in these cases. The intercostal pain is somewhat persistent and difficult of alleviation and requires, besides attention to the morbid states with which it may be associated —the hysterical and dyspeptic, the plethoric and hypochondriacal, the emaciation and weakness of exhausting diseases, a strictly regulated diet, with exercise and residence in a pure air. The pains originating in disordered conditions of the blood usually find relief in the regimen and treatment laid down for their alleviation.

T. Shapter.

PRÆSYSTOLIC.—A term implying antecedence to the ventricular systole, and used in connexion with a cardiac murmur or thrill occurring during this time of the cardiac revolution. *See* Heart, Valves of, Diseases of; and Physical Examination.

PREDISPOSITION TO DISEASE.—Definition.—That state of the body which renders it peculiarly liable to be affected injuriously by a morbific agent; determining in the case of a 'non-specific' agent the particular disease which it shall induce in each of several individuals similarly exposed to it; whilst, in the case of a 'specific' agent or 'morbid-poison,' it determines the relative liability of several individuals similarly exposed to it, to become the subjects of the particular disease it is capable of originating, and also influences the severity of its attack.

Thus, of several persons equally exposed to severe cold, which, by chilling the general surface, produces contraction of the cutaneous capillaries and consequent internal congestion, some shall not suffer seriously in any way; but one shall be attacked by bronchitis, another by pneumonia, another by apoplexy, another by gastro-intestinal disturbance, another by jaundice, another by nephritis, another by gout, and so on, according to the part of the body which the congestion most affects in each individual.

Again, of several individuals equally exposed to the poison of cholera, some shall escape altogether, whilst others shall be attacked by choleraic disease: and of the latter, some may suffer only from diarrhœa; in others nothing more may be induced than vomiting, cramps, and rice-water evacuations; whilst in others the disease may develop itself in its full intensity, and rapidly proceed to a fatal termination.

Predisposition may be either *congenital* or *acquired*; and in the former case—unless induced by malformation, or by causes acting through the maternal system during pregnancy, it is usually *hereditary*.

Hereditary predisposition to disease seems to follow the same modified laws of heredity as the transmission of *family* peculiarities. These do not imply the same duration or universality in the action of the causes which have evolved them as do the characters of species and race; and consequently, whilst tending to perpetuation if the parentage on both sides be limited to such as participate in them, they tend to die out by free interbreeding. Still, we often see a family feature, or some other physical or mental peculiarity, 'cropping-up' after a dormancy of several generations; thus clearly evidencing the transmission of a potency, which manifests itself whenever some deficient condition has been supplied. So there are certain constitutional states or *diatheses*, which particular abnormal habits of life tend to induce, when their operation continues with cumulative force through successive generations. These, when fully established, so penetrate the entire organism, that perhaps no one process goes on exactly as it would in perfect health. And, when they have once firmly rooted themselves in it, they tend to propagate themselves hereditarily like family characters, even when the original factors have ceased to act, but still more when they continue in operation. Of this we have a conspicuous instance in the hereditary transmission of goître, and its gradual aggravation into cretinism, among the inhabitants of those Alpine valleys in which a close stagnant atmosphere, privation of sunlight, bad ventilation of dwellings, filthy personal habits, and some other local conditions not yet understood, have concurred, through a long succession of generations, to engender the constitutional state which expresses itself in these forms of disease.

So, the fullest evolution of the gouty, the scrofulous, or the cancerous diathesis may require the continued action of their factors for several successive generations; it may be interfered with by the introduction of normal factors by intermarriage; and during its progress the manifestation of these diatheses may be so trivial as to attract but little notice. But when either of them has been fully established by the sufficiently prolonged action of its causes, its hereditary transmission, like that of family peculiarities, becomes the rule rather than the exception, save in so far as it is modified by interbreeding. And even where it seems to have died out, never showing itself in the spontaneous production of any of its characteristic forms of disease, it shall modify the course of almost any other malady, or complicate the results of some accidental injury. Where both parents are the subjects of the same well-marked diathesis, the transmission of it to the offspring is almost a certainty; and the manifestation of it is likely to be yet more marked, if the parents inherit also the same *family* idiosyncrasies.[1]

Although the predisposition to *insanity* is often undoubtedly hereditary, it does not seem to partake of the constitutional nature of a diathesis, except where it depends on the existence of one of the definite forms of mal-nutrition already specified. The fact seems to be that the nervous system is so peculiarly liable to be shaped and modified by the mode in which it is habitually called into exercise, that it takes-on a particular *abnormal* form of activity far more readily than any other organ; and thus, when a special form of malnutrition has once established itself, this may be transmitted to the offspring without the prolonged action of its special factor through many successive generations. We see this particularly in the effect of habitual alcoholic excess, which not only produces a tendency to insanity in the subject of it, but also engenders in the offspring (especially when *both* parents are drunkards) a disordered state of brain-nutrition, which may express itself in

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[1] The worst case of this kind that the writer ever saw or heard of, was where the parents were first cousins, —children of two brothers who were both gouty, and who belonged to a family noted for the strong personal and mental resemblance of its members.

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idiocy, epilepsy, alcoholic craving, mental instability, weakness of will, uncontrollable hysteria and the like, as well as in insanity. And the same may be said of abnormal moral habits, which, when they have fixed themselves in the cerebral organism, tend to reproduce themselves in succeeding generations; as we see in hereditary kleptomania.

But of all these acquired forms of disordered *neurosis* it may be said that, as it is the peculiarity of the nervous system rapidly to grow to the mode in which it is habitually exercised, so there is less tendency to the hereditary perpetuation of such disorder than where it depends upon an established diathesis, provided that the right methods of physical and moral invigoration are employed for the restoration of the brain's normal activity.

Although it can scarcely be doubted that various other acquired predispositions tend to reproduce themselves in the offspring, there are none which do so with any approach to the constancy and definiteness which are exhibited by those which have become 'constitutional'; and they may, therefore, be dismissed without special notice.

Among the diseases produced by the action of specific poisons, there are some to which the hereditary predisposition must be said to be *universal*; the cases in which these poisons are imbibed for the first time without producing their characteristic effects, being quite exceptional. In this category are to be ranked the exanthemata, and probably syphilis. Dismissing the latter as limited in its propagation by the speciality of its mode of transmission, we recognise the universality of the predisposition to the former in the extraordinary manner in which any exanthem introduced into a community, whose isolation had prevented its invasion for a long previous interval, spreads through a whole population.[1]

But the original liability to any of the exanthemata appears, as a rule, to be extinguished by one attack of it; the cases being exceptional in which the poison develops itself a second time in the body of anyone who has once *fully* exhibited its characteristic effects. And the liability is greatly diminished, and the severity of the second attack usually much mitigated, even when the first action has been incomplete —as is often seen in epidemics of measles and scarlatina. This seems the *rationale* of the 'protection' afforded by vaccination against small-pox; there being (in the writer's opinion) no reasonable doubt that the vaccine virus is nothing else than small-pox poison modified by transmission through the cow, and that the protective influence of vaccinia is thus of the same *kind* as that exerted by a first attack of variola, though perhaps rather lower (unless re-vaccination has been practised) in *degree*.

Much light has recently been thrown on this subject by parallel researches in epizoötic diseases; for it has been found that the poisons of 'Splenic Fever' and 'Fowl-cholera' can be modified in like manner by 'cultivation'; and that the inoculation of these modified poisons produces in the subjects of it very mild forms of those diseases, which serve as a protection against their malignant attacks. And it may now be laid down with tolerable certainty, (1) that the blood of an individual who has been the subject of any of those specific diseases which usually occur only once in life, is so altered (whether by addition or subtraction), that it is no longer liable to be acted on by the same poison; and (2) that this alteration may be produced, and 'protection' imparted to the subject of it, by even a greatly mitigated form of the disease, such as may be induced by the introduction of an artificially modified poison. It may not, Professor Lister thinks, be too sanguine an anticipation, that means may ere long be found for so tempering the poisons of measles and scarlatina, as to make an innocuous 'vaccination' afford a similar protection against their worst effects.[2]

Acquired Predisposition.—Any habitual infraction of the laws of health will induce a *general* liability to disease, by producing a depressed condition of the vital activity, whereby the organism is rendered less capable of resisting the influence of morbific agents. But this infraction may be of a kind which induces a liability to some particular disease; as when the habit of rapidly eating a large meal tends to injure the digestive power; or the habit of living in over-heated rooms predisposes to bronchial and pulmonary attacks.[3]

It is, however, in determining the invasion and epidemic spread of diseases that depend upon the *zymosis* set up in the blood by the introduction of certain specific poisons, that the effect of 'acquired predisposition' is most distinctly seen, and can be most definitely expressed. During the severest visitation of cholera or diphtheria, for example, the number attacked is really small in comparison with the entire population; and while, of those who escape, the great mass may be assumed not to have been exposed to the action of the poison at all, yet it is unquestionable that a large proportion of those who are as fully exposed as those attacked by the disease, do not become the subjects of it. A medical practitioner, again, may unconsciously carry about with him a septicæmic *contagium*, which is innocuous, not only to himself, but to a large proportion of the persons with whom he comes into contact; and yet it may take fatal effect upon certain individuals, who, nevertheless, have received no stronger a dose of the poison than the rest. Further, it is not unfrequently seen that the practitioner or nurse who long seems completely 'proof' against any attack of the epidemic malady to which he (or she) is ministering, at last succumbs to it. It is clear, in these and similar cases, that there must be some 'predisposing condition' not supplied by the *normal* human body, which determines the zymotic action of the *materies morbi* in the individuals who manifest its effects.

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[1] Thus, in 1846, the poison of measles having been conveyed to the Faroe Islands, where it had been unknown for sixty-five years, the disease rapidly spread among their inhabitants, affecting old and young alike; more than 6,000 persons out of a total of 7,782 were attacked by it in the course of six months; and scarcely any escaped, save the few aged persons who had been affected when young in the previous epidemic, and the inhabitants of one of the smaller islands, who kept up a rigid quarantine. The Icelandic records (which have been well kept for many centuries) show a similar prevalence of any exanthem that has been introduced after a long interval. Thus in 1707, out of a total population of about 65,000, no fewer than 16,000 (or nearly one-fourth) *died* in an epidemic of small-pox; so that it can scarcely be doubted that, as in the previous case, almost every individual exposed to the poison must have been *attacked* by the disease, unless he had previously been the subject of it. Thirty-four years had elapsed since the disease had been last known in the island; and many persons who had had it before, took it a second time.

[2] See his address 'On the Relation of Micro-organisms to Disease,' in *Quarterly Journal of Microscopic Science*, April, 1881.

[3] The writer was informed by Mr. Gulliver, when surgeon in the Life Guards, that the young powerful men of his regiment, mostly sons of Yorkshire farmers, suffered greatly from bronchitis and pneumonia; in consequence, he believed, of their liability to become chilled on going out into cold air, after being shut up for many hours a day in stables unduly heated for the purpose of imparting sleekness to the coats of the horses; the animals themselves suffering in like manner.

Such 'predispositions' have been recognised and specified by all who, at various times, have scientifically studied the ætiology of epidemics; and it has been universally noted that unwholesome food, bad water, and foul air have exerted a singular potency in favouring the action of the poison on individuals and communities. The advocates of the 'germ-theory' and of the 'chemical theory' of zymotic poisons are at one in regard to this fact—that the presence of nitrogenous matter in a decomposing or readily-decomposable state, affords the best possible *pabulum*, either for the development of bacillar organisms, or for the action of ferments. And, building on this foundation, the writer long since[1] came to the conclusion, that the common condition which *all* those agencies tend to produce, which experience has shown to be specially favourable to the development of zymotic disease, is this:—the presence, in the blood of the individual attacked, of an *excess* of those decomposing effete matters, with which the circulating current is normally charged to a limited amount, during their passage from the parts of the body in which they are poured into it, to the excretory organs by which they are eliminated and cast forth. If the amount of these matters be limited to that which is being continually generated in the ordinary 'waste' of the body, and if the great emunctories (the lungs, the liver, the intestinal glandulæ, the kidneys, and the skin) all do their proper work, the products of that 'waste' are drawn-off from the blood-current as fast as they are poured into it, so that the stream is kept pure. But if, on the one hand, such decomposing matters be either abnormally introduced from without, or be generated in abnormal amount within the body; or if, on the other hand, the normal process of elimination be in any way obstructed; or if, still more, an abnormal excess of the one process concurs with deficient activity of the other, a rapid accumulation of these matters takes place in the blood; and this, by providing the *pabulum* requisite for the development of the poison, supplies the very condition necessary for its morbific activity.

Of the effectiveness of the *introduction* of putrescent organic matter, either in food, water, or air, the cholera epidemic of 1848–9 afforded instances so 'glaring' that they here need only to be adverted to.

Of the even more marked potency of the *excessive generation of effete matter within the body*, we have a typical example in the extraordinary proclivity of the *puerperal female* to suffer from the action of any septic poison to which she may be exposed.[2] Nothing can be plainer to the physiologist, than that the return of the uterus, after parturition, to its non-pregnant condition, involves a rapid 'waste' of its muscular substance, the products of which will be poured into the blood-current far more rapidly than they can be eliminated; this state continuing until the process is completed. The like condition exists in subjects of *severe injuries*, and of *operations*; and not only do these exhibit a special proclivity to the action of specific poisons like scarlatina (the disease only then declaring itself, although its germs must have been previously received and lain dormant),[3] but they show a peculiar liability to suffer from the ordinary septic poisons which have no effect upon the healthy carriers of them, erysipelas and adynamic 'surgical fever' being thus communicable.[4]

Excessive exertion, again, whether bodily or mental (such excess being marked by the feeling of *fatigue*) has always ranked among the most potent of predisposing causes; and its action is clearly traceable to the same source, the abnormally rapid 'waste' of the tissues, whereby the blood-current becomes unduly charged with the products of their disintegration.[5]

Ample evidence is afforded by army experience, of the special liability of soldiers to zymotic disease, when on long and fatiguing marches; and this especially in hot climates, where, the activity of the respiratory process being reduced by the high external temperature, the products of the 'waste' tend to accumulate in the blood-current.

Of the predisposition induced by the accumulation of effete matter consequent upon *obstructed elimination*, none is more marked than that which results from *overcrowding*. The effect of defective air-supply is not only to reduce the quantity of carbonic acid got rid of by expiration, but also (which is probably of yet greater importance in relation to zymotic disease) to diminish the normal oxidation of those nitrogenous effete matters, of which (when thus metamorphosed) it is the special business of the kidneys and skin to get rid. The accumulation of these within the body speedily makes itself manifest in the offensiveness of the *halitus* of the breath (the condensation of which shows the presence of fœtid matter) and of the cutaneous transpiration; and thus, although there may be no introduction of decomposing matter into the body, or specially rapid internal production of it, the blood-current becomes as effectually charged with the *pabulum* of the zymotic poison as if this had been injected into it.[1]

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[1] See his Paper on 'The Predisposing Causes of Epidemics,' in the *Brit. and For. Med. Chir. Review*, vol. xi., 1853, p. 159.

[2] This proclivity was never more strikingly displayed than in the former experience of the Vienna Lying-in Hospital; where a comparison of the mortality in the two sides of the institution, one attended by midwives, and the other by medical students, showed that an annual average of from 400 to 500 deaths out of 3,000 deliveries was distinctly traceable to the unclean habits of the latter, who were accustomed to come into the wards fresh from the dead-house. The enforcement of proper precautions soon lowered this excessive mortality to the standard of the other side.

[3] Sir James Paget, in *British Medical Journal*, 1864, vol. ii. p. 237.

[4] Sir James Simpson in *Edinburgh Monthly Journal*, vols. xi. and xiii.

[5] It is within the experience of everyone, that the *sense* of fatigue bears no constant proportion to the amount of exertion put forth; and that whilst, on the one hand, any obstruction to the eliminating processes (as by bad ventilation of the sleeping apartment) prevents its removal by rest, an unusually severe and prolonged strain may be sustained without its induction, when the excretory apparatus is stimulated to increased activity, as in 'training.' And there is strong reason, therefore, for regarding this feeling as indicative of the degree in which the blood is charged with the products of nervo-muscular 'waste.'

The strong predisposition to zymotic disease induced by *intemperance*, which has been no less conspicuously manifested in the experience of our Indian army, seems clearly traceable to the same source. For the habitual presence of alcohol in the blood-current undoubtedly diminishes the oxidation of the 'waste' products, and thus occasions their accumulation in the system; and this at a greater rate in hot climates than in cold, on account of the already reduced activity of the respiratory process in the former. Where, again, the rate of 'waste' is abnormally increased—as on the march of troops—the evil influence of alcoholic liquors is still more strongly manifested; and this will be again aggravated by overcrowding in tents or barracks.[2]

On the connection between *famine* and *pestilence*, it is unnecessary to enlarge; but it affords the key-stone of our cumulative argument. For in whatever way it is to be accounted for, the fact is certain, that a state of general blood-contamination is produced by the accumulation of non-eliminated products of 'waste.' In the Irish famine of 1847, the fœtid secretions from the skin, the rapid supervention of general putrescence after death and its manifestation even previously, and the frequent termination of life by colliquative diarrhœa, all evidence the peculiar fitness of the body so conditioned for the development of a zymotic poison.

And thus we seem furnished with a scientific *rationale* for all that experience has taught as to the conditions of the spread of zymotic disease; which, by giving greater definiteness and consistency to medical doctrine, will afford a surer and more positive basis for preventive *hygiène*, both public and individual.

But whilst it is specially in establishing a predisposition to zymotic disease, and in aggravating the severity of its attacks, that the contamination of the blood-current by the accumulation of 'waste' products most strikingly manifests itself, there can be no doubt that it lowers the healthy vigour of the body generally, and thus renders it more ready to be affected by any disease to which it may be constitutionally liable. Where any form of mal-nutrition exists—whether resulting from imperfect performance of the primary digestive processes, producing ill-made blood, or from imperfect conversion of blood into tissue—there must be premature degeneration and augmented 'waste'; and the rate of this augmentation must tend to increase, if special attention be not given to the eliminating processes. Here we have the *rationale* of the fundamental importance of pure fresh air, as cool as it can be borne, to the scrofulous subject; and of the remarkable cures sometimes effected in patients in whose lungs tubercular deposit has already commenced, by the hazardous discipline of a hardy out-door life. When any serious malady has once established itself, the degeneration of tissue, as shown in the rapid wasting of the body, takes place with augmented rapidity; and the necessity for the removal of its products is proportionately urgent. And this is not the less important when the progress of the disease is stayed; for the purification of the blood from the contamination it has received is absolutely essential to the establishment of those recuperative processes on which the final issue depends. Of the due elimination of the waste-products, their oxidation is the first and most fundamentally-important act; and of the direful consequences of past ignorance and neglect of this principle—evinced on a large scale in the overcrowding and bad ventilation of hospitals, poorhouses, and gaols—their records too surely tell. Even now our practice is far from perfect in this particular; and it is scarcely going too far to affirm that, not only the public, but the medical profession, have still much to learn as to the importance of an ample supply of pure air, both for the prevention and the cure of disease.[1] WILLIAM B. CARPENTER.

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[1] Thus it has come about, that, while the average mortality of European troops in India under favourable circumstances does not exceed 30 per 1,000, it has been raised at particular stations through a long succession of years—solely by overcrowding in ill-ventilated barracks—to 75 or even 100 in the 1,000; whilst in certain Indian gaols, in which the air-space was actually at one time less than 100 cubic feet per prisoner, the mortality rose to an annual average of *one in four*.

A most remarkable instance of the combined action of the two last-named 'predisposing' causes, resulting in the *double*-charging of the blood with the *pabulum* most suited to the development of zymotic poison, was furnished by the terrible outbreak of cholera, which carried off *one-eighth* of the troops stationed at Kurrachee in 1846; no fewer than 464 deaths having then occurred out of a total strength of 3,746. Some of the troops (*a*) had recently come off a long and fatiguing march, but were well accommodated in airy barracks; and their loss was at the rate of 96·6 per thousand. In another regiment (*b*), which had not been on the march, but was overcrowded in small ill-ventilated tents, the rate was 108·6 per thousand. And in a third (*c*), which had made the march like *a*, and were overcrowded like *b*, the mortality was 218 per thousand, or at a rate actually exceeding *their* high rates added together.

[2] Of this, Dr. Parkes's experience as assistant-surgeon to the 84th Regiment in India, afforded a striking illustration. A large proportion of the men of this regiment were total abstainers, and the remainder were very temperate. During the year 1846–47, it was quartered for eight months in the healthy barracks of Fort St. George, Madras; it then performed a march of between 400 and 500 miles to Secunderabad, in a very wet and unhealthy season, through a country infested with fever and cholera; and the remaining two months were spent in overcrowded barracks at Secunderabad. Yet the mortality during that year was only 13 in an average strength of 1,072, or at the rate of 12·1 per 1,000. Continuing during the next year in the same overcrowded barracks, its loss was raised to 34·9 per 1,000; but this was *less than half* the average mortality of the troops quartered in the same barracks for fifteen years past. The 63rd Regiment, with which they had exchanged, though not specially noted for intemperance, had there lost 73 men in the first nine months of the previous year, or at the annual rate of 78·8 per 1,000; and, having then marched to Madras to take the place of the 84th, had so many sick when the two regiments met on the road, as to be forced to borrow the 84th's dhoolies.

PREGNANCY, Diseases and Disorders of.—SYNON.: Fr. *Maladies et Troubles de la Grossesse*; Ger. *Krankheiten und Stöhrungen der Schwangerschafts.*

Under this heading are included all those complaints which arise from the pregnant state, or which, occurring during gestation, are so modified, or exercise such an influence over it, as to require special treatment. The subjects of false pregnancy and concealed pregnancy will also be noticed. The principal conditions which demand consideration in this article are therefore the following:—1, vomiting; 2, abortion; 3, ptyalism; 4, retroversion and retroflexion of the uterus; 5, anteversion and anteflexion; 6, embolism; 7, extra-uterine pregnancy; 8, pruritus of the pudendum; 9, œdema of the labia and lower extremities; 10, œdema of the upper extremities; 11, hæmorrhoids; 12, dropsy of the amnion; 13, cramps; 14, eclampsia; 15, false, and 16, concealed pregnancy. *See* FŒTUS, Diseases of.

The foregoing list of the principal diseases of pregnancy might be much extended if, following the example of eminent obstetric authorities, we were to include jaundice, constipation, diarrhœa, cardialgia, headache, insomnia, palpitation and hypertrophy of the heart, rheumatism, inflammation of the uterus, &c. To these and most other diseases pregnant women are liable; but not being in any way peculiar to pregnancy, or essentially modified thereby, they require no notice in this place.

It would also be beyond the scope of this article to refer to all those anomalous sympathetic disturbances of the nervous system, such as longings, morbid or depraved appetite, hysterical irritability, nervous pains, odontalgia, &c., that sometimes attend gestation, and which, unless excessive, may be regarded as symptoms, and not included amongst the diseases of pregnancy.

1. Vomiting.—The most common complaint of pregnancy is morning sickness, or nausea and retching, usually confined to the forenoon, and continuing from the third week after conception until the period of quickening.

The sickness of pregnancy is generally attended by no loss of appetite or impairment of health, and may thus be distinguished from vomiting caused by gastric or other diseases.

In some exceptional instances, however, this complaint assumes a graver aspect; continues throughout the whole term of gestation; harasses the patient by continual retching; and, as occurred in one case which came under the notice of the writer, may even cause death from exhaustion.

ÆTIOLOGY.—The ætiology of morning sickness is a subject on which much ingenuity has been wasted. For many years Smellies' theory prevailed. 'Perhaps,' he says, 'this complaint is chiefly occasioned by fulness of the vessels of the uterus . . . . (this) being stretched by the ovum, a tension of that part ensues, affecting the nerves of that viscus, especially those that arise from the sympathetici maximi and communicate with the plexus at the mouth of the stomach.'

Most of the diseases peculiar to women are now ascribed by some authorities to displacements of the uterus, which are regarded by Dr. Grailey Hewitt as 'the almost universal cause of the vomiting of pregnancy.' The same writer —whose views, however, have been controverted by Dr. McClintock, Dr. Tilt, and others—insists that 'it is the compression undergone by the uterine tissues (markedly by the nervous fibres at the seat of the flexion) which is the cause of the nausea and sickness.'

TREATMENT.—The treatment of this complaint depends on the period of pregnancy, the severity of the symptoms, and the constitution of the patient. In ordinary cases it may be prevented by the patient remaining in bed until the usual period for its return has passed over. Her diet should be light, and she should take as little fluid as possible, especially avoiding all warm drinks, such as tea. The bowels should be regulated by mild antacid aperients or effervescing salines. At the same time some of the so-called specifics may be ordered, such as oxalate of cerium in two-grain doses, or hydrocyanic acid, with infusion of calumba. It is unnecessary to refer to all the, generally useless, remedies which have been proposed for this complaint, including the dilatation of the cervix uteri, first suggested by Dubois, and more recently recommended by the late Dr. Copeman, of Norwich; the hypodermic injection of morphia; chloral; carbolic acid; and minute doses of ipecacuanha.

In some cases of excessive vomiting occurring in plethoric patients, six or eight ounces of blood may be taken away with advantage. If, notwithstanding this, the sickness continues, and the patient is in danger of dying from exhaustion, the propriety of inducing premature labour becomes a grave question. In no case should so serious a measure be resorted to without full deliberation and consultation. In all cases it should be deferred as long as possible, and in fixing the period for its performance regard should always be paid to the possible viability of the fœtus.

2. Abortion.—The expulsion of the fœtus before the ordinary period of viability may result from diseases affecting either the mother or the ovum. Amongst the former are constitutional syphilis, scrofula, fevers (especially the exanthemata), and general plethora; and, according to Dr. R. Lee, 'all the chronic diseases to which the uterus and its appendages are liable may also be considered causes of abortion.' The ovuline causes are cystic or other placental diseases, and

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[1] The peculiar susceptibility of the nervous system of children often affords a most striking *test* of atmospheric impurity that might otherwise pass unheeded. In the last century, *trismus nascentium* (a disease now rarely seen) was one of the principal factors of the very high rate of infantile mortality which then prevailed. This disease continued to be very fatal in the Lying-in Hospitals of Dublin, after it had almost disappeared from those of London; and it was mainly by the attention to their ventilation enforced by Dr. Joseph Clarke, that the mortality of the infants born in them was reduced. The disease has continued to our own day, under precisely similar conditions, in St. Kilda, and some parts of Iceland, where *two-thirds* of all the children born have died in the first twelve days. Even in what would be accounted the well-ventilated dwellings of our own middle and higher classes, obstinate cases of spasmodic croup, recurring with the appearance of every tooth, are frequently seen, which immediately yield on the removal of the little patients to the pure air of the country or the seaside.

TREATMENT.—*Preventive.*—In the treatment of the convulsions of pregnancy, whenever any of the premonitory symptoms already described, and more especially albuminuria, are observed, we should direct our efforts to the depuration of the blood, by cupping over the kidneys, and the administration of mild diuretics, saline purgatives, and diaphoretics. At the same time we must endeavour to allay nervous irritability by sedatives, of which in these cases the best is bromide of potassium.

Immediate.—During the convulsions precautions to prevent a patient from biting her tongue, or from injuring her person in any way, should in the first instance be taken. One of the most effectual means of shortening the paroxysms is cold affusion on the head and face. In the asthenic form of eclampsia, however, this remedy should be used cautiously. In all cases the bowels should be unloaded by calomel and jalap, or by a drop of croton oil, or by the assafœtida enema; the head should be shaved and blistered, or ice applied, and at the same time sinapisms be put on the legs.

In cases of sthenic convulsions bloodletting is—notwithstanding the disusage into which this has now fallen—the only remedy of undoubted efficacy in subduing the convulsive action. If the patient be plethoric, and her pupils be contracted, we may, as a rule, bleed. If, on the contrary, the pupils be dilated, the condition of the brain may be considered as anæmic, and bloodletting would probably be out of the question.

The amount of blood that may be taken from a plethoric woman suffering from eclampsia should be measured by the patient's condition, and the effect produced, rather than by the quantity abstracted. In hysterical convulsions, if cold affusion does not suffice, the inhalation of chloroform or ether will generally cut short the attack. But in true puerperal convulsions, in which the writer has tried chloroform pretty extensively, it requires to be used with great caution, being contra-indicated whenever the circulation is depressed, or where there is any tendency to apoplectiform symptoms. In suitable cases, however, he has found chloroform serviceable in subduing the convulsions, and prolonging the intervals between them. Chloral was suggested by the writer several years ago. Opium was at one time largely prescribed in these cases; so also was belladonna, originally introduced into practice by M. Claussier upwards of fifty years ago, and again recommended by recent writers. As a substitute for bloodletting, the tincture of veratrum viride is now employed by some American obstetricians. In the actual treatment of convulsions time is too important to be wasted in experimenting with these uncertain drugs; though in the prophylactic treatment of convulsions during pregnancy and after parturition, the writer has found small doses of belladonna beneficial in calming the nervous susceptibility so intimately connected with convulsive action.

In every case of convulsions towards the end of pregnancy, our primary object should be to deliver the patient as speedily as is consistent with her safety and that of her child.

15. **False Pregnancy.**—SYNON.: Pseudocyesis.—This is a subject of considerable interest in an obstetric as well as a medico-legal aspect. Spurious pregnancy is of more frequent occurrence than is generally supposed; nor is it confined, as some writers assert, to sterile elderly women of the upper classes, many cases of the kind having come before the writer in hospital and dispensary as well as in private practice.

ÆTIOLOGY.—With regard to the period of life at which pseudocyesis is most frequent, authorities differ. The writer has known it to occur in a girl of sixteen years of age, but the great majority of cases are met with about the period of 'the turn of life,' or between the ages of forty-five and fifty. The causes of pseudocyesis, besides those before referred to, namely change of life, dyspepsia, and hysteria, are very numerous, including ovarian disease, uterine tumours and physometra, abdominal plethora and obesity, molar pregnancy, and cystic disease of the ovum. Molar pregnancy generally terminates between the third and fourth months; but if continued beyond the latter period, the absence of the positive signs of pregnancy would show the true nature of the case.

SYMPTOMS.—The symptoms of spurious pregnancy are occasionally so close an imitation of those of true gestation as to present great difficulties in their diagnosis. Most of the ordinary signs of pregnancy are simulated with extraordinary exactness in many cases of pseudocyesis. Thus we may have amenorrhœa, followed by irritable stomach; swelling of the mammæ; turgescence of the nipples; and great and rapid enlargement of the abdomen, concurring in a woman who wishes to become pregnant. In cases of pseudocyesis, the last of these symptoms may be traced to an excessive deposit of fat in the omentum, or to tumour; it may be caused by distension of the large intestines by accumulated fæces, or, more commonly, by flatus, constituting what the poor in Ireland graphically describe as 'a windy dropsy;' or it may be due to dropsical effusion into the peritoneal cavity.

If to these symptoms be added, as is generally the case, some derangement of the patient's nervous system, we have the superstructure on which most cases of spurious pregnancy are built. As a rule those who suffer from pseudocyesis either fear or wish to be pregnant, and having as it were coached themselves up on the subject, apply their knowledge to their own fancied symptoms with such a morbid concentration of their thoughts on this topic, that they become monomaniacal on it, and deceive themselves as well as others.

Few cases are more difficult to deal with in practice than those now under consideration, and seldom is the obstetric physician more unpleasantly situated than when called in consultation to a patient who, having persuaded herself and those about her that she is pregnant, has made all the usual preparations for the expected event, and who, deceived by those anomalous periodic pains that sometimes occur in spurious gestation, sends for medical assistance under the impression that she is in labour. Cases of this kind show the necessity for much caution in pronouncing any woman pregnant. If the physician disregard the caution, and unfortunately fall in with his patient's opinion, without sufficient examination in a case of pseudocyesis, as soon as the true state of the case becomes obvious, he will probably be made the scapegoat for the mistake, and suffer all the odium of which a woman's wounded pride is capable.

Diagnosis.—The diagnosis of spurious pregnancy is always a matter of much difficulty during the first months of the disorder. But, however closely the early symptoms of pregnancy may be simulated, the positive signs of pregnancy after the fifth month cannot be counterfeited. And, even from the very first, in spurious pregnancy, it may generally be ascertained, on careful enquiry, that there is something unusual in the symptoms—either some essential one is wanting, or else the symptoms which belong to one period of pregnancy manifest themselves at another, and commonly earlier, time than is natural.

The value of auscultation as a means of diagnosis in these cases is doubtful. Even in the last month of gestation, the fact of the sounds of the fœtal heart and placental *souffle* not being distinguished on auscultation, is no proof that the uterus may not contain a living child. Nor is the value of the positive evidence, derived from the sounds of the fœtal heart and placental *souffle*, as great as it is sometimes supposed to be. An experienced auscultator can with certainty pronounce on the existence of a living child *in utero* from the auscultatory signs present. But all medical practitioners are not experts in this special subject; and we have seen sufficient proof that, by those who form a diagnosis, in such cases, from the presence or absence of any one sign of pregnancy, opinions are sometimes pronounced in haste, which have to be repented at leisure.

A careful examination of the abdomen with both hands, will enable us to ascertain if there be any uterine enlargement, although not to distinguish between the enlargement caused by disease, and that occasioned by pregnancy. To do this, we must institute a vaginal exploration, to determine whether the conditions of the os and cervix uteri be what are usual at the corresponding period of pregnancy.

In cases of pseudocyesis where the patient, being anxious to be thought pregnant, contributes to the deception by making her abdominal muscles so tense and rigid that it becomes impossible to ascertain the size and position of the uterus, we may readily dissipate the phantom tumour, and overcome the action of the muscles, by the use of chloroform. If the abdominal or uterine enlargement be occasioned by flatus or by physometra, percussion over the tumour will afford an easy test.

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The pressure often comes from without, of which the following illustrations afford sufficient examples. General pressure upon the chest and abdomen preventing the movements of breathing, may lead to death from suffocation, to fractured ribs, or to other consequences. This sometimes happens, for instance, when a person is crushed in a crowd, or is buried in a fall of earth, although the head may be free. Hanging and strangulation are forms of violent pressure exercised on the windpipe and vessels in the neck. The pressure of clothing is often very injurious in connection with the chest, especially that produced by tight stays. This leads to contraction or distortion of the chest; interference with the functions of the lungs, heart, stomach, and other organs; displacement of organs; or actual pulmonary disease. A familiar illustration of the effects of pressure is found in the development of corns and deformities of the feet, from wearing tight boots; and in the distortions of the feet artificially produced in Chinese women by means of systematic pressure applied in early life. In this connection may also be mentioned the wearing of tight garters, or other forms of local constriction, which especially tend to interfere with the passage of the blood through the veins, and to develop varicose veins. Occupation may be the cause of pressure originating disease. Thus, prolonged sitting at various occupations has been supposed to set up sciatica. Direct compression upon any part of the body, by implements used in certain callings, may originate morbid conditions. For instance, pressure thus induced upon the sternum is liable to cause deformity of the chest; and when exercised upon the epigastrium, it has been supposed to account for the local development of cancer of the stomach. Lastly, prolonged pressure from lying in one position for a length of time not uncommonly causes localised inflammation, gangrene, and bed-sores, in persons suffering from low fevers, paralysis, emaciation, and other conditions. *See* ULCER.

Pressure is often exerted by morbid conditions in the body itself, affecting other structures in the neighbourhood, and thus inducing secondarily various symptoms, pathological phenomena, or actual diseases. It may be more or less diffused, as in the case of an effusion of fluid into a serous cavity; or concentrated upon a certain limited region or individual structure, as often happens with aneurisms and solid tumours. In this way movements may be interfered with, or more obvious effects may be produced, namely, displacement of organs and structures; compression of tubes, canals, hollow organs, or vessels, which may lead to their complete closure; irritation and inflammation, which may end in suppuration or gangrene; or actual destruction. The phenomena induced will depend upon the seat of the cause of pressure, and the structure which it affects.

2. **Pressure in Diagnosis.**—Patients may be conscious of a local subjective feeling of pressure, which in some instances may be of a certain value in diagnosis; but such sensations must never be regarded as reliable. The objective effects of pressure are, however, often evident, and afford clinical signs of the greatest diagnostic value, as is frequently illustrated in cases of diseases of the chest and abdomen. Moreover, the practitioner can, by means of pressure with the fingers or hand, himself determine many points of essential value in the investigation of numerous cases. Indeed, pressure is often an important part of palpation or manipulation, as employed in physical examination (*see* PHYSICAL EXAMINATION), and is especially useful in the following particulars:—By this means we are able to determine the existence and degree of local tenderness or hyperæsthesia. Pressure also helps to reveal the presence of air or fluid in the subcutaneous cellular tissue. It is absolutely necessary for bringing out the feeling of fluctuation, degree of resistance, tension, and other sensations; while the effect of pressure in modifying certain physical conditions may be of great service in diagnosis, as may be exemplified by the influence thus produced in many cases upon an accumulation of fæces in the intestines. Pressure upon arteries or veins is employed with the view of observing its effects upon the local circulation, arteries, tumours and other morbid conditions; and, in the case of the arteries, to determine the compressibility of the pulse.

3. **Pressure in Treatment.**—In this connection the first point to be noticed is the necessity of removing or avoiding any source of external pressure which is causing mischief; and also of getting rid of internal pressure, if this is practicable. Pressure may frequently be employed with advantage as a therapeutic agent. It may be thus used in a more or less diffused manner; or concentrated on a limited surface. It may be practised by the fingers or hand; by means of plasters, bandages, elastic apparatus, and similar appliances, sometimes of an elaborate kind; or by special surgical apparatus or appliances, such as the tourniquet, acupressure, the ligature, the clamp, or trusses of different forms. Pressure also constitutes one element in friction and shampooing.

As regards the objects for which pressure is employed, in the first place, it not uncommonly helps to relieve pain, which may be illustrated by the effects of manual pressure in subduing the pain of intestinal colic; the relief often afforded to certain forms of headache by applying a bandage or handkerchief tightly round the head; and the beneficial results following the fixing of more or less of one side of the chest, by means of strapping or other agents, in cases of pleurisy or pleurodynia. Local pressure may also cure certain forms of neuralgia. Again, direct compression is sometimes employed to check symptoms produced by reflex influence; thus pressure over the ovary may check vomiting, spasmodic or convulsive movements, and other phenomena connected with hysteria. Another use of pressure is to arrest the process of inflammation, which is exemplified by the practice of strapping the testicle in the early stage of orchitis. In relation to this point, a very important object for which it is employed is to promote the absorption of morbid accumulations and products of all kinds, whether originating from inflammation or other causes. Thus it helps to get rid of air; of fluid effusions, inflammatory or dropsical; of fibrinous exudations; and of thickenings or indurations remaining after acute inflammation, or resulting from chronic inflammatory process. Pressure is again frequently taken advantage of for its influence upon the blood-vessels. Thus it checks different forms of hæmorrhage, the kind of compression required varying with the precise form of bleeding. Elastic pressure, according to Esmarch's method, has been found of great service in preventing bleeding during operations. In connection with arteries direct compression is also often employed for the cure of aneurisms. As regards the veins, pressure is of essential service in preventing the injurious consequences likely to result from varicose dilatation of these vessels, and in giving them support; while it is also made use of in the cure of this condition, especially in connection with certain operative procedures. In the case of the abdomen, pressure is often of much service to counteract the ill-effects of relaxed and flabby walls. It may also be used to excite contraction in the intestines, bladder, or uterus, under certain circumstances; and to aid in the removal of accumulations in the bowels. Lastly, pressure is made use of in preventing certain forms of displacement of organs and structures; and in attempting to cure the conditions upon which they depend, as is exemplified by the application of a truss in cases of hernia, and by some of the operations for the radical cure of this complaint. Frederick T. Roberts.

PREVENTION OF DISEASE. *See* Personal Health; and Public Health.

PRIAPISM.—Synon.: Fr. *Priapisme*; Ger. *Priapismus*; *Ruthenkrampf.*

Definition.—A term generally understood to signify unduly occurring or unnaturally prolonged erection of the penis, accompanied or not, as the case may be, by inordinate sexual desire.

It is important to distinguish between mere turgescence of the organ—*false* priapism; and *true* priapism, or perfect erection. The former depends simply upon distension by blood, induced or permitted by relaxation of the walls of the blood-vessels and blood-spaces; it may be associated with comparative flaccidity, and, though uncomfortable, is rarely painful. The latter requires for its production, not only distension by blood, but a certain kind and degree of tension or contraction of the intrinsic muscular fibres of the trabeculæ and sheaths; it is characterised by manifest rigidity, and if long continued—as it may be for several days or even longer—may give rise to considerable suffering.

Description.—Priapism, more or less pronounced, from time to time occurs in connection with various morbid affections of the general system, or of particular organs. Thus it usually, though not invariably, attends erotic mental derangement. It occurs frequently in tetanus and hydrophobia, and sometimes, occasionally even to a distressing extent, during recovery from the eruptive fevers. It has been noted in some cases of tumour or other disease of the cerebellum and pons varolii; and in the earlier stages, or among the first indications, of certain diseases of the spinal cord, leading on to paraplegia. An overloaded condition of the lower bowel, especially in conjunction with enlarged and irritable prostate, inflamed hæmorrhoids, distension of the bladder, stone in the bladder, phimosis, urethritis, and other conditions, may be enumerated as not infrequent local causes of troublesome, though transient, priapism, acting either by pressure on the blood-vessels, or by reflex nervous influence. It also occurs among the results of injuries of the central nervous system, as well as of the penis itself. Injuries of the spinal cord, especially in the cervical and lumbar regions, are liable to be followed by continued or recurrent priapism, or by turgescence with flaccidity. Sudden erection, with emission, not infrequently attends injury of the cervical spine. Numerous cases are on record in which, during violent coitus, or otherwise during erection, the penis itself has undergone injury; and some portions or other of the sheaths of the corpora cavernosa, with the included blood-vessels, have been ruptured, or some blood-vessel has been ruptured, the sheaths remaining entire. In such cases extravasation of blood, followed by turgescence of the corpora cavernosa, occurs; and sooner or later the most persistent, and very often painful, priapism ensues.

Treatment.—The treatment generally must depend upon the due recognition and treatment of the condition on which the priapism depends. If of central origin, it is to this point that attention must be directed. But it not infrequently happens that the local suffering is so considerable as to demand special measures for its relief. In some cases cold applications, in others warm or hot fomentations with anodynes, have proved most efficacious. Leeching has rarely been useful. Bandaging, masturbation, and sexual congress have often been tried; but the result, as a rule, has been to increase rather than to mitigate the evil. In cases in which extravasation of blood following injury is the cause, it may be necessary to make incisions, turn out any clots, and arrest further hæmorrhage; but permanent damage to the organ usually results, sometimes after prolonged suppuration, and sometimes even after risk to life.

Among the medicines that have seemed more or less useful in various cases may be especially mentioned bromide of potassium, lupuline, camphor, hyoscyamus, and belladonna. Free purgation is beneficial in some cases.

Arthur E. Durham.

PRICKLY HEAT.—An eruption of minute pimples, which cover the skin more or less extensively, and are attended with burning heat, and a most tormenting prickly itching. The affection occurs for the most part in hot climates, and attacks principally those who are unaccustomed to extreme heat; hence it is often experienced by travellers in tropical regions. Pathologically it is a lichen, attended with great irritability of the skin, and from its dependence on heat of climate, has received the designation of *lichen tropicus*. This disorder will be found described under the head of Lichen.

PRIMARY (*primus*, the first).—This word is either used to imply that a disease originates in an organ or structure from a local cause, such as *primary pleurisy* or *peritonitis*, or *primary attacks*; or it is associated with the first manifestation of a disease, such as the *primary sore* of syphilis, or *primary cancer*. It is also applied to the *direct* or *immediate* symptoms of a disease, as distinguished from those which may be produced *secondarily* or *remotely*.

PROCIDENTIA (*pro*, downwards, and *cado*, I fall).—A falling down of certain organs or structures from their natural position, as of the uterus, rectum, or iris. *See* Prolapsus.

PROCTITIS (*πρωκτός*, the anus).—Inflammation of the anus or rectum. *See* Periproctitis; and Rectum, Diseases of.

PRODROMATA (*πρὸ*, before, and *δρόμος*, a course).—A synonym for premonitory symptoms. *See* Premonitory.

PROGNOSIS. *See* Disease, Prognosis of.

PROGRESSIVE MUSCULAR ATROPHY.—Synon.: *Paralysis atrophica*; Cruveilhier's Atrophy; Wasting Palsy; Fr. *Atrophie musculaire graisseuse progressive* (Duchenne); Ger. *Muskelatrophie; Muskellähmung.*

Definition.—A chronic wasting and alteration in the structure of the muscular tissue, which may consist of (1) simple atrophy; (2) atrophy with granular degeneration; (3) atrophy with fatty degeneration; and (4) atrophy with (the so-called) waxy degeneration.

Ætiology.—Progressive muscular atrophy mostly prevails among middle-aged persons and young adults, and the male sex is more liable to suffer than the female—in the proportion of about six to one. Consanguinity, or hereditary influence, is a powerful predisposing cause, and in the greater number of hereditary cases the atrophy becomes generalised.

The principal exciting causes are excessive muscular exertion; severe cold and wet—particularly when combined; and diseases or injuries of the spine. When the disease follows cold and wet, the atrophy is commonly preceded or accompanied by neuralgic or supposed rheumatic pains, either in the muscles or in the course of their nerves. The disease is also not uncommonly a consequence of syphilis. In those cases that seem to be hereditary there often appears to be no other assignable cause.

Pathology.—Progressive muscular atrophy does not originate, as was formerly believed, in the muscles themselves, but, as the writer has shown, from functional or structural alterations in the nervous centres and their nerves. In fatal cases these alterations are of various kinds. They consist of atrophy of the nerve-cells and their processes in the anterior cornua of the spinal cord, commencing in pigmentary degeneration, and ending frequently in their total disappearance. The blood-vessels are frequently dilated, sometimes to an enormous degree, and around them are generally found areas of granular or fluid disintegration, of greater or less extent, and mixed with exudations, or compound granular corpuscles. Frequently there is an abundance of corpora amylacea. These morbid changes occur in both the grey and white substance. Sometimes one and sometimes both of the anterior horns are reduced in bulk. The anterior nerve-roots are not unfrequently wasted to a greater or less extent, as Cruveilhier originally noticed. In some instances nothing remains of them but the neurilemma; in others the fibres are in process of partial disintegration.

Anatomical Characters.—The affected muscles suffer differently in their degrees of wasting, and present a variety of aspects. In the same muscle, bundles in different stages of atrophy may be seen by the side of others that are unaffected. If the wasting be extreme in all the bundles, a long muscle presents the appearance of a mere fibrous cord or tendon, and a flat muscle may be reduced in a similar way to a kind of membrane. The atrophy may consist of only *simple* wasting, without any granular or fatty degeneration; but in the majority of cases it is accompanied by both these alterations of structure to a greater or less extent, and by variable changes in colour. The muscle is paler than natural, and sometimes quite colourless, or may have a faint yellow tint. Its consistence, in consequence of the increase of interfibrillar connective tissue, is greater than normal. Under the microscope the transverse and longitudinal striæ are found to have disappeared to a variable extent and degree, or are even completely lost; while the sarcous or muscular tissue is transformed into granules, which are sometimes so fine that they cannot be distinguished as separate particles. These granules are soluble in acetic acid.

Granular degeneration or disintegration of the muscular tissue may be the only structural alteration, but it is often accompanied or followed by *fatty* degeneration. This latter change, however, may make its appearance at once.

In addition to this transformation of muscular tissue into fatty particles, fat-cells in great numbers are found between the fibres, sometimes in groups and sometimes in linear succession. These may increase in proportion as the muscular tissue is wasted, so that there may be no actual loss of volume in the limb.

The waxy or *vitreous degeneration* appears to be confined to the voluntary muscles, and never affects all the bundles of a muscle. It consists of a peculiar transformation of the tissue into a colourless, glistening, and homogeneous substance, in which the transverse and longitudinal striæ as well as the nuclei no longer exist. Although this kind of degeneration is more common after acute diseases, it is not unfrequently found in progressive muscular atrophy, in which, indeed, all the three kinds of alteration above mentioned may exist, not only in the same person, but in the same muscle.

Symptoms.—Progressive muscular atrophy differs in many respects from the simple atrophy which is consequent on exhausting diseases or on paralysis, is always chronic, but of variable and uncertain duration. It is irregular and capricious in its invasion. In most instances it first makes its appearance in the upper extremities, especially on the right side. The muscles of the hand are generally those which are first attacked—the thenar eminence, then the hypothenar, and the interossei. When the interossei are much wasted, the hand presents the appearance of a bird's claw, or what Duchenne termed the *main en griffe.* The atrophy may extend up the limb, and then the flexors and extensors of the fingers, and often the muscles at the back of the forearm, become affected. The disease may also involve the muscles of the arms and trunk—the biceps, deltoid, triceps, pectoral, latissimi dorsi, rhomboidei, extensors and flexors of the head, sacro-lumbales, the abdominal muscles, and the muscles of respiration and deglutition. In some instances the atrophy begins in the muscles about the thorax, and proceeds to a considerable extent, while the arms may escape. In other instances it is limited to the muscles of the forearm. Occasionally it spreads to the lower limbs, but seldom begins there.

A variety of alterations in the shape and position of the trunk and limbs is produced by this irregular wasting of the muscles, and such alterations are characteristic of the disease; for in ordinary atrophy following exhausting diseases the wasting of the muscles is uniform.

Loss of muscular power in the affected parts is one of the first symptoms, particularly after exertion or exposure to cold. The electric contractility of the wasted muscles is often slightly diminished. Still it is of great importance to note that the wasted muscles respond to the faradaic as well as to the voltaic current, unless the wasting has reached its final stage when healthy muscular fibres are almost wholly absent. The patient's movements are awkward, and there is a certain loss of muscular co-ordination, in consequence of the unequal wasting of the muscles, and the alteration in their relative force or antagonism. At an early period the affected muscles are subject to cramps, fibrillary tremors, and twitches. In some cases there is a variable degree of cutaneous anæsthesia, but usually the sensibility is unimpaired; while in about half the cases more or less pain is experienced in the atrophied muscles, or before the atrophy commences. When the muscles of the face are affected its expression is singularly altered, and the saliva dribbles from the mouth. The tongue is frequently shrunk and shrivelled from atrophy of its muscles, and articulation is imperfect; in this case, however, such signs and symptoms are usually regarded as pertaining to a distinct disease (*see* Labio-Glosso-Laryngeal Paralysis). When the apparatus of deglutition is involved, cough is excited on swallowing liquids, which frequently escape through the nose; when the muscles of respiration are much wasted, there is difficulty of breathing, and the patient commonly dies from some bronchial attack, in consequence of his inability to expectorate the mucus.

Diagnosis.—This is usually made without much difficulty. The fact of the slow progress of the disease, with the successive implication of different muscles or groups of muscles, is very characteristic. It is distinguished from cases of paralysis followed by muscular atrophy, by the fact that there is no paralysis first, and atrophy after, as in these cases, but rather a weakness which increases *pari passu* with the atrophy. Then, again, in progressive muscular atrophy the muscles still respond to faradisation, whereas in post-paralytic atrophy this is very apt not to be the case, and we have instead to do with some form of the 'reaction of degeneration.' *See* Paralysis.

Prognosis.—From what has been already said it is evident that progressive muscular atrophy is a malady of the gravest nature. The only probability of effecting a cure, is when the disease can be treated in its earliest stage, when the disorder of the nervous centres is merely functional, and before any organic lesions have supervened.

Treatment.—When the disease arises from the influence of damp and cold, or from over-exertion, these causes should, of course, be avoided. Warm clothing and warm baths—particularly the waters of Aix-la-Chapelle—are to be recommended. If there be reason for suspecting a syphilitic taint, iodide of potassium, or even mercury, if necessary, should be administered. In other cases cod-liver oil, phosphorus, mineral tonics, and arsenic have been found useful. But galvanism in the early stages of the disease has proved the most useful of remedies. The galvanic current should be applied to the spinal column, especially in the cervical region. When we consider that in the more advanced stages of the malady lesions of the spinal cord are induced, it is questionable whether the application of counter-irritants—especially blisters—to the spine, has had a sufficient trial.

J. Lockhart Clarke.

PROLAPSUS (*pro*, forward, and *labor*, I slip).—This word signifies that an organ or structure has fallen or slipped down, but implies a greater degree of displacement than *procidentia*; so that the organ or structure may protrude through a natural or artificial orifice. The condition is of most importance in connexion with the rectum and the uterus. *See* Procidentia; Anus, Diseases of; and Womb, Diseases of.

PROPHYLACTIC } (πρὸ, before, and
PROPHYLAXIS } φυλάσσω, I guard).
These terms are used in connexion with treatment, and indicate the means employed for the prevention of disease. *See* Disease, Treatment of.

PROSOPALGIA (πρόσωπον, the face, and ἄλγος, pain).—Prosopalgia signifies pain about the face. It may depend upon neuralgia of one or more branches of the fifth pair of nerves (*see* Tic-Douloureux). Its paroxysmal character, unilateral position, and anatomical localisation will indicate this form. Another form is of rheumatic origin. In this the pain is more or less constant, diffused about the face or forehead, and does not follow the course of a nerve-branch. Movements, and especially stooping, increase it. Occasionally such pain is of syphilitic origin, and is especially apt to occur in connection with the appearance of the secondary rash.

Diagnosis. — In rheumatic prosopalgia the pain is diffused and increased by pressure. If it depend on syphilitic periostitis there will be tenderness on pressure, and the parts will be swollen and less elastic than normal. There will also very likely be a certain amount of fever; and the pain will be increased at night.

Treatment.—Muriate of ammonia in half-drachm doses, dissolved in half a tumbler of water, should be given every four hours. If there be any evidence of syphilitic infection, iodide of potassium should be taken, in doses of from ten to twenty grains every four hours.

For the rheumatic form of face-ache five grains of iodide of potassium, with thirty grains of bicarbonate of potash, should be given every four or six hours, after the administration of an aperient. This may be followed up by quinine or iron. Locally a mixture of equal parts of camphor, choral, and vaseline may be applied; or a liniment containing chloroform, belladonna, and opium. Decayed teeth should be extracted.

T. Buzzard.

PROSTATE, Diseases of.—Synon.: Fr. *Maladies de la Prostate*; Ger. *Krankheiten des Prostate.*

It is not proposed in a work principally devoted to medical subjects to deal at all fully with the affections of the prostate gland; the present article must, accordingly, be taken rather as an index to guide the practitioner in his diagnosis, than as anything approaching a complete disquisition on their pathology or treatment.

General Relations.—The points of practical importance in connection with the anatomy of the prostate are as follows:—In the examination of the rectum the healthy prostate is felt as a firm substance in the middle line, somewhat divided into two lateral lobes. The whole organ is about 1½ inch in width, with its apex opposite, namely, in the recumbent posture below, the apex of the pubic arch; that is, about 1½ inch from the anus, in a moderately thin subject, but much further in a very fat one. The whole gland is 1½ inch in length, its posterior limit being usually about three inches from the anus—in other words, about the distance to which the forefinger can reach. From this it may be deduced that the *trigonum vesicæ* commences immediately behind it, and therefore that a fully distended bladder masks more or less completely the natural outline of the gland. It may thus also be gathered that the vesiculæ seminales are beyond the ordinary reach of the finger, and that when these are infiltrated by disease, their apices, or perhaps only the vasa efferentia, can be detected. The practitioner should by no means neglect the digital examination of the prostate, as it will often yield information of the greatest value. The deviations from the normal type he may expect to meet with are—uniform or partial enlargement from simple hypertrophy, or from chronic or acute inflammation, in the latter case possibly attended by a sense of fluctuation, due to abscess; irregular hardness, most marked about the vasa efferentia, depending on a tubercular deposit; the existence of small hard nodular masses, which are calculi in the substance of the gland; or the irregular enlargement caused by a new growth. It must be borne in mind that tumours or abscesses originating in neighbouring parts may surround the prostate and completely mask its outline; thus the writer has met with a case of a large hydatid cyst between the rectum and the bladder that rather closely simulated malignant disease of the prostate, and effectually prevented its actual condition from being determined. It will not be forgotten that a certain degree of tenderness of the prostate does not imply a deviation from health, and that a more or less considerable enlargement in old age is so common as to be almost reckoned by some authors as normal. The effect of this enlargement on micturition will be mentioned further on. The copious plexus of veins which surround the prostate communicates fully with those of the penis and rectum; and it is not unimportant, from a clinical point of view, to remember that these are thus connected not only with the systemic, but with the portal circulation. These veins may become the seat of phlebitis and its sequelæ from various causes.

The principal diseases of the prostate may be considered in the following order:—

1. **Prostate, Hypertrophy of.**—The results of Sir Henry Thompson's observations (*Clinical Lectures on Diseases of the Urinary Organs*) were, that one-third of all men over fifty-five have some enlargement of the prostate; but that a comparatively small number of these suffer any inconvenience from it; and that it usually begins between the ages of fifty-seven and sixty, though it may more rarely commence later. Very considerable enlargement of the lateral lobes may cause no inconvenience; but if the part which forms the floor of the prostatic urethra, the so-called middle lobe, be even slightly enlarged, difficulty in micturition is sure to result. It is thus easy to understand how a simple hypertrophy may reach enormous dimensions without giving rise to symptoms, while those which are caused by the enlargement of a prostate, which feels almost normal to the finger introduced into the rectum, may, on the other hand, be very severe indeed.

Symptoms.—The symptoms are briefly these: The stream of urine becomes dribbling, and there is an obvious difficulty in emptying the bladder; there is frequency of micturition, especially at night and in the early morning; perhaps a little pain before the act, but none afterwards; and no alteration in the characters of the urine. If unrelieved, these early symptoms are followed by incontinence, depending upon over-distension of the bladder; and, from the same cause not improbably, cystitis and dilatation of the bladder, dilated ureters, and, perhaps, pyelitis and chronic interstitial nephritis. Patients with chronic hypertrophy of the prostate usually suffer from time to time from attacks of acute congestion, such as are described below.

Anatomical Characters.—The structure of a hypertrophied prostate is but a slight modification of that of the gland itself.

Treatment.—In regard to treatment of hypertrophy of the prostate it is only necessary here to give two words of warning. First, that most of the evils resulting from this condition depend upon the fact that the bladder is never emptied; it is essential, therefore, that the patient's powers in this respect should be ascertained without delay by catheterisation, and if it be discovered that a certain amount of residual urine remains, he should be taught to pass an instrument himself, and directed to do so at least once a day. Secondly, cystitis has often been caused by setting up putrefaction of the urine by a catheter not surgically clean; the simple precaution of lubricating it with carbolised oil prevents with certainty this catastrophe. The reader must consult surgical works as to the difficulties which an enlarged prostate offers to the introduction of a catheter, and the manner in which they may be overcome.

2. **Prostate, Congestion of.**—Congestion is a condition which follows on chronic hypertrophy, and is commonly known as 'an attack of the prostate.'

Symptoms.—An old man, suffering from the symptoms above described, is suddenly seized—as the result of some indiscretion in diet, an exposure to cold, or some other apparently trivial cause—with complete retention, accompanied by bloody urine, possibly a raised temperature and quick pulse, and considerable local uneasiness. If the case do not improve, and especially if the urine be allowed to putrefy, the tongue becomes dry and brown, the pulse more rapid and more weak, and the patient passes into a low typhoid condition, which is not unlikely to end fatally.

TREATMENT.—The treatment is in large measure surgical, consisting in the proper passing of catheters; but scarcely less important is the careful regulation of the bowels; and the administration of a diet sufficiently light, and yet not too lowering, together with, in most cases, a certain amount of stimulant, for it must be remembered that the patient is probably weak, and that death from asthenia is much to be dreaded. The writer would urgently insist on the importance of preventing putrefaction of the urine, which is the most fertile source of death in such cases; he can affirm from experience that this end may be attained by the thoughtful employment of antiseptic treatment, even in those cases in which it becomes necessary to keep the bladder empty by tying a catheter into the urethra.

3. **Prostate, Chronic Inflammation of.**—SYNON.: Chronic prostatitis.—This is not an uncommon affection amongst young and middle-aged men, depending most frequently on a prolonged gonorrhœa, in which the prostatic part of the urethra has been involved.

SYMPTOMS.—The symptoms of this disease resemble rather closely those depending upon stone in the bladder, namely, frequent micturition, with a feeling of heat and weight in the perinæum, and pain along the penis, extending to the tip; there is also at times a little blood passed at the end of micturition; and all the symptoms are aggravated by exercise. Generally there are frequent nocturnal emissions. The urine is cloudy, and on standing yields a muco-purulent deposit. A rectal examination shows that the prostate is enlarged, sometimes very slightly, and seldom to any great extent; it is always tender. The diagnosis can scarcely be made without passing the sound.

TREATMENT.—The treatment consists in rest, the administration of laxative medicines, and the application of blisters or some other form of counter-irritation to the perinæum; alcoholic stimulants are to be avoided; and the urine should be rendered bland by alkalies and diluents, as in cases of urethritis.

4. **Acute Inflammation of the Prostate.**—SYNON.: Acute prostatitis.—Acute prostatitis may arise as the result of a gonorrhœa, or cystitis; from the irritation produced by calculi or other mechanical cause; perhaps sometimes idiopathically, or from exposure to cold or wet; and from undue sexual excitement, or the too free use of alcohol if gonorrhœa be present. This may occur in men of any age, and is accompanied by symptoms such as those depending on chronic inflammation, but much more intense; the frequency of micturition and pain during the act causing sometimes almost unbearable agony, and the dysuria amounting in some cases to complete retention, while the tenderness of the gland is very great, a condition which makes an action of the bowels very painful. Such cases may terminate by becoming chronic; they may undergo complete resolution; or suppuration may occur; in any case there will probably be some elevation of temperature, and in the event of the formation of abscess there may be great and sudden rises and falls, accompanied by rigors and sweatings, with a dry, brown tongue, forcibly suggesting pyæmia. Prostatic abscess may burst into the rectum, bladder, or perinæum.

TREATMENT.—The treatment of acute prostatitis consists in rest, and carefully-regulated diet; diluent and alkaline medicines; purgatives; local blood-letting from the perinæum, by leeches or otherwise (some French surgeons have recommended the application of leeches to the interior of the rectum); with hot fomentations, and morphia suppositories. If an abscess forms it may be opened through the rectum, but it is better to incise it through the perinæum, as this plan is most likely to prevent the formation of that most troublesome and almost incurable condition, a recto-vesical fistula.

Abscesses sometimes form *around* the prostate (periprostatic). They are not so likely to involve the danger of the formation of a recto-vesical fistula; and they should be treated by early incision.

5. **Prostate, Tubercle of.**—This, though not a common affection of the prostate, occurs perhaps more frequently than is generally supposed, and is of great interest to the practitioner. It is usually a part only of a more or less general affection of the genito-urinary tract. Thus in cases where the epidydimes are hard and swollen, and the cords knotty from tubercular deposit, the finger introduced into the rectum will probably detect a hard nodule in one or both of the vasa efferentia. This, if seen *post mortem*, is found to consist of a tubercular or cheesy mass, and if the condition have advanced further, the prostate itself may have become involved; there may be either separate nodules of tubercular deposit in a more or less advanced state of cheesy or, more rarely, calcareous degeneration; or the whole gland may have become hollowed out into an irregular cavity, filled in part with cheesy material, and discharging pus.

SYMPTOMS.—This disease may begin in childhood, or in adult life. Its symptoms are most obscure. At first there are probably none at all, but as the disease advances, there will arise those of tumour of the prostate, together with those of abscess; that is, there will be occasionally blood, and generally pus, in the urine; frequency and pain in micturition; tenderness and swelling in the rectum, and so forth. Abscess from this cause has been known to burst into the peritoneum.

TREATMENT.—The treatment can only be palliative, and must be directed to the relief of the symptoms as they arise; but at the best it is most unsatisfactory. Occasionally it may be possible to open a tubercular abscess through the perinæum, but it is open to doubt how far such a procedure is to the advantage of the patient.

6. **Prostatic Calculi.**—These are small bodies, generally multiple, formed in the glands of the prostate, usually late in life, but occasionally in comparatively young men. They probably begin as a deposit of animal matter,

but later are made up principally of phosphate, and partly of carbonate, of lime. They may produce no symptoms at all, or they may project into the urethra, and give rise to great irritation at the neck of the bladder, and the symptoms of vesical calculus; such will also be present if, as sometimes happens, they convert the whole gland into a single cavity, in which the calculi lie side by side. In this case they will be felt through the rectum, rubbing against one another; and indeed prostatic calculi are, as a rule, to be felt in this situation.

Vesical calculi of considerable size may become encysted in the prostate, and on the other hand prostatic calculi may find their way into the bladder. Prostatic calculi may give rise to abscess.

If any treatment be required, it is purely surgical, and must consist in the removal of the stones by forceps, a lithotrite, or a perinæal incision.

7. **Prostate, Phleboliths of.**—The pathologist very often meets with phleboliths in the veins surrounding the prostate, the result no doubt of old phlebitis.

8. **Prostate, Tumours of.**—The so-called *fibrous tumours* of the prostate are in all probability simply local hypertrophies, and are composed principally of plain muscular tissue. *Cystic disease* is described as a pathological rarity, the gland being occupied by numerous cysts, containing serous or mucous fluid. *Melanosis* of the gland has also been observed. *Cancer* of the prostate occurs not very unfrequently, and is usually soft, though it is sometimes hard enough to be worthy of the name of scirrhus. The writer would speak with great caution of malignant tumours of the prostate; such as he has himself examined have been cancers, with a very irregular arrangement of both stroma and epithelial cells.

Tumours of the prostate may be at present considered as beyond the reach of surgical interference, though suggestions for their removal have been lately gravely made in Germany.

9. **Prostate, Atrophy and Absence of.**—Atrophy of the prostate is said to occur as the result of pressure, sometimes from an unascertained cause, or from simple senile decay. Congenital absence of the prostate has also in rare cases been observed, but is of little clinical interest.

R. J. Godlee.

PROSTRATION (*pro*, forward; and *sterno*, I stretch).—This word signifies both the act of overthrowing, and the condition of being overthrown, overcome, or depressed. In medical science it is generally employed in the latter sense; and is used to express a condition of system in which the bodily energies as a whole, or the more active of them, have so completely succumbed to the effects of injury, disease, or powerful emotional influences, that they cannot be made to respond to ordinary stimuli. When prostration affects the *whole* system the patient is said to suffer from *general prostration of the vital powers*. The principal forms of prostration of a *single* system, on the other hand, are—(1) *muscular prostration*, in which there is complete exhaustion of the voluntary muscles; and (2) *nervous prostration*, in which the nerve-centres, and especially those associated with the mind, are so completely overpowered that sensation and motion appear to be in a measure temporarily suspended.

The causes, symptoms, and treatment of prostration in its several forms are more fully discussed in other articles. *See* Collapse; Debility; Exhaustion; Shock; and Syncope.

J. Mitchell Bruce.

PROXIMATE CAUSES (*proximus*, nearest).—A synonym for the immediate or exciting causes of disease. *See* Disease, Causes of.

PRURIGO (*prurire*, to itch).—Synon.: Fr. and Ger. *Prurigo*.

Description.—Prurigo is the disease of itching; but, as there are various forms of pruritus or itching of the skin, it becomes necessary to determine what, besides itching, constitutes prurigo.

Pruritus is an excited state of the nerves of the skin, and as such, is associated with various forms of skin-affection, for example, with scabies, eczema, and urticaria; but in these affections there is a difference in the cause of the disease. In scabies and eczema the cause lies in the tissues of the skin; in urticaria, on the contrary, it is present in the nerves themselves. Hence urticaria is denominated a neurosis, and *prurigo* is also a neurosis which leads onwards to a defective nutrition of the skin. What especially characterises prurigo is the combination of pruritus with an altered state of the skin, consequent on defective nutrition; and, as a rule, it may be said to be restricted to the elderly period of life, when nutritive power in general is weakened or exhausted.

The quality of the itching in prurigo is not so much intensity, for the itching of chronic eczema and simple neurotic pruritus from reflex causes is often more severe. Its especial character is its pungency, which resembles a burning and gnawing of the flesh; and also its mobility, suggesting the idea of animals creeping and eating their way through the substance of the skin. The degree of severity of the pruritus has suggested the names *mitis* and *formicans*—idle terms which ought to be abandoned; and as much may be said of the epithet *senilis*, inasmuch as general prurigo is necessarily a disease of an ill-nourished skin, and especially of the kind of defective nutrition which is incident to old age.

If we take, as factors, an ill-nourished integument, in an elderly person; a dry, hard uneven skin, discoloured from irregular pigmentation, fatless, and adhering loosely to the fasciæ beneath, suggesting the idea of leather or parchment; and an irritable nervous system, we shall then have a case deserving the name of prurigo. Moreover, to this state of skin we must add papules raised upon the surface, with heads torn off by scratching, and capped with small black crusts of desiccated blood; and abrasions caused by fierce and incessant scraping with the nails. All these conditions taken together constitute a true case of chronic prurigo, a real *prurigo senilis*.

Varieties.—Prurigo is a general affection of the skin, but it is likewise met with occasionally as a local disease, in the integument around the anus, *prurigo ani*; and in the folds of the clitoris, *prurigo clitoridis*. These latter cases are always accompanied with altered nutrition of the integument, more or less condensation and hardening of the tissues, and thickening of the epithelium. The symptoms otherwise are the same as those of general prurigo, but are often remarkable for their intense severity.

PATHOLOGY.—Prurigo is essentially neurotic in its nature; a feeble state of nerve-function gives rise to the altered nutrition of the integument, and irritability of nerve-structures to pruritus.

PROGNOSIS.—The disease is obstinate and enduring, vexatious to the patient, and tending to aggravate general irritability, but not hazardous to life. Occurring in old age, with a tendency to increase, it is apt to last for years. *Prurigo clitoridis* is one of the most rebellious of disorders, and has a tendency to degenerate into epithelioma.

TREATMENT.—The indications for treatment are to tranquillise the nervous system generally, and to improve the nutrition of the tissues of the skin. For this purpose the digestive organs should be regulated; a generous and nutritive diet enforced; and recourse had to nerve-tonics as well as to general tonics. Cod-liver oil is often a useful remedy, and will be assisted by quinia, strychnia, and phosphorus. Arsenic is indispensable. Sedatives are frequently required to relieve pruritus and procure sleep; and for this purpose the bromides and chloral hydrate will do good service, or in some constitutions hyoscyamus and morphia. Violent exacerbations of pruritus are best controlled by single large doses of quinia, namely, five to ten grains.

Locally, the heat and shampooing of the Turkish bath, frequently repeated and steadily pursued, may be regarded as curative in most cases. This should be succeeded by thorough inunction of the skin with some bland unguent, such as vaseline; and a wash-leather covering should be worn next the skin. Sponging with hot water or hot decoction of poppy-heads will relieve the pruritus for awhile, and in some instances lotions of tar, and almond emulsion, with borax and hydrocyanic acid, are very successful.

ERASMUS WILSON.

PRURITUS (*prurire*, to itch).—SYNON.: Fr. *Prurit*; Ger. *Jucken*.

DEFINITION.—A form of perverted sensation of the skin, and most external parts of the mucous membranes, characterised by itching.

ÆTIOLOGY.—This symptom accompanies those skin-diseases which involve the uppermost papillary layers of the cutis, in which lie the ends of sensory nerve-filaments. As a rule, it is absent in those which attack the lower layers, for example, most syphilitic rashes and leprosy. It may depend on any of the following causes:—

(1) *Local* irritation from rough clothing, parasites (scabies, pediculi, pityriasis versicolor, tinea tonsurans and circinata), and unhealthy discharges (saccharine urine, leucorrhœa). Perhaps the winter pruritus of Hutchinson and Duhring, which is clearly in some way due to the local effects of cold, should be placed here.

(2) *Inflammations* of the skin, including all forms of eczema, but especially the papular (lichen), psoriasis in the early stage, and, more rarely, pemphigus. It exists to a slight degree in roseola; and much irritation sometimes follows the pustular rashes caused by croton oil and tartar-emetic ointment. Mucous patches and all forms of papular syphilide, *if desquamating*, may itch.

(3) *Reflex irritation* from distant organs, such as the uterus and stomach in urticaria, and the kidneys in Bright's disease.

(4) The presence of certain *substances in the blood*, such as the bile-acids in jaundice, and copaiba.

(5) *Undiscovered causes*, as in true prurigo and the lichen urticatus, or strophulus, of children (*see* LICHEN; PRURIGO; and STROPHULUS). Kaposi admits a *pruritus cutaneus universalis* as a true idiopathic neurosis.

SYMPTOMS.—Pruritus may be local or general, slight or severe, continuous or intermittent. It is generally most marked at night. It is usual to describe three special local forms.

(α) *Pruritus genitalium.*—This form is chiefly found in women with uterine disease, such as a granular condition of the os uteri, or during pregnancy, or at the change of life. Diabetes is a frequent cause, and should always be sought for. In men *P. scroti et penis* depends on eczema or uncleanliness. Pruritus on and around the pubes should always suggest the presence of *pediculi pubis*.

(β) *Pruritus ani.*—This is usually connected, in adults, with piles, eczema, or profuse sweating; and in children with thread-worms.

(γ) *Pruritus senilis* occurs in people at or over sixty, and most often depends on the presence of *pediculi vestimentorum*, though in rare instances it seems to be a pure neurosis.

DIAGNOSIS.—It is essential to remember that pruritus is most often a symptom of external irritation, and to search for the various causes enumerated above, especially animal parasites. The possible presence of the latter should not be ignored because of the social position of the patient.

TREATMENT.—For general pruritus, if no cause can be found, the two best remedies are tar and sulphur. Tar may be used as a lotion—for instance, the following: ℞ Liquoris carbonis detergentis (Wright's), ℥ ss; glycerini, ℥ j; aquam ad ℥ x. Sulphur may be employed thus, as a bath: ℞ Potassii sulphidi, ℥ iv; aquæ calidæ, cong. xxx. Flannel should be removed from immediate contact with the skin. Carbolic acid with opium sometimes gives relief in the following form: ℞ Tincturæ opii, ʒ j; acidi carbolici, ʒ j; spiritus vini rectificati, ℥ vj. Internal remedies, such as potassium bromide, strychnia, conium, and morphia, are of very doubtful value; sulphate of atropia in 1 milligramme doses has proved effectual in a few cases of obstinate urticaria. In pruritus genitalium extreme cleanliness and a borax lotion are the best remedies: ℞ Glycerini boracis ℥ ij; aquam ad ℥ vj; ft. lotio. For pruritus ani, a calomel ointment—such as: ℞ Hydrargyri subchloridi, ʒ j; adipis benzoati, ʒj; ft. unguentum—is to be recommended. *See* Eczema; Phthiriasis; Scabies; and Urticaria. Edward J. Sparks.[1]

PRUSSIC ACID, Poisoning by.—Synon.: Fr. *Empoisonnement par l'acide cyanhydrique*; Ger. *Cyanwasserstoffsäurevergiftung*.

Prussic or hydrocyanic acid is one of the best known and most deadly of poisons. In the anhydrous condition it is stated to kill with almost lightning-like rapidity. Prussic acid is met with in commerce only in a diluted state. In this country two strengths of prussic acid are usual, the Pharmacopœial acid, containing two per cent., and the so-called Scheele's acid, containing about five per cent., respectively, of anhydrous prussic acid in aqueous solution. The soluble cyanides, more especially cyanide of potassium, largely used by photographers and by electro-platers, are common articles of commerce, and produce the same deadly results as the acid itself. The fatal dose of prussic acid is the equivalent of about one grain of the anhydrous acid.

Anatomical Characters.—In persons who have died of prussic acid poisoning the eyes are glistening; the extremities are blue; the face is pale or livid; and the lips are cyanosed. The blood throughout the body has frequently the peculiar odour of the acid, and is of a dull hue, with a peculiar bluish cast—a glimmering appearance. The stomach is sometimes reddened, but not more than is common after other asphyxial modes of death.

Symptoms.—In fatal doses the symptoms of prussic acid poisoning set in very speedily; and in consequence of the readiness with which this poison is absorbed from the alimentary canal, and diffused throughout the circulation, the onset of symptoms is reckoned by seconds rather than by minutes. Occasionally the patient may be able to walk into an adjoining room, to compose himself in bed, or perform like actions; but it is rarely that he will have time to dispose of the cup, glass, or bottle, in which the poison was contained before he is taken seriously ill. The symptoms may be divided into three stages. The *first stage* is very brief, and manifests itself by difficult respiration, slow cardiac action, with a tendency of the heart to stop in diastole, whilst its beats are irregular. There is disturbed cerebration, and an awe-stricken aspect of countenance. This preliminary stage speedily ushers in the *second* or *convulsive stage*, the onset of which is occasionally signalised by a piercing shriek, though this is less frequently observed in man than in animals. With widely dilated pupils, the patient is suddenly thrown into violent clonic and tonic convulsions. The respiration is marked by shortness of inspiration, and prolonged efforts at expiration. The countenance becomes cyanotic. Vomiting is commonly observed; and the urine, fæces, and even semen in the male are spasmodically evacuated. The patient now sinks down, probably in a state of unconsciousness, and with complete loss of muscular power. The convulsive stage speedily passes into the *third*, or, as it may be termed, *asphyxial stage*, with slow, gasping, stertorous respiration, extreme collapse, loss of pulse, and more or less complete paralysis of motion. The skin is cold, clammy, and cyanosed. Death may be ushered in with irregular spasms. The onset of symptoms being rarely delayed beyond one or two minutes, death may occur within two or three minutes more. Power of volition is rarely continued in fatal cases for more than two minutes after taking the poison. Fifteen minutes is the longest interval which has been known to elapse between the taking of the poison and the commencement of symptoms; and then the patient recovered. Should the patient survive for thirty minutes good hopes may be entertained of recovery. The longest period which is known to have elapsed between the taking of the poison and death was one hour and a quarter.

Diagnosis.—This is rarely difficult. The *foudroyant* character of the illness, and the usually speedy death of the patient, coupled with the peculiar odour of the acid, and the finding of a cup or glass containing the remnants of the dose, seldom leave any doubt as to the nature of the case. Nitro-benzol poisoning closely simulates prussic acid poisoning, however, except that the onset of symptoms is generally much later in nitro-benzol poisoning than when prussic acid has been taken. Nevertheless, when crude bitter-almond oil, impure from the presence of prussic acid, has been swallowed, the close similarity between the odour of the oil and that of nitro-benzol may lead to error. Fortunately, the same treatment may be adopted in both cases.

Prognosis.—This in all cases is very doubtful; and no general rules can be laid down.

Treatment.—Prompt inhalation of the fumes of ammonia should, if possible, never be neglected. The successive administration of a solution of the mixed per- and proto-salts of iron, followed by an alkaline carbonate, so as to convert the acid into an inert ferrocyanide, has been recommended on purely chemical grounds. There is, however, seldom or never time to admit of this elaborate treatment. A more practicable mode is to treat the patient with alternate douches of warm (115° Fahr.) and cold water, so as to stimulate the respiratory functions; artificial respiration may also be employed, together with friction of the limbs. An emetic should be administered. Faradaic currents of electricity to the cardiac region should not be neglected. Atropine is not, as has been asserted, a true physiological antidote to prussic acid; but, injected subcutaneously, it may be of use as a respiratory stimulant. Spite of all treatment, the patient usually succumbs. T. Stevenson.

PSEUDO- (ψευδής, false).—This is used as a prefix to various names of conditions, and signifies that they simulate certain diseases or conditions which they really are not; for example, *pseudo-angina*, *pseudo-asthma*, and *pseudo-cytosis*.

PSEUDOCYESIS (ψευδής, false, and κύησις, pregnancy). A synonym for spurious pregnancy. *See* Pregnancy, Diseases and Disorders of.

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.—Synon.: *Lipomatosis musculorum luxurians*; Fr. *Paralysie pseudo-hypertrophique*; *Paralysie myosclérosique*; Ger. *Atrophia musculorum lipomatosa*.

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[1] Revised by Dr. Alfred Sangster.

Definition.—This is a progressive muscular paralysis, appearing mostly in boys, in which the ultimate fibres of the affected muscles atrophy, but the muscles themselves appear to be hypertrophied, in consequence of the development of interstitial fat and fibrous tissue.

Ætiology. — Pseudo-hypertrophic muscular paralysis is a disease of boys, very few cases having been observed in girls or in adults. In a large number of cases it begins in infancy, the weakness becoming manifest at the time the child should begin to walk. In some instances it has been found to be hereditary, several children in the same family having been affected. Nothing definite is yet known as to the direct causation of the malady.

Anatomical Characters. — In the earlier stages of the malady, the muscles chiefly affected are those of the legs and lower part of the back, particularly the gastrocnemii, the posterior muscles of the thigh, and the erectores spinæ. These muscles are enlarged, and they are felt to be firm and hard. This is not, however, due to true hypertrophy, for if a portion of the muscle be removed during life by the *emporte-pièce*, an instrument constructed by Duchenne for this purpose, the muscular fibres are found to be atrophied, and much of the apparent bulk is seen to be due to an interstitial development of fat and fibrous tissue. Subsequently, the remaining muscles of the trunk, upper limbs, and sometimes even of the face become similarly affected, in most cases these muscles merely wasting without any apparent enlargement, but in other cases the apparent hypertrophy being present in the upper as well as the lower half of the body. In the later stages of the disease, the whole of the voluntary muscles, including those which at first were enlarged, become more or less wasted. The diseased muscles are found after death to be composed in a great measure of ordinary fat-cells. The true muscular substance has to a considerable extent disappeared, and only a few ultimate muscular fibres are seen running at intervals through the fat. Some of these ultimate fibres retain their normal size and appearance; others are much decreased in size, though still showing the striation; only a few of the atrophied fibres have lost their striation, and become granular. The diseased muscles also contain a considerable quantity of fibrous tissue, some of which is probably the remaining sheaths of muscular fibres which have undergone complete atrophy. There is less fat and fibrous tissue in the wasted muscles than in those which are pseudo-hypertrophic, but the changes in the ultimate muscular fibres are the same in both.

Some doubt still exists as to the pathological anatomy of the spinal cord in this disease. Several competent observers, such as Cohnheim and Charcot, have failed to find any morbid changes in the nervous system. Lockhart Clarke and Gowers have, however, discovered important alterations in the spinal cord in a case of this disease. The principal change was extensive disintegration of the grey matter at the centre of each lateral half of the cord, and of the anterior commissure.

Pathology.—It has been suggested by Friedreich and others that pseudo-hypertrophic muscular paralysis is essentially the same disease as progressive muscular atrophy, and this view is probably correct. The two diseases differ in this respect, that the former always begins in the lower limbs, the muscles of which are more exercised than the arms in children. The enlargement of the muscles might be explained by supposing a compensatory growth in the early stages of the malady in those diseased muscles which have the most important functions; and the posterior muscles of the legs and back have the important duty of keeping the body erect on the legs. It is a fact that the pseudo-hypertrophied muscles retain much greater power than the muscles which are merely atrophied.

Symptoms.—The symptoms of a well-marked case of pseudo-hypertrophic muscular paralysis are very striking, and cannot easily be overlooked or mistaken. When the child is stripped, the muscles of the calves are seen to be larger and firmer than natural, and the same apparent hypertrophy may be present in the muscles of the thigh, the glutei, the lumbar muscles, and others. Occasionally the muscles of the upper half of the body exhibit a similar increase in size, but much more frequently they are wasted, so that the emaciation of the upper half of the body contrasts strongly with the apparent excess of muscular development in the lower half. The next most obvious symptom is protuberance of the belly. There is no abdominal enlargement, but the antero-posterior curvature of the vertebral column in the lumbar region is much exaggerated, and the shoulders are thrown back. This unnatural curve is not caused by any disease of the vertebræ, for it entirely disappears when the patient sits or lies down. When the child stands, the legs are held apart, and the heels raised off the ground. He walks almost on tiptoe, as in talipes equinus, and with a most peculiar gait—a waddle, as if he needed to balance the body first on one leg and then on the other. Walking soon tires him. If he attempts to go fast he falls, and he is very easily knocked over. He can readily stoop so as to touch the floor, but generally has great difficulty in raising himself to the erect posture, using powerful muscular effort, and having to assist the movement by means of the hands placed on his knees. When sitting, he can recover himself from the bent position with comparative ease. The electro-contractility of the muscles is unimpaired. The general health of the patient is unaffected until the later stages of the disease. In many cases of pseudo-hypertrophic muscular paralysis there is some deficiency in mental power.

Duchenne divides the progress of pseudo-hypertrophic paralysis into three stages:—In the first stage, lasting several months or even one or more years, there is merely weakness of the muscles, causing the peculiarities in the attitude, and in the mode of progression. Little or no enlargement of the muscles has taken place. During this stage proper treatment may bring about recovery. In the second stage the characteristic hypertrophy appears, and the weakness extends to the muscles of the upper limbs. This stage may last for years. In the third stage complete paralysis of most of the muscles of the upper and lower limbs and of the trunk supervenes. The patient lies helpless, unable to change his position. All the muscles, even those which were formerly hypertrophied, pass into a state of atrophy. The sufferer may live in this weak state until carried off by some intercurrent disease.

Diagnosis.—Pseudo-hypertrophic muscular paralysis has such peculiar and well-marked characters that it cannot easily be mistaken. It is readily distinguished from the various forms of spinal paralysis by the evident enlargement and unusual firmness of the paralysed muscles of the lower limbs. From spinal curvature, depending on disease of the vertebral column, it differs in this respect, that the curve of the spine which is present in pseudo-hypertrophic paralysis disappears when the patient sits or lies down.

Prognosis.—The prognosis is most unfavourable.

Treatment.—This is only available in the first stage, before the hypertrophic symptoms are marked. Duchenne recommends localised faradization and shampooing, and he records two cases which were cured by these means. The writer has seen one case which had entered on the second stage, in which this treatment has completely checked the progress of the malady, and even brought about considerable improvement in the strength of the lower limbs. It is probable that the continuous current might prove useful. General tonic treatment is undoubtedly beneficial, but no medicinal remedies are known to have any special control over the disease.

Alexander Davidson.

PSOAS ABSCESS.—Synon.: Fr. *Abcès du Psoas*; Ger. *Psoas abscess.*

Definition.—A variety of spinal abscess, formed by a collection of pus, confined by the fascial sheath of the psoas magnus muscle; conducted by it beneath Poupart's ligament; and pointing in the thigh, in Scarpa's space, external to the femoral vessels.

Such is the ordinary course taken by the pus in psoas abscess, although it is liable to a good many modifications. Thus, the matter may be arrested just above Poupart's ligament, and the abscess occupy the venter ilii; it may make its way into the inguinal canal, and out at the external ring, and simulate a hernia; or, again, it may point above Poupart's ligament, but in this instance the abdominal muscles and fasciæ must have been perforated by ulceration. No real difference exists between the causes of lumbar abscess and psoas abscess; it is rather a question of degree, and of the position of the ulceration, and the initial terms may be regarded as topographical only.

Ætiology.—Psoas abscess is rarely met with before puberty, generally between that period and five-and-thirty years of age; and would seem to be more common in males than in females.

As a result of spinal caries the abscess is more liable to be of the psoas form, if the patient, during the early stages of the disease, has been able to get about.

Anatomical Characters.—Psoas abscess is generally a result of tuberculous osteitis, commencing on the anterior surface, and anterior portion of the cancellous tissue, or in the fibro-cartilages, of the lower dorsal or upper lumbar vertebræ (*see* Spine, Diseases of). It may follow injury, however; and, moreover, may exist independently of diseased bone.

The morbid process is one of ulceration and of suppuration. The tissues surrounding the affected parts become thickened, and confine the pus; whilst, from its sinking down, and from the spreading of the ulceration, the abscess grows in bulk. More rarely, acute inflammation may occur in the substance of, or immediately beneath, the fascia covering the psoas muscle, as in psoitis and peripsoitis.

The pus of the spinal abscess, having gained the abdominal side of the diaphragm, passes into the body of one or other, or of both, psoas muscles; arrives at Poupart's ligament; and commences its downward course, this point being called the 'neck' of the abscess. When once it has passed this point it increases rapidly in size, its appearance being preceded by a bulging in the fold of the groin. Its subsequent course is inwards and downwards, following the line of the inner edge of the sartorius. It may, however, lie over the adductors; or may pass entirely outwards; the direction straight downwards is rare. Cases have been met with where it has divided at the groin; where the matter passed the knee-joint, and pointed at the tendo Achillis; and where it has passed along the course of the profunda femoris vessels.

Sometimes the abscess does not pass beneath the crural arch, but by its expansion forms a well-defined globular tumour in the iliac fossa. In other cases, the pus may find its way into the inguinal canal; into the intestine; or, as is the case in children frequently, over the crest of the ilium, pointing in the buttock.

Symptoms.—The earliest symptoms preceding psoas abscess are generally not well-marked. There is gradual weakness, loss of flesh, a pallid complexion, and loss of appetite. Later on the limb becomes affected; limping occurs during or after walking; and the action of the psoas muscle becomes impaired. Subsequently a soreness, hardly amounting to severe pain, is experienced in the spine or in front of the thigh, aggravated by pressure; or a swelling may appear in the lumbar region, since this particular abscess is merely a form of lumbar. The peculiar symptom of psoas abscess is essentially a fluctuating swelling beneath and extending below Poupart's ligament; generally pointing external to the great vessels; receiving an impulse on coughing; and disappearing, or partially disappearing, on the patient's assuming the recumbent position. It must, however, be remembered that the pus may travel along other channels, or may encroach upon other fascial sheaths than its usual one. Yet its persistence at its 'neck' will materially assist in its physical diagnosis.

The contents of a psoas abscess are pus and tubercular matter, intermixed with flakes of lymph, and particles of bone and fibro-cartilage.

Diagnosis.—The chief point of difficulty in the diagnosis of psoas abscess is that of distinguishing it from iliac or cæcal abscess. In the early stages it is always associated with spinal mischief in young subjects. It points below Poupart's ligament; there is an inclination of the trunk forwards, and some disturbance of the functions of the psoas; and pain in walking is complained of. Iliac abscess arises in the loose areolar tissue of the iliac fossa, and in some cases may actually get into the sheath of the psoas.

Sometimes the caries commencing in the lower lumbar vertebræ may spread laterally, and rise above the crest of the ilium; and the pus, being discharged backwards, may appear to have commenced with hip-joint disease, as the movements of this joint are impaired. It is important in such cases to place the patient under an anæsthetic, and make a most careful examination.

Again, psoas abscess usually makes its appearance in the groin very suddenly, owing to the giving way of some confining tissue.

Medullary cancer may simulate psoas abscess; particularly if the disease has invaded the spine, and caused a curvature of the lumbar vertebræ. Aneurismal tumours, or blood which has escaped by the rupture of such tumours, may be mistaken for the disease, and particularly when such extravasation has found its way into the sheath of the psoas, and is non-pulsatile.

PROGNOSIS.—As a rule the prognosis of psoas abscess cannot be considered favourable. It is an advanced symptom of strumous dyscrasia; it rarely gets well of itself; it frequently impairs the functions of the spinal cord; and it may terminate fatally by hectic or lesion of the lungs or bowels.

TREATMENT.—The best method of treatment of psoas abscess is that adopted by Lister, of opening it by free incision antiseptically; inserting an adequate drainage-tube; and dressing it with scrupulous care from first to last (*see* ANTISEPTIC TREATMENT). The abscess may, however, open spontaneously, and no bad results follow; and, with great care, and the use of the prone couch, the patient may recover.

Good diet, cod-liver oil, iodides, and tonics appear to be the most suitable internal remedies.

EDWARD BELLAMY.

PSORIASIS (ψώω, I rub).—SYNON.: Fr. and Ger. *Psoriasis.*—This word expresses the effort to relieve itching; hence the word *psora*, applied to the disease eczema by the Greeks, but in modern pathology restricted to scabies. The term has been adopted by the French and Germans as the equivalent of the lepra of Willan, and is at present generally used in that sense. *See* LEPRA.

PSYCHOSIS. *See* SYCOSIS.

PSYDRACIUM (dim. of *ψύδρακες*, blisters).—A small blister, or pustule, without inflammatory base; a cold pustule, in contradistinction to *phlyzacium*, or hot pustule.

PTOMAINES. *See* APPENDIX.

PTOSIS (πτῶσις, a fall).—A drooping or falling of the upper eyelid, with inability to raise it, due to paralysis of the third cranial nerve. *See* THIRD NERVE, Diseases of.

PTYALISM (πτύαλον, saliva).—A synonym for salivation, or excessive flow of saliva. *See* SALIVARY SECRETION, Disorders of.

PUBERTY, Disorders of.—SYNON.: Fr. *Troubles de la Puberté;* Ger. *Störungen der Pubertät.*

Of the various periods into which existence is divisible, certainly not the least important, in its pathological aspect, is that intervening between childhood and maturity, when the reproductive powers become developed, and which is known as *Puberty.*

This epoch occurs earlier in warm climates, sanguine temperaments, and highly cultivated and luxurious states of society; it is retarded by the opposite conditions; and in these islands it generally commences between the ages of thirteen and fifteen in females, and a year later in males. Under the age of fourteen, a male is legally supposed incapable of committing a rape; and a female under twelve is deemed incapable of consenting to sexual intercourse. By the Roman law, the period of the commencement of puberty was identical with that at which the individual became liable to military duty. Thus Adrian commenced his service at the age of fifteen.

Puberty cannot, however, be estimated by age alone. Even in this climate, the period of the commencement of puberty varies widely; thus the writer has seen instances of menstruation in children under ten, and has assisted at the delivery of a girl of fourteen years of age. More frequently, however, puberty is postponed beyond the ordinary period, which may be also modified by family or hereditary peculiarities, and the influence of various diseases.

In the first stages of life, the functional differences between the sexes are comparatively slightly marked; but on the approach of puberty these suddenly become prominent, and so obvious does the influence of the uterine system become, that *propter uterum est mulier* is then almost literally the case.

The accession of puberty in the male is attended by a characteristic alteration of the voice, from 'the thin childish treble' to 'the deep manly bass,' owing to the development of the *pomum Adami*, and the elongation of the thyroid cartilage and thyro-arytænoid muscle. About the same time occurs the growth of hair on the skin on various parts of the body. Before this there are observed the development of the male genital organs, the enlargement of the testes and other parts of the sexual apparatus, the secretion of the seminal and other accessory fluids, and the first outburst of the sexual instincts and feelings. So slowly do the successive changes, which mark the occurrence of puberty in the male, proceed, that they are not completed until full age has been passed.

In the female, on the contrary, when puberty is reached, the individual passes at a bound, as it were, from childhood to womanhood, although the structural and functional changes involved in the transition are infinitely more complex and important than is the case in the other sex. Thus the enlargement of the external genital organs is accompanied with a still greater change of the internal organs of generation—the development of the uterus, ovaries, and mammæ, and the commencement of that periodic sanguineous discharge *per vaginam*, the recurrence of which at regular monthly intervals marks the period within which woman is capable of reproduction.

The writer has found it less easy to discover the true date of first menstruation than have some authorities whose tables are generally relied upon. In the great majority of cases the statements of those he questioned were so indefinite as to be practically valueless, and in only 497 instances did the writer get even any approach to accurate data on this point. Excluding all cases of so-called infantile menstruation, the results of these inquiries may be thus summarised, the mean age being 15:—

Under 12 . .	4	menstruated for first time.
At 12 . .	17	„ „ „ „
„ 13 . .	50	„ „ „ „
„ 14 . .	94	„ „ „ „
„ 15 . .	138	„ „ „ „
„ 16 . .	105	„ „ „ „
„ 17 . .	65	„ „ „ „
„ 18 . .	10	„ „ „ „
Upwards of 18	14	„ „ „ „

Generally speaking, therefore, between the ages of thirteen and fifteen in our climate, the human female undergoes the change from childhood to puberty; the essential characteristic of this change consisting in a periodic sanguineous discharge, *per vaginam*, resulting from ovulation. The process of menstruation, from its commencement in ovarian congestion, resulting in the discharge of an ovum, its transmission along the Fallopian tube, its transit through the congested uterus, its expulsion thence, together with the disintegrated endo-uterine mucous membrane, and the consequent hæmorrhagic discharge from the denuded uterus, is invariably productive of more or less general constitutional disturbance and mental irritation, so that no woman can be properly said to enjoy the *mens sana in corpore sano* whilst menstruating. When this function has become regularly established, the accompanying constitutional disturbance may be so slight as to be practically unrecognisable. But on the first occurrence of ovulation, few, if any, escape some sympathetic constitutional derangement, and more especially some one or other of the protean forms of hysteria. Hence, under the guise of nearly every disease that may affect a girl at the age of puberty, whether it be spinal, cardiac, pulmonary, or any other disorder, the practitioner must look carefully that he has not to deal with some variety of hysteria, directly resulting from the complex process by which puberty is accompanied.

Undue importance is attached to the non-appearance of menstruation, as the supposed cause of all the ills that female flesh is heir to. In the majority of cases of delayed menstruation the amenorrhœa is the result of constitutional disease, to the rational treatment of which, and not to any utero-ovarian stimulation, should the efforts of the physician be directed. At the same time, the part played by the development of the reproductive system in the transformation scene from childhood to maturity, is unquestionably of the first importance. The morbid influence of the premature indulgence of the newly-awakened sexual appetites at the age of puberty, and the many forms of disease by which the vice of masturbation is avenged by outraged nature, are subjects the medical importance of which it would be difficult to exaggerate, and which it would be impossible to discuss in this article.

Many of the ailments common about the period of puberty, are but accompaniments or forerunners of the functional and organic changes then commencing. More especially is this the case in the female sex. Hence the physician must bear in mind that the headaches, palpitations, symptoms of disordered nervous action, and many of the cases of hæmorrhage from various organs which create so much alarm, are, as Sir Henry Holland long since observed, but evidences of 'new balances struck in the allotment of the blood to different parts; and in the course of such changes, congestions and discharges are prone to occur, the latter relieving or preventing the former.' It is hardly necessary to point out the necessity for careful diagnosis between symptoms thus caused, and the evidences of actual disease; for in the former, the active treatment required by the latter would be not only unnecessary, but positively injurious, by interfering with the progress of those natural functional or organic changes on the establishment of which these symptoms will cease. The circulation is now vigorous; not only is the amount of blood in circulation greater during this period, but also its relative proportions of fibrin and red corpuscles are larger, and hence the roseate hues and plump outlines of early youth.

It is surprising how well young persons at this period bear hæmorrhagic discharges, with which the experienced physician will be slow to interfere, lest by their arrest he may bring on more serious consequences. Many of those cases of hæmoptysis which excite so much alarm, as supposed evidences of pulmonary disease, and the subsidence of which is ascribed to the particular treatment adopted, as well as most cases of hæmatemesis occurring in girls about this epoch, are merely symptomatic of the changes consequent on puberty, and require little or nothing in the way of repressive treatment.

There are few practical subjects more neglected by physicians than the moral hygienic and physical management of puberty. The effect of the evolution of puberty, as the occasional exciting cause of insanity, has been briefly alluded to by Dr. Maudsley and some other writers on mental disease. The influence of over mental stimulation during puberty, as an occasion of the increased proportion of nervous and cerebral disorders, is a subject of the greatest importance. At this period of life the present cramming system of education predisposes to insanity, the organ of the mind being goaded into premature activity, and overstrained in the effort to pass some competitive or other examination, deemed essential to entrance on official, commercial, or professional life. Thus the mental powers are worn out and exhausted before they have attained their perfection. In another respect the modern system is hurtful to the mind; for now-a-days, when education is too often divested of that moral restraint and control formerly held to be essential, 'it proves injurious,' as Dr. Copeland says, 'not only in the way thus stated, but in giving rise to forced, unnatural, overreaching ambitions, and unprincipled states of society; and these states, in proportion as they are developed, are the parents of crime, insanity, and suicide.'

THOMAS MORE MADDEN.

PUBLIC HEALTH.—In all civilised countries laws are made with the intention of removing conditions which injure the health of the people. In the United Kingdom these laws are now very numerous, and almost every year new statutes regulating public health are enacted. The, general fault of the laws in this country has been their tentative and permissive character; powers are not infrequently given which there is no obligation to use, and which are therefore not used, and the wording of the Acts has sometimes permitted evasion.

It may be believed that certain ambiguities of expression in the Acts were avoidable, but that they have arisen from the difficulty of determining the proper limits of the action of the State, *i.e.* to what point it is right to interfere with private property, with private enterprise, and with individual responsibilities.

These are difficult questions, for though it is undoubted that the community, as a body, has a just power of setting aside the rights of individuals when necessary for the benefit of all its members; yet it is obvious that such power must be exercised with great discretion, lest the right to property, and the incentive to labour and to self-improvement, should be endangered. Still it cannot be doubted that our sanitary laws have been influenced by an unnecessary timidity, and have been too much hampered by opposing opinions respecting the proper limits of these powers and rights. There are some writers who question whether the State has any right to interfere with individual action; but to this it seems answer enough to say that a community is, after all, nothing but a collection of individuals, whose united action is merely the individual action combined; that such union, as represented by the majority, is a necessity for the security of life and property, and in those cases is always enforced, and that there can be no reason why this combined action should not also regulate the important conditions of public health as well as the relations of property and the conduct of individuals. Practically, also, there are conditions affecting the health of its members with which the community at large alone can deal, and with which, therefore, it ought to deal. It can also be shown that this common action has already been productive of the greatest good in several cases, and is absolutely necessary in order to counteract the ignorance, carelessness, selfishness, and avarice of men.

Although there are many old statutes, and also provisions in the common law of England affecting the public health, the sanitary legislation of England may be said to date from the passing of the Public Health Act of 1848 (11 and 12 Vict. c. 63). That Act was followed between 1855 and 1872 by a variety of public Acts having sanitary objects, besides others of local application. These public Acts have been now consolidated in the great Act of 1875 (38 and 39 Vict. c. 55), an Act for consolidating and amending the Acts relating to public health in England. This Act is cited as the Public Health Act, 1875. It does not apply to Scotland or Ireland, which have their own Health Acts, nor to the Metropolis where former Nuisance Removal and Sanitary Acts continue in force. This statute repeals (except as regards the Metropolis and Scotland and Ireland in certain cases) no less than nineteen Acts,[1] and affects sixteen others. It has not only consolidated but has improved the law, and in several cases has given increased powers to local sanitary authorities.

In addition to this Act two others of importance were passed in the session of 1875: the Artisans and Labourers' Dwellings Improvement Act, 1875, which applies only to the Metropolis and to urban districts in England and Ireland having a population. according to the last census, of 25,000 and upwards. It gives powers to clear unhealthy areas, and to superintend and regulate the rebuilding on such areas. It is likely to prove a very important Act, and doubtless will in time be followed by a statute dealing with smaller populations.

In the same session an Act entitled 'An Act to repeal the Adulteration of Food Acts, and to make better provision for the Sale of Food and Drugs in a pure state' (38 and 39 Vict. c. 63)—short title, 'Sale of Food and Drugs Act'—was passed. It repeals entirely or partially four Acts, and provides for the appointment of public analysts, and for the purchase and examination of food and drugs.

[More recent Acts are (*a*) The Rivers Pollution Prevention Act of 1876, to which reference will be made in the course of the present article; (*b*) The Contagious Diseases (Animals) Act, of 1878, which confers certain powers for the proper keeping of cows and for the protection of milk against injurious influences; and (*c*) the 'Public Health (Water) Act' of 1878, enabling rural sanitary authorities to require the provision of sufficient water-supply. In intention, at least, these Acts fill some serious gaps in the sanitary legislation of the country.]

In the following article a general outline is given of the subject of Public Health. It is, of course, impossible to fill up the details, which require special works for almost every heading. But the outline will show the points which are especially deserving of attention, and which have to be considered both in legislation and in the practical performance of the duties of medical officers of health.

Condition of Open Lands, Forests, and Rivers. The drainage of land, so as to carry off water readily and thus to make both ground and air drier, has a great effect on public health. Ague, so common formerly in England, has greatly lessened, and dysentery, which so often went with it, has almost disappeared, in consequence of drainage.

The movements of the ground-water which, by its rises and falls, influences the moisture and the amount of air in the soil, and, through these conditions, alters the amount and rapidity of decomposition therein, has been supposed also to influence health, and to be especially connected with the development of typhoid fever and of cholera. A moist ground is also believed, on tolerably strong evidence, to be favourable to the production of destructive lung-diseases; and there is no doubt that rheumatism and catarrhal affections are more common on damp soils. Although the influence of the ground-water in cholera is questionable, and it is not always active in the production of typhoid fever, it is certain that lowering the level of the ground-water when it is near the surface is often followed by the best results on the general health of the people, and in hot countries malarious diseases have been greatly diminished, even when the lowering of the ground-water has not exceeded a few inches.

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[1] The only Sanitary Acts of previous sessions remaining unrepealed are the Bakehouses Regulations Act, the Baths and Washhouses Acts, the Labouring Classes Lodging Houses Acts, and the Artisans' and Labourers' Dwellings Act, 1868.

Land-drainage operations, as they influence public health, might therefore be undertaken by the State, but, practically, they have been carried on in this country by private and local enterprise, aided of late years by state loans on moderate terms of interest and repayment. In India this question of land drainage is of pressing importance in water-logged and malarious districts, and it is one which in that country must eventually be met by the State, though its magnitude and cost will probably cause the question to be deferred as long as possible.

The regulation of irrigation operations also may become an important matter of State control if sewage irrigation farms increase in number. These farms should not be situated near to houses (not within five hundred yards if possible), and the lands should be properly prepared and drained so that there is no stagnancy of the water. If properly arranged it seems clear that sewage irrigation is not hurtful to the public health. Rice-field irrigation is more difficult to manage, as the water must rest longer on the ground, and underground drainage is less rapid. Rice fields, then, should be situated at a greater distance from houses.

Up to the present time no law in England deals with the subject of land drainage in reference especially to public health, for the Land Drainage Act of 1861 (24 and 25 Vict. c. 133) refers only to agricultural purposes.

The regulation of forests ought to be considered a state matter, as the climate of a country and, therefore, health are greatly influenced by them. The removal of forests produces a variety of direct effects. Greater movement of air over the earth is permitted: the soil is rendered hotter in all temperate and hot countries, colder in northern lands; the air is drier everywhere, because the rainfall is lessened, the ground is drier, and the evaporation from leaves is lessened; the ground is drier, because there is not only less rain but freer evaporation, and the roots of the trees no longer obstruct the movement of the ground-water, which flows off more rapidly. These direct effects have a varying sanitary significance, according to circumstances: for example, increased movement of air may be injurious, if malarious air be no longer kept away from a town, as is supposed to be the case with the Roman Campagna; again, in hilly countries where the trees have been too much cleared off, there occurs aridity of soil as a rule, and greater rapidity in the amount of water passing into rivers during rains, and thus leading to floods. In this island the regulation of forests is not a matter of much national importance; it is otherwise in Germany and France, where laws exist which restrain private action; and in Italy, Greece, and Turkey the condition of the forests requires grave consideration as a matter of public health, as well as of climate and rainfall. In India this is also the case, and there are several important sanitary aspects under which the operations of the Forest Department need to be regarded.

The regulations of rivers, such as the embankments, narrowings, deepenings, and removal of obstructions, have generally been concerned with little else than navigation or the prevention of accumulations; but they are equally important as they may influence the outflow of the land-water from their drainage areas, and in that way may affect the dryness of the soil. In this regard the condition of all watercourses is a matter of importance, and seems obviously a case for state control. It is not, however, usually included in the subjects of public health, and when any large watercourse is out of order, and inundations from the river or from the sea are dreaded, the Crown usually appoints, on the application of the proprietors of the adjoining lands, a Commission of Sewers, under the above Land Drainage Act, to consider what should be done.

In another way the regulation of rivers is of importance. They supply the drinking-water of the community to a large extent, and freedom from contamination is, therefore, necessary. At present this is one of the most difficult questions of public health, and for some years a Royal Commission was engaged in enquiring into the causes and remedies of the pollution of rivers. The chief causes of contamination are the dirty water and sewage coming from towns, and the refuse of trade operations. The former can be best met by irrigation or by filtration through land, though the immense quantity of water to be purified, and the price or position of land, may cause difficulty. The admixture of trade refuse water presents, however, the greatest difficulty; to prohibit the flow into streams would sometimes be to prohibit the trade works.[1] At present there is no settled standard of purity for either town or trade water before its discharge into streams, and it is probable that the standard must vary with the place and trade, and must depend on the composition of the water as originally supplied, and the relation between its amount and the body of water into which it is discharged. Under the Public Health Act of 1875 (clauses 68 and 69) a Sanitary Authority can protect any watercourse within its jurisdiction from pollution with gas or with sewage, but not from pollution by trade refuse. On the other hand, an Authority can be indicted by landowners or others for creating a nuisance or for injuring the quality of the water by discharging sewage into a stream. In certain cases, as of the rivers Thames and Lea, special Acts restrain the pouring of sewage into them.

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[1] A Government Bill brought in in the session of 1875 had to be withdrawn in consequence of the large interests involved and in opposition to it.

It may be said on the whole that legislation with respect to pollution of rivers is at present hesitating, but that its general tendency is gradually to make the rules for preserving the purity of river water more and more stringent.

[The Act of 1876 forbids putting into a stream or inland water—(1) any solid refuse of any manufactory, or any rubbish or cinders; (2) any sewage, unless the best practicable means has been taken to render it harmless; (3) any polluting liquid from any factory, unless it have been similarly made harmless. Proceedings under this Act can only be taken with the assent of the Local Government Board, who are to have regard to the industrial interests involved.]

Conditions of Habitations.—In the case of a town of any size, the community is represented by the municipality or by a Board of Health or local Commissioners. In the case of country parts and villages that have no such special body, the Poor Law Guardians are *de facto* the sanitary authority. In the language of the Public Health Acts of 1872 and 1875, the former are the Urban, and the latter the Rural Sanitary Authorities.

Of conditions operative upon the health of the individual and of the community, the one that falls most conspicuously within the province of these public Sanitary Authorities, as of the Legislature which created them, is the condition under which people have their dwelling—the state and circumstances of their *habitation*, both in the particular and in the aggregate. So true is this, and so strongly is this consideration felt in practice, that it will be convenient to arrange the various subject-matters of the present article with the notion of condition of habitation in the foreground; and to regard each subject as it principally concerns communities inhabiting a larger or smaller place, or as it concerns the particular habitation. Thus the general subject of public health will, with little exception, be here discussed under the three following divisions:—

I. Collections of houses forming cities and towns, that is, populations over two thousand persons.[1]

II. Villages, that is, collections of houses, with populations of, or under, two thousand persons.

III. Separate houses.

I. Cities and Towns.—The health of the inhabitants of English towns, as judged of by the annual rate of mortality, is not so good as that of the people of rural districts. The mean annual mortality differs in different towns from 20 or 21 to 35 and 36 per 1,000 of population, while during certain periods it may be much more. In rural districts the mortality is from 12 to 23 or 24 per 1,000. The causes of the difference are various: in towns there is greater crowding, more of complete destitution, a higher degree of impurity in the air of the houses, a greater prevalence of infectious diseases, and greater exposure in unhealthy trades. The urban inhabitants are also on the whole more intemperate, are less vigorous in frame, and have less active exercise in the open air than the rural population. In towns, however, it is especially the mortality of children under five years old which swells the death-rate, owing to the bad food and nurture, and the exposure to impure air of the children of the poor. In all cities there are districts, inhabited by wealthy people, where the mortality will bear comparison with healthy country places. It ought to be possible, therefore, to raise the health of the inhabitants generally towards the standard of these favoured parts; and the object of the local government should be, by thought and contrivance, to overcome, as far as may be, the difficulties that poverty puts in the way of health.

Hygienic Conditions of Cities.—These are conditions referable to:—

1. The site and soil.
2. The arrangement and building of houses.
3. The water-supply.
4. The removal of refuse water and of dry refuse.
5. The removal of excreta.
6. The conservancy of the surface.
7. The supply of food, including the regulation of slaughterhouses and bakehouses.
8. The regulation of trades.
9. The arrest of infectious diseases.
10. The disposal of the dead.
11. The supervision of nuisances.

(1) *The Site and Soil.*—The sites of old cities were fixed by reason of war or commerce, or of vicinity to water-supply; when modern cities arise it is often in consequence of new industries being developed, coal and iron, or cotton, or woollen works, and the site is determined by convenience of trade. In England new towns and villages spring up without regulation, and when they attain a certain size and some sort of municipal government is formed, it is often too late to attend to arrangement and construction of houses and to proper preparation of the ground. It were to be desired that the Legislature should obtain for towns during their period of growth and extension, adequate attention to such matters. In the case of old towns Local Improvement or Health Acts are often obtained, by which the errors of by-gone times are slowly and laboriously removed.

In respect of the *site* it is necessary to dry the ground if it is at all damp, and to keep it from being contaminated by refuse and permeation of coal-gas. It is one of the advantages of sewering towns that the ground is thereby drained, and many sewers are now laid so as to facilitate the movement of the ground water as well as to serve as channels for house waters. For this reason alone every town ought to have either a system of sewers or deep drainage of some kind. There should be no cesspits or middens, or manure heaps, in uncemented holes; every refuse of this kind ought to be removed and never allowed to soak into the ground. The ground ought in fact to be secured against every source of contamination. Paving of all streets and courts, so as to prevent surface impurities from soaking in, and great care in the construction of the public sewers, so that they may allow of no outflow, will keep the soil of a city free from those impurities which, under the influence of heat, water, and air, generate injurious effluvia that may be sucked into houses. It is necessary also to have rules about 'made ground.' Inequalities in the surface of the ground are often levelled by filling in with refuse of all kinds; house and chemical refuse, and dredgings from rivers, with other rubbish, are sometimes used. Decomposition goes on in such soils, and eventually, if not too foul, they purify themselves, but for this time is required. In the 'cinder refuse' of Liverpool, which is tolerably free from impurities, at least three years are required for the disappearance of the more easily decomposed animal and vegetable matters. In other made soils it may be longer, and when soil is very impure, as in the case of old graveyards, it is uncertain how long it is before it would be safe to build upon it. Every made soil should be well drained, so that air and water may freely pass through it, and the best should have been laid down from two to four years before being built upon.

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[1] There is no official definition of what constitutes a town or village, but the above is practically the best that can be adopted.

The permeation of coal-gas from pipes is a point to be guarded against, and the ease of preventing this would be much increased by the use of subways, the objections against which are more theoretical than practical.

With respect to the means of covering the sides of city streets for foot passengers good stone paving is essential; it not only hinders the evolution of effluvia from the ground, but it greatly increases the ease of cleaning the surface. In many Acts full powers are given for this purpose. (Public Health Act 1875, clauses 149–150, and 42.)

The question of the best kind of road for horse and carriage traffic is not quite so easily settled; there are four principal plans: macadamizing, granite blocks, wood, and asphalte. As a mere matter of health the two last are preferable; there is less *débris*, greater ease of cleaning, and less noise. Both macadamizing and granite block roads soon get worn into fine mud, which is made up of finely comminuted stone mixed with droppings from horses, and the like. In wet weather this is washed into the sewers, which it aids in obstructing, and it forms a useless part of the sewage. In dry weather it becomes pulverised; floats in the air and is one of the ingredients of city air, from which it is deposited as dust. Wood and asphalte break up much more slowly and are more easily cleaned both by rain and by washing.

(2) *The arrangement and building of houses.* The arrangement of houses and streets in towns is influenced by many circumstances. A good return for money, facility of locomotion, and beauty are the chief considerations in new towns. In old cities questions of defence and of materials have especially regulated the size and direction of their streets, and the height and compression of their houses. Many considerations will always influence the formation of streets, but a free passage of air to all parts of a town is a cardinal point, which should receive the utmost attention. The more numerous and the wider the streets are, the less impeded will be the air-flow; in no case should a street be less in width than one and a-half times the height of a house.[1]

There should be open spaces at the back of the houses, and all back-to-back building should be illegal. The erection of narrow lanes and alleys should be prohibited in all new towns, and the back courts so common in our older towns ought to be gradually removed. Additional open spaces should be provided at intervals; and streets should be so arranged as not to form stagnant wells of air between the houses. Wide straight streets are useful for ventilation, and are best for the laying of pipes and tramways. Straight lines are by some not considered beautiful, but they are certainly most convenient.

In all these points the law gave some power both in the Public Health Act of 1848 and in some later Acts, which granted permissive powers to sanitary authorities to purchase dwellings in order to improve streets, to set back houses when rebuilt, &c. These powers are continued in the Public Health Act of 1875, clauses 149–160. As regards existing towns power is given to urban authorities to make bye-laws regulating the width of new streets, provision for sewerage, foundation of houses, spaces for air about houses, the drainage of buildings, and other points. So also a new provision in this Act orders that when only the front of a house in a street is taken down the urban authority may prescribe the line of the new building. Local Improvement Acts have also been obtained by some cities, giving larger powers of demolition and reconstruction, and the Artisans' Dwellings Act of 1875 strengthens these. As much, however, is left to local authorities in these matters, there will probably be no uniformity of action, and it seems important to make very stringent general rules on all these points. Moreover, as already said, due provision should be made beforehand for the proper construction of the many new towns which must needs spring up in the course of another century. The case seems clear for the community at large to regulate matters so important for the general health, to a greater degree than has been yet done in any Act.[2]

It is not possible to state with any precision the number of persons who may be located on an acre. This will depend in the main on the construction of the individual houses; but it may be laid down as a general rule that whatever be the size of the houses, the amount of ground not occupied by them in any given area should be considerably in excess of the amount actually taken up by houses.

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[1] In some local Acts the width of a street is fixed at the height of a house, but this is too small.

[2] As an instance of the necessity of this state interference, the case of Liverpool may be cited. More than 70 years ago the Corporation was warned by the medical practitioners of Liverpool, that the houses then being erected, and their arrangement, must prove unhealthy dwellings. No regard was paid to this, and now Liverpool will have to undo, at enormous cost, what might at the time have been put a stop to with ease. A paper by Dr. Russell, of Glasgow, in *Public Health*, March 1875, exemplifies the same thing in a most striking manner, by the case of Glasgow.

An important point to determine is the height of the houses. In England a large proportion of our towns consists of low brick houses; if these are not too crowded they give a good distribution of the inhabitants and oppose little obstacle to the movement of air. When the houses are very lofty the air-currents must be much more impeded, and therefore the streets ought to be much wider, and open spaces here and there more carefully provided. The construction of the separate houses cannot be altogether a matter of municipal control, but certain rules as to ground plan, foundations, and arrangement of closets, and the thickness of party walls, are in most towns enforced in respect of new houses.

So in all houses, whether urban or rural, there should be means of ventilation for every room; no inhabited room should have a borrowed light, but should have a window opening directly on the external air; every window should open, and especially at the top; every room should be of good height, not less than nine feet in the smallest, and ten and eleven feet in larger rooms; the closets ought to be arranged in such a manner that, in addition to ventilation of the closet itself, there should be thorough cross ventilation into the open air between the closet and the rest of the house, and this is best accomplished by having projecting portions of the building to contain the closets; every house should be properly provided with closets in proportion to its population; there should be proper water-supply, with easily inspected storage, if house-storage is permitted, and easy methods of carrying off the dirty house-water; there should be proper arrangements for the collection and temporary storage of dry house refuse; and house drains and pipes should be constructed and ventilated on the principles that will presently be set forth.

All these matters are easy to regulate without interfering too much with the plans of the architect, and have, in fact, been more or less dealt with in several Acts. In places with urban powers, indeed, bye-laws under the Public Health Act can be made to regulate the majority of such points.

(3) *The Water-supply.* In a town with sewers and water-closets it is generally considered that the supply of water per head daily should not be less than 25 gallons; and if there are trades using large quantities of water, from five to ten gallons additional (reckoned per head of population) are wanted for the town. If there are no water-closets, from 14 to 20 gallons per head daily appears to be the amount usually considered sufficient in large English towns.

Many Acts, public and local, regulate water-supply. The sanitary Authorities of any place have had large permissive powers (under previous Acts, and now under the Public Health Act of 1875, clauses 51–67) as to constructing, or buying and maintaining waterworks, and building and cleansing public cisterns, fountains, &c., and powers are given also to protect watercourses or watersheds whence the supply is derived. The Public Health Act of 1875 has also increased, in some ways, the powers of the local authority, and in certain cases the powers of the Public Health (Water) Act of 1878 can be exercised in towns. In local Acts powers are also given to ensure proper fittings in houses, to carry out constant service, and other points of the kind.

The following are the matters of chief importance in towns:—(*a*) The supply should be taken from sources capable of affording a quantity adequate to the present and proximate wants of the town, with such approach to constancy as may be attainable. In quality,[1] the great points are to ensure that the water is clear or is easily and completely freed from sediment by sand-filtration, and is well aërated, pleasant to taste, and without smell; that it contains no injurious animal constituents, and cannot become contaminated with excreta of men or animals, or with foul water from houses; that it contains no injurious amount of vegetable matter (not more than 2 or 3 grains per gallon) and that its mineral constituents are of moderate amount, not exceeding 60 grains per gallon as a maximum, and consisting of such mineral matters as are not likely to be injurious. With respect to lime especially, much discussion has taken place as to whether soft or hard water (from calcium carbonate) is best for a town; the soft water is preferred for many trades and is probably best for health, though it has been found impossible to prove this by statistics; it is certain that the inhabitants of numerous towns using a good chalk water have excellent health, and it would seem in fact that the question between water hard from calcium carbonate and soft water is not an important one. When water is hard from calcium chloride and sulphate it seems more injurious to health. The great point in choosing water is, in practice, its freedom from any chance of contamination with excreta, or with refuse matter from habitations.

The sources of supply are natural lakes, artificial lakes and gathering grounds, rivers, springs, and wells.

In towns of any size superficial and shallow wells are always suspicious sources, as it is impossible to secure them from foul overflows and soakages. Clause 70 of the Public Health Act 1875 gives power to close wells, tanks, cisterns, or pumps if the water be polluted.

The duties of a medical officer of health should include the supervision of the sources of supply, so as to detect and prevent any possible contamination.

(*b*) The water when supplied, except in the case of deep well waters, most commonly needs to be stored and filtered. The reservoirs of our towns contain from one to three months' supply, or less if the supply is very constant. The reservoirs require to be well placed; to be clear of trees, and protected from danger of anything being thrown into them. The filters are usually made of sand about 3 feet in depth, and the water is passed through at the rate of from ½ to 1 gallon to every square inch of surface in 24 hours. The upper sand of the filters requires frequent cleaning, and should be regularly inspected. This plan acts well, but constant supervision is necessary.

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[1] Section 55 of the Public Health Act, 1875, imposes on the Local Sanitary Authority the obligation of keeping the supply of water pure and wholesome in the case of waterworks which have been purchased or constructed by them.

(*c*) After filtration the water is distributed by means of pipes, usually by iron pipes, tarred or concreted inside, for the larger conduits, and then by lead pipes, or what is better, tinned-lead pipes for the smaller. Both iron and lead, and especially the latter, are dissolved by some waters, and the question whether lead is so dissolved has often to be answered; in examining into this matter the water should be taken after it has been in contact with the pipes for some hours. Carried down by these pipes the water is either delivered at intervals to house cisterns, or, what is far better, is supplied on the constant plan without house-storage. If it be not possible to dispense with house-cisterns, they should be well made of slate or concrete, should be able to be easily inspected and cleaned, and their overflow pipes should always end in the open air, never go into any sewer. The greatest care should be taken that the cistern water shall run no risk of contamination, by absorption of foul air or by soakage into the cistern, which should be well covered to prevent dust getting in.

If the constant system is in force it should be truly constant, for if the water is cut off at intervals, and the house-pipes are then emptied, air must be drawn into them and this air may be foul; it has even happened that dirty liquids have been sucked into water pipes, as where a closet service-pipe has dipped into a choked closet-pan, and in this way excreta have not only passed into these house-pipes but have even got into the mains. Under a constant system and under an intermitting system alike, small service-cisterns are needed for water-closets and for kitchen-boilers, and precautions have to be taken with these cisterns equally with larger storage-cisterns. In fact too great care cannot be taken in thoroughly guarding water-pipes and cisterns in every way. The dangers connected both with the intermittent and constant systems have only been fully recognised during the last few years.

The sources of contamination of drinking water are very numerous, and may affect the water at its source, in its flow, in the reservoir, or during distribution. If stored in houses it is especially exposed to risk; and this is the grand argument for constant service, that the water may be delivered immediately after filtration. The plan of cistern-storage, indeed, lessens those risks that are incidental to intermissions; but this plan demands that cisterns be properly made and placed, and be regularly cleaned. For low-rented houses these conditions are very difficult of attainment, and therefore the constant service is peculiarly adapted to the houses of the poor. Siphon-filters of animal charcoal placed in cisterns, filter the water immediately before use, and are much to be recommended.

In all towns the service should be at high pressure, so that water may be carried to every floor and thus labour be spared, and the freshness of the water be secured. In towns where the water is not carried into the houses, but is fetched from 'hydrants' or stand pipes in the street, it has to be stored in the houses in buckets and runs many chances of impurity.

A town requires water for public purposes, such as for public baths, washhouses, flooding and washing streets, flushing sewers, and putting out fires. Statutory powers are given for carrying out these objects.

(4) *The disposal of dirty house-water and dry refuse.*—After being distributed and used in houses or trades, the water with the impurities it has gathered must be carried out of the town. The inhabitants should have no difficulty in getting rid of their dirty water, or the same water will come to be used several times for cooking and for washing. Houses ought to have convenient sinks discharging by trapped pipes opening outside the house, not into a drain, but over a drain-grating. From hence it must go along pipes or sewers, and be disposed of at the outfall in some way. House-water, besides other impurities, invariably contains some portion of urine. It is not fit to be at once discharged into streams, but as its fertilising powers are small it is not well adapted for irrigation or precipitation. The best plan appears to be to filter it by intermittent filtration on a small area of properly prepared and drained ground, and then to carry it into the nearest stream.

The dry refuse of houses consists of cinders and ashes, remains of food, dust from sweepings, and various other used-up articles of house life. In some towns there is little difficulty in disposing of this refuse. After being carted away it is sorted, and every article finds a sale. In other towns, however, the disposal of the house-refuse is a matter of difficulty and expense. In some places the dry refuse is placed every day by the inhabitants in front of the houses and is removed by scavengers. In other cases there is storage of refuse on the premises; if this is done every house should have a properly prepared dust-bin, well-paved to prevent soakage, well-covered so as to be kept dry, and so placed as to be convenient for the house as well as for the town-scavengers. In the building of any house the arrangements for the position of the dust-bin are almost as important as those for the closets. The removal ought to be frequent and regular, but the frequency has to be fixed by special circumstances.

(5) *The removal of excreta.*—The excreta of the skin and lungs are got rid of by ventilation and washing, so that this heading refers only to the solid and liquid excreta. These average respectively (for both sexes and all ages) about 2½ ounces avoirdupois of solid excrement and 40 fluid ounces of urine *per diem*.

The excreta ought not to soak into the earth, or to remain near dwellings. The common privy and the 'midden' of northern towns cannot be brought to fulfil these conditions. In towns above 10,000 inhabitants it now seems clear that there is no possibility of using the earth or any deodorising plan, on account of the expense of transport. Therefore, for towns, two or perhaps three plans only remain: 1. The dry plan with frequent removal, with perhaps such deodorisation as the ashes of the house may give—this is the so-called 'pail system' in some one of its forms. 2. The water system, the excreta being carried off from the house along drains and sewers, by the aid of water. 3. The air or pneumatic system of Captain Liernur, in which the excreta, unmixed with water, are sucked through pipes into a central reservoir by an air-pump, worked by a steam-engine. This plan of removal is as yet unfamiliar. It is now being fully tried on the Continent, and in after years there will be reliable data as to cost for original plant and for maintenance, as to certainty and efficiency of working, and as to returns from sale, all of which are now matters of doubt.

It would not be possible to discuss here the relative value and the technical details of the pail and the water systems. Both are largely used in England. The former is used in towns where the barbarous cesspit and midden plans are abolished, and yet where proper sewers cannot be made, or water is deficient, or land cannot be obtained for irrigation or filtration; it has the disadvantage of keeping the excreta for some days near the house, and is sometimes attended with nuisances in the working, but, on the whole, it is capable of keeping a town clean when it is properly carried out, and it is an immense advance over the old midden system, which retained the excreta for long periods in the very midst of the people. It is, however, essential that the removal of the excreta should be frequent, that is, once a week or so—twice a week if practicable. After removal the excreta are applied at once to the land, or are made into poudrette. In some towns the house-ashes are thrown on a wire screen, so as to allow the fine ash to fall on the excreta—this is sometimes called the 'ash plan;' in other cases deodorants are used. The 'Goux system' is to place some absorbent material round the interior of the pail to absorb the urine.

The water system is more complicated, and probably more expensive, but if properly carried out is more effectual. If a town can make good sewers, and has water for flushing and land through which the sewer water can be passed by filtration or irrigation or both, the water system is the best for health.

It is essential, however, that sewers should be well constructed, and should allow no deposit, and that they should be thoroughly ventilated. Deposits are prevented by having egg-shaped sewers with a proper fall, easy means of access for inspection and cleaning, and a regular flow of water with periodical flushing. The ventilation of sewers, which is now enforced by law (clause 19, Public Health Act, 1875), is best effected by having numerous openings—as many, in fact, as can be made—so as to allow constant and free interchange between the sewer air and the atmosphere. These openings may be by street-gratings or by special shafts, according to circumstances. Ventilation through furnace chimneys can be sometimes done, but is of no avail for distant portions of the sewers. The openings may, at certain points where the shafts or gratings are near houses, have to be guarded by trays of charcoal, through which the sewer air passes. But in whatever way it is done, the rule must be to have the freest communication between the sewer air and the general atmosphere. This free ventilation occasions no offence if the sewers are properly made and kept; while, if the air of sewers at the ventilators is found offensive, the ventilation will at least have provided against the more dangerous discharge of the foul air into houses. As a further provision against possible reflux or suction of the air of the public sewers into houses the following arrangement should be rendered imperative by law. At some point in the course of every house-drain, before it reaches the main sewer, there should be complete disconnection by means of (*a*) a 'siphon-trap,' through which all the liquids of the house must pass, and which, therefore, must always be charged with water while the house is inhabited; and of (*b*) an opening from the house-drain to the outside air, made on the house side of the siphon-trap, to provide for the escape of any sewer-air that may force the trap, as well as for the ventilation of the house-drain proper. If this were done the spreading of disease by town sewers would be impossible, and the greatest objection to them would be removed. The community constructs the main sewers, but it would seem just that the owners of house property, who provide the house-drains and are obliged by law to connect them with the public sewer, should be compelled to put down one of the open-air traps, which renders reflux impossible into their houses.

Sewers have been objected to on account of the occasional spread of typhoid fever and diarrhœal affections, and perhaps of cholera and diphtheria by their agency; but, if properly arranged, and with disconnection between the sewer and houses, there would be no danger; and it is difficult in any case to see how sewers can be displaced or be substituted by any other plan. The house-water must be carried off, and it is impure even if no excreta are allowed to flow in. Even if the pail or pneumatic plan be adopted, there must still be town sewers for dirty house-water, and all the precautions above alluded to must be enforced. Sewers, then, whether or not they receive the excreta of a town, are a necessity, and with proper construction and management, they certainly ought to be solely beneficial to the public health. It is certain that when a town is well sewered the prevalence of enteric fever is lessened even to the point of extinction, and diarrhœal affections have appeared to be more uncommon. Drying of the soil by sewers also lessens phthisis. It is a question of engineering detail whether the sewers carrying the house-water should also carry off the rain water. In some cases the 'separate system' (that is, having different channels for house and rain water) appears clearly the best. The sewer water is less in amount, more regular in flow from day to day, and richer in fertilizing properties.

With regard to the disposal of the sewer water, three plans can be followed in the case of towns which cannot discharge at once into the sea or (without disobeying the Rivers Pollution Prevention Act of 1876) into a large river: first, precipitation at the outfall with a chemical agent such as lime, aluminous compounds, phosphate of lime and alumina, clay, &c. A great number of chemical agents have been proposed, and several clarify the water fairly, but none yield a deposit which pays the expenses either as manure or when burnt into cement. Precipitation must, however, be had recourse to when land cannot be obtained. Second, irrigation, one acre being sufficient for the excreta of about one hundred persons. Third, intermittent filtration, where one acre is sufficient for from 2,000 to 3,000 persons; the land receives water six hours out of the twenty-four, and is deeply drained. In neither extended irrigation nor in filtration on a limited area is there any adequate profit, but still there appears to be some, and the purification is more complete than by precipitation. In some cases after filtration the water is passed over farm land, and this double purification appears to be very satisfactory.

It appears certain that neither irrigation sewage farms nor filter-beds are hurtful to the public health when properly managed.

(6) *The conservancy of the surface area.*—The cleansing of the surface area of towns is secured partly by powers originally given in a variety of Sanitary Acts, general and local, and continued with additions in the Public Health Act of 1875, clauses 42–50. These powers are large and on the whole sufficient. The sanitary importance of thorough surface-cleansing is obvious; the mud and dirt of towns and refuse of all kinds, wetted by rain and exposed to heat, soon decompose and give out injurious effluvia, especially in narrow courts and lanes where the movement of air is impeded. The excellent effect on health of paving a town has been often observed. Public streets of all kinds can be easily kept clean, but want of paving and consequent foulness on private premises require to be sought out. Under the above and other clauses in the Act the supervision of pigsties and stables is carried out and, generally, conditions which can give rise to nuisances injurious to health can be legally dealt with.

(7) *The Supply of Food, including the Regulation of Slaughter-, Cow-, and Bake-houses.*—A very important duty of a municipality is to supervise the food of the people. While the price and quality must be left to the ordinary operations of commerce, the responsibility of preventing falsifications, and of ensuring that the article shall not be injurious to health, must rest on the sanitary authority. The regulation of slaughter-houses and knackers'-yards, directed by former Acts, is authorised afresh by the Public Health Act of 1875, clauses 166 to 170. Private *slaughter-houses* are licensed, and can be visited and subjected to bye-laws. They are often constructed out of buildings intended for other purposes, are not fitted with proper appliances, and are generally placed in the densest part of the town. The evils attending them are gradually being removed by the erection of public slaughter-houses, where abundant air, water, good sewers and means of cleansing are provided. The custom of slaughtering in the country and then sending the meat to cities is increasing, and this again renders private slaughter-houses less necessary.

The transport of cattle and sheep to towns is a matter of very great importance as respects both the goodness of the meat and the comfort of the animals. It is a matter which should be dealt with in the Public Health Act, and should be under control to a certain point. Space in the trucks, supply of water and food, length of journeys, and other matters, require regulation.

Cowhouses are usually inspected by sanitary authorities, in pursuance of the powers of the Public Health Act, §§ 91–92, or of private Acts. In the metropolis they have to be licensed by magistrates. A certain cubic space is usually allowed to each cow (1,000 cubic feet should be the minimum), and cleanliness is enforced. The condition of small cowhouses and dairies, and of the water-supply and drains attached to them, requires more attention than it has received, as both enteric and scarlet fever are now known to have been spread by the agency of milk.

[To these diseases must now be added diphtheria; and the suggestion that diseases of the animals themselves, as well as impurities received from water or air into their milk, are concerned in the production of milk-epidemics among human communities, will henceforth always have to be kept in view.

The foregoing requirement has been in a measure fulfilled by the Contagious Diseases (Animals) Act of 1878, which requires cowhouses to be licensed, and their sanitary condition attended to; and requires precautions to be taken in dairies and milkshops against the contamination or infection of milk. An Order of Council has been made respecting these various matters. It is observable that sanitary authorities are not charged with the duty of inspection under this Act, except in the case of corporate towns.]

Bakehouses are regulated under a special Act (26 and 27 Vict., c. 40) which was passed after long enquiry into the condition of the trade. By this Act the bakehouse is ordered to be kept in a cleanly condition, to be properly ventilated, protected from effluvia, and not to be used as a sleeping-place. The condition of the bakehouses disclosed by the enquiry referred to, was in the highest degree disgraceful and repugnant.

The inspection of the chief *articles of food* takes place under the Public Health Act of 1875, clauses 116 to 119, in respect of meat, game, poultry, fish, fruit, vegetables, corn, bread, flour, and milk, and under the Adulteration and Licensing Acts in respect to other articles of food.

The following are the chief sanitary points in each case:—

1. *Meat.*—Much doubt exists as to the extent to which the condemnation of meat exposed to sale should be carried. There is no doubt that meat sufficiently decomposed to be discoloured and to have a putrid smell, and meat with abscesses and suppurations, should be condemned, but the difficulty arises with meat apparently sound or not very obviously otherwise, but which is derived from diseased animals.

Though opinions differ on this point, it may perhaps be said that meat derived from animals dead of inflammatory diseases and of epidemic pleuro-pneumonia may be used, but that beef from cattle dead of cattle-plague and anthrax (malignant pustule), mutton from sheep with small-pox and splenic apoplexy, and pork from pigs with carbuncular diseases, hog-cholera, hog-typhus, and scarlet-fever, should not be used, although it is not easy to give conclusive evidence as to bad effect in some of these cases. Cattle-plague meat, for example, has been largely used without injury. Opinions are much divided as to whether the flesh of braxy sheep, or of cattle dead of foot-and-mouth disease, should be used or not, but at present the evidence is rather against the view that such flesh is injurious.

In the case of the parasitic diseases of animals the question is easier. It is of course highly dangerous to use pork with trichina. [Some recent experiences are pointing to trichinosis as a more common disease than had been suspected.] Cysticerci in pork, beef, and mutton should also, in the writer's opinion, be a valid ground for not permitting the sale, though this view is not universally or perhaps generally held, since as cysticerci are killed by a temperature of 160° Fahr., it is considered that good cooking removes all danger, and therefore that condemning meat for this cause is an improper restriction on supply. On the other hand, as it is impossible to secure that a sufficient temperature shall be applied, how can it be possible to prevent the development of tapeworm if the sale is permitted? The prohibition would probably not long affect supply, as the breeders and salesmen would take greater care in preserving the cattle from parasitic infection; and that this can be done, by supplying pure water and clean food, is shown by the experience of Upper India.

Flukes in the liver do not constitute a valid ground of rejection of the meat, though the liver ought not to be eaten.

Some very remarkable examples of an acute specific disease of peculiar characters have recently been observed among consumers of meats derived from the pig; where the sole evidence of disease in the meat has been the presence of a cultivable bacillus. *See* POISONOUS FOOD.

Sausages when musty and strong-smelling should be rejected, but, owing to the spices used, decomposition is not easily made out. The peculiar 'sausage-poison' has not been identified.

Wheat-Flour and Bread.—The chief points are to ascertain that there is no ergot, no fungi, nor acari; that alum has not been used; and that other grains or mineral matter are not mixed with it.

Under the Adulteration Act the following, among other articles, may have to be examined: *Milk*, the chief falsifications in which are addition of water or removal of cream. Falsification in other ways is not common. It may also be improper for use, owing to the presence of blood, lacteal casts, pus and fungi. *Butter*: the falsifications here are admixture with foreign fats, and excess of water or of salt. *Cheese*, which may be decomposed, mouldy, or have copper added to preserve it. *Coffee*, which may be putrid or decomposing, or mixed with chicory, roasted corn, &c. *Tea*, which may be decomposed, mixed with exhausted leaves, or with leaves of other than tea-plants, or with sand, iron ore, colouring matters or facings. *Cocoa*, to which various starches may have been added, or the fat exhausted. *Oatmeal*, to which inferior barley or wheat- or maize-flour may have been added. *Maranta arrowroots*, to which potato starch or inferior kinds of arrowroot may have been added. *Spirits*, *wine*, and *beer*, in which there may have been addition or subtraction of spirit; improper spirits, as methyl or other alcohols, added; addition of water, salt, sulphuric acid, ferrous sulphate, lime-salts, lead, cocculus indicus, hot spices, aloes, quassia, burnt sugar, &c.[1] *Vinegar*, the chief falsifications in which are the addition of water and occasionally of sulphuric acid in excess of that permitted by law ($\frac{1}{1000}$ part.)

In no case is an examination of food under the Adulteration or Licensing Act made to determine the quality of a pure food; it is directed simply to detect the presence and amount of foreign-substances, or of decomposition and putrefaction. The law permits mixtures to be sold in some cases, if the admixture is stated on a label.

(8) *The Regulation of Trades.*—Trades are affected by the law under two points of view: 1st, irrespective of the nature of the trade, the *place where it is carried on* is regulated under the Mines, Factories, and Workshops' Acts; and by the Public Health Act of 1875, urban authorities can make byelaws regulating offensive trades, such as blood and bone boilers, fellmongers, soap, tallow, and tripe boilers, &c. The object of the Factories and Workshops' Acts, among other things (such as restriction of labour at certain ages), is to provide that the common conditions of health are not violated. This is a very necessary point, for many workshops are deficient in light and air, are badly ventilated, or are rendered unhealthy by gas burnt for light. Many small workshops are owned by men of small capital, who often sacrifice the health of workmen by compelling them to work under very unfavourable conditions. Happily the faults are usually easily remedied by a little common sense and simple appliances, and in this respect the Workshops and Factories Acts have done great good. One special fault in many workshops is, however, still common, namely, the burning of gas in large quantities in dark shops, without proper means of carrying off the products; the very great influence of this condition on the lungs was long ago pointed out by Dr. Guy.

2. The other point in the regulation of trades is to prevent any of the *processes being nuisances* or injurious to the health, either of the workpeople or the inhabitants of the surrounding districts. This is an extremely wide subject. Trades may annoy and inconvenience the public, as by offensive effluvia, black smoke, or acid vapour which destroys vegetation, yet may not be distinctly injurious to health. On the other hand, without being notable nuisances in the above sense, they may be hurtful to health, especially those (and they are very numerous) which give rise to dust in the air of any kind. Cotton and

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[1] The examination of adulteration of beer is now so far more difficult as the law allows other bitters besides hops to be used, and it is understood there are numerous cheap bitters now used in place of hops. It is very desirable that the old law allowing only malt and hops to be used in the making of beer should be re-enacted.

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woollen *débris*, metallic vapours, filings and grindings, particles of size, clay, dry paints, and many other substances, come under this head. Much debate has taken place as to whether certain gases, such as carbonic acid, chlorine, iodine, sulphuretted hydrogen, sulphurous acid, or the fœtid vapours given off from catgut, gelatine, manure and other trades, are or are not injurious to the health of the workmen, or persons living near the factories. In many cases the discussion is not closed, and fuller enquiries are necessary; but at present it seems as if these gases and fœtid effluvia, in such proportions as they are met with about factories, are not proved to be unhealthy (though their innocuousness cannot be asserted), however disagreeable they may be; whereas there is no doubt that the inhalation of all solid particles, no matter whence derived, is highly injurious. Phosphoretted fumes escaping into the air have affected the jaw-bones of persons exposed to them; this happens now much less than formerly.

The spread of *infection by trade operations*, as of anthrax among woolsorters, and of smallpox among paper-makers, has recently come to demand recognition.

There is one article, the use of which gives rise directly and indirectly to a large amount of sickness, and the trade in which certainly requires regulation, if the public health is to be regarded. This is *alcohol* in its various forms. Owing to peculiar social customs, to the insufficient recognition of the immense amount of harm produced by excess of alcohol, and to a want of definition of what is excess, the laws of this country have not only legalized the sale of a dangerous article of diet, but have actually encouraged the sale, until an evil so gigantic has been produced that no one has yet suggested a reasonable remedy. Yet the sale of alcohol is so distinctly a source of disease and of injury to the State, that it must be considered by those who have charge of the Public Health, and in some way must eventually be restricted. One source of the error seems to be that alcohol is regarded by the State, not only as a source of revenue, but as an indispensable article of refreshment. There is, of course, no question that the public must be supplied with houses where they can obtain proper refreshments, such as meat, bread, vegetables, milk, coffee, tea, or other articles of the kind; and 'public-houses' were intended to supply articles of this description as well as the alcoholic liquids which enter into the ordinary diet of most people. Yet, unfortunately, a system has grown up by which our public-houses have become only places where alcoholic liquors are sold, and this is defended on the ground that such liquids are refreshments. The amount of temptation which has been put in the way of our working classes by the heedless multiplication of these grog-shops during the last forty years accounts for much of the drunkenness which so deeply affects our national life, and injures the health of the people. A remedy ought and must be found for this state of things, or else sanitary legislation will still present the absurd spectacle of raising up with one hand what it is smiting down with the other.

(9) *The arrest of the Contagious and Infectious Diseases.*— Small-pox, scarlet fever, measles, hooping-cough, diphtheria, enteric fever, typhus, and relapsing fever have to be dealt with. Among other contagious diseases also syphilis and gonorrhœa must be included.

Of late years, since the recognition of the fact that each of these diseases must have its own special cause, the prevention of the infectious diseases has become much easier, although the exact nature of the cause may be unknown. The general principles on which the prevention is based are—1. The recognition of the places of origin and conditions of formation of the morbid agent, that is, whether it arises from processes going on in some of the structures of the human body, or in substances outside and independent of the body, with further question as to the nature of these substances, structures, or processes; when these points are known, it is to be expected that the formation of the agent can be prevented or the agent can be destroyed. 2. The recognition of the means of spread of the agent, after its first formation, that is, whether it spreads by the help of the air, or is carried in drinking water, or in food, or is transferred directly from one person to another; so that when known the carriage of the agent may be stopped. 3. The early removal of the person affected from among the community, so that the risk of spreading in any way may be lessened.

In the case of each of these diseases the preventive measures are different, and it is impossible here to go into so large a subject as the prevention in each case. The measures include a continual supervision over the conditions of origin, introduction, and spread as far as they are known.

Two points must, however, be specially noted. The isolation of persons ill with any disease which directly or indirectly can spread from one person to another is a necessary step in all cases. In the crowded houses of towns some diseases such as typhus, scarlet fever, measles, relapsing fever, &c., spread with great rapidity, and the only possible check is to remove the sick at the earliest moment from the houses, and to prevent persons ill with infectious diseases from exposing themselves in public places and conveyances.

For the first purpose sanitary authorities have powers (Public Health Act 1875, clauses 120 to 140) to remove persons ill with infectious diseases to a proper hospital in special conveyances; to prevent sick persons frequenting public places or conveyances; to destroy bedding or clothing, and to disinfect rooms, houses, or clothing. Hospitals for infectious diseases can also be built, and are now being constructed in many towns; it is desirable to make them simple, cheap buildings of wood or iron, able to be thoroughly cleaned, or after a term of years to be destroyed and replaced. These hospitals should provide a cubic space of from 1,500 to 2,000 cubic feet with a floor space of from 120 to 140 feet for each patient, and efficient separation between patients suffering from one and another infectious disorder. The freest ventilation, supply of water, and means of disinfection are essential. Under the same Act a town is empowered to erect a proper place for disinfecting clothing and bedding; and disinfecting chambers (heated by hot air, steam pipes, or gas, and in which a heat of 240° Fahr. can be reached) are now provided in many towns for the immediate disinfection by heat of all soiled clothes taken from patients with any of these diseases.

The disinfection of the excreta or of discharges from the body, or of the air surrounding sick persons, is also attempted and is evidently a proper plan to follow, though the results are at present uncertain. The spread of scarlet fever, however, appears to be arrested by rubbing the skin with carbolized or camphorated oil; typhoid fever is probably stopped by strong chemicals added to the intestinal discharge; and the spread of typhus has been also lessened and perhaps arrested by aërial purifiers, especially nitrous acid fumes.

Small-pox is prevented by vaccination, and for this there are special Acts and a special organization.

The prevention of syphilis and gonorrhœa by periodical inspection of prostitutes, and removal of them to lock hospitals when diseased, is only carried out in this country in certain military and naval stations, where the effect has been to lessen primary syphilis by nearly one-half, and to abate its virulence. The effects of the Contagious Diseases Acts upon the women, in respect not only of curing them but of influencing them for good and of reclaiming them, has been very remarkable. In Germany, France, and Belgium precautions against venereal diseases have been carried out among the entire population for many years, with the effect of greatly lessening the amount and virulence of syphilis.

As syphilis has a most pernicious effect upon the health of a very large number of persons, it is most urgently to be hoped that the Legislature may before long deal thoroughly with this matter and attempt to lessen syphilis, not merely in the army and navy, but among the population at large.

(10) *The disposal of the Dead.*—Two points are involved in the disposal of the dead both in towns and villages.

1. In this country where so many families live in single rooms, and where the custom of keeping the dead five or even six days before burial is usual, it constantly happens that a corpse is kept for days in the room where all the family life is carried on. As decomposition, especially in some diseases, commences early, it cannot be doubted that an unfavourable effect on health must be often produced. To avoid this detention, mortuary chapels ought to be constructed in all towns and villages, and to these all corpses should be removed from the houses of the poor within thirty-six hours after death.

Power has long been given (Public Health Act of 1848) to the Sanitary Authority to provide mortuaries, and the Act of 1866 gave power to remove, when necessary, corpses from rooms where persons live and sleep. These powers are continued in the Public Health Act of 1875, and clause 141 also now imposes on the local authorities the duty of providing mortuaries, if required by the Local Government Board to do so. Very little has as yet been done in this way, and England is in this respect far behind some of the Continental States.

2. The second point is the disposal of the corpse. The law of England now allows no burial-grounds in large cities, nor burial under churches, and consequently cemeteries are provided at convenient distances from towns. These cemeteries ought to have a dry soil, so that the ground water shall never rise high enough to wet the corpse or to float it up in the vault, as sometimes happens; they should be as far from houses as practicable, and the minimum limit of 100 feet allowed by Government is much too little; there should be good drainage, and the water should not run into any well or water-course from which drinking-water is taken; the site should be well ventilated and well planted, so that the roots of plants may absorb the decomposing matters. The kind of soil will, of course, depend on the locality; in many cases there is no choice, but if there be a choice a marly soil, not too stiff, but allowing free permeation by air and free flow of water, should be chosen; gravelly soils act pretty well, but are said to form a compact mass round the body, which prevents access of air and moisture; the lime and chalk soils act better, and especially if the soil is alkaline; very stiff clay preserves bodies longer than less compact soils.

Bodies decay in very various times, according to soil, access of air, amount of pressure, &c. In some cases a corpse may be destroyed in three years; but when ground has to be used over again, a period of from five to thirty years is allowed in different countries before the second use. Bodies should be buried deeply (4 to 6 feet) in order to lessen the chance of contamination of the air, though it is supposed that when the graves are shallower, decomposition is more rapid; the graves should not be bricked, but the earth allowed to rest on the coffin.

It has been proposed to use not coffins, but sheets or wicker-baskets, so as to let the earth at once come in contact with the body; and, in fact, in many villages in England it was formerly the custom to carry the corpse in a coffin to the churchyard, but then to remove it from the coffin and place it in the ground in a sheet. If the coffin is not made too strongly it is probable that it does not much delay decomposition; so that this point does not seem very material.

The decomposition of bodies occurs by putrefaction, with rapid disengagement of effluvia; or by a sort of insensible decomposition, the products being decomposed as rapidly as they are formed by the earth. In other instances the decomposition is by saponification. This last condition is said especially to occur if the earth is too closely pressed on the body, and gets too saturated with the products of putrefaction.

As in some cases conveniently-situated and proper land cannot be obtained, a discussion has lately arisen whether burning, or, in the case of seaboard towns, burying the body in the sea, might not supersede burial in the ground. This article, however, is not the place to enter into this question.

(11) *The Supervision of Nuisances.*—[Nuisances

are defined in the Public Health Act, § 91, as being—(1) any premises, (2) any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain or ashpit, (3) any animal, (4) any accumulation or deposit, (5) any over-crowded house, or part of a house—that are 'a nuisance or injurious to health.' These words, as they occur here, must be read with reference to the general purposes of the Act, and will therefore include only things or conditions as above that are of a nature to injure health: mere disagreeableness or annoyance, though it may be a 'nuisance' at common law, not being enough to constitute a nuisance in the above cases. Moreover, (6) dirty or unventilated factories and work-places, or any that are unnecessarily dusty, and (7) manufacturing furnaces and the like that do not consume their own smoke, are, in this Act, included with nuisances under certain limitations.

It is the duty of every Sanitary Authority to cause inspection to be made of their district to discover nuisances; and a certain procedure for the abatement of nuisances, and for the prevention of their recurrence, is appointed by the Public Health Act. For the performance of these functions the Authority is required to appoint one or more Inspectors of Nuisances, to whose office certain powers are attached. [The work of nuisance-inspection, in its every-day concern with conditions injurious to health, cannot be properly performed without the constant and intimate relation of the Medical Officer of Health with the Inspector; and those districts are unquestionably best served as to sanitary inspection where the Authority has devolved on the Medical Officer the duty of instructing the Inspector and of supervising his work.]

II. **Villages.**—Although many of the earlier sanitary enactments had application to villages, it was not until the passing of the Public Health or Sanitary Act of 1872 (35 and 36 Vict., c. 79) that rural sanitary authorities were constituted. These authorities, namely, the Guardians of rural Poor Law Unions, can now exercise considerable powers, and if properly set in action by their medical health officers and inspectors of nuisances (whom the authorities are obliged to appoint), a great effect must be gradually produced upon the rural labouring-class, whose condition has up to this time been almost entirely neglected. As the urban authority in towns, so the rural sanitary authority in country places may provide water for public use, may make public cisterns or baths, may protect watercourses, may construct sewers and dispose of sewage matter; must take care that no closet or privy is a nuisance; may clean ditches and remove refuse, and may make regulations as to cellar-habitations and common lodging-houses. [Much increased power of securing proper water-supply in the particular house within rural districts has been recently given by the Public Health (Water) Act of 1878.] All powers possessed by urban authorities as to trades, sale of unwholesome food, removal of nuisances, providing mortuaries and hospitals for infectious diseases, are now also possessed by the Poor Law Unions (Public Health Act 1875, clauses 5 and 9).

At present, however, except in those places where several rural sanitary authorities have united to appoint a first-class sanitary officer, little has been done in English villages.

The problem is, in fact, by no means an easy one, but it is being vigorously discussed, and will be no doubt eventually solved by the officers of health of large areas, many of whom are men of great knowledge and distinction. The difficulty arises from the houses in the rural districts being, in a great number of cases, old, dilapidated, unsuited for dwellings, and destitute of proper conveniences. When new houses are built, the sanitary authority can enforce certain provisions, though it has far less control over building operations than is possessed by urban authorities. In the case of houses already built, however, its power is, from circumstances, even more limited. There is very little money available for improvements; the poor-rates are already often heavy, and guardians hesitate to increase them. The small number of houses in villages also, in comparison with the outlay needful to supply sewers and water, renders the cost per head relatively much greater than in towns. Progress, therefore, in rural districts must be slow, but yet it cannot be doubted that the present condition will be gradually improved. In addition to bad construction and dampness of houses, the most frequent sanitary defects of villages are as follows:—The water is too often drawn from shallow wells or from small streams, polluted by soaking, or from stagnant pools or ditches, and its supply is limited. Often there are no means for carrying away the dirty house-water, and it is thrown on the ground and soaks into the soil close to and under the cottage; the excreta are generally thrown into an ashpit near the house, or pass into a cesspit in the ground, into which they gradually soak, polluting both ground and water. All sanitary appliances are, in fact, often wanting. Attempts are now being made to purify and then to guard the wells; to collect rain-water in proper tanks when other sources are wanting; or to store the water collected from the surface-soil of some area secure from drainage, manuring, or like impurities (as recommended by Mr. Bailey Denton). For the disposal of the slop-water, open or partially-closed surface drains leading to ditches, or underground drains that shall allow the water to flow into the soil, and other plans have been proposed. It is, on any plan, important—but especially if shallow wells or the surface soil are to furnish the drinking water—to carry off to a distance all the slop-water by drains of some kind. For the removal of excreta (as sewers are generally out of the question) a pail system, with or without the use of dried earth or charcoal, according to circumstances, has to be used. If the cottages have gardens, then the simplest dry-earth plan, with proper storage and the subsequent digging into the gardens at intervals of not more than three or four weeks, seems to answer well; yet it is very difficult to get peasants to attend even to this simple matter. If the village be a large one, then conjoint action in the procuring, drying, and distributing the earth, and in the removal of the mixed earth and excreta, answers well when care is taken. In other cases a pail system, with weekly or fortnightly removals.

without the use of earth or other appliance, can be employed, and may answer, as the manure has some value.

These seem at present the directions in which the opinions of medical officers of health are tending where villages and labourers' cottages are concerned, and where larger works cannot be undertaken. The object, of course, is to obtain by simple means, and at not too burdensome a rate, the same results which are arrived at in towns by more costly plans, namely, to ensure pure drinking water, and to remove foul house-water and excreta; or, in other words, to ensure purity of the water, of the air, and of the ground.

III. **Houses.**—The inside of a house is supposed to be beyond the control of the Public Health Authority, and is so to a large extent, but not altogether. The law takes cognizance of the existence of nuisance inside, as well as outside, a house; and has special provisions for securing wholesomeness of habitation in the following cases:—

1. *Common lodging-houses* have been regulated since the great Public Health Act of 1848, the authors of which were evidently profoundly impressed with the great evils of overcrowding. These houses are registered and inspected; the number of lodgers is fixed; and ventilation, and cleanliness, and water-supply are attended to (Public Health Act, 1875, clauses 70-89). A certain cubic space per head in the sleeping-rooms of these houses is generally fixed by the Authority. In the Metropolis (where Acts of 1851 and 1853, administered by the police, remain in force) 240 cubic feet, in Dublin and many other towns 300 cubic feet, are required for each adult inmate.

2. *Cellar-habitations.* Since 1848 it has been unlawful to use cellar-habitations, unless they are in accord with certain conditions of space, height, window area, drainage, &c. In the Public Health Act of 1875, Clause 72 affirms these conditions afresh, and Clause 71 makes it unlawful to use any cellar as a dwelling (that is, a place where any person passes a night) which has been built or rebuilt after the passing of the Act, or which was not lawfully in use when the Act was passed.

With the supervision that has been given to common lodging-houses during the past thirty years, they have become much healthier and more decent habitations. During the same period the number of cellar-dwellings in our towns has much decreased, and the condition of those still used has notably improved.

3. '*Houses let in lodgings*,' or occupied by members of more than one family. These are distinguished from *common* lodging-houses, where common occupation of a single room by persons of different families, or occupation for very short periods, has been the distinction that one and another authority have relied on to establish their *common* quality. The regulation of tenemented houses, as the present class may conveniently be termed, dates from the Sanitary Act of 1866. At present, by Clause 90 of the Public Health Act, 1875, Sanitary Authorities have various important powers conferred on them in respect of that large class of houses where two or more families live in the same house. But, for these powers to arise, the consent of the Local Government Board is required.

4. *Overcrowding.* The Nuisances Removal Act of 1855 (18 and 19 Vict. c. 121) empowered the Sanitary Authority, on the certificate of the medical officer of health or of two qualified medical practitioners, to take proceedings before a justice to abate overcrowding if the inhabitants consisted of more than one family. In the Public Health Act of 1875, clause 91 makes overcrowding, when dangerous to the health of the inmates, whether of the same family or not, a nuisance to be dealt with as such under the Act. Some towns have also provisions in their local Acts, giving them the same authority, and in this way the immense evil of overcrowding is sought to be lessened. The question arises what is overcrowding, and usually the common lodging-house rules are taken, namely, an air-space of 300 cubic feet per head. But there is no legal amount, except in Scotland, where the General Improvement and Police Act of 1862 enacts that children under eight years of age shall have 150 cubic feet, and persons over that age 300. Obviously, the standard of space per person adopted as the minimum in the *bedrooms* of common lodging-houses, where the occupation is by night only, is too small for those who have to occupy the same room both by day and night, as is usually the case, where the question of overcrowding arises in the dwellings of the poor. It would be very desirable to raise the minimum (at all events for persons over ten years) to 400 cubic feet, and this is really little enough.

The law, then, in these several ways acts directly upon houses, and if any nuisance is reported, or if houses are found to be dangerous or unfit for habitation, further powers come into play.

Although public authority does not extend to all the conditions which are next to be passed in review, it will be convenient to consider together the various

CAUSES OF UNHEALTHINESS OF HOUSES.

1. *Dampness.*—Dampness arises from a damp soil, water rising into walls, rain beating through walls or coming from a leaking roof, or blocked water-pipes. Paving, concreting, damp-proof courses, hollow walls, &c., are the remedies. Damp houses are unhealthy, it would appear, by reason of the lowering of warmth, giving rise to catarrhal and rheumatic affections, and perhaps by reason of increased decomposition of organic substances from the constant excess of moisture.

2. *Excessive coldness of air from draughts or from insufficient warming.*—Although an airy house is the healthiest, there may be, not too much, but imperfect, movement of air, so that strong currents are caused; or the temperature may be lower than is good for health, even if persons are well-clothed. The draughtiness is matter of construction, and is obviated by proper plans of ventilation. Then, as to warming. In towns, the use of hot-water and steam pipes heated by a furnace common to several houses will, no doubt, soon supersede our present inefficient and expensive fireplaces, and since the supply of warmed

fresh air is a very simple proceeding when these pipes are used, not only will houses be better warmed, but better ventilated and less draughty.

3. *Impurity of the air.*—This arises from the following conditions:—impure air drawn from ground or basement into the house, or passing over impure earth or deposits; air in house contaminated by effluvia from closets and pipes; from combustion; from respiration and skin-transpiration; from uncleanliness of persons, clothes, walls, floors, and furniture.

Each of these conditions has to be examined into and rectified according to the usual rules laid down in works of hygiene. A few remarks may, however, be permitted on some of the headings.

The removal of respiratory impurities can only be accomplished by constantly removing the air of rooms and supplying fresh air. This is ventilation, which on account of the very mobile character of air and of the ease with which its currents are reversed, is a mechanical problem of no little difficulty. The amount of air required for an adult, in order to keep the air free from any odour, is 3,000 cubic feet per hour; the carbonic acid of respiration, which is taken as a measure of respiratory impurity, should not exceed ·2 per 1,000 volumes of air. Practically, the amount most persons get is not more than 600 to 1,200 cubic feet per hour, if so much, and the air of their rooms smells fusty from organic effluvia. In cold times of the year, the entering air must be warmed, if such great changes are to take place as is implied in the supply of 3,000 cubic feet, or in the change of air in the air-space three, four, or even five times per hour. When warmed to nearly the temperature of the surface of the body (80° to 90° Fahr.) considerable movement of air is borne without difficulty, but if the temperature be much lower a correspondingly slighter movement is felt. Ventilation in this climate is therefore inextricably mixed up with warming, and thorough ventilation of our rooms is impossible so long as we trust to radiant heat alone for warmth. The problem, therefore, which engineers have to solve in warming and ventilating our rooms, is what is the cheapest and most constant plan of introducing warm air, of a temperature under 90° or 95°, into our houses in cold weather, the conditions of the problem being a supply of 3,000 cubic feet per head per hour, at a rate of movement imperceptible to the feelings of the persons in the room.

The second point is connected with the impurity of the air from drains. The first thing is to be certain that the air of the house-drain is so thoroughly disconnected from the air of the town sewers that no reflux from them is possible; and, therefore, that if there is any drain air polluting the atmosphere of the house it is not the air of the common sewer. That point having been settled, it will follow that drain-smell in the house must come either from the ground or from the house pipes or closets themselves. If from the ground, there is probably (if the ground itself be clean, or if the smell be of new production) a leaky pipe somewhere, and the air is penetrating through the interstices of the soil and is drawn into the house; every house should have a plan of its drainage, so as to facilitate the search for a broken pipe. If not from the ground, the smell may be from some pipe in the house; this arises from imperfect junction, especially when metal pipes are joined on to earthenware, or from the pin-hole eating-away of metal pipes. Or a drain-pipe may be choked (generally through 'settling' at a joint occurring in an ill-laid and badly-bedded pipe), and decomposition be going on in its retained contents. Or there may be a clogged or imperfect trap with the water either sucked out of it or becoming thoroughly charged with fœtid effluvia. In the latter cases, there is a presumption that the ventilation of the house-drain is not what it should be.

In order to detect any of these conditions it is necessary that builders should alter all their plumbing arrangements; at present they try to conceal everything, so that, without pulling a house to pieces, it is impossible to examine if pipes and traps are in order. Instead of this every pipe should be kept out of walls and above ground, and if cased with wood, the case should be merely bolted, and not nailed. If a pipe must be carried underground it should be laid in a regular channel which can be opened; but, as far as possible, all pipes should be above ground and open to sight, and none should run under houses. The sewage and foul water arrangements of our houses will never be satisfactory till these matters are attended to, and till the examination of every pipe about the house can be made without difficulty, and clogging or air and water leakage detected.

In closets the chief points of leakage are the horizontal pipes and the traps. In all cases the soil pipe should be ventilated by a pipe carried to the open air at some point away from windows.

Another matter to be guarded against, whether there be drain-smell or not about a house, is the immediate opening of the cistern overflow-pipe, or of the usual rain-water pipe, into the sewer or house-drain; the common practice is to open them into the sewer, perhaps with a sigmoid trap, which, however, is often dry at the top of them. Then sewer air passes up and enters the cistern, or rooms which happen to be near the top of the rain-water pipe. All these pipes should open in free air over a grating, and if every householder would insist on the builder attending to these matters the chances of inflow of sewer air into houses would be much lessened.

Another, third, point of importance is the way in which the products of gas-combustion are allowed to pass into the air of rooms. Nothing can be worse than the usual arrangement; and, as gas-lights might be made a valuable means of ventilation if tubes were arranged to carry off the burnt gas, the present plan of chandeliers is not only hurtful, but involves an ignorant waste of useful force.

4. *Impurity of the Water.*—Water delivered to a house may become impure on the premises, usually from uncleaned uncovered cisterns, absorption of air from drains by the surface of the water, and sometimes by more direct leakage from pipes into cisterns. Lead may also be taken

up. The remedies for these conditions are obvious.

5. *Impurities from Uncleanliness of the House.* Walls and ceilings all absorb impurities which are given out again to the air, and often become highly impregnated with organic matters. The chinks of floors allow matters to collect below them, and then impure air rises into the room. Or furniture may harbour dirt, and thus continually contaminate the air.

The custom of re-papering walls without cleaning the old paper, the decomposition of paste and paper on damp walls, and the use of arsenical pigments, may disengage impurities. In the houses of the poor which are not regularly whitewashed, the half-crumbling plaster is often highly charged with animal material.

These matters are to be avoided by original good construction and by constant cleanliness. It is a great desideratum to make walls of impermeable material, so that they may be washed without difficulty; but, at present, this is an expensive matter.

If these various points, which are really questions of purity of air and water, and of temperature and movement of air, are properly dealt with, houses must be healthy. These are conditions which are not difficult to secure if they are clearly understood and if their importance is not underrated. The great point is to have the house-air pure, so as in no way to injure or depress the great function of respiration.

While we look to the Municipality or Local Sanitary Authority to keep the outer air pure, the task of doing the same for the house-air must necessarily fall on the inhabitants of the house.

VITAL STATISTICS.—The attention now paid to Public Health is in a large degree owing to the careful collection of the statistics of births and deaths, and of the causes of death, which have been tabulated in England for the last thirty-eight years. It may truly be said, indeed, that not only all Europe, but gradually the entire world, has been influenced by the work of the Registrar-General of England. We are now able to determine the limits of mortality and its causes with some precision, and are being led towards interpreting the causes of too high a death-rate.

The chief vital statistics bearing upon public health are the determination of the birth-rate; of the general death-rate; of death-rates according to sex, age, and disease; and of the health of classes of the community, as judged of by their expectation of life at given ages. There are many other problems, but these are the most important. The collection of statistics of sickness, apart from mortality, has not been hitherto successful, on account of the difficulty of collecting the data with sufficient accuracy. *See* MORBIDITY.

The gross death-rate, without distinction of sex or age, is that which is commonly used to express the health of a town or district. It is, of course, to be understood that it is but an elementary expression that should be accompanied by further analysis of mortality according to diseases and ages, and by consideration of the birth-rate also, for the deaths of newly born and young children form always a large item in the list. As far as it goes, however, the general death-rate is extremely useful. It is calculated on the population, which in England is ascertained positively by census every ten years, and in the intervals may be very fairly estimated from a variety of data ascertained for the particular place or district. It was in view of gross death-rates in various districts of England that it was assumed in 1848, when the first Public Health Act was passed, that in this country the public health is nowhere satisfactory if the death-rate of the locality exceed 23 per 1,000 of population per annum. And under the provisions of that Act the General Board of Health constituted by it was empowered to send an inspector to examine into the hygienic condition of any locality, wherein the number of deaths annually exceeded this rate. It would now seem that the number proper to be regarded as constituting a standard for such a purpose, might reasonably be lowered from 23 to 22 or even 21, but no legal or authoritative statement has been made of late years. *See* MORTALITY.

Further investigation of mortality statistics according to age and disease is, however, necessary to form a correct notion of the sanitary state of any district. Unexpected results are sometimes brought out, as, for example, that a general high death-rate may be owing entirely to an extremely high infantile mortality. The diseases which occasion the high death-rate will then also appear, and will indicate the directions for remedial measures. The child death-rate (that is, the death-rate at ages below five years, or even for every single year of the five, calculated on the population living at the several ages; or if that be not known, then on the gross population) is indeed most necessary to be known in every health-enquiry.

Among the poor population of our large cities the deaths of children under five years of age may be found to constitute half of the total deaths at all ages, and occasionally in some bad districts in unhealthy towns the deaths of children have reached 60 per cent. of the total deaths, whereas in all England the child death-rate (under five years) is but 40 per cent. of the total deaths, and in healthy districts and good families is below this, even below 30 per cent. of total deaths. In this way of reckoning, however, the excessive mortality of infants is obscured by an excessive mortality among older people; and a better measure is to be found in the rate of annual mortality among 100 children under five years of age living in a community. Thus measured, it is found that there may die annually only four among the better classes, and from ten up to the immense mortality of twenty-six in the worst parts of our large towns.

How wonderfully the child death-rate is influenced by the high social position of the parents, which implies greater care of the children, is strikingly shown by Mr. Ansell's very useful tables of mortality among the upper classes.

Of 100,000 children born alive there are living at the end of their fifth year in all England 74,000 (in round numbers we may say that one quarter have died), among the 'upper classes' (as defined by Mr. Ansell), 87,000 are living at the fifth year, while among the peerage not less than 90,000 are living. As a contrast, the writer would refer to a street in Liverpool, where he found the death-rate so high that only 10,000 children would be living at the end of five years out of 100,000; or 90 per cent. had died in five years.

The determination of the *diseases* producing a given mortality is also a necessary part of all vital statistics, regarded as expressions of the public health.

The chief diseases causing mortality under five years of age are diarrhœa and convulsions from bad food; acute chest-affections from cold and exposure and vitiated air; and the contagious infantile diseases. The mortality from these causes is of course greater in amount among the children of the poor. Among older people phthisis and chest-affections, and from time to time outbreaks of infectious diseases, hold the first rank.

The degree of prevalence of the infectious or so-called zymotic diseases must be always carefully noted, but there are many other preventible diseases quite as worthy of attention, and especially the acute and chronic chest-affections which are largely owing to removable unhealthy conditions of atmosphere and mode of life.

The calculations necessary to bring out the result are of the most simple kind if the data are known, namely, the number of the population, and of persons of various sexes and ages; the number of deaths, the sex and age of the persons dying, and the diseases causing the mortality.

The national census furnishes some of these figures, and the medical profession contribute the material for the rest. They bear, therefore, a very great responsibility; for inaccuracy of record by them may greatly affect the action of the community, taken on the faith of the accuracy of the statistics.

Heretofore statistics of mortality alone have been available for the purposes of the sanitary physician and administrator, and their utility has been unquestionable. Such statistics, however, are necessarily a very incomplete measure of the influences affecting the public health. When, in the future, it shall have become possible to make proper record of all sickness, whether fatal or not fatal, further progress in the investigation of the conditions productive of disease, and in securing for the community the most healthful circumstances of life, will become practicable.

The third statistical point to which reference has been made is the length of life a person of a given age may expect to live. This so-called 'expectation of life' or 'mean after-lifetime' is the most exact test of the general health of a people. It is one, however, which can only be applied at long intervals, and by the aid of very accurate and numerous census and death lists. It is not, therefore, applicable as a daily method of determining the degree of health. It appears, however, that, at the present time, as compared with former periods, the expectation of life is improving in the chief European countries, and the mean age at death is also greater than formerly.

It is the office, then, of the statistician, by his study of the distribution of disease and the incidence of mortality, to guide towards an appreciation of the causes thereof, and to a better knowledge of the natural laws which influence public health: and it is the business of the sanitary legislator and administrator to give due recognition to those natural laws in their endeavours to maintain the health and to save the lives of the people. The struggle with disease and death is never-ending, but is not indecisive. It is remarkable how steadily public health has improved with each new advance in wise legislation. In no case has disappointment resulted, and in some instances the good results have been really surprising. Much still remains to be done, and many sanitary problems wait for solution; but the rapid progress of late years makes us confident that greater effects still will follow as the knowledge of the causes of disease becomes more precise, and the technical means of prevention are more efficiently applied.[1]

E. A. Parkes.

PUERILE (*puer*, a boy).—This word is associated in medicine with the respiratory murmur when it is exaggerated, possessing the characters heard over the lungs in a healthy child. *See* Physical Examination.

PUERPERAL DISEASES.—The diseases associated with parturition, which fall for consideration in the present article, are:—1. Puerperal Convulsions; 2. Puerperal Fever; 3. Puerperal Peritonitis; and 4. Puerperal Thrombosis and Embolism. Certain other pathological conditions of equal importance, occurring during the puerperal state, are more conveniently discussed under their several special names. *See* Pelvic Abscess; Pelvic Cellulitis; Pelvic Peritonitis; and Phlegmasia Dolens. Puerperal insanity is described in the article Insanity, Varieties of.

1. Puerperal Convulsions.—Synon.: Puerperal Eclampsia; Fr. *Convulsions des femmes enceintes et en couche*; Ger. *Eklampsie in der Schwangerschaft und im Wochenbett.*

Definition.—A pecular kind of epileptiform convulsions, characterised by loss of consciousness and of sensibility, together with tonic and clonic spasms; occurring in the later months of pregnancy, during labour, or after delivery; and causing great danger to the lives of both mother and child.

Ætiology.—The frequent association of this disorder with albuminuria had till lately given rise to the belief that it is the result of uræmia. More recent observations, however, have thrown a doubt upon this doctrine. Many cases have been observed in which albumen was present in large quantity without convulsions occurring; and others in which the eclamptic attacks took place without any albumen, or a mere trace only, being present.

Traube and Rosenstein have referred the causation of the convulsions to acute cerebral

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[1] This article, which was written by Dr. Parkes before his lamented death, has been revised, and a few passages inserted, marked [ ], by Dr. George Buchanan.

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anæmia, resulting from changes in the blood incidental to pregnancy, the watery condition of the blood being associated with increased tension of the arterial system. More recently, Dr. Angus Macdonald, of Edinburgh, has pointed out that he has discovered by *post-mortem* examination, extreme anæmia of the cerebro-spinal centres, with congestion of the meninges, without œdema. He attributes the convulsive attacks to irritation of the vaso-motor centre from an anæmic condition of the blood, produced by the retention in it of excrementitious matters which should have been eliminated by the kidneys.

Symptoms.—Although frequently the convulsions occur suddenly, no previous indications having been observed, still on inquiry it will generally be found that certain premonitory symptoms have been present. The most prominent of these is headache, sometimes very intense, generally frontal. Derangement of vision is another grave indication. An important sign when present is œdema, which may attract notice by puffiness of the face, especially of the eyelids, and should immediately suggest an examination of the feet and ankles, and of the urine.

When the convulsive seizure occurs it cannot be mistaken. The eyes first become fixed, and rapid contraction of the muscles of the face occurs, with rolling of the eyeballs, the pupils being lost under the upper eyelids. The face becomes turned first towards one shoulder, then towards the other. The convulsions rapidly extend to the other parts of the body; after a short period of tonic contraction violent clonic spasms occur. The face becomes livid, the tongue is protruded, and, if care be not taken, it is lacerated by the teeth, colouring the frothy saliva which has been emitted at the angles of the mouth. The thumbs become clenched in the palms, and violent jerkings of the arms occur, whilst the muscles of the face give rise to a variety of contortions. Sometimes involuntary evacuations of the bladder and rectum occur during the fit. There is total loss of consciousness and sensation. After a few minutes the symptoms gradually subside; a longer interval occurs between the clonic muscular contractions; the face loses its lividity; and the breathing becomes more tranquil. After the first fit has passed off the patient may recover her consciousness; but if another occur with rapidity, and very little time elapses between the paroxysms, death may soon supervene. Where there is a considerable time between the attacks, it may be many hours or days before consciousness is restored, and recovery takes place. A remarkable feature of this disorder is that when the patient becomes sensible, and is restored to health, she has invariably no recollection of what occurred not only during her illness, but for some time preceding the fits. The writer has observed the case of a woman whose puffy face attracted his notice in the City of London Lying-in Hospital the morning after her labour; there was œdema of the ankles, and the urine contained abundance of albumen. Having remarked that it was a wonder she had not had convulsions, he was summoned to find her in this condition within a few hours. She was comatose for three days, and on subsequent inquiry she had no recollection of being taken in labour or of being conveyed to the hospital. This is by no means an exceptional case.

Prognosis.—This depends upon the severity and frequency of the paroxysms. It is generally considered that one in every three or four cases proves fatal. The mortality has probably diminished of late years, since indiscriminate venesection has been abolished, and other treatment adopted.

Treatment.—The treatment of puerperal convulsions depends greatly upon the period in relation to labour at which the eclamptic attack occurs. Generally the paroxysms in themselves are sufficient to provoke labour, and if this proceed well, it should be allowed to take its own course; officious manipulation is apt to increase the severity of the fits. Under some circumstances, however, the induction of premature labour is necessary; or it may be expedient to deliver as soon as possible when labour has commenced. Venesection, which used to be the universal treatment, is now very rarely adopted. There are, however, cases in which it is undoubtedly called for; in women of plethoric habit, with congested face, and full pulse, showing much arterial tension, it will probably be found of great benefit.

Compression of the carotids, first recommended by Trousseau in the convulsions of infants, has been successfully adopted by Dr. Playfair in puerperal eclampsia.

As soon as the attack commences it is well to administer an aperient, if possible.

The treatment which has of late been found most serviceable is the administration of chloroform, which not only modifies the force of the attacks, but appears in a marvellous way to diminish their frequency. It should be freely administered on the first symptoms of the attack, and its effect should be kept up until the fit has entirely subsided.

Chloral alone, or in combination with bromide of potassium, may be administered by the mouth or rectum, often with great advantage. This may obviate the necessity of a further continuance of the chloroform inhalation. The hypodermic injection of morphia, which has been condemned by some on account of the renal condition, has, nevertheless, been frequently found most efficacious, notwithstanding a large amount of albuminuria being present, and it is well worthy of a more extended trial in prolonged cases.

2. Puerperal Fever. — Synon.: Childbed fever; Puerperal Septicæmia; Fr. *Fièvre puerpérale*; Ger. *Puerperalfieber*; *Kindbettfieber*.

Definition.—A continued fever, occurring in connection with child-birth; often associated with local lesions of the uterus, vagina, or perineum; and caused by the absorption of septic matter, not infrequently arising from the retention of portions of placenta or membrane, or from a putrid fœtus.

Ætiology.—Puerperal fever occurs not only epidemically but endemically, especially in lying-in hospitals; and is communicable by contagion. Special sources from without are cadaveric matter communicated by the hands of the practitioner after making *post-mortem* examinations, and septic matter conveyed by nurses on their hands or on sponges. Prolonged mental distress, and an impoverished state of the blood from want of food, predispose to it. Puerperal fever may be produced by the contact of other diseases, especially erysipelas, which in some respects bears a close analogy to it, a prominent characteristic of both being a peculiar diffuse inflammation; in one the part affected being the skin and connective tissue, in the other the seat being the uterus, uterine veins, and peritoneum.

Anatomical Characters.—These differ very greatly according to the duration of the fever, and the parts of the body affected by the disease. In some rapidly fatal cases of a malignant type nothing has been found but a peculiar alteration in the blood—a great increase in the white corpuscles; a diminution in the red blood-cells; an increase also in the fibrine and extractive matters, lactic acid and fat; and frequently traces of bile-pigment.

Generally, however, local lesions exist, and if these are seen after death, in the shape of lacerations in the genital tract, they will present an unhealthy appearance, their edges being swollen and œdematous. The uterine surface is generally found intensely inflamed, softened, and occasionally in a state of slough. The results of inflammation may also be found in the veins, parenchyma of the uterus, and connective tissue around it; as well as in the lymphatics, so large and numerous at this time, pus being frequently discovered in these vessels. The peritoneum is nearly always affected; it may be only congested in patches, but is generally universally so; the intestines may all be glued together; and the sac may contain more or less serum or sero-pus, with flaky lymph. Inflammatory swelling, softening, or abscesses may be found almost anywhere, in the uterine wall, ovaries, kidneys, spleen, liver, lungs, muscles, and connective tissue. Effusion into all the serous cavities may arise, and pus may be discovered around, or even within, the joints. An embolus may be found, a fragment of infected thrombus having escaped.

Symptoms.—In no disease do the symptoms vary more than in this, depending upon the violence of the fever, and the localities attacked by the poison. The fever generally originates within three or four days after delivery, though sometimes later. Frequently there is, first of all, great depression, with headache; sometimes the first symptom is a rigor. The pulse becomes rapid and feeble, 130 or more per minute. The temperature rises to 103° Fahr., or higher. The skin is generally hot and dry. Vomiting frequently occurs early, the ejecta being like coffee-grounds, and of a peculiar odour. Diarrhœa is often very troublesome, the evacuations being horribly fetid. The tongue soon becomes coated with a heavy fur, later on becoming dry and raspy; and sordes appear on the lips. There is often acute pain, with tenderness and swelling, of the abdomen; but peritonitis with effusion may occur without any of these symptoms. Sometimes the swollen, tender uterus can be felt in the hypogastrium. The lochia are generally suppressed, and the secretion of milk arrested, though sometimes the mammæ are hard and painful. As a rule the intellect is unimpaired, though low muttering delirium frequently precedes death. The breathing is short and hurried. Pneumonia, pleurisy, or pericarditis occasionally ensue. Jaundice or albuminuria may be present. The joints may swell and suppurate; and abscesses may form in any part of the body, sometimes in the eye.

Course and Terminations. — The disease generally runs a rapid course, terminating fatally within a week. The pulse becomes more and more rapid and feeble; the breathing more hurried and panting; tympanites sets in; a cold clammy sweat breaks out; finally hiccough, subsultus, and low muttering delirium come on, with frequently incessant vomiting; and the patient sinks from exhaustion.

Treatment.—1. *Prophylactic.*—This is of the utmost importance. Keeping in mind the sources of the disease, it behoves the practitioner to avoid every means of communicating septic matter to the patient, either personally or by the nurse. If possible to arrange it, the genital organs should never be touched, for the purposes of examination or otherwise, without the hands having been first thoroughly rinsed in a solution of pure carbolic acid (1 to 20). All sponges should be permanently kept in a similar solution; and all instruments, such as vaginal syringes or catheters, be thoroughly soaked in the same before use. Instead of cold cream, a preparation containing 1 drachm of absolute carbolic acid to 2½ oz. of benzoated lard should be employed for lubricating. The utmost care should be observed, to avoid the smallest piece of the placenta or membrane being left within the uterus. Subsequently all washings or syringings of the genitals should be performed with a solution of carbolic acid (1 to 40). The practitioner should order all these preparations to be in the house previous to the expected time of delivery.

2. *General.*—The general treatment varies with the character of the disease. At first active antiphlogistic remedies may be indicated; and in some cases local depletion by leeches, in others blisters. Drugs, such as veratrum viride (much employed in America), aconite, digitalis, or salicylic acid, may be useful in lowering the temperature. The internal administration of turpentine has been highly extolled; this drug is often very efficacious when applied on hot flannel to the abdomen, or used as an enema where there is much tympanites. Opium, or morphia, is invariably demanded to subdue restlessness, allay pain, and induce sleep. Laudanum, applied in poultices to the abdomen, is sometimes very grateful to the patient. When, however, there is much tenderness and distension, a paste composed of two parts of extract of belladonna to one of glycerine, brushed thickly over the whole abdomen, will be preferable. Quinine is often of great value in diminishing the fever; it may be given in doses of 10 or 15 grains night and morning. Warburg's tincture may answer still better. The antiseptic douche should never be omitted; and a long vaginal tube should be employed, so as to ensure the fluid passing within the uterus. If used warm it is often very comforting, especially when the discharges are fetid. In cases of a more chronic type, where diarrhœa is a prominent symptom, tincture of

perchloride of iron in large doses, 20 to 30 minims, is sometimes very serviceable. One of the most important elements in the treatment of this exhausting disease is the frequent administration of nutritious food and stimulants—strong beef-tea, milk, eggs, champagne, or brandy—in small quantities at short intervals. In cases of obstinate vomiting recourse must be had to nutrient enemata. The most abundant supply of fresh air that can be admitted with safety should be secured.

It is impossible to map out any distinct line of treatment for puerperal fever. Each case must be combated according to its individual symptoms, and demands constant attention; for, though the disease is fearfully fatal, some of the most apparently hopeless cases recover.

3. **Puerperal Peritonitis.**—This, though one of the most frequent complications of puerperal fever, sometimes occurs independently of it, other symptoms than those consequent upon the local inflammatory attack being absent.

Anatomical Characters.— The *post-mortem* appearances, associated with puerperal peritonitis, differ only from those described in connection with puerperal septicæmia inasmuch as they are confined to the peritoneal cavity. There will probably be found an abundance of effused serum or sero-pus, and flaky lymph, intense congestion of the peritoneum, and the abdominal viscera will here and there be glued together. The uterus will probably be found preternaturally soft.

Symptoms.—Generally within a week following delivery a well-marked rigor occurs, followed by febrile disturbance. The patient complains of acute pain in the lower part of the abdomen, at first in one particular spot, but soon spreading over a larger area. The thighs become flexed on the abdomen to relieve the tension; the belly becomes much swollen, and excessively tender; and there are generally much tympanites and obstinate constipation. The pulse is very characteristic, being quick, wiry, and incompressible. Vomiting soon sets in. If the disease do not give way, the abdomen becomes more swollen and tense, and no pressure upon it can be borne. Everything that is taken is vomited; the pulse becomes more rapid and feeble; the tongue is dry and raspy; the constipation gives way to diarrhœa; the skin becomes clammy, and the extremities cold; and the patient dies.

Treatment.—The application of leeches to the abdomen, immediately the tenderness is complained of, may be of much service in subduing the local inflammation, and allaying pain. Opium is the drug of all others to be relied upon. Hot fomentations and counter-irritants, such as turpentine, often give great relief. In the first stage a copious enema of thin gruel with castor-oil, to obtain a free action of the bowels, should be given. Where there is much tympanites, the addition of turpentine may be of benefit in dispelling the flatus. If vomiting prevent nourishment being taken by the mouth, it should be administered *per rectum*.

4. **Puerperal Thrombosis and Embolism.**

Definition.—The occurrence of a blood-clot in the right side of the heart or pulmonary arteries, either formed *in situ* or conveyed there from a distance by the blood-current, often giving rise to sudden death after delivery.

Anatomical Characters.—The condition of the blood in pregnancy and the puerperal state renders it liable to form a coagulum, and this may occur in distant vessels. It is well known that in the later months of pregnancy the amount of fibrin in the blood is very greatly increased. Together with this a diminution in the volume of the blood from uterine hæmorrhage produces a state of exhaustion, which causes a great predisposition to thrombosis. If, therefore, such having occurred in distant vessels, a portion of coagulum become detached, and be carried away till it reach the pulmonary arteries, embolism is the result, and this is one of the great causes of sudden death occurring after parturition. It has been shown, however, that pulmonary thrombosis may occur independently of embolism; large, firm, decolourised coagula have been found, on *post-mortem* examination, occupying the right side of the heart and the larger branches of the pulmonary arteries, which have evidently formed there, all traces of thrombosis elsewhere being absent.

Symptoms.—These are common both to embolism and pulmonary thrombosis. In the great majority of cases, the patient is suddenly seized with severe dyspnœa; she starts up and gasps for breath; the face in some cases has been described as pale, in others livid. She feels she is dying, and calls out for air; the pulse becomes almost imperceptible; and generally death occurs very rapidly. In some cases, however, in which the clot is not sufficiently large to entirely obstruct the circulation in the lungs, it appears that absorption may ultimately take place and recovery ensue. Dr. Playfair has published some cases which support this theory.

Treatment.—In almost every case so rapidly fatal is the seizure that there is no time to think of treatment. When, however, the attack is not so terribly rapid in its termination, every effort must be made to rally the patient, by the administration of stimulants, such as brandy, ether, or ammonia, if at hand. The most perfect rest must be enjoined, so as to prevent the coagulum from becoming dislodged, and to promote its absorption. Dr. Richardson has recommended liquor ammoniæ in large doses, with a view of dissolving the fibrin. Clement Godson.

PUERPERAL INSANITY. *See* Insanity, Varieties of.

PULLNA, in Austria.—Sulphated waters. *See* Mineral Waters.

PULMONARY APOPLEXY.—A term for a certain form of hæmorrhage into the lungs. *See* Lungs, Hæmorrhage into.

PULMONARY DISEASES. *See* Lungs, Diseases of.

PULMONARY VESSELS, Diseases of. The vessels of the pulmonary circulation, more especially the veins, enjoy a considerable immunity from disease. Primary affections of these are of most exceptional occurrence, and the causes leading to their being secondarily involved are not numerous. It is not easy to account for this. The pulmonary arteries rarely present those diseased states which are of frequent occurrence in the arteries of the systemic circulation, and are not even as commonly affected as the systemic veins, with which they somewhat more closely agree in point of structure, and in the kind of blood carried by them. The portal vein, which is comparable to the pulmonary artery in other respects besides its plan of distribution, would appear to be similarly free. For these reasons affections of the pulmonary vessels are rather of pathological interest than clinical importance; in the majority of cases they are not to be recognised during life, or, if so, are beyond the application of any treatment. The trunk of the artery, and especially the orifice in the right ventricle, is singularly liable to present congenital abnormalities, which are treated of in the article HEART, Malformations of.

1. **Inflammation.** — ÆTIOLOGY. — Arteritis affecting the pulmonary artery, whether acute or chronic, is of very rare occurrence. Previous to birth it seems to be more liable to exist than subsequently, and some of the congenital deformities of the pulmonary artery and its valve are to be attributed to it. No satisfactory explanation has been offered of the greater tendency of the right heart and vessels to inflammation before birth, and of the left side and aorta subsequently. After birth it is almost invariably associated with such acute blood-diseases as pyæmia, or with those pyrexial states which are apt to assume a septic character, as scarlet fever. Very rarely cases are met with where no cause can be ascertained; but it is said that whilst syphilis favours arteritis in the aorta, chronic alcoholism predisposes to its development in the pulmonary artery. Emboli, especially if of a putrid character, which have become lodged in branches of the vessel, are very liable to set up inflammation in the contiguous walls.

ANATOMICAL CHARACTERS.—These correspond with the usual characters of arteritis. The process begins in the sub-epithelial layer of the inner coat, and results in the formation of a variety of connective tissue, which consists of fibres, fusiform fibre-cells, and homogeneous material; these constituents being developed in varying proportions, and forming patches of grey gelatinous or semi-cartilaginous material. The formation of pus and abscesses within the thickness of the walls, and their subsequent rupture into the lumen of the vessel, are practically unknown. The valves at the commencement of the vessel are the most frequent seat of inflammation, but it has been seen in the main trunk of the vessel. When the vessels have become much dilated, as from extreme mitral stenosis, the walls thus thinned are liable to undergo changes of a chronic inflammatory character (*see* ARTERIES, Diseases of). This state is only demonstrable after death; during life it is not recognised, except the valves be affected, by any known signs or symptoms, and a diagnosis of its existence has not hitherto been attempted. Under such circumstances no plan of treatment can be laid down.

2. **Degenerations.**—(*a*) *Atheroma.*—This, as in the systemic arteries, occurs in two forms. The one form is a sequence of inflammation, when the patches of grey translucent material abovementioned undergo fatty degeneration, and, as Virchow pointed out, tend to ulcerate, whilst similar patches in the aorta are more liable to calcify. The other form consists in a fatty degeneration of the deeper layers of the intima without any previous inflammation, and occurring as part of a general atheroma of all the vessels. It is in vessels whose structure has been much altered by distension that atheroma is most frequently seen. Calcification of the atheromatous areas is not unknown. No symptoms are to be referred to this condition, though Dr. Walshe suspects that 'in some instances it aids in the production of pulmonary apoplexy.'

(*b*) *Albuminoid degeneration.*—This has been recorded as having been seen in the muscular coat of branches of the pulmonary artery.

3. **Ulceration.**—As already said, inflammation of the vessel-walls very rarely extends to ulceration of the inner coat, but owing to the extreme frequency of ulcerative destruction of the lung-tissue, the intra-pulmonary branches of the vessels are constantly involved. Phthisis of whatever kind, abscess, or gangrene of the lungs, will each in their progress invade the vessels, the walls of which, though offering considerable resistance to the destructive process, sooner or later yield, and may be the cause of a fatal hæmorrhage, though very frequently a loss of blood is prevented by blocking up of the vessels with coagula.

4. **Dilatation and Aneurism.**—ANATOMICAL CHARACTERS.—Varying changes of abnormal distension are not unusual, occurring in both sexes and in all ages beyond childhood, and are estimated as forming 3 per cent. of aneurisms of all kinds. The dilatation may affect the trunk uniformly; and an extreme case has been recorded where the circumference of the vessel attained 6½ inches, the normal average being taken at 3¼ inches. Or, limited in extent, the bulging forms a sacculated, or, more rarely, a dissecting aneurism of the trunk or branches, from the size of a walnut to a pea, or even smaller, these latter being frequently multiple. The conditions which lead to these alterations in the normal calibre of the vessel are:—(*a*) Those causing a diminished resistance of their coats to the blood-pressure, especially if this be increased, which is often the case, by obliteration of some vessels, and consequent rise in tension in the remaining ones, or by general obstruction, such as mitral stenosis or emphysema would cause. (*b*) Those changes in the lung-structures which diminish the support of the vessels, and so allow of their yielding. The results of arteritis and atheroma will furnish the first condition, and ulceration and destruction of the pulmonary tissue will provide the latter. The walls of true aneurisms may be thicker or thinner than those of the healthy vessel, and it is remarkable that their contents are never laminated coagula, even in the largest, but always fresh clots.

An extreme case of distension of the pulmonary veins is recorded (*Dublin Journal,* 1832), especially the left, where the vessels were dilated to four times their normal size, owing to extensive obstructions at their openings into the left auricle.

SYMPTOMS.—When the main trunk of the

pulmonary artery is the seat of an aneurismal tumour, there are the usual signs of pulsation and prominence in variable degrees, most marked to the left of the sternum in the second intercostal space; over the same area a systolic bruit of a superficial quality is to be heard, not conducted above the sternum or clavicles; and a systolic thrill is to be felt. There is also accentuation of the second sound, with the signs of hypertrophy of the right ventricle. Should the tumour be of any considerable size, it will give rise to those conditions which commonly follow an obstruction to the pulmonary circulation—namely, lividity, dyspnœa, cough, and general anasarca, with scanty, high-coloured urine. In an exceptional case pallor of the face was noticed. Pain behind the sternum, and headache also exist. Since the greater part of the artery is included within the pericardium, it is into that sac that rupture will probably occur.

The small aneurisms of the intra-pulmonic branches give rise to no known symptoms until hæmoptysis indicates their rupture.

DIAGNOSIS.—An aneurism of the trunk of the pulmonary artery may have to be distinguished from a similar affection of the aorta, or from a post-sternal tumour to which pulsation has been communicated. The tendency of pulmonary aneurism to extend to the left side, and the non-conduction of the bruit to the vessels at the root of the neck, with the coincident signs of pulmonary obstruction, are grounds upon which to found a distinction.

PROGNOSIS.—This is of necessity grave, whatever the size of the lesion, and many cases of fatal hæmoptysis are due to rupture of a small-sized sac.

TREATMENT.—How far such treatment as galvano-puncture, the administration of iodide of potassium, &c., as pursued in aneurism of the systemic vessels, is applicable to similar affections of the pulmonary artery, is unknown. For the treatment of the hæmorrhage to which their rupture gives rise, *see* HÆMOPTYSIS.

5. **Stenosis.**—A narrowing of the pulmonary artery may take place at the orifice in the conus arteriosus, or more rarely in the trunk or main branches. In the former situations it is commonly congenital, the result of endocarditis or myocarditis, which, if developed within the first three months of fœtal life, is almost invariably accompanied by some compensating lesion, such as intraventricular communication; whilst if the affection of the heart be subsequent to the third month of development, the circulation is carried on through a patent foramen ovale and ductus arteriosus (*see* HEART, Malformations of). It is conceivable that stenosis of the conus arteriosus may be followed by secondary narrowing and closure of the pulmonary artery, and also that defective development of the lungs may cause a narrowed vessel. The condition is very rarely due to any acquired change in the vessel-walls, although a case is recorded of stenosis of the artery from cartilaginous thickening and calcification of its coats. The calibre of the tube may be diminished by the pressure of tumours, such as an aortic aneurism or adenoid growths, or by the shrinking of cicatricial tissue in the adjacent lungs.

When stenosis is developed at a very early period of fœtal life, the artery remains exceedingly narrow behind the obstruction. When it occurs late, the vessel may be of normal capacity, and if insufficiency co-exist with the obstruction, it may even be dilated (Lebert).

SYMPTOMS.—Whatever be the cause of pulmonary stenosis, there will be a deficient supply of blood to the lungs, producing dyspnœa, and the obstruction to the circulation will give rise to all the signs and symptoms of general venous congestion, although to a less degree than in affections of the tricuspid orifice. Hypertrophy of the right ventricle, as evidenced by increased transverse measurement of the area of cardiac dulness; a basic thrill; a systolic bruit, of maximum intensity over the heart's base, and conducted to the left of the sternum, but not audible along the course of the aorta and great vessels; and a marked accentuation of the second sound—are the most important diagnostic signs of this condition. Cyanosis is not a characteristic, and does not occur unless there be extreme venous congestion, or a communication between the two sides of the heart. The association of constriction of the pulmonary artery, both congenital and acquired, with tubercular phthisis, has now been too frequently observed for it to be regarded as a coincidence only, and their relation as cause and effect is generally admitted.

TREATMENT.—This affection is entirely beyond the reach of remedy.

6. **Rupture.**—Violent effort and great excitement have been followed by rupture of the pulmonary artery, either of the trunk or main branches; it is said, even without previous disease of the vessel (Chevers, 1846). But in the majority of recorded cases the coats were degenerated. Death is often instantaneous, but very frequently is delayed, even some hours. Aneurisms tend to burst sooner or later; those of the trunk usually opening into the pericardium, while the intra-pulmonary dilatations commonly rupture into cavities in the lung. Ulceration, as said, is of very rare occurrence, but a case is recorded of its existence and extension through all the coats of the vessel, with a suddenly fatal termination. Rupture of the pulmonary veins has been recorded.

7. **Embolism and Thrombosis.**—The pulmonary artery is especially liable to become plugged, both by substances lodged in it from elsewhere, and by coagula originating in the vessel itself. Its relationship to the venous circulation explains this. Portions of broken-down clots developed in the systemic veins, from whatever cause; the contents of hydatid and other cysts that have burst into the venous current; fragments of cancerous and other new growths, all of which readily travel onwards towards the heart, pass into the pulmonary artery, in the branches of which they become lodged, according to their size. Once located, the plug will increase in size by the deposition on it of successive layers of fibrin, sometimes to such an extent as to obliterate all traces of the original obstructing substance. Occasionally very large thrombi are detached in the systemic veins, and are arrested in the trunk and main branches of the pulmonary artery. The causes of thrombosis of the vessel are various.

The rare occurrence of inflammation or degeneration of the artery renders obstruction of the vessel from primary thrombosis very uncommon; but the development of clots in the smaller branches, in association with pneumonia, phthisis, gangrene, and other destructive lung-diseases, is frequent. In certain septic states, in parturient women, and in conditions of extreme anæmia, especially with diminished heart-power, when the blood is prone to clot in the vessels, the pulmonary artery is a favourite locality for this to occur. Thrombi may commence in the right ventricle, or, as would appear, sometimes on the semilunar valves, and extend into the trunk and, for variable distances, into the branches of the vessel. Such obstructions are frequently developed during the last hours of life, when the circulation is enfeebled and slow. *See* EMBOLISM; and HEART, Thrombosis of.

SYMPTOMS.—The symptoms will, of course, depend upon the extent and completeness of the obliteration of the pulmonary circulation. If only the smaller branches be occluded, there may be no symptoms to be directly ascribed to the obstruction. A very moderate dyspnœa or slight hæmoptysis would be equally attributable to the phthisis or other lung-state which had determined the formation of the thrombi.

In another class of cases, when larger branches are blocked, very marked dyspnœa is developed, with such symptoms as are conveniently grouped under the term 'anginal,' such as pain in the præcordia, a sense of great distress and faintness, palpitation, lividity, and extreme pallor, with cold sweats, but no loss of mental faculties, and an almost imperceptible pulse. The onset of such a condition may be gradual or rapid; in the former case it depends on the slow increase in size of a small thrombus; in the latter, on the sudden lodgment in some branch of the artery of a solid substance that has entered the venous current. In some cases these symptoms are present to an extreme degree, and death follows in a few minutes; in fact, this lesion constitutes one of the causes of sudden death. The appearances are not those of asphyxia, and it is usual to attribute the very rapidly fatal result to syncope or shock, as it would seem to be connected in some way with an arrest of the nerve-governance of the heart. In that class of cases which do not terminate so quickly, it is usual to find that the symptoms abate somewhat, and may be followed at a variable interval of hours or days by a second or even several attacks, finally ending fatally. The *post-mortem* examination of such cases shows a thrombus of considerable extent, with indications of its having been formed at different times.

Examination of the chest reveals no diagnostic signs. There is very likely to be a basic systolic murmur conducted along the course of the pulmonary artery; but this is not constant.

DIAGNOSIS.—This is often very uncertain. The conditions in which thrombosis is usually met with, such as anæmic or parturient women, are those in which breathlessness, cardiac pain, and discomfort, and even a pulmonary hæmic bruit, are of frequent occurrence. The symptoms, when not of extreme rapidity, are very similar to those caused by stenosis of the pulmonary artery, which in itself is difficult to diagnose; and, lastly, the suddenly fatal cases are almost identical in their manifestations with rupture of the heart or of a thoracic aneurism, or even angina pectoris. The supervention of the above-detailed symptoms in a case of existing phlebitis, in a woman within twelve or fourteen days after childbirth, renders it highly probable that they are due to a clot in the pulmonary artery.

PROGNOSIS.—This is to be looked upon as of the gravest character, if once symptoms arise which indicate the existence of a clot in the pulmonary vessels. The smallest plugs formed in branches which are being invaded by a progressive destructive change in the lungs, are protective in character, and prevent or diminish an hæmoptysis which erosion of the vessels might produce.

TREATMENT.—In the most rapid cases death takes place before anything can be done; but in the less severe cases two points have to be attended to, namely, absolute rest, and free stimulation by brandy, ether, and ammonia, for by such means only can any hope be entertained of preventing an extension of the clot. Sinapisms over the cardiac region often afford relief.

W. H. ALLCHIN.

PULMONARY MURMUR.—This word may be employed in two senses, namely as signifying, first, the respiratory sound heard over the lung; or, secondly, a bruit heard in connexion with the pulmonary artery and its valves. *See* HEART, Valves of, Diseases of; PHYSICAL EXAMINATION; and PULMONARY VESSELS, Diseases of.

PULMONARY VALVES AND ORIFICES, Diseases of. *See* HEART, Valves of, Diseases of; and PULMONARY VESSELS, Diseases of.

PULSATION (*pulso*, I beat).—Pulsation is a sensation of beating or throbbing, either objectively appreciated by inspection or palpation, or subjectively felt. It originates in the presence of a pulse or rhythmical rise and fall of blood-pressure, whether normal or abnormal, in connection with the part where it is situated. In most instances this is either the heart or some large blood-vessel; but in other instances the pulsation has a different origin, especially when the phenomenon is abnormal. As instances of *normal* pulsation may be mentioned the cardiac impulse; the arterial pulse generally; the pulsation of the umbilical cord; and the beating of the fontanelles. *Abnormal* pulsation may be referable (1) to dilatation of a blood-vessel, as in aneurism; (2) to vascular dilatation and cardiac enlargement, as in aortic incompetence; (3) to vascular dilatation and cardiac excitement, as in exophthalmic goître; (4) to interference with the passage of blood through a vein, or even regurgitation into it, as in the jugular pulse of tricuspid disease; or (5) to the presence of a tumour upon a large vessel, conveying the normal pulse unnaturally to the surface of the body, as in tumour of the pancreas or pylorus. Pulsation may also be present (6) in any part when it is the seat of inflammation, the small vessels being dilated; (7) in aneurism by anastomosis; and

(8) in malignant disease of bone, which may closely simulate aneurism.

With respect to the characters of this phenomenon, it is of great practical importance to distinguish *true* expansile or eccentric pulsation from pulsation which is *communicated* only. In the former case the seat of pulsation expands rhythmically in all directions; in the latter case it is moved in one direction only, that is, it rises and falls under the influence of the motion conveyed to it.

The various pathological conditions which give rise to pulsation, and their treatment, are fully discussed under appropriate heads.

J. Mitchell Bruce.

PULSE, The.—Synon.: Fr. *le Pouls*; Ger. *der Puls.*—Each contraction of the heart, by throwing the contents of the left ventricle into the aorta, causes a sudden change in the fulness of the systemic arteries, which is manifested by elongation and dilatation of these vessels. When the finger is placed upon an artery, which runs on a resisting plane, such as the radius forms beneath the radial artery at the wrist, slight compression by the finger enables us to detect an increased hardness in the vessel at each cardiac contraction. It is this increase of hardness, or fulness, or, in other words, this change in the distension of the artery, which constitutes the pulse. In feeling the pulse the finger slightly compresses the artery, and thus flattens it; the cylindrical form is restored by each pulsation. The amount of pressure required to flatten the artery completely, is the rough and ready way of estimating its fulness or tension, and is best performed by compressing the vessel with the index finger, whilst the middle and ring fingers, placed more distant from the heart, check off the pressure required to stop the blood-flow.

The movement of the artery perceived by the finger appears in most cases to be simple, but when registered by the sphygmograph it is found to be a compound of three waves, called the *summit wave*, the *tidal wave*, and the *dicrotism*. The *summit wave*, which caps the line of ascent of the trace, is due to the sudden vibration in the blood-column, following immediately on the lifting of the aortic valves by the discharge of the contents of the left ventricle. The *tidal wave*, or *wave of impletion*, or *first secondary wave*, as it is also called, is due to the distension of the arteries, following the increased pressure in the aorta and great vessels, from the reception of the ventricular contents. The *dicrotism*, or *great secondary wave*, is an oscillation of the blood-column, mainly, if not wholly, produced by the rebound of the blood from the closed aortic valves under the pressure of the aortic recoil. *See* Dicrotism.

A pulse-trace (fig. 55) consists then in a *line of ascent*, *a* to *b*, which ends in the *summit wave*, *b*, and corresponds to the first part of the ventricular systole; from the summit wave the tracing falls slightly, till it is again raised by the *tidal wave*, *c*, due to the impletion of the vessel. After the tidal wave a more marked descent occurs, called the *aortic notch*, *e*, and the line again rises, into the *dicrotic wave*, *d*. The *line of descent*, *b* to *a'*, is thus broken by two waves and two notches. The two waves have already been described; of the two notches one precedes the tidal wave, and indicates a slight collapse in the arterial wall after the oscillation called the summit wave; whilst the aortic notch preceding the dicrotism marks the fall in pressure in the arteries antecedent to the closure of the aortic valves. The moment these valves are closed the line of descent rises again. It is the bottom of this notch, marking as it does the closure of the aortic valves, which points out the termination of the ventricular systole. The remainder of the line of descent corresponds with the diastole of the ventricle.

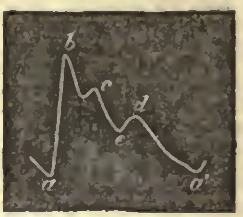

Fig. 55. Typical pulse-trace. *a* to *b*, line of ascent; *b* to *a'*, line of descent; *b*, summit wave; *c*, tidal wave; *d*, dicrotic wave or dicrotism; *e*, aortic notch.

The pulse-trace is modified in its chief features by the state of arterial fulness or tension. When the tension is high (fig. 56) the line of ascent is less lofty; the tidal wave is large, and often blended with the summit wave; the aortic notch is shallow; the dicrotism is not much developed; and the line of descent is gradual. When the tension is low (fig. 57), the line of ascent is lofty; the summit wave distinct; the tidal wave small; the aortic notch deep; the dicrotism highly developed; and the line of descent sudden. These modifications are interfered with, if the normal elasticity of the arteries be lost, as in arterial degeneration.

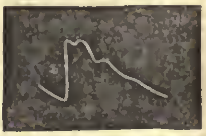

Fig. 56. Trace of pulse of high tension.

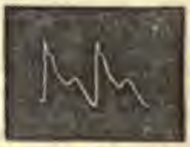

Fig. 57. Trace of pulse of low tension.

The pulse thus registered by the sphygmograph, or felt by the finger, is a movement of the blood-column, primarily caused by the heart, but greatly modified by the properties of the blood-vessels. On the heart depend the rate, the rhythm, and, to some extent, the force of the pulse; whilst on the vessels depend the mode of the blood-flow, and the ease of its passage. By virtue of their elasticity, the larger arteries convert the intermittent, jerky impulse given to the blood by the heart-beats, into an even flow of regular waves; and the smaller arteries regulate, by their permeability, the ease with which the blood-stream flows onward to the veins, thus governing to a great extent the fulness or tension of the arterial system.

The art of feeling the pulse consists in discovering, from the sensation imparted to the finger, the condition of the arterial wall and the arterial contents. When the artery is felt to be hard and cord-like, rolling more or less rigidly under the finger, changes in the arterial coats, due to degenerative arteritis or senile change, are indicated. The radial artery is sometimes congenitally anomalous, and a high bifurcation of the vessel or other peculiarity may account for the absence or smallness of the pulse on one or both sides. The finger, as above mentioned, also estimates the fulness of the vessel from its compressibility, and hence learns how the heart and arteries are acting. The effects of their action on the form of the pulse-wave the sphygmograph records. In children the pulse may often be most accurately observed in the temporal artery during sleep. *See* SPHYGMOGRAPH.

It will be convenient to consider in succession the *frequency*, the *rhythm*, and the *force* or *strength* of the pulse.

1. **Frequency.**—The frequency of the pulse depends on the rate of the heart's contractions. This rate varies with age, position, sex, stature, and a number of physical and psychical influences. In the newly-born infant the heart and pulse beat some 130 to 140 times a minute. The rate gradually falls, and after the sixth year it is usually below 100; and a further decrease of 30 beats a minute gradually occurs before the rate of manhood (70 to 75 a minute) is reached. In old age the pulse-rate often rises again slightly.

In the erect posture the pulse beats at some 10 a minute in the male, and 7 in the female, over the sitting rate, and some 5 more over the rate of the recumbent position. The female of seven years has some 10 pulse-beats a minute more than the male of the same age. As regards stature, we may say briefly that height diminishes the number of beats slightly, a man of 6 feet having a pulse of 3 or 4 slower than a man of 5½ feet.

Movement and exertion of all kinds quicken the pulse, and mental emotion or excitement in neurotic persons runs up the rate very high. In examining healthy people for life assurance, as well as when visiting patients, this must be taken into account. A good meal increases the fulness and frequency of the pulse, and so does the use of stimulants in health, though in acute diseases the reduction of the pulse-rate is often the test of their beneficial action. The pulse is less frequent during the night and during sleep; it rises in frequency during the early hours of the day.

Increased frequency.—Such are the conditions which affect the pulse-rate ordinarily in healthy persons. In disease increased frequency is one of the most common changes, as, for example, the frequent pulse of all pyrexial attacks. The pulse-rate and the pulse-form, as recorded by the sphygmograph, are closely connected with the temperature-elevation. The pyrexial pulse-trace shows important modifications in the dicrotic wave, which becomes more and more developed as the pyrexia increases. The aortic notch deepens, and when it reaches the level of the curve-basis (the line joining the commencement of each line of ascent) the pulse is called *dicrotous* or *fully dicrotous*; this form corresponds with a pulse-rate of over 100 per minute, and a temperature of about 103° Fahr. When the aortic notch sinks below the level of the curve-basis, and the dicrotic wave is blended with the line of ascent of the next pulsation, the pulse is called *hyper-dicrotous*, and the temperature is generally at or over 104° Fahr. (*see* fig. 62). The pulse-rate in many febrile cases becomes a prognostic sign of great value, sometimes, as in puerperal cases, being of more value than the temperature.

Diminished frequency.—A reduced pulse-rate is less commonly seen. It is met with in certain cases of blood-impurity, such as jaundice, anæmia, and diabetes; in convalescence from pneumonia; in relapsing fever; in fatty degeneration of the heart; and in some nervous affections, especially of the medulla. In one of these last cases the writer has observed a pulse of 24; and a rate as low as 14 a minute has been recorded.

2. **Rhythm.**—The rhythm of the pulse depends also on the rhythm of the heart; regular heart-action produces regular pulse, and *vice versâ*. Variations in rhythm are of two kinds, *intermittence* and *irregularity*.

Intermittence.—Intermittence means the omission of a beat from time to time. This omission may occur at regular intervals, for example, every tenth or twentieth beat; or it may occur irregularly, so that every now and then a beat is missed. Intermissions occur more rarely in the young than in the old, and may be associated with no other evidence of disease. In some cases nervous excitement will produce them; in others they depend on hypochondriasis, dyspepsia, the excessive use of tobacco, gout, over-work, and on fatty degeneration or some neurosis of the heart. Occasionally an intermittent pulse is the first indication of deep-seated malignant disease. Some patients are unconscious of the intermissions, while others feel the heart stumble in its work, as it were, at each last beat. In many persons intermissions are habitual, and do not necessarily indicate disease, but they impair the life-value. Intermittent action is often observed in old persons otherwise healthy.

Irregularity.—Irregularity, the other variety of disordered rhythm, presents itself in two forms, as irregularity in frequency, and irregularity in force or inequality. These two forms are frequently associated; of a number of pulsations no two may seem equal in force, and no two may succeed each other at equal intervals of time. In other cases a number of good, steady beats, regular in frequency and equal in force, may be followed by a disorderly series, unequal and irregular. These abnormalities are best observed in cases of mitral valve disease and in dilatation of the heart, although the pulse may be unequal and irregular in all forms of heart-disease at some period of their evolution. Mitral insufficiency affords the common examples of unequal and irregular pulse, though in this affection the pulse-beats may only be slightly unequal in size and form, but perfectly regular in the periodicity of their occurrence. In mitral stenosis irregularity and intermissions are generally associated with inequality. Some intermissions are what are commonly called *false* intermissions, the ventricular systole being too weak, or the wave of blood thrown into the aorta too scanty, to be perceived at the wrist. In such cases the sphygmograph records the wave which escapes the finger. In mitral cases irregularity and inequality are increased by exercise. *See* SPHYGMOGRAPH.

Inequality in the size of the pulsations often depends on respiratory influences. Deep inspiration normally reduces arterial tension, lessens the size of the pulsations, and quickens the pulse; while expiration raises the tension, increases the size of the pulsations, and slows the pulse. An exaggeration of these effects constitutes the *pulsus paradoxus* or *pulsus inspiratione intermittens*. In some cerebral cases the regular succession of large and small pulsations is observed, constituting the *pulsus alternans* or *bigeminus*.

In health the pulse may sometimes be noticed to be irregular on waking; and in convalescence from acute disease irregularity in force and time is not infrequent.

The pulse may be occasionally *suppressed* in one or all the arteries. When general, this is due to cardiac weakness, and the sphygmograph will often record a small gradual pulse-wave, which escapes the finger. When partial, the suppression is due to either compression, thrombosis, or aneurism of the main trunk.

The pulse in one radial occasionally is felt to occur later than in the other artery; this is called *retardation*, and usually indicates aneurism.

3. **Force.**—The force of the pulse, which the finger estimates by the amount of pressure required to obliterate it, and which the sphygmograph measures by the weight or pressure required to develop to the full the main features of each pulsation in the trace, is the product, in the first place, of the heart's vigour. The distribution of the heart's force, however, depends on the state of the smaller blood-vessels. When these are relaxed and open, a vigorous heart has its force distributed quickly over the whole vascular area by the rapid onward passage of the blood. When, on the contrary, the arterioles are contracted, the heart's force is retained in the arteries for a longer time. In the first case, the pulse is soft and compressible, from the small quantity of blood retained in the artery; in the second case, it is hard and incompressible, from the fulness of the artery with blood under high pressure. It may be well to point out here, that the size of the pulse and the amplitude of the pulse-trace are by no means fair indications of its force or strength. These qualities depend on the sudden variations in tension (fulness of blood) which the artery undergoes. For instance, a moderately strong ventricle will produce in states of easy blood-flow through the capillaries an ample pulse, but one easily compressed; whilst the same ventricle, acting with even more force, in conditions of lessened capillary permeability, will produce a pulse much less ample, but less easily compressed. The simple experiment of feeling, or recording with the sphygmograph, the pulse when the capillaries are dilated by a warm bath, and, again, when contracted by a cold one, will exemplify this. The permeability of the smaller vessels also reacts on the heart, and influences both the frequency and mode of contraction. When the capillary circulation is easy, the heart's action is more frequent, and the ventricular contractions shorter or more sudden; when, on the contrary, the circulation is obstructed by contraction of the peripheral vessels, the heart's action becomes less frequent, and the ventricular contraction is longer and less sudden. Thus the vascular tension may be said to be in inverse proportion to the frequency and suddenness of the heart's action. The force of the pulse, as thus modified by the state of the peripheral circulation, gives us some of our most important clinical information. Modern clinical research shows how valuable is a study of this force of the circulation as manifested by the tension of the arteries. It is this quality of tension which forms the best basis for the division of the various pulse-forms into the two great classes of *hard* and *soft* pulses, or pulses of high and low tension. The *hard* pulse requires considerable pressure to enable the sphygmograph to record its features to the full; the soft pulse yields the best trace to slight pressure.

Other Characters.—The *size* of the pulse depends on the development of the line of ascent and the tidal wave, which are modified by the volume of blood expelled by the ventricle, and the state of fulness of the arteries. When the arteries are contracted the pulse is hard and wiry; when the coats are relaxed it is large and soft. The *flickering* pulse is indicative of feeble and unequal ventricular contractions; and the *undulatory* character noticed in some weak pulses is due to the influence of the respiratory movements, causing variations in the tension. The quality of *suddenness* (quick ventricular systole) is betrayed by a nearly vertical line of ascent; while the *gradual* pulse (slow ventricular systole) has an oblique up-stroke.

The following arrangement shows in a small compass the principal varieties of pulse met with in practice, apart from the quality of regularity.

A. Varieties of Hard Pulse—Pulsus durus.

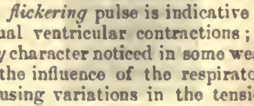

FIG. 58.

1. The *hard, frequent, sudden, and small pulse* of peritonitis, enteritis, and pericarditis:—

Pulsus durus et frequens et celer et parvus, fig. 58.

2. The *hard, slow, gradual*, and *large pulse* of contracted kidney:—

Pulsus durus et rarus et tardus et magnus, fig. 59.

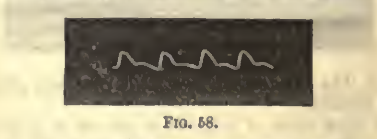

FIG. 59.

3. The *hard, large*, often *gradual pulse* of cardiac hypertrophy and degeneration of blood-vessels:—

Pulsus durus et magnus et tardus—fig. 60.

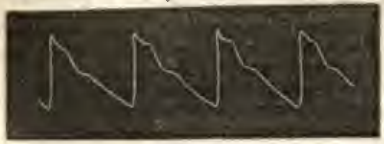

FIG. 60.

4. The *hand*, *sudden* (*jerky*), *large*, and *vibratory pulse* of aortic insufficiency, with strong ventricle:—

Pulsus durus et celer et magnus et vibrans—fig. 61.

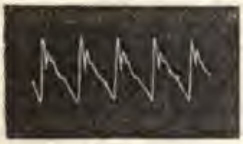

FIG. 61.

B. Varieties of Soft Pulse—Pulsus mollis.

1. The *soft*, *frequent pulse* of pyrexia: dicrotous and hyper-dicrotous pulses:—

Pulsus mollis et frequens—fig. 62.

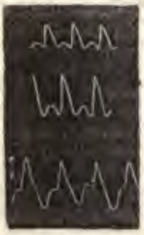

FIG. 62.

2. The *soft*, *frequent*, and *large pulse* of rheumatic fever:—

Pulsus mollis et frequens et magnus—fig. 63.

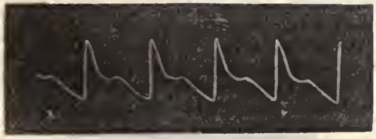

FIG. 63.

3. The *soft*, *small*, *frequent* and *sudden pulse* of debility:—

Pulsus mollis et frequens et parvus et celer—fig. 64.

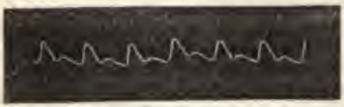

FIG. 64.

4. The *soft*, *frequent*, and *small* (*running*) *pulse* of collapse in fever:—

Pulsus mollis et frequens et parvus—fig. 65.

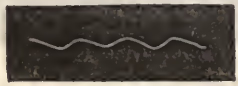

FIG. 65.

BALTHAZAR FOSTER.

PUPIL, Disorders of.—SYNON.: Fr. *Troubles de la Pupille*; Ger. *Störungen der Pupille.*—This normally-black aperture in the vari-coloured and more or less pigmented diaphragm called the iris, lies immediately in front of the lens of the eye. It is circular, or nearly so; and central, or rather nearer the nasal than the temporal side of the iris. Through the pupil light is transmitted to the retina, and, speaking generally, its size is in inverse proportion both to the amount of light admitted, and to the age of the individual. The activity and dilatability of the pupil, and the range within which it will vary in size, are greatest in the young, and least in old people. Its size varies very much in different persons exposed to the same amount of light. A diameter of from 3 to 5 mm. in ordinary daylight would be nothing unusual. The best method of measuring the size of the pupil is to have a row of black dots, of from 1 to 10 mm. diameter, which may be held up beside it for comparison. The exercise of the accommodation-power of the eye for near objects, and the act of convergence of the axes of the two eyes for the same purpose, are accompanied by contraction of the pupil. It is probably by exercising these voluntary powers that some persons, it is said, can contract their pupils *at will*. Hypermetropes, who make much use of their accommodation, have small, and, on the contrary, myopes have large pupils, as a rule. The iris has circular and radiating muscular fibres, by which the size of the pupil is altered. The radiating fibres of the dilator muscle are supplied by the sympathetic (through ciliary nerves from the lenticular ganglion), and also, probably, by the long ciliary nerves of the trifacial; and the sphincter pupillæ by the third nerve. So that in paralysis, or after section, of the third nerve, the sphincter being inefficient, the pupil is, in some degree at least, abnormally dilated, and irresponsive to light (mydriasis); and, on the contrary, contracted and immovable when the eye is shaded (myosis), if the sympathetic is defective. The pupil is quite passive, as regards the light and shade, and of an uniform and medium size, if both nerves are powerless. Paralytic mydriasis, or myosis, is not so much in degree as that produced by belladonna (atropin) and other mydriatics, or by calabar bean (eserin) and other myotics, respectively. If, for instance, in a case of complete third nerve paralysis, the ordinary solution of sulphate of atropine is dropped into the eye affected, the pupil becomes more widely dilated, and hence the drug is supposed to paralyse the sphincter of the normal eye, and to stimulate the dilator muscle simultaneously—to produce, in fact, an artificial mydriasis, simulating at once the paralytic and spasmodic forms of the disease. For mydriasis from disease may be a result of spasmodic action of the dilator, or of defect in the sphincter—of irritation of the sympathetic, or of paralysis of the third nerve. In the latter case only will atropine produce a greater dilatation. The converse is the truth as to the production of myosis from disease, from cerebral irritation, or from any disease paralysing the sympathetic. An exceedingly minute quantity of the sulphate of atropine locally applied will produce mydriasis, so that care must be taken not too readily to assume in any case that mydriasis has not been artificially produced.

Mode of Examination.—In estimating the movements of the pupil in an eye that is not blind, as the two irides have a mutual action, the other eye must, in the first place, be altogether covered and excluded; and then, opposite a good light, the effects of shading and exposing the eye alternately are observed. If it 'acts' doubtfully (reflex movement), the effect of using the accommodation, assuming that the power is retained, as in reading, and then, with both eyes open, of converging the axes, in looking at a very near object (voluntary movement), is to be tried. It should be observed also whether the pupil *dilates* normally when, in a moderate light, the patient looking into the distance, the eye is shaded. For want of care, mydriasis of one eye has been mistaken for myosis of the other, and *vice versâ*. The normal reflex excitability of the pupil is also noteworthy. If one of the extremities be irritated, if only the palm of the hand be scratched or tickled, the pupil will then dilate. The changes in size of the pupil, thus accurately tested in any case, are a very uncertain guide as to the amount of vision in the eye examined. If an eye has no perception of light (amaurosis) its presence or absence has no influence (though this is disputed) on the pupil, which is generally dilated, if the blindness is not of spinal origin, and especially if it is recent.

Varieties and Ætiology.—There are many other well-known signs of paralysis of the third nerve besides the dilated pupil, and but one of the signs only is very unlikely to appear in any such case. The disease may, however, be limited to the lenticular ganglion. As the cervical sympathetic, which supplies the dilator pupillæ, derives nerve-fibres from spinal nerves, contraction of the pupils is one of the many well-known signs of locomotor ataxy; but it is not always present. It is then of a paralytic nature. The pupils are uninfluenced by light, but contract in accommodating for near objects (Argyll-Robertson). Myosis may be spasmodic, as in the case of some watchmakers and others. Unilateral myosis may indicate an aneurism, tumour, or some other deep-seated disease on one side of the neck. The pupils are contracted when there is photophobia, and during sleep; dilated in syncope, nausea, stupor, hydrocephalus, dyspnœa, often in epileptic fits, and by various drugs given internally. A striking variability and want of symmetry as to the size of the pupils has been observed in the general paralysis of the insane. In mania the pupils are contracted, and in melancholia dilated. In 'tremulous iris,' the lens being gone or removed backwards from contact with the pupillary border of the iris, especially if the vitreous be fluid, it is moved to and fro by the movements of the eye-ball. If the lens is eccentrically misplaced, a part of the iris and pupil only may be thus shaken. *Hippus* (nystagmus affecting the iris) is a very rare condition, in which the pupil is dilated and contracted spasmodically, without any of the variations of light or other causes by which it is usually influenced. A not very uncommon congenital defect of the iris is *coloboma*—in which the pupil is balloon-shaped, the notch generally downwards. In fœtal life the membrana pupillaris covers the pupil, and some remains of this may be seen, in rare cases, in adult life, in the form of bands passing from the *front* surface of the iris, a little beyond the pupillary margin, across the pupil, or to the anterior lens-capsule. If the pupil, especially if it be somewhat contracted, is inactive, not circular, and irregular in shape, this is almost always the result of iritis, probably of existing adhesions of the pupillary margin. The pupil also mechanically, in some degree at least, may be dilated, inactive, and not round, vertically oval as a rule, in glaucoma—the lens being thrust forwards beyond the plane of the iris. On the other hand, when the tension of the eyeball is diminished, as in *paracentesis corneæ*, the pupil is at once contracted. Pupillary adhesions (*posterior synechiæ*) to the lens, as they are at the *back* of the iris, can be hardly seen unless a drop of a mydriatic solution has been used. This, if there are synechiæ, reveals them at once, as the iris can only dilate in the intervals between them. But if it have not been used before, during the inflammation, or insufficiently, the pupil becomes very much contracted, and may be altogether incapable of dilatation—excluded (*total posterior synechia*), or occluded, the iris being adherent to a false membrane which occupies the area of the pupil. *See* Eye, and its Appendages, Diseases of; and Third Nerve, Diseases of.

J. F. Streatfeild.

PURGATIVES.—Definition.—Substances which cause intestinal evacuations.

Enumeration.—Purgatives are divided into several classes, namely, *drastic*, *simple*, *saline*, *hydragogue*, *cholagogue*, and *laxative*. Under the *drastic* purgatives may be classed Colocynth, Croton oil, Gamboge, Jalap, Podophyllin, Scammony, and Elaterium. Amongst the *simple* purgatives are Aloes, Buckthorn juice, Castor oil, Rhubarb, and Senna. Under the head *saline* we have neutral salts, especially the Sulphates of Magnesia, Potash, and Soda; Citrate and Tartarate of Potash; Bitartarate of Potash, Tartarate of Soda, and Phosphate of Soda. *Hydragogues* include Bitartarate of Potash, Elaterium, and Gamboge. *Cholagogues* comprise Aloes; Mercurial preparations, such as Calomel, Blue pill, and Grey powder; Podophyllin, Iridin, Euonymin, and other substances of the same class. The *laxatives* are small doses of simple purgatives, such as Carbonate of Magnesia, Magnesia, Olive oil, Sulphur, as well as such vegetable substances as contain salines and sugar in considerable proportions, namely, Cassia, Figs, Honey, Manna, Prunes, Tamarinds, and Treacle.

Action.—The increased intestinal evacuation produced by purgatives is partly due to acceleration of the peristaltic movements of the intestine, so that the intestinal contents are hurried along more quickly, and less time is allowed for their absorption. Many authorities, especially in Germany, have held this to be the only way in which purgatives act; but there is no doubt that many of them also produce increased secretion from the intestinal glands. The different classes of purgatives affect the intestinal movements and intestinal secretion in different degrees. *Laxatives* and *simple purgatives* act chiefly, if not entirely, by increasing the peristaltic action. Some of the *drastic* purgatives act in both ways; whilst the *hydragogue cathartics*, as well as the *salines*, especially increase the intestinal secretion. In the case of some of the salines, as bitartarate of potash, the secretion is greatly increased, while the peristaltic movement is so little affected that the secretion may lie so long in the intestine as to be again re-absorbed, and the drug therefore fails to produce purgation at all. For this reason it is usual to combine such salines with simple purgatives, which will accelerate the peristalsis.

Besides their direct action upon the bowels, purgatives exert an indirect effect upon the circulation, weakening it, and lowering the pressure of blood within the vessels.

Cholagogue purgatives are those which have a special power to remove bile from the body. They may do this either by stimulating the secretion of the liver, or by quickening the expulsion of bile from the gall-bladder and ducts, so that more bile is poured into the intestine at a time when this is in active movement. The bile is therefore hurried down the intestinal tube, and reabsorption is thus prevented. This appears to be the mode of action of such purgatives as euonymin and iridin. Such mercurial preparations as blue pill and calomel appear to act in a somewhat different way. Experiments, contrary to expectation, have shown that they do not increase the secretion of bile, and yet they are amongst the most efficient cholagogue purgatives which we possess. Their cholagogue action is probably due to their exerting a special stimulating action upon the duodenum, quickening its peristaltic movements, and thus hurrying down the bile, and preventing its reabsorption. Their beneficial action as cholagogues is greatly increased by the subsequent administration of a saline purgative, which will tend to sweep the bile out of the lower part of the small and the large intestine, and prevent reabsorption from these.

Uses.—Purgatives are used, firstly, to remove fæcal matters from the intestinal tube. They thus not only prevent the accumulation of such matters, but remove the irritation which their presence produces, and which may evidence itself in disturbances of other organs, for example, headache and malaise. These disagreeable symptoms produced by constipation appear to be partly due to the irritation of the intestinal nerves, producing reflex disturbance of the circulation; but it is probable also that they may be caused in part by the toxic action of poisonous gases, liquids, or solids generated in the intestine by imperfect digestion or decomposition of the food. For such purposes as this we may employ, as we find them necessary, laxatives or simple purgatives. The second use of purgatives is to remove from the body an excess of certain secretions such as bile, and substances which may be contained in them, such as metallic or organic poisons which are excreted in the bile or intestinal mucus. The third use is to remove liquid from the body in cases of dropsy, due either to cardiac or to renal disease. For such purposes we use hydragogue cathartics. The fourth use is to lower the temperature in fever, and for this we chiefly use salines. The *modus operandi* here is not yet well understood. The fifth use of purgatives is to lower the blood-pressure, and thus to prevent the rupture of a blood-vessel, and consequent apoplexy; or to prevent further extravasation in a case where the vessel has already burst, as in hæmorrhage from the lungs.

T. Lauder Brunton.

PURGING.—A popular synonym for diarrhœa; and also applied to the therapeutical method purgation. *See* Diarrhœa; and Purgatives.

PURPURA.—Synon. Cutaneous hæmorrhages; Fr. *Purpura*; Ger. *Blutfleckenkrankheit.*

Definition.—A diseased condition in which circumscribed effusions of blood take place into the upper layers of the cutis, and beneath the epidermis; occurring without or with certain constitutional symptoms, or in the course of various diseases; and attended at times by hæmorrhages under and from the mucous membranes, as well as into the various serous cavities.

Ætiology.—Cutaneous hæmorrhages have been seen as early as the third day after birth, and indifferently at all other periods of life. Women appear to be more frequently attacked than men.

Cutaneous hæmorrhages, when not due to external injury, may occur in persons apparently in the most perfect health, or they may accompany the most various diseases of the general system. They are not infrequent in the course of Bright's disease and valvular disease of the heart; they have been seen in phthisis, acute rheumatism, cirrhosis of the liver, leucocythæmia, intermittent fever, and, in fact, in patients of the most different constitution and general condition, from perfect health to the most advanced cachexia. The exciting cause is usually quite obscure, but they have been seen to follow severe fright, and also sudden obstruction of the circulation, as in severe coughing and epilepsy, though this is exceptional. Purpuric eruptions have followed the use of chloral in excessive doses, and also of iodide of potassium in specially susceptible individuals.

Anatomical Characters.—The rete mucosum and the papillary layer of the cutis are the chief seat of the hæmorrhage in purpura. Owing probably to rupture of the capillaries over a limited area, the blood finds its way into the meshes of the connective tissue, and fills the interspaces between the hair-follicles and the ducts which traverse these parts. Absorption of the serum is soon followed by changes in the hæmatin set free from the red corpuscles, so that it passes through various tints of blue, green, and yellow, until it is completely absorbed. Very large extravasations may result in long-continued or even permanent pigmentation of the part, owing to the formation of hæmatoidin. Similar effusions to those beneath the skin are found in the severer cases beneath the mucous membranes also; but in these parts bleeding from their free surface is not uncommon, probably from the delicacy and slight resistance of the membrane covering the capillaries. *Post-mortem* examination in fatal cases has revealed extensive extravasation into the pleural, pericardial, and peritoneal, and, very rarely, into the arachnoid cavities. Extravasation may also occur into the muscles, the periosteum, and even the bones, as well as beneath the conjunctiva and into the retina. Cases complicated with other diseases, such as phthisis, or Bright's disease, will present their characteristic lesions.

Pathology.—Purpura appears to depend (1) on an alteration in the nutrition of the coats of the blood-vessels, which makes them unequal to the strain of arterial pressure, so that they rupture; or (2) on alterations in the blood itself (excess of water, or salts, &c.); or (3) on both causes combined. That weakness of the vessel-walls is a main cause, is shown by the greater frequency and extent of the purpuric eruption on the feet and legs, and on the most dependent parts, such as the back, if the patient be recumbent, where gravity intensifies arterial pressure. The influence of the nervous system may account for some cases of rapid hæmorrhage, for this condition has been experimentally produced in frogs by extirpation of the sympathetic ganglia.

Embolism and thrombosis have been suggested as an explanation of some cases. The relation of the joint-affections which so often accompany purpura to the latter is not clear, and there seems ground for believing that they are not always rheumatic, but due to hæmorrhages into the synovial membranes of the joints.

Symptoms.—Although, as has been stated above, cutaneous hæmorrhages may occur under such a variety of conditions that they can scarcely be looked on as characteristic of a definite disease, yet since they not unfrequently appear in apparently healthy persons, and run a definite course, it seems advisable to retain the time-honoured name of purpura in these cases, as well as to include under the generic name two or three minor species. It must, however, be distinctly understood that *there is no abrupt line of demarcation between any of the varieties of purpura*, but that the difference between them depends on the severity of the accompanying symptoms. The eruption has the same general characters in all forms of purpura. It consists of isolated spots, whose colour varies from bright red to a livid or dark purplish-red. They do not disappear on pressure. Their shape is generally round or irregular, and their edge is almost always uneven and denticulated. Their size varies usually from that of a pin's head to that of a pea or bean, but in some cases they may be as much as several inches in circumference. The smaller spots, not larger than a finger nail, are termed 'petechiæ,' the larger 'ecchymoses.' If they take the form of lines or broad stripes they are called 'vibices.' The spots are usually level with the skin, but they sometimes appear as small conical papules round the hair-follicles (purpura papulosa, lichen lividus—Willan), or as wheal-like nodules (purpura urticans). Very rarely the epidermis is raised into the form of bullæ containing serum and blood-corpuscles (purpura bullosa). The duration of each spot depends on the amount of extravasated blood giving rise to it, and on the time necessary for its absorption; but it usually disappears in a week or ten days. The spots, once formed, do not increase in size except by fresh hæmorrhage in their vicinity. They never end in desquamation, and only large ecchymoses are followed by more than transient pigmentation; but they all undergo colour-changes during absorption, by which they become brown, green, and yellow, while their edges become more and more indefinite. Their presence under the skin is unattended with pain or any kind of irritation or pruritus, so that the patient may only discover their existence accidentally while undressing.

Varieties.—We may now briefly consider the varieties of purpura:—

1. **Purpura Simplex.**—In this form the eruption is either preceded for a few days by languor and loss of appetite, or else it occurs without any previous symptom. The spots may be limited to the feet or legs, or they may be scattered over the whole body, including, in severe cases, the head and face. They come out in crops, each of which lasts from eight to ten days. There may be only one or two crops, or fresh ones may protract the disease for several weeks or months.

2. **Purpura Rheumatica.**—Synon.: *Peliosis rheumatica.*—Rheumatic purpura only differs from the simple variety in being attended with slight fever, general stiffness and weariness, and rheumatic pains in the knees and ankles. The rheumatic symptoms vary much in different cases, and in some cases the joints are not only painful and tender, but red and swollen. There may also be a good deal of gastric disturbance, nausea, and bilious vomiting; colicky pains in the belly, constipation, and diarrhœa are not uncommon. Peliosis rheumatica is most frequent in men, and in healthy individuals between the ages of twenty and thirty years. This form often relapses if the patient leave his bed too soon. Liveing connects P. rheumatica with symmetrical erythema (polymorphic erythema) through Erythema nodosum. Neither the arthritic symptoms, with purpuric tendencies, which are common to all these affections, nor the character of the eruption present, are considered to be of a sufficiently constant and distinctive nature to separate one from the other by any sharp line of demarcation.

3. **Purpura Hæmorrhagica.**—This form only differs from purpura rheumatica in the greater depression and constitutional disturbance which precede and accompany the outbreak of spots; in the greater extent of surface covered by the petechiæ; in the larger size of the ecchymoses; and, lastly and chiefly, in the occurrence of hæmorrhagic effusions beneath the mucous membranes of the lips, cheeks, gums, and palate, and of more or less copious free hæmorrhages from the nose, mouth, intestines, urinary tract, and more rarely from the lungs. The repetition of these hæmorrhages may rapidly exhaust the patient's strength, and cause death from anæmia and collapse, or he may die with so-called 'typhoid' symptoms. The hæmorrhages from internal parts do not bear any necessary proportion to the skin-eruption, and they may be very severe when the latter is small, or *vice versâ*; nor need they begin or end at the same time with it. Purpura hæmorrhagica may, like the other varieties, occur suddenly in apparently healthy

persons, living under the most favourable circumstances.

As rare complications of these three forms may be mentioned (*a*) true urticaria, running side by side with the purpuric eruption; (*b*) venous thrombosis; and (*c*) diarrhœa, not of a bloody character.

4. Symptomatic Purpura.—This title might be given to a purpuric eruption which sometimes occurs in the course of cholera, measles, scarlet fever, typhus fever, and small-pox, but which has no special significance except in the last-named disease. There the purpuric spots come out in the first three days, and so precede the special eruption of small-pox, and patients attacked with it frequently die with delirium and high fever.

Prognosis.—The prognosis of simple and rheumatic purpura is favourable, as recovery always occurs. In purpura hæmorrhagica recovery is the rule in uncomplicated cases, though there are a few instances on record which ended fatally from the exhaustion produced by repeated hæmorrhages, although no cause could be detected, and every known remedy was tried. Purpura accompanying organic disease, such as Bright's disease or morbus cordis, is unfavourable. The duration of all the forms is very uncertain, owing to their tendency to relapse.

Diagnosis.—The fact that the purpuric spots are unaltered by pressure, and unattended with itching, scaliness, or tendency to discharge, will separate them from almost every other affection of the skin. From scurvy purpura is distinguished by occurring in those whose health has not been impaired by long privation from fresh meat and vegetables; by the absence of spongy gums, painful swellings, and ulceration of the skin; and by its resistance to diet and the use of lime-juice. Secondary syphilitic stains on the lower extremities must be distinguished by the history and by other attendant phenomena. Bruises due to injury are not likely to lead to error.

Treatment.—In the treatment of purpura absolute rest in bed is necessary, if the eruption be general; elevation of the legs is advantageous if the disease be confined to them. Any derangement of internal organs must be remedied, if possible. As a rule, tonics, especially quinine and iron, do most good in purpura simplex. Tinctura ferri perchloridi ♏xv–xx, three times a day, is almost a specific in many cases; and the mineral acids, especially sulphuric acid, are of great value. The use of purgatives, as recommended by the older writers, especially Plumbe, has of late fallen into disrepute. In purpura hæmorrhagica, with copious bleedings, ergot has proved most effectual. It may be given either by the mouth, or else hypodermically, as a solution of ergotin. Turpentine, in ten-minim doses, gallic acid, and other hæmostatics also deserve a trial. Locally, cold applications, or injections of iced water, may be resorted to in severe epistaxis or hæmorrhage from the bowel. Iodide of potassium should not be given in purpura, as it aggravates it in some cases, and has even given rise to serious ulceration.

Edward I. Sparks.[1]

PURPURIC.—Relating to purpura. *See* Purpura.

PURRING TREMOR or THRILL.—Synon.: Fr. *Frémissement cataire*; Ger. *Schnurren.*—A physical sign felt by the hand applied over the heart or vessels in certain conditions, resembling the sensation conveyed by the purring of a cat. *See* Physical Examination.

PURTON (Wiltshire) Saline Spa, contains iodine. *See* Mineral Waters.

PURULENT INFECTION. — Infection from the absorption of pus, introduced from without, or formed within the body. *See* Pyæmia.

PUS.—A product of inflammation. *See* Inflammation.

PUSTULE. — Synon.: Fr. *Pustule*; Ger. *Pustel.*—A vesicle of the skin containing pus, as in small-pox and ecthyma. Vesicles originally containing serum are also apt to become pustules, by a purulent transformation of their contents.

PUSTULE, MALIGNANT.—Synon.: Contagious Carbuncle; Anthrax; Fr. *Charbon*; Ger. *Anthrax.*—Other names are used to designate the more diffuse and general forms.

Definition.—A specific contagious disease, communicated to man from the disease of horned cattle, horses, and sheep, &c., known as splenic fever, *mal de rate*, or *Milzbrand*, and due to the presence in the system of the *bacillus anthracis* (Cohn), or *bacteridium* (Davaine).

1. The *local* or *external* form of the affection, malignant pustule proper, is a carbuncular swelling having specific characters, attended with more or less intense surrounding inflammatory œdema, which may exist alone (anthrax œdema, *œdème malin*, anthrax erysipelas); usually also with lymphangitis. Constitutional symptoms may be slight or severe; and the disease is often fatal.

2. *General* or *internal* anthrax is another result of the same poison, which may exist independently of any external malignant pustule. This form has received various names—anthrax or charbon fever (*fièvre charbonneuse*), anthracæmia, internal anthrax, *mycosis intestinalis*; and also names derived from its connection with certain trades (woolsorter's disease), or its occurrence in certain countries (Siberian plague). This internal form is apparently identical with splenic fever of the lower animals; its symptoms are usually those of blood-poisoning, such especially as prostration, anxiety, congestion of the lungs, and rapid death; fever may be only slight. The chief *post-mortem* lesions are scattered hæmorrhages in various organs; diffuse cellular exudations; congestion of the lungs; and frequently a swollen and pulpy condition of the spleen.

Ætiology.—Anthrax, when occurring in man, is invariably derived from cases of splenic fever of the lower animals, either by direct or indirect contagion.

Splenic fever affects horned cattle, sheep, and horses in all parts of the world; and, less frequently, elephants, camels, and other herbivora. Though apparently endemic in certain regions, this is probably due to the great persistence of the contagion, and the various ways in which it is preserved, owing to the mode of disposal of the carcases. The disease assumes various forms, usually that of a general blood-poisoning, without external swelling; occasionally a form in which there is glandular swelling and inflammatory œdema (sometimes bloody) near the seat inoculation (usually the mouth and pharynx), together with the general blood-poisoning; and, least frequently, a form in which there are local phlegmonous or diffused œdematous swellings affecting various parts of the body. In the common internal form of splenic apoplexy the spleen is usually greatly swollen and pulpy; it may even rupture, and there may be hæmorrhages in the heart, lungs, kidneys, serous cavities, and other parts.

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[1] Revised by Dr. Alfred Sangster.

The *bacillus anthracis* or *bacteridium* is a bacterium first discovered by Pollender in 1849, the name of *bacteridium*, given by Davaine, being that commonly used in France; that of *bacillus anthracis*, given by Cohn, in Germany.

All parts of the bodies of animals dying of the disease are actively poisonous, and may convey the disease by direct or mediate contagion. Direct inoculation is rarely, perhaps never, from the living animal, usually from the carcase, affecting, therefore, chiefly butchers, slaughterers, tanners, &c. It may also arise from eating the flesh, though rarely, as the poison is destroyed by cooking. Contagion may also be conveyed by butter or milk (Hensinger). The bites of flies may also convey the poison.

Indirect contagion occurs chiefly in those who have to deal with the wool or hair of animals which have died of the disease, especially wool-packers and sorters, labourers in felt manufactories, horsehair-cleaners, furriers, tanners, and those engaged in like occupations. In these cases the poison may enter the system either by local inoculation, or by inhalation of the dust containing it. Lastly, certain less suspected modes of infection may probably be occasionally active in relation to man as to animals. The diffusion of the poison by water, and its distribution by means of wool-waste and bone-dust, used as manure, especially deserve notice, as capable of spreading the contagion unsuspected.

With regard to animals, the researches of Pasteur seem to show that the bacillus may be cultivated in the earth around buried carcases, carried to the surface by earth-worms, and so distributed on vegetation.

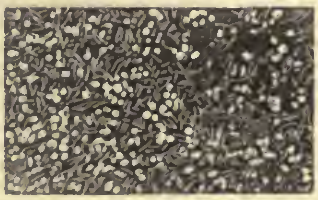

FIG. 66. Part of the spleen of a guinea-pig which died of anthrax, showing the relative proportion of bacillus rods and leucocytes. (× 100 diam.) From a photomicrograph.

MORPHOLOGICAL CHARACTERS AND MODE OF GROWTH.—As seen in the blood, the bacillus anthracis consists of a motionless, short, apparently homogeneous rod or filament, varying in length from 10 μ ($\frac{1}{2500}$ inch) to 20 μ ($\frac{1}{1250}$ inch), and in diameter averaging 1·4 μ ($\frac{1}{18000}$ inch). The filaments may greatly exceed this length, but are rarely less than $\frac{1}{2500}$ inch long.

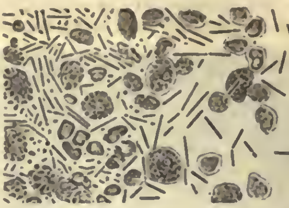

FIG. 67. A part of the same under a higher power (× 220 diam.) The rods are made to appear too thin in the woodcut. From a photomicrograph.

These filaments are either straight, slightly curved, or bent at an acute angle. The longer of them may be readily shown by reagents to be made up of numerous shorter segments, either enclosed in one sheath or showing signs of division.

In some cases longer filaments, curved or looped, are found in the blood and in the fluid of the serous cavities after death.

The mode of their development and multiplication has been studied artificially. The usual mode of multiplication in the blood is by transverse fission. The rods consist of a central protoplasmic core, surrounded by a more dense sheath. In ordinary rapid fission the rod simply increases to nearly double its length; then the central protoplasm splits in the middle, leaving a clear space; finally the outer sheath becomes constricted and divides; and this process is repeated in each segment.

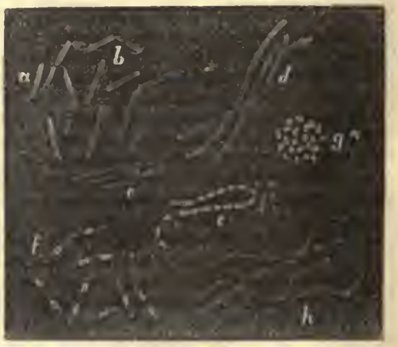

FIG. 68. Forms of bacillus anthracis. × 500. *a.* Very short rods. *b.* Rods of the usual length. *c.* Longer rods. *d.* Still longer rods, some bent, in course of division. *e.* A filament from the spleen after death, showing spore formation, and free spores. *f.* Rods in which spores have been formed, from the pericardial serum after death. *g.* A mass of spores. *h.* Jointed rods found in the spleen after death.

In their growth, either under natural conditions or by cultivation, the filaments, which are readily destructible, may produce spores which are highly tenacious of life.

Under cultivation the rods may elongate into filaments of great length, forming loops or curves or spirals, and become matted together into a felted mass.

The filaments may continue homogeneous, and show no external signs of division, although the protoplasmic contents often appear to be partially segmented. Then, at more or less regular intervals, appear more highly refractile points, around which the protoplasm appears to coalesce, forming masses which are at first cylindrical, then oblong, and finally become long, ovoid bodies, enclosed in the outer sheath (*see* figs. 68 and 69). These spores may either escape laterally from the filament, or the filament breaks up into short segments, each containing a central or a terminal spore (*see* fig. 68, *f*); or the filament may gradually dissolve, leaving a mass of spores with some jelly-like substance uniting them (*see* fig. 68, *g*).

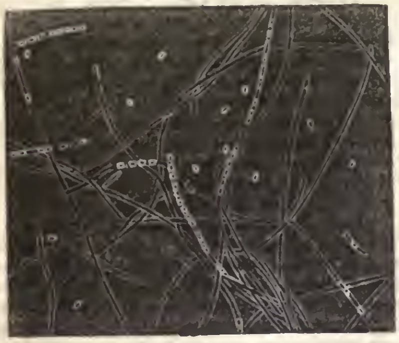

Fig. 69. From a cultivation of bacillus anthracis, after forty-eight hours, showing masses of filaments, some containing spores (which are too closely massed together in the woodcut). From a photomicrograph by Dr. Maddox. × 600 diameters.

However formed, the spore is capable of being preserved, regenerating the bacillus rod, and reproducing the disease.

Life-history of the anthrax bacillus.—The bacillus anthracis requires for its growth the presence of a nitrogenised—preferably albuminous—pabulum, and a supply of oxygen. Its vitality is destroyed by a temperature of 60° C., and probably by one even lower when it is in the rod state. Decomposition very rapidly detroys its vitality.

When dry the rods themselves can be preserved a short time (only a few weeks) in an active state. But the life of the spores is not destroyed by short exposure to a temperature of nearly 100° C. in a moist state, and probably still higher in a dry state. They retain their vitality for years, and are unaffected by ordinary changes of climate or temperature. Prolonged boiling, or exposure to a pressure of eight atmospheres of oxygen, destroys their vitality.

Anatomical Characters.—In cases of malignant pustule *rigor mortis* usually sets in early, and passes off somewhat speedily. The body is often cyanosed, and there is marked hypostasis. The face sometimes appears swollen; petechiæ on the chest and abdomen are not uncommon; decomposition is said usually to set in early; and there may be early *post-mortem* emphysema of the skin of the face and neck.

The blood is generally dark, lake, and tarry, and sometimes peculiarly viscid, and even in the heart it is often uncoagulated. Hæmorrhages, varying in size from a pin's-head ecchymosis to large extravasations, are found in various parts. Ecchymoses beneath the peri- and endo-cardium, and in the cardiac tissue, often occur; also in the muscles, the connective-tissue planes, and the subserous and submucous tissues.

In the lungs there are frequently hæmorrhages; and congestive œdema, with partial collapse, is common. The spleen is usually enlarged, but not invariably; its tissue is dark and pulpy, or may be completely diffluent. The liver is usually swollen, vascular, and somewhat softened, but hæmorrhages are rare. The kidneys are often hyperæmic, and rarely there are extravasations in the cortex or pelvis. The stomach and intestines often present nothing abnormal. In the brain there are frequently scattered, punctiform hæmorrhages, and, rarely, large extravasations in the pia mater.

Such are the general and constant conditions both in the external and internal forms. In the malignant pustule itself the process extends deeply into the subcutaneous cellular tissue; the inner portion is hæmorrhagic, and may be sloughing in the centre; and hæmorrhagic patches radiate into the surrounding tissue (Bollinger), which are extensively infiltrated with a semi-gelatinous blood-stained fluid.

In the *pulmonary* form ecchymosis and gelatinous exudation are sometimes found in the tissue of the neck, especially surrounding the trachea, in the mediastinal glands, and in the lungs and pleuræ. Occasionally the cervical gland may be swollen, and infiltrated with blood; the cellular tissue surrounding them may be œdematous, and sometimes contains large hæmorrhages. In the mediastinum is found a quantity of gelatinous fluid, sometimes blood-stained or mingled with small hæmorrhages. Both pleural cavities usually contain serous fluid, often two or three pints or more. In the pericardium there is a variable quantity of fluid. The bronchial glands are swollen, sometimes greatly so, and may contain extravasations of blood; and there may be large hæmorrhages in their vicinity. The mucous membrane of the trachea and bronchi may be congested, and the seat of small blood-extravasations; they frequently contain frothy blood-stained mucus. From observations which the writer has recently made, there seems to be no doubt that the lesions frequently present in the larger bronchi correspond, both in their anatomical characters and in their relation to the constitutional infection, with the external malignant pustule; and that the virus, having gained entrance by a local infection of the mucous membrane, is conveyed to the bronchial glands, and thence into the blood. The lungs may contain hæmorrhages into their substance, either scattered lobular patches, or more commonly wedge-shaped tracts at the periphery, and diffuse extravasations in the subpleural tissue; but in some cases the lungs appear natural to the naked eye. In this form the abdominal viscera often appear perfectly healthy.

In the *gastro-intestinal* form there is often some blood-stained serum in the peritoneal cavity. The mesentery and retro-peritoneal connective-tissue are infiltrated with semi-gelatinous fluid. The walls of the stomach, and parts of the intestines, are swollen and congested. In their submucous tissue there may be gelatinous blood-stained fluid or hæmorrhages, which may form solid coagula beneath the mucous membrane. The entire mucous membrane is injected, or merely stained with blood. The intestines contain either blood-stained mucus or watery fluid, more or less mingled with blood. There may also, though much more rarely, be pustular and carbuncular foci in the intestines, which are said to resemble the malignant pustules of the skin.

Microscopic Anatomy.—The most important point in the microscopic anatomy is the presence of the bacillus anthracis in the blood and tissues, either diffused, or forming masses in the vessels and lymphatics. It is unnecessary to describe here other more minute lesions.

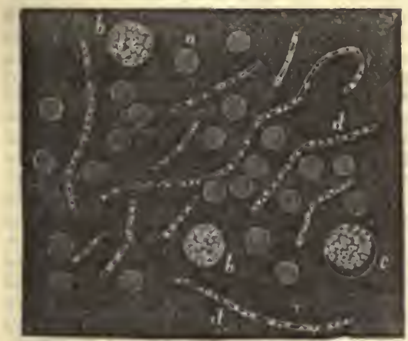

Fig. 70. Bacilli from the fluid exuded from the lung in a case of internal anthrax. × about 700 diam. *a*, Red blood-corpuscles. *b* and *c*, Large granular corpuscles from the lung. *d*, Bacilli of various lengths, containing highly refractile granules, or fully formed spores.

Symptoms and Course.—The symptoms of malignant pustule vary greatly with the form of the disease. At least three distinct forms may be considered.

1. *Malignant pustule* or *carbuncle* proper, the form from which the names of charbon and anthrax are derived. Usually it occurs as a primary lesion due to direct inoculation; very rarely secondarily to constitutional infection. The seat is usually either on the face, neck, hand, or arm—namely, those parts most exposed to inoculation.

At first a small red point or pimple appears within a few hours, or two or three days, after inoculation, and may be either painless, or attended by burning or itching. This rapidly extends, so that in a few hours a large red swelling may be formed. Sooner or later a small papule appears at the seat of inoculation, and this vesicates at the summit; the vesicle bursts and discharges a clear or turbid watery fluid, which is often deeply blood-stained. Beneath this there is a dark red spot, which dries up, leaving a central dark brown or black eschar, seated on an angry, red, indurated base. This central eschar enlarges until it may reach the size of a shilling; surrounding it is usually a narrow ring of vesicles, and beyond this a livid red area and extensive brawny œdema. When the pustule is situated on the face, the entire side of the face, head, and neck may be involved in the red œdematous swelling. The lymphatic glands of the part are often greatly swollen. The complete development of the pustule depends on the length of time the patient survives. If recovery ensue, the central black eschar, on the raised, indurated, and inflamed base, may be well-marked at the end of ten days or later.

The symptoms vary much. Even where the local condition is severe, constitutional symptoms may be slight or wanting; or some slight febrile symptoms may be present. But where the general system is involved, and the case takes an unfavourable form, the symptoms may still present great variety. There may be little fever, but great mental depression and physical exhaustion, cold sweats, sometimes diarrhœa, followed by delirium and coma. The mind may be clear to the last, only the increased prostration, embarrassed respiration, and cyanotic condition foretelling the fatal termination. In cases of external pustule, fever, which may be very high, usually predominates, and brain-symptoms are perhaps the rule in fatal cases. Death may occur in thirty or forty hours from the first appearance of the pustule, or be delayed till the fifth or sixth day, rarely later. Healing of the pustule may take place by sloughing, or the eschar may simply separate and the wound granulate. Multiple carbuncles are said to occur after general infection from a malignant pustule, but they appear to be usually merely ordinary furuncles or carbuncles. The mortality in cases of external malignant pustule appears to vary in different outbreaks; probably one in three is a safe estimate.

Malignant anthrax œdema, without definite pustule, has also been observed in outbreaks of the disease; it corresponds in the main with malignant pustule, and is usually rapidly fatal. The eyelids are the parts most commonly affected, but it may occur elsewhere.

2. *Internal anthrax* differs greatly from external, and may either be general, having no special lesion; or accompanied by local affections, usually pulmonary, or gastro-intestinal.

The symptoms common to these internal forms of anthrax vary much. The onset is often sudden, but sometimes gradual, preceded by a sense of depression and exhaustion, restlessness, loss of sleep, vague sensations in the limbs, and sometimes cold perspirations. These symptoms may last two or three days before more definite symptoms, but commonly only one or two days, or even a few hours. Whether after premonitory symptoms, or quite suddenly, acute symptoms may set in. There may be vomiting, shivering—amounting to distinct rigor or mere sense of chilliness—headache, and other symptoms common to the onset of many acute diseases. But what is usually most noticeable is extreme physical prostration, often with great mental depression and anxiety, coldness of the extremities, embarrassed respiration, and usually speedy collapse. The temperature is sometimes high, reaching 105° F. or more, but more commonly only slightly elevated; the rectal temperature being 100° to 101°, whilst the axillary may be subnormal. In some cases delirium occurs early; in others the mind is clear to the end. Vomiting may recur, but is not usually prominent. Amongst occasional symptoms of this form are sensations of numbness or tingling in various parts, particularly of the extremities. Death usually occurs in forty-eight to sixty hours from the onset of acute symptoms, but may be more rapid, or be delayed for five or six days. Owing to the absence of definite symptoms this form, '*anthracæmia*,' has been little studied. More commonly the symptoms assume a more definite character, related either to the respiratory or digestive system.

In the *pulmonary* form the symptoms may more nearly resemble those of acute bronchitis or of pneumonia. At the onset, there are usually some of the general symptoms just described. Some bronchitic sounds are heard over the lungs, especially posteriorly, and there may be patches of crepitation. Occasionally there is sore-throat and swelling of the glands in the neck, but not at all constantly. Cough may be slight or absent, and is rarely severe. But even at this stage there is an amount of prostration and embarrassment of breathing, and tendency to cyanosis, out of proportion to the physical signs. These rapidly increase, the patient takes to bed, there is great prostration, difficult and laborious respiration, cyanosis and collapse, with or without wandering delirium. Death may occur in twelve hours, or be delayed from two to five days. Frequently there are intermissions or remissions, followed by sudden relapse.

In its general features *intestinal anthrax* is somewhat analogous to those already described. But early in the case there appear other symptoms—vomiting, sometimes dysphagia slight pain, uneasiness in the abdomen, colic, and diarrhœa. The diarrhœa may be from the first bloody, and may continue so. Bleeding from the mouth and pharynx sometimes occurs, and may persist. The general symptoms are those of extreme prostration, cyanosis, and collapse, often without elevation of temperature. Death may occur in twenty-four hours, or be delayed two or three days, rarely longer. There may be swelling of the neck, due to glandular enlargement and infiltration of the cellular tissue; and this may be a marked feature in the case.

It is thus seen that in the internal form of anthrax the greatest variety is observed.

PROGNOSIS.—The prognosis in all these forms is extremely unfavourable. At the same time, it is stated that cases of milder and less fatal character sometimes occur.

DIAGNOSIS.—1. *Of malignant pustule proper.* In the earlier stages diagnosis is very difficult, except in persons who are known to be exposed to contagion. At a later stage the characteristic features of the pustule above described render the recognition comparatively easy; and microscopical examination of the serum contained in the vesicles shows the presence of the bacillus. Moreover, inoculation experiments on guinea-pigs or mice will, if successful, usually readily decide it; but no absolute conclusion can be drawn from failure.

2. *Anthrax œdema* without pustule is extremely difficult to diagnose, except by a known cause of contagion, or the presence of the bacillus in the subcutaneous exudation.

3. *Internal anthrax*, especially the pulmonary form, also presents very few characters by which it can be distinguished, unless there is some known source of contagion. In the later stages, if death is delayed three or four days, and acute inflammatory symptoms set in, the case is likely to be mistaken for acute pneumonia.

4. In *intestinal anthrax* there is also usually a known source of possible contagion, but not in all cases. When, however, the vomiting and purging have set in, the diagnosis from cases of irritant poisoning, especially by antimony or arsenic, must be difficult. In tropical climates the distinction from acute dysentery or from yellow fever may be doubtful.

TREATMENT.—In malignant pustule, the success of local treatment largely depends upon early diagnosis. As soon as any vesicle or pustule, likely to be due to this poison, is discovered in a person known to be exposed to contagion, active local treatment should be adopted. Excision and cauterisation are the two most effectual remedies. If there is only a small pimple, a free crucial incision, and cauterisation with pure carbolic acid, followed by dressing with carbolised oil or carbolic lint, is the course to pursue. The artificial leech may also be employed with advantage over the site of the crucial incision. When a distinct carbuncle, or rather eschar, has formed, free incision, followed by cauterisation, may be still employed with advantage. The caustics most available are carbolic acid and fuming nitric acid. The former is preferable. The statistics of recovery where this treatment is systematically carried out are highly encouraging.

No other than general treatment appears to be available in the internal form. The fact that carnivora suffer less readily than herbivora suggests the possible benefit of a largely animal diet in persons exposed to contagion. The internal administration of quinine and of carbolic acid are strongly indicated in all forms; and inhalation of air impregnated with carbolic acid might possibly be of value in the pulmonary form. In this form also, as death appears often to be due to compression of the lungs by pleural effusion, evacuation of the fluid should be tried. Stimulants, especially ammonia, ether, and alcohol, are also indicated.

Lastly, and chiefly, prophylaxis is by far the most important point. Stringent regulations with regard to the destruction of the carcases and hides of affected animals would do more to stamp out the disease than any other measure. But as the disease is often imported from distant countries, by means of wool, hair, or hides, which retain the contagion for long periods of time, it is only by the thorough systematic disinfection of these, and the destruction of all the material which is known to be infected, that the disease can be thoroughly prevented. Up to the present time (1881) there is no enactment in England, even in respect of animals known to have died of the disease, which enables anyone to interfere with such disposal of the carcase or the offal as the owner sees fit. It is greatly to be desired that measures were taken to place the law in this respect on a similar footing with that in Germany and France. W. S. Greenfield.

PUTRID FEVER.—A synonym for typhus fever. *See* Typhus Fever.

PUTRID SORE-THROAT.— Sloughing ulceration of the throat from any cause, such as diphtheria, scarlatina, or syphilis. *See* Pharynx, Diseases of; and Tonsils, Diseases of.

PYÆMIA (*πῦον*, pus, and *αἷμα*, blood).—Synon.: Purulent infection; Fr. *Pyohémie*; Ger. *Pyohämie; Pyämie.*

Definition.—A condition of blood-poisoning which gives rise to fever, accompanied either by severe gastro-enteritis and visceral congestions, or by certain local lesions, which are chiefly venous thrombosis, embolic abscesses in the viscera, acute suppurations of the serous membranes and joints, multiple abscesses in the connective tissue, and eruptions upon the skin. The disease is usually, but not always, sequential to a wound or injury.

Ætiology and Pathology.— The initiatory symptoms and the anatomical characters of pyæmia are such as point clearly to the introduction of some morbid material into the circulation, and not unnaturally gave rise to the idea, upon which the name of the disease was founded, that this material was pus. Several considerations formerly appeared to favour this belief, amongst which were especially these. Hunter believed that the lining membrane of a vein secreted pus. Now, as cases of pyæmia were found to be very commonly associated with phlebitis, and also with what were thought to be deposits of pus in the viscera, a very simple explanation of the disease seemed to be that the inflamed vein secreted pus, which became mixed with the blood, and was carried by the circulation to some distant organ, wherein, being arrested, it formed the focus of a suppuration.

Hunter observed that in cases in which an injury to a vein proved fatal, the coats of the injured vein were swollen and thickened, and its lining membrane was of an unusually red colour; and he supposed that the fragments of fibrin and the softening clots often found in such veins were the products of an inflammation of their lining membrane, which in the one case was of an adhesive, in the other of a suppurative character. He believed that the coagula generally found in inflamed veins were the means whereby these inflammatory products were prevented from being carried into the circulation, and that if such coagula were not formed, pus secreted by the inflamed vein might be mixed with the blood, and thus distributed.

Hunter, though perfectly familiar with the secondary abscesses of pyæmia, does not seem to have connected them with the introduction into the blood of morbid material from a wound. That these abscesses were the result of an entrance of pus into the blood, and the arrest of pus-globules in the capillaries of the affected organ, was maintained by others, who thus looked upon the process as a mechanical transference of pus-cells from one part of the body to another. These observers supposed that in healthy wounds the entrance of pus into the veins was prevented by the formation of a coagulum, but that if this coagulum were not formed, or became broken down, pus entered the circulation, and gave rise to the secondary abscesses by its arrest in distant organs. This view was supposed to be confirmed by Cruveilhier's experiments, in which he injected mercury into the veins, and found that abscesses were formed in the first set of capillaries to which these veins were distributed, and that such abscesses were formed around a globule of mercury. Thus, if the injection were made into the systemic veins, the abscesses were formed in the lungs; if into the portal veins, they were formed in the liver.

But this explanation of the phenomena of pyæmia was soon found to be insufficient, and also to be incompatible with many facts since ascertained. Cases of pyæmia occur in which there is no primary suppuration from whence the pus could be derived; there is no evidence that the lining membrane of a vein ever secretes pus; the secondary abscesses of pyæmia are not deposits of pus, but true inflammations, and, if examined at their commencement, are found not to be purulent. Again, the first set of capillaries occasionally escape, and the secondary lesions occur in parts beyond them in the order of the circulation; and the position of the abscesses—as, for instance, in the lung, where they chiefly occupy the lower parts of the organ—is not explained by the purely mechanical theory. Besides which, there are the general symptoms of systemic poisoning to be accounted for, and these are sometimes so severe as to kill the patient before any secondary lesions are developed. Experiments upon animals show that the injection into the veins of pus, or any material containing solid particles, is usually followed by the arrest of the solid particles in the first set of capillaries with which they meet, and a consequent obstruction of the capillary circulation; but the result of this capillary obstruction varies according to the nature of the obstructing substance. The injection of septic liquids filtered from solid particles, causes fever and other constitutional symptoms, varying according to the virulence of the poison contained.

An examination of the symptoms of pyæmia will show that it consists of two series of morbid processes, the first series manifesting the general constitutional disturbance due to the systemic poisoning, the second having relation to the secondary lesions thereupon developed. Both analogy and morbid anatomy point to the primary cause of these being the introduction into the blood of an animal poison, which at once gives rise to the first series or the general disease; and we shall see that the secondary lesions are to be accounted for, either by a venous thrombosis, leading to a capillary embolism, or by a stagnation of the diseased blood and the changes which ensue thereupon.

Of the exact nature of the poison which gives to the blood in pyæmia its infective character, we are in ignorance; and it is better to admit this. Our powers of organic analysis are not yet sufficient for the isolation of the subtle but potent poisons upon which so many of the specific diseases depend; and we do not yet know what it is which gives to a pyæmic clot its infective quality. It is certain, however, that the poison may be either generated within the body or introduced from without, and that there are predisposing causes which render a person peculiarly prone to its generation or reception.

Of predisposing causes, impure air, and especially that kind of impurity which results from the presence of decomposing animal matter, is doubtless the most important. Thus the crowding together of a number of persons with suppurating wounds, neglect in removing the discharges and excretions from sick persons, and imperfect drainage, are causes favouring the development of pyæmia. The puerperal condition is also a powerful predisposing cause. Disease of important excreting organs, whereby effete materials are retained in the blood, also renders a person more liable to pyæmia, as is often observed in cases of Bright's disease; and any great nervous depression (perhaps because of its influence in diminishing excretion) has a like effect. Intemperance, and acute fevers, probably render their subjects somewhat more prone to pyæmia; but it is a mistake to assert that chronic invalids, or persons in weak health, have any special liability to the disease. Children, though by no means exempt from, are somewhat less liable to pyæmia than adults.

Pyæmia, then, is caused by the entrance into the blood of an animal poison, which in the majority of instances originates in a wound, an injury, or a local inflammation; but in some few cases it has been impossible to determine where the disease began. It is especially liable to follow certain diseases and injuries, and is the gravest danger of many operations. Thus, it occurs very frequently after compound fractures, and operations involving the section of a bone; after injuries of the bones of the head, and in connection with acute necrosis of the long bones from suppurative periostitis; also after wounds or injuries of veins; after parturition; in connection with diffuse cellular inflammation, suppuration of the internal ear, and operations upon the urinary organs. Facial carbuncle is a disease peculiarly prone to lead to pyæmia.

Anatomical Characters.—The morbid anatomy of pyæmia reveals two series of changes—the one depending upon the primary infection of the blood, the other upon the secondary effects of this. When the blood is very profoundly infected, the results of general blood-poisoning are often all that can be found; the patient dies before the secondary affections can be produced. When the poison is smaller in quantity, or not much in excess of the eliminative powers, the secondary lesions predominate; but in most cases changes of both kinds are found.

The wound, or the tissues at the site of the primary disease or injury, from whence the poison has entered the blood, are found in various conditions. There is often, but not always, suppuration present, and the wound is bathed in foul and unhealthy pus; or the wound may be dry, and discharging only a little thin ichor; or the cellular tissue may be infiltrated with seropurulent fluid. The veins in the neighbourhood of the diseased tissues are often found blocked with coagula, extending a variable distance along their channels, and in different stages of disintegration. These clots may be soft and dark, or firm and adherent to the lining membrane of the vein, and partially decolourised; or they may be broken down in the centre to a reddish-yellow pulpy material, consisting of disintegrated fibrin. Sometimes the whole clot is thus softened, and the fragments of fibrin have been partly carried away into the circulation. Occasionally, but rarely, the clots contain real pus; but the puriform material found in the vessels is usually only broken-down fibrin, and the *débris* of cells.

An abscess may, however, open into a vein, and thus pus may gain a direct entrance into its channel; in such a case a coagulum, consisting of a mixture of pus and blood, is found in the vessel, and we have a true purulent clot. Softening thrombi are found with especial frequency in connection with injuries and diseases of bone, as, for instance, in the sinuses of the dura mater after bruising of the cranial bones, or in consequence of caries of the bones of the ear; or in the veins of an unhealthy stump, in which there is inflammation or necrosis of the bone.

But it may be certainly affirmed that many cases of pyæmia occur in which no thrombi are found, and in which the most careful examination fails to detect any morbid condition whatever of the veins. It is necessary to point this out, because it has been erroneously asserted by some that phlebitis is an essential process in the disease. It is to be observed also that the presence of pus is not a necessary element in the causation of pyæmia, as was once supposed; well-marked cases have been seen in which there has been neither wound nor suppuration for its origin. When a wound does exist, however, it is usually found in an unhealthy condition, and in this may probably be found the explanation of the spread of pyæmia by contagion. Healthy granulations do not allow the entrance of septic matter into the blood; a wound may be bathed with fœtid fluids of a most poisonous character, and yet none may be absorbed, as has been proved experimentally by Chauveau; but if the surface of the wound becomes unhealthy, the granulations no longer present a barrier to the absorption of poisonous fluids. This is probably due, as Mr. Savory has suggested, to the dialysing property of animal membranes. If, then, the secretions or exhalations of an unhealthy wound come in contact with another secreting surface, an unhealthy action may thereby be set up on that surface, producing a condition favourable to the absorption of septic material. This explains the prevalence of pyæmia where a number of persons with open wounds are crowded together. A similar condition of wound may also be induced by neglect of other sanitary precautions, especially by the presence of decomposing animal matter, and the escape of sewer-gas into the air surrounding the patient.

In cases of acute pyæmia the morbid changes found *post mortem* are chiefly congestion and softening of the viscera, local stagnation and extravasation of blood, and a general blood-staining of the tissues—conditions indicating profound changes in the state of the blood. In what these changes consist we are at present ignorant; but usually the blood contains an excess of leucocytes, and its fibrin is diminished in quantity and lacks contractility.

When the disease is not of this acutest form, but is of longer duration, there are developed those secondary lesions which are especially characteristic of pyæmia.

Most notable and commonest among these are the so-called 'secondary deposits' or 'secondary abscesses' of pyæmia. These are found most frequently near the surface of the viscera, and are the result of the obstruction of the terminal branches of the vessel supplying the part with blood. This obstruction is followed by engorgement and extravasation, by inflammation, and by rapid necrosis or suppuration. It is necessary more fully to describe this process before giving an account of the morbid anatomy of individual organs thus affected. The obstruction may be caused in several ways.

1. It may be embolic. A portion of a disintegrating clot may be carried into the circulation, until it meets with an artery too small to allow its transmission, or with the first set of capillaries in its route, wherein it becomes arrested. In this way a portion of the organ is deprived of its arterial blood-supply, and in consequence of the absence of the *vis-à-tergo* of the heart, regurgitation takes place from the veins into the capillaries, and even into the terminal arteries, giving rise to a venous engorgement of the affected region. The nutrition of the capillaries being interfered with by the lack of arterial blood, their walls become altered or necrosed, and extravasation of blood takes place, the area of extravasation corresponding with the part supplied by the obstructed vessel. At the same time the vessels of the tissues immediately surrounding the obstructed region become dilated, and so form a zone of intense hyperæmia. So far, this process is only what occurs in any case of embolism (as, for instance, when minute fragments of fibrin are detached from an inflamed mitral valve), but the importance of the process in pyæmia depends upon the changes which subsequently occur. Now the changes which occur in the tissues of a part the seat of embolism depend upon the character of the embolus. If the embolus come from a part which is gangrenous, gangrene will usually occur in the tissue to which it is carried; if the embolus be purulent, or come from a suppurating region, 'then the effect is a suppuration in the part implicated. This suppuration, however, is complicated with the embolic passive hyperæmia we have above described, so that the suppuration is incomplete, and consists rather in rapid breaking-down of the tissues than in the formation of a large number of pus-cells, while the characteristic deep-purple congested zone around the affected spot is much intensified. Some describe this as a true sphacelus of the affected part, but there is no necrosis, and no foul decomposition of the patch affected in the suppurative form of embolic inflammation. Lower degrees of inflammatory quality in the embolic clot induce similar but slighter inflammatory conditions, additional to the states described as due to the mechanical obstruction.' There are all gradations among such degrees (Wilks and Moxon).

If, then, the embolus originate in a wound infected with the pyæmic poison, it sets up an unhealthy inflammation and rapid disintegration of the tissues wherein it is arrested. The important difference, therefore, between pyæmic and other embolism consists in the fact that the pyæmic embolus is composed of *infected* clot. Virchow and others have maintained that this is the sole mode of production of the secondary pyæmic formations. This is incorrect, for, although such formations doubtless often have such an origin, they may also arise in a different manner. The embolic theory will not account for cases in which the first set of capillaries in the order of the circulation from the seat of injury escape, and secondary deposits are found in other organs beyond; as, for instance, where they occur in the liver after an injury of the head, and the lungs are not affected. Neither does this theory explain the cases in which the joints only are affected, as in connection with gonorrhœa or scarlatina; nor are the chronic cases in which only superficial abscesses occur thus explicable. It must be remembered, too, that the lesions in the lungs are found chiefly in the inferior parts of the organ, which is not what would be expected were their origin always embolic.

2. The capillary obstruction may be caused by a local stagnation depending upon the poisoned state of the blood. The infection of the blood interferes with the normal interchange between this fluid and the tissues, and produces a tendency to coagulation in the minuter vessels. This coagulation is especially prone to occur in organs or parts of organs already congested, for where the circulation is slow the impurity will be the greater. In this way the greater frequency of the secondary lesions in the lower than in the upper part of the lungs is accounted for. When this form of thrombosis has taken place, the part so affected is in a condition similar to that above described as due to embolism, and the same series of changes ensues. It must be remembered, also, that the impurity of the blood interferes with the nutrition of the vessels, which thus easily allow of the extravasations that are so frequently found, not only in the viscera, but on the surface of the skin and mucous membranes.

It is more difficult to explain the occurrence of the joint-affections, and the especial vulnerability of certain organs to the secondary inflammations of pyæmia. All that can be said on this part of the subject is that the poison of pyæmia selects certain organs and tissues wherein to expend itself, just as that of rheumatism, syphilis, or typhoid fever does.

The *lungs* are usually congested throughout, and are very prone to the secondary lesions. These are found chiefly near the surface and in the lower and posterior portions, and consist, in the early stage of the process, of small extravasations and patches of congestion; the minuter branches of the pulmonary artery are herein found plugged with coagulum; and hæmorrhage, or inflammatory exudation, has taken place into the surrounding tissues. Thus we have a patch of pulmonary hæmorrhage, or of lobular pneumonia. Later on, the centre of this area of consolidation is found in a state of necrosis, and its circumference surrounded by a ring of intense congestion. The process of disintegration occurs with great rapidity, and the central portion of the nodule may be found within forty-eight hours of the first symptom of pulmonary mischief, broken down into a soft yellow puriform material, or even containing true pus. The nodules are perfectly circumscribed, and average in size about that of a hazel-nut, though they may be smaller or larger. On section, they are seen to consist, in the centre, of a cavity filled with pus or puriform *débris*; surrounding this is an area of pneumonic consolidation, the circumference of which is formed by a narrow ring of intense congestion. The surrounding lung is usually simply congested, or it may even be natural in appearance. An examination of the early stages of these changes shows the first step in the process to be a blocking of the minute branches of the pulmonary artery; and this may occur either from a local coagulation, or by the transference of a portion of clot from some other part, that is to say, it may depend either upon thrombosis or upon embolism; but in whichever manner it originates it is followed by a rapid exudation into, and disintegration of, the portion of lung to which the blocked vessels belong. It has been pointed out that these changes take place chiefly in parts of the lung near the surface. The result of this is that the *pleura* becomes involved in the inflammation, and those nodules which have reached the surface of the lung are coated with a patch of lymph, which may subsequently become part of a more general pleurisy. Or one or more of the abscesses may burst into the pleura, when a rapid effusion of sero-purulent fluid takes place into its cavity.

Pleurisy may, however, occur independently of the lung-disease; and in this case, also, the effusion becomes rapidly purulent. In the early stage of the disease numerous subpleural ecchymoses are frequently found. Pleurisy is especially prone to occur in those cases of pyæmia originating in caries of the bones of the ear; and in children thus affected is often the first symptom of the pyæmic infection.

The *heart* is liable to be affected by the same kind of embolic abscesses as are found in other organs. They occur most often in pyæmia from acute necrosis, in young persons. In the early stage small spots of congestion, due to the plugging of small arteries, are found both on the surface and in the substance of the heart, and also beneath the endocardium. Later on, small cavities containing pus or puriform fluid, and surrounded by a zone of congestion, are found in the walls of the organ. These abscesses are sometimes very numerous, and may occur in any part of the organ; they may open on the surface or into the cavity of the heart; the muscular tissue around them is softened and broken down. The *pericardium* may thus become inflamed from the contiguity of an abscess in the wall of the heart; but, as with the pleura, pyæmic pericarditis may occur independently of such an origin, and in either case the effusion rapidly becomes purulent. The same process may lead to inflammation of the endocardium.

The *brain*, although less frequently the seat of pyæmic abscess than many of the organs, may be the sole organ affected by the secondary lesions; and it not uncommonly happens when this is so, that the general symptoms are unusually slight. Small extravasations are often found in the subarachnoid tissue. Circumscribed softening ending in abscess is most frequent in the white matter of the brain. It commences as a patch of red softening, due to obstructed vessels, which subsequently changes to a reddish-yellow pulp, or to greenish pus, enclosed by a more or less defined wall. Such an abscess may run a very chronic course, and is then found enclosed in a cyst of connective tissue.

The *peritoneum* is occasionally found acutely inflamed, its surface vascular and coated with lymph or pus; in other cases the membrane is spotted with numerous ecchymoses. Peritonitis may also be set up by secondary abscess of the liver making its way to the surface, or even bursting into the abdominal cavity. In some cases of strangulated hernia, death takes place with great rapidity after operation, from absorption of septic fluid which has escaped from the sac into the abdominal cavity. In addition to the usual visceral conditions, the peritoneum is then found vascular, and slightly coated with commencing exudation.

In acute cases of pyæmia the *alimentary canal* is often found in a state of catarrhal inflammation, or of intense congestion, accompanied by small spots of hæmorrhage. The intestinal flux is probably eliminative, for in animals which recover after the injection of septic matter into the blood, diarrhœa is usually a prominent symptom.

The *liver* is, next to the lungs, the organ in which secondary deposits are most frequently found in pyæmia. In acute cases the organ is found congested, softened, and swollen; it has lost elasticity; and its texture on section is confused and clouded. Secondary abscess is, of course, especially prone to occur in connection with dysenteric and other lesions of the bowel, but is also found in cases of general pyæmia, originating in any part of the body. It commences by plugging of the portal capillaries, leading, as has been explained with regard to the lung, to congestion and stagnation of blood in the affected portion; the nutrition of this portion being thus interfered with, necrotic changes soon commence, and the infective character of the clot gives the start to destructive inflammation. The capillaries surrounding the diseased area dilate, and inflammatory exudation occurs into its circumference; at the same time central disintegration is rapidly going on; and in a short time we find a purulent collection, surrounded by a zone of exudation and congestion. Occasionally these abscesses run a more chronic course, and become encysted; and it seems probable that the tropical hepatic abscesses, which often attain a large size, have an embolic origin, connected with the ulceration of dysentery, and may thus be classed with pyæmic suppurations. It must be remembered that pyæmic abscess in other parts is not always acute. Sometimes, but more rarely, hepatic abscess originates in embolism of the hepatic artery, in which case the suppurations are usually smaller and more scattered.

The *spleen* may be simply swollen and soft, or may contain abscesses precisely resembling those described in the liver; the same may be said of the *kidneys*.

Inflammation of the *bones and joints* may be either the cause or the effect of pyæmia. The frequency with which pyæmia originates in diffuse periostitis and osteo-myelitis is well known. In such cases the heart and kidneys are especially liable to be the seat of secondary deposits, and the disease is generally of a severe form. The bone is found stripped of its investing periosteum, and separated from it by a quantity of pus. The surface of the bone is bare, and of a yellowish-white colour; the medulla is usually also inflamed, and is tumid and vascular, or it may be infiltrated to a varying extent with purulent fluid. Sometimes, as after amputation, the medulla is the part chiefly affected, and the inflammation extends to a greater distance along the interior than the exterior of the bone. These changes may also be secondary effects of pyæmic infection from disease of other parts. The disease is usually arrested at the epiphyses, but it may spread to the adjacent joints. The joint-affection most commonly found in pyæmia is an extremely rapid suppuration. In no other kind of joint-inflammation does the destruction of the tissues involved so quickly take place. The cartilages may be found extensively ulcerated, and the joint filled with purulent fluid, within forty-eight hours of the first symptom of inflammation. At first the synovial membrane is swollen and vascular, and the joint distended with a slightly turbid fluid. This fluid usually quickly becomes purulent, and superficial erosions and softening of the cartilages occur, soon leading to extensive ulceration and irreparable destruction of the joint.

In 'gonorrhœal rheumatism,' which some consider a mild form of pyæmia, the effusion is not generally purulent, and the same may be said of the joint-swellings occurring in women with other purulent discharges. So again, scarlatinal pyæmia (in which the infection takes place from the ulcers in the throat), though often of a severe kind, is not infrequently attended with merely serous effusions into the joints, from which complete recovery takes place.

The *muscles and cellular tissue* are often invaded by pyæmic abscesses, and by inflammatory exudations and extravasations of blood. In the muscles the process commences in the cellular tissue between the fibres. Abscess in the intermuscular septa and the subcutaneous cellular tissue is often the result of the more chronic forms of pyæmia.

The *skin* in many cases of pyæmia is found more or less jaundiced; petechiæ and sudamina are not uncommon; and sometimes a pustular eruption is seen. Patches of livid congestion also occur, some of which may have passed into gangrene in the centre or where subjected to pressure.

The morbid anatomy of *other organs* shows that secondary abscesses may occur in almost any situation; among the less rare may be mentioned the eye, the prostate gland, and the testicle.

Before leaving the consideration of the pathology of pyæmia, it is necessary to allude to the connection which is supposed by some to exist between bacteria and this disease. It is said by Dr. Sanderson that great numbers of microzymes are found in the blood and inflammatory exudations of animals suffering from acute infective fever, produced by inoculation of septic matter. Others (Wilks, Moxon, Goodhart) have failed to find bacteria in the blood of living cases of pyæmia, though they may be found in great numbers after death. The committee appointed by the Pathological Society 'to investigate the nature and causes of those infective diseases known as pyæmia, septicæmia, and purulent infection,' state that, 'although bacteria of various forms were found in the blood in a number of cases, they could not be found in all the cases, nor were they discovered constantly in those cases where at one or other time they were present' (*Trans. of Path. Soc.*, vol. xxx. p. 44). Our knowledge of these organisms is at present insufficient to enable us to speak certainly of the part which they play in connection with this disease, but the investigation is one of great interest and importance. *See* BACTERIA; and MICROCOCCUS.

SYMPTOMS.—A patient who has become the subject of pyæmia, often appears to be progressing quite favourably up to the moment when the disease attacks him; in other cases there may have been loss of appetite, depression, or restlessness, for a day or two, with perhaps some little elevation of temperature. The wound, if there be one, has probably assumed an unhealthy appearance: its surface may be dry, or the discharge may be thin and offensive, the healing process is arrested, and recent adhesions may give way. The attack, however, is usually sudden, and is almost invariably ushered in by a severe rigor, followed by sweating. The rigors are of variable duration and frequency, but are usually severe while they last; occasionally they recur with such regularity as to simulate ague. The patient at first may not feel particularly ill, but he rapidly becomes so. Pains in the limbs and general uneasiness occur; the pulse becomes weak and rapid; fever, of an intermittent type, commences, with its usual accompaniments of loss of appetite, restlessness, and thirst. The tongue becomes dry and brown; diarrhœa frequently occurs; and the skin and conjunctivæ may become jaundiced. If the infection be profound, the prostration is extreme; there is usually cough and diarrhœa; muttering delirium sets in early, and soon leads to unconsciousness and death. In such cases the blood-poisoning kills before there is time for the development of any secondary lesions.

In less acute cases local symptoms soon begin to appear. A day or two after the initial rigor pain and swelling of one or more joints occurs, or a subcutaneous abscess forms, or discolourations or pustules are seen on the skin. Cough, attended with rusty expectoration, is common; the respirations are rapid and shallow; there is pain in the chest; and perhaps dyspnœa or orthopnœa from pleuritic effusion. Meanwhile the depression increases; jaundice frequently comes on; and the face assumes a pinched and anxious expression. There is, moreover, often a peculiar sweet smell about the patient, somewhat resembling that of diabetic urine. The rigors mostly cease after the first few days, but the temperature usually maintains a remittent character. The skin shows a tendency to slough on very slight pressure, so that troublesome bed-sores easily form; and patches of superficial gangrene sometimes occur without any such provocation. Vomiting is not a symptom of frequent occurrence; and though there is usually no appetite, yet nourishment is often freely taken and digested. The cerebral symptoms are not usually severe, unless there be secondary lesions in the brain; but there is often a low form of delirium; and towards the end the patient usually becomes unconscious, and passes the evacuations unknowingly. Death may occur from general exhaustion; or from the severity of some local lesion, as, for example, from pericarditis, pleurisy, or cerebral abscess.

The duration of the disease is, in the majority of cases, from a week to ten days. It may, however, prove fatal in forty-eight hours; or, on the other hand, it may be prolonged for weeks or even years.

Pyæmia may commence at any stage of disease or injury; the most common period of invasion is during the second week.

Certain peculiarities must be noted concerning some forms of pyæmia, for which no satisfactory explanation can be given. For instance, in acute necrosis pyæmic symptoms are frequently seen almost from the commencement of the disease, and yet these cases of pyæmia are sometimes of very long duration. Such cases, though severe, are among the least fatal; and when death does take place, abscesses are usually found in the heart and kidneys. The pyæmia arising from disease of the internal ear is especially prone to lead to pleurisy, which is often the prominent condition throughout. That variety of pyæmia associated with gonorrhœa and with scarlatina tends especially to affect the joints, and these are often the only parts invaded; but this joint-inflammation is very different from that which occurs in the course of other cases of pyæmia, for the effusion is generally slight, and does not become purulent. Such joint-affections are not uncommon after parturition. There is, moreover, a chronic form of pyæmia which is not very rare, and which resembles the acute and typical form 'in the formation of widely-dispersed, shapeless collections of pus or allied inflammatory matter; in the probability that these formations are due to some infection of the blood by the entrance of diseased inflammatory products; and often in the occurrence of rigors and profuse sweatings, of phlebitis, and inflammations of joints. But they differ from the acute type in that their course extends, continuously or with relapses, over many weeks or months, and is often free, at least in its later stages, from all severe general disturbance of the health, and from nearly all risk of life' (Paget). 'The election of a single tissue, and the observance of an uniform method of disease, in the secondary affections, are characteristic of chronic rather than of acute pyæmia. They are very marked in some of the cases that follow parturition, in which women suffer for many weeks with a succession of abscesses in the subcutaneous connective tissue of the limbs, and usually (after long suffering) recover completely. Such cases are also sometimes seen in men' (Paget).

Occasionally, also, cases are seen of unusual duration, in which there are severe constitutional symptoms throughout. For the particulars of the following remarkable case of pyæmia after parturition, in which severe symptoms extended over a period of five months, the writer is indebted to Mr. Pollock, who attended the patient with Sir Thomas Watson, Dr. Babington, and Mr. Headland:—

Lady P. was confined on July 9, 1849. A few days after confinement there was slight phlegmasia dolens of one leg, which passed off in a fortnight. On August 8, she was attacked with violent rigors, fever, and sweating, with rapid pulse and great anxiety of countenance; in fact, with well-marked symptoms of severe pyæmic fever. The rigors and sweatings continued with great severity for fifteen days, when she became slightly better, and was removed into the country. Early in September there was a recurrence of the symptoms, and these continued with varying severity till October 29, when she was attacked with acute pleuro-pneumonia. This subsided, but the rigors continued, and, in the latter part of November, Dr. Watson diagnosed consolidation and secondary abscess of the lung. A few days afterwards a quantity of pus was expectorated, and this was followed by rapid improvement, and eventually by complete recovery, the patient being quite well when the present article was written.

Diagnosis.—The chief difficulties in the diagnosis of pyæmia arise from the occasional prominence of some local symptom, which masks the general disease. Probably the most common mistake is to regard a case of acute necrosis, with early joint-symptoms and rigors, as one of rheumatism. Herein, however, there is an absence of the acid perspirations and the coated tongue of rheumatism; the rigors are more frequently repeated; and a careful examination will reveal mischief about the shaft of the bone as well as in the joint. When the chest-affection is severe, as in the pleurisy of children with disease of the internal ear, it may be looked upon as the primary disease; but a sudden attack of pleurisy occurring in anyone with otorrhœa, should at once give rise to a suspicion of pyæmia. The later stages of the disease may present some resemblance to typhus or enteric fever, but the history would give marked distinctions; and in the majority of cases the diagnosis is sufficiently easy at any period of the disease.

Prognosis.—The prognosis in all acute cases of pyæmia is very unfavourable. The great majority die, sooner or later; either early in the disease, from the general blood-poisoning, or subsequently, from the gravity or exhausting character of the secondary lesions. Yet some few do undoubtedly recover, and these are they in whom the viscera escape, and the disease expends itself upon the surface of the body, or runs a chronic course without involving vital organs. Puerperal pyæmia is less fatal than surgical.

Treatment.—The unsatisfactory results ot the treatment, and the great mortality of pyæmia, are the strongest reasons for taking every possible precaution for its prevention. A consideration of the causes which predispose to, and favour the development of, the disease, will suggest certain prophylactic measures. Of these none are more important than to surround a patient who is suffering from an injury or operation, with an abundance of fresh air, and to carefully guard him from the exhalations of decaying organic matter. Overcrowding, and especially the accumulation of cases in which suppuration is going on, should be avoided. The careful drainage of wounds is of the greatest importance; for whether germs be admitted or not, one obvious way of preventing decomposition in a wound is to take care that nothing is left therein to decompose. The wound should be kept scrupulously clean, and the dressings changed sufficiently often to prevent the discharge becoming foul. Antiseptic dressings are very useful in this respect, and, whatever other advantages they may or may not possess, it is certainly desirable to apply to a wound a dressing which prevents the decomposition of the discharge, and the contamination of the surrounding atmosphere (*see* ANTISEPTIC TREATMENT). The integrity and functional activity of the chief excreting organs should be inquired into in all cases of operation or injury, so that the accumulation of effete material in the blood may be guarded against; and it should be remembered that the sudden change of condition that an operation or accident frequently involves, may in itself seriously interfere with the action of the bowels and kidneys.

When, however, pyæmia is developed, it must be admitted that treatment has over it but little control. The chief indication is to combat the extreme depression which is always present, and to endeavour so to support the patient that he may be able, if vital organs escape, to pass through the series of severe local affections that may be anticipated. The satisfactory results obtained by Professor Polli, of Milan, from the administration of sulphurous acid to animals into whom putrid injections had been made, have not followed the use of this remedy in the human subject; yet there is reason to think it has sometimes done good, and to encourage us to give the sulphites in, at least, some of the more chronic cases. Probably, however, the most useful medicine is quinine, which sometimes produces marked benefit; it should be given in full and frequently-repeated doses.

The local affections must be treated on general principles. The secondary abscesses should be opened early; and this is especially important with regard to the joints, from whence the pus should be evacuated directly we are sure of its existence. When the infection appears to originate in the inflammation of an accessible vein, the vessel should be divided between the heart and the inflamed part, in the manner recommended by Mr. Henry Lee. If symptoms of pyæmia occur in connection with inflammation of a long bone, the question of amputation must be considered; and there are strong reasons for believing that by this measure the disease may sometimes be arrested. During the progress of the disease bed-sores must be carefully guarded against, and the diet studiously adjusted to the daily needs; in fact, much will depend in this, as in the majority of serious disorders, upon careful nursing, judicious feeding, and the observance of every hygienic precaution.

J. WARRINGTON HAWARD.

PYELITIS (πύελος, a vessel).—SYNON.: Fr. *Pyélite*; Ger. *Nierenbeckenentzündung.*—Inflammation of the pelvis of the kidney. *See* KIDNEYS, Diseases of.

PYLEPHLEBITIS.—Inflammation of the branches of the portal vein, often associated with thrombosis. *See* PORTAL THROMBOSIS.

PYLORUS, Diseases of.—The muscular fibres of the stomach are disposed in three layers. Immediately below the peritoneum they are placed in a longitudinal direction; these are continuous with those of the œsophagus, and pass downwards over the organ, being continued to the duodenum; they are collected into bands of considerable thickness along the curvatures, especially the upper, and become stronger as they approach the pylorus. The middle layer surrounds the whole of the stomach, but to the left of the cardiac orifice the fibres are thin, and are replaced by those that are oblique. At the pylorus they form a thick band or ring, acting as a sphincter to the opening into the duodenum. The oblique fibres are continuous with the deep layer of the muscular coat of the œsophagus. They arch over the fundus, but are quite lost towards the opposite end of the organ. The muscular coats of the stomach are formed of involuntary or unstriped fibres, being composed of elongated fibre-cells, which are united together by a sparing amount of connective tissue. The connective tissue is much thicker and stronger at the pylorus than at other parts of the organ, giving a great amount of firmness and strength to that region. The mucous membrane is also thicker, and the gastric tubes are wider than elsewhere. Most of these contain gastric cells, but are lined with conical epithelium to a greater depth than in the more actively secreting regions. Some anatomists have stated that in the human stomach, as in many of the lower animals, there are no pepsin-forming cells in this part; but in numerous cases the writer has been able to obtain an active artificial gastric juice from the mucous membrane covering it.

The pylorus participates in the diseases of the stomach, which are fully described under that heading (*see* STOMACH, Diseases of). As the outlet of that organ, however, the patency of the pylorus is of so great importance that its obstruction will be specially considered here.

Pylorus, Obstruction of.—An obstruction to the passage of the contents of the stomach into the duodenum is not unfrequent, and may arise from very different pathological conditions. 1. The most common of these is the presence of a *cancerous* tumour at the pyloric end of the stomach. It usually surrounds the opening, and rarely spreads to the intestines. On microscopical examination the muscular fibres in the vicinity of such tumours are sometimes found to be hypertrophied, the contractile fibres being enlarged and increased in number. More generally the cells are atrophied, although to the naked eye the muscular bundles may seem to be enlarged; sometimes the contractile cells are faint and small, in other cases they are reduced to fibrous tissue, and no trace of the original structure can be discovered. This condition of the muscular tissue furnishes us with an explanation of the fact, that there is often great obstruction to the passage of the gastric contents into the duodenum, where the pyloric opening seems only partially constricted; and it is to this loss of muscular contractility, and not to the mere narrowing of the opening, that we must look in order to understand how in many cases the stomach becomes dilated from its incapacity to discharge its contents. 2. The pylorus is sometimes narrowed by *fibroid thickening* of the submucous tissue. This morbid change may be confined to the opening only, or it may extend some distance from the part chiefly affected, producing a hard, leathery condition of the coats. The same effect, although to a less degree, is produced by an obstruction of this kind as by cancer. The muscular bundles become hypertrophied, their contraction being embarrassed by the tough, fibrous tissue that surrounds and separates them. 3. The pyloric opening may be obstructed by an *ulcer*. This may arise either by its cicatrix producing a contraction, which leaves only a small opening through which the food has to find its way; or, on the other hand, the muscular coat may have been destroyed by the ulceration, and the stomach may, in this way, be unable to force onwards its contents. 4. The pylorus or the duodenum may be constricted by the pressure of a *tumour*. Cases have occurred where a cancerous gall-bladder has compressed these parts, but more generally the pressure is caused by glands enlarged by malignant disease. In a case which came under the notice of the writer, the opening was constricted by enlarged scrofulous glands occurring in a man affected with phthisis. 5. *Adhesions* may form between the duodenum or pylorus and the neighbouring parts, and in this way they may produce a difficulty in the passage of the food from the stomach. A curious case fell under the writer's notice in which a man received a severe blow on the abdomen, which was followed by symptoms of obstructed pylorus. On *post-mortem* examination a portion of the upper part of the small intestine was found to be bent upon itself by the exudation of lymph into the mesentery close to its edge.

Effects.—The effect of any considerable obstruction at the pyloric opening is to produce a greater or less degree of dilatation of the stomach. The most prominent symptom is vomiting, occurring at irregular intervals, and usually several hours after taking food. Along with this we find heartburn, and other signs of indigestion; and a gradual loss of flesh and strength. The treatment must be directed to these effects and symptoms. *See* Stomach, Diseases of—*Dilatation.*

Samuel Fenwick.

PYONEPHRITIS.—Inflammation of the kidney, leading to the formation of abscess. *See* Kidney, Diseases of.

PYOPNEUMOTHORAX.—A morbid condition of the pleural cavity, in which it contains both pus and gas. *See* Pleura, Diseases of.

PYRENEES. *See* Bagnères-de-Bigorre; Eaux Bonnes; Eaux Chaudes; and Pau; and Climate, Treatment of Disease by.

PYREXIA (πῦρ, fire, and ἔχω, I have).—This word is commonly employed as a synonym for fever; but it is applied by some pathologists to elevation of the body-heat from any cause. *See* Fever; and Temperature.

PYRMONT, in Germany.—Iron waters and salt waters. *See* Mineral Waters.

PYROMANIA.—A name which has been given to insanity when the patient manifests a propensity to incendiarism. Its claim to be regarded as a special form of insanity has not been established. *See* Insanity, Varieties of.

PYROSIS (πυρόω, I burn.)—Synon.: Waterbrash; Fr. *Pyrosis*; Ger. *Sodbrennen.*

Description.—Patients affected with waterbrash experience a severe spasmodic pain at the epigastrium, which is often attended with a feeling of constriction, and after the lapse of a few minutes relief is afforded by the rejection of a quantity of watery fluid. The fluid is usually tasteless, without any smell, and seldom amounts to more than two or three ounces. Microscopically, it presents numerous epithelial scales from the mouth, and the writer has also found in it some gastric cells. It is neutral to test-paper, is not albuminous, and in one case in which he carefully examined it, it gave a dense precipitate with baryta, and a bulky precipitate with nitrate of silver, soluble in nitric acid. Frerichs remarked that the fluid contains sulphocyanuret of potassium, and therefore believed it was only saliva. But it is evident that it can scarcely be possible to obtain it entirely free from the salivary secretion, and therefore no great weight can be allowed to the observation. Waterbrash is not necessarily connected with structural disease of the stomach, for the majority of those who suffer from it recover perfectly. Again, in some cases the fluid rejected is evidently only saliva. In some persons affected with disease of the pylorus, the rejection of a tasteless fluid takes place, but this is neither accompanied nor preceded by pain.

Pathology and Ætiology.—Much difference of opinion has been expressed as to the source of the fluid which constitutes waterbrash. It has been referred to the œsophagus, stomach, duodenum, and pancreas. The pancreas seems unlikely to be the organ from which it comes, for the fluid is unmixed with bile, and we should imagine a more violent effort would be required to reject it from a part so distant from the mouth. Again, the œsophagus is very intolerant to any collection of liquid in it, and it would only be by a spasmodic closure of the cardiac orifice that such an accumulation could occur in this tube. As regards the stomach, it seems improbable that the larger and more active end of this organ should be the source of the liquid, for any irritation should produce an acid, not a tasteless, fluid. At the pyloric end, however, there is a mass of tubes, lined chiefly with conical epithelium, whose office it is to secrete mucus, and as the only organic change that has been found along with waterbrash is thickening at the pylorus, we may reasonably conclude that this is the part whence the fluid is ordinarily derived.

Waterbrash seldom occurs before puberty; it affects females more than males; and chiefly presents itself in persons of middle age. It is more prevalent in some countries than in others; and is most general amongst those who subsist on food of a coarse and indigestible kind.

Treatment.—All sources of gastric irritation should be removed, such as every form of insoluble or irritating food. Astringents, with or without opium, are the most efficacious remedies. They should be given in the intervals between digestion, so that they may act directly on the mucous membrane. Lime-water, bismuth, zinc, or other mineral astringents, or vegetable astringents, such as kino, krameria, logwood, or tannin, may be preferred; but, on the whole, the writer has found the oxide and nitrate of silver the most efficacious. Unless there be some objection to it, opium may be combined with the astringents, as it both lessens the pain and seems to restrain undue secretion; or mercurial alteratives may be given, as their use is often attended with the best results. Samuel Fenwick.

PYTHOGENIC FEVER (*πύθω*, I rot, and *γεννάω*, I beget).—A synonym for typhoid fever. *See* Typhoid Fever.

PYURIA (*πύον*, pus, and *οὖρον*, the urine).—A name for a condition of the urine in which it contains pus. *See* Urine, Morbid Conditions of.

Q

QUARANTINE (*quaranta*, Italian, forty). Synon.: Fr. *Quarantaine*; Ger. *Quarantäne*.

Definition.—The enforced isolation of individuals and certain objects coming, whether by sea or by land, from a place where dangerous communicable disease is presumably or actually present, with a view of limiting the spread of the malady. The objects liable to quarantine include—on the assumption of their being apt to carry the contagion or infection of the disease—the luggage and personal effects of the individuals isolated, certain articles of merchandise, and ships; and, in land quarantine, carriages and other vehicles. Sometimes entire communities and districts are subjected to quarantine.

History.—According to systematic writers, quarantine had its origin in the fourteenth century, when the principle of isolation, applied from a much earlier period to leprosy (*mal de St. Lazare*), began to be extended to pestilential diseases; and leper hospitals (*lazarets*), then falling into disuse from the decline of the disease, were converted to (as we should now say) quarantine uses. To this day quarantine establishments retain the name significant of their original purpose—namely, *lazarets*. Fodéré suggests that the period of forty days during which it was customary formerly to enforce isolation, and from which the designation *quarantine* is derived, had its source in the teaching of Hippocrates, who, according to Pythagoras, attributed a special virtue for the completion of many things to that period of time. The methodical establishment of quarantine dates from the sixteenth century, when the earliest doctrines of contagion, in the original acceptation of the term, were also formulated. These doctrines, fantastic though, in many respects, they now appear, still largely adhere to the practice of quarantine. Plague, as we now understand the word (*see* Plague), was the disease against which quarantine was chiefly, indeed almost wholly levelled, until the beginning of the present century; and the system is so imbued with the notions formerly held as to this malady, that it has been found impossible to disembarrass it from them, in endeavouring to apply quarantine to other forms of disease. It is noteworthy that, as plague declined in Western Europe, and the area of its prevalence in the Levant became more and more restricted, the system of quarantine appears to have become more elaborate. Speculative notions, uncontrolled by experience, and applied to the system, caused it to be overlaid with grotesque and puerile details. Notwithstanding, however, these drawbacks, the arbitrariness of the system, and the losses it inflicted upon commerce, without obvious proportionate gains, the advantages offered by quarantine in the protection of a country from pestilential disease appeared theoretically to be so great, that neither administrative follies, nor the lessons as to its fallacies derived from experience, nor its general futilities, availed to bring about the substitution of a more rational system of protection.

Quarantine remained substantially unmodified from the termination of the last century to the fifth decade of the present, since which time it has undergone great changes, with a view of rendering the practice more consistent with existing knowledge of the diseases to which it is applied, and of freeing it from the more preposterous detentions and practices which had become attached to it.

Quarantine Acts.—In the present article we shall deal only with quarantine as it exists in this country. In Great Britain and Ireland quarantine, which is carried out under an Act of Parliament passed in the reign of George IV. (6 Geo. IV., cap. 78), has no longer a medical signification. It is practised, and that only to a limited extent, solely with a view of relieving our maritime commerce from disabilities which would else be imposed upon it by other countries, in which quarantine is regarded as an essential part of the public health administration. The regulation of quarantine is not a function of the department of the Government which is concerned with the sanitary administration of the kingdom (the Local Government Board), but of the Privy Council, aided by the Board of Trade, the subject being dealt with as an international commercial question. In what follows an authoritative official memorandum of the late medical officer of the Local Government Board (Dr. E. C. Seaton) on the subject is closely adhered to.

The Quarantine Act provides for land quarantine and the quarantine of inland waters, as well as for maritime quarantine—internal and external quarantine, so to speak. It does not appear that internal quarantine has ever been enforced in this country since the Act was passed. Maritime quarantine alone has been practised, and this has been applied to three diseases only, all of them infectious diseases of foreign origin, namely, plague, cholera, and yellow fever. Of plague there has been no question in English ports for the last thirty years or thereabouts, except a slight alarm in 1879, consequent upon an outbreak in south-eastern Russia, province of Astrakhan. Against cholera quarantine has not been enforced since 1858, its futility as a precautionary measure in this country having then been abundantly manifested. Yellow fever is the sole disease at present subjected to it in our ports, and this, as already stated, not from the medical necessity, but from the commercial exigency of the case. The only quarantine establishment now remaining in England—that at the Motherbank—is maintained in respect of this disease. Infectious diseases habitually current in this country, such as small-pox, scarlet fever, &c., notwithstanding that the phraseology of the Quarantine Act covers *any* 'infectious disease or distemper,' have always been in practice exempt from quarantine, and dealt with under the general sanitary law of the kingdom. It appears to have been recognised that measures, primarily designed to prevent the introduction into the country of diseases only coming to us from abroad, and which involved international considerations, would be misapplied if used for the purpose of preventing the importation of diseases ordinarily existing here, the limitation of which, and not the exclusion, could alone be in question.

The measures which have been substituted for quarantine against cholera—the only foreign epidemic which at present much concerns the health of this country—consist in a 'system of medical inspection,' the details of which are set forth in an Order of the Local Government Board, dated the 17th July, 1873. This plan differs from 'quarantine' in the following essential respects:—

(*a*) It affects only such ships as have been ascertained to be, or as there is reasonable ground to suspect of being, *infected* with cholera or choleraic diarrhœa; no vessel being deemed infected unless there has been actual occurrence of cholera or of choleraic diarrhœa on board in the course of the voyage.

(*b*) It provides for the detention of the vessel only so long as is necessary for the requirements of a medical inspection; for dealing with the sick (if any) in the manner it prescribes; and for carrying out the processes of disinfection.

(*c*) It subjects the healthy on board to detention only for such length of time as admits of their state of health being determined by medical examination.

The measures for dealing with the sick under this Order are but an adaptation to a particular exigency of the principles of sanitary administration with regard to infectious diseases, which are in force under the general sanitary law of the kingdom.

But though quarantine has no present practical existence in this country, except as regards yellow fever, and all other infectious diseases are dealt with either under the general sanitary law of the country, or such modification of it as has been just described with regard to cholera, the machinery which is maintained under the Quarantine Acts, for obtaining information as to the existence of infectious diseases on board foreign-coming ships, is made available for dealing with all diseases of that kind, whether they are quarantinable or not. The quarantine questions, as they are termed, which it is the duty of the Customs to put to the masters of all such vessels, embrace all infectious diseases; and, in the event of any such disease not of a quarantinable kind being found to exist on board, or to to have existed in the course of the voyage, the quarantine officer is required to detain the vessel and to forward the information with the least practicable delay to the sanitary authority of the port. In regard to cholera, moreover, both the customs and the sanitary authority have certain powers of detaining the vessel specified in the order of the Local Government Board above referred to.

The provisions under Articles 12, 13, and 14 of the Order of the Local Government Board, as to the mode of dealing with persons who may arrive from abroad infected with cholera, will be better understood if a succinct statement be made of the ordinary provisions of the law with regard to infectious diseases in England. The authorities which have to administer that law, as now existing under the Public Health Act, 1875, are the urban, rural, and port sanitary authorities of the districts into which the whole kingdom is divided, and these authorities are empowered:—

(*a*) To provide hospitals or temporary places for the reception of the sick (section 131);

(*b*) Where a hospital or place for such purpose is provided, to remove thither by order of any justice, on a certificate signed by a legally qualified medical practitioner, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, *or on board any ship or vessel* (section 124);

(*c*) To make regulations (to be approved by the Local Government Board) for removing to any hospital, to which the local authority is entitled to remove patients, and for keeping in such hospital, so long as may be necessary, any persons brought within their district by any ship or boat, who are infected with a dangerous infectious disorder (section 125);

(*d*) To provide and maintain a carriage or carriages, suitable for the conveyance of persons suffering under any infectious disorder (section 123);

(*e*) To cleanse and disinfect infected premises, and articles therein; to destroy any bedding, clothing, or other articles which have been exposed to infection from dangerous infectious disorder, giving compensation for the same; and to provide all necessary means for the disinfection of infected things (sections 120, 121, 122);

(*f*) To take proceedings against (1) any person who, while suffering from any dangerous infectious disorder, wilfully exposes himself without proper precautions against spreading the said disorder, in any street, public place, shop, inn, or public conveyance, or enters into any public conveyance without previously notifying to the owner, conductor, or driver thereof that he is so suffering; or (2) any person who, being in charge of any person so suffering, so exposes such sufferer; or (3) any person who gives, lends, sells, transmits, or exposes without previous disinfection, any bedding, clothing, rags, or other things which have been exposed to infection from any such disorder; or (4) any owner or driver of a public conveyance, who shall not have immediately provided for the disinfection of such conveyance, after it has to his knowledge conveyed any person suffering from a dangerous infectious disorder; or (5) the owner of any house in which any person has been suffering from any dangerous infectious disorder, who shall knowingly let it or part of it for hire, without having previously disinfected it, and all articles therein liable to retain infection, to the satisfaction of a legally-qualified medical man; or (6) any person who, showing for the purpose of letting for hire any house or part of a house, shall make false statements as to the existence of infectious disease therein, or within six weeks previously (the several acts here enumerated constituting offences liable to penalty under the Public Health Act, secs. 126, 128, 129);

(*g*) To provide mortuaries, and to obtain the removal thither, by order of a justice, of the body of one who has died of any infectious disease, which is retained in a room where persons live or sleep, or of any dead body in such a state as to endanger the health of the inmates of the house or room in which it is retained (secs. 141, 142);

(*h*) To make inspection of their district, with a view to ascertain what nuisances exist calling for abatement under the powers of the Act, and to enforce the provisions of this Act in order to abate the same (sec. 92): a provision which extends to shipping—any ship or vessel lying in any river, harbour, or other water, within the district of a sanitary authority, being subject to the jurisdiction of that authority, in the same manner as if it were a *house* within such district;

(*i*) Finally, to appoint a medical officer of health, inspector of nuisances, or several of those officers, according to the needs of the district, and other requisite officers, to aid them in the proper and efficient execution of the Act (secs. 189, 190). The duties of the medical officer of health and of the inspector of nuisances, when (as is the case in the greater number of instances) the assent of the Local Government Board has to be given to their appointment, are set forth in Orders of the Board dated March 1880.

The general powers above enumerated, if exercised duly and with reasonable diligence, are held sufficient to provide for the exigencies which may arise in our ports from the introduction of infectious diseases by ships, whether the disease be current in this country or be of foreign origin not naturalised here; but in the case of a non-naturalised disease, such as cholera, certain additional securities are taken by the Order of the Local Government Board, 17th July, 1873, previously referred to. The general powers, moreover, which are available against the importation of infectious diseases by shipping, are available also, and have on occasions been used, against their exportation in like way to other places.

The relative advantages of the system of medical inspection and of quarantine as against cholera in the ports of Europe, underwent thorough discussion at the International Sanitary Conference which was held in Vienna in 1874. A large majority of the delegates, including those from every State of the first rank except France, declared in favour of the former system. The minority, while adhering to quarantine, agreed to a system which would considerably diminish its stringency as heretofore practised.

Harry Leach.

QUARTAN (*quartus*, the fourth).—A form of ague, in which the paroxysm returns after an intermission of two days. *See* Intermittent Fever.

QUEENSTOWN, in South of Ireland.—Mild, not relaxing, winter climate. Southern exposure, with shelter. Mean winter temperature 44·1° Fahr. *See* Climate, Treatment of Disease by.

QUINISM.—Synon.: Cinchonism; Fr. *Quinisme*; Ger. *Cinchonismus*.

Definition.—A group of symptoms, chiefly connected with the nervous system, produced by the presence of quinine in the system.

Anatomical Characters.—In the rare cases in man in which death has been due to quinism, *post-mortem* examination has revealed only congestion of the brain, liver, and lungs. In addition to these, congestion of the spinal cord, kidneys, stomach, and intestines has been found in experiments on animals.

Symptoms.—Large doses of quinine, or smaller doses long continued, may produce two separate sets of symptoms, each independent of the other, according as they act locally on the intestinal canal, or upon the nervous system after absorption. It is to the nervous symptoms that the term cinchonism is usually restricted.

Before considering these symptoms in detail, however, it may be advisable to mention the local effects of quinine upon the intestinal canal. These are, irritation, either of the stomach or intestines, which manifests itself sometimes in vomiting, and sometimes in purging. Not unfrequently, also, small doses of quinine will cause headache, independently of either vomiting, purging, or the nervous symptoms which are peculiar to cinchonism. This headache is probably caused reflexly by the irritant action of the quinine on the stomach or intestines, and may not depend on any special action that it exerts upon the nervous system after its absorption.

The nervous symptoms to which the term cinchonism is applied consist of affections of the hearing and sight, cephalalgia, and sometimes giddiness. Delirium, convulsions, and collapse are said to occur after very large doses.

Noises are heard in the ears, the sounds being of a humming character, or resembling a distant waterfall, the ringing of bells, or the striking of a clock. These noises are accompanied by more or less deafness, voices being heard as if the speakers were at a distance. Sometimes the deafness becomes complete. It is usually temporary, but frequently lasts for several days after the quinine has been stopped, and has occasionally proved permanent. Affections of the sight are less common. They consist of occasional optical illusions, intolerance of light, amblyopia, mydriasis, and even blindness after large doses. Headache may sometimes be produced by small doses of quinine, without any affection of the sight or hearing; and, on the other hand, the hearing may be very considerably affected without any headache occurring, although this is frequently present. The pain chiefly affects the top of the head and the temples. Occasionally a curious sensation is observed, as if the top of the head were coming off. This sensation is not accompanied by pain. Giddiness also comes on, so that the patient may have difficulty in standing or walking, either after a single large dose, or after repeated or continued moderate doses. This is preceded by an affection of hearing, sight remaining unaffected. The giddiness is probably partly due to weakness of the circulation, in part to the action of quinine on the nerves and nervous centres. Experiments on animals have shown that quinine diminishes greatly the reflex function of the spinal cord, diminishes also sensibility, and, finally, paralyses the extremities. In some persons large doses of quinine cause a febrile condition unaccompanied by cephalalgia, but preceded by humming in the ears, disturbance of the mental faculties, and a slight rigor. In others, the cerebral symptoms have been so marked as almost to amount to a temporary mania.

The circulation is weakened by large doses of quinine, the heart becoming feebler, and the arterial tension diminishing. Not unfrequently fainting has been observed; and therefore persons fully under the influence of quinine should be careful not to rise up suddenly. In some casse collapse and coma occur, occasionally accompanied by convulsions.

TREATMENT.—As a chemical antidote in cases of quinine poisoning, tannin or substances containing it should be given; and to combat the symptoms produced by quinine, already described, ammonia should be administered, and counter-irritation should be applied to the skin. Cold compresses to the head, leeches behind the ears, and purgatives may be employed when there is excitement or delirium. Alcohol and diffusible stimulants may be given if there is a tendency to collapse.

T. LAUDER BRUNTON.

QUINSY (*cynanche*, sore-throat).—A popular synonym for acute inflammation of the tonsils. *See* TONSILS, Diseases of.

QUINTAN (*quintus*, the fifth).—A form of ague, in which the paroxysm returns after an intermission of ninety-six hours. *See* INTERMITTENT FEVER.

QUOTIDIAN (*quotidie*, daily).—A form of ague, in which the paroxysm occurs at the same hour every day. *See* INTERMITTENT FEVER.

R

RABIES (*rabies*, rage or madness).—SYNON.: Fr. *la Rage*; Ger. *Hundswuth*.

DEFINITION.—A non-febrile disease, due to a specific poison; and most frequently met with in the canine, feline, vulpine, lupine, and other species of carnivora; but communicable by inoculation to all warm-blooded animals. It is accompanied by an inclination to attack other animals; and is characterised by nervous disturbances, together with listlessness, uneasiness, wildness, cramps, paralysis, rapid emaciation, altered voice, quick course, and fatal termination.

ÆTIOLOGY.—Various antecedent phenomena are supposed to be either the actual or predisposing causes of rabies; but we may say that neither climate, season, food, water, sex, genital excitement, pain, anger, age, nor breed, as far as we are able to judge, has the slightest effect in producing the disease.

Many persons still adhere to the belief that rabies arises spontaneously in the canine, and probably also in the feline, lupine, and vulpine species of carnivora; although most, if not all, admit such cases to be extremely rare (Boerhaave, Hamilton, Gilman, Coleman, Renault, Haubner, Williams, Hill, &c.). Others (Maynell, Blaine, Youatt, Virchow, Gerlach, Röll, Böllinger, the writer and many more) believe that it never arises spontaneously, but that it is always

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the result of the introduction of the specific animal poison into the system, either by a bite from a rabid animal, or by the absorption of the virus through the medium of an abraded surface. To prove beyond doubt, in any given case, that affected animals had never been bitten, nor placed in contact with those already diseased, is extremely difficult.

Contagium.—The nature, composition, and the circumstances necessary for the production of this, as well as of most other animal poisons, is still a mystery. All we know is, that it is a *fixed virus*, and therefore, can only be introduced into the system by inoculation. It seems to be more concentrated and abundant in the saliva than in any other part of the body; but we have reason to believe, it is present in the secretions and excretions (Röll, Hering), in the blood, and consequently in all organs and parts of the still warm body (Haubner, Eckel, Lafosse, Röll, Fleming, and others); although others (Breschet, Majendie, Dupuytren), from some cause or other failed to transmit the disease by inoculating with the blood of rabid animals. Whether the poison is present in the saliva, blood, and other parts during the incubative stage is unknown. There is no evidence to show that dried virus is virulent; and the contagium is found to be destroyed by ordinary influences, such as heat, calcium chloride, caustic alkalies, and concentrated acids. It is a disputed point whether the meat and milk of rabid animals are fit for animal food; but few doubt the innocuousness of butter and cheese made from such milk. M. Galtier has recently (1881) found that the saliva of a rabid dog which has succumbed to the disease, or has been killed, does not lose its virulent properties through mere cooling of the body. It is important, therefore, in examining the cavities of the throat and mouth after death, to guard against inoculation. The same observer has also found that the saliva of a rabid dog, obtained from the living animal and kept in water, continues virulent for five, fourteen, or even twenty-four hours in the case of the rabbit. Water from which a mad dog may have drunk must, therefore, be considered dangerous for at least twenty-four hours. Although previous observations and experiments seem to prove that the virus loses its potency as soon as the body is cold, or *rigor mortis* has set in, and it has therefore been assumed, *à fortiori*, that the flesh of rabid animals might be eaten cooked (Dr. Lecamus) or uncooked (Decroix, Bourrel, &c.) with impunity, even if the mucous surfaces were injured, these statements must now be received with great reserve.

Animals that are inoculated with fresh (warm) saliva, blood, &c. do not in all cases contract the disease. Renault inoculated ninety-nine animals (horses, dogs, and sheep), and only sixty-seven became affected. Röll says that successful inoculations vary from 24 to 70 per cent., whilst from the bites of rabid dogs the proportion varies between 20 and 70 per cent., showing that the disease is comparatively less likely to follow from the natural (bite) than from the artificial (injection, &c.) introduction of the virus. This is probably due to the bleeding produced by the bite washing the poison out again, or to the bitten subject, the clothes, hair, &c. wiping the teeth before they pierce the skin. The recent researches of MM. Pasteur and Galtier seem to show that the diluted poison of hydrophobia, injected into the blood of animals, acts as a preventive of the development of the disease. It must also be remembered that the percentage—however the poison is introduced—is larger in carnivorous than in herbivorous animals or man. Fleming tabulates them thus:—'Dogs and cats hold the first place in the scale of susceptibility; then man and the pig; next ruminants, the sheep and goat being more susceptible than the ox; and lastly the horse.'

It has been denied by some authorities (Betti, Girard, Vakl, Huzard, Dupuy, Lafosse, &c.), that the virus of other than canine and feline animals, or those which use their teeth as natural weapons of defence, is capable of transmitting the disease to others. But of late years, this has been proved by many (Bourrell, Eckel, Berndt, Youatt, Breschet, Majendie, Earle, and others) to be incorrect.

Incubation.—The period of incubation in rabies ranges between extremely wide limits; but the average period in any animal may be said to be from three to six weeks. It is comparatively shorter in young than in old animals. Spinola said that gestation prolongs it, and according to Fleming it appears sometimes to be hastened by excitement, anger, sexual irritability, terror, injury to the cicatrix, sudden changes of temperature, and other causes.

Anatomical Characters. — The anatomical changes in rabies are by no means constant, nor do they at all equal what one would expect to find, judging from the symptoms presented during life. The following are the principal lesions found.

The skin may be covered with mud, and wounded, especially about the lips. The visible mucous membranes may be injected; the teeth fractured; the tongue swollen, dark red, and wounded. The mucous membrane of the fauces, larynx, trachea, pharynx, œsophagus, stomach, and intestines may be swollen, congested, hyperæmic, or may present hæmorrhagic erosions, and signs of catarrh. The tonsils and salivary glands may be enlarged and vascular. The stomach usually contains some indigestible and foreign substances, such as pieces of wood, leather, straw, hay, or iron. These, however, are rarely found in herbivorous animals. The small intestines are usually empty, or only contain a mixture of bile and mucus. The solitary, agminate, and mesenteric glands may be found enlarged. The spleen is frequently enlarged and congested, hence the disease has often been mistaken for anthrax. The blood is dark-coloured, and coagulates with a soft loose clot. The kidneys and bladder may be hyperæmic, and the latter is usually emptied and contracted. The lungs are generally gorged with blood. The vessels of the cerebro-spinal coverings may be congested, and serous effusions in the cavities will be sometimes observed. Williams says: 'On the lower surface of the medulla oblongata, at the origin of the seventh, eighth, and ninth pairs of nerves, the membranes are generally highly congested, thickened, softened, and matted together.' The brain-substance may be soft and friable; there is rarely congestion; and, as a rule, the brain is pale and bloodless (Fleming).

The *microscopical* changes have not at present been thoroughly worked out. Benedikt concludes, from examinations of numerous sections taken from various parts of the nervous centres, that the pathological process in this disease consists in acute exudative inflammation with hyaloid degeneration, which doubtless arises from the exudative infiltration of the connective tissue (Fleming). *See* HYDROPHOBIA.

SYMPTOMS.—In the lower animals, the trains of symptoms are so marked, that they have given rise to the distinction of two different forms of the disease: one in which the nervous system is excited, hence the terms *furious*, *wild*, or 'excited' rabies; the other, where it seems to be depressed, and to which the names of '*dumb* tranquil,' 'torpid,' or 'paralytic' rabies have been given. Although this distinction is convenient for description, it must not be forgotten that paralysis, in some form or other, usually sets in, sooner or later, in the excited form; whereas in the latter it is rarely, and then only for a short time, preceded by any signs of excitement or inclination for mischief. In other words, the symptoms of rabies may be divided into three stages, namely, the *premonitory*, *irritative*, and *paralytic*. In the 'furious' form, all three stages are well-marked; but in the 'dumb' form, only the first and last. The transition from one stage to the other is gradual and imperceptible.

The *premonitory stage* is characterised by an alteration in the manner and habits of the animal. Dogs, for instance, that are naturally friendly and docile, suddenly turn surly and bad-tempered, and as quickly return again to their former docile manner, showing more affection than usual. Nearly all animals are restless, and frequently change their posture and position. Most are dull, lazy, languid, and seek seclusion from society by hiding themselves in dark and quiet places. Irritation at the seat of inoculation, demonstrated by rubbing, nibbling, or scratching the cicatrix, is frequently an early symptom. The appetite is lost, and in ruminants rumination is suspended. Sometimes a depraved appetite is present, evidenced in dogs and pigs by their eating all sorts of strange things, such as wood, iron, &c.; and these, as well as sheep, often swallow their own fæces and urine; whilst the latter have been seen to lick blood and even eat their wool. Carnivorous animals and pigs frequently 'gulp,' as if trying to swallow something, or retch, as though to free their throat from some foreign body; and vomiting sometimes occurs. The visible mucous membranes are red, and saliva almost always (except in horses) drivels from the mouth, due in all probability to dysphagia. The sexual organs of all species, except the pig (Haubner), are frequently excited in the early stage of this disease, and ungovernable salacity is present. The bowels are constipated; the urine suppressed.

These symptoms may last from twelve to forty-eight hours, and then gradually pass either into the irritative, marking the 'maniacal' form, or into the paralytic stage, characteristic of th 'melancholic' form.

The *irritative stage* is distinguished by a propensity to injure other animals; by great uneasiness; and by paroxysms of fury and excitement, with intervals of quietude and exhaustion.

The increased restlessness, which marks the commencement of this stage, is manifested differently by various animals. They are constantly changing their position and posture. Dogs lie down in one place and quickly shift to another; horses move their ears backwards and forwards, as though they were listening to some distant sound.

During the paroxysms dogs become excited; disturb their beds; tear carpets, mats, or whatever comes in their way; and bite their kennels, chains, other animals, and even their own bodies. They may lie quietly for a time, and then suddenly jump up with a peculiar howl; remain in the same posture for a time; look vacantly around them; then suddenly walk forward as though following something; and all at once snap at some imaginary object. The dog may obey its master's call, although reluctantly, and look up pitifully, as though it did not wish to be disturbed. The tongue is swollen, and frequently dipped into water to cool it, although the poor creature cannot swallow any, and saliva hangs in strings from the angles of its mouth. The countenance is anxious and haggard. If the animal should succeed in escaping from its kennel at the early part of this stage, he wanders forth 'on the march,' apparently not knowing or caring where he goes. If anything comes in his way he immediately attacks it, and then resumes his journey. The gait and carriage of the dog are at first natural, but as the nervous energy fails, he becomes unsteady and tottering; the tail drops between his legs; his head is carried near the ground; the abdomen is 'tucked up;' and the poor beast, which a few days previously was plump and fresh-looking, is now comparatively a skeleton. Dogs generally endeavour to retrace their way back to their homes to die. Cats are very savage, arch their backs, lash their tails, and freely use their teeth and claws. Horses become very violent, frequently neigh, bite the bars and mangers, kick, paw, and endeavour to get loose. Cattle rarely, if ever, use their teeth, but bellow, paw the ground, butt and toss, frequently breaking their horns. Sheep seldom, but goats often, use their teeth. Their natural timidity is replaced by a pugnacious disposition, and they will even attack dogs. Pigs slaver at the mouth, bite their fellows and other animals, and become very wild. Poultry make stupid high jumps and other frenzied movements, peck one another, and chuckle frequently. The voice of all animals affected with rabies is altered in character, and is continually being exercised. In dogs, the character of the voice is one of the best diagnostic signs of the disease. It has a peculiar high-toned, croupy, ringing sound, as if the bark and howl were blended together. In the early part of this stage of the malady, the eyes are bright and glaring—especially in cats; but as the disease advances, the bulbus oculi retracts in its orbit, and the membrana nictitans is forced half over the cornea, giving the animal a horrible and forlorn appearance.

At first the paroxysms are strong and prolonged, but as the disease progresses they become weak and short, and the periods of depression which intervene between the paroxysms are lengthened, until finally the animal has not power or strength to move his limbs, when the *paralytic* stage may be said to have commenced. We now notice continual twitching and convulsions of the muscles—even tetanus; and death soon takes place.

The *paralytic stage* of the 'dumb' or 'torpid' form of the disease is marked by 'dropping' or paralysis of the inferior maxilla, rendering the animal unable to bite or bark. Although at the commencement of this stage there may be an inclination in the dog to leave its abode and 'march;' still it is less so than in furious rabies, and if he do go, the creature either quickly returns again, or seeks some secluded spot in which to die. The animal endeavours to remain quietly in a dark place, and takes little notice of what is going on around him. The tongue is swollen, livid, and hangs out of the mouth; the saliva is tenacious and abundant. Paralysis of the posterior extremities soon sets in, and death quickly follows. When the tranquil form of rabies attacks other animals than dogs, it usually paralyses the posterior extremities.

Duration and Termination.—Rabies generally takes a rapid course, sometimes killing within forty-eight hours, and rarely lasting more than ten days, although cases of canine madness have been reported to have lasted from fifteen to twenty days. The duration depends to a certain extent upon the constitutional vigour of the animal. The termination is fatal in all animals.

Diagnosis.—Marochetti and others have asserted that rabies can be diagnosed a few days after inoculation, by the presence of a sublingual vesicular eruption, but there is no evidence to warrant us in believing this statement; and Mr. Fleming remarks, 'that it is much to be regretted that those who have seen these *lyssi* did not resort to inoculation with the contents of the vesicles to prove whether they really contained the morbific elements or not.'

The most characteristic symptom of the 'furious' form is undoubtedly the peculiar voice; and of the 'dumb' form the dropping of the inferior maxilla. But since these symptoms only appear when the disease is comparatively advanced, we must take other symptoms into consideration, such as the behaviour of the animal, its physiognomy, inclination to bite, and to eat strange and indigestible substances. An acquaintance with the history of the case is necessary if we would avoid confounding it with other diseases.

Epilepsy is distinguished from rabies by the sudden and complete loss of sense, champing of the jaws, foaming at the mouth, convulsions, cries, and rapid recovery.

Distemper has sometimes been mistaken for rabies, from the fact that catarrh of the eyes and nose, giddiness, weakness, and emaciation are sometimes present in both diseases; and it is just this, with the fact that epilepsy is sometimes a sequela to distemper, that undoubtedly led the late Mr. Grantley Berkeley, a professed authority on rabies, to state, 'that dogs become utterly insane from distemper, and that if this disease be prevented by vaccination, hydrophobia (rabies) will be decreased.' It is scarcely necessary to say that such assertions are liable to cause great mistakes.

Foreign substances in the fauces or pharynx, especially in the dog, may be distinguished from rabies by the history of the case, and by careful examination.

Inflammation of the throat only presents one symptom of rabies, namely, inability to swallow.

Gastritis and *enteritis* may be distinguished by the absence of the nervous symptoms, and by the pain produced on pressing the abdomen.

Phrenitis, especially in horses, may be confounded with rabies; but although the animals may be delirious, there is no inclination to do mischief, nor are they irritated by the presence of a dog or a person, and the course of the disease will soon decide the question.

Tetanus in the dog has been confounded with rabies, but this is such a rare disease in dogs, cats, cattle, sheep, goats, and pigs, as to call for no special mention. In horses such a mistake could scarcely happen.

Anthrax. The pathological changes of rabies and anthrax, says Mr. Fleming, have at times lent some support to the idea that they were identical, or at least resembled each other. Although vertigo, and a disposition to fury, do in some cases accompany anthrax in the lower animals (especially in the horse), the other symptoms of anthrax, the rapidity with which it runs its course, and the pathological anatomy of the several diseases, will serve to distinguish one from the other. The presence of the bacillus anthracis in the blood is absolutely characteristic.

Cattle-plague. The fits of delirium that now and again appear in this disease, as well as the great depression, apathy, and the unsteady gait, have a resemblance to those present in a certain stage of rabies. But this resemblance is very superficial. The existence of the plague in the district, and the appearance of the visible mucous membranes, and the other symptoms during life, as well as the pathological alterations after death, are sufficient to establish a distinction (Fleming).

A ferocious dog has frequently been mistaken for a rabid one.

There are no *post-mortem* signs sufficiently trustworthy or characteristic to enable us to form a correct diagnosis of rabies. The history of the case, however, together with the fact that foreign bodies are present in the stomach, and the mucous membrane of the fauces, larynx, and stomach congested, will materially assist us in forming a correct opinion.

Treatment.—The *curative* treatment of rabies, so far as our experience at present goes, has yet to be discovered; and since the malady is so dangerous to other animals and man, we think its cure ought not to be undertaken, except by experienced persons and under adequate restrictions.

The *prophylactic* treatment, however, deserves our best consideration. If an animal has been inoculated by a bite from a rabid animal or otherwise, the circulation in the part should be immediately stopped by a compress above it; the wound thoroughly washed, sucked, or cupped; and all parts that are supposed to have been in contact with the virus excised, and either the actual or potential cautery freely applied. In the lower animals, some of the wounds may escape our notice on account of the hair, and therefore even after the above precautions are taken, the subject must be treated as suspicious. Cows, sheep, and pigs, if the wounds have been promptly cauterised, may be used for food, provided they have been killed within twenty-four hours of the inoculation. If an animal is suspected of being inoculated from, or has been in company with, one affected with rabies, it should be kept in a secure place, and watched for at least four months, and then only allowed to go out muzzled, but it is preferable to destroy it. If such an animal has bitten any person, it should not be destroyed until it has been positively ascertained whether it is rabid or not. All affected animals should be killed at once and burned, or buried deep with quick-lime. The researches of MM. Pasteur and Galtier suggest the advantage that may result from the intravenous injection of the diluted poison, for the purpose not only of preventing the disease, but, even after an animal has been bitten, of mitigating the severity of the symptoms.

When a case of rabies has occurred, notice ought to be given at once to the local authorities, to prepare them for making and enforcing stringent measures to prevent its spread. No dogs ought to be allowed to enter public buildings or conveyances, or to frequent the public streets or highways, without a muzzle, under the penalty of being seized by the police.

If a rabid animal is at large, notice should be given of the fact to the neighbourhood as soon as possible. All kennels, chains, collars, and places with which a rabid animal has been in contact should be scalded and disinfected.

George A. Banham.

RACHITIS (ῥάχις, the spine).—A synonym for rickets. *See* Rickets.

RAGATZ, in Switzerland.—Simple thermal waters. *See* Mineral Waters.

RAILWAY ACCIDENTS, Results of.—The results of railway accidents are, first, *immediate*, such as those which follow directly and continuously on the occurrence of the accident; and, secondly, *indirect* or *remote*, which follow at a later period, after an interval of apparent immunity. The points of difference between railway injuries and those sustained in other ways, such, for instance, as by a fall from a horse or a carriage, are virtually those of degree. This effect is referable, firstly, to the great weight and impulse of the train, crushing perhaps completely some portion of the body; secondly, in the case of collision, to the sudden arrest of momentum of such ponderous bodies in more or less rapid motion, causing thereby violent vibratory shocks to the travellers. Thirdly, the occurrence being sudden and unexpected, the muscles are, as it were, taken by surprise, and before contraction takes place, the ligaments of the spine are frequently strained or even torn. There is no time for preparation; the whole is the work of an instant. Fourthly, in cases of injury to those who jump or fall from a train in motion, the gravity of the resulting injury depends on the rate of speed of the train at the moment; on the part of the body which first strikes the ground, and the angle at which it is struck; on the weight of the person; and also on the nature of the ground.

Accidents which happen to persons either getting into or out of trains not in motion, possess no special characters. It should, however, be mentioned that serious spinal injuries have occurred to persons sitting in a train not in motion, when, by a sudden unexpected jerk, a violent shock is sustained.

It is, therefore, this violent and sudden commotion of the system which constitutes the main feature in this class of injuries, a condition which does not obtain in cases where there is less sudden violence.

Most of the direct results of railway accidents are so obvious as not to need description here. They consist of various kinds of fractures, contusions, and lacerations, caused either by the force of the collision, or by crushing and grinding under the wheels of the carriages when the individual has been run over, or by fragments of splintered wood, iron, and glass, or by burns or scalds. These injuries either cause immediate death; or the patient may ultimately succumb, or he may be permanently injured, or recover. Occasionally death results simply from fright; the influence of intense fear on the minds, especially of persons suffering from heart-disease, aneurism, and the like, being sufficient to cause death. The primary depression produced on the nervous and circulatory system continues and deepens; there is no power to rally; and a fatal result from syncope ensues.

Direct results on the cerebro-spinal system.—The injuries following directly upon a railway accident are of considerable interest, both on account of the difficulty of arriving at a definite diagnosis, and because of the important issues dependent on the prognosis. They comprise conditions of general shock and concussion, where the symptoms presented are principally subjective; and of local injury, such as fracture of the skull or of the spine, implicating the brain, the spinal cord, or their membranes, stretching or rupture of spinal ligaments, to a greater or lesser extent, injury to the pelvis, and other lesions.

For a description of concussion of the cord, and the localisation of lesions of the spinal cord, *see* Spinal Cord, Diseases of.

Indirect results.—In this class of cases the extent of the injury is not evident at the time of the accident; for instance, a person in a collision receives a shock of apparently a temporary character; recovers himself sufficiently to be able to assist his fellow-sufferers; returns home; and resumes his usual avocations. After an interval of days, symptoms of spinal trouble show themselves; the person experiences pain in this region, tenderness on pressure or on the application of a hot sponge, and inability to sleep or to attend to business; he hears noises in the ears; and he feels a general exaltation of the sentient faculties. Cases such as these are frequently the subject of litigation as regards claims for damages against railway companies.

Medico-legal questions in connexion with railway accidents.—In cases of claim for compensation for these injuries, it is of the highest importance that the medical men engaged should make themselves thoroughly acquainted with all the circumstances connected with the accident and its results. This applies to the medical attendant of the injured person, as well as to the medical officer examining on behalf of the company.

It will, therefore, be well to refer to the general character of some of the fraudulent claims made upon railway companies.

Fraudulent claims.—There are three principal kinds of fraud practised, and sometimes with success, namely, first, by persons who, as may be subsequently proved, were not even present at the time of the accident; secondly, by those who, though present and unhurt, yet simulate symptoms of injury; and, thirdly, by those who, having sustained some trifling injury, wilfully and intentionally exaggerate their symptoms, in order to obtain an unfair amount of compensation. There are, therefore, certain points to which the medical man should attend, lest he should be led away by a well-planned history, and thus unwittingly be made a party to such transactions.

Duties of the medical attendant.—1. It is desirable to obtain in writing the patient's statement as regards the accident; if possible ascertaining, approximately, the rate of speed of the train when the accident occurred, the position of the person in the carriage, and whether other persons were present or not.

2. Note bruises or any sign of local injury on any part of the body.

3. Where injury to the spine is alleged, the investigation should be conducted as far as possible according to the following systematic plan:—

(1) Examine the spine by percussion, and by the application of a hot sponge.

(2) Seek for any paralytic phenomena by—

(*a*) Measurement of limbs.

(*b*) Comparative degree of surface sensibility.

(*c*) Comparative amount of electrical irritability of muscles.

(*d*) The existence of spasm or tremor of the muscles of the spine and limbs.

(3) Ophthalmoscopic examination must be made, in order to determine the existence or non-existence of local lesion, confirmatory or otherwise, of cerebral or spinal symptoms.

This done, it becomes the duty of the medical attendant to form an opinion after satisfying himself on the following points:—

α. Has the patient really been injured?

β. What is the nature of the injury?

γ. Is the injury a possible result of the accident as described?

δ. Is the train of symptoms consistent with the appearance of injury.

He should also remember that the simulation of symptoms, such as spinal tenderness or muscular tremor, can frequently be detected by distracting the attention, when pressure on the part previously complained of may be exercised with impunity, and the muscular tremors will cease. This, however, is not conclusive of imposture, for in hysteria, when the attention is diverted, the same occurs. Again, the existence of organic disease previous to the accident should be looked for, as it has happened that symptoms referable to disease—locomotor ataxy, for example—have been erroneously ascribed to injury. The urine should be examined in every case.

As an instance where the truth of a patient's statements may be tested by the astuteness of the medical man, a case may be mentioned where the plaintiff, who had travelled up some fifty miles to London to be examined, stated among other symptoms that his urine continually dribbled from him. The surgeon immediately asked to see his shirt, which had been worn at least six hours, when it was found perfectly dry and devoid of any stain of urine! In another case a man presented extreme spinal tenderness, even to the extent of complaining of pain when the part was blown upon with the breath. A sheet of paper being interposed, without the patient's knowledge, the effect was the same.

Duties of the medical officer examining on behalf of the railway company.—The medical officer of the company should not constitute himself the agent of the company for settling the terms of compensation. The examination should be made, if possible, in the presence of the patient's medical attendant, and should be conducted thoroughly, with tact, and without inflicting any unnecessary mental or bodily pain.

A report of the case should be drawn up at the time, giving:—

1. The patient's account of the accident, and of his subsequent and present symptoms.

2. The present condition of the patient, noting particularly any objective signs of injury.

3. An opinion as to whether the symptoms complained of are likely to be the result of the accident, as to the probability of recovery, and at what period.

As the plaintiff in an action has a right to a copy of this report, it should, of course, be worded with extreme care.

The actual question of pecuniary compensation does not concern either the medical attendant of the patient or the medical adviser of the company. They merely have respectively to bring forward facts in support of their opinions as to the value of symptoms, and how far they are dependent upon the injury.

By an early investigation in such a manner as indicated, the practice of fraud would be rendered impossible, and by an accurate knowledge and statement of facts much conflict of medical opinion might be avoided.

Unintentional exaggeration of symptoms. There are certain persons who, undoubtedly injured, without having any fraudulent design, may yet unintentionally exaggerate their symptoms in consequence of the continual direction of their minds to their sufferings, whilst an action for damages is pending. The suspense and anxiety, the examinations by the medical men, and the repeated interviews with their solicitors, keep them in a constant state of nervous excitement. When, therefore, their claims are settled, it is natural that the relief they experience should frequently be attended by beneficial results, or even complete recovery. *See* Feigned Diseases.

Treatment.—The chief injuries received at the time of a railway accident being surgical, the treatment adapted for each particular case will be found in surgical works. Nevertheless there are some general points in the immediate treatment, to which any medical man present on such occasions would do well to attend.

1. *Hæmorrhage.*—Death from hæmorrhage should be prevented by promptly adopting pressure of some kind. If no tourniquet be at hand, or india-rubber band, a handkerchief tied round the limb and twisted tight with a piece of stick, will suffice for the time, or direct pressure by the finger.

2. *Fractures.*—Temporary splints may be improvised out of cushions, newspapers, straps, and broken pieces of wood, &c., so that the injured may be removed with as little pain as possible, and simple fractures may be prevented becoming compound. Simple dislocations should be reduced at once if possible.

3. *Shock, collapse, and fright.*—In the treatment of these conditions great caution is required to maintain the vital power until reaction sets in. The temperature of the body, the strength and rate of the heart's action, together with the respiration, should be kept up by stimulants and warmth. Mr. Savory, in his article on Shock in Holmes's *System of Surgery*, is careful to point out, however, the dangers of over-stimulation, whereby the flickering powers may be extinguished altogether.

4. *Exposure to wet and cold.*—Every endeavour should of course be made to prevent prolonged exposure, by sheltering the injured as much as possible, and securing their early removal to any neighbouring houses.

W. Rose.

RÂLES (Fr., Rattles).—Certain adventitious sounds heard on auscultation, in connection with the respiratory organs, during the act of breathing, in various morbid conditions. *See* Physical Examination; and Rhonchus.

RAMOLLISSEMENT (Fr., Softening).—This word is associated with all forms of softening of tissues and organs; but by English pathologists it is generally used to denote softening of the central nervous system. *See* Softening.

RANULA (*ranula*, dim. of *rana*, a frog).—A cystic growth in connection with the mouth, and having several modes of origin. *See* Mouth, Diseases of.

RAPE.—Synon.: Fr. *Viol*; Ger. *Nothzucht.*

Definition.—By the English law rape is defined as 'the carnal knowledge of a woman forcibly and against her will.'

General Remarks.—The crime of rape is punishable by penal servitude for life. The carnal knowledge of any girl under ten years of age is punishable in the same way; and the carnal knowledge of any girl between ten and twelve, under any circumstances, is punishable by three years' penal servitude, since the law rightly considers that children under twelve can have no power to consent to sexual intercourse.

Of cases of rape recorded by Casper, 73 per cent. were upon the persons of little children under twelve. Of 136 cases put upon record by this author, the ages were as follows:—

From 2½ to 12 years of age,	99 cases.
„ 12 „ 14 „ „	20 „
„ 15 „ 18 „ „	8 „
„ 19 „ 25 „ „	7 „
47 „ „	1 „
68 „ „	1 „

For proof of the crime of rape it is not necessary that the force employed should have been of a violent physical kind. A mere *threat* of violence, or even of moral injury, is 'force' in the eyes of the law. The surreptitious administration of chloroform, or a narcotic, for the purpose of having intercourse with a woman against her will, is also force in the eyes of the law.

The moral character of the woman is theoretically, but seldom practically, beside the question; and, provided force be used and the woman's consent be wanting, sexual intercourse even with a prostitute is legally 'rape.'

The punishment of the crime of rape was provided for in the criminal code of Moses, who ordained that the ravisher of a betrothed damsel should die.

The Roman law punished the crime with death and confiscation of goods, but provided the following saving clause:—

Rapta raptoris, aut mortem, aut indotatas nuptias optet.

Upon this, says Percival, there arose what was thought a doubtful case: '*Una nocte quidam duas rapuit; altera mortem optat, altera nuptias.*'

Many accusations of rape are false and trumped up, and are only brought by the woman when she finds that some sexual indiscretion is likely to bring her into trouble, or cannot be concealed by reason of her pregnancy.

This being the case, *stale accusations* should be received with very great caution. The laws of Henry III. provided that the accusation should be made immediately, '*dum recens fuerit maleficium.*' By the old Scotch law no delay was allowed in bringing the accusation *ultra unam noctem*, and by the modern Scotch law a delay of three days is alone permitted. By the law of England no limit is placed on the time at which an accusation of rape may be made. An English jury is, however, naturally chary of giving credence to a stale charge of rape. Some few years back a charge of rape was brought against a gentleman of position in one of the home counties, by a girl with whom he had had connection some five months previously. There was no evidence that the girl had offered any resistance, and as the accusation was brought only after pregnancy had become evident, and after ineffectual attempts had been made to extort money from the defendant's relatives, and as the charge was evidently made at the instigation of an uncle who was a superintendent of police, and a cousin who was a lawyer, the case was dismissed.

It shows, we think, an imperfection in the English law that it should be possible, under such circumstances, to prefer a charge of so serious a crime.

The law for the substantiation of a charge of rape is satisfied with proof of a minimum amount of 'carnal knowledge.' The mere touching of the vulva by the penis is carnal knowledge in the eyes of the law. The complete introduction of the penis into the vagina need not be proved, and still more is proof of emission unnecessary.

THE SIGNS OF RAPE.—From what has gone before, it is evident that there need be no signs whatever. If a girl be overawed by a threat and her vulva be touched by the penis, that is rape; and, if proved, is punishable as such.

On the other hand, the signs of rape may be very obvious, for example:—

(*a*) The woman may have been heard to cry for help.

(*b*) There may be the signs of a struggle at the spot where the rape was alleged to have occurred.

(*c*) There may be damage to the woman's clothing, and bruises of various parts of her body—signs that she has been subjected to physical force.

(*d*) The genital organs may be found injured; the vulva bruised and perhaps bleeding; the hymen recently ruptured; and, in cases where the disparity in size between the man and woman is very great, rupture of the perinæum and mortal injuries to the vagina.

(*e*) Seminal spots may be found upon the woman's clothing, which is a certain proof of a previous 'intimate relation' with a male. Blood-spots also afford valuable evidence, but necessarily not so conclusive. Care must be taken not to confound menstrual fluid with blood.

The concurrence of all these signs would amount to certain evidence of forcible connection. It must be borne in mind, however, that violence may be done to the female organs in other ways than by forcible connection, and the medical examiner should be upon his guard against inferring too much from the evidence afforded. He also should be on the look-out for facts which may rebut assertions made by the woman. Thus, signs of a previous pregnancy or the evidence of previous venereal disease (scars in the groin, sores upon the pudenda, or symptoms of constitutional syphilis) may serve to disprove any assertions which might be made as to the woman's virginity or previous chastity. To *prove* whether or no a woman be '*virgo intacta*' is next to impossible, and we can only state the probabilities for and against. Such a question, however, is quite beside the mark in many cases of rape; but the presence of an unruptured hymen is an unlikely occurrence after forcible connection. An examination of the person of the supposed ravisher may afford some corroborative evidence. Blood or recent seminal spots upon the linen or clothing, and injury to the person or clothing, all afford their quota of evidence of a sexual act combined with violence.

It is a matter of doubt whether the rape of a woman of fair size and strength be possible by an unaided man. If a woman be in the enjoyment of her faculties she is capable of offering an amount of resistance which would be well-nigh insuperable; and if she have offered a decent resistance, the person of the ravisher should bear evidence of it.

Rape, as we have seen, is most often committed on children of tender years. It is well to be on one's guard against error with regard to the rape of little children. It must have come within the experience of most members of the profession, and especially of those engaged in hospital practice, to have brought to them children suffering from a purulent discharge from the vagina, the mother at the same time alleging that someone must have violated the child. It must be borne in mind that purulent discharges from the vagina are not uncommon in ill-fed, dirty, scrofulous children; and that after some of the infantile acute specifics, sloughing of the pudenda is a rare, though recognised, occurrence. The case of Jane Hampson, æt. 4, who died of sloughing of the genitals at Manchester in 1791, should stand as an incentive to caution in these matters. The signs were considered as those of defloration, and the coroner's jury returned a verdict of *murder* against the boy who slept with her, but luckily for the male child there occurred many other cases of sloughing of the pudenda in Manchester before he was brought to trial, and as the doctor who was called to Hampson recognised and acknowledged his error, the boy was discharged. It was at one time a popular belief that connection with a virgin was a sure cure for venereal disease, and this has led, no doubt, to many cases of rape on young children. The presence of venereal disease in one or both of the parties may be of value as evidence. Its presence in the woman and not in the man affords a strong presumption against rape.

The finding of spermatozoa within the vagina is proof positive of connection. But here, again, care must be taken not to mistake for spermatozoa the *trichomonas vaginalis*—a microscopic organism, not unlike a tadpole in shape, which has been described by M. Donné, as occasionally found in vaginal mucus. It must be remembered, also, that seminal fluid may contain no spermatozoa. Rape is occasionally effected with so much violence that death results. Ogston records the case of one Margaret Paterson, who was raped between Edinburgh and Dalkeith by two carters, who took her into their cart on the pretence of helping her on her journey. They forcibly held her down and repeatedly violated her person, and afterwards took stones from the road, coals, straw, prickly plants, &c., and forced them into the vagina. They then left her in a ditch, and she died in three days of her injuries. *Post mortem* the vagina and rectum were found lacerated and broken down into one passage, and the abdominal viscera in a high state of inflammation. The two carters were convicted and executed.

It has been doubted whether pregnancy can follow rape, but there seem to be no sufficient grounds for this doubt.

When called to a case of supposed rape the medical examiner must remember to take note of every circumstance—the time that has elapsed since the alleged outrage, the mental state of the woman, her size and physical power as compared with that of the man, evidences of a struggle in the surroundings of the woman, or on her clothing and person. He should keep his mind open to receive any facts which may throw light on the moral character of the woman. He should accurately take note of the exact condition of the genital organs and linen; should take possession of all stained linen for the purpose of chemical and microscopic examination; and should remove a portion of any discharge which may be found in the vagina for the same purpose. In drawing up a report, he should describe, as accurately and drily as possible, all facts which he may notice; and should be carefully upon his guard against drawing any undue conclusions from those facts. G. V. Poore.

RASH.—An outbreak of redness of the skin, or efflorescence; called by the Greeks an *exanthema*, or blossoming out. The word rash, or as it were 'rush,' conveys the idea of suddenness, whilst in reference to development it is generally extensive. The best illustrations of the rashes and of the meaning of the term are erythema, the red rash; roseola, the rose-rash; rubeola, the crimson rash, generally known as measles; scarlatina, the scarlet rash; purpura, the purple rash; and urticaria, the nettle rash.

RATIONAL (*ratio*, reason). In conformity to reason.—A term applied to the mental state; also to treatment when founded on scientific principles, in contradistinction to *empirical* treatment, founded solely on experience. *See* Consciousness, Disorders of; and Disease, Treatment of.

REACTION.—When any substance or influence affects the organism sufficiently to cause appreciable physiological disturbance within it, it is said to have a *physiological action* upon the body; or, more briefly, to *act* or to have an *action* upon it. If the effect of such an influence have been well-marked, the organism does not simply return to the original or ordinary condition, or to what is called the 'physiological balance,' with the cessation of the influence; but passes beyond it into a state characterised by phenomena, which are, speaking broadly, the opposite of the former. The condition which is thus the effect or outcome of the *action* is called the *reaction*; and the same name is also given to the *process* by which the primary effect passes into the secondary. The cold bath furnishes a familiar illustration of physiological action and reaction. The contraction of the superficial vessels, the pallor, the sensation of intense cold, and the fall of temperature, which are the immediate effects of the cold bath, are speedily replaced by such exactly opposite phenomena as dilatation of the cutaneous vessels, flushing of the skin, a warm glow, and a rise of temperature; and in the same way the primary nervous stimulation gives way to a feeling of general calmness and comfort. It is generally found that the phenomena of action and reaction are in direct proportion to each other, unless the action be excessive, in which case reaction may not set in. In other instances the irritability or excitability of the organism, whether as a whole or in part, may be either unnaturally increased or unnaturally diminished, and the reaction be *excessive* or *imperfect* accordingly.

Excessive emotional excitement, whether pleasurable or painful in nature, such as joy or fear, may similarly be followed by corresponding depression, by prostration, or even by death. In the reaction which follows severe injuries, especially when they are met with under circumstances of intense fear—for example, in railway accidents, both the bodily and the mental functions, so called, are simultaneously involved.

The effects of reaction are also illustrated *locally* in the condition of wounds. Local reaction takes the form chiefly of inflammation, and is carefully studied by the surgeon, who finds in it a ready means of estimating the severity of an injury; the vigour of the system generally, and of the affected part; or, it may be, the value of some particular kind of treatment.

Reaction may itself call for treatment when it is either imperfect or excessive. Stimulation is demanded in the former case, for instance, by warmth, alcohol, or ammonia. When reaction is excessive, nervous and circulatory sedatives are equally indicated.

J. Mitchell Bruce.

RECEPTACULUM CHYLI, Diseases of. The receptaculum chyli is the dilated portion forming the commencement of the thoracic duct, which receives the contents of the lacteal vessels and of the lymphatics of the lower limbs and abdomen. It lies deep in the abdominal cavity, about the level of the first lumbar vertebra. The only morbid conditions which need be specially noticed in connection with it are *dilatation* and *rupture*. The receptaculum has been found in rare instances enormously dilated, and its walls thickened. It has also been known to burst as a result of this dilatation, with the escape of its contents into the peritoneal cavity, fatal peritonitis being thus set up. It would be quite impossible to diagnose these conditions during life, and they have only been discovered on *post-mortem* examination.

Frederick T. Roberts.

RECRUDESCENCE (*re-*, again, and *crudesco*, I become fresh).—The increase or exacerbation of a disease or morbid process, after a temporary diminution; for example, of fever or inflammation.

RECTUM, Diseases of.—Synon.: Fr. *Maladies du Rectum*; Ger. *Krankheiten des Mastdarms*.

The diseases of the rectum may be conveniently discussed in the following order:—1. Congenital imperfections; 2. Fistula in Ano; 3. Malignant Disease; 4. Polypus; 5. Prolapsus; 6. Stricture; 7. Villous Tumour; and 8. Ulceration. Other diseases connected with the rectum will be found discussed under special headings. *See* Anus, Diseases of; Defæcation, Disorders of; Hæmorrhoids; and Stools, Characters of.

1. Congenital Imperfections.—Malformations of the rectum may be classed as follows:—1. Imperforate anus, without deficiency of the rectum. 2. Imperforate anus, the rectum being partially or wholly deficient. 3. Anus opening into a *cul-de-sac*, the rectum being partially or wholly deficient. 4. Imperforate anus in the male, the rectum being partially or wholly deficient, the bowel communicating with the urethra or neck of the bladder. 5. Imperforate anus in the female, the rectum being partially deficient and communicating with the vagina. 6. Imperforate anus, the rectum being partially deficient, and opening externally in an abnormal situation by a narrow outlet. 7. Narrowing of the anus. These imperfections can be remedied only partially or completely by surgical operations.

2. **Fistula in Ano.**—DESCRIPTION.—The loose areolar tissue around the lower part of the rectum is occasionally the seat of abscess, which bursts externally near the anus (*see* PERIPROCTITIS). But instead of the part healing afterwards, like abscesses in other situations, the walls contract and become fistulous, and the patient is annoyed by a discharge from the opening. On introducing a probe it may pass through a small opening in the coats of the rectum into the bowel. The case is then called a *complete fistula*. When there is no external opening, the complaint is named *blind internal fistula*. The external orifice is usually near the anus, being indicated by a button-like growth with a central opening. The abscess before bursting may have burrowed to some distance, and the external orifice may be situated in the direction of the buttock or perineum. Fistula in ano arises also in other ways. It commonly originates in a phlegmonous abscess, the action of the sphincter muscle and the disturbance of defæcation preventing the closure of the sac. An ulcer just within the external sphincter sometimes perforates the bowel, allowing the escape of fæculent matter into the areolar tissue, and thus leads to abscess. Ulceration induced by a pointed foreign body, as a fish-bone, may also induce a rectal abscess. In all these cases the inner orifice of the fistula is just within the external sphincter. Fistula occurs also in phthisical subjects, owing to tubercular ulceration of the mucous membrane of the rectum. The inner opening is sometimes found higher up the bowel, and there may be more than one, the sinuses being complicated. An anal fistula is an annoying complaint. The patient is troubled with a discharge which stains the linen, and with the escape of flatus. Fistula is a disease of middle life, more common in men than in women.

TREATMENT.—The cure is by a surgical operation.

3. **Malignant Disease.**—The coats of the rectum are subject to *carcinomatous* and *sarcomatous* disease. These growths invade the bowel to a greater or less extent, contracting the passage irregularly, and sometimes almost closing it. Fungoid growths also spring from the coats and project into the bowel, blocking the passage. The degeneration and invasion of tissues may reach the vagina in the female, or the urethra and bladder in the male, and may even penetrate the peritoneum. Malignant disease may attack any part of the bowel, but generally appears in the lower part, within three inches of the anus. It is liable also to affect, though less frequently, the point where the sigmoid flexure terminates.

DESCRIPTION.—The disease generally commences insidiously. Its early symptoms are often similar to those of simple stricture, and the real disease is not detected until a considerable change has taken place in the condition of the bowel. The patient is troubled with flatulency; has difficulty in passing his motions; and as the disease progresses, experiences pains about the sacrum, which gradually increase in severity, and dart down the limbs. The stools become relaxed and frequent; contain blood; and in passing cause a scalding pain. Often also there is a thin offensive serous discharge. Loss of retentive power may ensue, from destruction of the sphincter, or of the nerve supplying the muscle. As the disease advances the patient loses flesh, and exhibits the blanched, sallow look, anxious countenance, and emaciated appearance commonly observed in persons suffering from malignant disease. In consequence of communications established with the neighbouring passages, liquid fæces escape from the urethra in the male and vagina in the female; and at length the patient becomes hectic and exhausted, worn out by this painful and distressing malady. Complete obstruction may occur, and accelerate the fatal termination. There is great variety in the degree of suffering, and of constitutional derangement. The sufferings are in some instances excruciating, in others very slight. Malignant disease usually occurs in middle life, but occasionally in the aged. It is more common in men than in women.

TREATMENT.—Little can be effected by remedies in this terrible disease, beyond palliation of the symptoms, and ease from pain. The general health may be supported by tonics. The motions must be kept soft by medicines or by injections, and pain must be alleviated by chloral or morphia in suppositories or subcutaneous injections. In cases of obstruction, as well as in cases of severe suffering, life may be prolonged by colotomy. Excision of the diseased bowel has also been resorted to, but not with much success.

4. **Polypus.**—Polypus of the rectum occurs in two forms, the *soft* or *follicular*, and the *hard* or *fibrous*.

DESCRIPTION.—The *soft* polypus consists of an agglomeration of elongated follicles, covered with a distinct cylindrical epithelium, with a network of small vessels ramifying in it, and a peduncle which varies in length. The polypus is usually single, but several may exist. In children the polypus usually makes its appearance at the anus after a stool, resembling a small strawberry, being soft in texture, granular on the surface, and of a red colour. It has a narrow pedicle about the size of a crowquill, two or three inches in length, attached to the wall of the rectum. It produces no suffering, but causes a slight bloody discharge. The *hard* or fibrous polypus occurs in adults, is of a pear-shape, and has a peduncle more or less long and thick. It seldom bleeds, but occasions a slight mucous discharge; and when the peduncle is long, the growth protrudes at the anus after stool.

TREATMENT.—The treatment is very simple. For the *soft* polypus a ligature should be tied round the pedicle. This gives no pain, and the polypus comes away in two or three days. It should not be excised without the previous application of a ligature, as dangerous bleeding is liable to follow. The *hard* polypus may be removed by ligature or the écraseur.

5. **Prolapsus.**—In relaxed states of the sphincter muscle and coats of the bowel, loose folds of mucous membrane are liable to protrude and require replacement. This protrusion and exposure of thickened mucous membrane, with or without internal hæmorrhoids, has been erroneously described by writers as prolapsus of the rectum. In the true prolapsus, there is much more than an eversion of the lining membrane of the bowel. The gut is inverted; there is a 'falling-down' and protrusion of the whole of the coats—a change analogous to intussusception, but differing from it in the circumstance that the involved intestine, instead of being sheathed or invaginated, is uncovered and projects externally.

ÆTIOLOGY.—Prolapsus is observed generally between the ages of two and four, but may occur later in life. In infancy it is produced by protracted diarrhœa. The straining efforts to pass water in stone in the bladder also give rise to this affection in young subjects. In adults the descent results chiefly from a weakened condition of the sphincter and levator ani muscles. It is more common in women than in men, arising in the former from the parts being weakened in child-bearing. Young subjects generally outgrow this complaint by the period of puberty; and common as is prolapsus in early life, it is rather rare in young grown-up subjects.

DESCRIPTION.—The length of bowel protruded varies from an inch to six inches or even more. When not of any great length, the protrusion forms a rounded swelling which overlaps the anus, at which part it is contracted into a neck. In its centre there is a circular opening communicating with the intestinal canal. An inversion of greater length forms an elongated pyriform tumour, the free extremity of which is tilted forwards or to one side. The protrusion may present the usual florid appearance of the mucous membrane; or a violet, livid colour from congestion, consequent upon contraction of the sphincter. The mucous surface is often thickened and glandular, and sometimes ulcerated from friction against the thighs and clothes. Thickening of the coats of the bowel accounts for the difficulty in reducing the parts, and keeping them reduced afterwards, so often experienced in the treatment of these cases in children, the bowel being too large to be conveniently lodged in its natural position, and like a foreign body exciting the action of expulsion. An atonic or relaxed state of the sphincter muscle is shown by the facility with which one or two fingers can be passed through the anus even in young children.

TREATMENT.—In children irritability of the bowels and diarrhœa must be checked, and disordered secretions corrected, by suitable remedies. In slight cases it will be sufficient to direct the nurse by steady compression to push the protrusion back into the pelvis. The relaxed state of the membrane may be treated with astringent injections of alum, or muriated tincture of iron, used cold. If the bowel slips down when the child moves about, a rectal supporter may be worn. When the exposed surface is ulcerated, it may be painted with a solution of nitrate of silver, 20 grains to the ounce. The patient should be made to relieve the bowels in the recumbent posture. In adults the anal aperture may be contracted, and the fall of the rectum prevented, by the application of the mineral acids or of potassa fusa to the mucous membrane near its junction with the skin. In more severe cases the complaint may be remedied by operation.

6. **Stricture.**—Stricture may be very limited in extent, and is then termed *annular*; or the contraction may include a portion, more or less considerable, of the coats of the bowel. Above the stricture the rectum is commonly dilated and thickened, owing to a general hypertrophy of the bowel, particularly of the muscular coat. The mucous coat at this part is usually red from capillary injection, and ulcerated, and supplies an abundant purulent discharge. Often ulcerated apertures lead to fistulous passages, extending some distance, and opening externally near the anus or in the buttock, and in women in the vagina. The stricture is usually at the lower part of the bowel, from an inch and a half to two inches from the anus. It also occurs at the point where the sigmoid flexure terminates in the rectum. The disease originates in chronic inflammation of the mucous and submucous areolar tissue of the rectum. Women, in whom the disease is much more common than in men, have ascribed its origin to a difficult labour, during which the bowel was injured. Strictures of the rectum often also originate in the contraction consequent upon the healing of ulcers or wounds in the bowel, especially syphilitic. It is a disease of middle life.

DESCRIPTION.—The earliest symptom is habitual constipation, with difficult defæcation when the motions are solid. As the contraction increases, the constipation becomes more obstinate, and the stools are diminished in calibre, and are often voided in lumps. A brown slimy fluid escapes with the motions, and there is a burning sensation after stool, and flatulent distension of the colon. As the disease makes progress and ulceration ensues, the discharges become purulent and bloody, and the sufferings are much increased. There is sometimes so copious a discharge as to mislead the practitioner, the stricture being overlooked, and the case treated as one of protracted diarrhœa. The appetite may remain good, and the general health may be but little impaired; but in the course of time the derangement of the digestive functions, the irritation kept up by the disease, and the exhausting discharges bring on hectic symptoms. The appetite fails, the body emaciates, night-sweats become profuse, and the stricture directly or indirectly becomes the cause of death. This is sometimes hastened by a lodgment of hardened fæces or some foreign body just above the stricture, so as to block up the passage, and occasion all the symptoms of internal obstruction. In patients with stricture small flattened excrescences are usually observed at the margin of the anus. These cutaneous growths resemble collapsed external piles, except that they are redder in colour, and are kept moist by the escape of an irritating discharge from the bowel. In many cases the interior of the rectum is abundantly studded with small excrescences or irregular growths of the surface, and folds of the mucous membrane, the result of chronic inflammation.

Diagnosis.—A stricture in the lower part of the rectum can be easily detected by tactile examination. It must be borne in mind that the bowel is liable to be obstructed by disease of the neighbouring viscera, an enlarged or displaced uterus, fibrous tumours of this organ, an ovarian growth, pelvic hæmatocele, excessively hypertrophied prostate, or hydatid tumour between the bladder and rectum.

Treatment.—The main object in treatment is to dilate the contracted parts sufficiently for the free passage of the motions, and this is to be effected by mechanical means—by the passage of bougies. Means must also be adopted to relieve the irritability of the part, and to ensure the regular passage of soft evacuations. Opiate suppositories at bed-time, castor oil, cod-liver oil, aperient waters, and local applications of solution of nitrate of silver, are the remedies required. In old inveterate strictures, wearing out the patient's strength, the writer has recommended colotomy.

7. **Villous Tumour.**—Villous tumour, a growth similar to that which occurs in the bladder, springs from the mucous membrane of the rectum, generally by a broad base; is soft in structure; and is composed of a number of projecting papillæ or villi. It is innocent in character, and is not apt to return after removal. Its chief peculiarity is a remarkable disposition to bleed. The villous tumour occurs only in adults, and is a rare disease. It should be removed by ligature if possible, or by the clamp-forceps.

8. **Ulceration.**—Description.—Chronic ulceration may arise from *dysentery*, *tubercular disease*, or *syphilis*. *Dysenteric* ulcers are extensive, and occur to persons who have been in tropical climates, or exposed to hardships, and deprived of proper nutriment. The *tubercular* ulcer is usually small in size, but indisposed to heal. *Syphilitic* ulcers are large, deep, and irregular, and occur generally in women. It is a question whether they are due to direct contagion, the mucous membrane of the bowel becoming inoculated with matter from sores on the vulva, or in a more direct way, or whether the ulceration is the result of constitutional disease. The chief symptoms are a purulent discharge from the anus; motions loose and mixed, or coated with a slimy fluid and streaked with blood; soreness in defæcation; and occasionally tenesmus. The characters, position, and extent of ulceration can be ascertained by examination with the finger and with the speculum.

Treatment.—The treatment depends on the nature and extent of the disease, and upon the constitutional condition of the patient. In severe cases the patient should be kept in the recumbent position. In extensive destruction of the mucous surface, with free discharges, especially when originating in dysentery, vegetable astringents, such as simaruba and krameria, combined with mineral acids and opiates, are of great service in restraining the tenesmus and irritating discharges. The nitrate of bismuth, with magnesia and anodynes, also affords great relief, and the sulphate of copper with opium may often be given with advantage. When the ulceration is consequent on constitutional syphilis or scrofula, the remedies appropriate to these diseases are required. The local treatment consists in the application of weak solutions of nitrate of silver or sulphate of copper, and anodyne injections with mucilage, or anodyne suppositories.

T. B. Curling.

RECURRENT DISEASES.—Diseases which have a tendency to return after their actual or apparent cure or removal, either without any obvious cause, such as cancer or ague or from some very slight cause, such as gout or rheumatism.

RECURRENT INSANITY. *See* Insanity, Varieties of.

RECURRENT LARYNGEAL NERVE Diseases of.—*See* Pneumogastric Nerve, Diseases of.

RED GUM.—An eruption of scattered red pimples on the skin of infants; more scientifically described as *lichen urticatus*. In infants the eruption has obtained the name of *strophulus*, from its presumed association with a disordered state of the bowels, accompanied with colic. The term 'gum' alludes to a resemblance between a pimple on the skin and the exudation of gum from a tree in the form of a drop, and is an illustration of the frequent reference to the vegetable kingdom in the nomenclature of skin-diseases. *See* Lichen; and Strophulus.

Erasmus Wilson.

REDUPLICATION.—A doubling; a term generally used in reference to the sounds of the heart. *See* Physical Examination.

REDUX (Lat., returned).—A term signifying the return of certain physical signs, after their temporary disappearance in the course of a disease; usually associated with crepitation in pneumonia, and with friction in pleurisy and pericarditis. Redux signs are usually significant of a favourable tendency in a disease. *See* Physical Examination.

REFLEX DISORDERS.—These constitute a very varied group of affections, most of which are individually considered elsewhere, in separate articles. But it will be useful here to say a few words concerning them as a group, in order that the mutual relations of many apparently discordant conditions may thus be set forth, from the point of view of their origin or pathogenesis.

Pathology.—The factors concerned in the production of a reflex disorder are in kind those which are needful for the production of a 'reflex action'—though in the former case such causes act for an inordinately long time, or else with an intensity which is altogether unusual. In each case we must have (*a*) afferent impressions resulting from the influence of a foreign body or a pathological state (such as inflammation or ulceration), acting as an irritant upon *afferent* *nerves*, either in some part of their course, or in their peripheric sites of distribution—whether such sites be situated upon the external surface of the body, or upon some part of one or other of the mucous surfaces within the body. Thus it happens that the determining cause may in some cases be associated with painful impressions, though in many other instances such impressions may be more or less completely absent. Occasionally mental emotions may take the place of peripheric impressions, as inciters of abnormal reflex phenomena.

The next essential factor (*b*) is that the afferent impressions (painful or non-painful) produced by the irritant or pathological state, should pass from the nerves, conveying them through a related *nerve-centre*, which, from one or other cause, chances to be in a state of exalted activity; and thence (*c*) be reflected along one or other set of *efferent nerves*, so as to produce effects of this or that order.

Varieties.—As efferent nerves are distributed to glands, and to muscles (both involuntary and voluntary), reflex phenomena may show themselves in one or other of two principal directions —that is, (1) by the modification of the quantity or quality of some *secretion*, or (2) by the production of spasmodic contractions in certain *muscles*, either of the involuntary or of the voluntary type. In these ways, multitudinous and varied effects are apt to be produced on different occasions, as may be gathered from the following brief illustrations.

1. *Modified secretions.*—The morbid effects belonging to this class of reflex disorders show themselves, for the most part, by a diminution rather than by an increase in the amount of the secretion of the gland whose functions are affected, as when irritation of some of the abdominal nerves leads to a suppression of the renal secretion, by setting up some form or mode of inhibitory influence. The action of cold upon the external surface of the body in producing an increased secretion of urine, is probably brought about by an augmented determination of blood to the kidneys, and not as a simple result of reflex action. The mental conditions of anxiety, fear, or terror do, however, often lead to an increased secretion of urine; and the increased secretion in these cases may be brought about by simpler and more purely reflex influences. Again, precisely the same mental states may lead to an arrest of the salivary secretion, as well as to such an increase of the intestinal secretions as to produce loose evacuations or actual diarrhœa. Other instances might be included under this head, but they are all of them phenomena whose precise mechanism is comparatively obscure. Still in each case the mode of production of the phenomena would seem to conform to the type indicated.

2. *Muscular spasms.*—The morbid effects belonging to this second class of reflex disorders are also variable in their occurrence, and more or less uncertain as regards their precise mechanism. Still, reflex spasms, set up by some contiguous source of irritation, are met with not unfrequently in the urethra and neck of the bladder, in the sphincter of the vagina, or at the commencement of the œsophagus. They may also occur in the bronchi, or in portions of the intestinal canal; likewise in the ureters or in the gall-ducts, during the passage of calculi along either of them.

As an instance of a spasm engendered in involuntary muscular fibres, under the influence of a mental emotion or state, rather than a peripheric irritation, one may cite the sudden contraction of the uterus in certain cases of abortion induced by fright, anger, or other powerful mental emotion. Again, acts of vomiting are produced occasionally by certain sights or odours.

In the voluntary muscles tonic spasms of a reflex character occur, especially in children or in females of a nervous temperament, in the form of contractions of some of the muscles of the extremities more especially, though at other times the muscles of the jaw or some of the muscles of the neck may be the parts involved. *See* Spasm.

Of infinitely more importance, however, are the multitudinous cases in which some sources of irritation, either within or on the surface of the body, occasion, in various more or less obscure ways, through the intervention of the great encephalic centres, convulsions or fits of one or other variety (*see* Convulsions; and Epilepsy). Here we have, as a result of the peripheric irritation, a whole series of spasms, partly tonic and partly clonic in character. It is worthy of note, too, that an irritant at the surface of the brain, in certain regions, is just as potential as an irritant acting upon the mucous membrane of the intestine.

But another class of reflex muscular spasms still remains, to which an immense amount of importance is attached by some pathologists, namely, those which are brought about through the agency of vaso-motor nerves acting upon the contractile walls of blood-vessels. It is well known that under the influence of direct irritation, vaso-motor nerves may cause small arteries and arterioles to contract to an extreme degree, and that this condition is apt to be followed by one of extreme dilatation of these same vessels. It is known also that under the influence of emotions the calibre of the vessels in certain parts of the body is apt to vary greatly. Of this we have examples in the temporary pallor of the countenance produced by fright, and in the suffusion of the face and neck, from unnatural fulness of vessels of these parts, in the act of blushing. On the other hand it is assumed that, as a result of some abiding irritation in the intestine, in the bladder, or in other parts, reflex contractions of the arterioles in certain regions of the spinal cord (also of an abiding character) may be brought about, so as more or less completely to annul the functions of this particular portion of the cord, and thereby to lead to paralysis of the lower extremities—that is, to paralysis of the limbs chiefly in relation with the region of the cord affected. This is the generally assumed mode of production of a so-called 'reflex paralysis.' Others, however, imagine that, in certain cases at least, such a paralysis may be brought about differently—not by the reflex action producing a spasm of vessels in a part of the spinal cord, but by a spasm of the vessels supplying the great nerves and muscles of the limbs affected. The anæmia, thus supposed to be induced in either case, is regarded as the cause of an ensuing paralytic condition. But the question as to the probability of the existence of 'reflex paralysis' need not be here discussed, since the arguments for or against the existence of such a paralysis which are applicable to one form of it are applicable also to another, and these are set forth in the article Spinal Cord, Special Affections of—*Reflex Paraplegia.*

It is right here, however, to add that the late Dr. Meryon put forth an entirely different account of the origin of 'reflex paralysis.' He assumed that the irritating body or process (that is, an influence slight in degree, but long-continued) gave rise to a determination of blood in related portions of the spinal cord; that the continuance of this condition led to an overgrowth of connective tissue; that this overgrowth caused pressure upon the imbedded nerve-fibres; and thus induced paralysis in related portions of the body. This view is throughout based upon positions of which no proof exists; and if such a mode of production of paralysis, in response to local irritation, did really obtain, it would, by hypothesis, be by the establishment of a permanent lesion, as a result of which we certainly should have no right to expect a fluctuation in the degree of the paralysis, in accordance with fluctuations in the amount or intensity of the local irritation, or a comparatively sudden cessation of the paralysis so occasioned, sequential to a cessation of the local irritation. Yet these are the assumed differential characteristics of a paralysis of reflex origin.

It does not seem to be imagined by anyone that a local irritation is capable of engendering a condition of paralysis by any direct inhibitory process. The intervention of altered conditions of vaso-motor nerves and of altered states of vessels seems to be postulated by all. Yet some such direct influence may, perhaps, be more possible in those related cases in which the starting-point or primary cause of paralysis is a mental state rather than a peripheric irritation—that is, in the ætiologically obscure cases described by Reynolds as *paralysis dependent upon idea. See* Spinal Cord, Special Affections of, No. 9.

It is right here, also, to mention a class of phenomena which have some analogies to reflex disorders, that is, the numerous cases in which, as a consequence of irritation in one or other region, *pain* is felt in some more or less distant part of the body, as when a stone pressing upon the neck of the bladder causes severe pain at the meatus urinarius, or when disease of the stomach or of the liver causes a pain which is felt in the scapular region. H. Charlton Bastian.

REFLEXES, Spinal.—*See* Spinal Cord, Diseases of; p. 1458.

REFRACTION, Disorders of. *See* Vision, Disorders of.

REFRIGERANTS (*refrigero*, I cool).—Definition.—Remedial agents which lower the body-heat, either in health or in disease; or which allay thirst, and impart a feeling of coolness.

Enumeration.—The chief refrigerants are:—the whole class of Febrifuges; Water; Ice; Effervescing drinks; Acids; and the juices of Fruits.

Action.—As the name implies, anything may be ranked as a refrigerant which lowers the body temperature, and we may here consider in how far the drugs described under Febrifuges have the property of cooling down the healthy organism. Quinine and alcohol have but a slight and transient lowering effect, and salicylic acid has none at all; and this is readily explained, if we believe that their antipyretic properties in fever depend on their destructive influence over the protoplasm of septic ferments.

Refrigerants, however, are popularly held to be those drugs which relieve the thirst of the fever-stricken patient, by moistening his dry lips and cooling his parched tongue. Ice or iced drinks manifestly fulfil these indications; and acids, which are often the most grateful of all, act very efficiently by directly stimulating the salivary secretion. R. Farquharson.

REGIMEN (*rego*, I govern).—This word is not uncommonly used as synonymous with hygienic management. In a more restricted sense it is applied to the regulation of diet, both in health and disease. *See* Diet; and Personal Health.

REGURGITATION (*re-*, again, and *gurgito*, I swallow).—This word is technically applied to the reversal of the natural direction in which the current or contents flow through a tube or cavity of the body. Thus the food may regurgitate from the stomach into the œsophagus and mouth; the bile from the duodenum into the stomach; and blood from the aorta or pulmonary artery into the ventricles, from the ventricles into the auricles, or from the heart into the veins, when the respective valves are incompetent. *See* Heart, Valves of, Diseases of; and Rumination.

REHME (Oeynhausen), in Germany.—Gaseous thermal salt waters. *See* Mineral Waters.

REICHENHALL, in the Bavarian Alps. Common salt waters. *See* Mineral Waters.

REINERZ, in German Silesia.—Iron waters. *See* Mineral Waters.

RELAPSE (*re-*, back, and *labor*, I slip).—The return of a disease, which has apparently ceased, during or immediately after convalescence; or of a particular symptom in the course of a disease. Relapses are well exemplified in typhoid fever and acute rheumatism.

RELAPSING FEVER.—Synon.: Famine Fever (Irish writers); Fr. *Fièvre à rechute*; Ger. *Hungerpest.* Also many other names, according to the localities where it has prevailed as an epidemic.

Definition.—A continued contagious fever; characterised by absence of eruption, and a tendency to relapse at intervals of from five to seven days, and for an indefinite number of times; and generally occurring as an epidemic.

All medical writers, from the earliest times recognise the existence of a relapsing form of continued fever; but this disease had until recent years been included under the general term 'Continued fever.' Even in the great Irish famine fever of 1847, many of the Dublin physicians did not sufficiently distinguish between typhus and relapsing fever; and we find a statement often made that the fever relapsed into typhus, or that typhus relapsed into a form without spots. There is no doubt that typhus and relapsing fever co-existed at the time of the Irish famine, as they have invariably done at all times and places in seasons of great scarcity.

Geographical Distribution.—Northern Europe seems to be the favourite habitat of relapsing fever. It has been met with in America, but not as an epidemic, having been imported from Europe, and not showing a tendency to spread. An epidemic outbreak occurred at Peshawur in the Punjab, and also in Egypt. Epidemics have been more common in the British Isles than elsewhere. The most extensive epidemics have arisen in Ireland in times of famine, and extended thence to England and Scotland. An epidemic was confined to Scotland in 1843, and another to London in 1868.

Ætiology. — *Predisposing causes.* — Males suffer more from relapsing fever than females, in the proportion of about 1·5 to 1. The disease is most common between the ages of fifteen and twenty-five. Season seems to have little effect, but it appears to be more prevalent in winter than at other seasons, because the other predisposing causes are more intense at that time of the year. All the causes which predispose to contagious zymotics favour more or less the prevalence of relapsing fever. The most powerful, however, are scarcity of food, overcrowding, and want of cleanliness.

Exciting causes.—Relapsing fever is contagious, and has always been found to spread in proportion to the facilities for communication. It has been transported from long distances by affected persons; attacks attendants on the sick, and persons not predisposed when they are exposed to its contagion; and may be communicated by fomites. It seems to act through but a short distance. The period of incubation is uncertain, sometimes being apparently almost absent, at other times stated to extend to fourteen or twenty-one days.

Famine and its consequences, or famine alone, is a cause for the origin of relapsing fever *de novo.* Some doubt the truth of this statement, but it is usually received by writers upon the disease. The evidence in favour of famine as a cause rests upon the 'fact that after it has been absent for many years, it breaks out on each occasion under precisely similar circumstances' (Murchison). The circumstances preceding an outbreak are invariably failure of crops, and consequent famine. Relapsing fever, although usually prevailing among overcrowded persons in large towns, must not be considered to depend upon this condition, except so far as overcrowding favours the spread of contagion. The overcrowding in towns during an epidemic results from the same cause as that producing the fever; namely, the scarcity of food in the country, which drives people into the towns.

Anatomical Characters.—These are not marked, except where complications have caused death. The liver and spleen are both found enlarged in all cases, especially the latter organ. The digestive organs exhibit nothing particular, except in those cases where there has been long deprivation of food, or where dysentery or diarrhœa has accompanied or preceded the disease. Certain small bodies termed spirilla have been found in the blood of patients suffering from relapsing fever; these bodies decrease as the paroxysms subside, and are absent during the intermissions. Spirilla were discovered by Obermeier, of Berlin, in 1872, and the discovery was further confirmed by Engel in 1873. Spirilla vary considerably in number in different cases and at different times. They are constant in size, and form spiral fibrils, of which the convolutions are extremely small; the spiral form remains after all motion has ceased. Their movements are of three kinds—undulations passing along the whole fibril, flexions occurring at various points, and locomotive movements. These variations sometimes give the bodies a circular appearance, a figure-of-8 shape, or an arrangement in long chains. Large colourless transparent cells, in some cases from two to four times the size of colourless blood-corpuscles, are also found in the blood in relapsing fever. *See* Spirillum.

Symptoms.—The invasion of the disease is usually marked by rigors, frequently of a trivial character, amounting only to slight chilliness. This is followed by debility and giddiness; extreme weakness is not so marked as in the early stages of other forms of continued fever. There is headache, followed after a few hours by hot skin; the temperature rises to about 105° F., or sometimes, it is stated, as high as 108°; the pulse rises to from 110 to 130, occasionally counting 140 at an early stage of the disease. The tongue is covered with a moist creamy fur, which in severe cases becomes brown and dry in the centre, and in the worst forms becomes black all over. There is great thirst, as in all febrile diseases; loss of appetite; some abdominal tenderness, especially in the epigastric region; occasionally nausea, and more rarely vomiting; the bowels are usually confined, but in some cases diarrhœa prevails. In such cases the diarrhœa is of a dysenteric character, and is probably due to the dysenteric tendency which usually prevails in time of famine, when relapsing fever is prevalent. The skin generally presents a jaundiced hue; and careful examination will detect more or less enlargement of the liver and spleen. There is great muscular and articular pain. The pain in the back is frequently of the most intense character. Headache is more complained of than in the other forms of fever. There is sometimes, but not as a rule, delirium towards the end of the first week. In from five to seven days from the invasion of the disease, the symptoms suddenly subside, and the patient quickly becomes convalescent, being for the time apparently well. This convalescence is frequently accompanied or preceded by a critical evacuation from the bowels, kidneys, or uterus, or by profuse diaphoresis. It may be permanent, but more commonly the patient remains well for a few days or a week, and then suddenly relapses, and passes through all the symptoms previously detailed. There may be a second or a third relapse, and even a fourth has been recorded. At no time during the progress of the disease is any specific eruption developed, although on the second or third day a reddish mottled rash has been met with, which, however, is irregular in its appearance, development, and duration, and usually terminates in desquamation. Purpuric spots have been sometimes, and sudamina very frequently met with.

Complications.—Pulmonary complications are not so common in relapsing fever as in typhus or enteric fever. Bronchitis, pneumonia, and laryngitis may occur, especially bronchitis, but these complications are not severe. Cardiac, arterial, or venous affections are rare, with the exception of hæmorrhages, which must be considered as being connected with the purpuric tendency which usually prevails in times of scarcity. Nervous complications are more rare than in any other form of adynamic fever. Dysentery and diarrhœa in some epidemics have proved to be most serious complications, and are of frequent occurrence whenever relapsing fever prevails. Abscess and other suppurative forms of inflammation are not common. In pregnant females attacked by this fever abortion usually occurs at an early stage; and premature labour, with death of the fœtus, and considerable danger to the mother, in the later stages of pregnancy. Death of the mother has sometimes happened from *post-partum* hæmorrhage.

Diagnosis.—Relapsing fever is most likely to be mistaken for other forms of continued fever, and may be confounded with the eruptive fevers in their earlier stages, especially small-pox. It differs from typhus in having a higher temperature and quicker pulse at the outset; in the absence of the specific eruption, of the extremely heavy aspect of the patient, and of the delirium of typhus; in the presence of extreme pains in the back, vomiting, and jaundiced tinge of the skin; and finally in the sudden cessation of symptoms, and the tendency to relapse.

It differs from enteric fever in the suddenness of its onset, enteric fever having a slow invasion; the want of the marked and extensive daily variations in temperature; the absence of the characteristic abdominal symptoms and eruption; and the absence of the localised iliac tenderness and the peculiar diarrhœa of enteric fever. The tongue also serves to distinguish relapsing from enteric fever; in the latter having a well-marked red tip and edges, in the former a light covering fur. Relapsing fever at its commencement has been confounded with small-pox, on account of the extreme pain in the back and marked vomiting which accompany both these diseases, but the appearance of the specific eruption will soon decide the question.

Prognosis, Duration, Terminations, and Mortality.—The prognosis of relapsing fever is usually favourable, the mortality being low, from 1·2 to 2 per cent. in London, up to 4 and 4·5 per cent. in other places; the average rate being about 4 per cent. The chief causes influencing the rate of mortality seem to be the prior state of the patient, and the duration of the disease before medical relief is applied for. Purpuric symptoms, severe dysentery or diarrhœa, serious hæmorrhages, or extensive chest-complications, always indicate a grave prognosis.

Treatment.—The treatment of the disease must be preventive and curative. The chief promoting causes of the disease being famine and contagion, the means for prophylaxis are obvious. The active treatment must chiefly be directed towards the relief of symptoms, and sustaining the strength of the patient. The use of quinine and mineral acids in the earlier stages, and a plentiful supply of light and nourishing food in the later, will be found sufficient. A considerable amount of the success of treatment must depend upon the dieting of the patient. It must be kept in mind that most of these patients have been in a state of starvation. It will be necessary, therefore, to carefully and gradually increase the supply of food. The food at first must be of a most digestible and fluid kind, which may gradually be altered to a diet of a more solid and general character. Dysentery has not infrequently been caused by the sudden feeding of patients suffering from relapsing fever in its early stages. Milk, light starchy puddings made with milk, thin custards, and finally chicken, chops, and general diet will be found the best course in this disease. Stimulants may be occasionally requisite, but are seldom necessary in any quantity, or for a length of time.

T. W. Grimshaw.

RELAXATION
RELAXED } (*re-*, again, and *laxo*, I loose).—These words signify a condition of looseness, and are used somewhat vaguely in a variety of associations. Thus we speak of *general relaxation*, to express a want of muscular tone or vigor. *Local relaxation* refers to a condition of abnormal looseness of a part, as of the joints, muscles, the uvula, or the throat, which are then said to be *relaxed*. Another signification of the term relaxation is that of looseness of the bowels, as in diarrhœa.

REMEDY (*remedium*, a cure).—A remedy properly signifies a therapeutic agent which possesses a recognised influence in preventing, relieving, or removing a particular morbid condition. Thus vaccination is a remedy for small-pox; quinine for ague; mercury and iodide of potassium for syphilis; and opium for pain. *See* Disease, Treatment of.

REMISSION
REMITTENT } (*re-*, again, and *mitto*, I send).—A disease is said to be remittent when it is characterised by periodical diminutions of symptoms, followed by exacerbations, as in remittent fever and neuralgia. The period during which the symptoms are in abeyance is called a *remission*. *See* Remittent Fever.

REMITTENT FEVER.—Synon.: Bilious Remittent; Fr. *Fièvre rémittente*; Ger. *Bösartiges Endemisches Fieber*.

Definition.—A paroxysmal fever of malarial origin, in which the paroxysms do not intermit, but only, as the name implies, remit.

General Observations.—Remittent fever is the most severe of the class to which it belongs; it is a more acute affection than intermittent fever, more severe in its symptoms, more rapid in its course, and the direct mortality is ten times greater than in any other form of malarial fever. It is commonly known in India as *jungle fever*, because it is in jungles there at certain seasons of the year that it is most frequently contracted. It often obtains local names derived from places notorious for producing it, a practice productive only of confusion and misapprehension. It is sometimes said to hold a middle place between intermittent and continued fever; the more nearly it resembles the latter, the more dangerous it is. In other words, the less distinct the periods of remission, and the longer the stage of exacerbation, with its high temperature, and other disturbances of the system which characterise that stage, the greater is the risk of such blood- and organic changes as are incompatible with life.

Remittent fever is usually seen in its gravest forms in hot climates, but has often been very fatal in malarial regions in temperate climates, as in Walcheren. This, in unhealthy countries, is often the first form of fever that attacks new-comers, but such are seldom exposed to second attacks; in other words, there is in this type less tendency to a recurrence of the disease than in the intermitting form. It may be that the extremely energetic character of the symptoms in the remittent type is more effectual in destroying, altering, or 'eliminating' the poison, than the milder intermittent attack. In 1865, out of 3,199 cases of remittent fever admitted into the military hospitals of Algeria, only 359 had second attacks; while out of 15,080 cases of intermittent fevers, 4,295 were re-admitted with the same type of fever (*Statistique Médicale de l'Armée*, 1865). The medical officers of our army in Spain observed that their men, on entering a malarial locality, generally suffered severely from the remittent form, while the inhabitants of the country were only affected by the intermittent type. Survivors, however, who remain in the locality, become, like the inhabitants, only liable to the milder type of the disease.

Ætiology.—Remittent fever is found whenever its specific cause is generated in sufficient concentration to cause it. This will probably be found to correspond with the germ origin of intermittent fever (*see* Intermittent Fever; and Malaria). It prevails in the malarial parts of the Old and New World. Our armies have suffered from it both in temperate and hot climates; in the East and West Indies, and, with extreme malignity, on the West Coast of Africa. It is a common disease in the malarious parts of Italy; and the French army has suffered much from it in Algeria. It is seen in the deltas of great rivers, in the *terrais* of India, in jungles, and in other districts in the same country long left uncultivated.

Anatomical Characters.—The morbid anatomy of remittent fever is the same as in intermittent fever; the difference is only in degree. Congestion of the mucous coat of the stomach and duodenum, with softening, is more marked than in other types of malarial fever, as well as enlargement of Brünner's glands. The pigmentary degeneration of the spleen and liver is more intense, often extending also to the brain and spinal cord, giving them a bronzed appearance.

Symptoms.—**Premonitory.**—These are much the same as in a severe intermittent.

Cold Stage.—The term is hardly applicable in this fever; the patient is sensible only of a slight sensation of chilliness, which very rarely passes into rigors. Nevertheless, the thermometer indicates a temperature above the normal, and in the hot stage this quickly rises to 106°, 107°, and sometimes to 110° F.

Hot Stage.—As this develops, the whole system is profoundly disturbed. There is the high temperature already indicated, which, when fully developed in the worst cases, approaches within three degrees of that in which the albuminoid constituents of the muscular tissue begin to coagulate. This grave symptom is seen in its utmost intensity in those who have exposed themselves, perhaps after indulging in alcoholic liquor, to a powerful sun, without reasonable precautions. With this there is necessarily pungent heat of skin; an intensely flushed face; severe headache; pain in the back and limbs; quick respiration; a pulse of 120 or more; a foul, dry, and bile-tinted tongue; a sense of oppression at the epigastrium, with fulness and tension in that region; and violent vomiting, which brings no relief to the gastric oppression.

This vomiting is one of the most distressing symptoms; the quantity of fluid vomited far exceeds what has been taken by the patient; at first it is colourless, then bilious, and sometimes bloody. In pernicious cases it closely resembles the 'black vomit' of specific yellow fever. With the above symptoms there is an anxious countenance, and much restlessness. In this condition the patient remains from six to twelve hours. Then the more urgent symptoms abate; the temperature falls two, three, or more degrees; the skin becomes slightly moist, far short of the profuse sweating in an intermittent fever; headache sensibly diminishes; and the nausea, vomiting, and epigastric tension either cease or sensibly abate. This is the *remission*, always anxiously looked for, not only as a relief to the patient, but as a precious time for treatment. In bad cases, when the other symptoms remit so little as to escape the notice of all but an experienced observer, the thermometer will indicate at least an attempt at a remission. This lasts from two to twelve hours; the longer it is, the more favourable is the prognosis. A feeling of chilliness then returns, quickly followed by the hot stage, with all its distressing symptoms. This is the *exacerbation* of systematic authors, which in its turn gives way to the remission.

A morning remission in this fever is so invariable as to be a point of diagnostic value, and it is an old rule in military practice so to time the morning visit as to insure seeing the patient while it lasts. The exacerbation usually returns about noon, and in severe cases lasts till midnight. Sometimes two exacerbations occur, one at noon, the other at midnight, with a slight evening, and more distinct morning, remission.

The *skin* sometimes assumes a yellow tint, and if there be with this anything resembling black vomit, a false diagnosis of yellow fever may be made. The term 'yellow remittent' is correctly enough applied to such cases, but the resemblance between these and cases of specific yellow fever is only superficial.

Hiccough is a troublesome symptom, and if it appears late in the disease, and continues during the remission, is not a favourable one.

The *bowels* are usually constipated, but in pernicious cases the motions sometimes become very loose, bloody and offensive, a condition of evil omen.

Jaundice is rare, although, as already said, the skin has often a yellowish tinge, more dependent on blood-changes than from an icteric cause.

Hepatitis.—The only cases of suppurative inflammation of the liver, occurring in the course of remittent fever, that have come under the writer's observation, were brought to Netley from the Gold Coast, where this serious complication appears common.

Delirium.—Except in men who have lived imprudently, and, in addition to the poison of malaria, have indulged freely in alcohol, active delirium is rare. Like in all malarial fevers, the symptoms and lesions in remittents point more to implication of the abdominal organs than of the nerve-centres.

The *urine* is acid, scanty and high-coloured, rarely albuminous—so rarely, that its absence is a point of diagnosis between malarial remittent and specific yellow fever. During the hot stage the secretion of urea is greatly increased, but lessened when convalescence sets in. In two very severe cases treated by the writer in India, there was profuse secretion of bloody urine throughout, which lasted until convalescence set in.

The *adynamic form* of remittent fever is one of great gravity. It is becoming every day more apparent that in bygone years—and perhaps even now in India—cases of enteric fever have been, and are, mistaken for malarial remittent. The diagnosis is not so easy as it may appear to those who are familiar with enteric fever pure and simple, as seen in temperate climates. There are cases of a mixed nature, in which a thread of malaria, so to speak, runs through the symptoms and obscures them. The term 'typhomalarial' has come into use in India to distinguish this class of cases, which are as difficult to treat successfully as to diagnose clearly. French and Italian writers would apply their favourite term 'pernicious' to such cases, which are characterised from an early stage by great prostration; brief and uncertain remissions; a quick and compressible pulse; a black and dry tongue, the teeth being covered with sordes; rapid respiration; epigastric tension and oppression; the bowels being loose, and the motions bloody, with a disposition to hæmorrhage from the mucous surfaces generally. Such cases are often fatal, and *post-mortem* examination, in addition to the common lesions of malarial fever, reveals ulceration of Peyer's patches.

Duration.—The duration of a remittent fever is from five to fourteen days; but, as in all miasmatic fevers, it is much affected by the action of remedies. In the worst forms death is rare before the eighth day.

Diagnosis.—1. From *specific yellow fever.*—Remittent is paroxysmal; yellow fever is continued. Remittent has a morning remission; yellow fever has not. Hæmorrhage from any source is exceptional in remittent; in yellow fever it proceeds from mouth, nose, eyes, ears, bowels, and even the urinary passages. Even in the worst remittents albuminous urine is rare; it is the rule in yellow fever. Over remittent fever the power of quinine is beyond question; the drug is powerless in yellow fever. Death in the worst remittents is never seen before the eighth day; in specific yellow fever it is common on the third day. The mortality rate in yellow fever is often forty per cent. of those affected; that of remittent does not in ordinary circumstances exceed four or five per cent., and is often less. Yellow fever is portable and contagious; remittent is neither. Yellow fever has a special *habitat* of its own, and can only exist as an endemic disease in countries where the mean temperature does not fall below 72° F. Lastly, specific yellow fever has never established a footing on the shores of India, where malarial remittent is an endemic disease.

2. *Enteric fever*, pure and simple, ought not to be easily confounded with remittent. It is marked off by the difference in the thermometric curve: in enteric fever, the rise of temperature is slow; in remittents it attains its maximum in a few hours. There is also the characteristic eruption, the iliac gurgling, and the peculiar stools of typhoid, all absent in remittent. As mentioned above, the diagnosis is not so easy when the peculiar symptoms of malarial mask or obscure those of enteric fever. Still, due observation of the peculiar combination of symptoms will enable careful practitioners to make a good practical diagnosis, and to regulate their treatment accordingly. It may seem unscientific to speak of two specific diseases existing together, and as it were struggling for the mastery in the system. The writer's belief is, that in the doubtful cases the real disease is enteric fever, the symptoms being merely modified by malaria, in the same way as they are in many other diseases.

Prognosis.—This is favourable when the remissions are distinct; when each succeeding exacerbation diminishes in force; when the skin acts freely; and when the urine deposits the sediment described as critical in intermittent fever as the attacks pass off.

Faint and uncertain remissions; a tendency to collapse at the close of an exacerbation; the sudden setting in of dangerous complications; the predominance of typhoid symptoms; suppression of urine; and a general disposition to hæmorrhage from the mucous surfaces, are all signs of evil omen.

Treatment.—After a large experience in the treatment of malarial fevers in some of the most unhealthy regions in the East, the writer desires to place on record the fact that he has never seen any but disastrous results from treatment based on the belief that remittent fever is an inflammatory disease. The practitioner who keeps this in view, and acts on the principle of saving power as much as possible, will save more lives than the man who, alarmed by the violent disturbance of the system, attempts to calm it by lowering treatment · or the other, who, halting between two opinions, seeks to cure his patients by an incompatible mixture of depressing and conservative remedies. With the reservations already given when treating of intermittent fever, no better combination of a purgative with quinine can be given, to begin the treatment, than Livingstone's, described in the article on that disease; but whatever be the purgative selected, it should be suited to bring away copious bilious discharges, which will greatly mitigate the vomiting, and it should be combined with quinine. A good formula is from 3 to 5 grains of calomel, compound extract of colocynth, and powder of scammony, with a drop or two of any aromatic oil; this acts effectually on the whole tract of the intestine, usually without nausea or griping, and a like quantity of quinine may be added.

Two courses are now open to the practitioner. One is to postpone the further administration of quinine until the first remission. In the other the exacerbation is disregarded, and quinine is given in full and effective doses at once. If the first plan be decided on, much may be done to promote the comfort of the patient, to lower the temperature, and thus to hasten the period of remission. In strong men, when the temperature is high, exceeding 105° Fahr., with headache, violent action of the heart, rapid respiration, oppression and restlessness, drop doses of the tincture of aconite every quarter of an hour until ten or twelve doses have been taken, calm the patient, reduce the force of the heart's action, assuage the headache, and sometimes in a marked manner relieve urgent and distressing symptoms. Used in this way, and its effects watched, aconite is a valuable and safe remedy, and, acting in the same way, it is as useful in specific yellow fever. It has also this great recommendation, if cautiously used, that it leaves no sting behind.

When the temperature rises, as it often does, to 105–6° or 110°, more energetic means are called for. The patient should be placed in a bath at 90° Fahr., which should be cooled down until the thermometer indicates a temperature 15° below the normal temperature of his body. The effect of this in calming the patient, relieving the oppression, and checking vomiting, is often very striking. When removed from the bath the patient should be wrapped in a blanket. In adynamic cases, where the use of the bath is not deemed prudent, the same good effects may be brought about by sponging the surface with water, the temperature of which is gradually reduced as directed above.

On the first appearance of the remission quinine must be given by the mouth, bowel, or skin. If there is no vomiting, by the mouth; if the remedy will not remain on the stomach, then it must be given by bowel or skin. Of the inconveniences and occasional danger of the latter method, the writer has spoken in the article INTERMITTENT FEVER, to which the reader is referred. If the hypodermic method is ever justifiable, in the face of the danger of inducing tetanus in the manner described, it is in the grave and pernicious forms of this disease, when life is threatened, and time presses. If the remedy is given by mouth or rectum, at least half a drachm should be introduced into the system during the remission. It is in remittent fever of the urgent kind under notice that the Tinctura Warburgi already mentioned (*see* INTERMITTENT FEVER) is most useful. As is now well known, the active ingredient in this remedy is quinine; and, if used as directed in the article referred to, it is as safe as it is effective. American physicians appear, in treating this disease, to follow chiefly the second plan mentioned, and trusting to the known property of quinine to diminish and not to increase temperature, they give it during the hot stage. The great difficulty here is the vomiting; during the exacerbation it is almost impossible to get anything to remain on the stomach. It must then be administered by enema to the extent of half a drachm, half the quantity being given in the same way three hours before the return of the exacerbations. Full doses of from 15 to 20 grains of the bromide of potassium at bedtime tend to calm restlessness and promote sleep. The above treatment must be persistently followed day by day until the fever is overcome.

It will be seen from the above remarks that obstinate vomiting is not only a source of extreme and exhausting distress to the patient, but also one of the chief embarrassments of the practitioner. The means advised above are often effectual in checking it, and they may be supplemented by the use of ice when available, by external stimulants over the stomach, or by the application of cloths sprinkled with chloroform over the same region. Drop doses of Fowler's solution of arsenic have been found by Bellot the younger effective in checking this distressing symptom in yellow fever, and the same remedy may possibly be of use in cases resisting other means. But in the writer's experience vomiting, as a rule, subsides with the other symptoms, when the exacerbations are controlled by quinine. What was said, under the head of intermittent fever, of the danger of pausing in the use of quinine, to treat this or that complication, is most emphatically repeated here.

On the first sign of collapse in any stage, recourse must be had to stimulants; white wine whey is an excellent vehicle for the administration of alcohol, if that be called for; good champagne, if available, or the best Rhenish wine within reach, often answer admirably, and are keenly relished. Livingstone's party used bitter ale, and speak in praise of it as a stimulant grateful to the patient, 'frequently remaining on the stomach when all others are rejected.' The large experience of such intelligent observers on such a subject is worthy of respect. It is hardly necessary to dwell on the necessity of sustaining the patient during the remission by a diet adapted to the irritable condition of the stomach. With one remark—one pregnant remark by the Rev. Horace Waller, the fellow-traveller, friend, and biographer of the illustrious Livingstone—we shall close this article: 'One thing, however, must be strongly urged: it is that all notions about not being able to "stand quinine," that it "flies to the head," and so forth, must be banished as utter nonsense. In Africa everyone can stand quinine; there is scarcely a disorder there in which it is not positively required.' The writer adds from his experience that this is as true of malarial regions in other parts of the world as it is of Africa. W. C. Maclean.

REMOTE CAUSES.—This expression is used as a synonym for predisposing causes. *See* Disease, Causes of; and Predisposition to Disease.

RENAL CALCULUS.—Synon.: Nephrolithiasis; Fr. *Calcul rénal*; Ger. *Nierenstein*.

Definition.—A concretion formed by the deposit of one or more of the solid constituents of the urine. It differs only in size from the gritty particles called 'gravel'; it may be single, or there may be many; it may be present in one or both kidneys at the same time; and it occurs at all periods of life, from the fœtus *in utero* up to the extremest age.

Ætiology.—The majority of urinary calculi are primarily formed in the infundibula or uriniferous tubes of the kidney; and are caused by precipitation, in the nascent state, of uric acid or oxalate of lime. This precipitation may be due to a real excess of the insoluble uric acid, or to deficiency of the water of the urine; but the precise form and proximate cause of the deposit are determined by the presence of a colloid matrix, composed of mucus or blood-globules, or other animal basis (*see* Calculus). Increase by gradual accretion goes slowly on until blockage of the duct occurs; the calculus is then either floated by the urinary stream into the pelvis of the kidney and onwards through the ureter, or it becomes impacted in some part of its transit and develops into a full-formed renal stone, which, minute at first, may grow to enormous proportions.

Varieties.—By far the most frequent variety of renal calculus in this country is that composed of uric acid; in the eastern counties, where stone is most common, it is very rare indeed to find in the adult any other primary form. Even in children, in whom oxalate of lime is not uncommon, uric acid is the most prevalent. It is thought by some pathologists that oxalate of lime forms the first starting-point even of uric acid stones, but this statement lacks proof. The sparing solubility of uric acid and oxalate of lime is probably the cause of their greater frequency in calculi; but other agents may occasionally be found to constitute the primary nucleus of renal stone, such as cystine, carbonate of lime, phosphate of lime, either by itself or in combination with the ammonio-magnesian phosphate, forming what is designated the fusible calculus, and urate of ammonia or the mixed urates. The phosphates and urates, however, are more likely to occur as secondary than as primary deposits. Mixed or alternating calculi are frequently met with, in which are seen alternate strata or layers of uric acid, oxalate of lime, and phosphates, the latter generally constituting the external part.

Pathological Effects.—The action of a calculus on the structure and condition of the kidney depends much on its size. At first it may produce irritation and local congestion, possibly leading to actual inflammation, and even abscess within or external to the capsule. This may happen when the stone develops in the tubular or secreting structure; but when it remains and enlarges in the pelvis of the kidney, chronic pyelitis is more likely to ensue, with changes of an atrophic character. The pelvis dilates; pressure comes to be slowly exerted on the renal structure, causing wasting, until but little secreting tissue is left; and a large stone remains, occupying the pelvis and branching into the calyces, in shape resembling a cauliflower, and with little covering beyond the capsule of the kidney.

Symptoms.—The genesis of renal concretions is always unrevealed by symptoms; their retention and development up to a considerable size or in great numbers may be unsuspected and unnoticed; and even their transit and escape through the urinary passages may be painless. Usually, however, there is some degree of lumbar pain, generally restricted to the side affected, spreading more or less to the front of the body, and down towards the groin and bladder. The pain is apt to be aggravated by exercise—especially by carriage exercise, and it is liable on such occasions to become very severe; so also when, from any cause, it is disturbed in its bed, or makes a fruitless attempt to enter the ureter (renal colic).

When a stone of some magnitude is passing down the ureter, symptoms of a very acute character usually ensue. The pain rises to intense agony in the loin, and along the course of the ureter down to the bladder and testicle; frequently there is sickness or vomiting; the patient is bathed in warm perspiration; and he sometimes passes into a state of fainting and collapse. The bladder is frequently irritable; the urine is smoky from the presence of blood, or of elongated clots; or almost pure blood escapes. These symptoms may come on suddenly; may last a few hours or a few days; and may end as suddenly when the calculus reaches the bladder.

The changes produced in the urine by renal calculus may be very slight. Hæmorrhage is the most common and most characteristic; sometimes it is in quantity enough to render the urine smoky or like porter; at other times it can only be detected by the microscope. When it exists in any palpable amount, albumen will, of course, be present too. Pus, mucus, and epithelium corpuscles will show themselves when the calculus has produced some degree of pyelitis. In long-standing cases a tumour may be felt in the situation of the kidney. The patient resting on his back, and the knees being drawn up, the surgeon with one hand behind presses the kidney forwards, and with the other in front presses it backwards below the margin of the ribs. He may thus, in young and thin persons—aided, perhaps, by the administration of ether—differentiate a renal stone from any of the usual kinds of renal tumours.

Diagnosis.—Renal calculus may be mistaken for various diseases:—1. Bilious attacks, intestinal colic, or perityphlitis. The sickness and pain in the flank are present in all, but in nephritic colic the pain is apt to be more located in the loin, although this is by no means always so. The presence of hæmaturia will be conclusive. In typhlitis and perityphlitis there will be fever and local tenderness. 2. Obscure pain in the back, due to chronic lumbago or neuralgia. In these conditions the pain is generally across the back, and not unilateral; it is aggravated by movements of the affected muscles; and there is no hæmaturia or other urinary complication. 3. Cancer or other renal tumour. Pain and hæmaturia are characteristic of both stone and cancer, but in calculus the health is generally good, while in cancer it is always deteriorated. In stone there is seldom any tumour, and when it does exist it must be of limited size and hard, whereas in cancer it is diffused and may be soft.

Prognosis. — The frequent formation and escape of renal stones may continue for a great many years without any material injury to the general health. Even when blockage of the ureter takes place, leading to hydronephrosis and atrophy of the organ, or to nephritis or perinephritis with abscess, a fair measure of health may be preserved, provided the other kidney is in a healthy condition. When both organs are affected, or when complications arise, such as amyloid or tubercular disease, or chronic pyelitis, then the health steadily deteriorates, emaciation proceeds, with hectic and fatal exhaustion.

Treatment.—Bearing in mind that the large majority of renal stones are composed of uric acid, and that it is not difficult to form a correct diagnosis on this point, it will be necessary chiefly to consider the treatment of this form of concretion. Preventive treatment consists in a rigid limitation as to the *quantity* of food taken. It is customary to condemn a free use of animal food and highly-seasoned dishes; but it should be borne in mind that stone prevails largely amongst the poor, who seldom can indulge in animal food to excess, and it is not unfrequent in countries where no animal food is taken. Far more important is it, both as to food and drink, to observe a strict moderation as to the amount taken. In this way digestion and assimilation will be easy and perfect; crude matters will not find their way into the blood; the chemical conversion of uric acid will be complete; and precipitation in the uriniferous tubes will be obviated. When the proclivity to uric acid calculi is decided, or when a small stone is known to exist, the free use of diluents and alkaline remedies is undoubtedly of importance. The waters of Vichy, Ems, and Neuenahr, taken freely at the springs, with or without baths, but with the great aid of change of air and mode of life, constitute the most efficient plan of treatment; but it must be admitted that in the majority of cases this good effect is only transient. Some high authorities recommend, in preference to the simple alkaline treatment, the use of those saline aperient waters whose chief ingredient is sulphate of soda, such as Carlsbad and Friedrichshall; and undoubtedly they have a most beneficial action, by promoting digestion and assimilation. But as with the alkaline remedies, whether natural waters or drugs, so with the salines, their action is evanescent. Leave them off and let the patient return, perhaps to a place where calculus is frequent, or to habits of careless living, or to over-work, and the morbid tendency will almost certainly recur. If there are clear indications of the actual presence of a renal stone, composed of uric acid, of moderate size and recent date, the solvent treatment, as described by Dr. Wm. Roberts, should be fully carried out. It depends for its success on the known solubility of uric acid and its salts in alkaline solutions of definite strength, the most efficient being about 60 grains to the pint; above and below this strength the solvent power diminishes. The patient, if an adult, should take 40 to 60 grains of the acetate or citrate of potash in 3 or 4 ozs. of water every three hours during the day, and once at least in the night; this plan should be continued for two or three months. During the treatment the urine should be frequently examined, and if any approach to an ammoniacal state should appear, the treatment must be suspended for a time. The effect of the treatment must be estimated by the diminution of lumbar pain, and by the escape of small calculi; no ill-effects are caused; seldom any indigestion; and no impairment of general health. Other drugs have been employed for the solution of uric acid, such as carbonate of lithia, phosphate of soda, tartrates and carbonate of potash and soda, and carbonate of lime. Some years ago the writer conducted some experiments with prepared chalk, and found that, when given to the extent of 20 to 30 grains in mucilage and mint water, three or four times a day, it had a most marked effect in quickly removing uric acid deposits, and it will have this effect even in the febrile state. It did not, in the quantities given, produce alkalinity of the urine, but it acted distinctly as a diuretic.

In the crisis of nephritic colic, narcotics are called for, in doses large enough and frequent enough to control the pain. If sickness is troublesome, morphia may be administered subcutaneously, and if there be vesical irritation, by suppository. If the agony be extreme and in paroxysms, chloroform may be inhaled occasionally; while the hot bath, anodyne fomentations, and stupes are useful aids to relieve and soothe.

Surgical treatment of renal stone is coming prominently into notice at the present time. Incision in the lumbar region and removal of stone from the kidney is as old as Hippocrates; and when abscess and sinus exist, leading to a stone impacted in the kidney, or when a lumbar swelling is present which is obviously caused by a renal stone, an exploratory incision for its removal is clearly warranted, and has been successful in several instances. So, too, has the entire extirpation of a kidney containing calculi, as well as for other diseases of the organ. For the conditions which justify and call for these operations, and for the steps to be taken in their execution, the records of surgery must be consulted.

Wm. Cadge.

RENAL COLIC. — Synon.: *Nephralgia calculosa*; Fr. *Colique néphrétique*; Ger. *Nierenschmerzen.*—The name commonly applied to the symptoms which arise when a renal calculus either passes, or attempts to pass, down the ureter. *See* Renal Calculus.

RENAL DISEASES.—*See* Kidneys, Diseases of.

RESISTANCE.—The sensation recognised by the fingers, of the degree to which a part yields or resists when palpation or percussion is being performed. *See* Physical Examination.

RESOLUTION (*resolvo*, I loose).—The return of a diseased part to its natural condition; chiefly applied to the process of inflammation when it subsides gradually, and without the occurrence of suppuration or other unfavourable termination. *See* Inflammation.

RESOLVENTS (*resolvo*, I loose).—Anything which aids the absorption of effused products may be included in this class of remedies; the most efficient being, externally, counter-irritation and poultices; and internally, mercury and iodide of potassium. Our knowledge of the precise mode of their action is still very vague. The subject of blisters and the like is considered under Counter-irritation. It is generally held that mercury renders fibrin less cohesive; and that iodide of potassium—in virtue, probably, of the free iodine which is separated within the blood—has a special affinity for albuminous bodies, and for that form of lowly organised fibrin which is so commonly deposited in the tissues during the more advanced stages of constitutional syphilis. It is difficult, however, to discuss this therapeutical heading from a strictly scientific standpoint, deriving its origin as it does from a past epoch, when pathological science was still in its infancy, and when very active modes of treatment were held to possess virtues which further experience has not confirmed. Free bleeding and blistering, combined with copious salivation, were held in these days to have a most powerful influence in checking inflammation and removing its sequelæ; and we are only now learning to assign to unaided nature the due share which she takes in effecting what we are accustomed to call the 'cure' of disease.

R. Farquharson.

RESONANCE (*resono*, I sound again, echo). Resonance signifies the character of the sound yielded on percussion over the greater part of the chest, and, within wide limits, of the abdomen also. The degree of resonance depends principally upon the proportion of air contained in the underlying cavities or organs. *Vocal resonance* is the voice-sound transmitted through the chest to the ear of the auscultator. It is increased or diminished in accordance with the physical conditions present in the chest-cavity.

Hyper-resonance is a term used to signify undue resonance over a given part.

Deficient resonance is commonly called *dulness*. It is often used with the same comparative or local application as hyper-resonance. *See* Physical Examination.

R. Douglas Powell.

RESPIRATION, Disorders of.—A due performance of the function of respiration is essential to the well-being of the economy, and any derangement of this function is likely to be followed by more or less disturbance of the system, varying in degree and gravity, but often of a serious character. Moreover, the phenomena resulting from such a derangement are commonly of much significance with reference to diagnosis, prognosis, and treatment. Therefore, disorders affecting breathing demand attentive and careful observation and consideration in every case; while their general study by no means receives the thought and attention which its importance emphatically requires. In a short article it will be impossible to do more than give a very condensed summary of the subject, and to suggest points for the further consideration of those who are interested in it. The several forms of disordered breathing associated with particular diseases are indicated in their appropriate articles.

Before considering the disorders of respiration, it will be well to call to mind the following points relating to the performance of the act in health. The average frequency of breathing is from sixteen to twenty per minute in adults, although this rate is easily disturbed temporarily by various physiological conditions. The function is powerfully under the influence of the nervous system, and it is ordinarily carried on either by centric or reflex stimulation, without any consciousness of the act on the part of the individual, and independent of any voluntary effort. In ordinary respiration scarcely any movement or other sign of the act is observable to an onlooker, and the actual quantity of air changed with each breath is very small, amounting only to from 16 to 20 cubic inches; but in this respect also the act is very liable to be disturbed, while a person is able voluntarily, without any difficulty, to breathe more or less deeply, performing 'extraordinary respiration,' and he may thus change large quantities of air, and call into play every part of his lungs. Remembering what respiration is intended for, the conditions required for its proper performance in connection with the breathing-apparatus are, that there should be a sufficient supply of air suitable for the purpose, and an adequate passage for its entrance and exit; that there should be enough healthy lung-tissue; that the blood should pass freely through the lungs, and be within certain limits of a proper quality; that there should be no mechanical impediment to the free working of the lungs, especially if suddenly called upon to do extra work; and that the forces by which the respiratory movements are carried on, namely, the muscles, including the diaphragm, and the elasticity of the lungs and chest-walls, are equal to their work. If the act of breathing is watched and investigated, it will be found that normally expiration is rather longer than inspiration; but there is no striking difference between the two divisions, the ratio being as twelve to ten in males, fourteen to ten in females. Moreover, the movements are both thoracic and abdominal, the former being distinctly made up of expansion and elevation during inspiration, of retraction and depression during expiration, especially when a full breath is taken. The intercostal spaces in most parts, as well as the supra-clavicular fossæ, seem to sink in during inspiration, so as to become more evident, this being more marked in proportion to the depth of the inspiration. It will further be noticed that the precise movements differ in different persons, and according to the extent of respiration. The lower ribs and diaphragm act principally in males and children during ordinary breathing; in adult females the respiration is upper costal. In extraordinary breathing the movements are chiefly upper thoracic in all persons.

Respiration is markedly influenced by physiological conditions, such as exercise, diet, sleep, and various others; these must be remembered in considering its derangements.

With these introductory remarks, the disorders of respiration may now be more conveniently studied.

Ætiology and Pathology.—The numerous causes and conditions which lead to disturbances of respiration can be brought within well-defined groups, and it is desirable in the first instance to study them from such a general point of view. This, however, only gives a superficial insight into the subject, and does not indicate the kind of disorder that is produced by each cause, or how it acts, while many conditions act in more ways than one; and still further, in any individual case there may be more than one, perhaps several causes at work, all of which ought to be recognised. These causes and conditions may be summarised in the following manner, and it will be seen that several of them act indirectly on the respiratory process:—

1. *Conditions acting directly through the nervous system.*—These include:—(*a*) Centric lesions in connection with the brain, involving the respiratory centre, either directly or indirectly, such as injury, hæmorrhage, or a tumour. (*b*) Disease or injury of the upper part of the spinal cord, paralysing the nerves supplying the respiratory muscles. (*c*) Functional nervous disturbance, as from mere nervousness, emotion, hysteria, trance, or chorea. (*d*) Conditions affecting immediately the nerves concerned in respiration, either irritating or paralysing them, especially the pneumogastric, recurrent laryngeal, or phrenic nerves. These nerves may be themselves diseased, or affected by a neighbouring condition, such as a tumour. (*e*) Reflex causes, transmitted from the skin, as when cold water is dashed upon it; or from organs, as the stomach, intestines, or ovaries. It is important to remember that causes connected with the nervous system frequently aggravate disorders of breathing otherwise occasioned.

2. *Abnormal conditions of the blood.*—In this group are merely included conditions of the blood as a whole, and not any local derangement affecting the pulmonary circulation. They are:—(*a*) Deficient quantity of blood, especially from a sudden or rapid loss. (*b*) Anæmia or hydræmia. (*c*) Deficient aëration. (*d*) A poisoned, impure state of the blood in connection with narcotism, the anæsthetic state, pyrexia, the typhoid condition, uræmia, pyæmia or septicæmia, diabetes, and other diseases.

3. *Functional disorders, or organic diseases, connected with the heart.*—These are common sources of disturbance of breathing of various kinds, depending upon the intimate relation of the nerves and nerve-centres governing the heart and respiratory organs; upon the effects they produce as regards the pulmonary circulation; or sometimes upon their direct interference with the movements of breathing, by exerting pressure upon the lungs, especially the left, upon the left bronchus, or upon the chest-walls, particularly the diaphragm. This last cause is only noticed in cases of great enlargement of the heart, or of considerable pericardial effusion. The breathing, however, is frequently disturbed in connection with disorders of cardiac action; diseases of valves and orifices, especially the mitral and tricuspid; enlargements of the heart, particularly dilatation; degenerations; congenital malformations; and clotting of blood in the cavities of the heart.

4. *Abnormal conditions of the air inhaled.*—The physiological effects produced upon the respiratory act by various states of the air inspired are well known. These especially depend upon its composition; its temperature; and its condensation or degree of pressure. From a clinical point of view these deviations have to be borne in mind, as they are more liable to be induced in certain diseases, and may also be made available for therapeutic purposes.

5. *Conditions affecting the apparatus concerned in the respiratory movements.*—These refer to the chest-walls and the diaphragm, and they include:—(*a*) Certain painful affections, causing the patient to limit or modify the movements, such as the early stage of pleurisy, pleurodynia, or peritonitis. (*b*) Spasm or paralysis of the muscles, from any cause. (*c*) Organic changes, as undue softness or rigidity of the thoracic walls, cancerous infiltration, muscular atrophy or fatty degeneration, acute or chronic inflammation of the diaphragm.

6. *Obstruction involving the main air-passages.* This may be situated in the mouth, throat, larynx, trachea, or primary bronchial divisions, and is due to a variety of causes, which cannot be discussed here further than to state that the obstruction may depend upon pressure from without; spasm or paralysis of the muscles of the larynx; some internal obstruction, whether from deposits, secretion, foreign bodies, or new growths; or organic changes in the walls of the tubes, leading to their constriction.

7. *Physical conditions independent of the respiratory apparatus, but interfering with it in various ways.*—These may lie within the chest, as in the case of thoracic aneurism, or a mediastinal solid tumour or abscess. They act by compressing the lungs or heart, obstructing tubes, affecting nerves, or interfering with the moving apparatus. Or the cause of the disorder may lie in the abdomen, such as excessive flatulence or tympanites, abundant fluid in the peritoneum, enlarged organs, ovarian tumours, or a pregnant uterus. They act mainly mechanically, by impairing the movements of the diaphragm. Breathing often becomes worse after food, in consequence of dyspepsia leading to flatulent distension.

8. *Conditions affecting the pleuræ.*—Any accumulation of air or fluid in one or both pleural sacs will necessarily tend to disturb respiration, as in pneumothorax, pleurisy, hydrothorax, or hæmothorax. It acts mechanically, and the degree of disorder will depend on the amount of the collection, the rapidity with which it takes place, the previous condition of the lungs, and other circumstances. Pleuritic adhesions and agglutinations also tend to embarrass respiration more or less seriously.

9. *Morbid conditions of the lungs.*—These have been left to the last, and it will be readily understood that all diseases of the lungs tend more or less to produce disorders of breathing. At the same time it must not be forgotten

that these organs may be affected, even somewhat extensively, under certain conditions, without any obvious respiratory disturbance. Pulmonary diseases act in various ways, of which the most important are by affecting the pulmonary circulation and the amount of blood in the lungs; by interfering with the entrance or exit of air through the bronchial tubes; by temporarily disabling or permanently destroying more or less of the pulmonary textures; or by influencing the respiratory act through its forces, and especially through the impairment or loss of the elastic force of the lungs required for expiration.

Classification.—The arrangement of the numerous forms of disordered respiration is by no means an easy matter, and may be founded on different plans. Before giving that which seems to the writer to be a practical arrangement, he would urge the great importance of endeavouring to recognise in every case, by due investigation, what is the real nature of the deviation from normal breathing, and not merely to call it 'dyspnœa,' or 'difficulty of breathing.' Moreover, it must be remembered that there may be more than one form of disordered respiration in the same case.

The disturbance of breathing may be sudden, acute, or chronic; and its several forms may be included under three main divisions, namely:— **1. Deficient Respiration. 2. Dyspnœa or Difficulty of Breathing. 3. Peculiar Disorders.**

1. Deficient Respiration.—This comprehends the following:—

(*a*) *Slow breathing.*—The frequency of the respirations may be notably reduced, without any other obvious disorder. Or this may be associated with marked shallowness of the movements, so that in extreme cases breathing seems to have almost or entirely ceased, and can scarcely be recognised even by the most delicate tests. These deviations are observed in various conditions or diseases affecting the nervous system, such as hysteria, trance, shock or collapse, narcotic poisoning, and some cases of cerebral disease. They are accompanied by impairment or loss of consciousness, real or assumed, and with other varying symptoms. Sometimes the breathing is slow but deep, and may then be sighing, stertorous, or attended with flapping of the cheeks in expiration; this is noticed in apoplectic conditions. These disorders of breathing do not obviously disturb the patient.

(*b*) *Restrained breathing.*—By this is meant that the patient makes a voluntary and conscious effort to restrain or modify the act, because it produces or increases some painful or other morbid sensation. It may be obvious at once to the observer, or may only be revealed when the patient is made to take a deep inspiration. The respirations are often increased in frequency, but may be below the normal. The entire movements may be affected, or only those of either the chest or the abdomen, or even only of one side of the chest. The early stage of pleurisy, peritonitis, and angina pectoris afford examples of diseases causing this disorder of breathing.

(*c*) *Shallow and feeble breathing.*—The most striking feature in some conditions is the extreme feebleness and limitation of the act of respiration. This has already been alluded to, as noticed in some cases of slow breathing, but the frequency is often much above the normal, and the class of cases now under consideration differ essentially from those previously mentioned. The disorder indicates gradual cessation of the respiratory functions and pulmonary action, becoming more and more obvious, and gradually terminating in death. Little or no air is changed, and at last the breathing becomes a mere ineffectual gasp. This form of disturbance is observed in persons slowly dying from various causes; in gradual filling of the air-tubes in fatal cases of bronchitis; and in cases of apoplexy or narcotism. It is often accompanied by rattling or gurgling *râles*, due to the presence of fluid in the air-passages, which become by degrees filled up. It may follow certain forms of dyspnœa.

(*d*) *Ineffectual breathing.*—The derangement thus named can only be recognised by making the patient attempt to draw a full breath. He may then have the sensation of an inability to do this, or to expand the chest properly. What is more important, however, is that this impairment of the respiratory act is often evident on objective examination, when it is seen that in certain conditions the most powerful efforts to breathe produce little or no result, and the movements are obviously more or less ineffectual, either as a whole, unilaterally, or locally. This may arise from various causes, such as paralysis or spasm of the muscles, rigidity of the chest-walls, distension of the lungs in emphysema, pleuritic and other conditions interfering with their expansion, and certain morbid changes in these organs. Ineffectual breathing is frequently associated with some form of dyspnœa.

2. Dyspnœa or Difficulty of Breathing.—Without making too marked a distinction between them, and remembering that they may be combined, there are certain forms of disordered breathing, usually characterised as *dyspnœa*, which deserve separate recognition.

(*a*) *Obstructive dyspnœa.*—This signifies that there is some obvious impediment or difficulty presented to the transmission of air through some part of the air-passages in respiration. The nature and severity of the disorder vary with the seat, cause, and degree of obstruction. Thus it may be that a swollen tongue, or enlarged tonsils or other throat-conditions, block up the passage more or less completely, and the patient breathes through the nose, often with obvious difficulty; or if some air passes by the throat, it does so with much noise, especially when the patient is asleep.

The most important form of obstructive dyspnœa, however, is that which is connected with the main air-tube, and it usually attracts immediate attention. It may be associated either with the larynx or the trachea, and in the former case is liable to exacerbations. The gravity of the phenomena vary with the degree of obstruction, but they are more or less of the following kind. The patient is usually conscious of a difficulty in the passage of the air during respiration, referred to some spot, which may become very distressing; the act of breathing is usually more or less laboured, and this may culminate in a violent effort or struggle to breathe. The frequency of respiration is often below the normal, or at any rate it is but little increased, while the relative length of inspiration and expiration is disturbed. The difficulty may be experienced only during inspiration, or during both divisions of the act of breathing, but is usually most marked in inspiration, though occasionally during expiration. Various noises are produced by the passage of the air through the narrowed part, and with experience these become of great importance as indicating the existence and seat of obstruction. Signs of deficient aëration of the blood are liable to accompany this form of dyspnœa; and in acute or sudden cases, or if the obstruction is very marked, there is danger of actual suffocation or apnœa, which may occur rapidly or even suddenly. Physical examination will indicate that air does not enter properly into the lungs, as evidenced especially by recession of the lower part of the chest, particularly marked in children, in whom this form of dyspnœa is likely to lead to most serious consequences.

The obstruction may be situated lower down in the respiratory tract, either in one of the main bronchial divisions, or in the tubes distributed through the lungs, and then the character of the disorder merges in that of ordinary dyspnœa, except that it is likely to be attended with various noises, and that the physical signs of deficient entrance of air into one or both lungs are evident. When there are objective signs of deficient entrance of air into the lungs, the condition is termed *inspiratory dyspnœa.* This, however, may also depend upon weakness of the chest-walls, and of the inspiratory muscles, as in rickets.

(*b*) *Excessive breathing—Ordinary dyspnœa.*—This is the disorder usually met with in various degrees, and it implies that respiration is carried on in excess. The act may be too frequent, or too powerful, or both, so that more than the ordinary amount of air is changed in a given time. The movements of the chest are more or less free under different circumstances. In severe cases the patient is obviously distressed, and the act of breathing is laboured, and may be noisy. Then the alæ nasi are seen to work; the patient cannot speak except in broken sentences, owing to want of breath; and there may be signs of apnœa. This form of dyspnœa is familiarly illustrated by the effects of undue exercise, such as running. Clinically it is associated in different degrees with numerous conditions, such as nervous disorders; fevers and other blood-diseases; many cardiac affections; conditions interfering with the action of the lungs; and various diseases of these organs, interfering with their functions, especially if acute.

(*c*) *Shortness of breath.*—While associated with other forms of dyspnœa, this disorder frequently exists alone in various degrees, and it may be of much consequence in drawing attention to disease of a serious character. Shortness of breath signifies that the breathing becomes more or less hurried, and the individual becomes conscious of dyspnœa, after making some effort, which ordinarily does not cause any such effects, such as walking rather quickly or upstairs, singing, coughing, or even taking a few deep breaths in physical examination of the chest. When at rest he may feel perfectly comfortable, and breathing is quite natural, but it is easily disturbed in the manner above indicated. This disorder is observed in general debility; very markedly in anæmia; in many cardiac conditions, especially degeneration; in pleurisy frequently; and in many cases of chronic lung-disease, such as phthisis or emphysema.

(*d*) *Expiratory dyspnœa.*—In the form thus designated the difficulty is experienced in expiration, which becomes prolonged and laboured, in some cases extremely so, the extraordinary muscles of expiration being called fully into play. The relative lengths of inspiration, expiration, and the pauses are thus deranged, and inspiration may become very short, even a mere gasp. There is often a sense of discomfort or even distress, and this is liable in certain conditions to be increased by exertion, or after taking food, or in certain postures. Expiratory dyspnœa may be a prominent feature in some cases of obstruction of the air-tubes; but is essentially connected with impairment of the expiratory elastic force of the lungs in cases of emphysema, and of the chest-walls when they are rigid, these two conditions often going together. These conditions are frequently aided materially by blocking-up of the bronchi, as the result of bronchitis; or by spasmodic contraction of these tubes, in connection with asthma.

(*e*) *Orthopnœa.*—This is almost always combined with one or more of the other forms of dyspnœa, and the term indicates that the patient can only breathe at all, or at any rate comfortably, when the body is in a more or less upright posture. In some cases it is sufficient if he is propped up; in others he has to sit bolt upright in bed, or to bend forward; in others still he is obliged to sit up altogether in some kind of chair, or even to stand, this being the only posture in which breathing can be carried on. Cases of cardiac disease, of acute pericardial and pleuritic effusion, of acute pneumonia, of asthma, and of aneurismal or other thoracic tumours, afford illustrations of the causes of this disorder.

(*f*) *Paroxysmal dyspnœa.*—This may be of various kinds, but as its designation implies, it signifies that the dyspnœa comes on mainly or entirely in fits or paroxysms. It is chiefly exemplified by paroxysms of laryngeal dyspnœa; by some cases of cardiac dyspnœa; and, above all, by fits of bronchial asthma. *See* ASTHMA.

3. Peculiar Disorders.—It is scarcely practicable to bring these under any definite subdivisions, and it will suffice to notice the very curious and often indescribable disorders of breathing observed in certain nervous cases; the interrupted, jerky, sighing, or yawning respiration which may be present in various conditions; and the peculiar disturbance which has been named *Cheyne-Stokes respiration.* This is rare, but may occur in connection with certain cardiac diseases, especially fatty degeneration; injury to the brain; and cerebral hæmorrhage. It is characterised by the breathing at intervals becoming by degrees more and more rapid and deep up to a certain point; and then subsiding in the same gradual manner, until finally there is a complete cessation of respiration, with a dead silence, the pause lasting a variable time, and then the same series of phenomena being repeated.

Effects.—Many of the disorders of breathing which have now been considered are not attended with any obvious effects, and are practically of little or no consequence. Moreover, it must be noted that patients may become so accustomed even to marked derangements of the function of respiration, that they are not conscious of any injurious results therefrom. Most individuals under such circumstances, however, are conscious of more or less discomfort or other sensations, referable to some part of the respiratory apparatus. These are very unreliable and vague in their meaning; but there are effects which give important information in many cases, and which depend either upon the want of due aëration of the blood, or upon the interference with the general venous circulation which disorders of breathing so frequently induce. These will vary, not only with the nature of the disorder, but also with its degree, and the rapidity with which it is set up. Thus there may be actual suffocation, sudden or rapid, or a condition approaching more or less that of asphyxia or apnœa (*see* Asphyxia). Or a chronic state of venous congestion and venosity of the blood may be set up, indicated by a tendency to cyanosis, with enlargement of the superficial capillaries; general chilliness and coldness of the extremities; mental apathy or dulness, with headache and other signs of morbid blood-supply to the brain; general languor, laziness, and muscular weakness; dyspeptic disorders; changes in the urine; and other phenomena. In cases where the respiratory functions are chronically affected in children and young persons, in such a way that the blood is never properly aërated, growth and development are markedly impeded. Patients suffering thus may present a peculiarly stunted appearance. The features tend to become permanently thick and coarse; and the ends of the fingers and toes may become clubbed. In certain forms of dyspnœa the fat of the body tends to disappear; while the muscles of respiration may become hypertrophied from excessive use.

Treatment.—The indications to be fulfilled in treating disorders of respiration, and the measures by which these are to be carried out, must obviously present considerable variety in different cases, and it will only be practicable here to offer a few general hints on the subject. In the first place no treatment whatever may be called for in some instances; while in other cases nothing can be of any service. The primary indication should always be to attend to the cause of the disorder, and by curing, removing, or alleviating this, the disturbance may often be got rid of or materially diminished. This may be illustrated by treatment directed to laryngeal obstruction, anæmia, pleuritic pain or effusion, bronchitis, or cardiac derangement. By improving the condition of the blood when anæmia is present, breathing is frequently much improved, even when there is some actual disease to disturb it, such as phthisis or cardiac disease. Attention to the condition of the air inhaled is in some cases of much importance, as regards its purity, temperature, degree of moisture, pressure, and other points. It must be remembered that some forms of dyspnœa actually require an atmosphere which contains an excess of carbonic acid. Great advantage frequently arises from giving proper instructions to patients as regards posture, avoidance of exertion, diet, the act of coughing, or even the act of breathing itself. This is especially important in certain forms of paroxysmal dyspnœa; and any cause which is known to produce any such attack should be carefully avoided. Moreover, the patient may sometimes be materially assisted in the act of breathing by mechanical means. Not uncommonly active measures are called for, for the purpose of relieving some more or less urgent form of dyspnœa. For this purpose various means are indicated in different cases, such as venesection, or local removal of blood from the chest; dry-cupping over the chest; the internal administration of antispasmodics, stimulants, pulmonary sedatives, or other appropriate agents; inhalations of different kinds, in the form of gas, vapour, or smoke; subcutaneous injections of morphia or other active drugs; or the application to the chest of sinapisms, hot poultices, fomentations, or turpentine stupes. Treatment may be urgently demanded, directed to the asphyxial condition (*see* Asphyxia); and operative procedures, such as laryngotomy or tracheotomy, may be called for. In chronic cases, where the respiratory functions are imperfectly carried on, the conditions resulting therefrom must be remembered, and as far as possible obviated. Warm clothing is essential under such circumstances; and, if practicable, a residence in a genial and warm climate is often of the greatest consequence.

Frederick T. Roberts.

RESPIRATORY MURMUR.—The sound heard on auscultation over the lungs in respiration. *See* Physical Examination.

RESPIRATORY ORGANS, Diseases of. The diseases which must be referred to in this article are those involving the special organs by which the function of respiration is performed. These organs comprise, first, the lungs, in which the process of respiration takes place; secondly, those organs through which the air is brought into contact with the blood, that is, the air-passages, and the agencies by which the movement of the air is effected; and thirdly, indirectly, those organs by which the blood is brought into contact with the air, that is, the heart and blood-vessels.

Frequency and Fatality.—General Ætiology.—Before enumerating the several morbid conditions of the respiratory organs, it will be well to indicate the importance of this class of diseases—an importance which is due partly to the remarkable frequency with which they occur, and partly to the great fatality by which they are attended.

On reference to the returns of the Registrar-General (*Annual Report* for 1880), we find his calculations showing that whilst during 25 years (1850–74) 5038·7 per million of persons living died of zymotic diseases, no fewer than 5840 died of diseases of the respiratory organs (in-

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cluding phthisis, and excluding the organs of circulation). This report further shows that the two great classes of diseases, the zymotic and respiratory, together accounted for almost one-half of all the deaths from every cause, including accidents. It must be remembered, further, that these figures represent only the number of *deaths* from respiratory diseases, and give but a rough indication of the number of instances of illness more or less grave from the same causes.

When we come to investigate more closely the nature of these diseases, it is not difficult to account for the frequency of their occurrence. Complicated, delicate, and sensitive as the respiratory organs are in structure and function, including the pulmonary circulation, and the very important changes in the blood which occur in the capillaries of the lungs; controlled by the nervous system, itself subject to a great variety of influences of a morbific character; dependent for the performance of the healthy act of respiration upon the continual movement of the mechanism which admits air to the lungs, namely, the chest-walls and the respiratory passages; affected also by the temperature of the air, subject as it is to great variety, by its purity, liable as this is to be contaminated by noxious gases and impure particles, as well as to be damaged in its quality by alterations as regards dryness and moisture—it is easy to understand how the respiratory organs should become so frequently the seat of disease. Besides the more important influences to which we have referred, it will suffice to mention the effect that is exerted by such factors as occupation, age, sex, and climate. These several ætiological points will be found fully discussed in the articles CLIMATE; and DISEASE, Causes of. The influences of inheritance and diathesis also contribute powerfully to the causation of disease of the respiratory organs, more especially as predisposing elements in the production of phthisis, although the influence of both can be traced in certain other morbid states, such as bronchitis, asthma, &c.

GENERAL PATHOLOGY.—The respiratory organs are liable to the several forms of injury and of disease which affect the other organs and tissues of the body. The injuries, including wounds and the presence of foreign bodies, are chiefly of surgical interest. The chief diseases are:—1, disturbances of circulation, including inflammation and its effects; 2, degenerations; 3, new growths; 4, malformations and malpositions; 5, deformities; and 6, nervo-muscular disorders.

1. Disturbances of the circulation are found more especially in the mucous membrane of the air-passages, in the substance of the lungs, and in the serous coverings of these organs. Thus we have—as instances of inflammation, specific or otherwise—laryngitis and tracheitis (including croup and diphtheria); bronchitis, in its several and varied forms; pneumonia, and pleurisy; ulceration, which may occur in any part of the tract; and gangrene, especially of the lungs. Congestion more generally affects the lung-substance, but it is also to be met with in the mucous membranes of the passages. Hæmorrhage may occur from any portion of the air-passages, or from the substance of the lung itself, as the result of congestion, of tubercular disease and its effects, of disease of the heart and blood-vessels, and other causes. Examples of thrombosis and embolism may be found in the pulmonary artery and veins.

2. Examples of degenerative disease are presented by the indurations which the cartilaginous tissues of the larynx, trachea, and chest-walls undergo; in the degeneration which is traceable in the air-cells in connection with emphysema; the pigmentary and calcareous changes found in the bronchial glands and lung-tissue; and the caseous degeneration of inflammatory and new growths, such as tubercle.

3. The most important of the new growths are tubercle; malignant disease in its several forms, whether primary or secondary, extending from surrounding parts; syphilis in its various stages, more especially affecting the larynx; and hydatids.

4. Malformations and malpositions of the lungs and air-passages are of rare occurrence, and are of most importance when portions of the lungs are undeveloped, as in atelectasis.

5. Deformities implicate most frequently the walls of the chest.

6. Lastly, there are the various nervo-muscular affections comprehended under the names of whooping cough, nervous aphonia, spasmodic cough, laryngismus stridulus, hiccup, spasmodic dyspnœa including asthma, paralysis of the laryngeal muscles, of the walls of the chest, or of the diaphragm; also pleurodynia and intercostal neuralgia.

Although we have thus spoken of the several portions of the respiratory organs, and the diseases which affect them, as having, so to say, separate relations, we find no such isolation existing in the natural history of their diseases. Thus, for example, we seldom find inflammation of the lung in the absence of an affection of the pleura; whilst when the like process affects the air-passages, it is rarely limited to one part, such as the larynx, trachea, or bronchi, without involving others, and it frequently passes on into the substance of the lung itself. Again one morbid process may be, and is very frequently, associated with others; thus inflammation may lead to degeneration of tissue, or *vice versâ*; new growths may give rise to obstruction of breathing, to inflammation, and frequently to hæmorrhage; and nervo-muscular affections may be either the cause or the effect of similar disorder or disease. Here, too, we have to observe the relation between heart-disease and disease of the lungs; likewise between morbid states of these organs and diseases of the abdominal organs.

GENERAL SYMPTOMATOLOGY.—The special symptoms of disease of the respiratory organs are founded essentially on disturbances which prominently affect their functions. Thus we have:—1. disorders of the respiration, as fully discussed in the preceding article. 2. There are also obstructions and consequent disturbances of the circulation, which cause (*a*) congestion of the superficial or deep-seated organs, including the heart itself, the cavities of which may become dilated; and (*b*) hæmorrhages, especially hæmoptysis. 3. There occur disorders of secretions and morbid products, giving rise to varieties of expectoration of more or less importance, as symptomatic of different forms of disease (*see* EXPECTORATION). 4. Cough is a symptom seldom absent, presenting many varieties. It is sometimes entirely referable to nervous disturbance, and of a reflex character; whilst at other times it is the means by which secretions are expelled, which might otherwise accumulate, and lead to further embarrassment and distress (*see* COUGH). The diseases of the respiratory organs are often attended by local and constitutional disturbance, as are diseases of other organs, such as pain, fever, wasting, and general debility, which will vary according to the nature of the morbid process and the part involved, as will be found fully described under special headings.

PHYSICAL SIGNS.—The function of respiration is so intimately associated with physical conditions and mechanical actions, that the respiratory organs afford special materials for the application of the principles of physical diagnosis. The movements of air and the resonance of the voice through the several classes of air-passages, and into the minute textures of the lungs, cause characteristic sounds which are readily recognisable by the ear. These sounds become modified by the presence of disease, and afford characteristic evidence, by which its existence and nature may be determined. The size, the shape, and the movements of the chest-walls afford also available evidence in physical diagnosis. Valuable information is afforded by a part that is resonant becoming dull, or by a part which should be dull becoming resonant. For further information on these points *see* PHYSICAL EXAMINATION.

TREATMENT.—The diseases of the respiratory organs must be treated, whether for prevention or for cure, on those general principles which are applicable to the treatment of the diseases of other viscera; with such modifications as may be called for by the special structure and function of the organs themselves, and by any special features which disease affecting them may present. These general principles, and their particular applications, are so fully set forth in the articles which treat of the several diseases of the different parts of the respiratory system, that it is not necessary to discuss them again here.

But seeing the extreme frequency with which disease of these organs occurs, and its grave results, affecting alike the young and the aged, those who labour and those who pursue only pleasure, those who live in cabins and those who live in castles—for *æquo pulsat pede pauperum tabernas regumque turres*—we may enter a little more fully on the subject of their prevention.

Preventive Treatment.—The principles which must guide us in this direction, independently of those which fall under the head of general hygiene, fully treated of in other articles, are:—

1. That a supply of *uncontaminated air* is essential for the prevention of lung-disease. Impure air is found in the homes of the poor, and in their close and crowded workshops; but it also abounds in the assembly room, the banqueting hall, and such-like places. The remedy for this evil will be found, when people are made to feel that pure air is as essential to health and life as is unadulterated food; and when those who construct houses are convinced that they have no more essential duty to perform than that of devising means for the removal of impurities, and for the supply of pure air and pure water.

2. Pure air, however, can only be utilized by *freedom of the respiratory movements.* Many employments and trades involve constrained positions, which, no doubt, are often unavoidable; but even in such cases a knowledge of the fact that such positions are hurtful, with a desire to remedy the evil, will frequently suggest means for its mitigation. Like results follow a very different source of restriction on the movements of the chest, namely, the use of stays and other articles of dress, which not only compress the chest-walls and prevent their free movements, but even displace the contained organs. Much harm may also result from a practice which is called 'setting up' or drill in the army. The recruit is required to 'throw back the shoulders,' an act by which the pectoral muscles are made to act as constricting bands. The drill sergeant aims at expanding and throwing forward the chest-wall, which he does not effect by merely throwing back the shoulders. This object can only be accomplished by teaching the person drilled to take a deep inspiration, and to carry the chest-walls forward. The frequency with which diseases of the lungs, and of the organs of circulation within the chest, occur in the army is a recognised fact, which may in some degree be explained by this objectionable system of drill.

3. In the prevention of chest-disease it is necessary to guard against *vicissitudes of atmosphere and temperature.* This fact is more readily admitted than its teachings are adopted. Most persons cannot entirely avoid exposure to these vicissitudes, but even in such cases counteracting influences are often practicable, and should always be employed. Again, there are those who, not always from necessity, having respired heated air, perhaps for hours, suddenly expose the delicate respiratory mucous membrane to cold air, or the heated surface of the body to a chilling draught. Disease thus originated is within the knowledge of all of us, and all know that such results might have been obviated by forethought. Lastly, there is the necessity for protecting the organs within the chest by suitable covering. Suitable, for example, as is the dress worn by ladies during the day, the dress or rather the undress of many in the evening, would seem almost designed to leave uncovered and unprotected, both front and back, as much as possible of the space which contains the lungs. Many instances of grave disease have thus originated. The remedy is not far to seek, in resisting the objectionable rules of fashion.

If more attention were given to obtain pure air for respiration, and to secure freer action of the respiratory organs, and if more precautions were practised in guarding against the effects of atmospheric changes, it is but a truism—which will not lose in force by being repeated here—to say that diseases of the respiratory organs would be infinitely less frequent in their occurrence than they are, and less serious in their results.

Finally, if these remarks apply, as they do, to the strong and healthy, it is unnecessary to urge the absolute necessity of insisting upon the pracical suggestions which they convey in the case of persons whose respiratory organs are either constitutionally delicate by inheritance, or have been previously weakened by disease. Such are the chief victims of chronic lung-disease; and in no class of disease is prevention so absolutely essential. R. Quain, M.D.

REST. Therapeutics of.—In considering rest as a therapeutic agent it is requisite to understand its nature, the indications for its use, its varieties, and the ways of employing it. There are three chief varieties:—1, Rest of the *whole body* by sleep; 2, rest of the *mind*; and 3, local rest of a *diseased organ* or *inflamed part.* Of any of these, but of the third in particular, the practitioner may directly avail himself in the treatment of disease. The *modus operandi* of these varieties of rest consists in allowing the impaired, perverted, or lost functions of a part, or of the whole of the human frame, to be reinstated by maintaining the equilibrium of demand and supply. Hence it is only by availing oneself of the *physiological* properties of the component parts of the body, that rest becomes a therapeutic agent; and it must be borne in mind that *physiological* rest does not mean another variety, but rather that it regulates the employment of one or more of these varieties; and that whether applied to the whole frame, to the mind, or to a localised part, it is the agent, in the guiding hands of the practitioner, which cures.

1. *Rest of the whole body and mind: repose in sleep.*—This form of rest, which is so necessary to the well-being and the due performance of the several functions of the human body, accomplishes two ends:—First, the arrest of further waste of nerve-force and tissue-metamorphosis—a checking or 'diminution of chemical action' (B. Jones); and, secondly, the repair of the used-up materials. Rest of sleep, in a healthy man, does not of itself restore energy to the weary limbs, or vigour to the exhausted frame—it does but place the patient in the best possible condition for nature's recuperative powers to exercise their sway without detraction or interruption. Sleep may be looked upon as both a preventive of disease, and a curative means. The want of sleep and its attendant physiological processes of repair to the growing tissues of an infant—arising from whatever cause it may, such as teething, vesical calculus, flatulence, or worms—becomes of itself a direct cause of arrest of development and of wasting diseases, and lays the seeds of future misery and early death. A healthy adult can for a time, with impunity, do without much sleep; but let it never be forgotten not only that the want of it acts as a great predisponent to the infection of fever and all contagious diseases, and, in fever, to diseases of the brain; but also that in any disease, if carried too far, it becomes a cause of death.

2. *Rest of the mind: relaxation.*—The light story, the strains of music, the change of scene and society, are familiar to all as among the many ways by which rest is given to the overworked brain and careworn mind.

The waste of nerve-force attendant on long and deep thought, and the many strains put upon the brain in these days of emulation and hurry, must be repaired, in like manner as muscular waste, by sleep and cessation from all mental work for a time. In too many cases has it happened that insomnia, the first indication of the disturbance of that equilibrium of the mental state comprehended in the term 'sanity,' has ended, before long, within the portals of an asylum, in epilepsy, insanity, or idiocy.

Hence, 'in all diseases,' writes Hilton, 'of no matter what nature, of the cerebro-spinal system, when the evidence of disease is in deranged function, it becomes our duty to look upon and treat the altered nerve-substance as we do contusion and laceration of soft parts and congestion of organs, and to give the brain absolute rest, to rely on nature's power to repair the injury or disturbance, and to avoid stimulants which excite rapid circulation, as much as possible. The brain disturbed in its vital endowment becomes unequal to even its ordinary duties. It recovers itself slowly; it then soon becomes fatigued from use; and if claims are made upon it too soon after injury—that is, before structural and physiological integrity is re-acquired—the patient is very likely to suffer from serious disease of the brain. The brain requires absence from occupation, or rest, for its complete recovery, and this should be in proportion to the severity and duration of the symptoms it presents; in fact, the length of time which has been required by nature for the repair of the injury must be in proportion to the severity of the local injury; and the more severe the injury the longer the time required for perfect recovery of the functions of the brain. If this principle were only adopted generally and the plan carried out, we should not witness so many chronic diseases of the brain.' *See* Personal Health.

3. *Local rest.*—This, which may be called *mechanical rest*, is well known to every surgeon to be an agent of supreme value in the treatment of wounds, fractures, displacements or inflammation of joints; as it is obvious that every movement to which a wounded or inflamed part is subjected must act on the one hand like the repetition of the original injury, and upon the other like a continuance of the irritating cause. Thus rest is not only a negative advantage, as saving the patient from renewed injury or irritation, but a positive remedy, as it diminishes the heat of the body, reduces the pulse, and alleviates pain. Rest is of so much value in the treatment of inflammation, that in some instances no means will advance the cure without it, and numerous injuries of the body, externally or internally, would do well with perfect local rest and nothing else.

It was on this principle that Pott treated all fractures of the extremities, by relaxing the muscles which had been thrown into spasm by the fracture; and it is this principle that nature would teach, when we see, in hip-joint disease, immobility of the inflamed parts maintained by the vital anchylosis of the capsular muscles; when we notice the recti abdominis become hard and rigid in hepatic abscess or peritonitis; and when we find the fractured ends of a rib held together in a cylinder of ensheathing callus.

To a physician mechanical rest is an invaluable agent, and yet its benefits are not recognised in a practical way at all as frequently or as fully as they should be.

APPLICATION.—The application of rest in diseased conditions of the different parts of the body is so varied, and the cases in which it should be employed are so numerous, that it would be impossible to enumerate them all. In surgical practice rest is constantly used in the treatment of injuries and diseases. Here we shall only deal with its employment in medical practice, and shall select a few examples, to illustrate its benefit in different regions of the body.

A. **Diseases of the respiratory organs.** The objects of the treatment by rest may be stated to be (Roberts):—1. To maintain structures, which are actually diseased, or in danger of becoming so, in as quiescent a state as possible; in short to try to produce mechanical rest, as is ordinarily done in the case of a diseased joint. 2. To check or limit the entrance of irritating gases—be they noxious, or simply of a different degree of temperature or humidity from that of the internal part with which the air comes in contact. 3. To quiet the circulation through the organs, which are being placed in a condition suitable for repair.

1. *Acute inflammation of the larynx and bronchi.*—The patient is to be placed in an equable and moderately high temperature, and the atmosphere impregnated with moisture; all speaking or using the voice must be forbidden, while the patient's wants may be made known by means of a slate and pencil (Hilton). Thus, not only is the breathing quieter and less frequent, but all irritation of cold and of dry air prevented.

2. *Acute capillary bronchitis.*—In this disease, while general rest is to be maintained, the indications to relieve the congested right heart, and to remove the mucus which is causing the symptoms of asphyxia, predominate; and physiological rest cannot in this instance be obtained by mechanical rest. Here relief is attainable by restraining with the one hand the outpouring of mucus into the small tubes of the lung, and getting rid of that which is already poured out, by means of alkalies and stimulating expectorants; and by maintaining, with the other hand, the forces of the circulation, and relieving the overloaded right heart, by hydragogue cathartics, diuretics, and diaphoretics.

3. *Pleurisy.*—In addition to keeping the patient quiet, restraining breathing, and forbidding conversation, the most effectual way of employing rest to the inflamed surfaces of the serous membrane, is by mechanically fixing the side with adhesive plaster, as we would do for an inflamed joint. The forms of pleuritis to which this is most applicable are:—Acute general pleurisy, seen early; dry pleurisy of a small area; that accompanying pneumonia, the result of a fractured rib; and in the advanced stages of phthisis pulmonalis, where fits of coughing and pain are produced by stretching of those bands of organised lymph which bind the costal and visceral layers together. It is also applicable in external fistula, and in pleurodynia. The plan proposed by Dr. Roberts, and which has answered remarkably well in the hands of the writer, is as follows:—Apply two or three layers of plaster, cut in strips of about four inches, thus: the first strip is laid on obliquely in the direction of the ribs, the second across the course of the ribs, the third in the direction of the first, the fourth as the second, and so on until the entire side is covered. A strip is also passed over the shoulder, which is kept down by another fixed round the side across its ends. Each strip should be long enough to extend from the spine to the sternum.

4. *Phthisis pulmonalis.*—The stage at which mechanical rest becomes a decided therapeutic is that of breaking-down of the lung-tissue, and the formation of large cavities. Its application at an earlier stage is also useful in relieving the distress of breathing; but it seems most suitable as a means of checking the short hacking cough, and the stitch-like pains, produced by stretching of those parts of the lungs which have been united by adhesive inflammation to the costal layers of the pleura. By means of strapping the upper part of the chest, corresponding to the disease, with diachylon spread on leather, and filling all the hollows previously with cotton-wool, so as to prevent all motion on inspiration or expiration, rest and quiet is obtained, and not only is cicatrisation encouraged, should such have commenced, but the risk of either hæmorrhage by rupture of an artery, or the laceration of the pleura pulmonalis and consequent pneumothorax, is averted.

B. **Diseases of the heart and blood-vessels.**—1. *Pericarditis.* The mode of applying rest in this disease must necessarily be different from that which obtains in pleurisy, as actual arrest or even limitation, to any degree, of the heart's action—which theoretically and by analogy might be expected to be followed by the best results—would of course be out of the question. Rest must therefore be differently attained, by general rest and quiet, and by physiological medication. The advantages of perfect rest in the horizontal position, are evident, as by it the attrition of the inflamed surfaces against each other is lessened by some 17,280 beats in the twenty-four hours, and thereby the tendency to effusion diminished, and resolution encouraged. The medicine above all others to produce physiological quiet is opium. When not otherwise contra-indicated, and when carefully watched, it is to be used freely, in grain doses every second or third hour, as it is remarkably little liable to produce narcotism.

2. *Internal aneurism.*—For a long time, until recent years, this disease was looked upon as beyond the reach of medicines or cure. Valsalva saw the clue to treatment, and attempted to induce rest, and such a state of the general circulation that the aneurismal sac might be filled by the fibrin of the blood; but the means he adopted were not physiologically correct, and to Mr. Tufnell, of Dublin, is due the credit of having so modified the treatment as to obtain that rest which alone can cure the aneurism. Mr. Tufnell's method may shortly be stated to be as follows:—The patient is to be placed in a bright airy room on a prepared bed or couch, on which he must be contented to remain for eight or ten weeks. He must thus lie in the horizontal position, and not even for a moment assume the erect posture. Accordingly the bed must be so constructed that the requirements of nature can be attended to without alteration of position. The diet is to be restricted to a minimum of solids and fluids. The patient's mind is to be freed from

all anxiety, and pain and sleeplessness relieved by opium. The object of these means is to give rest to the aneurism (1) by reducing the absolute quantity of blood circulating, without taking any of its ingredients from it by bleeding; (2) by rendering the blood hyperinotic; (3) by diminishing the rate and force of the current through the sac. The horizontal position in a healthy individual makes a difference of at least twelve cardiac beats a minute less than in the erect position, and in disease this difference amounts to twenty or even forty beats. Taking it at the lowest rate of difference it is evident that in the horizontal position the blood circulates 17,280 times less through the body in the twenty-four hours. The aneurismal sac is proportionately less often distended, and the threatened breach in the wall of the artery is averted by layers of fibrin deposited by the more slowly moving and concentrated stream.

C. **Diseases of the abdominal viscera.**—In the therapeutic consideration of disease of these organs the principle of rest is not less plainly indicated than in the other parts of the body we have discussed; and by neglect of so simple and yet so potent an agent all other treatment may signally fail to relieve or to cure.

1. *Diseases of the stomach and intestines.*—The whole basis of treatment often depends upon strict diet, and in some cases temporary total deprivation of food, enemata supplying the requisite nourishment. Local rest can best be obtained by the physiological action of opium upon the vermicular movements of the intestines, and by avoiding all irritants or purgatives. Opium may be required in full doses, so as to arrest all peristalsis; and thus an inflamed or ulcerated surface is placed at rest, and nature is enabled to prevent perforation, and cure the disease. It cannot be too strongly stated that the injudicious employment of purgatives in threatened perforation is not only unscientific, but the worst possible practice, as it is almost sure to result in the death of the patient. This line of treatment by rest holds good in simple or cancerous gastric ulcer, Curling's ulcer, typhoid ulceration, and that due to foreign bodies in the appendix vermiformis. The practitioner will find it also his best guide and indispensable aid to cure in perityphlitis, hepatic abscess, ileus, after operations for hernia, and in various other conditions.

2. *Inflammation of the kidneys.*—As the skin and bowels may vicariously perform many of the excretory functions of the kidney, the first indication in acute nephritis is to relieve and rest that organ, by general rest, local depletion, and by calling vigorously upon the skin and intestines. In some cases where the equilibrium of secretion and excretion is thrown much out of balance, and where convulsions and dropsy point to an hydræmic and toxæmic state, we should use venesection as the readiest and most efficient means of attaining our object, of curing by rest.

Conclusion.—The foregoing illustrations show the benefit of rest in its varied aspects, not as a remedy to the exclusion of others, but as a therapeutic agent by which nature is reinstated on the throne, so that she may again exercise her vital powers to restore order, give health, and maintain life. J. Magee Finny.

RESTLESSNESS.—This signifies a condition of constant movement; the movements being random and non-purposive, or only semi-purposive and fitful in character. The condition itself may be due to the most various causes. Thus it may be met with in children who are the subjects of connate mental defects, and who are scarcely ever at rest during their waking hours; or it may be seen for a time, and especially in 'nervous' people under conditions of extreme mental excitement. In various forms of delirium, or of mania, either subacute or acute, restlessness also exists to a well-marked degree. Where it occurs in fevers to a notable extent it usually co-exists with delirium. Restlessness is likewise a prominent feature in patients who are suffering from severe and abiding pain in almost any part of the body; or in those who have suddenly lost large quantities of blood, either from the uterus or elsewhere. *See* Jactitation.

Treatment.—This being a mere symptom, dependent upon very many totally different underlying conditions, its treatment in each particular case resolves itself into the treatment of the general condition upon which the symptom is dependent.

H. Charlton Bastian.

RESUSCITATION (*re-*, again, and *suscito*, I stir up).—Definition.—The recovery from suspended animation or apparent death. In these conditions, of course all signs of circulation and respiration have disappeared, but usually the failure of one function has preceded the other. For the purposes of treatment we may regard as (A.) *syncope* those cases where the lips and mucous membrane are found pale and exsanguine; and as (B.) *asphyxia* those where they are dark-coloured.

A. *Syncope.*—Syncope may arise (1) from mental emotion, sudden pain, or shock; (2) from drugs and poisons, including anæsthetics, especially chloroform; (3) from hæmorrhage, or any thing which reduces the due supply of blood to the heart; and (4) from fatty degeneration or dilatation of that organ.

Treatment.—Place the patient horizontally on his left side, with the pelvis and feet raised. Nélaton has urged complete inversion of the body, but by its interference with the free action of the diaphragm this method may be injurious. The windows of the room should be opened; the face fanned; and a little cold water may be sprinkled on the forehead. Smelling salts being held to the nostrils, if natural breathing has not returned, begin *Howard's method* of artificial respiration:—*Position of patient.* Face upwards; a hard roll of clothing beneath thorax, with shoulders slightly declining over it. Head and neck bent back to the utmost. Hands on top of head. Strip clothing from waist and neck. *Position of operator.*—Kneel astride patient's hips; place your hands upon his chest, so that the ball of each thumb and little finger rest upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers dipping into the corresponding intercostal spaces. Fix your elbows firmly, making them one with your hips. *Action of operator.*—Pressing upwards and inwards towards the diaphragm, use your knees as a pivot, and throw your weight slowly forwards two or three seconds, until your face almost touches that of your patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds; then repeat this movement as before, continuing it at the rate of seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural.

This method is said to keep the passage through the larynx free without the aid of an assistant or any contrivance for the purpose, and is recommended for that reason. Artificial respiration must precede the use of the stomach-pump, and be continued until either the pulse or natural respiration returns. Keep up the temperature of the body by hot blankets or hot bottles. Stimulating the heart by galvanism has been recommended, but it is a doubtful remedy. It is not easy to make it produce general and effective contraction, such as would cause the blood to move forward, and, failing to do this, it probably does harm by exhausting the irritability of those parts which it does excite. Ether, or nitrite of amyl, may be held to the nostrils. A little brandy and hot water, eau de cologne and water, wine, or other stimulant, as sulphuric ether or sal volatile, is now to be given, with care that none of it enters the trachea. If swallowing is impracticable, inject warm fluids into the rectum. In cases of syncope from loss of blood transfusion may be required. *See* TRANSFUSION.

B. *Asphyxia.* (a) *Asphyxia Neonatorum.*—The mouth and nostrils of the infant should be wiped dry; and the body freely exposed, whilst the head is allowed to fall back over the hand which supports the nape. A few drops of cold water may be sprinkled upon the chest, and the face should be fanned or blown upon for one minute only. Next inflate the lungs by blowing into the nose and mouth; and then squeeze the trunk. The body should now be immersed in water at 100°, from which the chest should be raised every half-minute and sprinkled with cold water. Sylvester's method of artificial respiration is the best. Marshall Hall's and Howard's methods may be used after the first inspiration has occurred, or together with mouth-to-mouth insufflation (*see* ARTIFICIAL RESPIRATION). Experiments made by Dr. Champneys show that Hall and Howard's methods of artificial respiration are absolutely useless as a means of directly inflating the lungs of still-born children; and also that Sylvester's method, and its modification by Bain and Pacini, introduce more air than any other method.

(b) *Asphyxia from breathing noxious gases.* The body should be brought into fresh air; artificial respiration be at once commenced; whilst an assistant should blow into the nostrils three or four times; and hot blankets and hot water bottles be applied.

(c) *Asphyxia from mechanical obstruction of the air-passages.*—The cause of obstruction must be removed, if possible, by adopting the inverted position of Howard's method. Coins or plumstones may thus dislodge themselves. In the absence of forceps, a button-hook or the handle of a tablespoon may be useful, especially in the removal of a lump of hard food. Laryngotomy or tracheotomy must be performed the instant the pulse becomes imperceptible at the wrist.

(d) *Asphyxia from poisons or anæsthetics.*—In the asphyxia of advancing coma from narcotics and anæsthetics, the breathing may stop from failure of the medulla and respiratory tract. In this case artificial respiration, by simply compressing the chest at intervals of five seconds, may suffice, but very often there is the mechanical obstruction in the larynx to be considered. If raising the chin and throwing the head back do not effect a free passage of air, Howard's or some other method of artificial respiration should be commenced (*see* ARTIFICIAL RESPIRATION). It is well to understand that when the muscles of the larynx are paralysed, the glottis becomes valvular in action or partially so—that is to say, it permits air to pass outward freely, but only a weak current of air to pass inward. A strong current brings the sides together and gives rise to complete obstruction. This is chiefly caused by the drawing together of the relaxed arytæno-epiglottidean folds of mucous membrane; and in order to obviate this kind of obstruction, the folds should be tightened, by throwing back the head and raising the chin as far as possible away from the sternum. This will render it unnecessary to catch hold of the tongue with artery forceps, the treatment usually recommended.

(e) *Asphyxia from drowning.*—In asphyxia from immersion in water there are two serious complications, namely, first, the presence of water and mud in the air-passages, and, secondly, the depressing effect of cold. With the view of more effectually removing the water from the air-tubes Howard gives the following rules:—*Position of patient.* Face downwards. A hard roll of clothing beneath the epigastrium, making that the highest point, the mouth the lowest. Forehead resting on forearm or wrist, keeping mouth from ground. *Position and action of operator.* Place left hand, well-spread, upon the base of the thorax to the left of the spine; the right hand upon the spine, a little below the left and over the lower part of the stomach. Throw upon them, with a forward motion, all the weight and force the age and sex of the patient will justify, ending this pressure of two or three seconds by a sharp push, which helps you back again into the upright position. Repeat this two or three times, according to the duration of the emersion, and then resort to the method described in the treatment of syncope.

The following rules have been published by the Royal Humane Society. They recommend the Sylvester method, but probably this and the modification by Bain, in which the anterior fold of the axilla on both sides is grasped with the clavicle and pulled upwards, are less useful than the Howard plan, which favours the patency of the air-passages.

Directions for Restoring the Apparently Dead.

I.—If from DROWNING OR OTHER SUFFOCATION, OR NARCOTIC POISONING.—Send immediately for medical assistance, blankets, and dry clothing, but proceed to treat the patient INSTANTLY, securing as much fresh air as possible.

The points to be aimed at are—first, and immediately, the RESTORATION OF BREATHING; and, secondly, after breathing is restored, the PROMOTION OF WARMTH AND CIRCULATION.

The efforts to restore life must be persevered in until the arrival of medical assistance, or until the pulse and breathing have ceased for at least an hour.

Treatment to Restore Natural Breathing.

Rule 1.—*To maintain a free entrance of air into the windpipe.*—Cleanse the mouth and nostrils; open the mouth; draw forward the patient's tongue, and keep it forward: an elastic band over the tongue and under the chin will answer this purpose. Remove all tight clothing from about the neck and chest.

Rule 2.—*To adjust the patient's position.*—Place the patient on his back on a flat surface, inclined a little from the feet upwards; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder-blades.

Rule 3.—*To imitate the movements of breathing.*—Grasp the patient's arms just above the elbows, and draw the arms gently and steadily upwards, until they meet above the head (this is for the purpose of drawing air into the lungs); and keep the arms in that position for two seconds. Then turn down the patient's arms, and press them gently and firmly for two seconds against the sides of the chest (this is with the object of pressing air out of the lungs. Pressure on the breast-bone will aid this).

Repeat these measures alternately, deliberately, and perseveringly, fifteen times in a minute, until a spontaneous effort to respire is perceived, immediately upon which cease to imitate the movements of breathing, and proceed to INDUCE CIRCULATION AND WARMTH.

Should a warm bath be procurable, the body may be placed in it up to the neck, continuing to imitate the movements of breathing. Raise the body in twenty seconds in a sitting position, and dash cold water against the chest and face, and pass ammonia under the nose. The patient should not be kept in the warm bath longer than five or six minutes.

Rule 4.—*To excite inspiration.*—During the employment of the above method excite the nostrils with snuff or smelling-salts, or tickle the throat with a feather. Rub the chest and face briskly, and dash cold and hot water alternately on them.

Treatment after Natural Breathing has been Restored.

Rule 5.—*To induce circulation and warmth.* Wrap the patient in dry blankets, and commence rubbing the limbs upwards firmly and energetically. Promote the warmth of the body by the application of hot flannels, bottles, or bladders of hot water, hot bricks, &c., to the pit of the stomach, armpits, between the thighs, and at the soles of the feet. Warm clothing may generally be had from the bystanders. When swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee should be given. Sleep should be encouraged. During reaction large mustard poultices to the chest will relieve the distressed breathing.

II.—If from INTENSE COLD.—Rub the body with snow, ice, or cold water. Restore warmth by slow degrees. It is dangerous to apply heat too early.

III.—If from INTOXICATION.—Lay the individual on his side on a bed with his head raised. The patient should be induced to vomit.

IV.—If from APOPLEXY or SUNSTROKE.—Cold should be applied to the head, which should be kept raised. Tight clothing should be removed, and stimulants cautiously used.

How soon should alcoholic stimulants be given? Certainly not until natural respiration has been induced, and in cases of narcotic poisoning, not until consciousness has been restored. If, on the return of consciousness, the patient is in pain or faint, the inhalation of a few drops of ether or smelling ammonia is indicated. In their absence a few teaspoonfuls of brandy may be given. Hot tea and coffee should be the first refreshment swallowed, and in general it should not be pressed upon the patient, as vomiting is more exhausting than waiting a few hours for food.

J. T. CLOVER.

RETCHING (A.-Saxon, *hræcan*).—An ineffectual effort at vomiting, sometimes accompanied by the expulsion of gas from the stomach. *See* VOMITING.

RETENTION (*re-*, back, and *teneo*, I hold). This word is employed in medical science to imply that some material, whether solid or liquid, which ought to be discharged, is retained or kept back in a cavity or canal, either natural or artificial. Thus we speak of *retention of urine, fæces, menses,* and *bile*; and also of *pus* under certain circumstances.

RETENTION OF URINE.—*See* MICTURITION, Disorders of.

RETINITIS.—Inflammation of the retina. *See* EYE AND ITS APPENDAGES, Diseases of.

RETRACTED ABDOMEN.—The abdomen as a whole presents under certain circumstances more or less depression of its anterior wall, when it is said to be *retracted*, and this may reach such a degree that the abdomen becomes boat-shaped, and its anterior boundary sometimes seems almost to come into contact with the spinal column behind. The bony prominences of the crest and anterior angles of the ilium, the pubes, Poupart's ligament, and the lower margin of the chest often stand out prominently. In some instances the retraction is partial, involving the lower part of the abdomen, while the upper part is enlarged.

A retracted abdomen frequently renders it more easy to investigate by physical examination the contents of this cavity; and it must be remembered that the condition may be associated with diseases of abdominal organs which can thus be readily detected, or with abdominal tumours. It may, however, also itself give information of importance in diagnosis. The chief conditions under which a retracted abdomen may be met with, so as to be of clinical importance, are as follows:—1. In certain cases of disease of the brain or its membranes, and especially acute meningitis. 2. In some forms of intestinal colic, particularly that form associated with lead-poisoning—the so-called *painter's colic*. 3. As a part of marked general emaciation from any cause, but especially that due to starvation, or to chronic diarrhœa from intestinal ulceration and other conditions. 4. In connection with chronic diseases of the œsophagus, stomach, intestine, or pancreas, causing obstruction in some part of the alimentary canal, so that food cannot be taken in, or is prevented from passing along. Here the retraction is also partly due to the general emaciation. 5. As one of the consequences of chronic peritonitis. It will be seen, from a consideration of the causes just mentioned, that retraction of the abdomen immediately results either from a spasmodic contraction of the intestines and abdominal muscles; general wasting; absence of food from, and contraction of the alimentary canal; or peritoneal adhesions. It may be mentioned that marked temporary retraction of the abdomen is sometimes noticed in connection with the act of breathing, in consequence of disordered action of the diaphragm.

FREDERICK T. ROBERTS.

RETRACTED CHEST. *See* DEFORMITIES OF THE CHEST.

RETROCEDENT (*retro*, back, and *cedo*, I depart).—A term employed in connection with certain acute diseases, when their prominent external manifestations disappear or, as it were, go back. Retrocession is often associated with the simultaneous occurrence of internal disturbance. The phenomenon is observed in gout, rheumatism, certain skin-diseases, and the eruptive fevers.

RETROFLEXION (*retro*, back, and *flecto*, I bend).—A form of displacement in which an organ is bent backwards upon itself. *See* WOMB, Diseases of.

RETRO-PHARYNGEAL ABSCESS.—SYNON.: Post-pharyngeal abscess; Fr. *Abcès retro-pharyngien*; Ger. *Retropharyngeal Abscess*.

DEFINITION.—A collection of pus in the loose areolar tissue which connects the pharynx with the muscles lying upon the vertebral column, namely, the longus colli and the rectus anticus major.

ÆTIOLOGY.—This is a somewhat rare affection, and is more commonly met with in children than in adults, more particularly in those of a strumous diathesis. Idiopathic inflammation of this tissue, though usually assigned as one of the causes of the affection, is not often seen. More frequently the inflammation, and resulting abscess, is a secondary disorder, dependent upon an inflamed condition and suppuration of a post-pharyngeal gland, or caries of some of the cervical vertebræ, or their cartilages. Amongst other causes, pyæmia has been noted; and it has also been observed as a sequela to some of the acute fevers.

SYMPTOMS.—As in all disorders where inflammation plays a part, so here the onset of the disease is marked by increase of temperature and pulse, nausea, general restlessness and malaise, and already some amount of soreness of throat is complained of. The degree of pyrexia and constitutional disturbance will vary with the condition and constitution of the sufferer. Soon this soreness of throat develops into the true characteristic pain on making the attempt to swallow, a symptom which is never wanting, and which goes on gradually, though slowly, augmenting, till almost complete dysphagia is established. Accompanying this, or at least soon after, is observed a peculiar stiffness of the neck, which, coincidently with the difficulty of swallowing, becomes more apparent with the progress of the disease. A certain amount of swelling of the neck may also be observed, specially towards the angles of the lower jaw. Difficulty in breathing is another prominent symptom of the disorder, which, more particularly if the abscess be large, becomes greatly aggravated when the patient assumes the horizontal posture. On first looking at such a child with its embarrassed respiration, its anxious expression, its cyanotic lips and cheeks, one might well be excused for momentarily diagnosing the case as one of croup, were it not that, loud and hurried as are the respirations, they are not of a whistling character. Here also the voice is altered; at first hoarse and indistinct, it assumes what is described as a snuffling tone, or a toneless voice. On inspecting the throat, a round swelling is observed in the posterior wall of the pharynx, occupying the centre of the pharyngeal space, or more to one side, whereby the cavity is greatly diminished in size. The mucous membrane presents a livid colour. On passing the finger over the root of the tongue and beyond the soft palate, this tumour will be felt to be either hard and tense, or soft and somewhat indistinctly fluctuating, according to the stage of the disease. When the tumour attains an extraordinary size it has been seen to project in front of the soft palate. A quantity of mucus usually fills the mouth. All attempts at swallowing are fruitless.

PROGNOSIS.—The prognosis is always doubtful. Most usually well-pronounced cases terminate fatally—invariably so if the disease depends upon caries of the vertebræ.

TREATMENT.—Little can be expected in the way of arresting the disease. Usually it is well-pronounced before the physician is called to see the child, or it is some time before he can be quite sure of his diagnosis. Ice may be freely administered, and is most grateful to the patient. So soon as the presence of an abscess is distinctly established, surgical interference must at once be had recourse to, and the abscess laid open by a well-guarded bistoury. Sustaining treatment is urgently demanded.

CLAUD MUIRHEAD.

RETROVERSION (*retro*, back, and *verto*, I turn).—A form of displacement in which an organ is turned back. *See* WOMB, Diseases of.

RE-VACCINATION.—The operation of repeated vaccination. *See* VACCINATION.

REVULSENTS (*revello*, I draw away).—This term dates from the time of the humoral pathology, and signifies therapeutical measures which draw the humours from the part affected.

Any detailed consideration of such supposed effects could only be interesting from an historical point of view. R. Farquharson.

RHEUMATIC ARTHRITIS.—Synon.: Rheumatic Gout; Rheumatoid Arthritis; Fr. *Rhumatisme noueux*; *Usure des Cartilages*; Ger. *Arthritis Deformans.*

Definition.—A disease of the joints, the essential nature of which is still unknown; characterised by chronic inflammatory and degenerative changes, involving the various articular structures; and leading to deformity.

Ætiology.—In a considerable proportion of cases, rheumatic arthritis follows ordinary acute rheumatism immediately, or it appears after an interval of several years, during which time chronic rheumatism of a milder degree may have been complained of. Persons of all ages may thus suffer, but the disease generally begins between twenty and forty. It is commonly believed to be more frequent in women, but this is doubtful. Depressing influences of all kinds, including acute diseases, frequent pregnancy, super-lactation, prolonged physical exertion, and mental distress, are unquestionably predisposing factors. The disease is hereditary.

The *exciting* cause is generally chill; but in many instances injury of a joint is the starting point of the morbid process.

Anatomical Characters.—Two well-marked forms of this disease are met with, according as a single joint only, or several—perhaps all—of the joints are affected. In every respect the anatomical characters are identical in the two forms.

Examined at an *early* stage of the morbid process, an affected joint is found to be enlarged; the synovial membrane, capsule, and ligaments being distended and stretched by a considerable amount of effusion. The synovial membrane is hyperæmic, swollen, and thickened; its fimbriæ are enlarged and vascular; intra-articular fibro-cartilages, ligaments, and tendons are vascular and softened; and the articular cartilages are partially removed, leaving a roughened, vascular, porous-like surface behind.

In the more *advanced* stage of the process the effusion is considerably less, or may be completely re-absorbed; and the capsule and ligaments are much thickened, or even partially calcified. The intra-articular structures, including fibro-cartilages, ligaments, tendons, and articular cartilages, have disappeared in a great measure, leaving little or no trace behind. Peculiar pendulous bodies, consisting of masses of fibro-cartilage, are attached to the interior of the synovial membrane; more rarely they are free. The articular cartilages, where their opposed surfaces are in mutual contact, are replaced by an ivory-like layer of bone; whilst at other parts the surfaces present a pink colouration, with small spots of more intense hyperæmia. The articular surfaces are variously altered in shape and size. Thus articular cavities are widened, and occasionally deepened, by enlargement of the circumference, in the form of 'lips,' or by the production of separate bony masses in the same situation: whilst the heads of bones are enlarged; present similar 'lips' or sharp edges at their widened margins; become flattened at right angles to the axis of pressure; and thus preserve their relations with the corresponding cavities. The shafts of the bones may be considerably altered in shape, increased in size, and altered in density. The associated tendons are frequently dislocated from their course beside the articulations, and atrophied or actually absorbed; and the corresponding muscles are similarly atrophied. Bursæ in the neighbourhood of joints may be distended with fluid, and contain fibro-cartilaginous bodies. The anatomical changes in this disease frequently present a remarkably symmetrical distribution.

Pathology.—A diversity of opinion still prevails upon the essential nature of rheumatic arthritis. The view most generally held at the present time appears to be, that it is a disease distinct from rheumatism and gout, with which it was confounded until the time of Haygarth (1805). Quite recently Mr. Hutchinson has shown that, in a certain number of instances, there is an element of gout in the disease, as evidenced by the family and personal history of the patient, and by the occasional presence of urates in the articular structures *post mortem.* The writer's experience is almost entirely in favour of the strictly *rheumatic* nature of the disease, as was maintained by Todd. In a large proportion of cases he has found that the morbid process started in an attack of ordinary acute rheumatism; an observation which is entirely in accord with the account of the origin of rheumatic arthritis given by Dr. Adams, of Dublin, in his classical work on this subject. In numerous instances the family history is distinctly rheumatic. The writer has also found the heart diseased in a much larger proportion of cases than is usually stated in accounts of the disease. Finally, he has found that no line can be drawn between acute and sub-acute cases of rheumatism; between sub-acute and chronic cases of rheumatism; or between chronic rheumatism and so-called 'rheumatic arthritis,' the latter being only a more severe development of the former. Whatever, therefore, the essential nature of rheumatism may be, the writer holds that all the conditions named are expressions of one morbid process, which differ from each other chiefly in intensity and the manner of their evolution.

Symptoms.—The symptoms of rheumatic arthritis in its condition of full development are exceedingly characteristic. The patient complains of pain and stiffness in connection with one or more joints; and on examination these are found to be swollen, more or less distorted, and tender. The history of these changes in the joints proves to be that, either in consequence of an attack of acute rheumatism, or not, first one and then others of the articulations became painful, tender, hyperæmic and swollen; that the resulting enlargement had not completely disappeared before the acute symptoms recurred; and that, by a repetition of similar acute or subacute attacks, the joints have reached their present condition. Thus the disease, whilst chronic in its course, consists essentially at first of recurrent acute, or subacute, attacks, which increase in frequency whilst their effects persist, and so finally become fused as it were into a continuous whole.

The *local* symptoms and signs vary with the particular joint affected; but in every instance they are chiefly these—pain, tenderness, creaking on movement, impairment of mobility, enlargement, and deformity. The pain is generally distressing, and, by its continuousness and severity, may render the patient's life miserable, especially as it increases at night and prevents sleep. It is aggravated by movement, and there is tenderness on forcible disturbance of the articular surfaces. Creaking or crepitation, audible and palpable, is a highly characteristic feature, which can be elicited and appreciated either by the patient or by the practitioner, and in the case of large joints may be so loud as to be audible at a distance.

The mobility of the affected joints becomes more and more impaired as the disease progresses—at first on account of pain, afterwards in consequence of anatomical changes. Thus the various joints may become fixed by a 'false' (very rarely a 'true') anchylosis, so that the hands cannot be closed; the wrists are immovable; the arms can hardly be removed from the side; the jaws are fixed; the head cannot be rotated; the patient may be unable to sit; and the knees, ankles, and toes may be similarly impaired in function.

The variety of deformity is almost endless; and the particular character it assumes depends as much on the joint involved, as on the nature of the process itself. Thus the knee, elbow, wrist, and knuckles may present considerable intra-articular effusion, especially in the earlier stages; whilst the shoulder, hip, and intra-phalangeal joints exhibit more limited swelling and 'drier' signs. The terminal digital joints become cubical or 'nodous'; the middle digital joints become spheroidal in outline, or are partially dislocated backwards or forwards; and the knuckles are the seat of a peculiar, oblique dislocation of the fingers towards the ulnar side. The lower ends of the radius and ulna project backwards, and give a full appearance to the dorsum of the wrist, which may be further increased by carpal and bursal enlargements. The elbow-joint is swollen; and bursal collections—fluid and solid—develop over the olecranon. The shoulder presents signs of wasting, rather than of enlargement, due to atrophy of the deltoid and other muscles; the head of the humerus at the same time lies unnaturally forwards and upwards; and a corresponding depression is apparent behind. At the hip-joint the disease gives rise to flattening of the buttock, shortening of the limb, and eversion of the foot; enlargement can sometimes be felt in connection with the head of the bone and acetabulum; occasionally the patient may be not only lame but unable to sit, and must accordingly either stand or lie constantly. The knee is enlarged by the presence of considerable effusion in the earlier stage; and when this afterwards becomes absorbed, local bony growths are easily felt, giving increased breadth to the patella, and forming sharp crests at the lateral margins of the articular surface of the condyles. The disease, as it affects the ankle and foot, does not require special description. At the temporo-maxillary articulation rheumatic arthritis gives rise to obvious enlargement in front of the ears, and possibly to distortion or asymmetry of the chin. Prominent nodular swelling is the principal sign of the disease at the sterno-clavicular articulation. In the spine it produces rigidity chiefly, as well as pain locally and down the arms, and leads to stooping in various attitudes.

The *general* condition of the subject of rheumatic arthritis, when it is advanced, is one of debility and anæmia. The face is pale and expressive of suffering; the complexion is muddy. The skin is peculiarly inactive, and rarely perspires; the patient looks pinched, and complains of a feeling of cold; the extremities are often miserably cold and livid; and the palms of the hands are damp or even soppy. Bodily activity is greatly impaired, by interference with the movements of the limbs; in many instances the patient is completely crippled and bed-ridden. Even the voice and the hearing may be impaired, from involvement of the laryngeal and auditory articulations. The various bodily functions are feeble, and frequently deranged; and although the mind may be active, the condition is rendered wretched in the worst cases by pain and helplessness.

Course and Terminations.—Unless the disease be treated early, the course is essentially progressive towards deformity. Death from rheumatic arthritis is rare; its other distressing effects have been sufficiently indicated.

Diagnosis.—The diagnosis of rheumatic arthritis necessarily depends upon the view entertained of its pathology. If considered a distinct disease, it is, as a rule, easily separated from gout by the entire absence of tophi in the joints and ears; by the history of the disease; and in doubtful cases by the absence of uric acid in the blood. From chronic rheumatism, as ordinarily defined, it is diagnosed by the amount of deformity present; but the writer holds that the two conditions are identical. Chronic synovitis of traumatic or constitutional origin may be occasionally mistaken for rheumatic arthritis, but the presence of the latter disease in several joints, probably symmetrically, should remove all doubt. Rheumatic arthritis of the hip and shoulder has probably been frequently described as 'dislocation' and 'intracapsular fracture.'

Prognosis.—The prognosis of this disease is favourable as regards life; but unfavourable as regards cure, comfort, or ability to follow active bodily employment. The prognosis is much better in the rich, who can seek relief by change of climate in the earlier stages, than it is amongst the poor, in whom the disease must in a measure be allowed to pursue its progressive course.

Treatment.—The treatment of rheumatic arthritis must be applied in two directions; first, to arrest, if possible, the morbid process, and, secondly, to relieve the distressing symptoms. In a large number of cases the second indication only can be fulfilled, for the disease is frequently too advanced, or the circumstances of the patient are too poor, to afford a prospect of cure.

In the *early stages* of the disease much can be done by energetic treatment, which must be partly constitutional and partly local. If circumstances permit, the patient should be advised to visit, according to the season of the year, either the baths of this country, of Germany, or of France in summer; or the Algerian springs, the French Riviera, or Italy in winter. Buxton, Bath, and Strathpeffer are the best home baths. Aix-les-Bains, Aix-la-Chapelle, Baden-Baden, and Wiesbaden may be recommended from May till September. The other places named, especially Hammam R'Irha in Algiers, are winter resorts. A voyage to the tropics or subtropics will suit other cases. The climate of Egypt proves beneficial in some instances; and advantage may be taken there of the Eastern method of treating rheumatic affections by means of baths and rubbing, which are undoubtedly successful in some cases. *See* MINERAL WATERS.

The most valuable internal remedies for rheumatic arthritis are cod-liver oil, iron, and arsenic. Cod-liver oil should be taken regularly if the digestion permit. Either iron or arsenic, or the two combined, should be taken in full doses for periods of weeks or months, and their effect carefully noted. Dr. Garrod especially recommends the syrup of the iodide of iron.

The diet should be carefully ordered. Whilst all excess is avoided, as well as indulgence in malt liquors, wines, and rich indigestible dishes, a generous supply of mixed animal and vegetable food will be found to be most suitable. The clothing must be warm, flannel or other woollen material being worn both summer and winter. The greatest possible care must be exercised to avoid cold and damp, in the choice of a residence and in the routine of daily life.

The *local* treatment is to be considered of hardly less importance than the constitutional. On the first appearance of the disease, counter-irritation should be freely applied to the joints. The most convenient form is iodine paint, which should be used so freely that the skin becomes of a mahogany colour, and desquamation follows in a few days. The joints should be carefully protected by cotton-wool or flannel. Between the subacute attacks of the disease, efforts should be made to restore the healthy nutrition of the affected joints. Whilst the internal treatment already indicated is persevered with, or a trial is given to guaiacum or iodide of potassium in obstinate cases, counter-irritation should be replaced by a method of less severe but systematic stimulation. The joints that can be easily reached should be thoroughly fomented night and morning, by wrapping a piece of cambric or flannel around them, and sponging water over this, as hot as can be borne. After several minutes of such treatment the joint should be thoroughly rubbed, either with a stimulating liniment, such as the turpentine or acetic turpentine liniment, with a mild mercurial ointment, or with some bland oil, such as cod-liver oil or goose-grease. The effect of such local treatment, if pursued steadily, is in the experience of the writer often remarkable, mobility being restored in cases where the joints have been useless for months.

In very *advanced cases*, especially in old subjects, it is manifestly impossible to expect much improvement. Anodyne treatment is then chiefly called for, and a good deal can be done in this direction by well-chosen local applications, the preparations of opium being of course the most successful. The general health will demand support by a well-regulated diet, and the internal treatment suggested above.

J. MITCHELL BRUCE.

RHEUMATIC FEVER.—A popular synonym for acute rheumatism. *See* RHEUMATISM, Acute.

RHEUMATIC GOUT.—A popular name for several kinds of chronic joint-disease, especially rheumatic arthritis and chronic rheumatism.

RHEUMATISM, Acute (ῥεῦμα, a fluxion).—SYNON.: Rheumatic Fever; Fr. *Rhumatisme articulaire aigu*; Ger. *Hitziger Gelenkrheumatismus.*

DEFINITION.—An acute febrile disease; caused by certain obscure climatic and diathetic influences; and characterised by pyrexia, sweats, and acute shifting inflammation of the joints and other structures.

ÆTIOLOGY.—*Predisposing causes.*—Of the predisposing causes of acute rheumatism, the most important is inheritance, which can be traced in 27 per cent. of all cases. Previous attacks increase the liability to a return of the disease; but there is a limit to predisposition from this cause after several attacks. The great majority of first attacks occur in persons under the age of thirty; and the larger proportion of these between the ages of sixteen and twenty-five. At the same time, rheumatism is by no means uncommon either in children or in persons past middle life. Rather more males than females suffer; but, apart from other circumstances, the influence of sex is inconsiderable. Occupation and social position are important as predisposing causes; laborious outdoor occupations, in which persons are exposed to chills, poverty, and the many evils associated with these, contributing to furnish the largest percentage of cases. Certain regions or districts, or even parts of districts, appear to deserve the name of 'rheumatic,' from the number of residents who suffer from the disease, and from the probability that a person, otherwise predisposed to rheumatism, will be more likely to be attacked if he enter such an area.

Determining causes.—The most common exciting cause of acute rheumatism is exposure to cold and wet; or, to express the same fact in other words, the disease has an intimate ætiological relation to weather, season, and climate. Some apparent exceptions to this statement really accord with it; thus acute rheumatism is not uncommon in warm weather, on account of the frequency of chills from over-heating. Rheumatism may suddenly make its appearance after a sprain or other injury to a joint, which may also determine the distribution of the disease in the articulations. Similarly, the order of invasion of the several joints is due in some instances to the amount of exercise to which they have been respectively subjected. An attack of acute rheumatism is occasionally referred to derangement of digestion, and of the functions of the liver, especially in subjects who have previously suffered. Indulgence in abundant rich or indigestible food will certainly determine a relapse in persons convalescing from the disease, and may possibly induce an attack in the predisposed.

Depressing bodily or mental influences may excite rheumatism under similar circumstances. Exhaustion by lactation, or by chronic uterine diseases, tedious convalescence, the puerperal state, and possibly simple despondency, may act in this way in different instances.

Anatomical Characters.—The *post-mortem* appearances in acute rheumatism are, on the whole, remarkably negative, not so much on account of the absence of morbid changes in the affected parts, as from the slight degree to which these changes have advanced. On opening an affected joint, we find moderate hyperæmia, with occasional ecchymosis, of the synovial membrane and fibrous tissues connected with the articulation; a somewhat opaque, granular, swollen appearance of the synovial surfaces; and a considerable amount of inflammatory effusion. This effusion is generally a thin, clear, alkaline, albuminous fluid; occasionally turbid, with flakes of fibrin and cell-products; rarely purulent. The cartilages connected with the joint probably share in the inflammatory changes, especially if the process be severe; and the associated soft parts, including the tendons and their sheaths, are very frequently hyperæmic, and the seat of effusion.

A fatal termination in acute rheumatism is always the result of some complication, intercurrent disease, or injury; and in such cases the non-arthritic lesions are necessarily the most important. Of these the most frequent are congestion or inflammation of the lungs, and inflammation of the heart and pericardium. Inflammation of the pleura is much less commonly found; and in rarer instances inflammation of the peritoneum, larynx, testes, and renal tubules. When pyrexia has been great the solid viscera present granular degeneration, and are prone to rapid decomposition; and in cases of hyperpyrexia the blood is fluid. The blood has frequently been subjected to chemical analysis, but without any positive result of a pathological kind. The reaction of the liquor sanguinis is alkaline, as in health. The fibrin has been said to increase in amount to 1 per cent. instead of ·2 per cent. The amount of urea is not above the normal. Neither uric acid, lactic acid, nor any other abnormal principle has been found in the blood during an attack of acute rheumatism.

Pathology.—The pathology of acute rheumatism is still obscure, and in the present article it will be sufficient to enumerate the principal theories upon the subject.

1. *Lactic acid theory.*—Lactic acid accumulates in the body, and the symptoms are directly referable to the action of this poison upon the system (Prout, Todd, Richardson).

2. *Nervous theory.*—Chill of the peripheral parts of the body, especially of the skin and joints, causes disturbance of corresponding parts of the central nervous system; and this gives rise to pain and vaso-motor (?) or trophic changes of the same peripheral parts, and to fever (Canstatt; Seitz).

3. *Combination of* 1 *and* 2.—Chill causes accumulation or retention of lactic acid; this acts on the central nervous system; and the disordered nervous centres react upon the joints, &c., as in 2 (Senator).

4. *Combination of* 2 *and* 1.—Chill disturbs the nervous system; this disturbs nutrition generally; lactic or some other acid is retained, and acts as a poison, as in 1 (Fuller).

5. *Infective theory.*—Chills are attended with the entrance of micrococci into the system, and endocarditis is the result. The joint-symptoms are secondary and embolic, as in pyæmic arthritis (Hueter).

6. *Germ theory.*—The disease is due to the presence in the blood of a vegetable organism of definite characters—*Zymotosis translucens* (Salisbury).

7. *Malarial theory.*—Rheumatism is due to the presence in the system of a poison, which is of the nature of a miasm, entering from without. This miasm is generically allied to, but specifically distinct from, the miasm of malarial fever (Maclagan).

Without attempting to criticise these theories, we may conclude that, whilst the true pathology of acute rheumatism cannot possibly be settled until the essential nature of fever is thoroughly understood, the most promising directions from which we may expect light to be thrown upon it are, first, the effect on the system of organic poisons, whether introduced from without, or produced within it as the intermediate products of nutrition; and, secondly, the intimate relation of the nervous system to the body-heat, to the skin, and to nutrition.

Under these circumstances it is impossible at present to estimate the respective significance and relative importance of the phenomena constituting the 'disease' rheumatism. But for the purpose of intelligible description, it is necessary that such of the phenomena as are only occasional in their appearance should be separated from such as are constant; and that the latter should be treated as the essential symptoms of the disease, whilst the former are regarded as complications. The constant phenomena of acute rheumatism, thus considered, are probably but three, namely, fever, sweats, and arthritis; whilst inflammation of the cardiac structures, lungs, and serous membranes would be included under the head of the occasional phenomena or complications. This plan of description of acute rheumatism will be adopted in the present article, for convenience' sake only, and will imply no actual criticism of the theories of the pathology of the disease just enumerated; although with several of them it necessarily cannot agree.

Symptoms. — **General description.**— After suffering for a time from aching pains in the limbs and trunk, flying pains and stiffness in the joints, malaise, chilliness, and sore-throat, the subject of an attack of acute rheumatism is seized with severe pain in one or more of his joints, experiences a chill or slight rigor, and is found to have several degrees of fever. The local and general symptoms quickly develop; and a striking picture is presented by the patient. He lies motionless in bed, flat on his back, with every joint at rest and carefully guarded. The neck, back, and legs are straight; the arms folded across the body, or extended along either side; the eyes alone are moved, and follow the practitioner as he approaches the bedside. The face is found bedewed with perspiration; and the rest of the body is profusely covered with sweat, which gives off a sour, acrid odour. The countenance is full, heavy, and expressive of a subdued feeling of pain and dread of movement; the complexion may be of a dirty, sallow colour, or even slightly jaundiced; and the cheeks are probably flushed. The affected joints prove to be swollen and red; hot to the touch; remarkably tender; and the seat of pain, which varies much in character and intensity. One joint, or several, or nearly every joint in the body, may be found in the condition just described. The patient complains of a feeling of illness, thirst, and anorexia; the tongue is foul and creamy; the throat is somewhat sore; and the bowels are irregular. The pulse is frequent, weak even to dicrotism, and rather full. Respiration is somewhat accelerated; and there may be slight cough. The urine is scanty, high-coloured, very acid, and loaded with lithates. The skin is covered with perspiration, congested, and warm; and probably presents sudamina or miliaria in places. The patient's mind is perfectly clear, and his attention appears to be chiefly directed to the maintenance of the affected joints in the most easy position possible. Until successful in this endeavour he is restless and miserable; and even if he have obtained temporary relief and have gone to sleep, he is liable to be suddenly aroused by involuntary spasm of the muscles connected with the affected joints. The pain is so severe when the disease is at its height, that sleep cannot be obtained.

Such is the condition of a patient suffering from a fully-developed attack of uncomplicated rheumatism. For a period, which would appear to be perfectly indefinite, these symptoms continue, varying considerably in intensity from day to day. But whilst the condition thus persists, the remarkable and characteristic fact is constantly observed in this disease, that the arthritic phenomena are at once transient and erratic, that is, that the rheumatism passes rapidly from joint to joint, the joints which were affected the one day being nearly well the next, and a fresh series swollen and painful. In this manner most of the joints of the limbs may have been affected in the course of a week, and the number of joints simultaneously affected is very variable. Thereafter the disease may make a further invasion of joints previously involved, and that repeatedly.

At last, the rheumatism appears to have exhausted itself; no fresh joint is attacked; and the parts last affected lose more or less completely the final traces, both objective and subjective, of the severe process which they have undergone, being for some time, however, stiff, feeble, and painful on movement. The patient now assumes a less constrained posture; the other symptoms decline; the perspirations disappear; the countenance becomes more bright; spirits and strength return; the tongue cleans, and the appetite is rapidly restored; the pulse falls in frequency; urine is passed in greater quantity, is less acid, and no longer deposits urates; and the temperature falls to the normal.

The patient being convalescent, a relapse of the disease by no means uncommonly occurs, after a few days or weeks; and that in any degree, from a slight swelling, redness, and pain of a single joint, to a combination of the various symptoms, as severe as the first, or possibly more so.

Analysis of symptoms.—*Invasion.*—In the great majority of cases the patient gradually 'sickens for' acute rheumatism for several days before the symptoms are fully declared. He feels ill and out of sorts, chilly, indisposed to eat or work; sleeps badly; complains of slight sore-throat, aching pains in the limbs, and shooting shifting pains in the joints; and presents a sallow, patchy complexion, and a dull, heavy yellowish appearance of the eyes. Altogether, the condition of the patient is very much that of the subject of a severe catarrh; the tongue, digestion, bowels, urine, and pulse presenting the ordinary characters of moderate fever. On careful examination it is found that the pains are of two kinds. The first kind are by far the more severe, and consist of severe muscular aching in various parts of the limbs and trunk; whilst the second kind are of the nature of flying pains in the joints or associated parts. The muscular aching appears to be similar to, or even identical with the 'break-bone' pains which are familiar in common catarrh, and in the invasion stage of some eruptive fevers. They are, therefore, not characteristic. The flying pains, which are, however, not always present—especially in first attacks, are actually situated in the articulations, for instance the ankles, knees, or wrists, and are of the nature of sharp twinges, suddenly leaving one joint to return as quickly in another. Towards the end of the stage of invasion, these pains become less 'shifting;' and when, as the patient will say, they have 'settled' in one or more joints, the rheumatism has passed into the second stage, that of the declared disease. Stiffness of the joints may also be present, especially in recurrent attacks.

In the invasion period the skin does not yet present the perspiratory activity which is so characteristic a symptom of acute rheumatism; but rather a moistness, greasiness, or oiliness, with heat and some congestion. The temperature is raised one degree or more. The sore-throat, which consists in pharyngeal catarrh, follicular tonsillitis, or even actual acute suppurative inflammation, is remarkably characteristic. The milder forms are soon lost in the more urgent symptoms.

The duration of the stage of invasion of acute rheumatism varies greatly, the flying pains in the joints 'settling' much more quickly in some cases than in others. In a small proportion of cases the disease is so rapidly developed that the stage of invasion is wanting. The patient on waking in the morning finds one or more joints affected; or he appears to be struck down during the day without the slightest warning; and instances are not uncommon in which persons, thus suddenly seized with acute rheumatism, have been removed to hospital, for supposed sprain or fracture of the limbs. In rarer instances the feverish symptoms of the invasion stage may be well-marked without any pains whatever.

Declared disease.—1. *Phenomena connected with the joints.*—The physical signs presented by a joint affected with acute rheumatism naturally vary much. The *swelling* is usually considerable, and is chiefly referable to effusion into the cavity of the articulation, fluctuation being frequently discoverable. It is rare for the peri-articular effusion to be so abundant as to yield pitting on pressure. The amount of intra-articular effusion (as well as the pain) greatly influences the position of the joint, but most joints are maintained in a position a few degrees removed from extension. Careful examination will determine the increase and the disappearance of the swelling, as the joints are attacked and recover respectively.

Pain is the most distressing of all the symptoms in uncomplicated rheumatism. It is always severe, and sometimes almost unbearable; but it varies with the different joints, and with the degree and duration of their involvement. In degree it may be said to increase steadily for several hours; it remains excessive for a time; and it then slowly and steadily declines. Its character is very differently described by different sufferers. When a joint is attacked by rheumatism, the first sensation felt by the patient is one of soreness on movement. As the condition develops, the soreness increases to an ache of a subdued, throbbing character. In the course of a few hours the ache 'works up' into an intense pain, apparently associated with a feeling of cramp, the slightest movement of the articulation being almost unbearable. The severe pain now gradually declines—in some instances from the time the swelling reaches its height. After several hours the only pain that remains is a distressing sensation as if the parts had been severely bruised; and the effusion which accompanied the excessive pain having declined along with it, rest of the joint again becomes all-important, the very slightest movement being sufficient to restore the wearying ache. Finally, the pain completely disappears, and nothing remains beyond a feeling of stiffness and helplessness when the joint is moved.

Whilst the course of the pain of an acute rheumatic attack is usually such as has been described, it is greatly modified by a variety of circumstances, such as the particular joint affected, the age and sex of the patient, the condition of the nervous system, and the presence of certain temperaments. In some instances the pains are increased at night.

Tenderness is a constant and well-marked symptom of acute rheumatism. Reference has already been made to the effect of movement on the pain in its different stages, especially towards the end; and to the characteristic posture and anxious expression of the patient, who suffers intensely from the slightest shake of the bed, or even a footfall on the floor. Tenderness finally declines into the feeling of stiffness.

The *redness* of a rheumatic joint is a simple pink blush of erythema, very rarely purpuric. Its intensity varies much with the deep or superficial situation of the articulation, and it is therefore most marked in connection with the joints of the hands and feet, the knees, and the ankles.

Heat of the affected joint is a well-marked objective sign of acute rheumatism. The articulation feels decidedly warmer to the hand than the surrounding parts; and this observation is confirmed by the thermometer.

The *electrical sensibility* of the skin connected with an acutely rheumatic joint has been described by Drosdoff as being remarkably diminished, the area of nervous alteration corresponding exactly with the area of redness, and its duration with the duration of the other local signs and symptoms.

The *favourite joints involved* in acute rheumatism are the larger articulations, especially the knees, ankles, wrists, shoulders, and elbows; the hip joint less frequently than the others. The fingers come next in order of frequency; then the toes; whilst the remaining articulations are more rarely affected.

Corresponding rather closely with the frequency of attack is the favourite *order of invasion*; the ankles being more frequently the first to be involved, then the knees, and so on. In other instances it is observed that the disease passes along the joints of the lower limbs, including the hips, to those of the upper limbs; frequently its distribution is symmetrical bilaterally; whilst in some cases it is unilateral, the homologous joints of the upper and lower limb being simultaneously invaded. The smaller joints suffer, as a rule, towards the termination of the attack.

2. *Disorders of neighbouring muscles.*—The muscular pains of the stage of invasion of acute rheumatism disappear in the declared disease, or are lost in the presence of more severe symptoms. They are replaced, however, by pains in the soft parts of the limbs related to the affected joints, especially the muscular insertions and fasciæ; and even the whole limb may ache, with much stiffness and a feeling of utter powerlessness. Painful twitchings are also common, especially during sleep; and when the acute pain has passed off, marked muscular debility remains behind.

3. *Temperature.*—Acute rheumatism is attended by well-marked pyrexia, but this, like the disease as a whole, is variable in degree, course, and duration. The sudden invasion of the several joints, their speedy relief, the alternation of extreme bodily distress with comparative comfort, and especially the variety of pyrexic diseases with which the rheumatism may be complicated, would hardly lead us to expect a typical temperature curve. In uncomplicated cases, however, the fever follows a tolerably definite course. Pyrexia makes its appearance at invasion; it continues as long as the local symptoms preserve an acute or subacute character; and with them it declines and disappears. The *degree* of the pyrexia, in the great majority of cases, is in direct proportion to the severity of the joint-disease. Mild local symptoms—that is, moderate pain, short duration of symptoms in any given joint, and a small number of joints affected, are accompanied by moderate fever, ranging from 99° to 102° Fahr. On the other hand, severe local symptoms—that is, severe pain, the full development of the several signs in the affected parts, and the simultaneous involvement of several joints, are attended by a temperature of 101° to 104° Fahr. In another, but very small class of cases, the temperature, whatever it may previously have been, rises rapidly to an alarming height, so as to be entirely out of proportion to the joint-symptoms,

which either continue as before, or even disappear. This condition of hyperpyrexia is regarded in the light of a complication, and as such will be presently described.

The *type* of the fever in uncomplicated cases is remittent, the thermometer rising ·25°, ·50°, or 1·0°Fh. in the evening. The primary elevation of temperature at the commencement of the disease is somewhat rapid; the decline or defervescence is decidedly more gradual, although it is generally irregular, being almost invariably broken by temporary rises, or interrupted by the supervention of some pyrexic complication. The occurrence of a relapse is marked by a return of pyrexia, which probably presents the same general characters as before.

4. *Skin.*—Profuse acid sweats constitute one of the characteristic phenomena of acute rheumatism. The brow is covered with drops which trickle down the face; and the whole body perspires profusely, and is bathed in an atmosphere of wet steam. Although usually universal, the sweats may sometimes be unequally distributed. It is doubtful whether any relation can be traced between the amount of perspiration and the hour of the day or night, the temperature, or the pulse; but it perhaps varies directly with the severity of the pain. The sweats continue throughout the whole attack, making their appearance at an early date and disappearing gradually with the subsidence of the other symptoms. They do not intermit in the striking way of the sweats of the hectic or septic states, unless towards the end of a severe protracted attack, when the patient is greatly debilitated; but at certain parts of the day the skin may be found to be perspiring less freely, or even to be perfectly dry. The sweat of acute rheumatism possesses a peculiar sour, acrid smell; and this is so powerful, and pervades so thoroughly the neighbourhood of the patient when the blankets are disturbed, that the diagnosis of the disease can frequently be made from it alone. Like the sweat in health, it is acid in reaction, rarely alkaline from decomposition. No other test can be readily applied to it clinically. The rheumatic patient may complain of the unpleasant, but never of the 'weakening' effect of the perspirations which is observed in hectic fever; on the contrary, he may describe them as bringing great relief to the bodily condition. In less acute cases the skin may present a shiny or greasy appearance, rather than actual perspiration. When the sweats are severe, sudamina make their appearance, especially about the trunk; and in some cases the skin is covered with a profuse eruption of miliaria.

5. *Digestive system.*—The tongue is covered with a thick, white, moist fur, which varies closely with the rheumatic condition, and serves as a ready indication of the same. The thickness of the coating is sometimes very great. Occasionally the tongue is dry; very rarely brown, baked-looking, or cracked. The sense of taste is, in a great measure, lost; the mouth is parched; thirst is urgent and difficult to satisfy; and the reaction of the saliva, or, more correctly, of the fluids of the mouth, is said to become acid. Appetite is lost, until the disease begins to decline, when hunger returns very early and urgently. Sore-throat occurs in some cases during the declared disease, but is much less common than in the stage of invasion. Sickness is rarely present. Dyspepsia, attended with flatulence, is common, unless the most digestible food only be given. Irregularity of the bowels is characteristic of acute rheumatism, either constipation or diarrhœa being almost constantly present; and the two conditions frequently alternate. Diarrhœa is perhaps more common in first than in subsequent attacks. The motions are dark and foul. Pains in the belly are by no means rare, and are frequently connected with diarrhœa, but they occur also in constipation; and at times they are accompanied by attacks of distressing flatulence.

6. *Circulation.*—The circulatory symptoms proper to acute rheumatism are modified by complications affecting the heart in a very large proportion of cases. When no special circulatory complication exists, the pulse is regular, 80 to 120, full, sometimes hard, sometimes soft, or even dicrotic; but it naturally varies much with the severity and stage of the disease. The effect of the various complications on the pulse will be presently described.

7. *Respiratory system.*— The frequency of the respirations in uncomplicated rheumatism is somewhat increased; slight cough is occasionally present; and under these circumstances a few dry rhonchi may be heard over the chest. On the other hand respiratory complications may be of a serious and even fatal character, and will demand consideration in their proper place.

8. *Urine.*— Throughout an attack of acute rheumatism the urine is scanty, high-coloured, and strongly acid; and it deposits a quantity of urates. Albuminuria is rare. Quantitatively examined, the urine is found to contain an actual excess of urea, and a considerable (but probably only a relative) excess of uric acid, colouring matter, and sulphates; the water is below the normal amount; and the chlorides are diminished, although less so than in pneumonia. Lactic acid has never been found in excess. Any marked departure from these characters of the urine, especially in the appearance of more than a passing trace of albumin, is to be considered as a complication of the rheumatism.

9. *Nervous system.*—As a rule, consciousness and clearness of intellect are preserved throughout. Delirium is very uncommon; and when either delirium or stupor supervenes, it will generally be found that, in otherwise uncomplicated cases, the temperature has risen to an excessive degree. Very rarely the pyrexia remains moderate in these circumstances, and such cases have been described by the name of 'cerebral rheumatism.' There is generally great distress of mind in acute rheumatism; and in other than first attacks, the previous experience of its protracted course and dangers, and the recollection of the pains and other sources of bodily discomfort greatly affect the patient, and produce an amount of anxiety which is almost characteristic of the disease. Sleep is either impossible, or at best is constantly broken and unrefreshing, when the pain is severe.

10. *Expression.*—The debility or prostration, which forms an important element of fever from whatever cause, is present in acute rheumatism, but it is in a great measure obscured by the ex-

pression referable to pain, and to the effort to preserve an easy position. Towards the end of an attack, when pain is subsiding and movement is comparatively easy, the patient and the practitioner begin to appreciate the degree to which the bodily strength has been reduced. This loss is always great, and is sometimes extreme, varying, of course, with the severity and duration of the disease.

VARIETIES.—The description just given applies to a fully-developed attack of acute rheumatism, without complication, of indefinite but not protracted course, and of favourable termination. It is only a minority of cases, however, that are of this nature. Occasionally the symptoms are very mild or the attack very short, in which event the rheumatism is said to be *subacute*. Again, as nearly as possible every second case proves to be *complicated* with some affection of the viscera, especially the organs of circulation and respiration. These departures from the 'typical' course of acute rheumatism, as it is called for the sake of description, will next be considered.

Subacute rheumatism.—Under this name are comprised a variety of cases of the disease, which, whilst of comparatively little severity, exhibit the greatest possible differences in their other clinical characters. Several well-marked groups of these may be distinguished, and demand separate consideration.

(*a*) The *first* group of subacute cases is one in which the duration of the disease is unusually short—probably from one to three days. The number of joints affected is very small; and the general symptoms appear to be arrested before attaining any considerable severity.

(*b*) In a *second* group of subacute cases, after exceedingly mild invasion-symptoms, a single joint only is attacked, with little pyrexia, whilst the skin presents a shiny or oily dampness rather than true perspiration. The rheumatism disappears in a few days; or it shortly relapses in the same or in some other joint. This form of subacute rheumatism may be difficult to diagnose from gout.

(*c*) Widely different from the foregoing is another and the most common variety of subacute rheumatism. Such are many of the *recurrent* cases of the disease, and of the instances of first attacks in old subjects. It may be stated broadly that the first attack, or first and second attacks, of rheumatism are more severe than subsequent ones; that the severity diminishes with each recurrence of the disease; and that persons attacked for the first time after middle life, suffer less than younger subjects. In all these cases, the phenomena connected with the joints, and the general symptoms, including the pyrexia and the sweats, are mild in degree, although by no means of short duration. In recurrent cases the patients are frequently the subjects of chronic heart-disease, in whom exposure to some of the determining causes of rheumatism has lighted up fresh endo- and peri-carditis, and therewith moderate fever and subacute rheumatism of the joints. The anxiety of the practitioner will be confined to the condition of the heart; but during the progress of the complaint, joint after joint may become painful, tender, slightly swollen, and red.

(*d*) *Lastly*, there is a large and well-marked group of subacute cases of rheumatism in which the disease runs what may be called a *latent* course, and which occur especially in children. The joints are so slightly affected that the characteristic signs and symptoms of rheumatism may be entirely overlooked. Children frequently pass through an attack of acute rheumatism, without the true nature of the complaint being suspected by their medical attendant; and in other instances the diagnosis is first made on the discovery of one or other of its familiar complications, notably heart-disease. The child is feverish, and complains of pain and tenderness in the limbs. Moderate swelling and redness of the affected joints pass unheeded in the full and high-coloured body of the patient; and pain and tenderness in these subjects are either entirely disregarded, or referred to 'growing,' or to 'a cold.' Lastly, the sweats are much less profuse, or entirely wanting, the skin being hot with several degrees of fever. Whilst the disease in children runs this exceedingly mild course, and one which seldom exceeds a week in length, it is accompanied, in a comparatively large proportion of cases, by acute cardiac disease—a fact which greatly increases the necessity for its early diagnosis. A more completely latent form of acute rheumatism has been described by Graves, in which articular symptoms are entirely wanting, whilst the other symptoms may be of the usual character and follow the usual course.

When these four prominent groups of subacute rheumatism have been described, there still remain a large number of mild cases, which are too indefinite to be treated of in a general article. All possible varieties of the disease will be encountered in practice, according as, on the one hand, the 'typical' course is pursued, or, on the other hand, the disease assumes a subacute character.

COURSE, DURATION, AND TERMINATIONS.—The course of acute rheumatism is extremely indefinite. The average duration *of acute symptoms* under expectant treatment has been estimated at nine days; it is probably rather less under certain other methods of treatment; and it is much prolonged by neglect. The entire duration *of an attack* is much greater than this, and necessarily less definite, namely, two to six or even ten weeks; and, speaking broadly, it increases with the age of the patient, up to middle age. Convalescence is generally protracted (before the health is perfectly restored); and it is very common to hear persons who have suffered from acute rheumatism state three or four months as the time they were 'ill.' Convalescence is accompanied by desquamation of the hands and feet, and perhaps of the body generally; and may be marked by obstinate anæmia. In many cases stiffness, pain, and weakness remain in the joints and neighbouring muscles.

The great majority of cases of acute rheumatism ultimately end in recovery, the proportion of deaths as the immediate result of an attack being only about four per cent. On the other hand, a large number of persons suffer from remote effects of the disease, many of which are not only distressing, but likely to lead to death. Of the immediately fatal cases, the larger proportion are associated with, if not actually due to, acute disease of the respiratory organs. The fatal cases which present cardiac disease, especially acute pericarditis, are scarcely less numerous. Altogether it may be said that from a half to three-fourths of all cases of death during acute rheumatism are referable to acute cardiac and pulmonary disease, either separately or combined. It is doubtful whether acute rheumatism *per se* ever proves fatal—that is, whether any patient dies from excessive pain, sweating, and consequent exhaustion. Hyperpyrexia is the most common cause of death next to pulmonary and cardiac complications. In a small number of cases, meningitis, acute alcoholism, and other complications, to be mentioned presently, lead to a fatal termination.

The *remote consequences* of acute rheumatism are, on the whole, more serious than the immediate effects. In a few instances the disease leaves behind it a condition of joints which passes into 'chronic rheumatism' or 'rheumatic arthritis.' A more common effect is valvular disease of the heart, which, in the majority of cases, is referable to acute endocarditis occurring as a complication of rheumatism. It is impossible to estimate the number of cases of disease of the lungs, vessels, brain, kidneys, and other organs, which, in their turn, are caused by such heart-disease. It is also probable that the vessels suffer directly from the effects of rheumatism. When, in addition to these effects, we consider the remote effects of pneumonia and pleurisy, and of the other less common complications of rheumatism, as well as the liability to a return of the disease and its complications which seems to be engendered by a first attack, it is difficult to exaggerate the extent and seriousness of the ultimate results of this disease.

Complications.—Acute rheumatism is frequently accompanied by certain other affections, which modify its course and greatly increase its gravity. The appearance of these complications is in every case anxiously apprehended; and the prevention of the most serious of them is regarded as the chief indication in the treatment of the disease. The principal are—inflammation of the heart and pericardium; hyperæmia and inflammation of the lungs, bronchi, and larynx; inflammation of the various serous membranes; various nervous affections, such as chorea, meningitis, and mental derangement; erythema nodosum, and scarlatina; albuminuria; hyperpyrexia; hæmorrhages; and, lastly, various concomitant or intercurrent conditions.

The relations of these complications to acute rheumatism are very various. The largest and by far the most important group, comprising cardiac inflammations, pneumonia, pleurisy, peritonitis, erythema nodosum, chorea, and meningitis, can only be described as having an intimate but obscure *genetic relation* to rheumatism. This relation is indicated in many ways, such as the frequency of their occurrence during an attack of acute rheumatism; the comparative infrequency of certain of them in any other connection; the manifest analogy that exists between the parts affected in some of them and the joints; the direct increase of their frequency with the intensity of the general rheumatic symptoms, that is, of the cause of the disease; the transient and migratory character which they may present, alternating as they sometimes do with each other and with the arthritis; their occasional occurrence before the joint-symptoms, or even without them, or in the person of a blood-relation of a rheumatic subject; their amenability to anti-rheumatic treatment; and, lastly, their occurrence in the course of acute rheumatism as a part only of a manifestly general disease.

Other complications appear to be *effects* of rheumatism, such as albuminuria and mental disorder: and chorea is believed by some authorities to belong to this category rather than to the former. Scarlatina, dysentery, and profuse hæmorrhages are perhaps related to it *ætiologically*. Lastly, such conditions as bronchitis, hyperpyrexia, and delirium tremens are to be considered as merely *concomitant* or *intercurrent* diseases.

The chief of these complications must now be considered in detail, in the order of their relative importance.

1. **Cardiac complications.**—These are by far the most frequent complications of rheumatism, being present in no fewer than fifty per cent. of all cases. The percentage of acute cardiac disease is, however, less than this—almost certainly about one-third, the remaining cases being chronic, or chronic and acute cardiac disease combined. These numbers refer only to organic disease of the heart, namely, endocarditis, pericarditis, myocarditis, and the effects of these, singly or in combination. But, besides inflammatory affections, there may occur functional disorders of the heart, characterised chiefly by palpitation, cardiac distress, and the presence of various abnormal physical signs; and, according to some observers, the latter class are of as frequent occurrence as the former.

The circumstances under which cardiac inflammation most frequently makes its appearance in acute rheumatism are—first, and specially, early age, rheumatic children rarely escaping disease of the heart, youths seldom, and the liability rapidly diminishing after the thirtieth year; secondly, severity of the rheumatic attack—with which the liability to cardiac complication increases in direct proportion; thirdly, the female sex—women being more subject to rheumatic disease of the heart than men; and, fourthly, neglect of proper treatment during and after the attack.

The *time of appearance* of cardiac symptoms has been variously stated by different observers. As a matter of fact, they are generally discovered when the patient comes under observation; they certainly begin most frequently in the first week of illness; but they by no means uncommonly make their appearance in the second week, and may occur at any period.

Inflammation of the heart and pericardium are fully described under their appropriate headings (*see* Heart, Inflammation of; and Pericardium, Diseases of). The influence of the presence of cardiac complications on the course and prognosis of an attack of acute rheumatism, is so important as to alter the whole aspect of the case, and to prove the chief cause of anxiety. Affections of the heart are by far the most common cause of death from rheumatism, immediate and remote; and even when they do not prove fatal, they constitute the most distressing of the remote effects of the disease.

2. Respiratory complications.—Diseases of the respiratory organs have been variously stated to occur in from one in every six to one in every sixteen cases of acute rheumatism; and in the larger proportion of immediately fatal cases they are the direct cause of death. The most common is pleuro-pneumonia; pleurisy alone the next; then pneumonia; and severe bronchitis, pulmonary congestion, and laryngitis are more rare. They may probably occur at any period of the rheumatic attack; but the most serious forms will necessarily appear towards the termination, for the obvious reason that they so frequently prove fatal. The supervention of acute respiratory diseases is, as a rule, easily recognised by the appearance of their several symptoms and signs.

3. Hyperpyrexia.—This is one of the most alarming complications of acute rheumatism, but happily one of the most rare. The condition is fully described in another article (*see* TEMPERATURE). Hyperpyrexia may occur at any period of the disease; generally when the symptoms are fully developed; but even during convalescence. The principal indications of the approach of hyperpyrexia, which it is of the last importance to recognise, are flushing of the face; brightness and restlessness of the eyes; an eager, excited expression and behaviour; disappearance of pain and swelling from the joints, and arrest of the perspirations; delirium; and increase of the general symptoms of fever. On the occurrence of any of these symptoms in an otherwise uncomplicated case of acute rheumatism, the temperature should at once be taken, and the observation repeated every half-hour. If the body-heat prove to be over 103°, and to be still rising, measures must be immediately adopted to prevent the hyperpyrexia, which is certainly threatening.

4. Nervous complications.—The reputed frequency of these complications has been greatly reduced since the discovery that the majority of the cases of so-called 'cerebral rheumatism' and 'rheumatic meningitis' are really instances of hyperpyrexia. These cases being excluded, the frequency of cerebral disturbance, in uncomplicated rheumatism, is not greater than in other pyrexial diseases. Cerebral embolism may occur from endocarditis; meningitis is very rarely observed; and a peculiar form of insanity has been described by German authors in connection with acute rheumatism. Delirium tremens occasionally supervenes when there is a history of alcoholism. Chorea bears a remarkable relation to acute rheumatism (*see* CHOREA). Occasionally it appears during an attack; and choreic twitchings may thus be the prominent symptoms during the first days of the illness, especially in children.

5. Cutaneous complications.—In a small proportion of instances, acute rheumatism, or a condition which practically cannot be distinguished from it, is associated with erythema nodosum; sometimes the arthritic symptoms and sometimes the skin-affection being the first to appear, and the two conditions being further associated with some of the complications already mentioned. Urticaria is less frequently seen in the same connections. A remarkable condition, in which arthritic symptoms are associated with purpura, hæmorrhages, vascular thromboses, and possibly ulcerative endocarditis, is known as *peliosis rheumatica*, or *purpura rheumatica*. *See* ERYTHEMA; PURPURA; and URTICARIA.

6. Renal complications.—Albuminuria does not occur in more than ½ or 1 per cent. of all cases of acute rheumatism; and the so-called 'rheumatic nephritis,' has probably no real existence. The frequency of albuminuria is not greater than can be accounted for by renal embolism, the probable existence of chronic cardiac and renal disease, the possible association of scarlatina, and the presence of pyrexia.

7. Serous inflammations.—Peritonitis is a very rare complication, described chiefly by French writers. Rheumatic 'orchitis,' or inflammation of the tunica vaginalis, is occasionally met with. Rheumatic pleurisy and meningitis have been already referred to.

8. Gout.—When acute rheumatism attacks a subject of the gouty diathesis, its symptoms may be considerably modified. The pain, swelling, and selection of particular joints have all a gouty character more or less; and whilst the disease is more amenable to treatment directed against the gout, it has possibly a greater tendency to lapse into a chronic affection of the smaller joints.

9. Scarlatina.—Scarlatina may make its appearance at any period during the course of acute rheumatism. The concurrence of the two diseases may occasionally be accidental; possibly they mutually predispose to each other, by lowering the general health and increasing the liability to chill; whilst some authorities hold that many of the ordinary complications of scarlatina, as well as the arthritis, are essentially rheumatic, such as serous inflammations and nephritis. The occurrence of rheumatism as a complication of scarlatina is discussed elsewhere. *See* SCARLET FEVER.

DIAGNOSIS.—Although acute rheumatism can generally be easily recognised, its diagnosis is sometimes a matter of the greatest difficulty.

In the stage of *invasion*, it is most readily confounded with the acute specific fevers, including influenza, and with catarrh, in which pyrexia and aching of the limbs are prominent symptoms. If sore-throat be comparatively well-marked, and the development of the joint-affection slow, the practitioner may be led to diagnose simple catarrh instead of rheumatism, and to make light of a complaint which is about to develop into a serious disease. In every doubtful case a certain number of facts should be kept clearly in view, namely, the history of the attack; the possible occurrence of previous attacks of rheumatism; the family history; the absence of symptoms characteristic of other diseases, such as eruptions or coryza; the development of pain or tenderness in a definite joint, and acid sweats; and most important of all, the discovery of the signs of inflammation of the heart.

In the second or *declared* stage, when one or more joints are involved, an entirely different group of diseases have to be diagnosed from rheumatism, namely, gout, 'rheumatic arthritis,' gonorrhœal rheumatism, pyæmia, glanders, and acute synovitis or arthritis of traumatic or diathetic origin. In doubtful cases the characteristic phenomena of rheumatism must be kept clearly in mind, especially the transient and erratic course of the arthritic symptoms, and the probable presence of cardiac complications.

Acute gout may generally be diagnosed by the sudden invasion at night of a single joint—probably the great toe, in a man of middle or advanced age; by the severity of the pain, which is relieved by the occurrence of a characteristic swelling of the part; by the history of previous attacks of the same description; and by the insignificant amount of constitutional disturbance attending the arthritis. The discovery of uric acid in the blood will definitely settle the diagnosis of gout.

Pyæmia is usually associated with an injury or pre-existing surgical disease; and the fever has a markedly remittent character. Rigors are the rule, whilst they are the exception in rheumatism; the sweats are distinctly intermittent; the arthritis is neither transient nor migratory, but may advance to suppuration of the joints; and the symptoms of blood-poisoning and extensive and multiple visceral disease shortly supervene. Still it is a fact, which cannot be insisted upon too strongly, that cases of pyæmia are frequently mistaken at first for acute rheumatism.

Gonorrhœal rheumatism may be recognised by being persistent, whether one or more joints be involved; by the type and degree of the pyrexia; by the absence of cardiac complications, as a rule; by the presence of conjunctivitis; and, most certainly of all, by the existence of a urethral discharge.

Rheumatic arthritis may be distinguished by the characteristic deformity of the joints.

For the diagnosis of glanders *see* Glanders.

Ordinary *synovitis* is rarely multiple; is persistent and not migratory; and has an appreciable cause, whether traumatic or diathetic. *See* Joints, Diseases of.

The numerous difficulties which beset the diagnosis of sub-acute rheumatism, in children especially, have already been sufficiently dwelt upon.

Prognosis.—In a disease which runs so uncertain a course, and which may be complicated by such a variety of dangers, the prognosis is necessarily most uncertain. The proportion of fatal cases, and of cardiac complications, and the average duration of an attack, can easily be stated; but in a given case there is at first no positive means of foretelling what course the disease will run in any one of these respects. The prognosis must be specially guarded in persons worn out by mental or physical overwork or anxiety; in young women of full flabby habit, with tendency to anæmia and disturbance of the uterus, stomach, and circulation; and in women after delivery—all subjects in whom cardiac inflammation and failure, and pulmonary complications are to be apprehended. Ill-declared, 'weak' symptoms, connected with the joints, indicating that the bodily strength and power of resistance are low, are less favourable than well-pronounced 'honest' pains and a warm sweating skin, which generally point to a favourable termination as regards life. It must, however, be observed that the risk of complications in some degree increases with the severity of the local symptoms. The probability of cardiac complications decidedly declines after the first week, but the possibility continues as long as fresh joints are being invaded. Rheumatism may be expected to run an exceedingly mild course in children, but the danger of cardiac complications is very great. In old subjects it may be safely assumed that the disease will end favourably. The supervention of pulmonary complications, especially in association with cardiac disease, or of hyperpyrexia, should cause anxiety, as immediately threatening life. Remote danger from acute rheumatism is chiefly to be estimated by the occurrence of heart-disease, and by the nature of the same.

Treatment.—The difficulties which beset an attempt to estimate the relative and absolute value of the different measures that have been proposed for the treatment of acute rheumatism, may be said to be at present insurmountable. Under the most favourable circumstances the number of carefully observed cases of any disease, subjected to a particular treatment, must be very large, before a safe conclusion can be drawn respecting the result. The most favourable circumstance for therapeutical observations is manifestly uniformity of the course of the morbid process. This condition is as much as possible wanting in the problem before us. Rheumatism is a disease of indefinite duration, of infinite degree of severity, and beset with a number of complications. It is not always possible to estimate the duration of the attack when the case first comes under observation. Lastly, many of the recorded cases have been treated by such complicated methods, that it is frequently quite impossible to eliminate the respective effects of the various drugs administered. In approaching the question of the therapeutics of acute rheumatism at the present time, these facts cannot be kept too clearly in view, for perhaps no disease has been alleged to have been successfully treated by so many different remedies.

1. **General treatment**—When called upon to treat a case of acute rheumatism, the practitioner must, in the first place, make certain special arrangements for the nursing of the patient. In addition to the ordinary measures proper in every case of an acute febrile disease which will probably prove of some duration, he must especially secure for the rheumatic patient perfect quiet, extreme gentleness of every necessary movement, and the prevention or relief of the discomfort attendant on constant and profuse perspirations. Next to a good strong nurse, and perfect hygienic arrangements of the sick-room, a proper bed is of the utmost importance in the general management of the case. The bed must be firm; standing on a firm floor; sufficiently narrow; and placed in such a position as to be readily accessible from either side, and allow the attendants to reach any part of the limbs or trunk of the patient, without interfering with the position and comfort of the other parts. Further, the bed must be 'made' as a 'rheumatic bed;' that is, a pair of blankets must be placed between the sheets—the one

over, the other under the patient, so as to absorb the profuse sweat, and diminish the risk of chill from dampness of the linen. The patient should be furnished with a long flannel bed-gown, made to fasten with tapes down the front and along the arms, so that the chest or any joint may be reached with the least possible disturbance. Arrangements must be made for collecting the urine and stools in bed; and the use of a urinal and a bed-pan, or a properly arranged towel for these purposes, is imperative.

These nursing arrangements being completed, the physician may turn his attention to the consideration of the therapeutics proper of the case. Two indications have to be fulfilled, namely, first, the relief of local symptoms which may be urgent; and, secondly, the reduction of the fever and the removal of the general distress. An effort must be made to secure these ends by separate measures, or by following some system that will effect both. The various measures at our disposal will now be considered, beginning with those which are at once the most simple, and the most urgently required.

2. **Local palliative treatment.**—*Rest.*—The most ready and satisfactory measure of a local kind for the relief of symptoms is the application of cotton-wool to the rheumatic joints. Cotton-wool is to be wrapped in some quantity around the parts, and secured by a moderately firm roller, or by a piece of warm flannel with the ends stitched together. The affected articulation is thus at once kept at rest and protected from cold and pressure; whilst uniform support is obtained. The relief obtained by this simple arrangement is often remarkable. The joints should be carefully sponged with warm water and soap, or warm water slightly alkalinized by carbonate of soda, before this or any other application; and the cotton-wool must be occasionally changed, especially if the perspirations be profuse. The principle of support and prevention of movement is more thoroughly carried out in a method of treatment which has found more favour with Continental than with English practitioners. This method consists in placing the joints in splints, as they become affected; in bandaging them firmly; or in encasing them in plaster of Paris. The results are said to be very satisfactory; the pain being reduced to a minimum, the fever falling, and the course of the disease essentially shortened.

Anodynes.—When the pain is severe, and relief is not to be obtained by simple rest and protection, anodynes may be applied to the rheumatic joints. Opium in any of its ordinary forms, belladonna and its allies, and other familiar anodynes, may severally answer best in particular instances. These substances may be applied on the surface of lint, secured and supported by a bandage; or the affected part may be lightly rubbed or smeared with the anodyne preparation in the form of liniment, and then wrapped in cotton-wool or flannel, as already described. Heat is generally grateful to acute rheumatic joints, but in many cases it is felt to be useless in the acute stage unless it be quite extreme. Thus simple warm fomentations may give relief; but the patient may urgently demand their constant renewal, so that they may be almost scalding. There are obvious objections to such a plan of treatment. Extreme cold has been recommended by some authorities, notably Professors Esmarch and Hueter, in the form of ice. It is seldom used in this country.

Blisters.—A favourite method of treatment with some physicians consists in the application of blisters to the rheumatic joints. The blisters, usually of cantharides, are intended to act less as counter-irritants than as 'derivatives' or 'evacuants.' Dr. Herbert Davies, who introduced the blister-treatment in this country, contends that the rheumatic poison is especially abundant in the neighbourhood of the joints, and is actually separated with the blister-serum, and so removed from the body. In its original and complete form, the blister-treatment consists in applying a strip of cantharides plaster near every affected joint at the height of the inflammatory stage. In some cases the amount of blistered surface may thus be enormous. The serum is encouraged to drain away, and the surface heals in due course. It has been claimed for the blister-treatment that it relieves the pain, shortens the course of the disease, and lessens the tendency to cardiac complications. Of the first effect, there is probably little doubt; the other effects are questionable; and statistics show that other methods of treatment are more efficacious in these respects. On the other hand, the danger of strangury, sloughing, and even pyæmia, and the substitution of another form of severe pain for that dispelled, must be mentioned as objections to its employment. For these and other reasons, a modification of the blister-treatment has been proposed, probably at the sacrifice of the principle, namely, local blistering when a stimulant is demanded, in cases attended with much depression; when the joint-symptoms are unusually severe; when other less severe means have failed; and when the condition threatens to become chronic.

Leeches.—The local abstraction of blood by means of leeches, whilst it relieves pain, is very rarely called for, unless the arthritis be so severe and persistent as to threaten to lead to suppuration.

Electricity.—It is said that, in some cases, marked relief follows galvanization of the rheumatic joints.

Indirect anodynes.—Certain lotions, of other than direct anodyne properties, have been recommended as local applications, to produce a specific effect upon the rheumatic joints, and thus indirectly afford relief. The chief of these are alkaline solutions, especially solutions of the carbonates of potash and soda, sopped into flannel wrapped around the joints. They may be combined with preparations of opium. Their value is somewhat doubtful.

3. **Medicinal treatment.**—(*a*) *Alkalies.*—Before the introduction of salicylic acid the alkalies were in general use in the treatment of acute rheumatism. The alkaline method consists in the internal administration of sufficiently large doses of certain alkaline salts, such as the carbonates, citrates, tartrates, and acetates, to render the urine quickly alkaline; in maintaining this reaction as long as the rheumatic symptoms

continue; and in gradually allowing a neutral or an acid reaction to return by diminishing the dose as the disease declines. It is claimed for this method that as the alkalies begin to exhibit their action on the system, the whole aspect of the case becomes more favourable, the general distress being alleviated, the temperature falling, and the local symptoms relieved; that these favourable effects continue to become more and more marked, until the rheumatic condition has disappeared; that the average duration of the attack is greatly shortened, not exceeding 6·75 days in the acute stage, and 13·5 days before the disappearance of pain; and that the proportion of complications is reduced as low as 2 per cent. only. In other words, it is asserted that in alkalies a direct antidote exists to the morbid influence (whatever that may be) which is the essence of rheumatism.

The *plan of administering* alkalies varies considerably. Some practitioners give large and frequently repeated doses, in order to obtain the speediest possible effect upon the system; whilst others give a moderate amount, or otherwise modify the exhibition of the salts. Of the two plans the first is unhesitatingly to be preferred. To obtain the full effect of potash upon the system, not less than half a drachm of the bicarbonate in an ounce of water should be prescribed at once, either alone or with citric acid in the effervescing form; and the dose is to be repeated every four hours. An equal amount of the acetate of potash may be added to each dose, if a still more rapid and powerful action of the alkalies be desired. The urine will probably become alkaline within twenty-four hours, and when once this effect has been obtained, it may very easily be kept up, by continuing the alkalies at longer intervals, which may be further increased as the symptoms decline. The effect of the drugs upon the patient must be carefully watched, and the amount and frequency of the dose varied accordingly, or its administration, if necessary, stopped. Finally, when the rheumatism is relieved, quinine may be added to the alkaline mixture; and as convalescence advances, the potash may be entirely withdrawn. Constipation occurring in the course of treatment may be relieved by combining the tartrate of potash and soda with the bicarbonate instead of the acetate, tartaric acid being used to cause effervescence; or if more obstinate, by a calomel and colocynth pill.

The alkaline influence upon the system may be further increased, in a very agreeable way, by supplying the ordinary effervescing potash or soda-water as a drink, either alone, or combined with milk, or with fresh lemon-juice. The patient may be encouraged to drink this in quantity, unless there be special indications to the contrary, such as cardiac distress. Should there be diarrhœa, lime-water may be substituted for the potash or soda-water. Should alkalies persistently cause purgation, their administration must be discontinued.

The *objections* that have been raised to the alkaline treatment are chiefly two: first, that it is useless—an objection which is not supported by statistics; and, secondly, that it is dangerous, an objection which only bears testimony to the power of the means employed, and suggests that the greatest care must be taken lest the exhibition of alkalies should be overdone.

(*b*) *Modified alkaline treatment.*—A modification of the preceding plan has been highly recommended by Dr. Garrod, and consists in the administration of quinine from the very first, in combination with large doses of alkalies; as much as five grains of the alkaloid (thus in the form of a carbonate) being given every four hours.

(*c*) *Symptomatic remedies.*—The most obvious general remedies for the relief of symptoms are *anodynes* and *apyretics*. So much benefit follows the use of opium in some cases, by relieving pain and diminishing nervous irritability, that it has acquired a reputation even as a specific. Although formerly given in large and frequent doses, such as a grain every three or eight hours, either alone or combined with mercury, opium is now seldom employed in acute rheumatism, except in the form of a moderate dose of Dover's powder, or of a morphia draught at night, to relieve pain and induce sleep. For these purposes it is employed by most practitioners, including those who adopt what they call the purely expectant method of treatment. The effect of the opium must be carefully watched, in the presence of the many complications which may possibly arise and contra-indicate its use.

Apyretics.—The vigorous employment of apyretic measures is unquestionably the method of treatment of acute rheumatism in greatest repute at present. It has been found that when the temperature is reduced by these means, the whole condition of the patient improves; the joint-symptoms decline; and the morbid process being apparently interrupted, the risk of cardiac complications is removed, at least for a time. Many apyretic remedies have been recommended, such as quinine, tartar emetic, veratrum viride, digitalis, aconite, mercury, and various diaphoretics. The use of quinine has been already referred to. At the present time reliance is chiefly placed upon two powerful remedies of this class, namely, the cold bath or the wet pack, and salicylic acid.

The *cold bath* is the most powerful and speedy method of reducing the temperature in acute rheumatism, but is seldom resorted to except in cases of hyperpyrexia. When this condition threatens, the cold bath or the wet pack is to be unhesitatingly employed, in the manner described elsewhere (*see* TEMPERATURE). If the symptoms be less urgent, cold sponging of the trunk may be sufficient to reduce the temperature.

The use of *salicylic acid*, the *salicylates*, and *salicin*, introduced by Dr. Maclagan, constitutes the present routine treatment of acute rheumatism; and the results obtained from it are certainly more favourable than from any other method. Fifteen to 25 grains of salicylate of soda, 20 grains of salicylic acid, or 15 grains of salicin, are given every one, two, three, or four hours, until the temperature falls to the normal, after which the dose of the drug is reduced, so as to be simply sufficient to maintain the apyrexia for several days. The salicylates are best given in watery solution, variously flavoured; salicylic acid in milk, or combined with liquor ammoniæ acetatis; and salicin in wafers, or in solution. Different practitioners prefer the different forms of the active substance; the salicylate of soda is probably most extensively used, being readily dissolved, whilst salicin is less liable to excite unpleasant symptoms. These are deafness and noises in the ears, delirium, cardiac depression, sickness, and collapse. Short of these effects, the salicylates reduce the temperature to the normal in the course of twenty-four to forty-eight hours, relieve the pain and other arthritic symptoms, and markedly improve the condition of the patient generally; the duration of the disease, and perhaps the risk of cardiac complications being thereby diminished. The average duration of acute symptoms under the salicylates is about three or four days.

The principal drawback to the use of the salicylates is the fact that, whilst they cannot be continued for any length of time in sufficient doses to maintain apyrexia, without the risk of producing toxic symptoms, the rheumatism frequently returns as soon as their exhibition is stopped. Thus on the second or third day after the disease has been checked, the symptoms are again as severe as at first, and the risk of cardiac complications is again present. Whilst this objection is undoubtedly valid, it is still true that in a considerable proportion of cases no such relapse occurs, and that the patients are therefore virtually relieved or cured within forty-eight to sixty hours. If the salicylates fail or disagree, recourse must be had to alkaline treatment or to some other method. Certain practitioners combine the full alkaline method with the salicylates from the first; others prescribe the alkalies in diminished doses. Unfortunately anæmia appears to be more marked, and convalescence more slow, after treatment with salicylates.

Hæmatinic remedies may be considered to be indicated by the great anæmia which accompanies, and yet more markedly follows, an attack of acute rheumatism. Dr. Russell Reynolds has recommended perchloride of iron in large doses; and very favourable results have attended its administration, forty-three per cent. of all cases being convalescent in the first week.

Alcoholic stimulants, in moderate doses, are indicated in a large proportion of cases of acute rheumatism, when the symptoms are severe and protracted. Besides this routine use of alcohol, a special virtue is claimed for its free administration, as in other fevers, by the school of Todd and his disciples, in preserving the strength and relieving the pain. Brandy may certainly be freely administered with advantage in cases attended with extreme depression, even to the amount of 24 ozs. *per diem*, especially in the event of cardiac failure.

Tonics are indicated during convalescence; for example, quinine and iron, separately or combined either with alkalies or acids, and strychnia. Tonics should not be commenced too early.

(*d*) *Empirical remedies.—Lemon-juice* appears to have proved successful in some cases, in doses of eight ounces or less in twenty-four hours. Since the course of acute rheumatism is now known to be indefinite, the number of carefully recorded cases treated by lemon-juice is insufficient to permit a trustworthy inference to be drawn respecting its value. Similar doubts may be cast upon the alleged value of many other so-called remedies for the disease, such as *propylamine* and *trimethylamine*, in 4- to 8-minim doses every two hours; *nitrate of potash* to the amount of an ounce in the twenty-four hours; *cynara* or artichoke; and the *cyanides* of potassium and zinc. *Colchicum* was formerly given extensively in acute rheumatism, but has fallen into disrepute since this disease has been separated from gout. It may, however, be given with advantage for rheumatism in a gouty subject, to relieve pain. *Guaiacum* is useful in sub-acute lingering cases. *Bromide of potassium* has been found very useful in American practice, probably by relieving pain and restlessness. *Calomel*, in doses of 5 to 10 or even 20 grains, repeated for several nights, followed by saline purgatives in the morning, was highly recommended in some cases by the last generation of medical authorities, but cannot be said to be employed at the present day. The same remark applies to *venesection*.

4. Expectant treatment.—Reference must here be made to the observations of Sir William Gull and Dr. Sutton upon the course of acute rheumatism when treated by simple rest, and the exhibition of a *placebo*. The comfort of the patient is secured by ordinary means; and small doses of opium are given to complete this effect when indicated. The results have been remarkably favourable, but less so than those of several other methods of treatment, nine days being the average duration of acute symptoms, and the number of cardiac complications being very small.

5. Treatment of complications.—For an account of the treatment of the complications of acute rheumatism, the reader is referred to the respective articles on each of these in other parts of this work (*see* HEART, Inflammation of; LUNGS, Inflammation of; PERICARDIUM, Diseases of; &c.) The plan of treatment which is being pursued for the rheumatism may have to be temporarily suspended, or possibly completely changed, on the appearance of any of these complications. The treatment of hyperpyrexia is described in the article HYDROTHERAPEUTICS.

The state of the bowels requires the most careful attention. Constipation must be relieved by any of the ordinary means; and a purgative sometimes gives remarkable relief. Diarrhœa may be checked by lime-water or bismuth, or by a judicious dose of castor oil, according to its cause. The surface of the body must be regularly sponged with a very weak tepid solution of an alkaline carbonate.

6. Diet.—The proper diet in acute rheumatism is the same as that in most other kinds of fever. The patient must be fed at short and regular intervals, night and day, with the most digestible forms of nutritious food; and may be encouraged to drink milk, or milk and soda-water occasionally. It must not be forgotten, however, that in all probability the system is already overloaded with the products of imperfect assimilation and transformation; that the digestive system is weak and irritable; and that the heart may be seriously affected by the addition of much fluid or solid material to the blood. As the acute symptoms decline and appetite returns, fish, milk-puddings, and shortly afterwards chicken, sweetbread, and other 'light' articles of diet may be allowed, and will be greatly relished. Meat must be strictly forbidden until every rheumatic symptom has disappeared. Thirst is best relieved in the acute stage, as already stated, by aërated alkaline waters, either alone or in combination with lemon-juice or milk, the quantity given being regulated by the practitioner, and accurately recorded.

7. **General after-treatment.**—The general management of a case of rheumatism after the decline of the acute symptoms is scarcely less important than at the commencement of the attack. The patient should be encouraged to keep his bed for several days after the disappearance of the joint-symptoms; and this advice becomes imperative when cardiac complications exist. Rest and comfort of body and mind must be secured at this period, for the purpose of quieting the action of the heart, and allowing the endocarditic process which affects the valves, and which probably outlasts the articular process, quietly to subside. All attempts must therefore be avoided at completing the cure of acute rheumatism within a certain small number of days. Even with these precautions the first day of sitting up generally proves an anxious time to the practitioner in cardiac cases. Locomotion must be forbidden for several days, and very gradually permitted. When the patient is able to move about and go into the open air, the danger of a relapse during the first weeks must be carefully kept in mind. Sudden and extreme changes of temperature are especially to be avoided; and for this purpose the patient must be warmly clad, and studiously avoid draughts and exposure to cold in other forms.

J. Mitchell Bruce.

RHEUMATISM, Chronic.—Synon.: Fr. *Rhumatisme articulaire chronique*; Ger. *Chronischer Rheumatismus*.

Definition.—A disease of the joints, of chronic course; referable to certain obscure influences of a diathetic and climatic nature; and characterised by various degrees of inflammatory and degenerative changes in the articular structures.

Ætiology.—The causes of chronic rheumatism, as far as they are known, are the same as those of the acute disease. The most powerful predisposing causes are inheritance, previous attacks of acute rheumatism, poverty, physical and mental depression, and laborious occupations entailing exposure to chills. For the last reason men are more liable to the disease than women. Chronic rheumatism is most common in middle life or advanced age, although by no means rare in young adults. Exacerbations of the symptoms are usually referable to exposure, and are accordingly most frequent or protracted in cold wet weather.

Anatomical Characters and Pathology.—A variety of anatomical changes may be met with in chronic rheumatism, whilst in the least severe form of the disease no definite changes in the articular structures can be discovered. In one variety recurrent hyperæmia and effusion are found in connection with the synovial structures, and with the articular and periarticular tissues generally. In the most severe cases the joints are enlarged and deformed, in consequence of anatomical changes which appear to be identical with those of rheumatic arthritis. *See* Rheumatic Arthritis.

This disease is truly rheumatic in its nature, being intimately associated with acute rheumatism. In many of the best marked cases the patient has previously suffered from the acute disease, either immediately before or more remotely; whilst in other instances one or more acute attacks occur in the course of the chronic disease. In yet another group of cases, a single member of a family will suffer from chronic rheumatism, ending in deformity, whilst his brothers and sisters are, without exception, attacked with the acute disease. The predisposing and exciting causes are also identical in acute and chronic rheumatism. Indeed, in every particular the two forms of affection run into each other, and are inseparably associated.

Symptoms.—The clinical characters of chronic rheumatism vary extremely in different instances. The leading symptoms of the disease are chiefly two, namely, pain and stiffness in connection with the joints and associated structures, recurring indefinitely for any length of time, aggravated by cold wet weather, and decidedly increased at night. More carefully investigated, the pains are found to have their seat in the joints, in the tissues of the limbs between the joints, or in both. Any or all of the articulations may be affected, but the site differs considerably in the different classes of the disease to be presently described. The pain is of a severe, aching, wearying character, attended with a sense of heaviness and uselessness of the limb; it is relieved by rubbing, and by exposure to a cold atmosphere; and is increased by slight warmth. Free use of the joint, although at first attended by much pain, often affords relief; whilst, on the other hand, severe exercise of the limbs during the day is liable to be followed by severe aching in the night. The affected joints also feel markedly dry and stiff, and creak on movement; but exercise or rubbing may also remove these sensations.

These symptoms may last indefinitely for years, either recurring at intervals, especially in the winter and spring seasons, or being persistent almost day and night without intermission.

Such are the essential characters of chronic rheumatism. Its other features are so variable as to permit of the formation of several well-defined classes or degrees of the disease, as follows:—

1. *First degree.*—In this class of chronic rheumatic cases the pain and stiffness just described are the only articular symptoms present. No apparent anatomical change is produced, either in the joints or in the associated parts. The subjects of this form of the disease may be otherwise well, vigorous, and long-lived, in spite of the severe pains by which their rest is broken in cold wet weather. They may or may not have, or have had, acute rheumatism.

2. *Second degree.*—In a more severe form of chronic rheumatism, the pain is associated with obvious anatomical changes; and the disease assumes the character of a recurrent subacute rheumatism, making its appearance at intervals

for years. The articular phenomena consist of redness, tenderness, and swelling, the hands being the favourite seat of the affection. These subacute attacks last for days; and leave behind them a distinct amount of swelling, which may not have completely disappeared before the next invasion. The process may thus, in course of time, lead to considerable enlargement, or even deformity of the joints.

3. *Third degree.*—Chronic rheumatism of the most marked degree generally occurs in persons who either have had, or may afterwards have, acute rheumatism; and is characterised by recurrent attacks of severe pain, tenderness, swelling, and hyperæmia of one or more joints, which lead to marked enlargement and deformity. A single joint may be affected at first; but the disease gradually invades the others, both large and small, until the whole articular system is involved. After some years the subacute attacks follow so closely upon each other, and their local effects are so marked, that the patient is never free from distressing pain; and the joints become anchylosed, dislocated, and otherwise disorganised. At the same time the general nutrition is gradually impaired; and the sufferer is anæmic, wasted, and debilitated. Chronic rheumatism of the most severe degree thus merges into, if it be not actually identical with, the class of disease known as 'rheumatoid' or 'rheumatic' arthritis. *See* Rheumatic Arthritis.

It is necessary to understand that the division just made of the leading varieties of chronic rheumatism into three groups, according to its degree, has been employed for the sake of description only. In a large number of instances the disease possesses certain characters both of the first and second degrees; whilst it is evident that cases belonging to the second degree may very readily advance into the third.

Course and Terminations.—The disease, as its name implies, is essentially chronic, generally lasting throughout the life of the individual whom it attacks, and leading to various conditions of debility and deformity, according to the degree of its intensity. In many instances the patient is rendered unfit for work; and such cases form a considerable proportion of the inmates of union infirmaries and other charitable institutions. Death as a direct result of the disease is rare.

Complications.—Cardiac disease is met with in a considerable number of cases belonging to the third or most severe degree of chronic rheumatism, being referable to endocarditis, which complicated the original acute attack. Dyspepsia and calculous disorders are not unfrequently seen in the subjects of the less severe forms.

Diagnosis.—If chronic rheumatism be regarded as a distinct disease from 'chronic rheumatic arthritis,' it is only in its most severe form that it can be confounded with the latter. A definite history of acute rheumatism; the presence of cardiac disease; and the non-involvement of such articulations as the jaw, the sterno-clavicular joint, and the spine, are considered to be features which render probable the diagnosis of true chronic rheumatism from rheumatic arthritis. But in the opinion of the writer, the two diseases are identical.

The pain, swelling, heaviness, weariness, and weakness associated with varix of the lower extremities, sometimes resemble closely the symptoms of the milder forms of chronic rheumatism. Physical examination at once removes all doubt.

Prognosis.—The prognosis of chronic rheumatism is favourable as regards life, but very unfavourable as regards cure; patients rarely losing the tendency to recurrence of pain throughout the whole of their life. Within a short time of the commencement of the disease it will be easy to discover which of the principal forms it is likely to assume; and the prognosis may be made accordingly.

Treatment.—The treatment of chronic rheumatism consists in (1) the relief of pain; and (2) the arrest of the rheumatic tendency, or the treatment of the disease proper.

1. *Palliative treatment.*—This chiefly consists in counter-irritation by iodine or cantharides; the application of anodynes, such as preparations of opium, belladonna, and chloroform; or friction with various stimulating liniments, containing camphor, soap, turpentine, or acetic acid. Regular warm fomentations night and morning, with very warm or even hot water, followed by rubbing and the application of a stimulating liniment under warm rollers, is one of the most efficacious methods of local treatment, the pains being prevented or relieved, and the stiffness removed often to a remarkable degree. Altogether, whatever view may be taken of the pathology of the disease, thorough local treatment of the joints and limbs will generally be attended with decided relief.

2. *General treatment.*—The most successful treatment of the condition of system with which chronic rheumatism is associated, is removal of the patient from the variable weather of England, to the warm and settled climate of sub-tropical or tropical countries. In the case of the poor this is, of course, impossible; and in them we have recourse to warmth of clothing and housing, as far as they can be secured, relief from muscular exertion, and the most nutritious and heat-producing diet that can be supplied, especially oils. To secure these necessary comforts, the chronic rheumatic poor have frequently to be admitted permanently into charitable institutions. Iron and cod-liver oil are the drugs best suited to support the general health. Courses of the mineral waters of Bath, Buxton, and Strathpeffer, in this country; and of many foreign baths, such as Aix-les-Bains, Aix-la-Chapelle, Wiesbaden, Baden-Baden, and Hamman R'Irha, prove invaluable in many cases to those who can afford to try them. The ordinary Turkish bath may also afford temporary relief, if properly employed. *See* Rheumatic Arthritis.

J. Mitchell Bruce.

RHEUMATISM, Gonorrhœal.

—Synon.: Fr. *Arthrite blennorrhagique*; Ger. *Tripperrheumatismus.*

Definition.—A form of inflammation of the joints and associated structures, the essential nature of which is unknown, occurring in the subjects of inflammatory discharge from the genito-urinary mucous membranes.

Ætiology.—This disease, as its name implies, is generally referable to the presence of gonorrhœa. It may originate, however, in any kind of inflammatory discharge connected with the urethra, such as gouty or traumatic urethritis or gleet. It is much more common in men than in women, apparently on account of the comparative immunity from gonorrhœa of the female urethra; but, on the other hand, an affection of the joints which strongly resembles it, is found in connection with chronic uterine disease, or in the puerperal state. Either a rheumatic or a gouty history is frequently to be traced in the patient. Previous attacks powerfully predispose to the return of the disease on the recurrence of urethritis, even in a mild form.

Amongst exciting causes the most important appear to be injury of a joint, such as sprain; and chill during the course of gonorrhœa.

Persons who have suffered from the disease are frequently found to be, and to have been, peculiarly susceptible of urethral inflammation; excessive sexual intercourse being regularly followed by discharge in such individuals.

Anatomical Characters.—In recent cases of this disease the structures connected with one or more of the articulations are acutely inflamed. The cavity contains a variable amount of serous effusion, according to its form and size; the knee, for example, being considerably distended, whilst the digital joints are more moderately enlarged. The various component parts are hyperæmic and swollen; and the peri-articular structures full or even œdematous. In more advanced cases the joints are found to contain either sero-purulent or purulent materials; the cartilages may be eroded; and finally the articulations may become completely disorganised or anchylosed. The cardiac structures are not affected. The eye may present the ordinary appearances of catarrhal conjunctivitis.

Symptoms.—The disease, as ordinarily observed, commences at any period in the course of gonorrhœa—very frequently within a week of its appearance, but possibly not until it has degenerated into a slight gleet, or apparently disappeared. The patient is probably first aware of pain in the loins, or of swelling and pain in the soles of the feet, and very shortly these symptoms involve the ankles. In other instances the knees or wrist-joints suddenly become painful, tender, and swollen—possibly after strain or exertion. At the same time the patient is feverish, suffering from malaise and anorexia; the tongue becomes foul; and the pain, helplessness, gonorrhœa, and general illness give rise to restlessness and depression. Along with, perhaps even before, the articular symptoms, conjunctivitis sets in, affecting one or both eyes, and although of a well-marked catarrhal kind, usually passes off in a few days with little or no treatment.

The physical signs connected with the joints are generally well-marked, the parts being hyperæmic and much swollen, both from intra-articular effusion and from exudation around. The amount of œdema of the dorsum of the hand or foot when the neighbouring joints are involved by gonorrhœal rheumatism, and of the upper part of the subcutaneous surface of the tibia when the knee-joint is affected, is often remarkable. The severity of the pain varies much. At times it is great, preventing sleep, especially as it is usually aggravated at night; in other instances it is extremely slight, and the condition is then more chronic in character. The pain is 'gnawing' or 'aching;' according to some patients, it is more severe before the swelling appears, according to others it is aggravated by the swelling. An important feature of the pains in gonorrhœal rheumatism is that in some cases they are not limited to the joints, but involve the fibrous structures, especially the loins, the plantar and palmar fasciæ, the tendo Achillis, and the sheaths of nerves, such as the great sciatic. The muscles, or their aponeuroses, also appear to suffer; the fleshy parts of the arm, forearm, and thigh being occasionally complained of. Frequently indeed the patient declares that the pains are universal. Stiffness is also felt, particularly when a joint or limb has been kept long in one position. Tenderness varies much, like the other phenomena, being exquisite in some instances, and entirely absent in others. Portions of the tendon-sheaths may be found swollen and tender.

The heart and pericardium are very rarely, if ever, involved.

Such is the usual appearance presented by a case of gonorrhœal rheumatism within the first week of its appearance. Under favourable circumstances the symptoms may decline; but in the majority of instances one joint after another is invaded by the morbid process, whilst those already attacked either slowly recover or continue affected, the disease being thus protracted for several weeks or even months. Cases are met with in which all the joints of one or more limbs are simultaneously affected with gonorrhœal rheumatism, and have been so affected for ten or sixteen weeks; certain of the articulations being but recently invaded, whilst others are slowly recovering from the attack with which the disease commenced. In this manner every joint in the body may be invaded, including the jaw, the sterno-clavicular articulations, and the spinal column.

The class of case just described constitutes the most severe form of gonorrhœal rheumatism. Happily, in most instances the disease is much milder, only one or two joints being affected, and the process either ending with a sharp painful burst of acute synovitis, or, on the contrary, lapsing into a state of chronic intra-articular effusion, with neither tenderness nor pain.

When the disease is protracted, either in one or in many joints, the constitutional symptoms lose their acute character. There is little or no pyrexia; the appetite is fair; and the patient may even go about his work. But the health is gradually impaired, the patient being debilitated and depressed; in the most severe cases he may be completely crippled, and reduced to a condition of great helplessness and wretchedness.

Pathology.—Opinion is greatly divided upon the essential nature of gonorrhœal rheumatism. Three leading views may be mentioned. It is believed by some pathologists that 'gonorrhœal rheumatism' is nothing more than acute or subacute rheumatism, associated with gonorrhœa or other similar discharge. Other authorities recognise in the disease a mild form of pyæmia, the source of infection being usually the urethra. The third view is perhaps not inconsistent with either of the other two. It represents gonorrhœal rheumatism as a trophic or nutritive disorder, due to reflex disturbance; the urethral inflammation affecting primarily certain centres in the spinal cord and brain, and the altered condition of these giving rise to the articular changes.

According to both the pyæmic and the trophic or reflex theory of gonorrhœal rheumatism, the joint-affection may originate in a purulent discharge from any mucous surface, the urethra included. Thus joint-disease has occasionally been observed in association with chronic uterine discharges, dysentery, and chronic bronchitis. It is beside the purpose of the present article to enter into a discussion of these theories.

Course, Duration, and Terminations.—The variable course of gonorrhœal rheumatism has been already sufficiently indicated. The duration of the disease is quite indefinite, varying from a few days to many months. The most unfavourable termination of the disease is anchylosis of the joints, with hopeless crippling; but this is rare. It never proves fatal directly.

Diagnosis.—The diagnosis of this disease turns upon the existence of an urethral discharge, in association with articular inflammation. The occurrence of the latter in young male subjects should always rouse the suspicions of the practitioner as to the presence of gonorrhœa; and he ought at once to ascertain, by careful inspection, the state of the urethra, never accepting the patient's statement on the subject. In some instances the history of a recent gonorrhœa may alone remain. The previous occurrence of one or more similar attacks in connection with gonorrhœa will confirm the diagnosis. Ophthalmia in association with subacute articular symptoms ought immediately to suggest the presence of gonorrhœal rheumatism.

Prognosis.—The prognosis is generally favourable. In young, healthy subjects, under careful treatment, the disease will probably shortly subside; whilst it will prove protracted and obstinate under the opposite circumstances. Gonorrhœal rheumatism increases in severity, and the prognosis is correspondingly more unfavourable, in subsequent attacks. Another point which should be seriously impressed upon the patient, by way of warning, is that the risk of the recurrence of arthritis also increases with each exposure to gonorrhœal infection.

Treatment. — The treatment of gonorrhœal rheumatism is still unsatisfactory. Whilst some practitioners endeavour to check the urethral inflammation as speedily as possible, others strive to encourage the discharge. The former plan appears to be the more rational and the more successful; and the treatment of the gonorrhœa should therefore be persevered with. The attention of the practitioner will, however, be directed chiefly to the joints. If the local symptoms be severe, absolute rest is necessary, the patient being confined to bed, and the affected limb protected by a splint in such a way that applications can be made to the joints. Anodynes may be called for at first, such as poultices, fomentations —simple or opiated or a liniment composed of equal parts of extract of belladonna and glycerine. In other instances leeches may be tried; and blistering in others, where there is either great pain, unrelieved by anodynes, or persistent effusion. In subacute cases with little pain or general disturbance, strapping may be sufficient; and in a more chronic form of the disease friction of the joint and moderate exercise may effect a cure, for example, of the knee by walking.

Internal treatment must be pursued simultaneously. In acute cases free purgation should be obtained at first, and this should be followed by a course of alkaline salines, either alone or in combination with quinine. If the disease persist, iodide of potassium should be given, combined with alkalies or with iron, according to circumstances. In other cases mercurials effect a cure, especially if there be a syphilitic taint, which is not uncommonly the case. The diet must be carefully regulated in the different stages. In very chronic cases of gonorrhœal rheumatism, with threatening anchylosis, the patient should be sent if possible, to a warm watering-place, and be subjected to a thorough course of treatment both externally and internally. *See* Rheumatic Arthritis.

J. Mitchell Bruce.

RHEUMATISM, Muscular.—Synon.: Fr. *Rhumatisme musculaire*; Ger. *Muskelrheumatismus.*

Definition.—A disorder connected with fibromuscular structures; generally associated with the rheumatic diathesis; and characterised by local pain and spasm, and a certain degree of fever.

Ætiology.—Muscular rheumatism is most frequently observed in the subjects of the rheumatic diathesis. It occurs in both sexes, and at all ages; children and adults being specially liable to rheumatic torticollis, and older subjects to lumbago and chronic muscular rheumatism of the limbs. The exciting causes are chiefly two; first, exposure to cold—above all, exposure of a muscular part to a 'draught' after exertion; and secondly, sprain or strain of the fibromuscular structures. Muscular pain, tenderness, and spasms are also common in the invasion of acute rheumatism, and in gonorrhœal and chronic articular rheumatism.

Anatomical Characters.—Nothing is known respecting the anatomical characters of muscular rheumatism, if, indeed, there be any discoverable change in the muscular or fibrous structures.

Symptoms.—The disorder usually commences with slight febrile disturbance, possibly accompanied by sore-throat. Either simultaneously, or in children after one or two days, pain is experienced in the region of some definite muscle or muscular mass, such as the sterno-mastoid or the muscles of the loins; and this speedily becomes so severe as to constitute the leading symptom of the attack. The pain is present only when the affected muscle is thrown into action, so that it may be perfectly relieved by relaxation or rest of the parts involved. The slightest movement, however, from the position of relief is instantly attended with excruciating pain, of a peculiar spasmodic character, which persists until relaxation is again secured. The constant effort to avoid pain gives rise to a feeling and appearance of stiffness, causing the patient to assume characteristic attitudes of the head, trunk, or limbs. Tenderness on grasping the muscle is occasionally well-marked. In some cases several of the joints may be affected with pain and stiffness.

The constitutional symptoms of muscular rheumatism are generally those of mild pyrexia. The tongue is furred; the appetite is impaired; the bowels are confined; the pulse is somewhat frequent, full, and soft; and there is a feeling of malaise. In other instances these symptoms are extremely slight or altogether wanting, the patient suffering from nothing more than local pain. Occasionally there is catarrhal ophthalmia.

Muscular rheumatism usually persists for several days, and gradually declines, but in the milder cases it may last for weeks. One form of the disorder is essentially chronic, the patient suffering for years from pain in various fibro-muscular structures, especially those of the shoulder, arm, thigh, and leg, during cold, wet weather.

VARIETIES.—The following local varieties of muscular rheumatism are recognised by special names:—

1. **Muscular torticollis.**—SYNON.: Acute Wry-neck; 'Stiff-neck'; *Caput obstipum.*—Here the sterno-mastoid muscle is chiefly involved, but any or all of the cervical muscles may be painful. This form is most frequently observed in young subjects, and is often markedly recurrent. It is easily recognised by the fixed position of the head; and has to be diagnosed from spasmodic torticollis, sterno-mastoid tumour, sprain, and spinal disease.

2. **Pleurodynia.**—The fibro-muscular structures of the chest-wall are the seat of rheumatism in this variety. Cough is a common exciting cause of the complaint, which is seen chiefly in adults. Pain is complained of in the chest-wall, usually on one side; and in some instances it may be excruciating, and of a distressing spasmodic character. On examination it is found that a particular intercostal space, or the origin of the pectoral or serratus muscles, is the seat of localised tenderness; and that every respiratory act causes lancinating pain in the same situation. The respiratory movements of the affected side are restrained; but the ordinary physical signs of pleural, pulmonary, and cardiac disease are absent, as are also the *points douloureux*, which characterise intercostal neuralgia. If the movements of the corresponding ribs be restrained by plaster or bandage, the pain is effectually controlled. The direct constitutional disturbance is generally not great, unless sleep be prevented by pain.

3. **Lumbago.**—The muscular and fibrous structures of the loins are here the seat of pain, most commonly the erector spinæ, less commonly the latissimus dorsi, or other smaller muscles in the same situation, on one or both sides. As the muscles of the back support the body in the erect position, and participate in the various movements of bending the trunk in all directions, the patient may be compelled to remain at absolute rest in bed. More frequently he is able to go about, although with pain, or in a stooping attitude. The amount of febrile disturbance is generally moderate.

Lumbago is easily recognised by the characteristic muscular pain referred to the loins, greatly increased by bending, straightening the back, or by turning in bed; and by tenderness of the muscles on pinching, without acute defined tenderness on pressure, as in abscess or neuralgia. At the same time it cannot be insisted upon too strongly, that careful examination of the back, of the abdomen generally, and of the urine, will alone prevent the practitioner from falling into the not uncommon error of treating cases of serious disease for simple lumbago. Renal calculus, lumbar abscess connected with spinal caries, perinephritis, perityphlitis, abdominal aneurism, disease of the rectum, uterus, or bladder, and spinal meningitis, are the principal morbid conditions which must be borne in mind and excluded in every instance, before the diagnosis is settled. Pain in the loins is also a very common accompaniment of affections of the buttock and lower limbs, such as sciatica, rheumatic affections of the hip-joint, and perhaps lameness from any cause. It is also very frequently met with in gonorrhœal rheumatism.

4. **Cephalodynia.**—Muscular rheumatism may affect the scalp, giving rise to a dull, aching kind of headache, on the brow or occiput, aggravated by movement, and occasionally complicated with tenderness of the eyeballs and ophthalmia.

5. **Dorsodynia.**—SYNON.: Omodynia; Scapulodynia.—These names are given to rheumatism involving the structures of the upper part of the back and shoulders. It occurs chiefly in persons much exposed to the weather; and has to be diagnosed chiefly from rheumatism of the shoulder-joint, and certain less common forms of neuralgia connected with the upper dorsal nerves and arms.

6. **Abdominal rheumatism.**—Muscular rheumatism of the abdominal walls is occasionally observed, either alone or in association with lumbago.

DIAGNOSIS.—Speaking generally, muscular rheumatism has chiefly to be diagnosed from neuralgia, and, as a rule, this can easily be done by the paroxysmal character of the latter, the ætiological relations, and especially the physical signs. The practical diagnosis of the chief local varieties has already been sufficiently indicated.

PROGNOSIS.—The prognosis of muscular rheumatism is highly favourable. Under careful treatment recovery may be anticipated in a few days or weeks. But the disorder is one which is peculiarly liable to recur on exposure to its exciting causes.

TREATMENT.—The treatment of muscular rheumatism consists in remedying the constitutional condition; and in relieving the local pain. At the very commencement of the illness, a hot air or Turkish bath may answer both these indications, and give immediate relief. The first indication will, however, be generally best fulfilled by free purgation, followed by alkaline salines, such as the bicarbonate, citrate, or acetate of potash, and acetate of ammonia. In more feeble subjects quinine may be given in combination with alkalics; and iodide of potassium in protracted cases. The diet should be of the simplest character.

The best local treatment consists of absolute rest of the affected parts, which may be variously secured in different instances by confinement to bed, by strapping, or by plasters. Counter-irritants or anodynes, applied locally, give great relief, and for this purpose either a hypodermic injection of morphia, mustard poultices, cupping, warm opiate fomentations, or various liniments composed of extract of belladonna and glycerine, opium, aconite, or chloroform and camphor, or of various combinations of these, may be ordered. Belladonna plaster gives at once relief and support in mild cases. The continuous galvanic current occasionally dispels the pain and stiffness almost immediately. The affected muscles must be kept warm and carefully protected from cold, especially in torticollis. When rheumatism involves the muscles of the limbs, warm anodyne liniments are the best local application.

Great care should be exercised to prevent the recurrence of muscular rheumatism, by wearing warm woollen clothing; by avoiding exposure to damp and draughts; by attending to the digestion and the bowels; and by abstaining from severe, sudden, and awkward muscular efforts. In chronic or recurrent cases of the disorder, the patient should, if possible, visit some of the English or foreign baths indicated in the article on Rheumatic Arthritis.

J. Mitchell Bruce.

RHINOSCOPY (ῥὶν, the nose, and σκοπέω, I examine).—Synon.: Fr. and Ger. *Rhinoscopie.* The practitioner is often called upon to explore the nasal cavities, either with the fingers or with instruments. In proceeding to see the interior of the fossæ, it must be borne in mind that the apertures of the nostrils descend lower than their bony floor; therefore, after having thrown back the patient's head, the nose should be elevated, and the nostrils dilated by means of dressing forceps. Owing to the narrowness of the fossæ digital examination is difficult, but a knowledge of their anatomy will facilitate the introduction of instruments; and the finger can be passed through the mouth and behind the velum pendulum palati, to explore the margins of the posterior nares, and the naso-pharyngeal cavity.

Rhinoscopy, or the optical examination of the cnoanæ, may be either anterior or posterior. Anterior rhinoscopy is simply and easily conducted by means of a speculum, either in the form of a small aural speculum; or, better still, by Thudichum's nasal dilator; and it will be found that reflected light, in most instances, answers better than direct sunlight. Posterior rhinoscopy must be employed to obtain a view of the deeper portions of the structures, and of the posterior aspect of the nares.

Instruments and Method.—The instruments used, and the method of examination, are the same as that in laryngoscopy (*see* Laryngoscope, The), excepting that the mouth-mirror is directed forwards and upwards, and placed beneath or behind the velum pendulum palati. By this means, not only the nasal passages are brought under observation, but the structures in immediate relation with them.

On proceeding to make a rhinoscopic examination, the patient should be directed to breathe through the nostrils while the mouth is open, so that the velum may be flaccid, and the introduction of the mirror facilitated. Some patients are unable to sustain this means of respiration, and in such cases, by causing the emission of nasal sounds, such as the French *en*, the velum is forced forwards and the palate drops. The velum may be pulled forward by means of forceps, but this operation is liable to cause spasmodic action of the palatal muscles, and it may take a long time before the parts become accustomed to the proceeding. It is almost always necessary to use a tongue depressor, as more room is obtained, both for observation and manipulation. The best form of hand mirror is the ordinary laryngoscopic one, with the glass set at an oblique, and not a right angle to the handle; and in using it, and looking at the reflection of the various structures at the back of the nares or vault of the pharynx, it must be remembered that only a perspective view can be obtained, owing to the position of the parts. The structures which come under observation by the use of the rhinoscopic mirror are—the posterior surface of the soft palate and uvula, the posterior and part of the lateral portions of the septum of the nose, the turbinated bones, the nasal meatuses, the pharyngeal walls of the Eustachian tube and its orifice, the vault or roof of the pharynx, the lateral walls of the pharynx, and the upper portion of the posterior wall of the pharynx.

The morbid conditions, for the inspection and treatment of which it may be requisite to use the rhinoscope, are described in the articles Nose, Diseases of; and Pharynx, Diseases of.

Edward Bellamy.

RHONCHAL FREMITUS.—A physical sign, appreciated by palpation of the chest, elicited by the act of breathing when certain secretions or other materials are present in the larger air-tubes or in a cavity. *See* Physical Examination.

RHONCHUS (ῥέγχω, I snore).—Rhonchi are sounds heard on auscultation when the air-channels are partially obstructed. The term is restricted by some authors to the so-called *dry* and more or less musical sounds produced in the bronchial tubes, for instance, *sonorous* and *sibilant* rhonchus; the bubbling and crepitating sounds in chest-disease being spoken of as *râles*. By other authorities, again, all such sounds, whether sibilant or crackling, are described either as *rhonchi* or as *râles*, the terms being interchangeable. *See* Physical Examination.

R. Douglas Powell.

RHYTHM (ῥυθμὸς, a measured movement). The relative proportion between the several parts of certain actions. In medical science it is generally applied to the movements of respiration, and to the action of the heart. *See* Physical Examination.

RIBS, Diseases of.—*See* Chest-walls, Diseases of.

RICKETS (A.-Saxon, *ricg*, the back).—Synon.: Rachitis; Fr. *Rhachitisme*; Ger. *Rhachitis*; *Englische Krankheit.*

Definition.—A general disease affecting the nutrition of the whole body; arresting natural growth and development; perverting and delaying ossification; retarding dentition; causing the bones to become soft, and to yield to pressure, and the muscles and ligaments to waste; and in many cases producing alteration of the brain, liver, spleen, and lymphatic glands.

Ætiology.—Rickets is the consequence of slow impairment of nutrition, and the causes which produce it are principally:—bad feeding, foul air, damp cold rooms, want of sunlight, want of exercise, and want of cleanliness. Of these, perhaps the first two have the greatest influence in causing the disease; for if the quantity of nutritive material introduced into the system be restricted by an improper selection of food, and if the oxidation of waste matters be hindered by an insufficient supply of fresh air, interference with nutrition is necessarily carried to a high degree. A pure bracing air will by itself do much in counteracting the effects of an improper dietary, for it has been noticed that injudicious feeding is less hurtful in country places where the air is dry than in large towns. This, however, may be partly explained by the greater vigour of the digestive organs in the former case, enabling the child to derive nourishment from food which, under other conditions, would be innutritious. Some children are affected more readily and more severely by these causes than are others, for the more the strength of the child is reduced before the actual exciting causes of the disease come into play, the more quickly does the patient fall a victim to their effects. Therefore, all influences which impair the general strength, such as weakness in the parents, or, in the case of the child himself, an attack of acute disease, or even unusually troublesome dentition, must be looked upon as predisposing causes of the disorder. There is no proof that rickets is hereditary. A tubercular family predisposition renders the occurrence of rickets unlikely. Recently a distinguished foreign physician has attempted, by arguments drawn chiefly from morbid anatomy, to prove rickets to be invariably a consequence of inherited syphilis. But the reasons for rejecting this hypothesis are overwhelming.

Anatomical Characters.—The bones are affected in three ways:—growth is retarded; the spread of ossification into parts still cartilaginous is interfered with; and bone already ossified is softened. The growth of bone is not completely arrested; it rather becomes irregular. There is considerable development of the cartilaginous epiphyses, and also of the fibrous periosteum; but these parts ossify incompletely and slowly; and as the normal increase in size of the medullary cavity continues in the usual way, the bone comes gradually to consist less and less of osseous substance, and more and more of, as yet, unossified matter proliferated at the circumference. It is in this way that the bones become soft, and not from any abnormal absorption of earthy salts from bone already ossified. The process of calcification itself, besides being retarded, is abnormal; it has indeed been described as rather a process of petrifaction than of true ossification. On account of the softness of the long bones, serious deformities ensue, as will be afterwards described. The flat bones become greatly thickened from proliferation of the periosteum. This is especially noticeable at the edges of the cranial bones; and when ossification is completed, the sutures of the skull can be felt to be prominent. In parts, however, and especially in the occipital bone, the osseous substance becomes thinned in places from absorption under the pressure of the growing brain. This condition, which is called 'craniotabes,' can be detected by palpation. Calcification is very slow in the cranial bones, and the fontanelle often remains open long after the end of the second year.

The liver, spleen, lymphatic glands, and kidneys are sometimes enlarged. The increase in size is due, not to the presence of any foreign growth or deposit in these organs, but to irregular hypertrophy of their fibroid and epithelial elements, conjoined with a deficiency in earthy salts—an alteration analogous to the changes in the bones. The brain is enlarged from an increase of the neuroglia, not of the nerve-elements. The voluntary muscles are small, pale, flabby, and soft. Under the microscope their striæ are seen to be indistinct. The urine contains less urea and uric acid than natural, but more phosphates, especially phosphate of lime.

Symptoms.—In most cases the symptoms proper to rickets are preceded by others which indicate a certain amount of interference with the digestive functions. There is occasional vomiting; the bowels are often relaxed; and the motions are habitually loose, pasty-looking, and offensive.

The beginning of the disease is marked by profuse sweating of the head, face, and neck; this is especially seen if the child fall asleep either at night or in the day. Almost at the same time he begins to throw off the bed-clothes at night. He will do this even in winter, and may be seen lying almost naked in the coldest weather. Later on, it is noticed that the child dislikes to be touched, and cries when danced about. He seems to be generally tender, and to dread movement of any kind. The occurrence of tenderness marks the commencement of the characteristic changes in the bones. The ends of the long bones enlarge; the flat bones become thickened; and all the bones lose their firmness and grow softer. These changes affect the osseous system as a whole, and lead to serious deformities. If the child had been able to walk, he becomes unsteady on his legs, or even loses the power of walking altogether. He sits or lies about; is drowsy in the daytime; and at night moves his head restlessly from side to side, so as in many cases to wear the hair off the occiput. The flesh is soft and flabby; the motions remain loose and offensive; and the child appears to be occasionally troubled with abdominal discomfort, for he may be found asleep in his cot, resting upon his hands and knees with his head buried in the pillow.

The softness of the bones causes them to yield readily to pressure, and it is to this cause, and not to the force of muscular action, as was at one time supposed, that the deformities are chiefly due. The long bones become bent and twisted. The direction of the bending depends upon the direction in which the force of pressure is applied, and in the lower limbs will therefore vary according as to whether the child can or cannot walk. Sometimes, however, if the disease begins before the child is able to support himself upon his feet, the lower limbs may escape deformity altogether. They are usually in such cases particularly small and thin, with weak, flabby muscles, but the bones themselves are straight. Force of gravity is another cause of deformity of bone. Thus, in the humerus there is often a curve where the deltoid is inserted: this is produced in great measure by the weight of the hand and forearm when the limb is raised by the deltoid muscle.

The skull is elongated from before backwards; the fontanelle is wide; the sutures are thickened; the forehead is high, square, and sometimes prominent; and the head generally looks large. The face, on the contrary, appears small out of proportion to the head, for the growth of the facial bones is arrested. By palpation of the occiput the condition named 'craniotabes' can sometimes be detected. It is an early symptom. Dentition is much delayed, and the teeth when cut are deficient in dental enamel, so that they decay rapidly.

The spine is curved on account of muscular and ligamentous weakness; and if this weakness be great, the natural posterior curve of the spine is so much exaggerated as almost to simulate angular curvature. It disappears, however, at once when the child is lifted up by the shoulders. Sometimes the spine is curved laterally.

The deformity of the chest has the following characters:—The softened ribs sink in so as to present a groove passing downwards and outwards on each side of the sternum. The bottom of the groove is formed more by the ribs than the cartilages, so that the enlarged ends of the ribs, looking like a row of beads under the skin, can be seen lying along the outer side of the groove. The sternum is forced forwards by this bending of the ribs, and the antero-posterior diameter of the chest is increased. The deformity is due to the pressure of the external air. In healthy breathing this pressure is overcome by the resistance of the thoracic walls, aided by the force of the inspired air. In the rickety child the resistance offered by the softened ribs is greatly reduced, and they therefore sink in at the parts where they are least supported. On account of the softened state of his ribs, the breathing of a rickety child is quick and laborious.

The pelvis is pressed upon from above by the spine and the abdominal contents, from below by the heads of the thigh-bones; and the direction of these forces varies according to the position of the child. The general shape thus produced is triangular, and the pelvic cavity is often greatly narrowed.

A rickety child is short for his age; for his limbs, besides being bent, are stunted, growth in them being more or less arrested. His joints are large, and loose from relaxation of the ligaments. If the disease be severe, the child gets anæmic and wastes, and the muscles become very flabby and small. His belly is big, even when there is no splenic enlargement, from shallowness of pelvis and flatulent accumulation. Such children give little trouble. They are quiet, and seldom cry if left alone. They are late in walking, late in talking, cut their teeth late, and in nursery phraseology are 'backward children.'

COMPLICATIONS.—One of the chief characteristics of rickets is the intense sensitiveness to cold with which it is always accompanied; and it is to chills in different forms that a large proportion of deaths occurring in this disease must be attributed. A catarrh may affect the chest or the belly, and in either case the complication is a very dangerous one.

A pulmonary catarrh in a young child should never be made light of, on account of its tendency to cause collapse of the lung; and if the child be the subject of rickets, the danger is really imminent on account of the softness of the ribs.

If the chill affect the abdomen, as it is very apt to do, an intestinal catarrh is set up, and unless the diarrhœa be quickly arrested, the strength of the child becomes seriously reduced.

Besides its influence in increasing the susceptibility of the body to cold, rickets also heightens the nervous impressibility of the child. This effect is not a common result of mere weakness, for in an ordinary case of malnutrition with wasting, the natural sensitiveness of the nervous system to external impressions is impaired. It must be therefore looked upon as a peculiarity of the rickety state. Its effects are seen in the attacks of laryngismus stridulus and convulsions to which these children are so liable. Few cases of laryngismus occur in children who are not the subjects of rickets. Such patients usually have carpo-pedal contractions, and are liable to be convulsed upon the very slightest provocation. On account of the backwardness of the teeth in this disease, all nervous derangements are commonly attributed to dentition; but in rickets dentition, although delayed, is not necessarily troublesome; in fact the teeth, when they appear, are usually cut with singular ease.

Another complication often met with in rickets is chronic hydrocephalus: the excess of fluid is however small. This complication is often suspected where it does not really exist.

DIAGNOSIS.—When the symptoms of rickets are well marked, the bony distortions themselves are sufficiently characteristic to make the nature of the disease unmistakeable. It is, however, of great importance to recognise the early symptoms of the disorder, so that by prompt treatment we may prevent the osseous and other changes taking place. It must be remembered that loss of flesh is a late symptom, and that a rickety child is not necessarily a thin one. If an infant pass the ninth month without any appearance of a tooth; if his wrists enlarge; and if on inquiry we find that he is subject to head-sweats at night, and likes to lie naked in his cot, the diagnosis of rickets may be made without hesitation. Weakness of the legs in a young child is often a source of anxiety to parents, and a medical practitioner is consulted because the child is twelve months old and cannot stand. In these cases the early signs of rickets will almost certainly be discovered. Looseness in the joints is common in cases of rickets, where the symptoms of the disease manifest themselves at the end of the second year. The relaxation of the ligaments is not as a rule combined with much bone deformity, although it may be so. Weakness of the legs from rickets is distinguished from essential paralysis by the fact that, although there may be no power of standing, the child is yet able to move his limbs; and that the muscles, although weak, are not powerless.

Prognosis.—The duration of rickets is dependent upon the duration of the causes which produce it. So long as the baneful influences under which the disease originated are in operation, the morbid processes continue; but when a better hygiene is adopted, and failing nutrition is restored, recovery begins.

When recovery takes place, the symptoms gradually become less intense and finally disappear. The enlargement of the joints greatly diminishes, and even the bony distortions become notably reduced, while the bones themselves become thick and strong. Growth, however, is not rapid, and if the disease have been severe, the child seldom reaches the average height.

When the disease terminates fatally, it is usually through one of the complications which have been mentioned. Sometimes the child sinks and dies, apparently worn out by the intensity of the general disease; but even in these cases the immediate cause of death is usually asphyxia, through the softened state of the ribs. One cause of the great mortality from bronchitis in children is the frequency with which that complaint attacks rickety subjects, even a mild catarrh being seriously dangerous when the ribs are much softened.

In estimating the prospects of recovery in any particular case, we must pay attention to the amount of chest-distortion; and to the presence or absence of disease of the glandular system. If the ribs be much softened, there is always cause for anxiety; and if in a case of pulmonary catarrh there be great recession of the lower ribs in inspiration, the condition is a serious one. The presence of any complication, except perhaps chronic hydrocephalus, necessarily increases the gravity of the case.

Treatment.—As rickets is the direct result of mal-nutrition produced by the anti-hygienic conditions in which the child has been living, our first care must be to alter these conditions. We must see that the living rooms are thoroughly ventilated; that the child is taken out regularly into the open air; that he is warmly dressed; and that his skin is kept perfectly clean by the abundant use of soap and water. We must next select a diet for the patient which is at once sufficiently digestible and nutritious. The term 'digestible' as applied to diet is a relative term. Food digestible to one infant is indigestible to another, and food readily digested by a child in his natural state of health becomes indigestible to him when his stomach is temporarily weakened by teething or any febrile attack. It is not, however, sufficient that the diet should be digestible; it must also be nutritious. Children kept too long at the breast frequently become rickety even although fed at the same time upon other and suitable food; for the watery breast-milk, which forms the principal part of their diet, is sufficient by its bulk to satisfy their desire for food, without supplying the required nourishment to the tissues. Rickety children at the breast should at once be weaned, and if under twelve months old, should be fed principally upon milk guarded with liquor calcis saccharatus, in the proportion of fifteen drops to the bottleful. They may take besides, broths, bread and butter, and occasionally the yolk of an egg lightly boiled or beaten up with milk. Instead of bread and butter, the milk may be thickened for some meals with Chapman's wheat flour baked in an oven; but farinaceous food should be given with very great caution to these children, on account of their tendency to acid indigestion, which renders a starchy diet particularly likely to disagree. Under twelve months of age the child can seldom bear more than one teaspoonful of a farinaceous powder twice in the day. After the first year, strong beef-gravy, and flower of broccoli stewed, may be added to the diet. At sixteen or eighteen months old, a little mutton may be given, carefully pounded in a warm mortar. A mealy potato well boiled and mashed may be allowed, but the effect of all farinaceous food is to be carefully watched. The presence of flatulent pains is a sure sign that the proper quantity has been exceeded.

The diet and general hygienic arrangements having been regulated, the secondary question of drug-giving has to be considered. Before adopting tonic treatment, it is important to improve the condition of the bowels. A dose of castor oil or of rhubarb and soda should be given to clear away undigested food, and afterwards a few grains of bicarbonate of soda with a drop of tincture of opium in a little aromatic water will soon remove the offensiveness of the motions. Citrate of iron may then be added to the mixture, and the child should begin at once to take cod-liver oil. The dose of the oil should be small at first (♏ xv—xx), and while it is being taken, the motions should be watched for any appearance of oil in the stools; if this occur, the dose is too large and must be diminished. As convalescence advances other medicines may be given; and iron wine, quinine, decoction of oak bark, reduced iron, and Parrish's food are all useful. So long as the previous directions have been attended to, the exact tonic used is of comparatively little moment; but cod-liver oil should never be omitted from the treatment. Lime has been strongly recommended by some authors, but according to the writer's experience is of little value unless combined with iron as in Parrish's food, in which case it is probably not to the lime that the benefit is to be attributed. It may once more be repeated that in rickets the success of treatment is in direct proportion to the conscientiousness with which the rules relative to diet and general management have been carried out; and the mother should be made to understand that the child's recovery depends upon her own watchfulness and care.

The bone deformities can be prevented to a certain extent, by hindering the child from walking while the bones are still soft. The bowing of the legs is often owing to the child's getting upon his feet before the bones have become sufficiently consolidated to bear the weight of the body. In these cases light well-padded splints which project below the feet will be the best safeguard. When the ligaments of the joints are loose and weak, the joints may be much strengthened by a well-fitting silk elastic support.

After the tenderness of the body has subsided, the child should be well shampooed, especially along the spine, both morning and evening.

With regard to the complications:—diarrhœa and pulmonary catarrh must be treated upon ordinary principles. A good flannel bandage very much diminishes the tendency to relaxation of the bowels, and is of further value in retarding the too rapid descent of the diaphragm, and so in diminishing to a certain extent the recession of the chest-walls during inspiration. The nervous complications are best treated with bromide of ammonium or of potassium. Laryngismus stridulus is often cured at once by bathing the whole body three times a day with water of the temperature of 60° Fh.

Eustace Smith.

RIGIDITY (*rigidus*, cold, frozen, stiff).—Synon.: Fr. *Rigidité*; Ger. *Starrheit*.—This term implies the existence of a more or less fixed condition in parts that ought to be freely movable. It is a state met with principally in the limbs, where it is dependent upon certain unnatural conditions of the joints or of the muscles, either separately or in combination. It may, however, occur in the trunk as a whole, or in the neck, owing to the existence of tetanic or tonic spasms in muscles, due to one or other of various causes. The valves of the heart, and the arteries, when stiffened by fibrosis, are said to be rigid. Again it is a term commonly applied to a condition of the 'os uteri' during parturition, in certain women, in whom the orifice of the womb does not dilate co-ordinately with the increase in force of the uterine contractions. The term is also sometimes used in connection with the features. Marked rigidity of a limb at this or that joint often results from joint-disease. Perhaps more frequently, however, rigidity in a limb is primarily dependent upon altered functional or nutritive conditions of its muscles, which may or may not be associated with actual paralysis implicating the same parts.

Numerous cases exist in which, without the existence of paralysis, or with a comparatively small amount of it, tonic spasms occur in the muscles of a limb, so as to entail rigidity (*see* Spasm). This may be met with, for instance, in hysteria, and in the early stages of some spinal diseases, more especially in primary lateral sclerosis.

More frequently still, however, rigidity is found in association with distinct paralysis. For many years a distinction has been made between two kinds of rigidity associated with paralysis; the one of which, known as 'early rigidity,' is apt to supervene soon after the onset of a cerebral or spinal paralytic affection; whilst the other, known as 'late rigidity,' comes on rather in old cases in which mere paralysis with flaccidity of muscles may have been previously present. The former is now believed in many cases to have a tendency to pass into the latter form; and where this latter becomes well-developed, it is commonly associated with a secondary or with a primary sclerosis of the corresponding lateral column of the spinal cord, even though the initial paralysing lesion may be in some portion of the motor tract of the opposite cerebral hemisphere (*see* Spinal Cord, Introduction to Diseases of). In early rigidity we have to do with mere functional changes in the muscles, and the condition itself of rigidity is not constant; it intermits from time to time during the day, and commonly disappears during sleep. But in late rigidity, associated with extensive secondary degenerations in the spinal cord, the nutrition of the nerves, as well as of the muscles and their tendons, appears to suffer, and that, for the most part, in an irretrievable manner. This more severe condition of rigidity is associated with actual shortening of muscles or tendons, and in this stage but little, if any, difference exists between the degree of rigidity of the limbs by night and by day. *See* Motility, Disorders of.

H. Charlton Bastian.

RIGOR.—Synon.: Shivering-fit; Fr. *Frisson*; Ger. *Frostanfall*.

Symptoms.—This state is characterised by the following phenomena:—There is general shivering, the tremulous movements not infrequently being so great as to cause chattering of the teeth. The face wears an expression of great discomfort, or even of distress. The complexion, especially on the lips and beneath the nails, is blue and livid. The tongue is moist, although thirst is felt. The fingers are shrivelled and 'dead;' the skin dry and corrugated (*cutis anserina*); and the cutaneous sensibility diminished. The respiration is quickened and shallow. The pulse is frequent, small, and firm. The temperature of the general surface is raised, although a sensation of cold—sometimes of severe cold—often referred to the back or the abdomen, is present. The extremities, however, as the fingers, ears, and nose, may be colder than natural. With these may be combined other symptoms, such as headache, nausea, vomiting, and the special pains in the back or the limbs, which are proper to the different species of fever; but delirium is rarely present.

Pathology and Ætiology.—Rigors are the result of the disturbance of some, as yet undetermined, nervous tract, which, however, is clearly connected with, if not indeed the same as, the great co-ordinating centre in the medulla for the respiratory, cardiac, and vascular movements, and which must, further, be in intimate relation with the thermotaxic centre, if such exist. One of the exciting causes of this disturbance may be the existence of some abnormal differences between the temperature of the surface and that of the interior of the body. This suggestion of Liebermeister, at any rate, supplies an answer to one or two perplexing questions. It enables us to understand how it is that a man already in the grasp of a serious disorder, the temperature of whose body is raised, and is rapidly rising, has yet the same sensation of cold as a healthy man whose external temperature is below the normal, and whose nervous and vascular systems are merely reacting in a perfectly natural manner under one of the commonest conditions of animal life, for in each case the surface is colder than the deeper parts, and thus gives rise to a sensation of cold. It gives a plausible solution of the paradox that the greater the absolute heat of the body as a whole, the more acute is the sensation of cold; and it establishes on a scientific basis the empirical belief in the value of rigors as marking the access of disease, when it is seen that their presence is a proof that increased tissue-change, as shown by the increased production of heat—the very essence of fever—has already begun.

The early diagnosis of fevers, whether idiopathic or symptomatic, is often greatly facilitated by the careful study of the phenomena of the initial rigors. Putting on one side the cases in which a local cause may be found to exist, very violent rigors occur chiefly in connection with the following diseases:—Malarial fevers, relapsing fever, variola, scarlatina, erysipelas, pyæmia, and croupous pneumonia. They are less marked in typhus and enteric fever, pleurisy, catarrhal pneumonia, and bronchitis. It must, however, be remembered that, in appraising the value of any nervous symptom, such as rigors, the personal factor is of extreme importance, and that general rules derived from averages are here more than ever misleading, if applied indiscriminately to individuals.

An additional argument for their central origin is found in the well-known fact, that in children and in persons of unstable nervous equilibrium—for example, epileptics—convulsions are a frequent result of the same causes which produce rigors in other cases.

Rigors occur under the following conditions:—1. In health, when a more or less extensive part of the surface of the body is chilled by external cold. Indeed the chilling of even a very small extent of skin is sufficient to produce them. 2. From irritation of a sensory nerve, and especially in connection with some mucous surface. Thus rigors are an everyday result of the presence of irritating matters in the stomach or bowels, of catheterism, and of the passage of biliary or renal calculi. 3. With the access or the exacerbation of some local disease, especially if it be one which is to end in the formation of pus. Rigors occur, not only at the beginning, but also during the progress, and with great violence just before the bursting of an abscess. Thrombosis in veins is also attended by rigors. The writer himself once experienced very violent rigors in connection with extensive thrombosis of the veins of the left arm, due to a prick received at a *post-mortem* examination, although no suppuration whatever took place during the whole course of his illness. 4. At the beginning of idiopathic and symptomatic fevers, that is, when the fever has already begun, and the increased heat-production in the viscera has destroyed the natural balance between the temperature of the interior and of the surface of the body.

Although for practical purposes it is convenient to distinguish these different modes of origin of rigors, they are essentially identical; that is, in each we have the effect of irritation of a certain kind conveyed by afferent nerves to some central tract or organ.

TREATMENT.—Warm, mildly stimulating drinks and external warmth are always grateful to the patient, and perhaps shorten the duration of the attack. Tincture of aconite, in 5-minim doses, has the reputation of preventing the occurrence of rigors from local sources of irritation, and may perhaps be useful when they arise from more general or from constitutional causes. Nitrite of amyl also has been employed, apparently with some measure of success. But the only effectual treatment is that of the diseased condition with which they are associated, and this can rarely be begun with advantage before the termination of the rigors or 'cold stage.' Until that period has arrived it is at best useless to attempt any internal medication; even quinine is of little or no avail in this stage of malarial fever, and often seems merely to aggravate the sickness, headache, and general discomfort, which are the usual concomitants of rigors.

J. ANDREW.

RIGOR MORTIS (Lat. The stiffness of death).—SYNON.: Fr. *Rigidité cadavérique*; Ger. *Todtenstarre.*—The stiffening of the muscles after death, due to coagulation of their plasma. *See* DEATH, Signs of.

RINGWORM.—SYNON.: Tinea; Fr. *Teigne*; Ger. *Ringwurm.*

DEFINITION.—A disease of the hair-follicles and hair, of a circular figure, and spreading in the form of a ring.

ÆTIOLOGY.—Ringworm is essentially a disease of the nutritive period of life; it is contagious, and sometimes communicated to the adult, particularly to women; in the latter case appearing on the unhairy parts of the body, such as the neck, the shoulders, the chest, and the arms. It is very generally taught and believed that the cause of tinea is the growth and development of a fungus-plant; that the disease is propagated by means of sporules, which are accidentally conveyed from one person to another; and that the subsequent folliculitis and other pathological processes result from the irritation caused by the parasitic fungus. That the disease does not become universal, instead of being sporadic, is explained by the admission that the spores require a favourable, that is, a morbid soil for their evolution and growth. The writer of this article entertains, however, a different opinion, and believes that the folliculitis is consequent on a depressed state of health of the individual; that the follicular epithelium is, therefore, imperfectly developed; and that the phytiform growth is a proliferation of the granular elements of the immature epithelial cells and of the hair-cells—a degeneration, in fact, of their component elements.

DESCRIPTION.—Ringworm of the scalp is recognised by loss of hair in one or numerous patches of a circular or oval figure, and of an average diameter of half an inch or an inch. The base of the patch is somewhat elevated; more or less papulated, from prominence of unhealthy follicles; coated with a furfuraceous desquamation; roughened by the stumps of hair broken at different lengths; and sometimes covered with a matted stratum of withered and discoloured hair. There is rarely any redness or inflammation of the patches, their prominence being due to distension of the follicles with dry epithelial exuviæ, and accumulation of furfuraceous desquamation. Occasionally, however, the patch is bordered by an inflammatory ring, and the latter is sometimes surmounted with minute pustules. On the scalp it destroys the hair, which loses colour and texture, appears like tow, and breaks off close to the follicle. In chronic cases a peculiar scurfiness—'diffuse ringworm'—is the result. On the body it forms red, slightly raised rings, which may present a concentric arrangement.

ANATOMICAL CHARACTERS.—A microscopic examination of the epithelium of the follicles and of the hair, detects in the substance of both a phytiform structure, which is identical in appearance with that of mucedinous fungi, consisting of mycelium and sporules, and growing and proliferating like a vegetable fungus (*see* EPIPHYTA); and this parasitic fungus has received the name of *trichophyton.* Hence, ringworm is regarded as a parasitic disease, and its contagion is supposed to reside in the sporules of the epiphyte, which, it is presumed, are communicated from one child to another by the agency of combs, brushes and the atmosphere itself.

The permeation of the shaft of the hairs by the trichophyton renders them brittle; they break off close to the aperture of the follicle; and when this occurs over the whole surface of the patch, the ragged stumps suggest the idea of having been eaten off by the grub of a tinea or moth. Hence the terms *tinea* and *ringworm* applied to the disease; the grub being presumed to devour the hairs from the centre towards the circumference, and so to give rise to the ring or circular figure of the patch. Looking to the scurfiness of the patches, Willan adopted the term *porrigo* for its designation; for example, *porrigo tonsurans* and *porrigo scutulata*; the latter from the shield-like figure of the patches. Its growth by the circumference, creeping as it were into the surrounding skin, suggested the term *herpes tonsurans*; and the discovery by Gruby of a fungus-structure commends the term *phytosis* as a generic title. A variety of ringworm is known as *kerion*. *See* KERION.

Pathologically, tinea is a chronic folliculitis with some degree of infiltration of the skin; it is propagated from a centre to neighbouring follicles, and constitutes a thickened disk with thickened margin. On the scalp, where the follicles are large, the former prevails and the disease becomes chronic; whereas on the non-hairy skin, where the follicles are small, the inflammation subsides within the area, and travels onwards by the circumference. The folliculitis of ringworm rarely exceeds in pathological manifestation the production of a papule with congested and infiltrated base; but in certain constitutions it may give rise to a vesicle, and even to a pustule; the latter more particularly where the strumous diathesis prevails. The more pathognomonic characters of tinea are evinced by an excessive accumulation of laminæ of epithelium within the follicles, and by a disorganised condition of the hair; the epithelium as well as the hair being penetrated and filled with the mycelium and sporules of the trichophyte. In the shaft of the hair the trichophyte is seen in the form of stems branching from point to point, or rows of globular sporules; whilst the envelope of the hair is oftentimes composed exclusively of sporules.

DIAGNOSIS.—The diagnosis of ringworm in its fully developed state is by no means difficult. The circular and oval disks, and stumps of broken hair, are pathognomonic of tinea of the scalp; whilst the circular, red, and elevated rings of tinea annulata on the non-hairy skin are equally so. Only two affections approach it in appearance, namely, dry eczema and area; but in eczema capitis, which is often furfuraceous, there are no stumps of broken hairs, the hairs being unaffected, and the disease is more chronic, or there may be a previous history of eczema, or evidence of its presence on other regions of the body. Alopecia areata or porrigo decalvans exhibits a total loss of hair on a smooth spot, with no other morbid affection of the skin than simple atrophy. *See also* KERION.

PROGNOSIS.—The prognosis of ringworm is twofold:—Is it contagious? Will it last long? To which we must answer that it is contagious wherever that state of health exists which is favourable to its development; and, secondly, that its duration will be governed by the age, as well as by the powers of constitution of the patient. It is very rarely met with in infancy and never in the adult; and, left to itself, it has a natural tendency towards cure. Nevertheless, it is sometimes prolonged for several years, and may interfere very seriously with the education of children afflicted with it; while, in general, it is kept up by defective hygienic conditions and unsuitable diet.

TREATMENT.—The treatment of ringworm must be *constitutional* as well as *local*: constitutional to improve assimilation and nutrition; and local to stimulate a feeble tissue to a more vigorous and healthy function. The constitutional remedies must consist of generous diet, fresh air, and exercise; ordinary tonics, and especially arsenic in nutritive doses—for example, two or three minims of liquor arsenicalis, or their equivalent of other arsenical preparations, with the meals, three times a day. The best local treatment is moderate friction with the iodide of sulphur ointment, diluted with two-thirds of benzoated lard, night and morning; daily brushing with the hair-brush; and no washing. Where the iodide of sulphur ointment proves irritating, the nitric oxide of mercury ointment, diluted in similar proportion, may be substituted. Tinea annulata of the body should be pencilled with the liniment of iodine daily, until the rings are arrested; and the same liniment may be applied to suspicious spots on the scalp, or as an additional stimulus to the scuta themselves.

The parasitic theory of the disease has led to the use of sulphurous acid and perchloride of mercury under the name of 'parasiticides'; but these remedies have no special advantage over those already named; and the corrosive sublimate is dangerous unless employed with great care.

In the French school, avulsion of the hairs, called 'epilation,' is the practice commonly adopted—the process of tearing out the hair being followed by the use of a weak solution of corrosive sublimate. This practice brings to mind that terrible French remedy the pitch-cap, and is utterly unnecessary for cure. *See* Epiphytic Skin-Diseases; and Tinea.

Erasmus Wilson.

RIPPOLDSAU, in the Black Forest, Germany.—Mixed iron waters. *See* Mineral Waters.

RISUS SARDONICUS or SARDONIUS (*risus*, a laugh; and *sardonius*, connected with, or caused by, the herb *sardonia* or *sardoa*, that is, belonging to Sardinia).—A peculiar expression of the face, in which the features are distorted by spasm of the muscles, so as to present the appearance of a painful grin or laugh. It is usually observed in tetanus. *See* Tetanus.

RODENT ULCER.—Synon.: Fr. *Cancroïde*; Ger. *Epithelialkrebs*.—Rodent ulcer must be recognised as a kind of tumour; but its exact position amongst other forms of new growth is still not definitely decided. Hence, in this work a special article is devoted to its consideration. Most authors agree in classing it amongst the epitheliomas.

Clinical Characters.—*Naked-eye appearances.* A distinguishing feature of most rodent ulcers is the fact that ulceration follows *pari passu* with new growth, the result being that, as in the case of lupus, instead of the formation of a swelling or tumour, an actual diminution of the size of the part occurs. Another characteristic of the disease is, that while it often makes its appearance at a period of life which might be considered early for an epithelioma, it runs a course of extreme chronicity, and rarely, if ever, affects the lymphatic glands. Many cases last for twenty or thirty years, interfering but little with the general health, and at times in part undergoing a process of feeble cicatrization. Rodent ulcer begins as a pimple, usually on some part of the face, and most frequently on the side of the nose or about the eye. After remaining quiescent for a long time, perhaps years, ulceration occurs, and continues to spread with great slowness, involving in its course every structure that it meets. Thus in time huge caverns are excavated in the face; the eyeball may be destroyed; the nose and upper jaw may disappear; and, not unfrequently, if the disease reach the forehead, the dura mater is exposed, and the brain is seen pulsating at the bottom of the cavity. The appearance of the ulcer is characteristic: the surface is glistening, and is covered with very imperfect granulations; it has an uneven level, and is mottled with yellow and red: the margin is very slightly raised, and somewhat indurated, has a purplish pink colour, and is often considerably undermined. The discharge is thin and purulent. Capillary hæmorrhage not unfrequently occurs, but more severe bleeding is rare. A section through the edge shows the narrow margin of new growth, in which alone the characteristic structure is to be made out. Death may occur from old age or other causes independent of the disease; from an attack of erysipelas or meningitis, or from marasmus induced by the constant worry and discharge.

Microscopical Appearances.—Many tumours which approach somewhat nearly the condition above described will be found on examination to exhibit the structure of a lobular epithelioma (*see* Cancer); but the most typical ones will usually exhibit something like the appearance represented in fig. 119, facing p. 204. Beneath the epidermis, and imbedded in a varying amount of stroma, consisting of more or less well-developed fibrous tissue, are large, roundish, and irregular masses of densely-packed epithelial cells of small size, the circumferential ones taking an oval shape, while the deeper ones are circular. There is, as a rule, no tendency to the formation of globes; but, in some cases which have run a typical course, imperfect nests have been found; the so-called *prickle-cells* are, as far as the writer has observed, never seen. The cells are smaller than those usually seen in an epithelioma, and suggest the origin of the growth from the sweat-glands, a view which is favoured by the fact that the epithelial masses occasionally assume a more or less distinctly tubular arrangement. Strenuous advocates are found in support of, and in opposition to this theory of the primary source of rodent ulcer, and the same may be said of other hypotheses, such as that it starts from the hair-follicles or the sebaceous glands; but, in default of stronger evidence than is at present forthcoming, it would be unwise to dogmatise upon the question. The reader will find some of the literature of the subject in the late Mr. Charles H. Moore's book on rodent cancer, in Dr. J. Collins Warren's monograph on rodent ulcer, and in the various communications to the *Pathological Transactions*; but in German writings he must search under the head of Epithelial Cancer, to which class rodent ulcer has always been consigned.

Prognosis.—The prognosis in a case of rodent ulcer may be implied from what has been said of its clinical features.

Treatment.—The obvious treatment is free removal by the knife in the early stages. Mr. Moore was a strong supporter of the plan of removing even very large ulcers; he was in the habit of proceeding with the knife as far as prudence would allow, and applying chloride of zinc paste to any parts it was considered unsafe to remove. This treatment in his hands and in that of others has been followed by very marked success.

R. J. Godlee.

ROISDORF, in Germany.—Mixed alkaline table waters. *See* Mineral Waters.

ROME, Central Italy.—Moderately warm, moist, fairly calm, sedative winter climate. Mean temperature, winter, 46·75° Fahr. Prevailing winds, S.E. and N. *See* Climate, Treatment of Disease by.

ROSALIA (*rosa*, a rose).—A rose-coloured rash; a term formerly applied to scarlatina and rubeola, before these rashes were clearly differentiated.

ROSEOLA (*rosa*, a rose).—Synon.: Fr. *Roséole*, Ger. *Roseola*.—This affection, the name of which is derived from its crimson tint of colour, is one of the exanthemata or rashes of the skin, and in common parlance is called 'rose-rash.' In general characters it resembles a mild form of measles, and has consequently received the name of 'false measles.'

Ætiology.—The cause of this exanthem is feverish excitement, resulting from heat and exhaustion; hence it is frequently epidemic in hot weather. Although allied in appearance with measles, it cannot be regarded as contagious. Frequently it is symptomatic.

Description.—Roseola ordinarily assumes the form of a punctated rash, more or less suffused, but it sometimes occurs in small erythematous blotches, which spread by the circumference and form rings. In the latter cases it is only distinguishable from erythema by its roseate colour.

The exanthem forms part of a slight febrile attack, attended with weariness, lassitude, nausea, and prostration; and is accompanied with more or less redness of the fauces, and sometimes with swelling and tenderness of the submaxillary glands and occasionally of the neighbouring lymphatic glands. The exanthem has a course of four or five days or a week, and then disappears, leaving the patient convalescent; and, like its congeners the exanthemata, it begins with the head, then travels downwards to the trunk of the body, and is last perceivable on the arms and legs. It is rarely of sufficient force to be followed by exfoliation of the epidermis.

Varieties. — Besides those objective terms which liken roseola to measles, it has likewise been called after the seasons when it commonly occurs, *R. æstiva* and *R. autumnalis*. Other terms, such as *R. punctata*, *corymbosa*, *maculosa*, *orbicularis*, *annulata*, and *papulata* relate to varieties of its pathological characters. An exanthem, identical in appearance with idiopathic roseola, is met with in secondary syphilis; the punctated rash which is associated with continued fever is likewise a roseola; whilst other forms, which have been observed associated with variola, vaccinia, gout, rheumatism, and cholera, may be regarded as erythemata resulting from venous hyperæmia.

Diagnosis.—The diagnosis of roseola has been sufficiently illustrated by the above description —a punctated rash, corymboid like measles, but sometimes orbicular or annulate like erythema; its special pathognomonic characteristic being its crimson or rose colour.

Prognosis.—The prognosis of roseola is favourable; the feverish disturbance subsides in a few days or a week. The prognosis of symptomatic cases necessarily varies.

Treatment.—Rest and repose together form an important element in the treatment of roseola. A mild purge may be necessary to regulate the digestive organs, and may be accompanied with effervescent salines. Locally, the skin should be anointed with some soothing and un-irritating oily substance, such as vaseline, olive oil, or benzoated lard. Erasmus Wilson.

ROSE-RASH.—A popular name for roseola. *See* Roseola.

RÖTHELN.—The German synonym for rubella; frequently employed by English practitioners. *See* Rubella.

ROUND-WORMS.—In respect of their form the various species of nematoid entozoa more or less resemble earthworms, and, consequently, are collectively called *round-worms*; but the term is by many persons restricted to the large lumbricoid parasites which infest man and several of the lower animals.

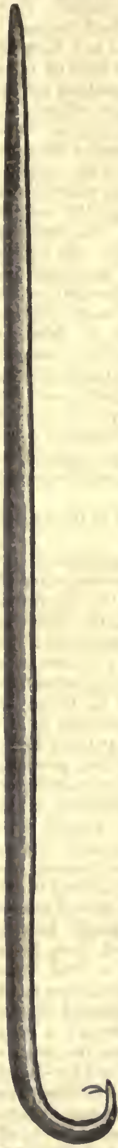

Fig. 71.—*Ascaris lumbricoides*; male, with exserted spicules. Nat. size (original).

Description.—The human round-worm (*Ascaris lumbricoides*) varies much in size, the males measuring from four to seven inches in length, and the females usually from nine to fourteen inches, though an instance has been recorded from America where a female measured seventeen inches. The general structure of the worm was long ago investigated by Cloquet, Owen, Dujardin, Busk, and others; but the most modern and important additions to our knowledge of its anatomy are due to the writings of Eberth, Bastian, Schneider, and Leuckart. In the matter of development, the writings and labours of Nelson, Thomson, Kölliker, Meissner, Richter, Davaine, and Heller are particularly noteworthy. The precise manner in which the essential act of fertilisation is accomplished in nematoids carries with it no practical issue, but experiments with the mature ova have an important bearing on questions of sanitation and infection. Verloren, Vix, and others have reared intra-chorional embryos of various nematode species in water; and the writer himself has watched the development of the eggs of *Ascaris lumbricoides*, in fresh water, through all the stages of yelk-segmentation up to the stage of an imperfectly organised, coiled embryo, subsequently keeping the ova alive in this condition for a period of three months. Dr. Davaine pushed the facts of development much further. He kept the ova alive for upwards of five years. He administered some of these five-year-old embryos to rats, and had the satisfaction of finding a few of the eggs in the rodents' fæces, with their contained embryos still alive, but striving to escape the shells. As a general result it may be said that the embryos escaped their shells; but only in the case of those eggs whose contents had arrived at an early embryonal stage of growth, did the gastric juice of the experimental animals act upon the shells, and thus liberate the contents of the ova.

Of yet more practical importance are the observations of Heller, respecting a *post-mortem* 'find' made in May, 1872. In the small intestines of a lunatic he discovered eighteen specimens of very young round-worms; all of them being referable to the species in question (*A. lumbricoides*). They severally measured from ⅛ to ½ an inch in length. Now, as Heller himself has pointed out, between the embryos as they appear at the time of their expulsion from the egg and the smallest round-worms hitherto seen in the human subject, we have, as regards size, an immense gap to bridge over. This 'find' of Heller's, therefore, tends to make it appear almost certain that the common round-worm completes its life-cycle without the necessity of having to pass through the body of any intermediary animal bearer. The truth of this conclusion, moreover, is borne out by numerous facts, which have come to the knowledge of the writer. In one instance brought under his notice, a local endemic of roundworm-helminthiasis was clearly traceable to drinking water from a filthy stream, into which sewage-deposits flowed. The further treatment of this subject, in reference to public health, will be found more fully discussed in the writer's second memoir 'On the Dispersion and Vitality of the Germs of Entozoa,' read before the Association of Medical Officers of Health (*Medical Times and Gazette*, 1871, p. 215).

The *Ascaris mystax* is described in the article Ascarides.

Symptoms.—The symptoms superinduced by round-worms, and the practical management of cases, more immediately concern the physician and practitioner; but in England, the disorder is, speaking relatively, not very prevalent. In some countries round-worms in the human subject are extremely frequent, this being especially the case in tropical regions, as in India, in China, in Central America, and, according to Dr. Dyce, still more notably in the Mauritius (*Medical Gazette*, 1834). Whilst, in British practice, we seldom encounter more than one, or, it may be, several specimens in each patient, it is no uncommon experience abroad to encounter several scores in a single bearer. Now and then from one to several hundred specimens have been removed from a single host, but such instances are comparatively rare in England. Marshy and low-lying grounds, in the neighbourhood of dwellings, are eminently productive of round-worms, hence their comparative abundance in some parts of Holland, and in the lake-districts of Sweden. Dr. Brandt, of Oporto, informs the writer that lumbricoids are very common in Portugal, affecting something like 75 per cent. of the children, who frequently pass large numbers by the mouth as well as by the anus.

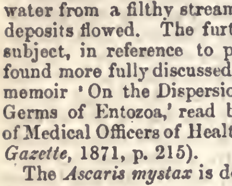

Fig. 72. *Ascaris mystax*; male (*a*), and female (*b*). Natural size. After Leuckart.

Many remarkable phenomena result from the presence of these large worms in the human subject. Ordinarily, the symptoms bear a close resemblance to those arising from thread-worms, but the results are commonly of a graver character. As stated in the writer's published lectures (*Worms*, p. 113), they give rise to colicky and shooting pains about the abdomen, followed generally by more or less dyspepsia, and accompanied with nasal itching, nausea, vomiting, and even diarrhœa. Sometimes, also, there is cerebral disturbance, attended with general restlessness and convulsive twitchings during sleep. In severe cases, amaurosis, catalepsy, convulsions, erotomania, and death by enteritis or by perforation of the intestine, have been known to occur. These worms have a remarkable tendency to grope about the intestinal canal, as if seeking a new abode, and thus it is that they not unfrequently make their way into various and, so to speak, unsuitable parts of the body, where they cannot thrive. Amongst other strange situations, they have not unfrequently been found in the gall-duct, in the cavity of the thorax, and especially in the parietes of the abdomen. This habit of wandering often proves fatal to them. Any foreign solid body in the intestine, with a suitable hole in it, is sure to attract their attention, and to form a sort of worm-trap. Thus these parasites have been strangled by metallic buttons, by 'hooks and eyes,' by an open-topped thimble, and by other miscellaneous foreign bodies accidentally or purposely swallowed by their human bearers.

Numerous cases, many of them fatal, have appeared in journals during the last half-century. The writer's treatises on *Entozoa* (1864) and *Parasites* (1879), as well as Davaine's *Traité* (1877), abound with references of this kind, and since these books were published other notable cases have been placed on record. Amongst fatal instances occurring in this country, the cases by Blair (*Edinburgh Medical Journal*, 1861) and Rogers (*Lancet*, 1848) deserve mention. An interesting example of perforation and consequent abdominal abscess, followed by successful treatment, was also recorded by Sheppard (*British Medical Journal*, 1861). A case very similar to this has been orally communicated to the writer by Dr. Reginald Pierson, of Leipzig, the patient, a soldier, having come under his care during the Franco-German war.

Children appear to be more liable to harbour large numbers of these worms than grown persons. Küchenmeister refers to a case where a child passed 103 worms, and to a second instance where another child was infested by upwards of 300; whilst, in Gilli's yet more striking case the child voided no less than 510 worms (*Giorn. d. Sci. Med. di Torino*, 1843). In a case communicated to the writer by Dr. Mackeith, of Sandhurst, Kent, the patient, a child of only five years, passed upwards of 300 worms, most of them having been expelled in consequence of appropriate treatment with santonine and aloetic mixtures. One of the specimens measured 15 inches in length. The sympathetic nervous symptoms are often most serious. Hysteria, catalepsy, chorea, epileptiform seizures, paralysis, loss of sight, deafness, mental defects, eclamptic fits, convulsions, maniacal excitement, and other obscurer phenomena, have been recorded as due to the presence of these worms. That these affections have in most instances been exclusively due to the presence of the parasites, is proved by the fact of the frequent and immediate disappearance of the symptoms following the expulsion of the worms. The writer is indebted to Dr. H. Cooper Rose for particulars of a case, in which a child only fifteen months old suffered from severe convulsions, the symptoms entirely disappearing after the expulsion of upwards of a score of these lumbricoids. Cases of the most violent delirium, and even of complete idiocy, have entirely recovered upon the employment of suitable vermifuges; whilst in instances where the presence of the worms has either been overlooked or disregarded, a fatal result has ensued. In the standard work by Davaine, numerous instructive references, with particulars of the cases, are fully recorded; whilst the writer's introductory work supplies many others. In this connection, also, an interesting and instructive paper by Assist.-Surg. G. D. D. Goopta appeared in the *Indian Medical Gazette*, and *London Medical Record*, 1874. From observations made at the dispensary at Tangail, he concludes that lumbricoid worms may be an exciting cause of suicide. Such deaths are more common among the Mussulmans than the Hindoos. Round-worms were found by Goopta in twelve out of eighteen bodies of suicidal hanging, that is, in about 67 per cent. The greater number of those who committed suicide were of the age at which the worm is frequent. When, by reflex action, the worms bring on irritation, the sufferers turn peevish and low-spirited, and can scarcely withstand any trifling reprimand or correction. To them these insignificant causes become so painful, that they immediately resolve to relieve themselves by suicide, the hanging-method being generally adopted.

Diagnosis.—The diagnosis of round-worm is usually a very simple matter, because the patient is sure sooner or later to pass one or more parasites, even though he or she may not have taken medicine. In cases where only one worm exists its presence is rarely suspected, and in those instances where the existence of these worms is overlooked, although many happen to be present, it often turns out that they are lodged in the stomach instead of occupying their more usual seat, namely, the small intestines. In all obscure cases of dyspepsia and the like, especially if there be colic, it is well for the practitioner to make a microscopic examination of the fæces. In cases of chronic vomiting, especially if there be hæmatemesis, the contents of the stomach should be carefully scrutinised, for in this way, as the writer himself has found, the ova of the lumbricoids may be detected, and the true nature of the case will at once become apparent. On the other hand, the practitioner should exercise the greatest caution lest he give encouragement to the notion of parasitism (so often erroneously entertained by hypochondriacal subjects), without fully going into the history and other particulars of any given case.

Treatment.—When once we are satisfied as to the presence of round-worms, their expulsion is necessary, and, fortunately, not very difficult of execution. Of the many vermifuges recommended, none are equal to santonine, which in the case of children may be administered in the form of powder, in doses of two to four grains, mixed with sugar and sprinkled on bread and butter, and followed by a saline cathartic, or a large spoonful of castor-oil. Many prefer to mix the crystalline powder with the oil itself, or to combine it with two or three grains of the resin of scammony. The plan of giving the drug over night, followed by a morning cathartic, is objectionable to some extent, since it leaves abundance of time for the santonine to exert its physiological action, which is not the purpose intended. For adults from five to ten or even fifteen grains are often employed on the Continent; but the writer has seen evil effects from the larger doses, and considers it imprudent to administer more than five grains once a day for three days in succession, combined with castor-oil. If larger doses are given the effects should be carefully watched, as this drug has been known to produce tenesmus, spasms, and even hæmorrhage. The writer has several times noticed giddiness, with more or less mental confusion, as the result of moderate dosing with santonine. In all cases it is as well to tell the patient that vision is apt to become temporarily impaired; and that the daylight, as well as all objects looked at, may appear yellow, or, in rarer cases, blue or green. The urine almost always acquires a deep yellow or red tinge, which is alone sufficient to alarm some patients. Fortunately these physiological phenomena quickly disappear. Perhaps, as regards the employment of santonine, it is as well, in the case of young persons, to follow the advice of Küchenmeister, who remarked that we 'should never administer more than eight grains in two days, divided into doses of two grains each twice a day.'

Amongst the various other remedies employed, aloes, scammony, jalap, calomel, sulphur, and turpentine hold a prominent place; but their utility as vermifuges is for the most part due rather to their drastic properties than to any specific action on the worms themselves. As a lumbricifuge, no remedy is equal to santonine, which, however, may be combined with, or followed by, any one of the above-mentioned drugs with advantage. If santonine and turpentine be employed, they should be combined with castor-oil. Dr. Pockles, of Holzminden, recommends the powdered root of male fern in conjunction with ordinary purgatives; whilst kamala and kousso are spoken of favourably by others. In doses of from one to two drachms, the kamala powder has proved effectual in the hands of Drs. Mackinnon, Ramskill, and Leared. The South African fern-powder, or 'payna,' so much employed by the Kaffirs for tape-worm, has also been recommended; but its lumbricifuge virtues are probably inferior to those of kousso and male fern, which latter drugs ought, in the writer's opinion, to be employed only in cases of tænia. According to Davaine, the so-called 'varec,' or Corsican moss, which is procured from various species of sea-weed, is much employed in France, but the results obtained are variable, probably owing to adulteration. Dr. E. J. Waring speaks favourably of several Indian remedies. Thus the *set-si* or *theet-tsee*, the black varnish of the Burmese, is said to be a most efficacious lumbricifuge, and the Burmese also employ a fungus, or worm-mushroom, called *thanmo*, which, according to Dr. Packman, has considerable anthelmintic power. The inhabitants of Java, and the Chinese living at Macao, employ a worm-fruit termed câ̂y-tlum, obtained from the plant *quisqualis indica*. There is also a small annual, *vernonia anthelmintica*, extensively distributed throughout Hindostan, the seeds of which, according to Waring, are held in the highest repute amongst the people of Southern India. Many other drugs having drastic and anthelmintic properties are employed in Eastern countries; but of all the various remedies none is so satisfactory as santonine, combined with or followed by purgatives, and continued for several days in succession. *See* Ascarides; and Lumbricus.

T. S. Cobbold.

ROYAT, in France.—Muriated alkaline waters. *See* Mineral Waters.

RUBBING SOUND.—A synonym for friction-sound. *See* Physical Examination.

RUBEFACIENTS (*ruber*, red, and *facio*, I make).—A class of counter-irritants which produce simple redness of the skin. *See* Counter-irritants.

RUBELLA (dim. of *Rubeola*).—Synon.: *Rubeola sine catarrho*; False Measles; German Measles; Epidemic Roseola; Fr. *Rougeole*; Ger. *Rötheln*.

Definition.—A specific eruptive fever, the rash appearing during the first day of the illness, beginning on the face in rose-red spots, extending next day to the body and limbs, subsiding with the fever on the third day, and not preceded by catarrh or followed by desquamation.

Ætiology.—Propagated by contagion, rubella occurs in epidemics, often of limited extent, but with sporadic offshoots. It has a long period of incubation, mostly a fortnight, the extremes being from six to twenty-one days. Hence a difficulty in tracing the source of personal infection; this is increased by the slight and transient nature of the illness allowing patients to mix freely with others. One attack is preventive of a recurrence, but is not protective against either measles or scarlet-fever, nor do attacks of either of these diseases in any way modify the liability to this one; it is as distinct from them as is chicken-pox from small-pox. During epidemics of measles or of scarlet-fever mild and irregular cases of both are not unfrequently mistaken for this exanthem; well-marked outbreaks of it are often attributed to measles, while slight attacks of scarlet-fever are miscalled rötheln, and a hybrid disease imagined which has no existence. Very young infants seem less susceptible than older children; a child at the breast has been known to escape when the mother and other children in the family have been attacked. Adults not unfrequently suffer, as many persons escape attacks in childhood; sex makes no difference. The disease is contagious, even before the rash is thrown out, and it continues to be so for some days, or it may be weeks afterwards. Second attacks are rarer than in scarlet-fever, but the rule against them may be less absolute than for measles. Rötheln is seldom fatal; when a mortality is reported as high as 3 per cent. of the attacks, measles is present.

Symptoms.—Slight fulness of head, heaviness, pain, or giddiness is felt, with aching of the back or limbs, and a little tenderness of the throat, for twelve hours or a day before the rash appears. Very often the rash is first seen with surprise, as the feeling of illness has passed or may have escaped notice. Some enlargement of the lymphatic glands in the neck is an early sign, most marked in children. There is redness of the fauces and uvula, less mottled than in measles, not so intense as in scarlet fever; the tonsils are full and smooth; there is no ulceration. Sometimes an odour, as in measles, attends the rash. The eyes are suffused, but there is little or no coryza; the lids are somewhat swollen and irritable; the face is flushed, and the cheeks are red or full before the appearance of the spots. These are bright red, raised, rounded, with clear skin between them, but they soon coalesce; not grouped as in measles, the spots are more prominent than in scarlet-fever, and there is not the finely-diffused redness of the neck and chest observed in that disease. Moreover, the rash is already fading from the face and upper part of the body while extending to the limbs, so that it is less intense on the third day. It leaves some itching, or a very fleeting yellowish tinge, but no discoloured mottling of the skin, and no desquamation. However little illness is felt at the beginning, a continuous rise of temperature commences with, or just before the rash; it may reach 102°–3°, or be only 2° Fahr. above the normal; with rest in bed this may fall one degree by the end of the second day, but is evenly maintained as the eruption proceeds, and subsides with it on the third day. During the following week it is readily disturbed, either raised by exertion or depressed by fatigue or chill. At this time recrudescence of the rash has been observed.

Slight catarrhal signs not unfrequently come on after the rash has faded, the eyelids are sticky, the nostrils stuffed, the throat sore, or some cough begins. Exposure, or want of care at this time may determine serious disturbance of health, generally with pulmonary complication.

The urine is often high-coloured in the early part of the illness, the chlorides are increased, but there is no albuminuria, nor has this ever been known to follow. In some few cases transient complaint of the throat or of fatigue has been made a week before the rash, or epistaxis has occurred; fulness of the small cervical glands is often felt, but no constant intermediate symptoms are found, and any feeling of sickness is without fever.

Diagnosis.—The sudden onset of this form of rubeola without previous sneezing or cough distinguishes it from measles, to which it is much more nearly allied, as well by general characters as by the kind of rash, than to scarlet-fever; but the spots are more evenly distributed at wider intervals, each with an areola of its own before coalescence, and not in groups with a common areola; there is no gradual rise of temperature before the rash, nor the sudden fall afterwards, both characteristic of measles. The small lymphatic glands in this ailment are palpably enlarged down the sides of the neck, and perhaps behind the ears, but not specially at the angle of the jaw, as in scarlet-fever. The rash on the second day may look like that of scarlet-fever, or the red flush of scarlet-fever at first sparsely distributed, or with prominent red papillæ, may lead to mistake; but the sudden onset is much more marked in scarlet-fever when, should the rash appear as early, yet it is more intense on the third day, especially on the neck and chest; moreover, the fever persists till the fifth day, even when not greatly elevated; there is also the state of the pulse and tongue, and the prominence of throat-symptoms. Sometimes it is not till the second or third week that the kind of desquamation, and possibly signs of renal irritation, or the occurrence of other cases, complete the diagnosis. The length of interval between successive cases is also a distinction. Roseola is not contagious; it occurs in red points or spots, not raised above the healthy skin between; there are no throat-symptoms, no enlarged lymphatic glands, or fever. Erythema affects parts of the skin only: attention restricted to the character of the eruption often leads to error.

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Pathology.—As in most infectious diseases, particles given off from the sick, chiefly by the breath, attach themselves to the mucous surface of the throat or air-passages, and either multiply themselves, or produce a morbid change in the material around them; this morbid matter entering the lymphatics is at first arrested in their glands, and thence enters the blood. For a time some of this may be deposited again at the point from which it started, or the amount be too small to produce that arrest of nerve-tone which permits the dilated vessels and increased combustion of general fever. A special effect on the vaso-motor nerves of the skin is necessary to produce the turgidity of the rash, and this not of the momentary character of a passing irritation. Local irritation of the sympathetic in the neck, starting from the mucous membrane, may determine the early appearance of the rash on the face. The skin generally has not the intense vascular injection, with the exudation that results in detached epidermis, as seen in scarlet-fever, nor do the congested vessels of the papillæ leave such dilated meshes as after measles. Whether any special microzyme is associated with rubella there is no histological research to show.

Prognosis.—Recovery is so much the rule, that were it not for the mischief any febrile disturbance may excite in weakly children, and the risk of pulmonary disease from premature exposure, all cases of rubella might be expected to do well. In severe cases the throat must be looked to, and in all cases the chest examined. We must bear in mind that infection persists for a month, and that two months may elapse before health is quite restored.

Treatment.—Rest in bed for three days, and confinement to the house for a week, is almost all that is required; the fever demands no secretion to be increased for its mitigation, nor any special means for its control. Dilute acids may be given for relaxed throat; and tonics, such as bark or iron, during convalescence.

William Squire.

RUBEOLA.—A synonym for measles. *See* Measles.

RUMINATION (*rumino*, I chew again.)—Synon.: Fr. *Rumination*; Ger. *Wiederkauen*.—Rumination, which is the normal method of digestion in a large class of animals, occurs occasionally in the human subject. In the cases recorded the return of the food usually took place about a quarter of an hour after the meal had been finished. The regurgitation seems to have been produced by the contractions of the muscular coat of the stomach, assisted by those of the diaphragm and abdominal muscles. The food is usually stated to have had no acid taste, and therefore could not have undergone any digestion. Dr. Copland recommends that the meals should be deliberately and carefully masticated. As to medicinal treatment, he had found benefit from ipecacuanha and aloes twice a day, and a tonic draught one hour before dinner.

Samuel Fenwick.

RUPIA (*ῥύπος*, dirt or filth).—Synon.: Fr. and Ger. *Rupia*.—A term applied to the crusts formed by the desiccation of purulent and ichorous discharge, over the foul sores or ulcers of syphilis and lupus.

Description.—The crusts of *syphilitic* rupia vary in thickness and extent. Sometimes they are flat and rugged, and sometimes prominent; and they are generally marked on the surface by concentric lines, which indicate the peripheral growth of the ulcers which they conceal. Their colour is grey, sometimes brown, and more or less mottled with black, from admixture of blood with the purulent secretion. When of large size and flat they suggest the idea of an oyster-shell imbedded in the skin; at other times they are conical in shape, like the shell of the limpet. This latter variety results from the desiccation of the discharges poured out by a pustule in course of centrifugal growth, and the consequent superaddition of fresh layers to the under surface of the original crust.

Rupial crusts found in *lupus* are harder, and never so large as those of syphilis. They differ also in pathological structure, being concretions of epidermal substance, instead of mere desiccated masses of morbid secretions.

Treatment.— The treatment of these two forms of affection is that of the diseases which they separately represent, namely, syphilis and struma. Syphilitic rupia is chronic syphilis in a state of ulceration, and calls for the treatment applicable to that disease. Iodide of potassium will heal the ulcerations, and then the crusts of rupia will fall off of themselves. It is better to avoid removing them artificially, as they constitute a natural covering to the ulcers whilst the latter remain in existence.

Erasmus Wilson.

RUPTURES (*rumpo*, I break).—Synon.: Fr. *Ruptures*; Ger. *Risse*.—The subject of rupture of organs generally has been thoroughly discussed in the article Perforations and Ruptures.

to which the reader is referred; and the consideration of this lesion in connection with particular organs is fully entered upon where this is required, as in the case of the heart, stomach, and other important viscera. The general meaning of the word is so evident that it needs no definition. In addition to its obvious meaning, the word is used in a popular sense as a synonym for hernia, which is spoken of as *a rupture*. *See* HERNIA.

FREDERICK T. ROBERTS.

S

SACCHORRHŒA (*σάκχαρον*, sugar, and *ῥέω*, I flow).—A term applied to the escape of sugar from the body in any of the excretions or in discharges, such as the urine, sweat, or expectoration. *See* DIABETES MELLITUS.

ST. ANTHONY'S FIRE. — A popular synonym for erysipelas. *See* ERYSIPELAS.

ST. GALMIER, in Loire, France.—A simple acidulated table-water. *See* MINERAL WATERS.

ST. MORITZ, in Upper Engadine, Switzerland.—A cool, bracing, mountain climate. Mixed chalybeate springs. Altitude, 6,000 feet. *See* CLIMATE, Treatment of Disease by; and MINERAL WATERS.

ST. SAUVEUR, in the French Pyrenees. Sulphur Waters. *See* MINERAL WATERS.

ST. VITUS'S DANCE.—A popular synonym for chorea. *See* CHOREA.

SALIVARY GLANDS, Diseases of.—SYNON.: Fr. *Maladies des glandes salivaires*; Ger. *Krankheiten der Speicheldrüsen.*

SUMMARY.—These glands, as well as their ducts, are liable to be attacked by inflammation; the latter may also become mechanically occluded. The parotid gland is the seat of the disorder known by the name of *Cynanche parotidea*, or Mumps (*see* MUMPS). *Salivary calculus* and *salivary fistula*, as well as *ranula*, are described in the article MOUTH, Diseases of. Occasionally the parotid is sympathetically invaded by inflammation during the height of, or at the termination of, other acute diseases, and this affection requires special consideration here.

Metastatic or symptomatic Parotitis.—This affection is met with during the course of, or convalescence from, several of the acute eruptive fevers, such as typhus, enteric fever, scarlatina, small-pox, or measles. It commences, according to the researches of Virchow, with congestion of the gland, followed by the usual result. Soon thereafter the duct becomes affected; and there is found in it a tough, filamentous, whitish substance, which speedily is transformed into pus. This invades the lobules of the gland; these then soften and break down, until the whole of the gland-tissue is more or less destroyed, as well as the interstitial tissue, by phlegmonous inflammation. Sometimes, however, only the gland-tissue proper is destroyed, and the gland, when examined *post mortem*, appears as if studded with numerous suppurating islands. This phlegmonous inflammation spreads from its seat of origin in various directions, most frequently to the neighbouring connective tissue enveloping the muscles found in this situation, descending even to the clavicle, not even sparing the periosteum and bones; and it has even been known to pass to the brain and its coverings.

SYMPTOMS.—If this affection develop itself during the height of an acute disease, then, by reason of the stupifying effect of the primary disease, the more manifest subjective symptoms are wanting, and the complaint is consequently said, somewhat improperly, to come on insidiously. But careful observation will reveal, by the unusual rise in temperature, the increased restlessness, and the somewhat distressed look of the patient, that some new complication is about to discover itself, and will warn the intelligent practitioner to make a close physical examination of the various organs. Probably the first indication of this metastatic parotitis will be a little swelling about the lobe of the ear, and closer investigation will show loss of the usual depression between the lower jaw and the mastoid process, and in its place a more or less hard tumour. Pressure will usually elicit an expression of pain from the apathetic patient. The inflammation may end either in resolution or in suppuration. The former termination may be looked for if the enlargement have formed slowly, and during the convalescence of the individual from the original disease. Suppuration is, in all cases, to be dreaded; and this is indicated by the irregularly reddened appearance of the swelling, and ultimately the sense of fluctuation. Occasionally the pus finds its way outwards, or discharges through the external auditory meatus, this latter being by no means an uncommon method of exit; or the pus burrows about in the cellular tissue investing the various muscles in this region.

PROGNOSIS.—This depends greatly on the severity of, and the stage of, the primary disease during which this complication declares itself. If it make its appearance at the height of the fever, and particularly if that be a grave form of fever, then the prognosis must be very guarded. Trousseau remarks that it is an affection from which he has almost never seen enteric or other fever patients recover. This is certainly not in accord with the experience of this country. If it occur during convalescence from a fever or other disease, the prognosis is then much more favourable.

Treatment.—Warm poultices must be applied from the first; supporting measures used; and the patient's powers sustained by plentiful nourishment, and the exhibition of stimulants and tonics. If there be any tendency to suppuration, the poulticing must be diligently maintained, and an opening made into the abscess the moment that fluctuation is sensibly made out. Caution must be exercised in this case, for if no pus be evacuated, the incision not only is useless, but rather increases the œdema of the tissues, besides putting the already weakened patient to unnecessary pain.

Enlargement of the Parotid Gland.—This may be either benign or malignant. In the former case it is usually the result of a previous parotitis, or it may be due to the development of some tumour in the body of the gland. Such cases are distinguished from the malignant variety by the skin always remaining freely movable over the tumour, and over the lower jaw; while in the malignant affection the lower jaw is with difficulty defined, and is not readily moved. The tumour is always limited to one side; and the malignant growth never has its starting point in this gland, similar disease being found in other organs. The simple tumour may be modified, if not altogether removed, by the external and internal use of iodine long continued; failing this, surgical operation is called for. The malignant variety is incurable. Claud Muirhead.

SALIVATION.— Synon.: Ptyalism; Fr. *Salivation*; Ger. *Speichelfluss.*—Increased flow of saliva can only be styled a disease when the amount secreted exceeds that which in health passes into the stomach. Strictly speaking, ptyalism is not a distinct disease, any more than dropsy can be so accounted, but it obtains a position as an independent disorder in the nomenclature of diseases, and must therefore be shortly noticed.

Ætiology.—The causes which give rise to salivation are numerous, as are also the diseases of which it is a symptom. Thus any irritation of the mucous membrane of the mouth and fauces at once induces an increased flow of saliva. Hence this is one of the leading symptoms of aphthæ, thrush, cancrum oris, ulcers, and excoriations of the mouth and tongue, scorbutic and syphilitic affections of the mouth, glossitis, mumps, and various affections of the fauces and pharynx. This salivation may also be a reflex effect, as when it occurs in cases of tic, facial neuralgia, pregnancy, or gastric affections. Ptyalism is also the result of the ingestion of certain drugs, mineral and vegetable, as in the case of the prolonged use of mercury and iodine. These seem to produce an alteration in the character of the saliva, as well as in the quantity. An increased or diminished flow of saliva is also induced by direct nervous agency, as when mental emotions, such as fear, suddenly render the mouth parched and dry; and the opposite effect is induced by the thought of palatable articles of food, and then the mouth is said to 'water.' In various conditions the saliva dribbles away, as in the insane, in paralytic persons, in those stupified by disease, such as typhus, and in teething children.

Symptoms.—The symptoms of salivation are evident enough. The individual complains of no pain, but of the exceeding discomfort in the constant spitting and gathering of saliva in the mouth, which interrupts speech, deglutition, and sleep. If it continue unchecked for some time the patient emaciates. When the affection is due to mercury, the first evidence of the constitutional action of the drug, which precedes the salivation, is a peculiar taste in the mouth, of a 'coppery' nature, with tenderness of the gums of the upper jaw, and fœtid odour of the breath; then there are observed salivation, large flabby tongue, and if it goes still farther, ulceration of the gums and mouth.

Treatment.—When salivation is due to some nervous cause, or if the cause be not very apparent, ten-drop doses of tincture of belladonna thrice daily are often sufficient to put an end to it in one or two days. If it be induced by mercury or other drug, the use of this must be entirely suspended. Mild astringent mouth-washes should be ordered, such as chlorate of potash, alum, or acetate of lead in solution, to be used frequently. Claud Muirhead.

SALZBRUNN, in German Silesia.—Alkaline waters. *See* Mineral Waters.

SALZKAMMERGUT, in Austria.—An inland bracing summer climate. *See* Climate, Treatment of Disease by; and Ischl.

SAND-WORM. — A term sometimes employed to designate the sand-flea or jigger. *See* Chigoe.

SANGUINE TEMPERAMENT. *See* Temperament.

SANGUINEOUS (*sanguis*, blood).—This word is used in relation to the presence of blood in discharges, effusions, or extravasations, when they consist more or less of this fluid, as in hæmoptysis, hæmorrhagic pleurisy, and cerebral hæmorrhage.

SANITARY (*sanitas*, health).—Relating to health; a term generally used in connection with laws, measures, &c., bearing on health. *See* Personal Health; and Public Health.

SAN REMO, Western Italian Riviera. A mild, sheltered, equable, moderately dry, and calm winter climate. Mean temp. winter, 48·5°. Exposed to E. winds. Soil, clay. *See* Climate, Treatment of Disease by.

SARATOGA, in New York, United States. Alkaline chalybeate waters, containing traces of iodine and bromine. The springs of Ballston, a few miles from Saratoga, are of a like character. *See* Mineral Waters.

SARCINA (*sarcina*, a pack or bundle).—A genus of microscopic fungi, belonging to the order Saccharomycetes of the lowest division of the vegetable kingdom, *Protophyta*, and of occasional occurrence in the human body, where they were first discovered by Goodsir in 1842 (*see* Parasites, Vegetable). This organism presents under the microscope a characteristic appearance, best to be compared to a corded wool-pack, hence the name. The constituent cells, of a diameter of about $\frac{1}{10000}$th of an inch, are arranged in square groups of four, sixteen, or thirty-two. For an illustration *see* Microscope in Medicine, fig. 38.

Three species of sarcina are of interest in human pathology, namely—1. *Sarcina ventriculi*; 2. *Sarcina urinæ*; and 3, *Sarcina botulina*.

1. **Sarcina ventriculi.**—This species of sarcina is of frequent occurrence in the stomach, and in the vomit of gastric dilatation from pyloric obstruction; in some cases of gastric ulcer and carcinoma without dilatation; and in rare cases of gastric catarrh. Sarcinæ are not sufficiently constant to be of much diagnostic value, and are certainly not pathognomonic of a dilated stomach, as has been supposed. Their appearance is usually associated with a state of fermentation of the gastric contents, which appear like yeast, and are of an acid reaction and smell; but it would seem that the organism is developed in the progress of the fermentation, and is not the actual cause of the condition, for when placed in suitable surroundings, living sarcinæ have not been observed to set up fermentative changes, and cases are recorded by Beale and others of their occurrence in vomit that showed no signs of fermentation.

Sarcinæ are easily detected under the microscope. A drop of liquor potassæ added to a fragment of vomit on the glass slide, and covered with thin glass, is sufficient to display their characteristic appearances.

2. **Sarcina urinæ.**—This species of sarcina is of much rarer occurrence; and it is very doubtful whether it is not always developed after the urine has been voided. It is somewhat smaller than the gastric variety, but otherwise closely resembles it.

3. **Sarcina botulina.**—The 'sausage poison' has been attributed by M. Van den Corput to the presence of a species of sarcina, to which this name has been given. *See* Poisonous Food.

Sarcinæ have also been stated to have been found in the fæces, in a case of abscess of the lung, in the ventricles of the brain, in hydrocele fluid, in gangrenous intestines, and in cholera stools.

W. H. Allchin.

SARCOCELE (σὰρξ, flesh, and κήλη, a tumour).—A name for any solid enlargement of the testes. *See* Testes, Diseases of.

SARCOMA (σὰρξ, flesh).—A tumour composed of some modification of embryonic connective tissue. *See* Tumours.

SARCOPTES SCABIEI.—A synonym for acarus scabiei. *See* Acarus.

SATURNISM (*saturnus*, lead).—A synonym for lead-poisoning. *See* Lead, Poisoning by.

SATYRIASIS (σάτυρος, a satyr).—A morbid desire for, and indulgence in, sexual intercourse in the male.

SCAB.—A rough incrustation formed by the drying-up of the discharge from a wound or an ulcer, or of the contents of a pustule. The word is also vulgarly used as a synonym for scabies.

SCABIES (*scabies*, scab, mange).—Synon.: Itch; Fr. *Gale*; Ger. *Krätze*.

Definition.—A simple inflammation of the skin, produced by the irritation of the *acarus scabiei* and the scratching of the sufferer.

Ætiology.—The cause of scabies is the presence of the acarus scabiei. Scabies is contagious, inasmuch as the parasite is easily transferred from one person to another. *See* Acarus.

Description.—The parts of the body most likely to be attacked are the soft skin between the fingers, and on the flexor side of the wrists and elbows; the lower part of the abdomen, buttocks, and penis; and in children the feet and legs. The acarus generally attacks both sides of the body symmetrically, and in adults is never met with in the skin of the face or scalp; but any other part of the body may be affected.

The eruption produced by the acari and by scratching is a scattered artificial eczema; and the extent and severity of the disease will depend chiefly on its duration. The most characteristic feature for the purposes of diagnosis is the scabies' burrow, which resembles roughly an old pin-scratch. Examined closely, it has a dotted and beaded appearance with ragged dirty edges at its entrance, where the roof of the cuniculus has been worn away by rubbing. At the distant end of the burrow may be sometimes seen the parent acarus, which is easily extracted by inserting the point of a pin along the burrow and touching the animal, which immediately adheres to the pin, and may thus be removed for the purpose of examination.

Diagnosis.—The following points serve to distinguish scabies:—(1) the particular parts attacked; (2) the eruption, which consists of scattered and isolated papules, vesicles, and pustules, with their tops more or less torn by scratching; (3) the history of the case, and especially of contagion; (4) the presence of the scabies' burrow; and (5) the demonstration of the acarus by means of the microscope.

Treatment.—The usual plan of treating scabies is by the use of either (1) sulphur ointment; or (2) sulphur baths or lotions. The former is the more effectual method, although the latter may be occasionally preferred. In order to cure an ordinary case of scabies, it is simply necessary that the patient, before going to bed, should thoroughly apply and gently rub in the sulphur ointment to every part of the body, excepting the skin of the face and scalp; and in order to keep the ointment in contact with the skin, he should sleep in his under clothes, such as drawers, jersey, socks, and gloves, and in the morning take a warm bath and put on clean clothes. The process should be repeated the next night; after which the ointment should be used, every night for a week or ten days, to those parts of the body only which are especially attacked by the disease.

The ointment should contain a drachm of sulphur to an ounce of benzoated lard, but for young children an ointment of about half this strength is most suitable. A common mistake is to continue the use of the strong sulphur ointment of the Pharmacopœia for several weeks, thus producing an irritable state of skin, which is mistaken for a continuation of the scabies.

If a sulphur bath be preferred, it may be made by dissolving half a pound of sulphurated potash in thirty gallons of water. It is necessary to repeat the bath several times at intervals of a few days.

If it be desired to treat scabies by a lotion, Vlemingkx's solution may be used. It is made by boiling five gallons of water with a quarter of a pound of quick lime and half a pound of sulphur until three gallons are left. This lotion is effective, but it is apt to irritate the skin, and is not so generally useful as the sulphur ointment. R. Liveing.

SCALD.—An injury to any part of the body, caused by the action of moist heat, either in the form of steam or of a hot fluid. *See* Heat, Effects of Severe or Extreme.

SCALD-HEAD (Saxon *scall*, a separation or discontinuity of surface).—A popular term, commonly used as the negation of ring-worm; all diseases of the scalp, in the belief of the people, being either ringworm or scald-head. The term finds a more suitable application to that form of folliculitis of the scalp which is denominated *kerion*. Kerion begins with circumscribed tumefaction of the scalp and profuse exudation from the hair-follicles, and terminates by elimination of the hair and baldness; the latter being generally temporary but sometimes permanent. Erasmus Wilson.

SCALY ERUPTION.—The pathology of a scaly eruption is an excessive formation of unhealthy epidermis, which, instead of presenting the normal characters of that structure, is laminated and brittle, and falls off in the shape of scales. The scales offer various degrees of size and cohesion, some being minute, silvery, and micaceous, and others large and tough. Three scaly eruptions have been described by dermatological authors; the lepra vulgaris of Willan, now called psoriasis; the psoriasis of Willan, which is a chronic eczema; and pityriasis. But besides these, inflammation of the skin of whatever denomination, is attended with desquamation of the epidermis, of which the most striking example is dermatitis exfoliativa or pityriasis rubra. Erasmus Wilson.

SCARIFICATION (*scarifico*, I make an incision).—This is an operation in which small superficial incisions are made, either through the skin or mucous membrane, to allow the escape of blood, as in wet-cupping; of serous fluid, in relieving dropsical effusions; or to liberate the teeth, as in difficult dentition.

SCARLATINA.—A synonym for scarlet fever. *See* Scarlet Fever.

SCARLET FEVER.—Synon.: Scarlatina; *Febris Scarlatina*; Fr. *Scarlatine*; Ger. *Scharlach fieber*.

Definition.—An infectious specific fever, characterised by deep redness of the throat; a finely diffused scarlet rash, most intense on the third day, beginning to fade on the fifth or sixth with some subsidence of fever, and followed by desquamation of the cuticle, in both small and large flakes; and afterwards possibly by rheumatic or renal symptoms, with a tendency to serous effusions.

Ætiology.—Some product of the sick, however conveyed to those hitherto unaffected, especially the young, always reproduces this disease, which again gives off infecting material with identical properties. No other origin for scarlet fever can now be admitted; its extension to any new locality is traceable to an imported infection. The periodical recurrence of epidemics in large communities is mainly attributable to an increase in the number of the susceptible. Wherever scarlatina spreads, children are the chief victims. Even among people not protected by a previous attack, a less liability is noticed with advancing years.

In adults, unless specially predisposed, the attack is less severe than during adolescence and childhood; young infants often escape or have the disease in a mitigated form. In England, where scarlet fever prevails more than in any other country, except perhaps the United States, and causes the highest mortality of any epidemic disease, two-thirds of all the deaths from it occur in the first five years of childhood. Five per cent. of the whole mortality falls in the first year, fifteen in the second, twenty per cent. in each of the two next years, thence progressively decreasing, that for all ages over fifteen being less than five per cent., and more than half of those deaths being in the next decade. The following decade shows a slightly increased incidence on women, partly because they are more with the sick, and partly from a greater susceptibility after childbirth. Sex has no directly predisposing influence. The proportional mortality from this cause is about eight to ten thousand of population in England and Wales, the range being from 0·5 to 1·5 per 1,000; in Liverpool this has reached to 3·7, and in London to two per thousand. From two to five per cent. of all the yearly deaths are from this disease; in London this proportion varied from eight per cent. in 1870, to one per cent. two years afterwards. Epidemics of scarlet fever are not evenly distributed—they subside in one place, while they extend in another; in epidemic years (as 1863 and 1870) the increase becomes very general.

The fatality of 3,984 cases treated in special hospitals in London in three years, 1877 to 1879, was 440. The death-rate ranges from 6 to 16 per cent. Taken generally, the proportion of deaths to attacks must be near ten per cent.; nor is this rate of fatality less in non-epidemic years, or in seasons when the disease is less prevalent. It varies greatly in different epidemics, and in different communities, only in limited puerperal epidemics ever reaching the high proportion measles sometimes does. Sometimes it passes as lightly as measles often does, but it is very often much higher. Consequently, since many more children have measles and fewer die, while many families escape scarlet fever altogether and the deaths from it are double those from measles, the proportional fatality of scarlet fever is much greater than in measles. In both diseases many of the milder cases escape notice, and so the rate given may be too high.

The influence of season on scarlet fever is marked with us by an autumnal increase of the disease; the number of deaths from it in London is always at its highest at the end of October. Cold has very little effect on the intensity of the disease; in many indirect ways it may check its spread. Heat favours its diffusion, but lessens the severity of the attack or of its after-consequences. Epidemics tend to recur every five or six years, as a fresh series of the susceptible arises. They often extend with us in dry seasons, and subside after wet ones. In opposition to some views of the relation of moist air and subsoil water to infection, we see rain wash the air of floating particles, and carry off others by the sewers.

A defective hygiene from imperfectly drained dwellings greatly increases the dangers of this disease. Defective ventilation will aggravate the type, or intensify the infection which a free ventilation would dissipate. The best conditions of personal hygiene are often powerless in modifying the dangers of individual liability; the healthy and well-to-do enjoy no exemption; no mildness of type in the infecting source is any safeguard against the dangers to follow, even to members of the same family. Individual susceptibility is most variable; sometimes persons in not very good health escape while with the sick, but on returning in improved health to them as convalescents, or to the house they have left, are at once seized. After surgical operations the predisposition to receive infection is increased; any shock or injury may determine a seizure after an exposure otherwise harmless. How long after quitting an infected place such injury may excite disease is uncertain. An idiosyncrasy to suffer seriously from this kind of disease marks even the robust in certain families; in others there is a liability to more than one attack. The rule against a recurrence prevails so largely as to be the great element of personal safety to anyone again exposed to infection. Any person, however safe, may be the carrier of infection; not only the hands that have touched the sick and things in actual contact with them, but clothes or even papers that have been in the sick-room may convey it.

Infection attaches to the whole period of illness. Greatest at the height of the disease, it is given off for six weeks, it may be for nine and ten weeks after. A recrudescence or relapse is possible as late as the fourth week; this, if not a re-infection, prolongs the duration of the infectious period; so also may any serious complication delaying convalescence. During all this time infection may be received by clothes or near surfaces, and retained by them for months, unless driven off by cleansing and disinfectants. A dry heat of 212° will disinfect woollen clothing; a curtain from the bed of a child only sickening for scarlet fever, folded and put away without such care, has set up the disease after a long interval. Clothes removed to a distance and unpacked months afterwards will give off infection. Persons protected by a previous attack from again undergoing scarlet fever, when much exposed to it may have sore-throat or other signs of partial sickening, sufficient to start the disease elsewhere. Every case of sore-throat occurring in an infected house is capable of conveying scarlet fever, whether the subject of it be protected or not. Sore-throat in children is always a sufficient reason for keeping them at home. It is the slight cases of infectious sore-throat, not bad enough to prevent children from going out of doors, or even to schools and parties, that elude our efforts to arrest epidemics of this kind in their usual course. Infection begins at the very commencement of sickening, but at that time is more readily controlled. Scarlet fever having gained entrance into a healthy house need not spread; timely isolation of the first case, or separation of the susceptible, is mostly successful, for the rash is an early symptom at once attracting attention. If others have received infection the sickness will appear in less than a week, when a second separation is sure to be effective. Till the week is over those who may have escaped are not to be sent among other families.

The period of incubation is a short one: not more than from three to five days, it may be as short as three hours; it may possibly extend to seven days. The longest clear interval from a single definite exposure to sickening has been four and a half days. In most of the instances where four to five days have intervened, two or three of these days have not been without sore-throat or other signs of invasion. It is such cases that are infectious before the seizure is definite. In separating children from an infected house anyone who has received infection is sure to show evidence of it before the week end. The only exceptions to this rule are, where some communication has been kept up with the infected house, where clothes have retained infection, or some source of it has existed in the second house. All accurate investigation of the cause of infection in scarlet fever tends to reduce the estimate of the average incubation-period to less than three days. In the longer periods adduced it is probable that infection attaches to something without, instead of immediately acting on or within the sufferer. A week or more may intervene between successive cases in any family, when precautions sufficient only to delay the spread of infection have been maintained.

Inoculation will reproduce scarlatina, all the symptoms appearing with the usual rapidity and not less than the usual severity. Some modification has resulted from inoculating a serous exudation from the skin during eruption; redness began at the point of insertion in thirty hours, this extended during three days, faded after five days, and proved protective. Attempts at implanting the disease by desquamated epidermic scales have mostly failed; as with diphtheritic exfoliations, the active contagion is not long or intimately associated with dead material. The particulate contagion, carried in the blood, can permeate everywhere, for mothers ill from it have given birth to infants affected with angina; yet the mother may suffer, and the child escape. Animals are inoculable with the blood of persons with scarlet fever. A dog has contracted fever and bad throat from being in bed with a scarlet fever patient; such illness is not necessarily identical with that originating it, nor need it be directly transmissible as a specific disease either to dogs or men, but here is a way in which animals may carry infection from one person to another.

Infection has many times been traced to milk. The facility with which this fluid will absorb and convey infection is very remarkable; for it to stand in the room with sick people is enough to cause it to be tainted; the cream is specially prone to impregnation. In some cases convalescents from scarlet fever, in others healthy persons coming from an infected house, have milked the cows, and handled or distributed the milk. In no case has any diseased state of the cows been discovered to exist.

Pathology and Anatomical Characters.—Scarlet fever results from the entrance of an infecting particle into the blood; how minute or of what nature is uncertain. Micrococci are found in the blood during this fever, even within the globules; and in the serum rapidly oscillating bodies appear as dark specks among the globules (×500); also rod-like bodies made up of three or four of the more minute ones. Such serum injected under the skin caused sudden fever in the rabbit, with similar bodies in the blood, again inoculable. Not only the blood and serum of the subject of scarlet fever, but most secretions of the body carry infection. Minute spores, similar to those in the blood, traverse membranous septa, and have been found in the renal epithelium. Most abundant in the breath, infection attaches also to the nasal or pharyngeal secretion. The first serous exudation from the skin has been used for inoculation; desquamated cuticle is less effective. Infection is generally received by the throat and lungs, seldom by a wound or abrasion of the skin, and never by the unabraded skin; at first it multiplies at the point of reception, hence probably the day or two of sore-throat; and is delayed but little in the lymphatics before entering the blood. Infection is most rapid when carried direct to the lungs, as when inhaled through a tracheotomy tube, no particles being detained on the pharynx. Many of the first effects of the disease, such as the quick pulse and nerve-disturbance, are directly attributable to the high temperature. The state of the skin adds to the fever; secretion is checked; there is a general hyperæmia, not specially of the papillæ as in measles, with serous exudation in its upper layers. A bad throat gives rise to irritating and injurious secretions, keeps up the fever, and interferes with the supply of necessary diluents. The products of increased tissue-change are imperfectly eliminated by the kidneys. Further stress on the kidneys is caused, partly by the high fever, and partly by a special irritant in the blood acting upon its vascular and secreting structures. The vascular changes occur early, chiefly in the cortical part; the glomeruli are obstructed; there is a proliferation of epithelial nuclei in the Malpighian corpuscles, distending them to twice their size, and so compressing the vascular tuft; there is hyaline degeneration of their capillaries, and in the elastic intima of the afferent vessels, which has been found after two days' illness (Klein); also thickening of the small arteries in other parts, with germinating nuclei in the muscular coat. The brunt of the disease falls first on the glomeruli; thence arise stasis and hyperæmia of intertubular capillaries; then signs of parenchymatous nephritis, with cloudy swelling of epithelium-cells, increase of their nuclei, and granular change in some of the convoluted tubes may be found. Sometimes there is granular matter or blood in them, and in the cavity of Bowman's capsule. Epithelium in some cases begins to be detached from the larger ducts of the pyramids. After the first week changes due to interstitial as well as to parenchymatous nephritis commence; the connective tissue round the larger vessels is infiltrated with lymphoid cells, thence spreading to the base of the pyramids and to the cortex, some parts of which become pale and firm, and the tubules obliterated. After this process has reached a certain degree the evidence of parenchymatous change increases—crowding of the urinary tubes with lymphoid cells, granular and fatty degeneration of epithelium, with casts or cylinders of various kinds in the tubes, and abundant products of inflammation. These changes may commence round an artery plugged with fibrin; they lead to enlargement of the kidney, with obliteration of tubules and Malpighian corpuscles, the latter undergoing fibrous degeneration. Klein also describes early interstitial hepatitis. He found the same hyaline degeneration and thickening of arteries in the spleen and intestines as in enteric fever, but most marked in the spleen, with degeneration of surrounding adenoid tissue. Veins obstructed with fibrin were found in the cervical glands, with degenerative changes; in the centre of the lymphatic follicles here, and in the pharynx and tonsils, the lymph-cells were replaced by large granular cells.

Thickening of the walls of the smaller arteries, and some change in the capillaries of the pia mater, have been noticed in this as in other acute fevers, otherwise the early cerebral symptoms are not marked by anatomical change. In uræmia leucocytes are found in the perivascular spaces of the brain and cord. Later cerebral mischief, except from caries of the temporal bone, is more rare than after measles. Hemiplegia from embolism has occurred in the second week of scarlet fever. Besides the results of endo- and peri-carditis, blood-clots and fibrinous coagula are found in the heart. The blood in scarlet fever has been said to be deficient in fibrin; it is less readily formed in this, as in other specific fevers, until some secondary inflammation arises; in the after dyscrasia it more readily separates. Tubercular peritonitis has followed.

Ulcerative endocarditis, or suppurative synovitis, almost as certainly fatal, may occur. Among the secondary lesions of scarlet fever are the ulceration and suppuration of inflamed glands, with sloughing of the cellular tissue around them or in other parts. Fatal hæmorrhage has resulted from an injured artery. Good recovery has been made after sloughing in the neck has extended to the sheath of the carotid, exposing all the deep muscles, and leaving the salivary glands bare but uninjured.

Symptoms.—The invasion of scarlet fever is abrupt. The ingress of fever is seldom marked by rigors, not always by chilliness; slight pallor, languor, vertigo, drowsiness by day, restlessness, starting, or delirium at night, aching of the limbs and forehead, sore-throat, and vomiting, are constant; in children convulsions or coma may occur. Sudden illness comes on within an hour of apparent health, or after a day or two's warning sensations in the throat. The temperature begins to rise at once, the pulse becomes very rapid, and this at first is perhaps more marked than the rise in temperature; but soon suffusion of the eyes, flushing of the face, and great heat succeed, with thirst and pain in deglutition, or some stiffness of neck. The lymphatic glands at the angles of the jaw can be felt enlarged and tender; already the arch of the palate and both tonsils are red; the redness extends a little on to the palate; the tongue is furred, not red, except at the edges and tip. Very often a fine flush of redness suffuses the neck and chest soon after the sore-throat is complained of, perhaps within a few hours of the first suspicion of illness. The eruption may thus be among the earliest obvious signs of the disease; it generally appears by the second day, and is well established on the third, or it may be delayed, suppressed, or recede, when the severity of the prodromata serve as a guide. Coma, convulsions, or vomiting may persist, with considerable depression, and yet the temperature be near 105°; it may even reach 106° Fahr. at this time. More frequently the greatest disturbance of pulse and temperature is from the the third to the fifth day.

The *rash* begins in fine red points, closely spread over a large surface; the specks, brightest in the centre, fade into each other so as to leave no clear skin between; not raised above the widely diffused flush, they disappear under the pressure of the finger, and return directly it is removed. These bright dots may be closely set, forming red patches in some places, or be more scattered in others, and these may seem to be slightly raised before the skin is turgid. The red patches are well seen in the flexures of the joints; the finger-nail drawn firmly across this redness on the abdomen or thigh leaves a white streak where the vessels contract for a time; after steady pressure the skin is of a yellowish tint; or petechiæ may be seen. The sides of the neck, the face, and the chest first show the rash, which soon spreads to the trunk and limbs; or it may come out on them at once. The skin is of a burning heat, not always dry, sometimes with free perspiration; miliaria often appear where the rash is most intense; these minute exudations are not the result of perspiration, though sudamina may occur. The eruption reaches its fullest extension and intensity by the fourth day, fading on the fifth and sixth. The heat and swelling then subside, and the skin feels dry and inelastic, or a partial subcutaneous œdema of the eyelids, feet, or hands is noticeable; in other parts the cuticle is easily thrown into fine wrinkles, and is ready to desquamate; this begins from the sixth to the ninth day, when the specific morbid process is subsiding.

Sore-throat is always present; during the day or two before the seizure, and almost from the time of receiving the infection, some traces of this are observable. During the attack the redness spreads from the tonsils to the palate, uvula, pharynx, and epiglottis; it becomes more intense; and there is swelling with some œdema. The mucous membrane is either dry and shining, or coated with thick mucus clogging the fauces; the tonsils project and are smeared with sticky secretion, while sometimes there is abrasion of their surface or slight ulceration, rarely abscess. These conditions and the symptoms they produce are worst during the first three days of the illness, and subside as the rash is thrown out. After the first week, in severe cases, ulceration, not confined to the tonsils, may occur; the connective tissue around the lymphatic glands in the neck becomes brawny and may slough, or that under the lower lid suppurate; persistent coryza stuffs the nostrils with acrid discharge, or, extending along the Eustachian tube, fills the middle ear with pus, bursting the tympanum, deafness not being the only or worst result. Otorrhœa from the meatus is less serious; this is not at first purulent. The tongue is red and bare after the eruption, the white fur clearing from before backwards; the mucous surfaces are left tender, and care as to ingesta is required; there may be also much and serious trouble with deglutition; vomiting, the most constant of the ingressional nervous signs, rarely persists as a gastric symptom; sometimes there is a tendency to diarrhœa, but constipation is rare, except as an after-consequence.

The *pyrexia* of scarlet fever is characteristic; high at the first, it keeps high, or rises higher for three or four days; there is then a marked, though incomplete subsidence after the rash is thrown out, mostly on the fifth or sixth days, sometimes earlier; but the temperature rarely becomes normal till the second week, some fever lingering after the eruption is over. When the greatest tension of skin is passed, the surface temperature has been found on the fifth and sixth days at 97°, with 101° *in axillâ* and 105° *in recto*; the latter keeping at 103° for two or three days longer. A crisis is to be looked for on the fourth or fifth day; defervescence not till the eighth or ninth; and this is often further delayed by complications or relapse. There are no other constant remissions during the febrile period, but some nocturnal exacerbations occur during the first part of it, often associated with harmless delirium. The persistence of more serious delirium then and later in persons of all ages points to meningeal irritation; coma in children may depend, not only on the high temperature, but on the state of the arachnoid cavities; even hemiplegic signs have occurred independently of the embolism so often consequent on endocarditis; uræmic coma is rare; intra-cranial inflammation and abscess not unfrequently result from caries of the temporal bone after otitis.

The chief respiratory disturbances are, at first irritative cough, and symptoms resulting from œdema of the glottis; the breathing is always quickened when the pulse is rapid and the fever high. Pleurisy with effusion has occurred at all periods of scarlatina, more frequently in the later stages, with a limited pneumonia, pulmonary congestion, or broncho-pneumonia.

On the side of the circulation, besides the quick pulse, there is the liability to endocarditis during the eruptive period or later, and to pericarditis; these complications often prolong the duration of the fever, and give rise to special symptoms and dangers.

The urine is altered as in other fevers; the increase of nitrogenous waste, in proportion to the degree of fever, is eliminated most largely at the crisis. At first the quantity of urine is less; the chlorides, much diminished, reappear as the fever declines; the urea, relatively increased, is less absolutely so than it is afterwards with a freer excretion; urate of soda is deposited; uric acid, diminished on the second and third days, increases at the febrile crisis, often appearing in abundance on the fifth and sixth days, then again normal, but increasing after rheumatism or other febrile disturbance; phosphoric acid, normal during the first four days, is much diminished on the fifth, then remains below the standard till the eighth or ninth day, when there is often a deposit of earthy phosphates, with a pale, barely acid urine. Oxaluria may follow.

The *kidneys*, almost as constantly as the throat and skin, are the seat of important changes, to which the state of the urine is a trustworthy guide; this consequently must be the subject of repeated examination. At first there may be suppression of urine for more than one day; this yielding, tube-casts, blood, and albumin are found, clearing off as the secretion becomes freer. Such transient albuminuria may occur in other fevers, but here the first congestion of the glomeruli increases—it may be while the skin-affection is at its height, more frequently in its decline—and a distinctive form of nephritis is set up, generally about the ninth and tenth day, when the skin is desquamating. This has a marked febrile disturbance of its own, often leads to chronic kidney-disease, and is attended throughout with albuminuria. Later in the disease albuminuria and hæmaturia set in without rise of temperature. Both these conditions are often followed by dropsy. Albuminuria commonly begins during the desquamation-period in the second week; possibly as early as the fourth day; rarely for the first time, with fever or signs of kidney-irritation, after the twenty-first, but even as late as the thirty-first day. Three stages of this condition are noticed. The quantity of urine in the first stage is much diminished, the urea even more in proportion than the water; the specific gravity is increased; the turbidity from urates deposited is cleared by heat or the addition of hot water, showing no smoky tint from blood; if this stage be prolonged, albumin is found, with finely granular or clear casts, seldom with blood-discs or renal epithelium; but they, together with epithelial tube-casts, are freely washed out as this stage is passing away. The second stage is marked by diuresis; the pale urine of low specific gravity acquires a smoky tint from blood-discolouration; this may deepen to brown or give a brighter red deposit; albumin to a large amount may pass, with pale urine, when there is but little blood; the whole quantity of albumin may be greater, though proportionally less than in the earlier stage; it diminishes towards the close of this period, as the urine gradually clears; some blood-corpuscles, renal epithelium, and tube-casts are found in the deposit. Clear urine still in excess and slightly flocculent, marks the third stage, in which the albumin gradually, but not always entirely, disappears.

The urine may not be much lessened, at first, in mild cases, and yet afterwards become albuminous; or a well-marked first stage in a severe case is not always followed by albuminuria. This is often a specific effect of the disease, and independent of chill. There may be hæmaglobinuria in the later stages, with deep bloody colour, and no great increase of albumen.

Hæmaturia, if partly dependent on a blood-state, is one of the more obvious indications of kidney-mischief. Another is afforded by the occurrence of scarlatinal dropsy. Allowing for an error from mere surface-œdema being mistaken for it in the first week, and later for the effects of anæmia, anasarca is fairly indicative of albuminuria past or present.

Albuminuria may be absent, or only have existed for a day or two before the anasarca or ascites began. Anæmia is a very marked late feature of the disease, so that pallor and chronic dropsical cachexia often go together. Apart from renal dropsy, there is a form of scarlatinal dropsy which occurs suddenly in the second or third week, as the result of a special inflammation of serous membranes, often associated with rheumatism, or with some degree of albuminuria. Serous effusions into the pericardium or pleuræ, indicated by dyspnœa, are ascertained by their distinctive physical signs. They are part of a general tendency to inflammation of the serous membranes. Pleurisy is more commonly associated with albuminuria; it may tend either to hydrothorax or to empyema. Pericarditis is more commonly associated with rheumatism.

Rheumatism is frequently induced by scarlet-fever; before the end of the first week, just after the rash is fullest, pains begin in several joints—wrists, ankles, or knees; the fever, instead of subsiding, rises; and the pulse again becomes quick, full, and hard. At this time pericardial friction is to be looked for, or an endocardial murmur may be heard either at base or apex; an apex murmur is sometimes heard when there is neither rheumatism nor albuminuria, and may not necessarily mean endocarditis. Pains in the limbs, or arthritic symptoms, may come on as late as the third week, with renewed fever of the rheumatic type, sometimes with profuse perspirations; the articular swellings mostly subside, but there is also, unlike what is seen in rheumatism, the possibility of suppuration.

Sloughing of the cellular tissue around inflamed glands, or of the skin over them, is a more frequent and less fatal evidence of the same tendency. Sometimes diphtheritic necrosis of mucous membrane, or of blistered and ulcerated surfaces, after scarlet fever, evinces a specific dyscrasia.

Desquamation begins earliest where the rash has been most intense; it may be seen as early as the fourth day, more frequently on the sixth and seventh; rarely it is delayed beyond the tenth day; it may be to three weeks; and it is seldom completely over in less than six weeks. The desquamation-period, really the whole time of cure, is also spoken of as occupying the second week, and as marked by a subsidence of fever even to below the normal. There is generally a remission of fever at this time, but without any great depression of temperature; the pulse also is weak, and may be irregular; considerable depression and a sense of debility about the tenth day are frequently to be noticed. All this, if coincident, can hardly be consequent upon desquamation. As soon as the vessels of the skin are less tense, the wrinkled epidermis becomes scurfy and separates. This is first seen on the chin and sides of the neck, the less delicate cuticle being raised and removed on small patches, which increase as the edges are detached, leaving a large new surface of skin; the thick epidermis of fingers and feet peels off in larger flakes, or in casts. A shreddy look of hands or toes may betray a mild attack of scarlet fever, overlooked from three to six or eight weeks before.

New cuticle is rapidly formed during convalescence, and is more than once cast off and renewed. Sometimes there is a pause in this process, and desquamation is thought to be over, when, with change of air or improved nutrition, a further peeling of what seems healthy cuticle occurs, not without risk of a further dissemination of infection, up to the ninth week of convalescence. Any form of desquamation beginning later than this can seldom or never be the bearer of infecting particles; even the flakes of a second desquamation carry infection so loosely as to be readily deprived of it by the ordinary means of washing and exposure. In fact, desquamation, though a very good sign that infection still attaches to its subject, because recovery is barely complete, is not the only, nor even the chief, means of its diffusion. It is only the fine dust first rising from the surface, just after the rash is at its height, and especially when attended with miliary exudation, that is charged with the intensest essence of infection.

But infection is given off before this is formed, as well as after it is cast off. The secondary lesions of the throat, nose, and lips are infectious; abscesses, formed more than three weeks after the disease began, yield an infecting pus contaminating specifically the lancet used for their evacuation; nor can any definite time less than six weeks be fixed when the specific morbid process may be supposed to have ceased. A kind of recrudescence, but without the reappearance of the rash, would seem possible up to the eighth week; and, as in menstruation, the casting off in the tenth week of débris of tissue formed perhaps a fortnight before, may not be without the elements of infection. Children are very liable to weak throat or a return of coryza for some months after convalescence from scarlet fever; also to ecthyma, eczema, or psoriasis long after all possibility of infection has ceased.

VARIETIES.—1. *Scarlatina mitior*, called also *Scarlatina simplex* or *benigna*. The rash appears only on parts of the skin, and soon fades; the throat, hardly sore, is of a pinky red, with tonsils just rounded, the back of the pharynx, perhaps, streaked with mucus from the small glands; the fever is so slight that it is said to be absent; the early fine desquamation escapes notice; and it may be three, four, or five weeks before peeling on the hands and feet proves the true nature of the illness. In some mild cases the rash is well-marked, but there is no high fever; the temperature, not exceeding 102°, falls on the third or fourth day. In neither of these cases is apyrexia complete till the third week; but there is no great illness, the rash is forgotten, and precautions are relaxed till some anasarca is noticed, or others are ill with more marked symptoms. Desquamation is not later after a mild attack, nor more prolonged than after a severe one, but it may be the only distinctive sign left of a marked impairment of health and of its cause.

2. *Scarlatina gravior.*—This includes all the more serious cases, some called *Scarlatina anginosa*, when endangered by the severity of the throat-symptoms; others *Scarlatina maligna*, when marked from the first by high fever or its consequences. This latter form is known also as the *adynamic* when exhaustion or collapse rapidly ensues, in some cases even before the rash has had time to appear. There are all grades of severity between these and the slighter forms of the disease. We sometimes see the mildest kind of attack in one child set up the worst form in another; or the disease may begin moderately, and bad symptoms appear on the third or fifth day, such as restlessness, depression, weak and rapid pulse, dusky rash, lividity or pallor, dysphagia, sore mouth, dry tongue, tympanites, and cold perspirations. Again, these signs of exhaustion may follow upon some complication in the second week, while the temperature is still high; or appear as late as the fourth or fifth, after great emaciation, when the fever is over. Diphtheria, either of mucous surfaces or of the skin, appears in some of these cases, not as a new infection, but as one result of the disease. So among several children with scarlet fever, one may have only a faint rash, slow to appear, soon fading, or perhaps again returning, called *Scarlatina anginosa maligna*; but the appearances in the throat and other signs are those of diphtheria; or one child with such a throat and no noticeable rash has started scarlatina among others. Some malignant cases, mostly fatal, show extreme prostration from the first, with rapid pulse and grave nervous disturbance; the temperature is always high—105° or more, even when the skin feels cool. Several of these fatal cases follow one another in a household, either from a developed intensity in the infection, from a family predisposition to suffer from it, or from some such tendency to excessive temperature-disturbance.

The infection of scarlet fever is readily received, by those who have not previously suffered from it, in the course of most diseases; and in many of them it proves a serious complication. Surgical scarlet fever differs in no respect from ordinary scarlet fever; it will spread to the susceptible who have no wound or open sore, not to those who are protected by a previous attack, though in the same ward and recently operated on. One attack of scarlet fever is so generally protective against a recurrence that the not infrequent instances of exceptions to this rule in no way invalidate the more important practical deductions from it; those who have already had it may attend on the sick or mix with convalescents. Some persons have two or three attacks, or are liable to sore-throat whenever they come in contact with it; still the rule is constant enough to be depended on for purposes of diagnosis.

DIAGNOSIS.—The sudden illness, with high temperature, quick pulse, and severe nervous symptoms, without previous cough or sneezing, but with sore-throat and tender swelling of the glands at the angle of the jaw, at once point to scarlet fever in a child who has not had it; this is made certain by the early rash.

Diphtheria may come on in the same way, with slight suffusion of face, or more insidiously, but the throat-signs are distinctive. Herpetic sore-throat has a shorter febrile stage, and no rash. The rash of rubeola is in spots, and less diffused at first; in doubtful cases, perhaps called febrile roseola, albumin is to be looked for in the first fortnight, and desquamation afterwards, before an absolute diagnosis from rubeola is formed. Erythema may result from septicæmia, and from mercury, arsenic, sulphur, iodine, bromides, chloral, salicine, quinine, copaiba, ipecacuanha, belladonna, opium, and oil of turpentine—the two last only of these followed by desquamation.

Prognosis.—Caution is needed in the prognosis of the mildest cases of scarlet fever, as these are not exempt from all the complications of the illness, or the accidents of convalescence.

High initial fever, severe angina, fever rising on the fifth day or persisting beyond the tenth, and great depression, all betoken danger. There is danger from sloughs and secondary suppuration; from cardiac inflammation and its consequences; and from kidney-disease, either at first, or from albuminuria slowly increasing for two or three months; the earlier effects of renal dropsy are of more hopeful prognosis. Family predisposition is to be considered, as well as the age of the patient; individual susceptibility more than the character of the prevailing epidemic. The temperature has reached 111° Fahr. with recovery, and 115° in a fatal case.

Treatment.—This must have regard to the care of the patient, and the safety of others. All cases must be treated in bed for two or three weeks; a hair mattress, not too thick, is better than a feather bed, and no extra covering is required. Carpets and woollen curtains should be removed from the room; this must be kept cool and well-ventilated by a partly-open window and an open fire, but without draughts that come directly on to the patient. A linen screen suspended before the door is useful; a basin of water made pink with permanganate of potash should stand ready, in which to dip the fingers, or anything used by the patient; a stronger solution is required for the immersion of body linen when removed, or for the excretions. No medicines will cut short scarlet fever; simple salines, as acetate of ammonia or chlorate of potash, which act slightly on the skin and kidneys, tend to its mitigation if plenty of liquid be given. The best relief is obtained from tepid sponging over the whole body, part at a time, twice in the twenty-four hours, or a tepid bath, and oil or cold-cream used to the skin afterwards. Where the fever is not very high nor the rash intense, a warm bath is comfortable. The hot pack is injurious, most so when the rash is imperfect and the nervous disturbance indicates excessive body-heat. In such cases cold affusion or the cautious use of the wet pack would moderate fever; but these means must be so used as to soothe and not to tire the patient. Frequent enemata of cold water supply fluid to the body and reduce temperature. It is not until after the fever is over that scrubbing with carbolic soap, and detergent baths, with carbolic inunctions, should be practised. During the fever a little Condy's fluid, or aromatic vinegar, added to the water for sponging the body, or the solution of peroxide of hydrogen, is agreeable and refreshing, neutralising some of the morbid exhalations, if not quite disinfecting them. For this latter purpose strong acetic acid (1 to 5), or carbolic acid (1 to 20 of oil), would be required. Carbolated oil (1 to 40) can be used with advantage from the first, so that the earliest skin-dust may be intercepted. Condy's fluid sprayed into the room at times sweetens the air, or chlorinated soda may be sprinkled about the room.

The throat-symptoms often claim early attention. Swallowing soon becomes easier and the external swelling less after small lumps of ice have been repeatedly held to melt at the back of the mouth; young children can have a teaspoonful of iced-water with a morsel of ice in it given frequently; older persons find relief from inhaling steam. A warm compress with cotton-wool over it should be applied round the neck. Puffy swelling over the glands is often removed by fomentation, or by warm linseed poultices constantly renewed. A warm poultice held close up to the ear relieves pain from the tonsil. Mischief within the throat is lessened by taking chlorate of potash into the mouth, or by the solution of it in spray; a sloughy throat requires chlorinated soda solution, one part to ten of water. Here also the acid chlorine mixture is useful; it is made by dropping strong hydrochloric acid on to chlorate of potash in a bottle (♏3 of the acid and gr. j of the salt to each ounce of capacity), and then adding water to dissolve the liberated chlorine. Large doses of chlorate of potash are objectionable, as tending to renal irritation. For the control of fever eliminants and depressants are to be avoided; aconite is not needed in the mild cases of fever and sore-throat; it is prejudicial in the more severe forms. The mineral acids moderately control heat-production, and may be given diluted from the first. A tendency on the fifth day to increase of an already high temperature has been checked by the substitution of acids for salines. In all cases with high temperature stronger remedies of this class are required. Of these, the two most effective and most suitable in scarlet fever are quinine and digitalis. Of the former, two or three doses, on the third or fifth day, at the rate of one grain for every two years of age, reduces fever, and so prevents the worse forms of throat and kidney mischief. If the urine be scanty, or already contain albumin, digitalis is to be preferred; it is of marked benefit where the pulse has been much accelerated in the early stages; and it is specially suited to combine with iron in the later stages of the disease, or with iron and a saline when diuretics are required. The combination of digitalis and quinine in all the graver forms of scarlet fever seems to be specially indicated. The sulpho-carbolate of soda has been used with more advantage than the newer derivative of carbolic acid, the salicylic. Salicylate of soda is not well suited for administration in scarlet fever, as the acid is secreted by the kidneys and may irritate them; when given it has caused perspiration and reduced the pulse and temperature, but the worst symptoms of bad cases were not lessened by it, while the tendency to rheumatism and to albuminuria were increased. It is effective against the rheumatism that follows scarlet-fever when there is no kidney-lesion. In most of these cases perchloride of iron in full doses is the best remedy. Acute kidney-congestion should be treated by dry-cupping to the loins, hot epithems round the body, or a warmly-packed poultice across the back; a brisk aperient is often most useful at the beginning of this as of other secondary complications. Here free secretion from the bowels is to be favoured by salines, and their diuretic action should be aided by plenty of liquid. Free action of the skin can be obtained by the hot-air bath, or by the hypodermic injection of pilocarpin. Two drops of a 5 per cent. solution of the muriate answers well; the sixth of a grain will produce perspiration in an adult; or one-twentieth of a grain may be given every hour till perspiration ensues. Children require full doses of pilocarpin, up to one-tenth of a grain twice a day in azoturia. More urea and less water has resulted after some days' use of it. Diarrhœa at the febrile crisis seldom need be checked; care as to ingesta, and warm applications or poultices, perhaps with a little opium externally, suffice for its relief. Great caution is required at all times in the use of any opiates; there are many soothing means which promote sleep without resorting to direct sedatives. Chloral is not very suitable.

The diet, at first limited to milk and liquids, may consist also of eggs and beef-tea as soon as more food can be taken, with fish or fowl, and soup with vegetables. Lemon-juice, oranges, or grapes may supplement the vegetable-supply in rheumatic or renal complications. Caution is required as to meat, and even the supply of beef-tea should be limited, while milk can be given *ad libitum*, and eggs may be largely depended on. Alcoholic stimulants are only to be used with great caution; they are apt to excite a return of fever if given early, and may embarrass the restoration of the kidney-function; still there are many bad cases where a little brandy has to be added to the egg and milk, or where wine must be allowed. Moreover, after high fever a condition like that of heat-exhaustion comes on, with shallow breathing, weak, slow, or irregular pulse, cool surface, restlessness and threatened collapse, where brandy, ammonia, bark, and even opium may be needed. During convalescence chill and fatigue must be guarded against. Careful diet is required, and some preparation of iron with meals, or bitters and bark as tonics. We must not advise change of air too soon; three weeks indoors for the disease to cease, and three weeks at home after that, for restoration of health, is the safest rule for all. Warm baths on three or four successive days, with plenty of soap to remove all roughness of skin, and fresh woollen clothing, are required before leaving the sick-room. The hair should be dressed with carbolic oil after washing, or with a mixture of acetic acid, glycerine, and spirit. Infection can be removed from clothes and bedding by stoving all that does not undergo a heat of 212° in washing. The best means of disinfecting the room, and what is not easy to remove from it, is by burning sulphur or bisulphide of carbon in it. An ounce and a half of sulphur should be burnt for every 100 cubic feet of clear space. *See* Disinfection.

No convalescent should mix with susceptible children until six weeks from the seizure, however slight the attack; if convalescence have been interrupted, or some after-effects of the disease remain, this interval has to be two or three weeks longer. Those much with the sick should wash their hands after assisting the patient, and change their outer dress on leaving the room. A solution of salicylic acid in glycerine promises to be of some use in clearing infectious particles from the throat, and so may act as a preventive against one mode of infection. No true prophylactic is known.

William Squire.

SCHINZNACH, in Switzerland.—Sulphur waters. *See* Mineral Waters.

SCHLANGENBAD, in Germany.—Simple thermal waters. *See* Mineral Waters.

SCIATICA.—Synon.: Fr. *Névralgie sciatique*; Ger. *Hüftweh.*

Definition.—Neuralgia in the district of the sciatic nerve.

Sciatica is signalised by paroxysmal pain in any or all of the following localities: the buttock; the back of the thigh; the knee; the front, back, and outside of the leg; and the whole foot except its inner border. The condition is frequently of peripheral origin, and is then dependent on inflammation of the sheath and surroundings of the nerve-trunk. Or it may arise independently, to all appearance, of any local cause in the nerve itself, and is then probably caused by some impairment of nutrition of a nerve-centre. As the diagnosis of peri-neuritis from neuralgia is as yet not certainly differentiated, the two conditions will be considered together.

Ætiology.—*Predisposing causes.*—The predisposing causes of sciatica are arterial degeneration; anæmia; the rheumatic and gouty diatheses; the toxic influence of malaria, chronic alcoholism, syphilis, and lead; inherited neurotic disposition; fatigue; and a damp and cold climate.

Exciting causes.—These include exposure of the limb to a draught of cold air for some long time, which is a common source of the affection; sitting on a cold or damp seat; over-walking; strains; concussion of the spine; the encroachment of morbid growths; blows upon or wounds of the nerve-trunk; malignant and other tumours of the pelvis; disease of the vertebræ or pelvic bones; the pressure of the gravid uterus; rheumatic or gouty inflammation of the sheath of the sciatic nerve, or of one or other of its branches; syphilitic periostitis, causing a swelling which presses upon the trunk or some branch of the sciatic nerve; and a gumma in the sheath of the nerve.

In chronic rheumatic arthritis of the hip-joint the sciatic nerve may sometimes be felt to have hard, knotty swellings upon it, apparently arising from a chronic peri-neuritis. This is associated with very obstinate sciatica.

Sciatica affects especially the middle age of life—from forty to fifty years, is rare in youth, and but seldom commences in elderly persons.

Venereal excesses have a closer connection with sciatica than with any other form of neuralgia.

The violent manipulation of a professional rubber, employed to treat a dull aching in the sciatic region, may bring about acute sciatica.

Anatomical Characters.—Nothing certain is as yet known of the seat of the lesion in cases of neuralgia proper manifested in the district of the sciatic nerves.

The few changes which have been observed *post mortem* in cases of sciatica have been in the direction of thickening of the sheath of the nerve, the result of inflammation. It has often happened, however, that in cases which during life have been supposed to be examples of neuritis, no trace of the inflammatory process has been found in the nerve or its covering.

Symptoms.—After more or less of vague discomfort in the affected limb, deadness, tingling, stiffness, or some such abnormal sensation, pain occurs in some part of the district already indicated. This is variously spoken of as shooting, darting, screwing, tingling, or burning; and the sufferer will often map out with precision the course of various branches of the nerve as the seat of his distress. Sometimes the leg is described as being numbed, and as if it were going to burst. Occasionally the feeling resembles a very faint shock of a battery. As is characteristic of neuralgia generally, the pain may be apparently spontaneous in origin, whilst in certain cases it is also liable to be aggravated by movement, but in no case is it *only* excited when muscular contraction takes place. It may either occur in paroxysms, with intervals of complete immunity varying from minutes to hours; or there may be more or less continuous suffering, with frequent and violent exacerbations. Throbbings or pulsations of the pain are often described. It is not, as a rule, accompanied by pyrexia. When the pain is at its height, a powerlessness of the muscles of the limbs is apt to be experienced, and this not simply on account of the distress of moving, but from an actual paresis, dependent doubtless upon a depressing influence communicated to the motor centres. From a like cause affecting the vaso-motor centres the limb will feel cold, not only subjectively, but to the touch of another.

Tender points may be met with in all, but more often in some few only, of the following situations:—the posterior inferior spine of the ilium; about midway between the tuber ischii and trochanter major; the fold of the buttock; head of the fibula; behind each malleolus; in the popliteal space. There is commonly some cutaneous anæsthesia in some part of the limb, and sometimes replacing this there will be found patches of skin which are hyperalgesic. The tactile sense proper is lowered at these points, whilst the sense of temperature, especially for heat, is often heightened. At the same place a weak voltaic current is felt as extremely and quite abnormally painful. Cramp of the calf muscles is common. It is often impossible for the patient to sit, owing to the tenderness of the nerve-trunk near the tuber ischii. The act of putting on a stocking, stooping, or sneezing gives rise to great pain.

There are great differences in the course and character of the affection. In some persons the disease from the first presents the characters of a chronic affection. There is never pain sufficient, for example, to prevent sleep, and it may not arrive at a degree of severity to interfere much with locomotion. But the patient is worn by a more or less constant aching in the district of the sciatic nerve, which becomes especially marked after long sitting, as on a railway journey, and most of all if the seat is somewhat hard. Fatigue of body and mental worry have great effect, in such cases, in intensifying the symptoms, which, on the other hand, may almost entirely disappear in circumstances favourable to health and mental exhilaration. Sciatica of this type is prone to attack the middle-aged, to be permanent, and to acquire additional intensity with advancing years. In contrast with such cases are those which from the first exhibit the characteristics of an acute affection. The pain is so agonizing that no posture affords relief, sleep is impossible, the general health suffers, and the patient is placed completely *hors de combat.* The disease may last for weeks or months without material intermission, the patient being confined helplessly to his bed. Or after some weeks of acute suffering, improvement may take place, to be followed only by a relapse, which is even more violent than the original attack.

Although the recumbent position is always that which is most grateful to the patient, yet it will happen that after a night passed in sleep attempts to move the affected limb cause it to be more painful than after walking, and there is a distressing stiffness about it.

In some persons the disease attacks once, in a very severe form, it may be at a comparatively early period of life, and never recurs. More often it tends to recurrence, and with such persistence that the patient will speak of 'his sciatica' as a companion which is always present, though occasionally for a term out of sight. Or it may alternate with attacks of typical neuralgia in other parts of the body; or be replaced by various functional disorders of the nervous system, accompanying an excess of uric acid in the urine.

The disease may be accompanied by considerable muscular atrophy of the limb, and a quasi-paralytic condition, which, though capable of improvement, may leave the patient more or less lame for the rest of his life. Or the wasting which has accompanied the acute symptoms of the disease may gradually cease as these subside, and during the somewhat prolonged convalescence the limb may be restored to its original size, and the lameness be no longer observed. Sciatica often follows lumbago. In some cases years may elapse between the attacks, but much more frequently it is a question of a few days or weeks.

Diagnosis.—There are three conditions of the muscular system which are apt to be confounded with sciatica:—1. Myalgia from over-exertion of the flexor muscles at the back of the thigh. Here the pain will be found at the points of insertion of the muscles, and is only felt during their action. 2. Rheumatism in the muscles from exposure to cold. Here again, the pain is not spontaneous, as in sciatic neuralgia, but is always dependent on muscular action. 3. A low inflammation of the loose bursal tissue which separates the large muscles of the thigh, brought about by the presence of some morbid material conveyed by the lymphatic vessels with which the spaces are in direct communication. Uric acid and pus are especially liable to cause this affection. Sacro-iliac disease may be distinguished by its always occurring in youth; by the pain being confined to the sacral neighbourhood; and by the limb being lengthened at an early period. From hip-joint disease, especially in the slow insidious form which it sometimes takes, sciatica is not always distinguished with facility. The paroxysmal character of the pain, presence of tender points, absence of result from forcible movement of the joint, and absence of characteristic position or shortening of the limb, will best serve for diagnosis. The lameness in sciatica may lead to the idea of paraplegia, from which the disease may be distinguished by the perfect integrity of the other limb, as well as by the paroxysmal pains, tender points, and the history showing that the powerlessness was secondary to the pain. From the darting pains in the thigh consequent on renal calculus, sciatica may be easily distinguished by careful examination.

The affection may be limited to a single branch, and when this is the terminal portion of the anterior tibial nerve supplying the big toe, there is a *primâ facie* resemblance to gout. It may be distinguished from this, however, by noting the absence of heat, swelling, redness, or pain on moving the joint; and the presence of a small spot, at which alone pressure is extremely painful.

Syphilitic periostitis, with inflammation of the sheath of the sciatic, may be distinguished from malignant disease by the effect of large doses of iodide of potassium. Sciatica may be distinguished from the lightning-like pains of locomotor ataxy by the presence of the patellar tendon-reflex. *See* also Lecture by Mr. Hutchinson, *Medical Times and Gazette*, Vol. I. 1882.

TREATMENT.—This should be constitutional, as well as local. Gout, rheumatism, syphilis, malaria, if inquiry show that either of these conditions lies at the base of the disease, will need the treatment appropriate to each. Against a gouty or rheumatic basis the diet should be spare, and mainly of a vegetable character, with milk—all stimulants being avoided. Bicarbonate of potash in effervescence, citrate of lithia, iodide of potassium, and colchicum will be the drugs most likely to afford relief. If the rheumatic character be very pronounced, it will be well to give salicylate of soda in twenty- or thirty-grain doses, dissolved in half a tumbler of water, every three or four hours. If syphilis be suspected, iodide of potassium or of sodium should be given, in doses of from ten to thirty grains three times a day or oftener.

Quinine, in doses of five grains, may be employed if there be reason to believe that there is a malarious taint.

The recumbent position is very necessary in all cases of any severity; and, should the distress be very great, it is a good plan to put the patient on a water mattress. Warmth is also necessary. Sometimes the rapidly-repeated application of hot linseed poultices will give much relief. Occasionally, if the pain and tenderness be very exquisite, and the patient's age and condition do not counter-indicate it, the application of a few leeches to the upper and back part of the thigh is useful. The hypodermic injection of morphia gives, of all remedies, the most speedy relief. It is best to employ a solution of one grain in thirty minims, and to inject at first three minims twice in the twenty-four hours, if necessary. The dose may be increased by one minim at a time if it be found desirable; but it is rarely necessary, except in cases of malignant disease, to exceed eight minims of such a solution. The dose and frequency should be diminished as relief is obtained. The bowels should be kept thoroughly relieved. Flying blisters, not larger than a five-shilling piece, one following another as it heals, not on the same but on a closely adjoining part of the skin, may usually be applied with much advantage. Even in cases dependent upon malignant disease they will often give relief for a time. Spongiopiline wrung out of boiling water, and sprinkled with the linimentum sinapis compositum, makes a good counter-irritant, and will sometimes take the place of blistering.

The continuous voltaic current is often palliative, and sometimes perhaps curative. From 20 to 40 cells may be employed, and whilst one rheophore is applied to the sacro-iliac synchondrosis, the other is put into a tub of salt water, in which the patient places his foot. The strength should be arrived at gradually, and the application continued for ten minutes at a time. Then, without removing the rheophores, the strength of the current must be gradually reduced to zero. Without this precaution a shock will be given, which is very undesirable. The electrical application should not be employed during the very acute stage, but rather in cases of moderate severity, or where the most formidable suffering has subsided. The current may be conveyed into a bath if preferred. One rheophore is allowed to fall into the bath, the other is held by the patient above the level of the water, which should be of a temperature of 95° Fahrenheit, and should contain some salt. In some cases, after acute symptoms have subsided, good has appeared to be done by enveloping the limb in a flannel bandage, over the folds of which sulphur is sprinkled. In other cases it is said that the spirit of turpentine taken internally has cured where other remedies have failed. In obstinate cases the sheath of the nerve may be punctured in a few places with a sharp needle. *See* ACUPUNCTURE.

The baths of Buxton, Wiesbaden, Wildbad, Royat, and Gastein have been found useful in treating sciatica; and artificial hot air or vapour baths may be beneficial in some instances.

The sciatic nerve has been cut down upon and stretched with advantage in several cases of confirmed sciatica. *See* NERVES, Diseases of (3).

T. BUZZARD.

SCIRRHUS (σκίῤῥος, a hard tumour).—A hard, glandular, cancerous tumour. *See* TUMOURS.

SCLEREMA NEONATORUM (σκληρὸς, hard; and *neonatorum*, of the newly-born).—SYNON.: Skin-bound disease.

Definition.—A congenital affection, or one appearing in early infancy, characterised by a stretched and tense condition of the skin.

Description.—The disease usually commences on the lower extremities, and gradually involves the entire surface. The skin becomes glossy-looking and of a yellowish or reddish colour, but it may be mottled. To the touch it is firm and rigid, like bacon-rind, and cannot be pinched up between the fingers. The surface is cold, feeling like that of a half-frozen corpse. The infant is, in fact, skin-bound; all movement becomes impossible; and the features remain fixed and staring. Death within a limited period is the ordinary termination, recovery rarely occurring spontaneously.

The disease is usually associated with affections of the respiratory and circulatory systems, and has been observed in connection apparently with congenital syphilis.

Microscopic observation has thrown but little light on the nature of sclerema neonatorum. The subcutaneous tissue has been found to contain a stiff, stearine-like deposit; but the disease seems to differ from the scleroderma of adults in the absence of increased fibrous tissue, which is peculiar to the latter affection.

Treatment.—No treatment appears to avail in this disease, but that for syphilitic taint has been suggested. Alfred Sangster.

SCLERODERMA (σκληρὸς, hard, and δέρμα, the skin).—Definition.—A disease characterised by hardness of the skin.

Ætiology.—The cause of this singular complaint must be regarded as an error of nutrition, or rather a perversion of nutrition. A tissue of low organisation, white fibrous tissue, grows in excess and without restraint; strangles and destroys the more highly organised structures—vessels, nerves, and muscles; and takes the place of the vanished structures, thereby converting a part enjoying active life into an inert, almost bloodless and nerveless cicatricial mass.

Anatomical Characters.—Scleroderma consists in the development and proliferation of white fibrous tissue, and the atrophy, to a greater or less extent, of the more highly organised tissues which enter into the composition of the part. This morbid change is most energetic wherever the white fibrous tissue is most abundant; hence its occupation of the integument and the ligamentous structures of the fingers and joints. And for a similar reason it is apt to follow the sheaths of muscles, and produce consolidation of an entire limb. The newly-formed fibrous tissue is identical with cicatricial tissue, and, like the latter, manifests a disposition to contract, which, in fact, is one of the main features of the disease.

Description.—The integument in this disease is hard, rigid, white, and contracted. On the face the features are distorted by the contraction of the skin; the eyelids are drawn apart; the mouth is pinched in size, or forced open; the neck and limbs are clasped by the morbid skin; the fingers and toes are bent and deformed; and even the bones are forced through ulcerated openings, produced by the pressure of the skin against the ends of the last phalanges or the prominences of the joints. This is an extreme picture of generalised scleroderma. More frequently the disease is partial, and is limited to certain regions of the body; and most commonly it is met with in the clavicular regions of the trunk. Here it may appear as white blotches, irregular, smooth and shining, dense, and suggesting the appearance of ivory or marble; but at first they may be hyperæmic. Occasionally minute glittering spots may be seen dispersed around, and among these larger blotches. Similar blotches may be found on the trunk and limbs, rarely numerous, and occasionally solitary; the latter are known as *morphœa*. As these blotches sometimes occur in the course of nerves, scleroderma is believed by some to be of neurotic origin.

Diagnosis.—The diagnosis of scleroderma is embodied in the preceding description; the parts affected are hard, rigid, white, smooth or wrinkled, and distorted or deformed.

Prognosis.—The prognosis of scleroderma is highly unsatisfactory. Parts of small extent have been known to recover their healthy texture and function; even when extensive, the disease has been known to improve; but, in general, it must be regarded as incurable.

Treatment.—In the treatment of scleroderma, the whole of our tonic measures, both in diet and drugs, must be brought into use—quinine, iron, phosphorus, strychnia, arsenic, cod-liver oil, and so forth. As a local stimulant, electricity has been employed, apparently with some beneficial result. But as yet the treatment of scleroderma is as essentially unsatisfactory as its cause is difficult to determine.

Erasmus Wilson.

SCLEROMA (σκληρὸς, hard).—A term signifying a hardening of the softer tissues of the body under the influence of disease. *See* Sclerema Neonatorum; Scleroderma; and Sclerosis.

SCLEROSIS (σκληρὸς, hard).—Synon.: Fr. *Sclérose*; Ger. *Sclerosis*.

Definition.—A state of induration, hardness, or toughness. The term is also applied to the process by which such a state is brought about in organs and tissues.

Induration of organs has long been recognised, and before the microscope came into ordinary use, this term, as well as its correlative, 'softening,' was very commonly employed by pathologists in their descriptions of certain morbid conditions found in different organs of the body.

Since Laennec, under the influence of a mistaken impression, first gave the name 'cirrhosis of the liver' to one of the common diseases of that organ, it has gradually become more and more common to apply this name, cirrhosis, to analogous conditions of induration in other organs; hence the word 'cirrhosis,' and the phrase 'cirrhotic process,' have come to be used as the equivalents of 'induration,' and 'process of induration,' although the Greek word from which cirrhosis is derived (κιρρὸς, yellow, or tawny), has a totally different signification. *See* Cirrhosis.

In recent times a limitation in the use of this phrase has sprung up. The real nature of indurations of organs of the central nervous system as well as the frequency of such processes, were recognised much later than the period above referred to. Yet if we make allowance for the peculiarities in the texture of the brain and spinal cord, and remember that even its connective tissue (neuroglia) has a modified constitution as compared with that of other organs, it is evident that these indurations of brain and spinal cord are due to so-called 'cirrhotic processes.' Such processes, in fact, occur in them with great frequency, and constitute the anatomical basis of several distinct diseases. Only it so happens that the old and etymologically unsuitable name has never been applied to them. It has always been common to speak of such an indurating process, as it occurs in the brain or in the spinal cord, by a word of similar import derived from the Greek language—that is, as a 'sclerosing process,' and of the pathological state itself as one of 'sclerosis.' The subject will be found fully treated of in other parts of this work. *See* INSANITY, Morbid Histology of; and SPINAL CORD, Special Diseases of.

H. CHARLTON BASTIAN.

SCLEROSIS, Cerebro-Spinal
SCLEROSIS, Spinal } *See* SPINAL CORD, Special Diseases of. *Disseminated or Multilocular Sclerosis.*

SCLEROSTOMA (*σκληρὸς*, hard, and *στόμα*, a mouth).—A genus of strongyloid parasites in which may be placed the species of human nematode sometimes called *strongylus quadridentatus* after Siebold, *dochmius duodenalis* after Leuckart, or, more commonly, *anchylostomum duodenale* after Dubini, Diesing, and other helminthologists. This helminth gives rise to a special form of tropical anæmia which is not uncommon in Brazil, where it is designated *oppilação*, or *cançaço*. As in Europe the parasite is most frequently called the *Anchylostomum*, so also the disease occasioned by its presence is often called *Anchylostomosis*. Without doubt C. von Siebold's nomenclature is the best, zoologically speaking; but it has been found more convenient to treat of the parasite and its disease in this place.

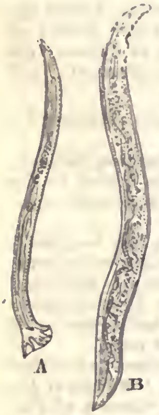

FIG. 73.—*Sclerostoma duodenale*; male (A), and female (B) × 5 diameters.

DESCRIPTION.—The male parasite measures about one-third of an inch in length, the female being very nearly half an inch. The Hunterian Museum contains specimens of this entozoon contributed by Dr. J. F. da Silva Lima, of Bahia.

SYMPTOMS AND DIAGNOSIS.—In persons affected with this disease, according to the late Dr. Wucherer, there is extreme pallor of the visible mucous membranes, with excessive weakness, dyspnœa, palpitation, and a tendency to syncope. Dropsical effusions supervene, and death sometimes follows from dysentery and diarrhœa; but the loss of blood consequent upon the suction-wounds of the sclerostomes is the real cause of the malady, whether the attacks prove fatal or not. When the symptoms just mentioned occur in any person resident in a warm country, the presence of these parasites will naturally be suspected. In such cases anthelmintics should be administered, followed by a careful inspection of the fæces, in which the worms or their ova may be found.

HISTORY.—The worm was first discovered by Dubini at Milan, and seems to be tolerably common throughout Northern Italy; but, according to Pruner, Bilharz, and Griesinger, it is still more abundant in Egypt. The 'Egyptian chlorosis,' as the disorder is also sometimes termed, has been described in the standard works of Küchenmeister and Davaine, and also, with great care, by Leuckart (*Die Mensch. Par.*, s. 455 *et seq.*), who closely follows Griesinger (*Archiv f. physiol. Heilk.*, 1854). The writer has carefully gone over the late Dr. Wucherer's admirable memoir on this subject, and only refrains from quoting his statements at greater length from want of space ('Ueber die Anchylostomumkrankheit, tropische Chlorose, oder tropische Hypoämie,' *Deutsches Archiv für Klin. Med.*, 1872, ss. 379–400). The estimable author not only supplied the writer with abundant materials for confirming what others had already made out respecting the structure of this worm (*Entozoa*, p. 361); but he supplied the specimens which formed the subject of the excellent illustrations given by Dr. Weber in the *Path. Soc. Trans.* for 1867 (vol. xviii., p. 274). Numerous prior observations made by Wucherer in the *Gazeta Medica da Bahia* are included in the memoir above quoted, and they have been referred to in the writer's recent work (*Parasites*, 1879, p. 213 *et seq.*). When Wucherer announced, through Dr. Jobini at the Rio Academy, his discovery of the Egyptian chlorosis in Brazil, his views as to the true cause of the disorder met with opposition. The general opinion was that the *Anchylostomata* were not the primary and necessary cause of this tropical anæmia, but rather a co-operating agent in its production. Against this view Dr. Wucherer afterwards very properly protested (*Gazeta*, January 15, 1868). In the meantime, says Wucherer, 'Dr. Le Roy de Mericourt, prompted by my first communication, had invited the physicians of the French colonies to seek for anchylostomes. Drs. Monester and Grenet, at Mayotta (which lies about 12° S. lat. to the north-east of Madagascar), ascertained the presence of entozoa in hypoæmics. Dr. Grenet sent the duodenum and a portion of the jejunum of an hypoæmic corpse to Le Roy de Mericourt, who compared the anchylostomes with Davaine's description, and recognised them as examples of *A. duodenale*. In the year 1868 Dr. Rion Kérangel found anchylostomes in the bodies of hypoæmics in Cayenne. Thus (adds Wucherer) the occurrence of anchylostomes in hypoæmics has been authenticated by Pruner, Bilharz, and Griesinger, in Egypt; by myself, Dr. Moura, Dr. Turinho, and other physicians, in Brazil; by Monestier and Grenet, in Comorens; and by Rion Kérangel in Cayenne. It thus also appears, from the wide separation of these several localities, that the anchylostomes, if duly sought for, will be found in many other countries.' Dr. Wucherer was correct; and what has since been unwisely called *Tunnel Trichinosis* is merely another name for the same disease, which recently caused so much havoc among the workmen in the St. Gothard tunnel. This outbreak was specially investigated by Professor Perroncito, of Turin, and by Dr. Bugnion of Geneva. The memoir by Perroncito (*Osserv. Elmint. relative alla Malattia sviluppatasi endemica* – R. Accad. dei Lincei, 1879-80), is illustrated with figures of the larval anchylostomes. Figures of the adult worm are given by Bugnion in his memoir, with a valuable bibliography (*Revue Méd. de la Suisse Romande*, May and June 1881). More recently Dr. Perroncito has communicated to the Académie des Sciences his observations on a like outbreak amongst the miners of St. Etienne.

Treatment.—Perroncito gives the following excellent advice as to treatment:—'The strength should be sustained with food easy of digestion, very nourishing, aided by the best tonics and reconstituents, whilst we proceed at the same time to destroy the worms which constitute the fundamental cause of the oligæmia. None of the patients subjected to treatment with the best anthelmintics, with a good meat diet and rich wine, need succumb, unless the anæmia has arrived at that extreme degree in which the organic powers cease to regenerate the blood; and still less, if at the same time they take preparations of iron and bitters.' He adds: 'The ethereal extract of male fern appears to me most adapted to kill the different species of parasites; only it must not be supposed that one or two doses will be sufficient to liberate the intestines from thousands and perhaps millions of helminths that live on chyle and blood.' Prof. Perroncito mentions the case of a young St. Gothard patient, with large quantities of anchylostomes, combined with not a few anguillulæ and some ascarides, who was treated with male fern so successfully that even the 'first draught' occasioned great relief. This was followed by santonine and the nourishing diet above recommended. The patient's strength rapidly increased, and he was afterwards perfectly restored to health. In many other cases under Perroncito's care the same excellent results followed. This success has been acknowledged by Dr. Bugnion in his admirable paper published in the *Brit. Med. Jour.* for March 12, 1881. Like Wucherer, Dr. Perroncito had to encounter much opposition. The tunnel disease was referred by his opponents to any cause rather than the true one. At length, says Dr. Bugnion, the parasitic character of the malady was irresistibly recognised when 'Dr. Sonderegger had treated a young engineer of the works. The patient showed all the symptoms of Egyptian chlorosis; and after having taken santonine with calomel, evacuated the anchylostomes in large numbers.' The writer has encountered similar opposition in respect of certain destructive animal epidemics, which he has found to be caused by strongyloid and other parasites. Further confirmation of the truth of Perroncito's determinations was afforded by cases under the care of Professor Bäumler, Dr. Schönbochler, and Dr. Damur respectively. Particulars of these cases are given by Dr. Bugnion, who also concludes his interesting paper by the surprising statement that 'in the report published in June 1880 by Dr. Sonderegger, who was retained by the Federal Government, of the bodies in 117 cases of death only a single examination was made.' The conduct of the authorities of Airolo in refusing the necessary *post-mortem* inspections was certainly most reprehensible.

T. S. Cobbold.

SCLEROTIC, Diseases of. *See* Eye and its Appendages, Diseases of.

SCORBUTUS.—A synonym for scurvy. *See* Scurvy.

SCRIVENER'S PALSY.—A synonym for writer's cramp. *See* Writer's Cramp.

SCROFULA (*scrofa*, a sow).—Synon.: Fr. *Scrofule*; Ger. *Scrofeln*.—If we would raise the true doctrine of scrofula we must build upon the foundations of the ancients. The Hippocratic choirades (χοιράδες), *struma vera*, or glandular scrofula, should ever be the criterion or note of what is scrofulous. Guided by this principle, we may extend the use of the word scrofula far beyond its ancient limits, without any fear lest the meaning of the term should become proportionally vague and indefinite. In the first place, struma vera will be to us the sign of a present and antecedent strumous diathesis, or special disposition to this form of disease. In the next place, upon the strumous diathesis, thus signified, will be found to depend many forms of disease other than glandular. And for this very reason, because the meaning of the word scrofula can be thus widened, it becomes highly important that the criterion, note, or principle itself should be well defined and understood.

I. Struma Vera: Scrofulous Lymphatic Glands.

Anatomical Characters.—Matthew Baillie writes thus: 'The most common morbid affection of the absorbent glands is scrofula. In this case the glands are frequently a good deal enlarged, and sometimes feel a little softer to the touch than in a healthy state. When cut into, they sometimes exhibit very much the natural appearance; but it is more common to find that some of them contain a white, soft, cheesy matter, mixed with a thick pus: this is the most decided mark of a scrofulous affection.'

But this cheesy change is a late stage of the strumous affection. Scrofulous glands, which are only potentially, but not actually, cheesy, present to the naked eye very much the natural appearance, as Baillie says. If we take a chain of lymphatic glands, all somewhat enlarged, but only some of them cheesy, we should expect to find the earlier stage of the strumous lesion in the glands which look most natural. These apparently natural lymphatic glands, therefore, are those which we choose for examination first of all.

Virchow taught that the primitive strumous lesion consisted in a simple hyperplasia of the gland-tissue. But to Schüppel (1871) belongs the merit of having proved that a scrofulous gland is indeed a tuberculous gland. In the earlier stage of the lesion, the gland is studded with microscopic tubercles, possessing characters described in the article on tubercle. And the subsequent changes, cheesy and other, which the gland undergoes, are due to changes in the tubercles. (See *Scrofula* by Mr. Treves, Lond. 1882.)

Symptoms.—In the living person strumous lymphadenitis may be distinguished from what we may call genuine lymphadenitis. The first character of the scrofulous disease consists in an excessive irritability or inflammability of the glands, constituting what Thomas White long ago called an 'inflammable diathesis.' Vulnerability is a word employed by Virchow to signify the same peculiarity, which may assume two forms: namely (i.) that the inflammation is much greater in a scrofulous person than in a healthy person, under the same conditions; and (ii.) that glands, which in a person not scrofulous, would not inflame at all under the circumstances, in a strumous person do inflame. Another character of the scrofulous disease consists in its obstinacy, intractability, pertinacity. Once enlarged, the strumous gland remains enlarged for a long time. The reason of this lies in the nature of the scrofulous inflammation and its products. A genuine lymphadenitis, in a healthy person, will resolve, suppurate, or organise in a short time. In struma vera, resolution, suppuration, and organisation take place very slowly, even when they take place at all. Commonly the inflammatory products remain, where they were produced, inert and passive, and sooner or later undergo the cheesy change. Hence the intractability of strumous lymphadenitis.

II. Antecedent Scrofulous Lesions.—Lymphatic glands do not enlarge spontaneously. There is always some antecedent lesion which sets up a change, similar to itself, in the associated glands. Of all tissues of the body, the lymphatic is the most embryonic, the least differentiated or organised. For this reason it is also the most plastic of all tissues, and endowed with most potentiality. A venereal sore causes a venereal bubo, cancer causes cancer, and so forth. Let us inquire into the characters of the lesions which precede and cause the strumous or tuberculous lymphadenitis.

In general, these primitive lesions are also inflammatory. And inflammations being commonly the result of injury, we might expect these primitive inflammations to be usually seated in those parts of the body which are most directly subject to injury. Such is the case. The skin, the mucous membranes, the subcutaneous connective tissue, the bones, and the joints are the most frequent seats of the original scrofulous disease. Occasionally the primitive lesion affects the solid secreting glands, especially the kidneys and the testicles.

The distinguishing characters of these primitive lesions are those common to all strumous inflammations, and those peculiar to the special inflammation. 1. The common characters of scrofulous inflammation have already been partly enumerated with respect to the lymphatic glands. Functionally, vulnerability and obstinacy mark the primary as well as the secondary lesions. Structurally, the chief peculiarities are found in the inflammatory product. This, when fresh, is rich in cells, which are much larger than the corpuscles of a genuine exudation, and which consist of a dim glistening protoplasma, and a large nucleus, either single or double; in short, epithelioid cells. Scrofulous exudation is either infiltrated, diffused, and assuming no particular shape; or it is tubercular. And lastly, it is rebellious, and resolves, suppurates, or organises slowly and imperfectly. The defective vascularity of strumous products will account in part for these peculiarities. 2. The special characters of scrofulous inflammations can only briefly be alluded to. In the skin, the most characteristic lesions are those which the French school have called *scrofulides*. The common dermatitis, or eczema, is modified when it occurs in a scrofulous person: eczema impetiginodes, in particular, often shows the characters of vulnerability, obstinacy, and recidivity, and of an exudation rich in cells. Impetigo of the eyelashes (tinea tarsi), and otitis externa are common strumous diseases. In the mucous membranes scrofulous inflammations possess similar characters. The secretion is sticky, rich in cells, and tending to form scabs. The mucosa, according to Rindfleisch, is infiltrated with an exudation, sometimes so copious that the corpuscles form a complete layer beneath the epithelium, and reach deeply into the submucosa. Actual tubercles may form, and intractable ulceration may follow upon the exudation, whether diffused or tubercular. Ophthalmia, coryza, ozæna, angina faucium, otitis interna, laryngitis, bronchitis, enteritis, pyelitis, cystitis, vaginal and vulvar catarrh, are common forms of strumous inflammation of mucous membranes. In the connective tissue scrofulous disease possesses the same characters, which need not be narrated again; slow cold abscesses, which will neither discharge nor disperse. Besides abscesses, local exudations, which are equally obstinate, but which go no further than a chronic œdema or induration, are often present in the subcutaneous tissue of scrofulous persons; the lips and eyelids are affected thus with especial frequency. Scrofulous arthritis, osteitis, and periostitis are described under their appropriate articles. Lastly, the lungs, kidneys, and testicles may be the seat of primitive strumous disease.

III. Tertiary Scrofula.—We have traced struma backwards from the secondary lymphadenitis to the primary lesion. We must now assert that scrofulous disease may be disseminated over the whole body, in a manner precisely similar to the dissemination of cancer in its last stage. This disseminated or tertiary scrofula is nothing else than general tuberculosis. The tubercular dyscrasia, approached from our present point of view, is tertiary scrofula. *See* Tubercle.

IV. The Scrofulous Diathesis.—Strumous lesions imply the existence of a strumous diathesis, or special disposition to strumous disease. Upon this topic we will ask three questions: How may the strumous diathesis be recognised? What is the strumous diathesis in itself? and What are its causes?

1. The strumous diathesis may be detected in two ways—directly or indirectly; it may be manifested by the patient himself or by his kindred. The latter or indirect means of discovering

scrofula depends upon a fact in ætiology, to wit, the strongly hereditary nature of this diathesis.

i. Struma manifests itself in the patient himself, in the first place, by means of the characteristic lesions which have been already enumerated; and secondly, by means of the phlegmatic temperament. Now the doctrine of temperaments, however true we may feel it to be, seems to lie beyond the power of exact definition. With regard to the phlegmatic or lymphatic temperament more particularly, we may say that its chief characters seem to consist, structurally, in a defect of blood, and an excess of serum, lymph, or phlegm; and functionally, in languor. But although scrofula is especially common in the phlegmatic temperament, the phlegmatic temperament does not necessarily imply scrofula; and, moreover, scrofula may be met with in sanguineous and melancholic temperaments. So that, as was afore said, it is not possible to lay down any definite rule upon this topic.

ii. Struma, manifesting itself in the kindred of a person, may be deemed a proof that the person akin possesses the same diathesis. In the first place, his kindred may be known to have suffered from strumous diseases. In the next place, a great mortality in the family would probably be due to the strumous diathesis, since no other diathesis can compare with it in highly hereditary character, and in the large number of dependent fatal lesions, occurring at all ages.

2. Of the intimate nature of scrofula we know very little. When we ask what that property is which serves as bond of union between the diathesis and its manifestations, and between those manifestations among themselves, we cannot say more than that scrofula is a special form of constitutional weakness, debility, or degeneracy of mankind. We do not know what determines the special form, nor what are the relations between struma and other degenerate habits, such as bronchocele, leprosy, cancer. The scrofulous debility or defective vitality manifests itself chiefly in two ways. First, in a defective power of resistance to external influences; hence the vulnerability of strumous persons. Next, in a defective power of growth and development; a defect which shows itself not only in the inflammatory process (constituting obstinacy, intractability), but also in the delayed or defective growth of some or all parts of the body. This opens up the whole topic of malformations, congenital idiocy, delayed developments; but at present experience hardly carries us any further.

3. Ætiology is another weak part of the doctrine of scrofula. In this place it is not possible, and under any circumstances it would hardly be profitable, to do more than set down a few general propositions. Whatever lessens health and strength tends to beget scrofula; and tends to beget it, not so much in the enfeebled person himself, as in his offspring. Once produced, struma is highly hereditary. The latter two propositions, taken together, express the fact that the scrofulous diathesis is commonly congenital. Among the anti-hygienic conditions in the parent, which tend to manifest themselves as scrofula in the child, must be mentioned constitutional syphilis, and the age of the parents at the time of conception, either too advanced or too youthful. Congenital scrofula does not often show itself during the first year of life. From the second year onwards, during the whole period of growth and development, strumous diseases are very common. After middle life they become less common; yet a strumous person may manifest his diathesis even in extreme old age.

Treatment.—The treatment of scrofula is preventive and curative; and relates, moreover, to the strumous disposition and the dependent structural lesions. The prevention of the disposition clearly consists in avoiding the predisposing and exciting causes thereof. Its cure is to be sought in carrying out the rules of health: fresh air and sunlight are especially needful (*see* Personal Health). Iodine, once thought to be a specific, has much sunk in repute; cod-liver oil ought perhaps to be reckoned food rather than a drug. The cure of the local lesions does not only relate to the sundry lesions themselves, but is also a means of preventing further development of the disease. Cure and prevention thus go hand in hand. The treatment of the primary local inflammations will be found in the appropriate articles. With regard to the glandular abscesses and phlegmonous scrofulides—the chief sources of general tubercular infection—it would seem to be more reasonable to favour an outward discharge of the matter, than to strive to promote its absorption. Scrofulous bones have been removed with the same intention.

S. J. Gee.

SCURF.—A popular name for the furfur or bran-like exfoliation which forms at the roots of the hair. It is also called *dandruff.* It is composed of the normal desquamation of the epidermis of the scalp, with the addition of the epithelial exuviæ thrown off by the hair-follicles. *See* Pityriasis.

SCURVY.—Synon.: Scorbutus; Fr. *Scorbut*; Ger. *Scharbock.*

Definition.—Scurvy is characterised clinically by intense general debility; sponginess and swelling of the gums; ecchymoses, closely resembling bruises, about the thighs and legs; a brawny hardness about, and sometimes a contraction of, the muscles of the calf; pearly conjunctivæ; and a sallow aspect somewhat akin to mild jaundice.

From a pathological point of view the disease is characterised by effusion of a semi-organisable fibrinous material in the tissues of the gums, between the striæ of the muscles of the thighs, legs, and sometimes (but comparatively seldom) of the arms, and also between the periosteum and the bones of the extremities, and occasionally of the ribs; ecchymoses sometimes found about the thoracic and abdominal aortæ and the alimentary canal; and a generally blanched condition of all the tissues.

Ætiology.—Scurvy is, in an eminent degree, cosmopolitan. It may prevail in a mild or severe, an intermittent or endemic form, in any latitude, in any country, or among any variety of the human race, inasmuch as the predisposing and exciting causes may exist anywhere under certain circumstances. War, famine, shipwreck, or any other accident or exigency that deprives

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human beings for a length of time of fresh vegetable food, is sufficient to introduce scurvy into a community. Although very vaguely described by Hippocrates and other early writers, there is no doubt that in semi-civilised and savage countries scurvy was endemic. Most military historians, who have chronicled the sanitary circumstances of armies from the thirteenth century to the date of the last American war, speak of its ravages, and in the early months of the Crimean War the French lost more men by scurvy than by the guns of the enemy. It has also from the earliest times been a chief foe to sailors, and until the beginning of the seventeenth century, it constituted a formidable item in the mortality list of the navy, in this as in other countries. In the spring of 1840, an outbreak of the disease occurred among the prisoners at the Millbank Penitentiary, and was confined exclusively to the military sections of the inmates, whose diet differed in one important respect from that of the other convicts. The last extensive outbreak on land, other than those that have arisen in consequence of war, occurred in Ireland during the potato famine in 1847, when the inhabitants suffered severely. Since, however, the prophylactic properties of a vegetable diet have been understood, scurvy, except in times of war, has—unless under very exceptional and always preventable conditions—ceased to assume formidable proportions either ashore or afloat. It is indeed in civilised communities very rarely found on land. It is almost extinct in the Royal Navy, owing to the introduction of lime- and lemon-juice, and also to the greater variety in the scales of diet; and during the last eight years it has diminished in the British Mercantile Marine, by from seventy to eighty per cent., in consequence of legislative enactments that secure a proper quantity and quality of antiscorbutics to the crews of all long-voyage ships. Cases of the disease are still seen occasionally at the Seamen's Hospital at Greenwich, usually associated with some other disease, as dysentery, ague, etc.; but in some instances clearly caused by carelessness, either on the part of the captain in serving, or on the part of the crew in not taking, the lime-juice provided.

Pathology and Anatomical Characters.—Although the ætiology of scurvy is so well understood, yet we are still in ignorance of the precise nature of the alterations of the blood and tissues which precede and accompany the development of the disease. The most important contributions hitherto made to our knowledge of the pathology of scurvy are those of Mr. George Busk and Dr. Garrod. The former, in a series of analyses made of the blood drawn from scorbutic patients, showed that there was a considerable diminution of the red blood-corpuscles, an increase in the amount of fibrin and albumen, and no decrease in the amount of potash salts. Dr. Garrod observed that in scorbutic diets potash existed in smaller quantities than in antiscorbutic ones, and was led to determine the amount of that substance in the blood and urine of a patient suffering from scurvy, and he found it considerably diminished. From this observation, he brought forward the theory that scurvy depended upon a deficiency of potash in the system. The fact that potash is diminished in the urine of patients suffering from scurvy, has been confirmed by Ralfe and others. But it is doubtful whether the disease is produced by a deficiency of that base in the system, since the administration of large quantities of beef-tea, containing more potash than in the ordinary anti-scorbutic dietary of the Seamen's Hospital, fails to exercise a curative effect, and it is not till the patient obtains lime-juice or potato that he recovers. Dr. Buzzard considers that, although the organic acids and potash separately do not represent the requisite material, it is to be found in the chemical combination of the acid and the base. Dr. Ralfe, from observations founded on the effect which the withdrawal, for a considerable period, of all fresh succulent vegetables and fruits has on the urine of healthy persons, and from the analyses of urines from patients suffering from the disease, states that the 'primary alterations in scurvy seem to depend on a general alteration between the various acids, inorganic as well as organic, and the bases found in the blood, by which (*a*) the neutral salts, such as the chlorides, are either increased relatively at the expense of the alkaline salts; or, (*b*) that these alkaline salts are absolutely decreased. This condition produces diminution of the normal alkalinity of the blood, and he suggests that this diminution produces the same results in scurvy patients as happens in animals when attempts are made to reduce the alkalinity of the body (either by injecting acids into the blood or feeding with acid salts), namely, dissolution of the blood-corpuscles, ecchymoses and blood-stains on mucous surfaces, and fatty degeneration of the muscles of the heart, the muscles generally, and the secreting cells of the liver and kidney.'

The most marked morbid changes of scurvy are the œdematous, spongy, and occasionally ulcerated gums; the bruised-like condition of the legs; and the brawny hardness, confined usually to the gastrocnemius and hamstring muscles. On cutting these across, tough fibrinous effusions are found packed between the muscular striæ, giving the cut surface a streaky appearance. If the anterior surface of the tibia be examined, the same kind of effusion will be often found between the periosteum and the bone. It would appear that the effusion is due, not to the degenerated condition of the vessels, but to a chemical alteration of the blood.

In severe cases the ribs will sometimes be found detached from the cartilages, and old fractures occasionally become disunited. Beyond a general anæmic condition, and occasional ecchymotic spots about the pleura and pericardium, the contents of the thorax present no special appearances. In examining the abdominal viscera, attention should be directed to the spleen, which is usually friable, and often rotten and pulpy; to the external coats of the intestines, in which patches of effusion will frequently be found; and to the mucous coat of the large intestine, which if, as is frequently the case, the disease be complicated with dysentery, will be studded with ulcers of varying depth, which have, however, entirely lost their dysenteric character, and become ragged along the edges, ill-defined, but not, as a rule, very much excavated. The body is not always badly nourished, and the cheeks are usually puffy on account of the swollen gums, but local or general dropsy is seldom present.

SYMPTOMS.—The most striking features of scurvy are a complexion of sallow, dull, leaden hue, analogous only to that of a patient who has been for a long time subject to attacks of some form of remittent or intermittent fever, or to that of a person recovering from jaundice; pearly-white conjunctivæ; puffy and sometimes bloated cheeks; gums spongy, bluish-red in colour, swollen sometimes to such an extent as to hide the teeth both in front and behind, and tending to bleed; teeth more or less loose, some already lost; tongue clean and pale; no special characteristic about trunk and upper limbs (though the latter are now and then slightly ecchymosed); shortness of breath, but no other chest-complication; no abdominal tenderness or anything abnormal as to the functions of the abdominal organs; thighs and legs usually presenting a more or less bruised appearance, particularly just above and below the knee; brawny indurations of the hams and calves of the legs, often painful and tender; and the effusions above described may be so dense and abundant as to fix the legs in a semi-flexed position. Node-like swellings are also often observed over the tibia, owing to effusions between the periosteum and the bone. There are also usually a large number of spots and patches, very much like those of purpura, scattered indifferently about the lower limbs. There is sometimes considerable œdema about the ankles; but in uncomplicated scurvy, pitting on pressure anywhere is the exception rather than the rule. The bowels are more or less constipated, appetite is good, and there is no thirst. The breath has a peculiar offensive odour, and this may be aggravated by ulceration or sloughing of the gums, or necrosis of the jaw. General debility varies in degree, but may be excessive, with weak voice, and some tendency to fainting, if the patient is put or kept in a sitting position. He feels more or less general aching, and a sensation of contusion in the legs. The skin is dry and harsh, and desquamates over the legs. Heart and lung sounds are normal. The urine is free from albumin, of normal specific gravity, with abundant chlorides; urea, phosphates, and potash are said to be deficient.

COMPLICATIONS AND SEQUELÆ.—Simple scurvy is now rarely seen inland (except in times of war or famine), and not very often afloat. It still, however, complicates diseases or accidents that occur at sea to a considerable extent, and so prolongs convalescence almost indefinitely. A sailor, for example, goes out from England to Calcutta, and shortly after arrival in the latter port is attacked with dysentery or intermittent fever, fractures a limb, or becomes syphilitic. He remains in India a very short time, ships in a convalescent and enfeebled condition, lies up before the ship has been at sea many days, and probably does little or no work during the entire passage. The berth that he occupies constantly (and with very little change of clothing) is probably wet, his food scanty and unvaried, and his lime-juice or other antiscorbutics (as he cannot go to fetch them) served out irregularly, or perhaps refused when given. Under such circumstances, scurvy soon begins to 'colour' the original disease. The intestinal canal in cases of dysentery, the spleen in cases of ague, buboes and chancres in syphilis, are all attacked, so to speak, scorbutically. Wounds, scratches, ulcers, or any other breaches of surface will not heal, and fractures sometimes become disunited; so that, as a consequence, the recovery of the patient after his arrival is deferred (solely on account of the existence of this scorbutic condition) for several weeks or months. In fact, all processes of repair, internally and externally, appear to be arrested, and no advance is made until the scorbutic symptoms have entirely disappeared. Hemeralopia is sometimes associated with scurvy, and it may be considered that night-blindness is induced by scorbutic conditions, inasmuch as this affection has decreased *pari passu* as scurvy has diminished in the British Mercantile Marine, and is now seldom complained of by sailors. In bad cases hæmorrhage may take place from mucous surfaces. Nausea and vomiting may also occur.

The sequelæ of uncomplicated scurvy are, practically speaking, *nil*, for the patient, when properly treated, makes a rapid and complete recovery, leaving no trace of the disease behind. There appears, however, to be little doubt that one illness renders the patient less able to resist successfully future attacks of the disease, if placed under the same predisposing conditions. Several instances are recorded of old sailors, who have been the subjects of two or three attacks; but these have been generally complicated with some other disorder, delirium tremens being occasionally superadded.

DIAGNOSIS.—The diagnosis of scurvy cannot be difficult if the symptoms described above exist, and a dietetic history is carefully made out. As Parker records, in a very valuable paper published on that subject in the second volume of the *British and Foreign Medico-Chirurgical Review*, 'it may be confidently asserted that an invariable antecedent of every case of scurvy is a deficiency or absolute want of fresh vegetable food.' This important item of information being established, the spongy gums, and the bruised-like condition of the lower limbs (this latter condition not being connected with any history of accident or injury), with great general debility, should be sufficient to determine the nature of the disease. For even in mild cases the condition of the gums is quite unlike that produced by mercury. Moreover, the mercurial fœtor is absent, but a fœtid, earthy odour exists. Nor has the dull blue margin seen in the gums in cases of lead-poisoning any resemblance to the scorbutic condition. Scurvy might be occasionally confounded with purpura, as in some cases hæmorrhagic spots only exist about the legs, with no ecchymoses or hardness round the calf and hamstring muscles. But the condition of the mouth, the absence of severe cachexia, and, as Niemeyer remarks, the comparative absence of epistaxis, hæmatemesis, hæmatoma, and bloody evacuations from the bowels in scurvy, will aid at once to settle the diagnosis. The disease is now, under ordinary circumstances, rare among women and children. The possibility of its existence should not, however, be overlooked. Dr. H. G. Sutton read at the Clinical Society, in 1871, notes of two cases of acute scurvy in women, but no particulars as to dietetics are given. Dr. Dickinson had under his care at the Children's Hospital, Great Ormond Street, a girl, ten years of age, who was the subject of genuine uncomplicated scurvy, whose diet had for some months consisted chiefly of bread and butter, with no meat, and little or no milk. Single cases are also occasionally noted by physicians, caused for the most part by pursuing strictly a scorbutic regimen, for the purpose of combating some other obstinate disorder.

Prognosis.—Scurvy existing apart from other maladies is not a fatal disease. The patient may be seen in a state of excessive prostration, with feeble pulse, whispering voice, and a tendency to syncope, unless the recumbent position be rigorously maintained; but a few days' rest, under favourable conditions, and proper treatment, produce a marvellous change, which results in a steady and very satisfactory convalescence. But before this prognosis is given, care should be taken to ascertain that the scurvy does not cover any other chronic or organic disease. Dysentery, syphilis, and the various forms of intermittent fever, are undoubtedly its worst complications, and either of these maladies will, even under favourable circumstances, prolong convalescence considerably. The duration of the disease is limited only by the vitality of the causes that produce it, for as long as the scorbutic diet and other predisposing conditions exist, so long will the disease maintain the mastery, and progressively increase in severity. M. Villemin, writing on the causes and nature of scurvy, in the *Gazette des Hôpitaux*, 1874, says, as the result of experiences gleaned during the siege of Paris, that scurvy is a contagious disease, and should be classed with typhus. It is impossible, in face of facts recorded both as to sea and land scurvy, to subscribe to this opinion, and it is difficult to understand on what grounds such a dictum can be based.

Treatment.—If the patient, when first brought under notice, be so ill as to be unable to walk or stand, great care should be taken that the recumbent position is adopted and maintained. Many severe cases of scurvy have been lost by the neglect of this apparently simple precaution. The patient, in the absence of the nurse, sits up in bed, and has a sudden attack of syncope, from which he never recovers. Having regard to this, let the patient be undressed carefully, and washed (without a bath), any wounds or abrasions being covered with simple water-dressing. The direct treatment of the disease is almost purely dietetic, starting upon the principle that want of fresh vegetable diet has been the exciting cause of the illness. So the diet should consist of mashed potatoes; any variety of green meat (the *Cruciferæ* being perhaps the best); oranges, pears, apples; and, as a convenient antiscorbutic, lime- or lemon-juice at the rate of from three to four ounces daily, mixed with about eight times its bulk of water, sweetened to taste, and used as a drink. Solid animal food should be given at least once a day, and in liberal quantity, as soon as it can be properly masticated. Begin in bad cases with beef tea, mutton broth, milk, eggs, fish and minced meat, in fact, any and all varieties of nutritious animal food, in conjunction with the vegetable diet; for the appetite is usually good, and the digestive powers almost unimpaired. If great prostration exist, brandy, in small and frequent doses, must of course be given; but as a general rule, very little is required. Malt liquors are undoubtedly antiscorbutic, and it is well to give a pint of ale or porter daily if no dysenteric complication exist. Milk is also to a certain extent antiscorbutic, and should be given freely. Sir James Paget relates of a surgeon that he lived for nineteen years, engaged in active practice, on milk and breadstuffs exclusively, and at the end of that time only was attacked with scurvy. As regards therapeutics, little or nothing need be done. All active treatment, general and local, is emphatically wrong. The administration of mercury to scorbutic patients (through errors of diagnosis) did, in former years, an enormous amount of mischief, and, even in the presence of chest-complications, all counter-irritants to the skin must be avoided. Chlorate of potash, in the form of a mouth-wash, or given internally, probably assists to cleanse and purify the gums and mouth; and if old ulcers or open sores exist upon any part of the body, lint, wetted with weak lime-juice, is said to promote a healthy surface. But whether any complication be internal or external, no processes of elimination or repair will advance satisfactorily until the scorbutic symptoms disappear. If no grave disorder beyond the scurvy exist, recovery is very rapid, and few diseases are so eminently satisfactory to treat. The gum-swellings recede, and the ecchymoses on the legs begin to disappear after two or three days of treatment; and the brawny tenderness of the muscles of the lower limbs diminishes daily, the fibrinous effusions causing it being steadily and quickly absorbed. Dysentery is the most common complication of scurvy, and is usually tedious and troublesome. A fair trial should be given to the treatment above recommended, excluding malt liquors, and substituting a small allowance of brandy, and as a rule the dysentery and scurvy will disappear together.

The antiscorbutic treatment proper to combat the advent of this disease is sufficiently indicated in the above remarks, for it will be plainly seen that scurvy is due to the absence of certain necessary ingredients in diet. When these ingredients cannot be given in the usual form, the most convenient substitutes are lime-juice, lemon-juice, and in a minor degree citric acid. Garrod recommends salts of potash, and John Morgan, of Dublin, thinks that phosphorus is deficient where scurvy exists. But the great mass of evidence, collected during the last fifty years, goes to prove that lime- and lemon-juice contain, in natural combination, the best and most convenient prophylactic elements against scurvy. Its use in the Royal Navy has, since the close of the last century, been chiefly instrumental in driving the disease out of the service; and legislative enactments passed in 1867, whereby a proper and genuine supply of juice was secured to all British sailors, have resulted in the decrease of scurvy in our own Mercantile Marine by from 70 to 80 per cent. Single cases are, of course, occasionally met with afloat, for the disease, although almost entirely preventible, will never be practically exterminated from the merchant navy until legislators, ship-owners, and ship-masters are convinced that it is commercial economy to send to sea only healthy men. Scurvy will, of course, always be liable to occur in times of war and famine; and among any class of the population the possibility of its existence in single cases, in consequence of dietetic deficiencies, should never be overlooked.

Harry Leach.

SCYBALA (*σκύβαλον*, dung).—Fæces in the form of hard rounded lumps, whether discharged or retained in the intestine. *See* Fæces, Examination of.

SEA-AIR; SEA-BATHS; SEA-VOYAGES.—The physiological and therapeutical effects of sea-bathing cannot be separated from those of sea-air; for it is impossible to take sea-baths without being under the influence of sea-air; and the stay at the seaside alone, without sea-bathing, produces on many constitutions all the effects which are usually ascribed to sea-bathing. Residence at the seaside, that is, the influence of sea-air, is to be regarded as a special kind of climatic treatment, while the action of the sea-bath is analogous to the stimulating forms of the cold-water treatment.

As the sea-air and the sea-bath owe part of their properties to the constitution of sea-water, it will be well to begin with the latter, then consider the characters and influences of the sea-air and the sea-bath, and add some notes on seaside watering-places, and on sea-voyages.

Sea-water.—*Temperature.*—The sea-water is of more equable temperature than the surrounding air. It is, as a rule, warmer than the atmosphere in winter, and cooler in summer; although on chilly days in summer, especially after a series of hot ones, the temperature of the sea-water is often higher than that of the air. The variations of the temperature of sea-water from night to day, and from one day to another, are much less than those of the air. It would, however, be erroneous to assume, as is sometimes done, that the temperature of the sea-water near the shore is the same at different times of the day. The writer has often measured it at the Riviera, and the south coast of England, and has repeatedly found it, at one P.M. and two P.M., from 5° to 7° Fahr. higher than on the corresponding mornings at seven or eight A.M. As to the different seasons, the sea-water reaches its highest temperature in summer much later than the air; and as it loses its heat less rapidly than the latter, it is mostly warmer in autumn and winter than the surrounding air, and gives off warmth to the latter. During the sea-bathing season, namely, from the end of May to the beginning of October, the temperature of the sea-water at the coasts of England, the north of France, Belgium, Holland, and Germany, varies in general from about 56° to 72° Fahr., while in the Bay of Biscay and in the Mediterranean it is considerably higher.

Constituents.—Sea-water holds in solution a large amount of salts, varying somewhat in different localities, and slightly even in the same place at different times. The Mediterranean is richest, with about 2¾ to 3½ per cent.; whilst the water at the coasts of the British Channel and German Ocean varies from 2¼ to 3¼ per cent. The water of the Baltic, owing to the large number of streams which enter it, is much less salt, containing only about ½ per cent. Five-sixths of all the salts are chlorides of sodium and magnesium, whilst the remainder consist of the sulphates and carbonates of lime, magnesia, and potash.

Sea-air.—The sea-air, and the air at the sea-shore, are considerably influenced by the constant evaporation taking place from the sea, and also by the temperature of the sea. Owing to these circumstances, the sea-air contains in general more moisture, relative as well as absolute; and is more equable in temperature, the summer being less hot, and the winter less cold at the seaside than at inland places in the same latitude; the day also may be regarded as less warm in summer, the night as less cool in winter. A very important fact is the comparative purity of the sea-air from organic admixture and inorganic dust, while the occasional presence of a greater or smaller amount of saline particles cannot be regarded as a disadvantage. The amount of ozone is greater; that of carbonic acid smaller. The variations of the barometer are greater, but more regular in their occurrence, and this possibly exercises a beneficial influence on the functions of life. The greater density of the atmosphere, which means a comparatively large amount of oxygen in a given volume of air, is often considered as one of the principal causes of the stimulating effect of sea-air; but Frankland's and Tyndall's experiments on combustion render the usual reasoning on this point, with regard to combustion and tissue-change, rather doubtful. Nor is the fact to be overlooked that the air at the sea-shore is mostly in greater agitation than the inland air; and by this circumstance is probably to be explained the experience of Benecke ('Sea-air and Mountain-air,' *Deutsch. Arch. f. Klin. Med.*, vol. xiii. p. 80, 1874), that the same body of hot water loses its heat more rapidly at the sea-shore than at various elevations in Switzerland, varying from 3,000 to 6,000 feet above sea-level—an experience from which we may infer that living bodies likewise give off more heat at the sea-shore than in elevated inland regions. The physiological effects of sea-air may be designated, with Braun (*Curative Effects of Baths and Waters*, English edition, 1875, p. 253), as 'powerful stimulation of the change of substance, both retrogressive and formative, expressed in a striking increase of urea, and decrease of uric acid and phosphoric acid in the urine, in the greatly increased requirements of food, and in the rapid and considerable increase of the weight of the body.' A certain power of responding to the increased stimulus of the sea-air is, however, required of the constitution; for the increased tissue-change necessitates an increase in the ingestion of food, and in the processes of excretion of the products of retrogressive tissue-change. If the digestive and assimilative organs be unable to satisfy the former demand, various digestive disturbances arise, the appetite fails, and emaciation is often the consequence. In many of these conditions greater benefit is derived from mountain health-resorts, where the demands made on the constitution are less great, and where less food is required. If the excretory functions be imperfect, as is the case in so-called 'bilious' individuals, and in some undefined gouty tendencies, headaches, giddiness, constipation, or other symptoms usually called 'biliousness,' make their appearance, and sometimes render the removal from the sea-shore necessary, though the use of aperient remedies, reduction in the amount of food, and especially of stimulants, and active exercise at some distance from the sea, often suffice to correct this defective elimination and its consequences. In many cases of this kind, however, courses of mineral waters, especially the alkaline, saline, or common salt springs, ought to precede the stay at the seaside. *See* MINERAL WATERS.

Sea-baths.—The sea-bath may be regarded as a powerfully stimulating cold-water bath, modified in its action by the saline ingredients; by the admixture of mechanical particles, organic as well as inorganic; by the varying degree of motion through the waves; and by the alternation in the exposure of a part of the body to the waves and to the air. We have already discussed the temperature of the sea-water, and the saline ingredients; but the temperature of the surrounding air, and the degree of motion in the air, also exercise a modifying influence on the effects of the sea-bath. The motion of the water varies constantly, according to the size and force of the waves, and the effect of the bath to a great degree depends on this point. When the waves are in any degree powerful, the upper part of the body is exposed to the coming, the lower to the receding wave, and the cutaneous nerves are not only influenced by the cold, but also by the force of the water, and by the sand and other substances mixed with it. In a quiet sea these influences are considerably lessened. The alternation of exposure to the water and the air, likewise occasioned by the waves, is peculiar to the sea-bath, and is another source of constantly changing impressions on the cutaneous nerves.

BATHING-SEASON, AND RULES FOR USING IT.—The season for sea-bathing varies according to the climate of the locality. Thus it extends on the Mediterranean shores from May to October and even November; on the shores of the English Channel and German Ocean from June to September and the beginning of October. The time of the day for sea-bathing must depend on the individual, on the weather, and on the tide. Delicate persons ought not to bathe with a perfectly empty stomach; but also never after a full meal. The duration of each bath is to be regulated according to the constitution of the bather, the force of the waves, and the temperature of the water. Weakly persons ought not to remain in the water over half a minute to five minutes, but immersion for one and two minutes is in many such cases all that is useful and permissible, while stronger individuals may remain from five to ten minutes. The bather, we may say in general terms, ought to leave the water as soon as the reaction manifests itself.

In many cases, the warm sea-water bath may be recommended with advantage, when the cold sea-bath is forbidden. Indeed, courses of bathing in warm sea-water are not sufficiently used in a systematic way, though the medical practitioner possesses in them a gentle, manageable, and efficacious means of treatment during winter as well as during summer. They are in their action analogous to warm common salt-baths (*see* BATHS; and MINERAL WATERS). Unfortunately the arrangements are still very defective at many localities. Some physicians at seaside places are beginning to make more extensive use of them, and with excellent results. The tepid swimming-bath of sea-water we may regard as intermediate between the warm-bath and the bath in the open sea, and likewise as very useful in appropriate cases. With due care it can be employed also in winter. It offers the advantage of the combination of one of the most perfect modes of muscular exercise, with exposure of the skin to the influences of the sea-water bath.

The physiological effects of the sea-baths are similar to those of the sea-air. Abstraction of heat and stimulation of the cutaneous nerves lead to increased tissue-change, retrogressive as well as productive. Increased appetite and increased weight of body are usually observed in those who are benefited by sea-baths; while loss of appetite, headache, digestive disturbances, and loss of weight are often observed in those who are unable to bear the shock, or the increased demand on the body, or who remain too long in the bath, or take it too frequently.

CASES NOT SUITED FOR SEA-BATHING.—Persons affected with diseases of the heart, or of the blood-vessels and lungs, with organic diseases of the nervous system, with enlargement of the liver, or with other organic diseases of the abdominal viscera, ought to avoid bathing in the open sea, which may produce most injurious effects, such as violent palpitation and dyspnœa extending over many months, sleeplessness, total loss of appetite, and great emaciation. Old persons, and persons with feeble circulation, whether from age or otherwise, ought to avoid bathing in the open sea, excepting on warm days, and with a very quiet sea.

CASES TO BE BENEFITED BY SEA-BATHING.—Sea-bathing is useful in many conditions connected with weakness or atony of the skin, such as tendency to profuse perspiration, or to taking cold at every change of temperature, or exposure to wind or draught.

In scrofulous complaints, long-continued residence at the seaside promises more than other climatic agents; but, as we have to deal with constitutional defects, and as our aim must be to alter the constitution, two, three, or even more years are often required. In many cases, judicious courses of sea-bathing, the use of warm sea-water baths, and sponging with sea-water, assist the climatic element of seaside residence. Education at schools situated at the seaside offers, in scrofulous children, the greatest advantages.

In muscular rheumatism, the moderate use of the sea-bath combined with sea-air is useful. In more recent rheumatic joint-affections the sea-bath is mostly injurious, whilst the more gentle action of the sea-air, combined with the use of warm sea-water in local and general baths, is frequently beneficial. Persons affected with so-called nervous rheumatism—a term which is applied sometimes to hysterical cases, sometimes to spinal irritation, and also to rheumatism combined with nervous weakness—often derive benefit from the gentle use of the sea-bath, and still more from the sea-air.

In some functional diseases of the nervous system, the sea-bath forms an excellent remedy, if it be adapted to the individual case; for instance, in hysterical paralysis and other forms of hysteria, in the milder forms of diphtheritic paralysis, and in nervous dyspepsia. It must, however, be borne in mind that many persons, with a tendency to neuralgia, nervous asthma, hysterical convulsions, and other forms of hysteria, are unable to stand prolonged residence at the sea, especially at the Riviera. In such cases, mountain climates are generally more advantageous, during summer and autumn. In many forms of anæmia, when it does not depend on organic disease of the heart and blood-vessels or other viscera, but on direct loss of blood or its constituents, on confinement, grief, and imperfect food, on slow and imperfect development, sea-air exercises a good effect. Hence the benefit obtained in many cases of amenorrhœa, chlorosis, and allied complaints. Often, however, the demands made by the sea-air on the constitution are too great, and the invalids lose weight; whereas they gain on mountains of moderate elevation.

In chronic pneumonia, in the remains of pleuritic effusion, and in phthisis, the sea-air, by its purity and its more equable temperature, is useful; but as wind is in most cases to be avoided, sheltered localities are essential. Sea-bathing is in this class of cases hazardous. The beneficial effects in whooping-cough, when the first stage is over, are well known. Regarding asthma, nothing can be said with certainty; some cases of nervous asthma are benefited at the seaside, while others are aggravated; on the whole the writer's experience is more in favour of elevated regions than of the seaside. Whenever the effect is not yet known, the recommendation of seaside residence or mountain-air must be regarded as a trial; only in complications with heart-disease, the injurious effect may be regarded as certain. The advantage to be obtained in tendency to catarrh we have already mentioned.

In addition to the conditions named, there are many which cannot be designated by the name of any disease; but which are only states of weakness, manifesting themselves in various ways, as inability to sustain mental or bodily efforts, tendency to abortions, to leucorrhœa without any disease, &c. In such states of weakness the stimulating effect of the sea-air, combined with the grand aspect of the sea, are found eminently useful.

Seaside Watering-places.—England is remarkably well provided with seaside places, and the different localities offer considerable variety with regard to climate. The east coast, which may be designated as drier and more bracing, is especially to be recommended from the middle of June to the middle of October. The principal places on the east coast are, beginning with the north, Tynemouth, Redcar, Saltburn-by-the-Sea, Whitby, Scarborough, Filey, Bridlington, Cromer, Yarmouth, Lowestoft, Aldborough, Dovercourt, Walton-on-the-Naze, Southend, Margate, Broadstairs, Ramsgate, Deal, and Dover. On the south-eastern and southern coast, which may be regarded as intermediate between the eastern and the south-western coast, we have Folkestone, Sandgate, Hastings with St. Leonards-on-Sea, Eastbourne, Seaford, Brighton, Worthing, Littlehampton, Bognor, the Isle of Wight, Bournemouth, and the Channel Islands. These places differ considerably with respect to the soil on which they lie; the position—close to the sea or on a cliff; the aspect; and the configuration of the locality itself and the surrounding country. Even different parts of the same place offer different advantages. Thus the lower part of Folkestone, near the lower Sandgate road, is sheltered from the north by the cliff, while the houses on the cliff itself are more or less freely exposed to the winds from all quarters, and therefore preferable during the summer months. Hastings with St. Leonards is remarkably sheltered from the north, north-west, and to some degree from the north-east winds, and is through this, and through the influence of the sea, some degrees warmer during the late autumn and the early winter months—we may say till February—than closely adjacent but less sheltered places. In the Isle of Wight, the Undercliff, with Ventnor and Bonchurch, is sheltered by the hills from north and north-east winds, like Hastings, and more so; and has during winter a more equable and a higher temperature than other parts of the island. The Undercliff is therefore more adapted for climatic treatment during the colder part of the year; while Sandown, Shanklin, Cowes, Ryde, Alum Bay, and Freshwater are more suited for sea-bathing and climatic purposes during the warmer months. Bournemouth is sheltered as well by the configuration of the hills as by the pine-woods, which serve as a protection from violent winds. On the south-western coast, which may be regarded as somewhat moister and more sedative, Swanage, Weymouth, Sidmouth, Budleigh Salterton, Dawlish, Torquay, Teignmouth, and Penzance are the principal sea-bathing places, amongst which Torquay may be regarded as the most important winter health-resort. On the North Devon coast we may name Lynmouth, Ilfracombe, and Minehead; on the Bristol Channel, Weston-super-Mare, Portishead, and Clevedon; on the Welsh coast, Tenby, Aberystwith, Penmaenmawr, Llandudno, Rhyl; and in Lancashire, Westmoreland, and Cumberland, Grange, sheltered by configuration, Southport and Blackpool, Fleetwood, St. Bees, and Silloth.

Scotland likewise offers abundant localities for sea-bathing, the most frequented of which are Nairn on the east coast, Rothesay in Bute, Ardrossan near the firth of Clyde, and the Isle of Arran on the west.

Ireland is even richer, with Bray and Kingstown, near Dublin; Duncannon and Tramore on the south coast; Rostrevor and Portrush further north; Bundoran in the north-west; Kilkee in the south-west; and Queenstown, a sheltered and warm, but moist, climatic health-resort in the south, where are also Youghal and Ballycotton.

On the north coast of France, Calais, Boulogne, St. Valery, Tréport, Dieppe, Etretat, Fécamp, Havre, Trouville, Deauville, Villers-sur-Mer, and Dinard, are the most favourite resorts; on the south-west, Arcachon and Biarritz; and on the south, Marseilles, Cannes, and Nice.

The west and south-west coasts of Italy possess many good localities for sea-bathing for those requiring, or at all events bearing heat, such as Bordighera, Alassio, San Remo, Castellamare, Sorrento, and the islands of Capri and Ischia.

On the coast of Belgium, Holland, and Germany the most important localities are Blankenberghe, Ostend, Scheveningen, Borkum, Norderney, Baltrum, Langeroog, Spikeroog, Wangeroog, Dangast, Cuxhaven, Wyk, and Westerland.

The coasts of Norway, Sweden, and Denmark offer likewise good opportunities for sea-bathing, combined with bracing sea-air, from July to September.

Sea-voyages.—Sea-voyages have from remote antiquity formed a mode of treatment in chronic diseases, especially of the respiratory organs, and have more lately been much recommended in the treatment of consumption and scrofulous affections; but the different influences to which the invalid is exposed on long sea-voyages are but little appreciated in their details by the majority of the public, or by medical men.

The essential advantages which are generally ascribed to sea-voyages are the enjoyment of perfectly pure sea-air, abundance of light, and free exposure to the sea-breezes; absence, or at all events great limitation, of bodily exertion; and the probability of psychical repose. The uninitiated frequently regard these advantages as more or less fixed and, so to say, measurable qualities, and speak of sea-voyages in the same way as of sea-bathing, cold-water treatment, mineral-water cures, or mountain climates. The advantages of sea-voyages are, however, by no means fixed qualities, and they are often mixed up with unfavourable influences, such as bad weather, sea-sickness, improper food, &c. In every-day life it is an acknowledged fact, and not less so in all climatic cures, that the house in which the invalid lives exercises a most powerful influence on his chance of regaining and maintaining his health; and that the house alone often mars the effect of the best adapted climatic change. In the same way the floating house, the ship, with its arrangements, forms one of the most important elements in the compound agent 'sea-voyage.' The arrangements of ships, however, are notoriously often very imperfect, and the narrow cabin never stands comparison with a good bedroom, the only counterbalance to this drawback often being that the invalid is forced to be the whole day long on deck, that is, in the open air, in order to escape from the confined state of the cabin. By this circumstance alone, however, the majority of the more serious cases ought to be excluded from sea-voyages in ordinary ships, as they cannot be easily moved from the cabins to the deck, and *vice versâ*. The hygienic conditions of the ship, the space allotted to each passenger, the ventilation of the rooms, the arrangement of the decks, must in every case be a matter of careful enquiry; but it would require too much space to enter into the details in this place. There are iron and wooden ships, steamers and sailing vessels. The iron ships have the advantage of being easily kept clean and free from smells, but they are apt to become very hot under the influence of the tropical sun. The sailing vessels can be kept more free from smoke and dust; but they are dependent on wind, and if they meet in the tropics with perfect calms (doldrums), the passengers may have to endure intolerable heat for several days and possibly weeks. The combination, therefore, of sailing power for ordinary conditions, with steam to be used only in case of need, would appear to possess the preference for ships to be used for therapeutic purposes (invalid ships).

A second point of paramount importance for every delicate person is the food, and in this respect again the ship-life on long voyages is less advantageous than the life in well-supplied health-resorts or at home. Although the food on first-rate ships is now much improved, compared with former times, yet it is impossible to offer the same variety, or the same delicate cooking, as in first-class hotels or private establishments. A certain amount of monotony in food is scarcely to be avoided, and invalids with a delicate appetite ought therefore not to attempt long sea-voyages, excepting under very favourable circumstances, as, for instance, on large private yachts provided with good cooks.

Sea-sickness, or rather the degree of liability to sea-sickness, depends on peculiarities of constitution, which are only to be recognised by exposure to the influences of the open sea in different states of agitation. *See* SEA-SICKNESS.

We have given, under the head of sea-air, the prominent qualities of sea-climates; but the most cursory consideration of the climatic conditions to be encountered in a long sea-voyage, shows that there must be great differences between the physiological and therapeutical influences of sea-climates in latitude 50° and in latitudes 15° and 5°. The air in the tropical regions has a much higher temperature and a larger amount of absolute moisture; the atmospheric movement is, as a rule, though by no means always, slighter; the barometric pressure is somewhat less in the tropics than in the temperate zones; and the daily and annual variations of atmospheric pressure are greater in the former than in the latter. There is also a difference between the same degrees of latitude on the north and south of the equator, the temperature in the southern hemisphere, for instance, being somewhat lower than in the northern, but these differences are comparatively small. The effects of the climatic conditions of sea-life in different latitudes on the constitution are very complicated. We will here only point to a few facts, namely, that in some delicate constitutions the functions of life are performed more easily under the influence of greater heat; that many delicate persons can eat and digest better, are able to take more exercise, sleep better, and their mental functions are more active under the same circumstances; but that in the majority of average persons continued great heat produces lassitude, a tendency to diarrhœa and other digestive derangements, and imperfect sleep. Further, that in most individuals the bodily temperature rises above the natural heat (in general about $\frac{1}{2}$° Fahr., and in some persons as much as 2° and 3° Fahr.); and that pulmonary hæmorrhage occurs more frequently under high than under ordinary degrees of heat. Morbid states accompanied with pyrexia and with a tendency to pulmonary hæmorrhage ought therefore not to be exposed to tropical heat.

The climatic conditions to be met with in different voyages through the same regions vary at different seasons, but they vary still more in voyages through different seas, especially according to the longitude and latitude. Our knowledge of different sea-climates, that is, of the different climatic conditions in different parts of the ocean, is as yet not perfect. Dr. Faber, in a communication 'On the Influence of Sea-voyages on the Human Body,' *Practitioner*, March 1876), shows that the equability of sea-climates is by no means so complete as is generally assumed; and that great changes in temperature and atmospheric movements occur not rarely on successive days, and even on the same day.

THERAPEUTICAL USES.—The opinions of different writers on the therapeutic value of sea-voyages in the treatment of disease vary considerably. In the last century Gilchrist revived the practice of sea-voyages, and strongly recommended them in cases of phthisis. In more recent times Jules Rochard, the well-known French climatologist, has collected a large body of evidence from the French Navy to dispel the faith in sea-voyages; but we must bear in mind that the hygienic condition in which the sailors used to live were not perfect, and are no doubt inferior to those of well-arranged private ships of the present day. Dr. Walshe, on the other hand, is in favour of well-planned voyages. The majority of physicians entirely, or almost entirely, confine themselves to diseases of the respiratory organs in recommending sea-voyages; but their therapeutic field is no doubt much larger, and the result is probably more generally favourable in some other complaints.

1. *Phthisis.*—The writer has had the opportunity of witnessing the effects of sea-voyages of two to seven months' duration, in twenty-one cases of phthisis in the first or the beginning of the second stage. Of these twenty-one cases ten benefited considerably, six remained stationary, five became worse. The voyages were all either to the Cape of Good Hope and back, or to Australia and New Zealand and back, between the months of September and May. Of the five bad results three occurred in patients who went to Australia and India and back, with scarcely any rest on land; they seemed to have gained in the first part of the journey, but more than lost the gain in the latter part, apparently from dislike of food, from the monotony of the life, and from exhaustion. In seven cases of phthisis in the second stage the result of sea-voyages was favourable only in 2, indifferent in 2, bad in 3 cases. In 4 cases in the third stage the result was bad in 2, indifferent in the two others, which latter were stationary or 'quiescent' cases. The writer has also notes of 4 cases of phthisis in the first and the beginning of the second stage, where long summer voyages (namely, from three to five months) with whalers to the northern seas, were tried, the result being favourable in 3 cases, unfavourable in 1, apparently through inability to bear the want of variety in food.

2. *Laryngeal and bronchial catarrh and asthma.* In simple chronic catarrh of the larynx sea-voyages, or cruising in yachts from this country to the Mediterranean, to the Azores and Madeira, had very good results in 8 cases out of 9. Satisfactory was also the effect of a similar plan in 7 cases of chronic bronchial catarrh. In a tendency to bronchitis from pulmonary emphysema the benefit was likewise evident in 7 cases out of 8, but here the effect was, from the nature of the circumstances, less permanent. Of 6 cases of asthma, 2 cases of a bronchitic kind were benefited; 2 of a nervous character aggravated; and 2 were neither better nor worse. Eight cases of hay-asthma were, while on the high seas, quite free, but those who returned while the complaint was still in season, were immediately attacked.

3. *Scrofula.*—In 9 cases of scrofulous affections (caries of bones, affections of joints, glandular swellings and ulcerations) one or several long sea-voyages were tried; in 6 of them the effect was quite satisfactory, in 3 less decided.

4. *Vesical disease.*—In 3 cases of irritable bladder sea-voyages on yachts in warm climates have likewise proved useful.

5. *Cardiac disease.*—Decidedly injurious was the effect of sea-voyages in 5 cases of dilatation of the heart, combined with chronic bronchitis. In 2 cases of enlargement of the liver, connected with weakness of the heart, the result was likewise unsatisfactory.

6. *Skin-disease.*—Chronic eczema was, in 4 cases out of 6, aggravated by sea-voyages.

7. *Nervous disorders.*—In 4 out of 6 cases of mental irritability, long sea-voyages, especially in yachts, had favourable results; in the 5th the mental condition was aggravated; in the 6th great improvement of the mental state was obtained, but this was accompanied by considerable exhaustion, from inability to take a sufficient amount of food. Of 3 cases of melancholia 2 were apparently cured, the third remained uninfluenced. In 4 cases of locomotor ataxy, in the earlier stage, cruising in comfortable yachts in the Mediterranean, with occasional landing, during the autumn, winter, and spring months, has been very beneficial; in two of these the disease has apparently been arrested, by persevering with this course during five and six years.

8. *Dipsomania.*—Finally, the writer has tried long sea-voyages in yachts in five cases of dipsomania, stimulants having been entirely excluded from the dietary. In one of these cases the result appears to be permanently good; in the four others it was good for the time with regard to the state of the body as well as of the mind, but there were relapses, which in two of the cases have led to several repetitions of the trial, each time apparently with more lasting, but as yet

not permanent, result. Well-arranged sea-voyages deserve therefore, at all events, a place in the management of this most terrible affection.

Conclusions.—From a comparison of these experiences with those of other observers, the writer is inclined to infer that, under favourable circumstances, sea-voyages of not too long duration may be rendered beneficial in the early stages of phthisis. The voyage to Australia and New Zealand and back, after a stay of a few months in these climates—Hobart's Town, in Tasmania, for instance—specially recommends itself. The invalids referred to left in the second half of September, or in October or November, and returned in May or June. In this way the more unfavourable seasons of England are avoided, and instead of the short and sunless days, long and bright ones are obtained. To go to Australia and to return immediately has proved exhausting in several instances. Another good plan is to go to the Cape of Good Hope, and ascend in easy stages, by diligence and bullock-carts, to the higher regions (Bloemfontein, for instance), and to return after a stay of three or four months or more. This plan, however, is rather expensive; and it requires a considerable amount of bodily strength, and the inclination to stand a certain amount of roughing with regard to accommodation and food.

The voyage to the northern seas requires a peculiar mental disposition, and would, under the present conditions, be resorted to only under exceptional circumstances; but it has been very beneficial in the three cases of early phthisis mentioned—all of them possessing a satisfactory fund of strength, combined with love of sea-life and a good digestion.

The combination of yachting in the Mediterranean, and residence at one or several of the health-resorts of those regions, or with a visit to Upper Egypt, has repeatedly proved successful in cases under the observation of the writer, not only in pulmonary invalids, but also in cases of mental irritability, exhaustion, chronic rheumatism, and gout. This plan, however, is somewhat expensive.

In hay-asthma sea-voyages during the season of the complaint are to be recommended; but in other forms of asthma the result is uncertain, and the advice should not be given without consideration of all the circumstances.

In some forms of mental irritability, and in the earlier stages of locomotor ataxy, sea-voyages, and especially yachting, in the subtropical regions, offer many advantages, particularly during the colder and damper seasons of our climate, as it allows of the combination of the enjoyment of sun, light, and pure air, with rest of body and mental repose. In slighter forms of mental irritability or overwork shorter voyages are often sufficient, and even preferable; and the voyages to Madeira, to the West Indies, or to Brazil and the River Plate, may thus be recommended during the colder season.

Dipsomania and other morbid passions may be treated with great advantage by sea-voyages and yachting, provided that stimulants and the other injurious influences which the weak person is unable to resist, can thus be entirely removed.

The time may come when we shall have *therapeutic ships*, specially arranged for different classes of invalids. It would, for instance, not be wise to mix those suffering from dipsomania with sick persons to whom a moderate amount of stimulants is useful.

Circumstances counter-indicating Sea-voyages. The circumstances which render it necessary to avoid sea-voyages are:—

1. Unconquerable sea-sickness.
2. Great temporary or permanent weakness and exhaustion.
3. Permanent delicacy of appetite, with inability to become accustomed to a certain monotony of food, or to a certain coarseness in the preparation of food.
4. Inability to bear the glare of the sea, as it occurs in tendency to glaucoma.
5. Persistent sleeplessness while at sea.
6. Dilatation and weakness of the fibres of the heart, with or without valvular disease.
7. Enlargement of the liver, especially when caused by dilatation of the right ventricle.
8. Advanced stages of consumption, unless the affection be quite stationary.
9. Morbid conditions with a tendency to pyrexia.
10. A tendency to hæmorrhage.

It is the influence of great heat that ought to be avoided by the two classes of cases last mentioned. A voyage through tropical seas, especially in sailing ships, might prove dangerous in such subjects, from the possibility of being becalmed.

11. A tendency to epilepsy or maniacal fits. This ought specially to contraindicate sea-voyages to tropical climates.

For further information regarding sea-voyages, reference may be made to *The Ocean as a Health-resort*, 1880, by Mr. William S. Wilson; and further to a treatise on sea-voyages, by Dr. Faber of Stuttgart, which is issued as a part of Von Ziemssen's *Handbuch der Allgemeinen Therapie*.

Hermann Weber.

SEA-SICKNESS.

SEA-SICKNESS.—Synon.: Fr. *Mal de mer*; Ger. *Seekrankheit*.

Definition.—A peculiar functional disturbance of the nervous system, produced by shock, resulting from the motion of a ship. The most prominent symptoms are a state of general depression, giddiness, vomiting, and derangement of the bowels and of the urinary secretion.

Pathology.—The immediate cause of sea-sickness is referable to the shock, or series of shocks, to the nervous system, produced by the motion of a ship. A precisely similar condition may frequently be induced by any forcible motion for which the individual is unprepared, or to which he is unaccustomed, as the motion of a swing. The nervous system is taken unawares, and is unable to adapt the emissions of nerve-force to the unexpected demands made on it. The momentary displacement of the viscera, especially the stomach, the unusual impression on the vision, and the feeling of insecurity, further contribute to the general shock.

The action of the heart and of the arteries is deranged through reflex influence, causing giddiness from anæmia of the brain, and diminished peripheral circulation. The stomach is also affected through reflex action, rendering it intolerant of the presence of any substance, and causing the gastric juice to be actively secreted. The acid secretion acts as a direct irritant to the stomach, and prolongs the sickness. At length *habit* enables the nervous system to adapt itself to the new condition of motion, and to overcome the disturbing influence; shock consequently ceases to be produced; the reflex derangements of the circulation and viscera, giddiness, nausea, and other disorders, are no longer called forth; and convalescence ensues. It is not within the scope of this article to notice the many theories which have been adduced to account for sea-sickness, but most late writers attribute it to reflex nervous disturbance. Dr. Chapman's theory is, that there is an undue amount of blood in the nervous centres along the back, producing an abnormally large number of exciting impulses, which cause a copious secretion of mucus in the stomach and bowels, vomiting, and coldness of the extremities from contraction of the minute arteries. Some persons are totally insusceptible to the shock producing sea-sickness.

Constipation is probably the result of the want of the gastro-biliary juices and mucus in the bowels, these being vomited; and the diminution of urine may be accounted for, in part at least, by the increased secretion of mucus and saliva.

Anatomical Characters.—The writer has only had the opportunity of taking notes of one autopsy in a case of ordinary sea-sickness, in which the patient died suddenly. The appearances were those of death by simple syncope, there being no organic disease present. The brain, however, was not examined.

Symptoms.—Sea-sickness may be divided into the stages of (1) Depression, (2) Exhaustion, (3) Reaction, and (4) Convalescence.

The early symptoms are sudden giddiness, slight at first, but increasing with the motion of the vessel; and a sense of weight and uneasiness at the epigastrium, speedily followed by nausea and vomiting. At first any food that may have been in the stomach is rejected; and afterwards acid, greenish-yellow, gastro-biliary secretions, often in large quantity, with mucus. Diarrhœa is sometimes present, but constipation is more usually the rule throughout. The flow of saliva is increased, while the urinary secretion is lessened. Appetite is lost, even the sight or smell of food being loathsome. The secretion of milk is frequently arrested in nursing women; in others the menstrual flow is augmented. Sea-sick patients are always worse in the morning. Women suffer more severely than men as a rule, while old people and young children are but slightly affected, or escape altogether. In the majority of cases a favourable *reaction* takes place without further symptoms, the vomiting and nausea cease spontaneously, a ravenous appetite succeeds, and the patient feels well. In other instances great *exhaustion* supervenes rapidly or gradually The patient feels miserably helpless. He suffers from coldness of the extremities, thirst, headache, and spasmodic pain in the stomach, and complains of numbness of the surface of the body. There is frequently a great tendency to heavy sleepiness; and vomiting of gastro-biliary fluids, sometimes mixed with striæ of blood, takes place whenever they collect in the stomach. A semi-comatose condition, from which the patient is with some difficulty roused, is sometimes met with in very severe cases, and requires assiduous treatment.

In these prolonged cases *reaction* may assume a febrile character, with a rapid pulse, flushed face, hot skin, and urine containing lithates; and convalescence is slow.

An occasional but rare form of sea-sickness is swooning, but without vomiting or any other symptom. The patient lies motionless and almost deathlike for a variable period. This state is not without danger. Another form is frontal headache, neuralgic or anæmic.

Complications and Sequelæ.—Fainting and hysterical attacks are the most common complications of sea-sickness in women. Pregnant women occasionally abort. A weak and irritable condition of the stomach, resembling subacute gastritis, or a state of general debility, may remain for a long time.

Duration.—The ordinary duration of sea-sickness in long voyages is from three to five days, but it may last for weeks.

Prognosis.—This is almost invariably favourable, yet death, although extremely rare, may occur from syncope or from exhaustion.

Treatment.—It may be premised that there is no known means of preventing sea-sickness in those susceptible of it. The majority of cases get well spontaneously, but there are many which will require systematic treatment, especially in long voyages. Measures should be taken to counteract the nervous shock, and to sustain the system during its continuance.

Diet before embarking should be light. Fresh air is a powerful element in the treatment, to obtain which the voyager should remain on deck whenever the weather permits, or in a deck-room. The temperature of the body should be maintained by wrapping up in shawls, and hot bottles applied to the feet if necessary. The face may be bathed occasionally with eau de Cologne, and the vapour of ammonia inhaled through the nose. In the early stages alkalies are indicated, to counteract the irritant effects of the acid gastro-biliary secretions, together with diffusible stimulants frequently administered. A draught may be given, consisting of bicarbonate of soda, grains 10–20, ammoniated tincture of valerian, ♏xv, chloroform, ♏iii–v, dissolved in half a drachm of rectified spirit, mucilage of acacia, ʒjss, and camphor water to ℥j. Such a draught may be given every two hours, or, omitting the mucilage, it may be given in effervescence with citric acid. Chloroform is valuable as a sedative to the stomach, as well as being a general stimulant. Other useful drugs are Hoffman's anodyne, hydrocyanic acid, and, in prolonged cases, bismuth. Iced champagne is often valuable. Ice sucked slowly allays thirst, and relieves vomiting. A full dose of opium sometimes acts like a charm, through the rest which it procures, or morphia may be injected subcutaneously. Hydrate of chloral is also a valuable narcotic. More recently nitrite of amyl and nitro-glycerine have been successfully employed in some instances.

External sedative applications over the stomach do good, such as a liniment composed of equal parts of belladonna, chloroform, and camphor liniments; and a binder rolled firmly round the body is useful. When the patient is in his berth he should lie on his back, with his head low, as immovable as possible. Notwithstanding the vomiting, food should be pressed on the patient; and, lest exhaustion occur, light semi-fluid food is the best, such as arrowroot, given frequently in small quantities. Afterwards toasted bread, with beef-tea or chicken broth, and when these are borne, boiled fowl, pickled meats, or corned meat with pickles, may be tried. Acids at this stage aid digestion, which has become weakened through the vomiting of so much gastric juice and bile. Beer and alcoholic drinks should be avoided in the earlier stages; but at a later period, claret, champagne, or brandy, or stout, may be allowed with benefit. Diarrhœa and other symptoms should be treated on general principles. For short voyages the best that can be done is to remain on deck when possible, avoid alcoholic drinks, and follow the general directions above given. Dr. Chapman recommends the application of ice along the spine, in order to lessen the nervous currents by its sedative influence; and this treatment is occasionally successful in arresting the vomiting.

J. DE ZOUCHE.

SEAT-WORM.—A synonym of the small thread-worm, or *oxyuris vermicularis*. By practitioners the small and troublesome entozoa here referred to are more frequently spoken of as *ascarides*, though, as explained elsewhere, the expression is not correct. The term seat-worm is suggestive, inasmuch as the presence of these parasites is apt to give rise to irritation in the neighbourhood of the anus; but it is somewhat objectionable and misleading, since it tends to favour the view still very commonly entertained and taught by medical men, that the rectum and sigmoid flexure of the colon constitute the true habitat of this entozoon. The cæcum forms the 'head-quarters' of the seat-worm, and the knowledge of this fact has an important bearing upon the method of treatment to be pursued. *See* ASCARIDES; OXYURIS; and THREAD-WORM.

T. S. COBBOLD.

SEBACEOUS FOLLICLES, Diseases of.—SYNON.: Fr. *Maladies des Follicules sébacés*; Ger. *Krankheiten der Talgdrüsen.*

The sebaceous follicles of the skin are subject to disease depending both upon internal and external causes. Those follicles which are attached to hairs, and those which are isolated, show little difference in this respect.

Enlargement or *hypertrophy* of the follicles is often seen, and appears to arise chiefly from internal causes, occurring either at a particular stage of development, or from some general alteration of nutrition, such as follows a particular diet or excess of particular kinds of food. This form constitutes *acne punctata*, an affection in which the affected portion of skin appears covered with black spots; these being the openings of the enlarged sebaceous follicles, choked with plugs of sebaceous matter, the outer ends of which become blackened. The plugs or *comedones*, when examined, are found to consist of solid fatty matter (sebaceous secretion), closely packed epithelial scales, and minute rudiments of hairs. The parasite *Demodex folliculorum* is often present, but does not appear to exercise any influence on the disease. Not unfrequently an imperfectly formed hair occupies the centre of the mass. Acne punctata occurs in those parts of the body where there are numerous rudiments of hairs, and where hairs grow commonly, though not uniformly, in the male sex. Hence it is confined to the face, neck, and upper part of the back and chest.

When *inflammation* is set up in hypertrophied follicles suppuration follows, and we have *acne suppurativa*.

The condition called *lichen pilaris* is substantially the same as hypertrophic acne, being produced by over-growth of cells in the sheath of the hair and the sebaceous follicle. *See* ACNE.

J. F. PAYNE.

SEBORRHŒA (*sebum*, fat, and ῥέω, I flow). An ungrammatical synonym for stearrhœa. *See* STEARRHŒA.

SECONDARY (*secundus*, the second).—In contra-distinction to *primary*, the word secondary is used with the following significations. Ætiologically it implies that a disease is not local in its causation and origin, but is manifested as a *secondary* lesion—either as the result of some general or constitutional condition, or of an affection which has previously involved some other structure or organ, it may be in a remote part of the body. It also signifies the later manifestations of a disease, as distinguished from those which occur at an early period, as in the case of *secondary syphilis* or *secondary cancer*. The term is, moreover, applied to symptoms, when they are more or less remote from the seat of mischief, or are only indirectly set up by the disease with which they are associated.

FREDERICK T. ROBERTS.

SECRETIONS AND EXCRETIONS, Disorders of.—Although the derangements affecting the chief secretions and excretions of the human body are considered in detail in other parts of this work, it may serve a useful purpose to deal with them from a general standpoint, as there are several facts which apply to them collectively. Those that have principally to be borne in mind are the secretions poured into the alimentary canal—namely, the saliva, gastric juice, bile, pancreatic juice, and intestinal secretions; the milk; the urine; and the sweat. Of secondary importance, from a clinical point of view, are the various mucous secretions, the tears, and the semen; the serous secretions have also to be remembered. It is assumed that the physiological distinction between a secretion and an excretion is understood.

VARIETIES OF DISORDER.—1. Secretions and excretions are very liable to *changes in quantity*. A definite amount of each of these should be formed during the twenty-four hours, varying within recognised limits, and influenced by certain physiological conditions. The quantity produced, however, often deviates from the healthy standard, in the direction either of (*a*) *excess*, or (*b*) *deficiency*. In the former case the amount of the secretion formed is often far above the normal, or what is needful for its purpose; in the latter case various degrees of deficiency occur, culminating in an absolute suppression of a particular secretion or excretion.

2. *Changes in quality* are also frequently noticed, and these may be associated with changes in quantity, or they may exist alone. The qualitative changes include the absence or deficiency of one or more of the normal chemical ingredients of the fluid; excess of either of these ingredients; absence, deficiency, or imperfection of formed organic elements, as in the case of the semen; or the presence of adventitious and abnormal ingredients. It may also be mentioned here that the quality of secretions is often modified by admixture with excess of mucus or with morbid products.

3. Another disorder affecting certain secretions and excretions is *interference with their escape* by the normal channels, so that they are retained. This applies particularly to those which have one or more special ducts for their exit, liable to be obstructed in various ways. The escape of the bile, pancreatic juice, urine, parotid secretion, milk, and other fluids may be thus prevented.

4. Allied to the deviation just noticed is that in which a secretion *flows in some abnormal direction*. As illustrations may be mentioned salivary fistula, in which the parotid secretion escapes through an opening on the outside of the cheek; external biliary fistula, or the opening of the gall-bladder in various other directions; vesico-vaginal or vesico-rectal fistula, where the urine passes from the bladder into the vagina and rectum respectively; and closure of the lachrymal duct, so that the tears flow over the cheeks. In this connection allusion must also be made to those cases in which a reservoir of some secretion ruptures, and thus its contents escape. For instance, the gall-bladder may give way, or the urinary bladder, the bile or urine consequently escaping into the peritoneum.

Ætiology.—The causes which produce one or other of the disorders of secretion just indicated are as follows:—1. Alterations in quantity and quality are often immediately induced by nervous disturbance. The influence of the nervous system upon the act of secretion is well known, and it may be centric in origin, as in the case of strong emotion; direct, when the nerve influencing a particular secretion is irritated, compressed, or otherwise disturbed; or reflex, due to some remote irritation affecting such a nerve. The effect of neuralgia upon the secretion of the tears, saliva, and perspiration, is often very striking. 2. Similar disorders frequently depend upon derangements affecting the local circulation in the secreting gland. This is well exemplified in the case of the urine, which is abundant and watery as the result of active congestion of the kidney; deficient, concentrated, and otherwise abnormal when these organs are the seat of venous congestion. The bile is also considerably modified in quantity and quality by portal congestion. 3. General conditions of the system materially affect secretions, from various causes, such as pyrexia, plethora or anæmia, shock or collapse, and the typhoid condition. Moreover, they may be disordered in connection with diseases which produce marked effects upon the general system, such as phthisis. 4. Functional derangements of the glandular structures which form different secretions are very common, and may be due to many causes. Amongst others may be mentioned a want of due and proper stimulation; excessive or too frequent stimulation; injurious habits which affect certain secretions; and want of tone or imperfect nutrition of secreting tissues. Such causes frequently operate injuriously in relation to the secretions poured into the alimentary canal. The sweat is affected by neglecting cleanliness of the skin. 5. Organic diseases of the glandular structures necessarily modify secretions more or less, either temporarily from acute disease, or permanently from some chronic mischief, which may ultimately entirely check a secretion. These diseases are of different kinds, and cannot be specially indicated here, but they all tend to alter or destroy the secreting structures. 6. The secretions generally may be affected by certain abnormal elements which accumulate in the blood. Under such circumstances, however, some excretions become the special channels for the elimination of these elements, and thus are liable to be seriously deranged. Thus in diabetes, whatever its pathology may be, the accumulation of sugar in the system leads to the characteristic changes in the urine observed in this disease, while at the same time the cutaneous excretion is diminished. It may further be remarked here that if the elements which ought to be removed by a certain excretion are not thus eliminated, they may find their way by other channels, and thus modify the quality of other fluids. This is exemplified by the elimination of urea in other directions when it is not excreted by the kidneys. 7. A secretion may be properly formed, but it is in many cases subsequently modified by admixture with morbid products derived from surfaces with which it has to come in contact, such as excess of or unhealthy mucus, or pus. Also, in the case of the stomach, the habit of taking large quantities of water or other fluids may so dilute the digestive secretions, as to make them unfit to perform their functions properly. 8. With regard to the causes which impede the escape of secretions, these are either of a mechanical nature, the duct being obstructed by something lodging in it, such as a calculus or plug of mucus, or being pressed upon from the outside; or due to organic disease, narrowing or closing the channel or its orifice; or possibly occasionally to muscular spasm or to paralysis of the duct. Such conditions may be temporary or permanent. The discharge of secretions in abnormal directions is the result of organic lesions, either congenital or acquired, by which the unusual channels and communications are formed.

Effects and Symptoms.—Disorders affecting secretions and excretions are often directly accountable for a variety of symptoms, as well as for certain definite morbid conditions, and these effects are usually readily explained. 1. With reference to their quantity, secretions and excretions must be regarded as mere liquids of a particular kind, and symptoms may therefore simply depend upon their amount. For instance, deficiency or excess of saliva and buccal mucus will cause respectively dryness of the mouth, or a more or less profuse flow of saliva; an abundance of gastric juice may account for acidity and acid eructations; the quantity of the secretions in the alimentary canal often aids in the causation of diarrhœa or constipation; and variations in the amount of the cutaneous excretion give rise either to undue sweating, or to dryness of the skin. 2. Certain actions are frequently influenced by disorders of secretion. Mere alterations in quantity may affect these actions. Thus, profuse salivation causes frequent spitting or swallowing; abundant secretion in the air-passages excites coughing and expectoration; excess of fluids in the stomach or intestine may cause vomiting or purging respectively; a free secretion of urine renders micturition more frequent. But, apart from the quantity, the quality of a secretion may further influence these actions. Of this we have a striking illustration in diabetic urine, which is in itself irritating, and excites the bladder to empty itself. The bile is another example, for undoubtedly this fluid has an irritating effect upon the intestine, and may also increase the secretions of this canal, so that in these ways excess of bile may be a cause of diarrhœa, while its deficiency is an important element in many cases of constipation, owing to the want of its stimulating action upon the intestinal wall. 3. Each secretion, as distinguished from an excretion, has certain definite functions to fulfil, and a number of symptoms may be due to the fact that a particular secretion fails to perform its functions. This may arise from the fact that it is suppressed or deficient in quantity; abnormal in quality, and therefore inadequate for its work; or for some reason or other does not reach the place in which this work is carried on, as when a duct is obstructed, or a fistula allows the escape of a secretion, so that it is lost. Symptoms arising from this cause are mainly observed in connection with the alimentary canal, and they are of extremely common occurrence, as well as of varied character. Many of the symptoms in dyspeptic cases are to be thus explained, and a knowledge of the physiological uses of the different digestive secretions will indicate the derangements to be anticipated when one or other of them is unequal to its work. It must be remembered not only that these secretions are concerned directly in digesting the food, but that some of them also prevent fermentation and decomposition, and their imperfect action in these respects may originate important symptoms. Under this heading the lacteal secretion may be alluded to. Deficiency in its quantity, or imperfection in its quality, often renders it unfit to fulfil its function, that is, the proper nourishment of the infant who is supposed to live upon the maternal milk. 4. If certain secretions or excretions are seriously checked or altogether suppressed, or if they are retained in any part, so that they become subsequently absorbed, obvious effects on the entire system are produced, which may be of a very serious character. Thus, in the case of the bile, jaundice and its accompanying phenomena are evident; in connection with the urine we may have dropsy or uræmic symptoms. Impaired cutaneous excretion also produces effects upon the system, although these are not so marked. 5. What may be regarded as the secondary effects of disorders connected with secretions must also not be forgotten. If their escape be prevented, they are liable mechanically to produce important lesions. Thus they often lead to distension of hollow organs, such as the bladder or gall-bladder. Moreover, they may at the same time excite irritation and inflammation, especially if, as in the case of the urine, decomposition take place, with the formation of irritating products. By these combined effects, important organs may ultimately be completely disorganised, such as the kidney or liver. Retention of milk in the mammary glands is one important cause of inflammation and abscess in these organs. When certain secretions or excretions find their way into abnormal situations they may also originate more or less serious conditions. Thus if urine or bile escape into the peritoneum, acute peritonitis will be set up.

Treatment.—Without entering into any details, it will suffice to indicate in this article the principles upon which disorders of the secretions and excretions are to be treated. 1. Any obvious cause of such disorders must be rectified or got rid of at the outset, if practicable, as, for instance, injurious habits, neuralgia, and many other causes. 2. When secretions are abnormal in their formation, either as regards quantity or quality, means are often within reach for correcting these errors. This may not uncommonly be effected by acting upon the general system, by means of tonics or other suitable agents, and thus indirectly influencing secretion; but there are also special therapeutic agents employed for their immediate effects upon particular secretions or excretions, such as the gastric juice, the bile, the urine, and the sweat. With regard to quantity, remedies are used to diminish this when excessive, as well as to increase it when deficient. It may be mentioned here that measures for augmenting certain secretions, and especially excretions, are often resorted to for other therapeutic purposes, when they are not in any way abnormal. Care must be taken not to carry measures for promoting the formation of secretions too far, otherwise in the long run they are liable, by over-stimulation and in other ways, to do far more harm than good. This applies particularly to those cases where there is organic mischief affecting the glandular structures, and interfering with their formation. Secretions and excretions are often materially influenced in quantity and quality by acting upon the circulation in the organs which form them, either directly or indirectly. 3. It may be practicable to treat some disease which originates a disordered secretion, and thus to influence it. This may be illustrated by diabetes, and by diseases of particular organs, the secretions of which are affected. In this way marked effects are sometimes produced. 4. When certain secretions are wanting or very deficient, especially the gastric juice and bile, their place may be supplied by administering the important elements of these secretions, or by making them artificially. The elements of the pancreatic juice are also now frequently given in different forms. Thus the want or deficiency of these fluids in the digestive process may often be entirely made up for. An important use of some of these substitutes, at present much in vogue, is that introduced by Dr. William Roberts, by which the food is artificially digested in different degrees before it is taken by the patient. 5. The symptoms which disorders of secretions give rise to often need special treatment, whether they be of a local or general character—for instance, constipation, diarrhœa, flatulence, jaundice, uræmia, and other phenomena. 6. In many cases attention has to be directed to the prevention of an accumulation of a secretion or excretion, or to its removal if it have accumulated. This may be illustrated by retention of the milk in the mammary gland; and of the urine in the bladder. The effects of any such accumulation also need to be recognised in treatment, such as dilatation of an organ, inflammation, or rupture. 7. Operative procedures may be required in some cases, either to remove an accumulation which cannot otherwise be got rid of; or to cause a secretion to pass in its proper direction, in those cases where there is an abnormal communication or fistula, or a closed passage, such as an obstructed lachrymal duct.

It must be remembered that there are many disorders of secretions and excretions which are merely temporary, and which need no treatment whatever. FREDERICK T. ROBERTS.

SEDATIVES (*sedo*, I ease or assuage).—SYNON.: Fr. *Sédatifs*; Ger. *Beruhigende Mittel*.

DEFINITION.— Therapeutic measures which exert a soothing action upon the system, by diminishing pain, lessening functional activity, or tranquillising disordered muscular movement.

Sedatives may be divided into the following groups:—

1. **General Sedatives.**—Constitutional sedatives, like stimulants, widely overlap other therapeutic divisions. The type of all soothing action assuredly must be a full narcotic, an anæsthetic vapour, or a subcutaneous injection of morphia, either of which renders the sufferer temporarily oblivious to any excruciating agony, such as that of biliary or renal colic. In fact, general sedatives must be looked for exclusively in the narcotic and anæsthetic class; and if the constant consumption of vital energy by disease be not compensated by sleep, we prescribe opium, chloral, or hyoscyamus.

2. **Local Sedatives.**—Under this heading we must place extreme cold, which, applied either in the form of ice, or more effectually by the ether spray, deadens the sensibility of the skin, and prevents the prick or cut of a slight operation from being felt. Next come aconite, opium, belladonna, veratria, and blisters, which soothe by a direct action on the sensory nerves, or by influencing the circulation of the parts around. These are useful in neuralgic or rheumatic pain, or in the acute suffering of superficial inflammatory conditions. Again some substances may be regarded as sedatives, in virtue of their power in allaying the excessive itching of prurigo and other chronic skin-affections. Hydrocyanic acid, carbolic acid, chloroform, borax, and chloral are among the best remedies for this purpose.

3. **Pulmonary Sedatives.**—Pulmonary sedatives are also deserving of mention, and, passing by emetics and nauseants, which undoubtedly depress the breathing power, we find that veratria, Calabar bean, prussic acid, and several other drugs directly tend to paralyse the respiratory centre, on which action the greater part of their poisonous influence seems to depend.

4. **Spinal Sedatives.**—Spinal sedatives have precisely an opposite effect to spinal stimulants, and it has been amply proved that Calabar bean, gelsemiuum, bromide of potassium, and methylconia powerfully lower reflex excitability through the cord and the great ganglia of the brain.

5. **Stomachic Sedatives.**—Irritable conditions of the mucous membrane of the stomach, giving rise to pain, vomiting, pyrosis, and other symptoms, are commonly met with, and require a considerable variety of treatment. If gastrodynia fails to yield to bismuth, soda, or hydrocyanic acid, recourse may be had to small doses of nitrate of silver or of arsenic; or blistering over the epigastrium may produce the desired effect. If vomiting be the prevailing symptom, hydrocyanic acid again proves useful, carbonic acid in the form of effervescing draughts, or minute and oft-repeated doses of nux vomica or ipecacuanha. Combined with this, we must take especial care to enjoin a mild and unstimulating dietary, of which milk and lime-water should form the principal ingredients.

6. **Vascular Sedatives.**—Vascular sedatives have the power of lowering the heart's action: and emetics and tobacco do this by the general depression following nausea and the act of vomiting. Other drugs, however, act directly on the heart itself, either by paralysing the muscular tissue of which its walls are composed, or by a more special influence over its nerve-supply. Slowing of its action may be effected either by stimulation of the inhibitory branches of the vagus, or by interference with the sympathetic ganglia which work in the opposite direction; and experiment has not in all cases made it quite clear what is the true explanation. But whatever the exact physiological explanation may be, we have some practical rules for our guidance in the use of these remedies, and more especially of digitalis, which, cardiac tonic though it be, is also a true sedative to that organ. When the heart-muscle is weak and languid, its contractions are necessarily less efficient than in health; and in order to perform its allotted amount of routine work in propelling the blood, its cavities must fill and empty more rapidly than usual. The result of this is seen in the hurried, feeble, and often irregular pulsations of the organ; and digitalis, by bracing up the muscular fibres, and giving increased tone, renders its action more efficient, and enables it to take more prolonged periods of repose. Other cardiac sedatives are aconite, veratrum viride, colchicum, and hydrocyanic acid, but they are seldom used for this purpose, although aconite, whether through its action on the heart, or on the small vessels, is very effective in early inflammatory conditions. R. FARQUHARSON.

SELTERS, in Germany.—Muriated alkaline table-water. *See* MINERAL WATERS.

SEMEIOLOGY (σημεῖον, a symptom; and λόγος, a discourse).—A synonym for symptomatology, or the doctrine of the signs and symptoms of disease. *See* Disease, Symptoms and Signs of.

SEMILUNAR VALVES, Diseases of. *See* Heart, Valves of, Diseases of.

SENILE INSANITY. *See* Dementia.

SENILITY (*senex*, an old man).—Synon.: Senile marasmus; Fr. *Vieillesse*; Ger. *Greisenalter*.

Definition.—That condition of body which usually supervenes naturally after the seventieth year, but sometimes occurs prematurely.

Senility is separated from the previous period of maturity by the climacteric stage, which in men occurs between the ages of fifty and sixty, and in women about ten years earlier. When of premature occurrence this state is commonly secondary to some exhausting illness, where failure of the trophic influence of the nervous system has been marked. All the signs and symptoms of senility have been seen in individuals under twenty years old.

We do not know why the body, after it has reached a state of maturity and vigour, should gradually decline; why, when once an even balance between tissue-waste and restitution is established, it is not maintained indefinitely. How far the failure is due to some inherent tendency, and how far to external influences, is wholly conjectural. The term 'involution' has been suggested to express the progressive senile changes in the tissues and organs.

Anatomical Characters.—The most universal structural characteristic of old age is a progressive *atrophy* of almost all the tissues and organs. The degree of wasting varies, but there is a general diminution in body-weight and height, except in persons whose climacteric has been marked by an increase of the adipose tissue, when the total loss of weight may be inconsiderable. Among the organs which exhibit simple atrophy in the highest degree, are the brain and spinal cord; the generative organs, especially the ovaries, and to a less extent the testes, the uterus, and the mammary glands; the mucous membrane and glands of the digestive tract; the bronchial and vesical mucous membranes; the spleen and lymphatic glands, the latter even to complete disappearance; and the kidneys. The teeth fall out; the muscles waste; and the bones become thin and deficient in animal matter, some, as the lower jaw, being much altered in shape. A most important change, and one that exerts a very direct influence on tissue-nutrition, is an extensive shrinking and even obliteration of the capillaries in almost all the textures. The skin becomes much diminished in thickness, especially in the papillary layer, the constituent papillæ being very indistinct; and loss of hair and change of colour are well-known features.

An exception to the almost universal atrophy occurs in the prostate, the fibro-muscular structures of which undergo considerable hypertrophy in most old men. The entire organ may be so affected, or only one lobe; and the weight has been recorded as attaining, in an extreme case, to 20 ounces. Very rarely the viscus wastes with age.

Associated with this atrophy it is usual to find *degenerations*—fatty, calcareous, or pigmentary—all of which are to be regarded as evidences of deficient nutrition, comparable to the differentiation and growth which characterise the commencement of life. The arcus senilis the atheroma and calcareous degeneration of the vessels, the calcification of cartilages, the fatty degeneration of muscular and glandular epithelial tissue, the deposition of pigment in some spots, and the deficiency of the same in the hair and skin of the coloured races, are illustrations of true degenerative changes.

The products of degeneration may accumulate in the textures, and cause them to be thicker than they are in health, as is seen in the vessels, the walls of which are often much thickened, and the meninges of the brain, which are opaque and toughened. The pericardium and endocardium, and the capsule of the liver and spleen, are similarly altered.

The blood contains fewer corpuscles and less solid constituents, is more watery, and coagulates more readily. The total quantity is less.

The semen is very frequently wanting in spermatozoa, and contains in their place granular fatty cells, like colostrum corpuscles, with a few red blood-corpuscles; but this is not invariably the case, for perfect spermatozoa are occasionally met with at an advanced age.

Physiological Characters.—The results of such structural imperfections appear in deterioration of the purely physical, as well as of the specially vital, properties of the tissues. There is an increased rigidity in some parts, as the tendons and blood-vessels; and a diminished cohesion in others, as the nails and bones, which are brittle and easily broken. Perhaps the most prominent and distinguishing mark of old age is a loss of elasticity; the skin, cartilages, blood-vessels, and lungs show this to a very marked extent, in the wrinkled integuments, dilated vessels, and distended air-cells. It has been noticed that this dilatation particularly affects the thin-walled veins, and more especially those which do not run with arteries, are more superficial in position, and are concerned less with nutrition than with the proper return of blood—the 'derivative circulation' of Sucquet. The advantage of this is apparent, for such an arrangement must be a safety-valve in the case of the brain, to which organ there is a liability to determination of blood, and where the vessels are apt to rupture; hence the frequent turgescence of the nose and ears, and development of the veins of the diploe, in the aged. The muscular contractility and nervous irritability are diminished; and degeneration of the cells of glands leads to failure in their powers of secretion.

The heart's beat is weak, and frequently intermittent, from defect in rhythmical nervous stimulation; the sounds are feeble and often altered; and there is a general tendency to venous congestion. The mean rate of pulse after the age of sixty-five years is 75, gradually diminishing to 70.

The tissues, which differ in chemical composition from those of mature life, must in their metabolism form different products of waste; whilst the altered blood, circulating in a restricted area with diminished force, must offer to the organs a different pabulum from that which they have hitherto received, supplied as it is by impaired digestive organs. The enfeebled respiration prevents complete oxidation; and the excretory organs, being degenerated, withdraw from the body less perfectly the results of metamorphosis. The quantity of urine is often diminished to 15 or 20 ounces *per diem*, in old men enjoying good health. It contains a total amount of solids less than the normal standard, but the urine itself may be relatively of higher specific gravity, and deeper colour, from its diminished quantity.

As the nutritive functions fail, so do those of the neuro-muscular system. The sense-organs imperfectly receive impressions, which are but dimly communicated to the sensorium, whence feebly emanate the impulses needful to determine movements in muscles whose protoplasmic contractility is gradually diminishing. Meanwhile the higher mental qualities, such as memory, judgment, and reason, dependent as they are upon the most perfect nutrition, gradually fail. The opposite conditions of wakefulness and drowsiness are frequently met with, and seem to be due to brain-wasting, as well as to some change in the cerebral circulation.

Notwithstanding the lowered vitality, the average body-temperature is slightly higher than it is in adult life, but the power of resisting cold is diminished.

The power of reproduction, lost by women at the climacteric, before the stage of senility sets in, is occasionally preserved by men to an advanced age.

Thus the old man presents a strong contrast in his vitality to that of the child, for whilst the life of the latter is so largely dependent upon, and so readily responsive to, external or peripheral impressions, the former lives more and more within himself; the distinctive animal functions gradually failing, as his existence becomes restricted to the performance of those of self-nutrition. The progressive impermeability of the capillaries, and the lessened vitality of the skin, alike tend to withdraw from the surface towards the central organs the manifestations of life.

Diseases of Old Age.—In a certain number of cases, the progressive deterioration in structure and failure in functional capacity mutually adapt themselves, and produce an old age which may be as healthy as the maturity or childhood may have been. But in the course of the changes which mark this period, the body is liable to certain influences, both intrinsic and extrinsic, which lead to diseases characteristic of this stage of life, as there are those of infancy and puberty. Death from old age, when the organs have gradually and uniformly failed, is not unknown, but the fatal end is more commonly due to some disease, which has either lasted from an earlier period, or is especially the acquirement of this stage.

The maladies particularly characteristic of old age are marked by certain general features, which they owe to that condition of nutrition in which the tissues are at this period. Thus, as a rule, they present but little activity in their progress, or but slight severity in symptoms, though they are none the less likely to bring about a fatal result, from the ill-resisting power of the whole system. Diseases of an acute character are rare at this time, and such as do occur assume an adynamic form and are very liable to run a most insidious and even latent course. When once established, an illness tends more perhaps towards maintaining an isolated attitude, without those sympathetic disturbances of many other organs so pre-eminently the case in children. The power of reaction possessed by the aged is but very slight; owing to this, diseases readily lapse into a chronic state, or even present a chronic character from the outset, whilst comparatively trifling causes may lead to serious results.

There is probably no single disease which is met with in advanced age only; rather is it the case that many diseases which prevail at certain periods of life are wanting in old age. The degeneration of every tissue and organ entails a failure in function; and should this failure predominate in any one system, we have some exception to what may be taken as the normal standard of the senile state, and therefore a disease of it. The same difficulties surround the question why one set of organs should be affected rather than another, as at other ages; but there nevertheless does exist a preference towards affections of the brain, heart, and lungs.

Diseases of the brain.—The cerebral lesions may be a general senile wasting and softening, with complete enfeeblement of nerve-function; or of a more localised character from rupture or occlusion of some vessel. The liability to venous engorgement is very prone to manifest itself in the brain, and cerebral congestion of varying extent is frequent. The cerebral vessels are especially prone to atheromatous changes, and hence the great frequency of apoplexy in old age. The meninges are free from morbid change beyond thickenings, and offer none of the inflammatory conditions so common in early life.

Diseases of the heart.—The degeneration of the cardiac substance may lead to a state of asthenia, gradually becoming fatal; dilatation of the orifices may be the more prominent lesion, with all the consequent symptoms of obstructed circulation; or they may be constricted, from atheroma or thickening of the cusps or rings. All degrees of cardiac dyspnœa are met with; and every form of irregularity in cardiac rhythm.

Diseases of the lungs.—Pulmonary diseases are important, since they are commonly the immediate causes of death in the aged. A bronchial catarrh, or at least a considerable increase in the bronchial secretion, is a normal state in the very old; and this has been regarded as a compensation for the arrested skin-action. The transition from this to severe bronchitis is both easy and frequent, and is favoured by the liability to lung-congestion, and the enfeebled heart-power. Even more serious is a senile form of lobular pneumonia, which seems to be set up in the congested and œdematous areas, possibly as a further stage of the bronchitis. Such pneumonia is of very frequent occurrence, and often requires care-

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fully looking for, since direct symptoms are wanting. When a generally ill-defined illness is present in an old person, this condition should be suspected.

Diseases of the digestive organs.—The digestive organs, supposing they have escaped the dangers of earlier periods, are not often the seat of disease at this time of life. The perversions of function they present, such as constipation and flatulence, may be conveniently comprised under the term atonic dyspepsia, and are mainly to be attributed to deficient muscular power in the alimentary canal, and to a deficiency in the digestive fluids. Nevertheless, a good appetite and very fair digestion are far from being the exception in old people. An acute form of diarrhœa of a dysenteric character has been described as occurring at this period.

Diseases of the skin.—The skin, which suffers so much diminution in nutrition and thickness, often exhibits as a result marked changes in sensibility, even to the existence of an intolerable pruritus, no cause for which is visible. The scratching which is resorted to for relief sets up a prurigo which intensifies the discomfort. The unhealthy integument offers a very favourable nidus for pediculi, and phthiriasis is accordingly a common senile affection.

Diseases of the urinary organs.—Recent observations go to show that the senile kidney is in a condition of diffuse interstitial nephritis, with progressive atrophy of the tubes, similar in many respects to the 'gouty kidney,' but not, like it, associated with cardiac hypertrophy. The urine is in such cases albuminous, but the general symptoms of Bright's disease met with in middle life are usually wanting. Glycosuria, often intermittent, is of very frequent occurrence in old people; but is rarely attended by the constitutional disturbance of diabetes. Notwithstanding the very imperfect action of the skin and kidneys as excretory organs, diseases directly attributable to non-elimination of waste-products are not characteristic of old age, except, of course, so far as helping in the general degeneration.

Irritability of the bladder, or even vesical catarrh, is very common in old men, being largely determined by the prostatic enlargement; and both retention and incontinence of urine follow, from the diminished tone of the viscus.

Vascular disease.—The tendency of the blood to coagulate, added to the opportunities it has for stagnating in the dilated channels and cavities of a weak heart, makes thrombosis and embolism characteristic lesions of the senile state. The result of the obstruction is gangrene (*gangræna senilis*), which is readily established in tissues the capillaries of which have wasted or are obliterated, with corresponding deficiency of nutrition.

Arthritic lesions.—Very few old people escape chronic rheumatism in one or other of its many forms. The fibrous tissues of the joints, fasciæ, and tendons are thickened, with the result of producing that stiffness of the limbs so characteristic of the aged. The pain is rarely acute, but it is lasting, and aids in bringing about the general deficiency of motor power. Renal disease is to be found in a large proportion of these cases. True gout is scarcely a disease of old age, though often continued on from an early period of life.

Scrofula, Cancer, and Syphilis.—Sir James Paget refers to a senile form of scrofula occurring in people over sixty years of age, in whom the constitutional signs have appeared in early life, with almost complete freedom during maturity. He describes the general features of this condition as being similar to those in childhood, but slower in their course, and more complete in the degeneration produced. The cancerous and syphilitic cachexiæ very rarely manifest themselves for the first time in old age.

Treatment.—Old age itself, as a period of life, is clearly no more to be treated as such than life at any other stage. But regarded as a marasmus or cachexia, it has been sought to avert it as long as possible, or mitigate its effects; and for the attainment of longevity many means have been proposed, though as yet without any reliable result, the most diverse plans having been equally successful or futile. *See* Personal Health.

It is unnecessary in the present article to explain the treatment of the diseases of old age, as appropriate remedies are set forth under the special headings. It is sufficient here to indicate that, whatever may be the malady, and whatever be the treatment pursued, it must not be forgotten that we are dealing with organs in which the structure is deteriorating and whose vitality is failing, and that all measures of a depleting or depressing character must be avoided. The patient must be nourished in every way by food, stimulants, tonics, and such remedies; and this rule must not be departed from on any account. The power of secretion being so diminished, the efficacy of drugs is often lessened, and their good effects but imperfectly manifested. Among the most important hygienic indications is the maintenance of warmth. A fall in temperature both lowers the general vitality, and establishes a local disease, and its effects are more easily prevented, than cured when once established.

W. H. Allchin.

SENSATION, Disorders of.—The sensory apparatus—consisting of, 1st, a peripheral end-organ for receiving impressions; 2nd, an afferent nerve which conducts them; and, 3rd, a ganglionic nerve-centre which undergoes a change, perceived by the consciousness as a feeling—may be disordered in various degrees. The lesion occasioning the disorder may exist at any point of the apparatus. As regards (A) the nerves of *special sensibility*—the olfactory, optic, auditory, and gustatory, the terms *hyperæsthesia* or *excess of feeling*, and *anæsthesia* or *want of feeling*, are applied respectively to conditions of exaggerated or defective sensibility. In reference to (B) the remaining sensory nerves, the perceptions produced by which are known as *common sensations*, the same terms are used, as well as certain others indicating perversions of sensibility, which can scarcely be included in this simple classification. There is a good deal of confusion existing in the employment of these terms, and their use can only be defended on account of their possessing a certain amount of convenience for purposes of distinction. *Pain* is separately described. *See* Pain.

A. Special sensibility.

1. *Olfactory hyperæsthesia.* This is probably always of central origin. It is shown by subjective sensations of strong, usually disagreeable, odours; and occurs occasionally in the insane and epileptic, as well as in hysteria.

2. *Olfactory anæsthesia.* SYNON.: *Anosmia.*—This is occasionally congenital, but otherwise rare, and (unless where the mucous membrane of the nares has been destroyed by ulceration) is usually dependent on disease of the brain, or growths upon the olfactory lobes. It may also arise from laceration of the olfactory filaments, as a result of *contre-coup* in blows upon the occiput. There may be complete anosmia, whilst the common sensibility of the nares is retained. On the other hand, in peripheral lesion of the fifth nerve there may be partial loss of smell, owing doubtless to impaired nutrition of the nasal mucous membrane. Integrity of the mucous membrane is apparently necessary (probably for mechanical reasons) to the perfect functioning of this special sense. It sometimes happens that there are subjective sensations of bad odours, where the power of perceiving objective odours is absent. Anosmia may occasionally result from a long-continued nasal catarrh, and is then probably connected with some modification of the mucous membrane which receives olfactory impressions.

3. *Optic hyperæsthesia.*—This disorder is marked by the production of luminous and chromatic sensations, independent of external influences. The disordered function may be caused by, or associated with, coarse disease of the brain, overstimulation of the optic nerve by light, insanity, delirium tremens, epilepsy, or hypochondriasis. Spectra of luminous angularities, resembling the lines of fortifications, showers of sparks, or bright colours occur sometimes in the course of migraine. A subjective sensation of colours (most often red) occurs occasionally as the aura of an epileptic fit.

4. *Optic anæsthesia.*—This may depend upon changes in the retina, in the trunk of the optic nerve or tract, or in the nervous ganglia which form its central termination. The terms *amblyopia* and *amaurosis* are usually employed to designate different *degrees* of imperfect vision, the latter the most advanced. *Amblyopia* is often met with in the disused eye in cases of strabismus, without any structural change being necessarily capable of detection by the ophthalmoscope, such as would explain the loss of nervous sensibility. In some instances, however, of this kind, the optic disc has a shrivelled, ill-nourished look; it is dull; and the retinal vessels are small. Amblyopia may consist in a general obscurity of vision, a deficiency in the power of definition, a contraction of the field of vision, or anomalies of colour-vision. It occurs occasionally in hysterical hemianæsthesia, and is then limited to one eye, on the same side as the other defects of sensation; it is frequently the prelude of an epileptic fit.

Ophthalmoscopical examination of the eye, together with the patient's general condition, will usually reveal the cause with facility. *Amblyopia* may be a symptom of *optic neuritis.* The optic neuritis will probably be dependent upon tumour, abscess, aneurism, or some coarse change within the cranium, such as meningitis. Or there may be *neuro-retinitis*, in which the retina still more largely participates in the inflammatory changes, a condition liable to be induced, amongst other causes, by syphilis, diphtheria, or over-lactation. But the symptom is frequently absent in both conditions up to a certain point, the patient being able to read small print even when the pathological changes are strongly pronounced. Sometimes amaurosis also occurs in diabetes, from retinal changes. In *hemeralopia* there is retinal torpor, which is sometimes not accompanied by any manifest structural change. The disorder is connected with anæmia, impaired nutrition, and various causes of exhaustion, and is especially common in scurvy. It may occur in Bright's Disease, but is here found associated with hæmorrhages and other changes characteristic of albuminuric retinitis.

5. *Hemiopia.*—This is a condition in which a half of the field of vision—usually a lateral half—is cut off. It may depend upon coarse disease, such as a tumour or clot, pressing upon an optic tract. It occurs sometimes in hemiplegia, complicated with paralysis of the third nerve opposite to the side on which the limbs are paralysed, and depends then upon lesion of the corresponding crus cerebri. It is frequently seen in a hemiplegia which is attended with strongly marked and persistent anæsthesia of the affected limbs, and dependent upon coarse disease in the neighbourhood of the optic thalamus. It is not rarely met with also, but only as a transient symptom, in migraine. It is occasionally, but only seldom, met with in hysteria.

6. *Auditory hyperæsthesia.*—In certain states of nervous exhaustion in fever, and sometimes in hysteria and hypochondriasis, sound-producing vibrations painfully affect the auditory nerve. It is doubtful whether the proper function of the nerve is ever really much intensified. Pain, rather than an increased power of hearing, is the result of hyperæsthesia of the auditory nerve.

7. *Tinnitus aurium.*—This is almost always subjective, although it must be borne in mind that an aneurism in the neighbourhood of the temporal bone may occasion this condition, and this may possibly give evidence of its presence on auscultating the skull. The sounds may be of various kinds—rumbling, musical, roaring, hammering—and may depend either upon some irritation of the auditory nerve itself, or upon affection of some other part of the organ of hearing. It seems probable that affection of any portion, from the external auditory meatus to the Eustachian tube, may give rise to the condition. The difficulty of diagnosing the seat of the affection is very great.

Tinnitus aurium may also be dependent upon some altered condition of the walls of blood-vessels, in connection with anæmia or cerebral congestion. It is often produced by large doses of quinine. In certain cases it is of central origin. The sensation of a loud noise occasionally marks the commencement of an epileptic seizure or of a syncopal attack. Deranged digestion may produce it. There may be subjective sensations of sound in an ear which is quite deaf to external impressions.

Careful examination of such parts of the auditory apparatus as can be reached should be made, ere a conclusion is come to respecting the origin of tinnitus aurium in a particular case. It is not uncommonly found to be dependent simply upon an accumulation of wax in the external auditory meatus. Tinnitus aurium is very often associated with vertigo. Not uncommonly occurring in persons of gouty habit, it is possibly caused, in such cases, by some deposit in a joint of the ossicles, causing inflammation and stiffness.

Tinnitu aurium is always a distressing, and often an intractable, affection. Where it depends upon some anæmic condition, it is most likely to be cured by remedies appropriate to this state. Of course, if caused by accumulation of wax, the removal of this is a simple remedy. Subjective sensations of sounds, especially of voices of men or animals, occur frequently in various forms of insanity, in which case they are spoken of as hallucinations.

8. *Auditory anæsthesia.*—This may be due to disease or suspended functional activity of the auditory nerve; and probably, in some cases, to lesion of the superior temporo-sphenoidal convolution of the brain—Ferrier's centre for hearing. Hardness of hearing and deafness are the forms taken by varying degrees of acoustic anæsthesia. The cause may be disease in the osseous labyrinth of the bone itself or its lining membrane, or tumours which cause compression and atrophy of the nerve, basilar meningitis, extravasations, or new formations. Syphilis may bring about acoustic anæsthesia by causing periostitis and consequent pressure upon the auditory nerve. A most fruitful source of deafness is disease of the temporal bone from scarlatina. In some instances the auditory nerve is atrophied, as part of that generalised disorder of the sensory nervous system which is called locomotor ataxy. In cases of so-called nervous deafness enquiry should be made as to the occurrence of 'lightning pains,' and the state of the patellar tendon reflex should be investigated.

Disease of the pons Varolii or medulla oblongata may occasion deafness, through lesions affecting the nucleus of the auditory nerve or the commencement of its trunk. It is more likely than not that in these circumstances the auditory nucleus would not suffer alone, but that there would be evidence of other cranial nerves being involved, which would aid the diagnosis.

9. *Gustatory hyperæsthesia.*—This disorder occurs probably only in the course of mental and epileptic disorders, where the subjective sensation of a taste (most often perhaps of an offensive character) is sometimes complained of. Such a condition is of central origin.

10. *Gustatory anæsthesia.*—This is of frequent occurrence. There may be a total inability to appreciate the taste of substances applied to the tongue, or more or less delay in their recognition. It is sometimes observed in cases of peripheral paralysis of the facial muscles, and then depends upon the lesion of the portio dura involving the chorda tympani. It is the anterior portion of the tongue which, in such circumstances, exhibits the loss of function. So also in disease of the trigeminus in the floor of the skull, there is frequently gustatory anæsthesia in the anterior portion of the tongue. The glosso-pharyngeal nerve by its terminal branches presides over the sense of taste in the posterior third of the dorsal aspect of the tongue. Disease or lesion of the trunk of this nerve destroys the sense of taste in this region. *See* TASTE, Disorders of.

The disorders of special sensation which we have described are so bound up with lesions of the various nerves subserving the functions, or of the nervous centres, that they can only be considered from an ætiological and therapeutical point of view in connection with these. Reference must, therefore, be made to the sections devoted to such lesions.

B. Common Sensibility.—Disorders of those centripetal nerves, the perceptions produced by which are known as 'common sensations,' are considered under the head of TOUCH, Disorders of. T. BUZZARD.

SEPTIC (*σήπω*, I make rotten or putrid; I make fester or mortify.)—This word is used with some vagueness. It has been employed in both the senses indicated by the derivation, that is, either as merely synonymous with putrid, or as signifying some special or even specific virulence in decomposing matter. The confusion will be better understood by referring to the definition of SEPTICÆMIA. There is no doubt the word had better be abandoned, and *putrid* used in its stead; or else that it be clearly understood to have no meaning beyond putrid. MARCUS BECK.

SEPTICÆMIA (*σηπτικὸς*, putrid, and *αἷμα*, blood).—SYNON.: Fr. *Septicémie*; Ger. *Septicämie.*—This term properly means the condition produced by the entrance of septic matter into the blood. Great confusion has, however, been caused by using it to signify two entirely distinct conditions. The first of these cannot be better defined than in the words of Dr. Burdon Sanderson, in his Lectures on the 'Infective Processes of Disease' (*Brit. Med. Journ.*, Dec. 29, 1877). He says: 'What I mean by *septicæmia* is a constitutional disorder of limited duration, produced by the entrance into the blood-stream of a certain quantity of septic material. It must, therefore, be regarded, not so much as a disease as a complication, differing from pyæmia, not only in the fact that it has no necessary connection with any local process, either primary or secondary, but also in the important particular that it has no development. Pyæmia is a malignant process which goes on and on to its fatal end; but in the case of septicæmia, inasmuch as the poison which produces it has no tendency to multiply in the organism, there is no reason why the morbid process should not come to an end of itself, unless either the original dose is fatal, or a second infection takes place from the same or another source.' The process here described is merely poisoning by the absorption of the chemical products of putrefaction. It is no more an infective process than the poisoning that would result from the application of arsenic, mercury, or any other inorganic substance to a raw surface.

On the other hand, Koch of Berlin, Davaine, and many others include under the term septicæmia all those cases of general infection from a wound in which no metastatic inflammations are present. Koch especially describes as septicæmia in mice a disease in which, as the result of the inoculation of an infinitesimal dose, the animal dies within a certain period, without the formation of any secondary local centres of inflammation. The blood, however, is so completely impregnated with the poison that merely scratching the ear of another mouse with a needle dipped in the opened heart of the first, is sufficient to start a similar process in that animal, and so on indefinitely. In this case the process is truly infective, and the poison multiplies in the body of the animal. The poison has been shown by Koch to consist of a distinct form of microscopic organism.

These two conditions must be kept distinct if we are to avoid confusion. In both forms the development of the poison is associated with putrefaction, in the first necessarily, in the second accidentally. The former is an inevitable consequence of the entrance of the products of putrefaction into the circulation; the latter can only occur if the specific organism, which is the cause of it, should happen to find a place amongst those which are necessarily associated with all putrefactive changes. The latter also, although usually originating in conjunction with what we ordinarily speak of as putrefaction, can be transferred from animal to animal by inoculation, without the intervention of any putrefactive process whatever.

If, therefore, we use the word *septic* as meaning no more than putrid, the two conditions indicated above, at present often indiscriminately spoken of as septicæmia, may be defined as follows:—

Septic poisoning.—The effects produced by the absorption of a poisonous dose of the chemical products of putrefaction.

Septic infection.—An infective disease caused by the entrance into the blood, and by the multiplication therein, of a specific organism most commonly developing in wounds or cavities, the fluids of which are at the same time in a state of putrefaction.

It must be understood that this article is merely intended to indicate the meanings of the word *septicæmia*. The fuller discussion of the subject comes under Pyæmia. *See* PYÆMIA.

MARCUS BECK.

SEPTUM CORDIS, Deficiency of. *See* HEART, Malformations of.

SEQUELÆ (*sequor*, I follow).—Consequences or sequels. This word is applied to symptoms or morbid conditions which either remain or supervene after various diseases have run their course; such as renal disease after scarlatina, paralysis after diphtheria, or cardiac disease after acute rheumatism.

SEROUS CYST.—A cyst containing serous fluid. *See* CYSTS.

SEROUS FLUID } In physiology the liquid
SERUM }

portion of the blood, which separates after coagulation, is named *the serum*, and this is taken as a type of fluids of more or less similar composition, consisting of a watery solution of albumin with certain salts. In pathology we have to deal with serum outside the blood-vessels, either as a mere dropsical accumulation, or as a consequence of inflammation. It may be thus met with in the cellular tissue under the skin or a mucous membrane, and in other parts; in serous cavities; in certain organs, as the lungs and the ventricles of the brain; or as a discharge from the surface of the skin, as in cases of eczema. Its precise composition varies considerably under different circumstances. Clinically serous fluid is, as a rule, of most importance on account of its mechanical effects, when it accumulates in quantity in various parts, and these effects may be most serious. Its presence can usually be detected by objective or physical examination. The treatment required will be either that for dropsy or inflammation, modified by local considerations, according to the principles laid down in other special articles.

FREDERICK T. ROBERTS.

SEROUS MEMBRANES, Diseases of. SYNON.: *Maladies du système séreux*; Ger. *Krankheiten der Serösenhäute.*—These constitute an important class of diseases, and although they are discussed under the headings of the several serous membranes, it will be advantageous to consider them generally, according to the plan followed in the case of the mucous membranes. These membranes line closed cavities, except the peritoneum in the female, which communicates with the uterus through the Fallopian tubes, and thus with the exterior of the body. They consist of a basement-membrane, covered with epithelium, usually of the scaly variety, and a subserous cellular tissue underneath. In addition to their more obvious function, of allowing free movement for organs, they are intimately connected with the absorbent system, the vessels of which freely open on their surfaces. Fibro-serous membranes constitute a variety in which there is an outer fibrous covering, lined by a serous layer, of which the pericardium is an example. These introductory remarks will clear the way for the consideration of the nature and causes of the diseases of serous membranes, which will now be pointed out.

1. **Injury.**—The serous membranes are liable to be injured from without, chiefly as the result of wounds penetrating the cavities which they line, but also by fractured bones, especially in the case of the ribs and skull. It is believed that a severe external contusion may affect an underlying serous membrane. Another important cause of injury to these structures is some perforation or rupture taking place within the body (*see* PERFORATIONS and RUPTURES). They are frequently more or less injured in various operations. Any kind of injury to this class of membranes was formerly regarded with great dread, and operations in which they were in any way interfered with were considered highly dangerous; more recent experience has, however, shown that mere damage to a serous membrane is not serious in itself. More or less grave consequences are liable to follow, from hæmorrhage; from the admission of air, especially if it contains septic matters; or from the escape of solid or liquid materials into a serous cavity. In addition to their direct effects, these often set up inflammation, which may prove fatal.

2. **Inflammation.**—Serous inflammations are

of common occurrence, and without entering into details, their causes may be thus summarised: (*a*) Some injury from, without including that set up by fractured bones. (*b*) Perforations and ruptures within the body, the inflammation being then mainly due to the materials which gain access into the serous cavity. (*c*) Mechanical or chemical irritation of any kind. Many cases belonging to the former groups would come under this one; as well as those in which inflammation is set up by necrosed bone, diseased organs, and tumours, or as the result of over-distension of a serous membrane. This class would also include those cases in which a serous inflammation is purposely excited by the injection of certain chemical irritants. The occurrence of peritonitis from the entrance into the peritoneum of materials from the uterus may also be mentioned here. (*d*) Morbid growths in connection with a serous membrane. These deserve separate mention, though they likewise act by causing local irritation. (*e*) Extension of inflammation from other structures. In this way the morbid process may pass from one serous membrane to another. Serious forms of inflammation may probably extend to the serous membranes by means of the lymphatics. (*f*) Certain general states of the system, in connection with low fevers, Bright's disease, and other affections. (*g*) Causes acting upon the general system from without, such as cold, when the inflammation is said to be *idiopathic*. Different serous membranes present different degrees of liability to be affected by one or other of the causes mentioned; and these produce different effects, according to their nature.

Cases of serous inflammations present much diversity as regards their severity and rate of progress, and the morbid changes are thus materially influenced in their character, as well as by the cause of the inflammation, the particular membrane affected, and other circumstances. In general terms they may be grouped as *acute*, *subacute*, and *chronic* in their origin and course; but those which are more or less acute at first often leave behind permanent morbid conditions. Taking an ordinary case of an acute serous inflammation, running a regular course, it presents the following more or less obvious stages in its anatomical characters:—(*a*) Increased vascularization, consequent redness of the membrane, and sometimes small hæmorrhages, accompanied with dryness, loss of polish, opacity, and swelling. (*b*) Deposit of organisable lymph or fibrinous exudation upon the surface, containing a variable number of cells. (*c*) Effusion of fluid into the serous cavity, more or less of the nature of serum, but also containing a variable proportion of fibrin and cells. (*d*) Absorption of the fluid. (*e*) The formation of fibrous thickenings, or of adhesions, bands, or agglutinations between the opposing surfaces of the serous membrane.

Such being the usual course of events in a typical case of serous inflammation, it must suffice to point out, without entering into any details, some of the more common variations. There may be little or no fluid, the exudation being the prominent morbid product. This exudation varies much in its quality, and may be of a very low, unorganisable type, resembling in some instances thick pus. Again, the effusion is, under certain circumstances, liable to become sero-purulent or actually purulent, or it may be so from the first. In other conditions it is hæmorrhagic. Its quantity is very variable. There is a class of cases in which the prominent morbid change is the accumulation of a serous effusion, not uncommonly in large amount, and it may take place very gradually and insidiously. The slow and chronic formation of localised adhesions is very common in connection with serous membranes, without any clinical indications of their development. Gas may be present in serous cavities in cases of inflammation, and then results secondarily from decomposition of the effusion. In rare instances pus collects in the subserous tissue; or actual destruction or gangrene may occur.

With regard to the extent of the disease, cases of serous inflammation are usually divided into *general* or *diffuse*, and *local* or *circumscribed*, though the former terms do not necessarily imply that the whole of a serous membrane is implicated. As a rule the effusion is freely movable in the cavity, but it may be more or less limited by former adhesions, or even completely loculated and encysted. Serous inflammations are often accompanied with changes in the organs and structures which they cover, these being either the cause or effect of such inflammatory changes. Moreover, an effusion, especially if purulent, may open in various directions, and thus originate secondary consequences more or less serious. Not uncommonly it has to be removed by operation.

Pathologists are not quite agreed as to the microscopic changes which take place in inflammation of serous membranes, but the following are the chief points to be noticed. The epithelium undergoes marked changes, its cells usually becoming enlarged and swollen, granular, and cloudy, whilst its nuclei divide and multiply, and active proliferation goes on. In low forms they merely undergo fatty degeneration and destruction, and are shed abundantly. The fibrin escapes from the blood-vessels, and migration of corpuscles also takes place. The cells in the substance of the serous membrane, and the connective-tissue corpuscles proliferate more or less. Vascular granulations often form on the surface, which are believed to be of much service in absorbing the effusion, as well as in forming adhesions. Pus-cells are derived from the epithelium, and from migration. Adhesions ordinarily result from the development of the cellular elements in the exudation, the fibrin undergoing fatty degeneration; after pus is formed they originate by granulation. In these adhesions blood-vessels, elastic fibres, lymph-chambers, and even nerves may ultimately be developed.

3. **Dropsical Effusion.**—The serous cavities are often the seat of a mere dropsical accumulation, owing to the escape of fluid of a more or less serous character from the vessels. It may be in very large quantity, and collect either rapidly or gradually. Sometimes it is not easy to draw the line between an inflammatory and a dropsical effusion; and it is probable that the latter, by distending a serous membrane, may really set up a secondary inflammatory condition. The fluid is occasionally blood-stained. The condition may be entirely local, or a part of a more

or less general dropsy. It may arise from:—(*a*) Local obstruction to the venous circulation, which is best exemplified by ascites associated with portal obstruction. (*b*) General obstruction to the circulation, in certain cases of cardiac and pulmonary disease. (*c*) Bright's Disease. (*d*) Chronic adhesions and thickenings originating in past inflammation; and morbid growths, such as tubercle or cancer. These probably act by pressing upon the small vessels. (*e*) Exposure to cold, sudden suppression of chronic skin-diseases, and other causes which are supposed to originate active internal congestion.

4. **Hæmorrhage.**—As has been already stated, more or less blood may be present in inflammatory or dropsical effusions in serous cavities. As a distinct morbid condition, hæmorrhage into these spaces may be due to:—(*a*) External injury. (*b*) Rupture of an organ, whether healthy or diseased. (*c*) The bursting of an aneurism. (*d*) The rupture of vessels in connection with some morbid growth, especially cancer. (*e*) Purpura and scurvy in exceptional cases.

5. **Accumulation of Gas.**—This condition, in connection with serous cavities, may result from:—(*a*) Decomposition of inflammatory products, or of gangrenous materials. (*b*) Perforation or rupture of a hollow organ containing air or gas, whether due to external injury, or originating from within. This accounts for most cases of escape of air into the pleura from the lung, and of gas from the intestine into the peritoneum. (*c*) Transmission of gas through the walls of a hollow viscus into a serous cavity, which sometimes happens in the case of the intestine. The gas varies much in its composition, according to the cause of its presence, and its seat. In pneumothorax it is usually modified air; in pneumoperitoneum it is offensive and fœtid. Not unusually the gas is associated with inflammatory effusion or other materials; or it may set up inflammation, and cause effusion.

6. **Foreign Materials.**—Various objects may be found in serous cavities, either introduced from without, as the result of injuries; or having entered from internal organs, especially in the case of the abdomen. Amongst others may be mentioned dirt, bullets or shots, food, fæces, urine, worms, and calculi. These are very liable to set up inflammation, often of a very severe and dangerous character.

7. **Morbid Growths.**—Tubercle and cancer are the two important growths which may be found associated with serous membranes. In the folds of the peritoneum accumulation of fat often occurs. Amongst rare morbid formations may be mentioned hydatids; cysts of different kinds; fibromata; myxomata; and remnants of blood-clots. They may produce inflammation or mere serous effusion.

8. **Malformations.**—The serous membranes sometimes present unusual arrangements, especially the peritoneum, and these may become of clinical importance.

SYMPTOMS.—The clinical phenomena which are associated with diseases of serous membranes come within very defined limits, and can be readily understood, as the following outline will show.

1. *Morbid sensations.*—Pain is usually a prominent symptom in acute serous inflammations. It is not uncommonly very severe; variable in its character, but often sharp and darting; subject to exacerbations; and increased by any movement or action which disturbs the inflamed membrane. Where the membrane can be affected by pressure, as in the case of the peritoneum, marked tenderness is observed, and it may become extreme. It must be remembered, however, that pain is not a necessary accompaniment of acute serous inflammation. In connection with adhesions and thickenings, painful sensations may be experienced, owing to the implication of branches of nerves; and also in other conditions associated with chronic inflammation. Another kind of morbid sensation, often felt in diseases of serous membranes, is that of distension or fulness, due to various accumulations in their cavities.

2. *Effects on neighbouring structures.*—These account for most of the prominent symptoms associated with diseases of serous membranes. (*a*) Acute inflammation will at first cause irritation of certain muscular organs, such as the intestines, bladder, or heart, and thus excite or disturb their actions. A similar effect is liable to be produced on the brain and spinal cord. Subsequently these organs tend to become weakened, or even paralysed, owing to their tissues being involved in the inflammatory process; and thus striking, or even dangerous, symptoms may arise. (*b*) The various accumulations in serous cavities produce more or less mechanical effects, often of great importance, especially if the accumulation take place rapidly. The most evident are distension of the walls of cavities lined by serous membranes; compression of organs and tubes, as of the lungs; displacement of various structures; and embarrassment of the action of organs, such as the heart and lungs. In these several ways not only may subjective sensations be produced, but different objective phenomena, which may prove very serious, or even fatal. In the case of the arachnoid, lymph may affect important nerves, by enclosing and compressing them. (*c*) Another important class of symptoms are those due to the effects of adhesions, agglutinations, thickenings, or morbid growths. Thus organs may be fixed in abnormal positions, their actions interfered with, different structures directly pressed upon, or hollow organs strangulated and obstructed. *See* ADHESIONS.

3. *Ruptures and discharges.*—Accumulations in serous cavities may rupture in various directions, and in this way originate symptoms. If they burst internally, they will also probably set up secondary lesions, with their corresponding phenomena. When liquid accumulations open into organs which have an external communication, such as the lungs or intestines, they are discharged. They may also burst externally, either directly, or after having first made their way into the subcutaneous tissue.

4. *Physical signs.*—These are of great importance as clinical indications of morbid conditions of most of the serous membranes, of which they may be the only evidence. They are described in other appropriate articles, and it must suffice to state here that they reveal one or other of the

following conditions:—(*a*) Some deposit upon, or roughness of, the surfaces of the membrane, associated with inflammation or morbid growths. (*b*) Accumulation of a fluid, of whatever kind, and whether freely movable in the cavity or localised. (*c*) A collection of gas, or of gas and fluid together. (*d*) Adhesions or agglutinations. (*e*) The presence of solid masses, due to inflammatory thickening, or to morbid formations, especially cancer. (*f*) Physical effects produced on organs by the abnormal state of the serous cavities.

5. *General symptoms.*—The system is liable to suffer in different ways in cases of disease of serous membranes. Thus syncope, shock, or collapse may occur in connection with injuries and hæmorrhages. Inflammation causes pyrexia, usually varying much in degree, but in some instances very high. Septicæmia may arise from the absorption of inflammatory products of low type; and collapse occurs in many cases of peritonitis. Signs of the general cachexia may be present in cases of cancer or tuberculosis.

TREATMENT.—It is scarcely practicable to give any serviceable general outline of treatment directed to diseases of serous membranes, this being so much influenced by a variety of circumstances. In the large majority of cases the measures adopted have some relation to acute inflammation, being intended either to prevent, limit, or subdue this process; to get rid of its products, either by absorption or in other ways; to obviate or relieve its effects upon organs and other structures; to alleviate symptoms; and to affect the general condition. Attention may also have to be directed to the after-effects of inflammation, in the way of adhesions, or to similar conditions arising from chronic inflammation. In a considerable group of cases the object of treatment is to endeavour to remove accumulations, especially of fluid, from serous cavities, whether of inflammatory or other origin. For this purpose it is not uncommon at the present day to resort to operative interference, by means of aspiration, tapping with the trochar and cannula, and other methods. General and local rest are often of much service in the treatment of morbid conditions connected with serous membranes; and local applications are also frequently useful for various purposes. Bleeding, either general or local, has been extensively practised, and is still, in the treatment of serous inflammations, and also the exhibition of calomel and opium; but, in the writer's opinion, the routine adoption of this line of practice cannot be too strongly deprecated. Medicines and local measures which tend to promote absorption are often of decided value, especially in the case of inflammatory or dropsical effusions.

FREDERICK T. ROBERTS.

SERPIGINOUS (*serpo*, I creep).—This term is used in connection with certain morbid conditions, such as ulcers or eruptions, when they spread in a creeping manner.

SETON, Use of.—A method of counter-irritation, which consists in the insertion of a tape or cord beneath the skin. *See* COUNTER-IRRITANTS.

SEVENTH NERVE, Diseases of. *See* FACIAL PARALYSIS; FACIAL SPASM; HEARING, Disorders of; SALIVATION; and TASTE, Disorders of.

SEVILLE, in Spain.—A variable, rather bracing, inland winter climate. *See* CLIMATE, Treatment of Disease by.

SEXUAL FUNCTIONS IN THE FEMALE, Disorders of.—INTRODUCTION.—The influence of the sexual functions on the general health is alluded to in the article PUBERTY, Disorders of. But, as the ætiological importance of the reproductive system is by no means limited to that period, we may here briefly consider the effect of sexual disorders generally on the bodily health.

The connection between female sexual disorders and some of the derangements of the general health hardly admits of any satisfactory explanation beyond their dependence on reflex action originating in utero-ovarian irritation. Long, however, before this doctrine was applied to these complaints, their existence in connection with uterine and ovarian disorders was well-recognised, and was ascribed by old writers to what they termed the *consensus nervorum*, or sympathy, by which, as Prochaska says, 'the operation of a stimulus is not limited to the nerves immediately irritated, but is extended to distant parts in known or unknown connexion with the irritated nerves.'

The remarkable difference in the constitutional sympathies with sexual disorders in the opposite sexes, is accounted for by the comparatively subordinate character of the male reproductive organs. In the female, on the contrary, the utero-ovarian functions are connected with every vital action, from the evolution of puberty until the climacteric period, which terminates her distinctive sexual or reproductive life, is passed. Woman is therefore always liable, as Dr. Storer observes, 'to a host of diseases peculiar to her sex, to which we find neither homologue nor analogue in man.'

ÆTIOLOGY.—First, with respect to the effect of the general health in the causation of sexual disorders in women, there can be no doubt that these are in many cases the result of some constitutional diathesis. Of the large number of patients suffering from chronic uterine disorders, such as endometritis, cervicitis, ulceration and areolar hyperplasia of the cervix, ovaritis, pelvic or ovarian abscesses, sterility, repeated miscarriages, and all the derangements of menstruation that have come under the writer's care, the majority were of well-marked strumous diathesis, or suffered from scrofulous disease of other parts. The most common of uterine diseases is cervicitis, and in it the scrofulous form of inflammation is generally evident. The inflammatory action in these cases is attended by a characteristic tendency to produce excoriations of the cervical mucous membrane, resulting in typical strumous ulcers, which are tedious beyond patience in their cure by the local applications generally relied on, but yield readily when these are conjoined with appropriate constitutional treatment.

Gout and rheumatism, neuralgia, and secondary syphilis, should also be recognised as amongst the occasional constitutional causes of chronic uterine or peri-uterine disease. In all such cases the functions of the affected organs are deranged to a greater or less extent.

RESULTS.—We turn next to consider the converse question—the effect of sexual disorders on the bodily health. In many instances the local symptoms of uterine and ovarian complaints attract so much attention, that the practitioner may neglect the constitutional conditions with which sexual disorders are connected. Thus derangements of the catamenial function are generally associated with the nervous complaints of women. Many forms of hysteria, and the morbid excitability and perversion of the natural feminine instincts, without any tangible delusion or perceptible affection of the intellectual powers, which are so frequently met with, are thus conjoined with amenorrhœa or dysmenorrhœa. The connexion between hysteria and uterine or ovarian disorders is too obvious to call for any notice here (*see* HYSTERIA; and INSANITY, Varieties of). In the present article we shall briefly notice a few of the principal disorders which may thus originate in sexual disturbances.

Epilepsy.—Epilepsy in women is very often symptomatic of uterine or ovarian disorder, and is curable by the restoration of the suppressed functional discharge, or the allayment of the existing local irritation.

Perversions of tastes and temper.—The influence of the sexual system in the causation of nervous disorders is well illustrated by those strange alterations in tastes and dispositions, that irritable condition of mind, those unreasonable likings or aversions, irresistible longings and foolish fancies which, even in women naturally strong and well-minded, commonly accompany and are produced by pregnancy. Of a similar nature are the nervous excitability, waywardness of temper, physical and mental lassitude, and depression of spirits which have been generally noticed as constant attendants on the menstrual periods in many women. These are also of interest as demonstrating, despite any exceptional cases to the contrary, the futility of that hopeless contest with Nature's laws, in which those are now engaged who would have woman abandon her own high sphere, to become in every profession and in every avocation the rival, instead of the helpmate, of man.

Erotomania and Nymphomania.—In connection with this subject erotomania and nymphomania must be referred to. The former is but an undue exaltation of that sentimentality which to some extent is a natural characteristic of female youth, and which is fostered into morbid development by ill-directed education, and the prevailing sensuous tone of much of our popular literature. Highly-coloured amatory word-pictures fill the minds of the young, unfit them for the duties of life, and give rise to those predominant illusions which morbidly occupy the thoughts of the erotomaniac, and may ultimately pass into the grosser pruriency of nymphomania. Whether originating in this way or not, nymphomania, when developed, is an entirely distinct disorder from the last-named complaint, and is generally connected with physical irritation or disease of some part of the sexual organs. Frequently it is associated with subacute endometritis or ovaritis, resulting in irritation and congestion of the erectile structure of the internal, as well as of the external, generative organs. In these cases pruritus of the vulva generally exists; and the local hyperæsthetic condition is followed by structural disease in the affected parts, hypertrophy of the nymphæ and clitoris, vaginismus, and chronic follicular vulvitis.

The moral, hygienic, and medical treatment of these conditions is discussed in other articles in this work. Here it is only necessary to add, that in the treatment of no forms of disease is the exercise of the highest qualities of the physician more required than in the management of erotomania and nymphomania. In these cases he must act on the religious and moral as well as on the physical constitution of his patients; he must seek to turn the perverted current of thought into better channels; insist on healthy occupation of mind and body; and clearly point out the physical ill-health and mental debasement which surely await on sexual abuses. At the same time the judicious practitioner will endeavour to strengthen the physical powers by tonics; to diminish general plethora by saline purgatives, to remove local congestions by appropriate treatment; and to lessen nervous irritability by the bromides and other nerve-sedatives. Generally such patients are idle and over-fed, and require work and abstinence, and in addressing these persons their medical attendant may well re-echo the advice given to Falstaff by his quondam friend Prince Hal, and desire them to 'Purge, foreswear sack, and live cleanly.'

With regard to local treatment in cases of nymphomania, all that need be said is that, vaginal examinations, being likely to increase the irritability of the hyperæsthetic parts, should, as a general rule, be altogether avoided; or, at least, should be resorted to only in exceptional instances, and when absolutely indispensable. At the same time, however, it is obvious that where nymphomania is the result of local disease, neither moral nor general medical treatment can be of use until the topical exciting cause is removed. It may be admitted that, in certain exceptional cases and with suitable restrictions clitoridectomy is a useful procedure.

Insanity.—The effect of sexual disorders on the mental functions can be only very briefly alluded to. The fact is certain that insanity in women is frequently connected with functional derangement or organic disease of some portion of the utero-genital organs. Indeed in both sexes, although less obviously in men, reflex irritation from the sexual system has, probably, much to do with the causation of insanity. In the insane there is usually a peculiar insensibility to the ordinary symptoms of disease, resulting from the impaired nutrition and lowered vitality of the nervous centres and nerves of sensation. Therefore, in such cases, in the absence of the usual evidences of sexual disorders, the existence of these diseases is very likely to be overlooked. During the last few years several instances of mental derangement, of hysteria approximating to insanity, and of other forms of nervous disturbance arising from ovarian causes, have come within the writer's observation. In some of these cases the nervous disorder had existed for a considerable time before its local exciting cause was suspected. And, more than once, the writer has seen this ultimate recognition and treatment of obscure uterine or ovarian disease in a woman, who had been for years in a lunatic asylum, followed by the restoration of mental as well as physical health.

The ordinary occurrence of menstrual irregularities, and especially of amenorrhœa, in the early periods of insanity, is recognised by nearly all writers on this subject; and there seems a general concurrence of opinion as to the direct connection between suppression of the menses and mental derangement in many instances. One of the most remarkable cases of this kind is that of a girl, mentioned by Pinel, who 'from the age of ten years was in a state of incoherence from suppression of the catamenia. One day on rising from bed she ran and embraced her mother, exclaiming, "Mamma! I am well." The catamenia had just flowed spontaneously, and her reason was immediately restored.'

Puerperal mania.—Puerperal mania is another instance of the influence of uterine or peri-uterine causes in disturbing the nervous system. The ætiology of this disease is very complicated, and it must be ascribed to the combined operation of several distinct factors. Foremost amongst these is the local condition of the denuded uterus during involution; and the shock and exhaustion consequent on parturition under conditions of mental depression, as shown by the fact that twelve out of twenty cases that came under the writer's notice occurred amongst unmarried patients in the Lying-in Hospital. Any circumstances that occasion suppression of the lochia or of the mammary secretion at this time, when the nervous system is in a state of peculiar tension, and the physical powers lowered, act directly as exciting causes of puerperal mania.

Alcoholism.—Uterine and ovarian disorders must also be reckoned amongst the predisposing causes of intemperance. The craving for alcohol in women of all classes, may frequently be dated from the first painful menstrual period, when stimulants are often forced by foolish mothers into reluctant lips. The pain of dysmenorrhœa being thus relieved, at the next epoch the girl naturally, and no longer unwillingly, seeks similar solace, until, finally, the victim of dysmenorrhœal alcoholism becomes a habitual, and perhaps an incurable, drunkard.

Cardiac disorder.—Of the cases of supposed heart-disease in nervous women, which daily come before those connected with any large hospital, in the greater number of instances the cardiac complaints are the result of hysteria, originating from chronic uterine or ovarian disorder, on the cure of which all the cardiac symptoms will subside. It is needless to dwell further here on the functional irregularities—palpitation, dyspnœa, and other symptoms of the same kind—which are thus connected with overstimulation and irritation, or disease, of the female sexual system.

General health.—The consequences of premature or excessive indulgence and abuse of the sexual appetites on the general health, claim merely a passing notice in this article. At no former time was it so necessary as at present for medical practitioners to recognise the evidences of these abuses and excesses; to which are due a large and increasing proportion of the disorders, mental and physical, by which human life is embittered or its duration shortened. The pathological results of these abuses, acting through and upon the nervous system, and the long train of maladies thus occasioned, must be familiar to every experienced physician who encounters in his practice the cachectic and debilitated victims of the excesses referred to. To these causes must be mainly ascribed the failure of physical stamina, the hyperæsthetic nervous condition, and the want of mental power and determination, noticeable amongst too many of the youth of the present day. Thus the evils resulting from this wide-spread sensuality, the effects of which are now seen in our hospitals and lunatic asylums, have attained such proportions as to be a subject of national as well as medical importance.

With respect to the constitutional relations of chronic disorders of the female sexual organs, Dr. Barnes very truly observes 'that disorder of the sexual organs cannot long continue without entailing constitutional disorder, or injuriously affecting the condition of other organs.' The most common of the chronic complaints peculiar to women are subacute endometritis and cervicitis. Next in frequency are the functional disorders occasioned by ovarian congestion and irritation. And, thirdly, in this connection are the various displacements and flexions of the uterus. The two first of these in all cases react on the general health. And even in the third, where local symptoms and local treatment obviously claim most consideration, the secondary consequences of the uterine dislocation often require attention, after the displacement or flexion has been mechanically remedied.

Thomas More Madden.

SEXUAL FUNCTIONS IN THE MALE, Disorders of.—Disturbances of the most important sexual functions in the male are described under the following headings, to which the reader is referred:—Impotence; Masturbation; Spermatorrhœa; Sterility in the Male; and Testes, Diseases of.

SEXUAL ORGANS, Diseases of.—The diseases of the several sexual organs in the male and female will be found described under their special headings. *See* Penis, Diseases of; Testes, Diseases of; Ovaries, Diseases of; Vagina, Diseases of; Womb, Diseases of; &c.

SHAKING PALSY.—A synonym for paralysis agitans. *See* Paralysis Agitans.

SHAMPOOING.—Synon.: Massage; Kneading; Medical rubbing; Fr. *Massage*; Ger. *Massiren*.

Definition.—A process of treatment by rubbing, which consists in deep manipulation.

Applications.—The shampooer grasps the part, and by squeezing it laterally in the palms of his hands in a peculiar manner, in which the muscles of the thumb are brought into vigorous use, exerts a compressing force upon the deep muscular structures by a kind of kneading process. Muscular contractility is thus stimulated, and the circulation increased, so as to produce a corresponding increase of temperature.

By frequently repeating this process, the nutrition of the limbs operated upon is increased, and the flesh becomes much firmer, with a corresponding increase in muscular power. In India, where shampooing appears to have been an ancient practice, it is employed to restore enfeebled and debilitated muscles, exhausted by the heat of the climate. In England shampooing has of late years been much more generally used, and since the introduction of the Turkish baths, where trained shampooers are always in attendance, it can be more readily obtained.

Uses.—In infantile paralysis, if the limbs affected are shampooed for half-an-hour twice a day by a competent nurse, in addition to the use of galvanism and of warm clothing, the process of recovery—to which there is always a natural tendency—will be materially facilitated. In the more severe forms of paralysis, in the adult, less benefit can be expected from shampooing, though the warmth and circulation in paralysed limbs are improved by its use. In limbs weakened by the long-continued use of mechanical supports for any surgical purpose, shampooing is found to be of great service in improving the muscular strength, and restoring a healthy and vigorous circulation.

As employed by Dr. Weir Mitchell, and described by Dr. Playfair (*Lancet*, 1881, I. p. 857, and II. p. 991), shampooing appears to be of great value also in the systematic treatment of nervous prostration and hysteria.

William Adams.

SHINGLES (*cingulum*, a girdle).—A popular name for herpes zoster. *See* Herpes; and Zoster.

SHIVERING. *See* Rigor.

SHOCK.—Synon.: Fr. *Choc*; Ger. *Shok*; *Wundstupor*; *Wundschreck*.

Definition.—A condition of sudden depression of the whole of the functions of the body, due to powerful impressions upon the system by physical injury or mental emotion. Its more obvious manifestations are signs of lowered activity of the cardiac, respiratory, and sensorial functions; and reduction of the surface temperature.

General Description.—If a person be unexpectedly subjected to the influence of extreme terror, if a large bone or joint be shattered, or an important viscus injured, the entire system receives a profound impression, and its functional activity is more or less stunned. The whole body appears to sympathise with the injury inflicted on one of its parts; the patient is prostrated by an indescribable sense of bodily anguish and oppression; he feels sick and faint; is seized with tremor; totters or falls; the surface becomes pale, cold, and covered with sweat; the expression of countenance is vacant, yet anxious; and the respiration and circulation are weak and irregular.

Shock varies in degree, from the most trifling amount, which rapidly disappears, to that producing instantaneous death, as in the case of lightning stroke, or of a severe blow on the epigastrium.

The intensity of shock depends on the nature and extent of the injury producing it: on the coexistence of internal or external hæmorrhage; and also upon the age, habits, temperament, and idiosyncrasy of the individual, and his mental condition at the time of the injury. Direct violence applied to the brain or spinal cord produces shock in the most intense form, but in such cases, which are beyond the scope of this article, the symptoms due to the local lesion predominate, and are of course the more important.

Shock is usually immediate in its effects, but sometimes these may be for a time deferred by intense mental preoccupation or excitement. 'Nature,' as Hunter said, 'does not feel the injury.' The soldier during the excitement of battle may be unconscious for a time of the severity of his wound, but presently he is recalled to a sense of danger, and the depression which ensues will be increased in proportion to the previous excitement.

Ætiology.—Intense mental impressions, such as extreme terror, or apprehension of death or mutilation, are capable of producing shock in persons of excitable nervous temperament. Some individuals are so readily affected, that a certain degree of shock may be induced by the most trifling lesion, or even by the sight of an injury inflicted upon another.

It may be stated generally, however, that whatever is calculated to produce psychical depression, will aggravate the shock induced by other causes. Wounds, for instance, inflicted on the soldiers of a beaten army, or on those in a closely besieged town, are often followed by greater shock than are wounds of a similar severity occurring under different circumstances.

Injury is the chief cause of shock. As a rule the more extensive the injury, the nearer it is to the centre, and the more it assumes a crushing character, the greater will prove the amount of shock. The crushing of a finger or bruising of a testicle often occasions severe shock; so also do extensive burns and scalds. Intense pain, without serious organic lesion, is capable of producing shock, as may be witnessed during the passage of a gall-stone through the duct, or of a calculus through the ureter.

Loss of blood associated with the injury greatly augments the degree of shock; and it may be impossible to separate the symptoms due to the more direct physical impression from those caused by the hæmorrhage. Shock is, however, independent of the presence both of pain and of hæmorrhage. During the operation of castration a patient, while under the influence of chloroform, and in the absence of hæmorrhage, may present all the symptoms of profound shock, the moment the cord is divided. After disarticulation at the hip or shoulder joints, and in other great operations, the patient may present features of shock, altogether independently of either pain or loss of blood. Ovariotomy, especially the opening of the abdomen, is said to be occasionally attended by shock; but it does not occur after ovariotomy, except when the operation is severe and protracted, or associated with hæmorrhage.

The frequency of shock after operation has diminished since the introduction of anæsthetics, but chloroform itself may occasion some of its symptoms; and it is by no means unlikely that fatal accidents during chloroform-administration may be due to the combined depressing influences of the shock and the anæsthetic.

Injuries extensively involving the bones and joints are prone to induce shock. The temperature has been observed in some instances to fall during the sawing of the bone in amputation.

Railway accidents, happening as they do very suddenly, and occasioning great alarm; acute peritonitis caused by the escape of irritating substances into the abdominal cavity, as in perforation in typhoid fever; the strangulation of a hernia; or a sudden and severe intussusception, may each and all be attended by symptoms of shock in a more or less intense degree.

Pathology.—It is still difficult to explain the *modus operandi* by which any kind of physical injury, of sufficient severity, implicating any portion of the body, may produce the set of phenomena known as shock. The story told by the symptoms is one of depression of the whole vital functions, associated with all the evidences of a diminished circulation of blood in those portions of the periphery which we can examine during life. The integument is blanched and shrunken; the pulse is thready or imperceptible; the veins are collapsed; and open wounds, unless involving large arterial trunks, bleed slightly or cease to bleed; while the lowered temperature, as registered in the axilla and mouth, marks a coincident diminution of tissue-metamorphosis. That the brain suffers from a similar privation of blood is indicated by the enfeebled pulsation of the carotid arteries; by the anæmic condition of the retinal vessels, as shown by the ophthalmoscope; and by the mental torpor and feeble irritability, conjoined or separate, which constitute invariable features of the condition. How far the change is shared by other organs it is at present impossible to say, but, awaiting further investigations, the facts already known are sufficiently definite and constant to guide us in the direction of a rational pathology.

The manifestations of inadequate blood-supply to the tissues in general are almost identical with those of hæmorrhagic asthenia; but no hæmorrhage has taken place, and we must seek the blood which has left the anæmic parts in some other vascular territories.

If we make a *post-mortem* examination in a case where death has forestalled nature's effort at reaction, one striking phenomenon is revealed, namely, an enormous distension of the abdominal vessels governed by the splanchnics. Into this capacious set of vessels has been diverted a great mass of the blood destined for other regions; and being thus practically withdrawn from the general circulation, it has produced a useless congestion of the abdominal viscera, at the expense of the nutrition of the rest of the system, while the weakened heart contracts feebly but hastily upon the scanty supply which now passes through its cavities.

Physiologists have taught us the probable cause of this. Long since it was demonstrated that stimulation of the central end of the divided depressor branch of the vagus, in the rabbit, produces an immediate lowering of the blood-pressure in the arteries of the head, neck, and extremities; this effect coinciding with, and depending upon, a dilatation of the abdominal arteries, and a consequent derivation of the blood-flow in the direction of least resistance, or towards the abdominal viscera. If, however, the splanchnic nerves be cut, the reflex circuit is broken, and the balance of the circulation becomes restored, or nearly so, although the irritation of the depressor nerve be continued. The experiment of Goltz, of directly paralysing the splanchnic of a frog by sharply striking the abdomen, was followed by the same result as is the reflex paralysis of the same branches through the depressor nerve; and it is likely that the severe shock caused in man by a severe blow on the epigastrium, owes its origin to a similarly induced paralytic dilatation of the visceral arteries. For the present we may thus accept, as the most plausible interpretation of the symptoms of shock, a sudden dilatation of the abdominal vessels, attributable to an inhibitory influence exerted upon the splanchnics, through the medium of a special reflex centre, which is in more or less direct communication with the sensorium, and with all parts of the body. Much, however, remains to be done. It has been shown that when a rabbit is narcotized by chloral, stimulation of the central end of the divided sciatic nerve will induce a lowering of arterial pressure, corresponding closely to that initiated by stimulation of the depressor branch; and in all probability a similar experiment upon any nerve containing afferent fibres would be followed by the same result. But if, on the other hand, the same stimulation be performed while the animal is paralysed by curare, it is remarkable that the effect is reversed, the vessels controlled by the splanchnics contracting, and the general arterial tension being consequently increased. These observations are in the highest degree suggestive, and may hereafter form the basis for a plan of treatment of shock, that will be a landmark in surgical therapeutics.

Symptoms.—The symptoms of shock are of two kinds—namely, first, those due to a stunning or blunting of the vital powers, aptly styled *Wundstupor* by the Germans; and secondly, those attributable to mental terror, anxiety, and agitation—*Wundschreck*. These may exist together, or separately, or one may pass into the other.

1. *Pure* or *torpid shock*, as distinguished from the latter form, which may be termed 'erethitic shock,' is manifested, if only slight in degree, by transient symptoms. The patient becomes pale and faint; complains of nausea; trembles; and experiences a sense of oppression, confusion, and anxiety; the surface becomes cold and moist; beads of sweat form on the brow; and the limbs may be unable to support the weight of the body. The duration depends much on constitutional peculiarity; the symptoms either passing off in a few minutes, or lasting for an hour or two. If the shock be severe, the patient immediately after the receipt of the injury is stunned; his senses and consciousness are benumbed; the countenance and the surface generally become deadly pale, and are bathed with sweat; the animation

of the face is replaced by a mingled expression of torpor and anxiety; from time to time muscular contractions and uneasy movements of the body may occur, but usually there is an absence of voluntary effort; the eyes are dull, vacant, and motionless, and the pupils are usually dilated; the temperature—an important index to the severity of the shock—ranges from one to two degrees or more below the normal, and is much lower when there has been severe loss of blood; the respiration is remarkably slow and irregular—faint, scarcely perceptible, inspirations alternating with deep sighs; and the pulse may be almost or quite imperceptible at the wrist, very weak, insufficient, and very rapid. The patient is conscious, but he sees and acts as through a mist, and cannot realise his position; urgently questioned, he replies slowly and with evident effort; his voice is weak and hoarse; he may complain of coldness and numbness of his limbs, but appears scarcely sensible of pain. There may be nausea, and even vomiting; and relaxation of the sphincters, with involuntary discharge of fæces, is occasionally observed.

The fall of temperature in shock, excluding cases of injury to the brain and spinal cord—where it is greatest of all—is proportionately greater, other things being alike, in injuries extensively involving bones and joints, in burns and scalds, and in the cases where there has been considerable loss of blood. It is greater in amount in men of forty than in those of twenty. During the War of the Commune a number of observations were taken, and the average temperature varied from 96·5 to 97·5°, the lowest temperature observed being 93·5°. The fall was greater after shell- than bullet-wounds; and amongst the insurgents than in the regular troops.

2. In the *shock with excitement—restless* or *erethitic shock*—symptoms of anxiety and restlessness predominate. This form is often witnessed in association with previous hæmorrhage, or when there is great pain, as in crushing injuries of important parts, and in burns or scalds. Individual idiosyncrasy, however, has an important influence upon the condition. The ordinary symptoms of shock, such as pallor, cold surface, frequent pulse, and feeble respiration are present. The patient in addition betrays a marked and unceasing restlessness, tossing about in bed, and throwing his arms and head from side to side; his consciousness is but little impaired, yet he pays no heed to questions; nothing seems to comfort or quiet him; he appears as if overwhelmed by some indescribable anxiety and oppression, of which he vainly struggles to rid himself. Vomiting and painful eructations are usually present in such cases. There is often considerable tremor, and sometimes the case will pass into well-marked delirium tremens. The torpid may pass into the erethitic form of shock; or shock with excitement may lapse into a torpid condition, which is always a change of bad omen.

Duration.—Shock, unless it be the result of serious or fatal injury, is generally recovered from speedily and completely. It may be quite gone in fifteen minutes or half an hour; or it may continue five or six hours, or longer, and then pass away. The erethitic or restless form of shock does not continue so long as the torpid. The less important the vital lesion; the less it has been complicated with loss of blood; the greater the power of the individual; the less his nervous susceptibility; and, finally, the more efficient the treatment, the shorter will prove the duration of the shock.

Terminations.—Recovery or reaction takes place readily from the milder forms of shock, especially when aided by suitable treatment. From the more severe, it is more difficult and protracted; or the case may end more or less rapidly in fatal collapse. When the reaction proceeds favourably, the pulse becomes stronger and fuller, the respiration deeper, and the bodily warmth returns. The mind appears to awaken to the exercise of its faculties, to shake off its oppression, and to appreciate the nature of the previous injury, and of the existing circumstances; and both the mental and physical equilibrium are by degrees restored. Vomiting is often an early symptom of recovery.

The reaction is not always steady. Fluctuations may occur; and relapses after an improvement often occur once or twice, each time, however, with diminished severity.

When the torpid form of shock passes into the erethitic, the condition becomes one termed 'prostration with excitement'; the respiration is hurried, the skin hot, and the face flushed. There are great thirst, headache, and scanty urine, with restlessness, tremor, incoherence or delirium, and sleeplessness; and death from exhaustion frequently follows, preceded by a haggard, wild expression of face, a pulse that cannot be counted, subsultus, and hiccough.

After severe shock symptoms of excessive reaction are not uncommon; and their gravity will vary with the intensity of the previous shock.

Complications and Sequelæ.—The complications which may arise are those due chiefly to loss of blood, or peculiar to the form of injury received. From ordinary uncomplicated shock recovery is usually perfect, but occasionally, especially after railway shock, permanent deterioration of health follows, or some impairment of a special sense; or the mental vigour or temper of the individual may be changed for the worse. In these cases organic changes in the nerve-centres have probably supervened. In drunkards the shock of injury very often terminates in ordinary delirium tremens.

Pre-existing organic disease, especially of the heart or kidneys, renders persons more susceptible of the effects of shock, and shock more dangerous and severe.

Diagnosis.—The phenomena of shock bear some resemblance to those of concussion and of syncope. Concussion is usually distinguished from shock by the predominance of intellectual disturbance over the circulatory symptoms; and syncope is in most cases marked by its more transitory duration, and by its origin in loss of blood, or in other of the well-known causes of the condition. Shock, however, may co-exist with either concussion or syncope.

Prognosis.—This mainly depends on the nature of the injury, and the physical and mental power of the individual. Otherwise, the longer the shock endures, the feebler the manifestations of life, and more especially the lower the temperature falls, the more unfavourable becomes the prognosis. A fall of temperature below 96° nearly always presages a fatal issue. It is a very unfavourable sign when no rise of temperature takes place in four or eight hours after the receipt of injury. Extreme feebleness of pulse and respiration, marked tremor, profuse cold sweat, singultus, a feeling of impending dissolution, and involuntary evacuations, all indicate gravity of the case.

Treatment. — The objects of treatment in shock are to sustain the lessened vitality, but not to over-stimulate it; and to moderate subsequent reaction when it is excessive.

To apply external warmth is the first and plainest indication, as it is one of the best appeals to the misdirected circulation. Hot water bottles and hot blankets may be applied to the extremities; hot turpentine epithems and sinapisms to the precordia; and turpentine may be rubbed along the spine with advantage. If the patient cannot swallow, an alcoholic stimulant may be injected into the rectum; and ammonia may be inhaled, or subcutaneously injected. Slapping the hands and feet promotes recovery in some cases, but this measure is inefficacious in cases of severe injury, or those accompanied by great loss of blood.

In profound shock, unaccompanied by loss of blood, the breathing must be carefully watched, and failure guarded against by artificial respiration. The phrenic nerve may be usefully stimulated by electrodes placed along its course in the neck, and in the epigastrium. If the external jugular vein be gorged with blood, it may prove advantageous to open it, and thus relieve the stagnation of the venous circulation. Where shock has been accompanied by severe hæmorrhage, transfusion in extreme cases should be resorted to. As soon as practicable, nourishment must be administered, as well as stimulants. Tincture of belladonna has been given in half-drachm doses every hour in some cases, with the view of stimulating the cardiac action, and helping to contract the paralysed arterioles. The use of calabar bean has been recommended, on account of its power to diminish the venous accumulation in the abdomen, by causing contraction of the veins.

If shock be associated with excitement, which should be regarded as a sign of want of power, the patient always requires support; and opium, or, when this drug is not desirable, henbane or chloral, may often be given with advantage. An ice-coil to the head allays excitement and promotes sleep. In the torpid form of shock narcotics are inadmissible. Should inflammatory reaction take place, a regulated diet, rest to mind and body, a gentle mercurial purge, when the secretions are deranged, and in young plethoric subjects the cautious administration of antimony, or a local blood-letting, are the chief means to be adopted. Throughout the treatment caution should always be exercised not to strain the action of remedies too far.

The question of operation in shock may occasionally be difficult to solve. As a rule a patient suffering from severe shock should never be operated upon; unless, indeed, bleeding be going on, or the arteries and nerves are much exposed and lacerated from the violence of the injury. When an operation appears to be compulsory no anæsthetic is required. It is better, however, to await partial reaction whenever it is possible to do so.

William Mac Cormac.

SHORTNESS OF BREATH. *See* Respiration, Disorders of.

SHORT-SIGHTEDNESS. *See* Myopia; and Vision, Disorders of.

SIALAGOGUES (*σίαλον*, saliva, and *ἄγω*, I move).—Synon: Fr. *Sialagogues*; Ger. *Speicheltreibende Mitteln.*

Definition.—Remedies which increase the secretion of saliva.

Enumeration.—The principal sialagogues are Dilute Acids, Ether, Ginger, Rhubarb, Horseradish, Iodide of Potassium and other iodides, Jaborandi, Mezereon, Mercury and its salts, Mustard, Tobacco, Physostigma, Pyrethrum, and Pebbles.

Action.—There are two essential factors in the secretion of saliva; the first is the activity of the secreting cells in the gland, the second is a sufficient supply of nutritive material to them, from which they may form a secretion. This nutritive material, though it may be derived directly from the lymph-spaces around the cells, must be ultimately supplied by the blood circulating through the glands. Usually, therefore, when the gland is in action, the supply of blood is greatly increased, the arteries dilating, and the blood flowing rapidly through them. Some drugs, such as physostigma, will stimulate the secreting cells, while they contract the blood-vessels; and under these circumstances, although the secretion may begin actively, it soon comes to a standstill from want of material. The secreting cells may be excited to activity, by substances which stimulate the nervous structures within the gland itself, as, for example, calabar bean (physostigma); by stimuli proceeding directly from the encephalon, as seen in salivation occurring from the mere idea of savoury food; and by stimuli applied to the mouth and exciting the gland reflexly. Nausea is almost always accompanied by salivation, and substances which cause nausea almost invariably cause salivation, the irritation of the stomach causing reflex salivary secretion. The stimulus here passes up the afferent nerves to the medulla, and travels down the efferent nerve to the gland.

Sialagogues are divided, according to their mode of action, into two classes (1) *topical* or *direct*; and (2) *specific*, *remote*, or *indirect* sialagogues. The names *direct* and *indirect* are complete misnomers, just as they are in the case of emetics, and they ought to be discarded, inasmuch as the so-called 'direct' sialagogues are those which do *not* act directly on the gland, but on the mouth; and the 'indirect' are those which do act upon the gland, affecting either the nervous structure contained within it, or the nerve-centres directly connected with it.

The *topical* sialagogues are dilute acids, ether, ginger, rhubarb, horseradish, mezereon, mustard, pebbles, pyrethrum, and tobacco. The *remote* sialagogues are iodide of potassium and other iodides, jaborandi, mercury and its salts, physostigma, and tobacco.

Topical sialagogues excite secretion of saliva reflexly, the afferent nerves being the lingual and buccal branches of the fifth, and the glossopharyngeal nerves. The afferent nerves, through which nauseants probably excite the salivary secretion, are the vagi.

Of remote sialagogues, iodide of potassium probably acts upon the gland-structures, but upon which part has not yet been determined. It may, however, also act reflexly, by stimulating the sensory nerves of the mouth, as it is excreted in the saliva, and the taste of it is often persistent. Mercury probably acts partly by affecting the gland-structures, and partly by affecting the mouth. Jaborandi, physostigma, and tobacco appear to affect the terminal branches of the secretory nerves in the glands.

Uses.—Saliva is useful in keeping the mouth moist, and thus facilitating mastication, deglutition, and the movements of the tongue in speaking. By moistening the fauces it also prevents or lessens thirst. A pebble placed under the tongue, or masticated, will keep up a slight flow of saliva, and may be useful for these purposes. Where this is insufficient, dilute acids are employed (*see* Acids). As the flow of blood to the glands is greatly increased through secretion, sialagogues have been used as derivatives, to lessen inflammation, congestion, and pain in other parts of the head, as in tooth-ache, earache, and inflammation of the ear, nose, or scalp. Saliva has also, however, a digestive power upon starch, and increase of the flow may be advantageous in imperfect digestion of this substance. When swallowed, the saliva stimulates the secretion of gastric juice, and increased salivary secretion therefore tends to aid gastric digestion. To attain this object it is best to chew a piece of ginger or of rhubarb.

T. Lauder Brunton.

SIBBENS. — This term, derived from a Scotch word, signifying 'kindred,' is suggestive of a disease prevalent in families, and presumed to be a form of chronic syphilis.

SIBILANT RÂLE, or RHONCHUS: SIBILUS (*sibilus*, whistling).—A variety of dry *râle* or rhonchus, of a whistling or high-pitched musical character, usually produced in the smaller divisions of the bronchi. *See* Physical Examination; and Rhonchus.

SICILY.—A warm, moist, winter climate. Climate of base of Ætna more variable than N. coast. *See* Climate, Treatment of Disease by; and Palermo.

SICK HEADACHE.—A popular synonym for megrim. *See* Megrim.

SICKNESS.—A common name for vomiting. *See* Vomiting.

SIGHT, Disorders of. *See* Vision, Disorders of.

SIGNS OF DISEASE. *See* Disease, Symptoms and Signs of; and Physical Examination.

SINGULTUS (Lat. sobbing, hiccup).—A synonym for hiccup. *See* Hiccup.

SINUS (Lat.).—Pathologically, sinus means a narrow track of variable length, leading from a chronic abscess to a free surface. *See* Abscess.

SINUSES CEREBRAL, Diseases of. *See* Meninges, Diseases of.

SINUSES, NASAL, Diseases of. *See* Nose, Diseases of.

SIXTH NERVE, Diseases of.—The sixth nerve, or *abducens oculi*, confers motor power on the external rectus muscle of the eyeball, and its morbid states of excessive or defective function are indicated by corresponding spasm or paralysis of that muscle.

1. **Spasm of the external rectus.**—This condition is very rare, except as a consequence of some change in the visual functions of the eye. The external rectus may then habitually overact, causing divergent strabismus. Permanent contraction occurs when there is complete paralysis of its antagonist, the internal rectus. Spasm may occur from irritation of the nucleus or fibres of the sixth nerve, as in meningitis of the base. The symptoms are inclination outward of the affected eye, and consequent divergent strabismus. The treatment is that of the cause on which it depends. *See* Strabismus.

2. **Paralysis of the external rectus.**—Ætiology.—The common causes of this condition are cold, acting possibly on the nerve-fibres within the muscle, but more probably by giving rise to inflammation around the trunk of the nerve; syphilis, by causing growth on, or exudation round, the nerve, or meningeal thickening; meningitis; pressure on the nerve by aneurism or tumour; and organic diseases of the pons. Transient or permanent paralysis sometimes accompanies sclerosis of the posterior columns of the spinal cord (locomotor ataxy); its cause is obscure.

Symptoms.—Paralysis of the external rectus causes inability to move the affected eye outwards, and hence convergent strabismus, and homonymous diplopia when looking at an object on the affected (say left) side of the middle line, the images becoming more distant as the object is moved to the left, but parallel, and on the same level, so long as it is on the level of the eye. When looking up or down as well as out, the second image slants, the two being nearer together at the lower end, and the second image the lower of the two when looking up and out. On looking down and out, the two images are nearer together at the top than at the bottom, and the second image is on a higher level than the other. There is erroneous projection of the field of vision.

Diagnosis.—Paralysis of the sixth nerve is easily recognised, except when slight in degree. In the latter case it may often be detected by a careful search for the diplopia, or by the secondary deviation of the sound eye in the same direction when that eye is covered and an object fixed by means of the weak muscle. *See* Strabismus.

Prognosis.—The prognosis is most favourable when the paralysis is due to cold or syphilis; least favourable when due to meningitis or tumour. When associated with ataxy, it is usually recovered from, but a return is common.

Treatment.—When the complaint is of rheumatic origin, the treatment should consist of hot fomentations to the temple; counter-irritation by blisters; and iodide of potassium and tonics internally. If of syphilitic origin iodide of mercury or of potassium should of course be given.

In spinal mischief, strychnia and arsenic are useful. In obstinate cases, faradization, or the interrupted battery current, may be applied to the muscle through the eyelid, or to the temple to produce a reflex effect. The direct application to the muscle through the conjunctiva is too painful. W. R. Gowers.

SKIN, Diseases of.—Synon.: Fr. *Maladies de la Peau*; Ger. *Hautkrankheiten.*

Definition.—Cutaneous diseases may be defined as an aberration of the skin from the standard of health, evidenced by an alteration in its appearance, qualities, sensibility, functions, and relations to the rest of the organism.

Classification.—The ancients classed diseases of the skin according to colour, roughness or smoothness, and bulk. At the present time we shall find no better classification for all practical purposes than —(1) diseases of the *circulation*; (2) of *nutrition*; and (3) of *sensibility*. This applies to the skin in general; but the compound nature of the skin—consisting as it does of a pigment-organ, the rete mucosum; a horny covering, the epidermis; an apparatus of sebiparous and sudoriparous glands; and a special outgrowth of the derma, the hair—requires an expansion of this classification, so as to include specially the diseases of these separate parts. Hence a very simple subdivision of diseases of the skin, founded on the anatomical structure of the organ, would be, besides diseases of the *skin in general*—(4) diseases of the *rete mucosum*; (5) diseases of the *epidermis*; (6) diseases of the *glandular apparatus*; and (7) diseases of the *hair-follicles and hair.*

1. *Diseases of the Circulation.*—Diseases of the cutaneous circulation are manifested by hyperæmia, and principally by inflammation; and inflammation, according to its origin from ordinary constitutional causes or from blood-poison, admits of a division into *common* inflammation and *specific* inflammation. Common inflammation is represented by eczema, erythema, pemphigus and anthrax; and specific inflammation by the exanthemata, syphilis, and elephantiasis. The four examples of diseases of common inflammation above mentioned may be taken as types of so many groups of cutaneous disease, for example, eczematous, erythematous, phlyctenous, and anthracoid. The eczematous group comprises eczema, scabies, lichen, and impetigo; the erythematous group, erythema and erysipelas; the phlyctenoid group, miliaria, pemphigus, and herpes; and the anthracoid group, ecthyma, hordeolum, furunculus, and anthrax. In like manner, treating specific inflammation according to the same method, we have an exanthematous group, composed of rubeola, scarlatina, and variola; a syphilous group presenting itself in the forms of erythema, papule, tubercle, ulcer, and gummated tumour; and an elephantous group, which includes the macular, tubercular, anæsthetic, and mutilating forms of elephantiasis.

2. *Diseases of Nutrition.*—Diseases of nutrition are consequent on aberration of nutritive function, sometimes in the form of dystrophy or altered nutrition, sometimes as atrophy or absence of nutrition, and sometimes as hypertrophy or excessive growth. Under the head of dystrophic affections are to be included—lepra or psoriasis, struma or scrofula, lupus, lymphoma, xanthoma, and epithelioma; under that of atrophic affections—dermatoxerasia, ichthyosis, sauriosis, striæ atrophicæ, morphœa, and scleriasis; and under the head of hypertrophic affections—spilus, verruca, cornu, clavus, angeioma, fibroma general and partial, and mycosis; general fibroma including spargosis or elephantiasis Arabum; and partial fibroma, molluscum, and cheloma.

3. *Diseases of Sensibility.*—Diseases of innervation comprehend pruritus, prurigo, dermatalgia, neuroma, which are examples of dysæsthesia; with hyperæsthesia and anæsthesia.

4. *Diseases of Pigmentation.*—Disease of the rete mucosum, the seat of the colour of the skin, constituting chromatopathia and a group of chromatopathic affections, has its principal seat in the rete mucosum, and is manifested by excess of pigment, termed melasma or melanopathia; deficiency of pigment, termed achroma or leucopathia; and aberrations from the normal standard of colour, as in xanthochroia or excess of yellow, and cyanopathia, or the presence of blue pigment in the skin. To this group must also be added the leaden or slate-coloured hue of the integument, produced by the chemical operation of nitrate of silver on the superficial portion of the corium, named melasma tinctum and argyria.

5. *Diseases of the Epidermis and Nails.*—Diseases of the epidermis and nails constitute an epidermic and onychopathic group of affections of the skin, the former of these being remarkable for the presence of a phytiform growth within its structure, as in tinea or ringworm, and favus—the so-called *nosophyta*; and the latter embracing all the varieties of disease of form, texture, colour, and bulk of the nails.

6. *Diseases of the Cutaneous Glands.*—Diseases of the glands of the skin and their functions constitute a group of steatopathic affections, and another of idrotopathic affections. Of these, the former includes steatorrhœa or excessive secretion, comedones or impacted secretion, molluscum contagiosum *seu* adenosum or hypertrophy of the sebiparous glands, encysted tumours resulting from dilatation of the follicles with sebaceous secretion, and sebaceous horns consequent on the desiccation of inspissated sebaceous matter, exuded through an aperture of the cyst. The idrotopathic affections comprehend excess, deficiency, and alteration of cutaneous perspiration, represented by the terms hyperidrosis, anidrosis, osmidrosis or fœtid perspiration, chromidrosis or coloured perspiration, hæmidrosis or sanguineous sweat, and inflammation of the sweat-glands.

7. *Diseases of the Hairs and Hair-follicles.*—Diseases of the hair-follicles and hair are re-

presented by affections of the hair-follicles proper, for example, folliculitis, acne, gutta rosacea, sycosis, and favus; and by special affections of the hair, comprehending alteration of quantity, colour, and structure.

Ætiology.—The ætiology of cutaneous diseases embraces most of the causes which give rise to disease of other organs of the body; the only special characteristic of the skin being its peripheral distribution, and its consequent exposure to friction and to the action of the atmosphere. Like other organs it is dependent for its health upon healthy nutrition and innervation. When nutrition is defective in infancy and youth, the skin loses its powers of resistance; it becomes abnormally sensitive to the action of irritants from within and from without; and it is consequently prone to eczema, lichen, struma, and acne. Hence derangements of digestion and cutting of teeth are common causes of eczema in infants; struma is often developed for the first time with the appearance of the permanent teeth; and acne accompanies the active development of the hair at and after puberty. Thus, in considering the ætiology of diseases of the skin, we may take as a starting-point a weak organ, whatever the causes of that weakness of organ may have been, and then endeavour to discover the agency of the exciting cause. A weakly parent may become the mother of an ill-nourished infant, or may be unable to supply it with congenial food; a weak and sensitive skin follows; and then a variety of excitants, operating on a skin so predisposed, may give rise to an eczema. Or, if in place of a weakly parent we assume a faulty digestive apparatus, the skin may equally be the sufferer, and then an accidental malassimilation will become an exciting cause of eczema, erythema, or urticaria. In like manner an external irritant, such as friction, may promote the development of an eczema. The cause may, however, be in itself so potent as to develop an exanthem in an otherwise healthy skin, as in the exanthematous fevers.

Disturbances of innervation may be associated with discolouration of the skin, as in Addison's disease; or with eruptions, such as herpes.

Next to malassimilation and specific poisons as causes of cutaneous disease, defective nutrition is evinced in ichthyosis, achroma, alopecia, and lupus erythematosus; and aberration of nutrition in struma, lupus, lepra vulgaris, and in the various forms of hypertrophy, general and partial.

Poisonous articles of food may produce skin-eruptions. Thus urticaria follows the use of certain kinds of fish, more especially mussels, or of other indigestible substances. Certain drugs, too, have a specific action on the skin, giving rise to various forms of rash; for example, the salts of iodine and bromine, cubebs, copaiba, and quinine. Borax has recently been said by Dr. Gowers to produce psoriasis (*Lancet*, 1881, vol. ii.).

As a summary of the ætiology of cutaneous diseases, they may be said to be the product of a feeble organ, induced by debility or derangement of constitution; and the therapeutical corollary will follow—restore power to the constitution, the organ will recover, and the disease will cease.

Symptoms.—The semeiology or symptomatology of cutaneous diseases is principally manifested by alteration of the **colour, texture,** and **sensibility** of the skin. Change of colour may proceed from abnormal circulation, giving rise to various tints of red, ranging from scarlet to livid; or from aberrations of pigment. Change of texture is evinced by abnormal hardness or softness, thickness or thinness, roughness or smoothness, swelling or prominence, or solution of continuity in the form of cracks or ulcers.

Colour.—(*a*) The brighter tints of redness proceed from active *hyperæmia*, while the duller, the purple, and the livid are the consequence of passive hyperæmia. The brightest of the hues of redness are met with in erythema, urticaria, eczema, and scarlatina; the tint of roseola, rubeola, and the syphilodermata trenches on the purple; while the hyperæmia resulting from venous congestion is livid and almost black, as we see evinced in *morbus cæruleus*, in chilblain, and in anthrax. Angeiectasia and nævi are scarlet, crimson, purple or livid, in correspondence with the activity of circulation through their blood-vessels; and effusions of blood into the cutaneous tissues, as in purpura and ecchymosis, range between crimson and black. It is essential to distinguish between a redness which is transient and one which is permanent; between that which may be regarded as a pathological blush, such as erythema and urticaria, that which indicates a superficial inflammation, as in the case of eczema and erysipelas, or a deeper inflammation, as in the instance of furunculus and anthrax; and in the case of permanent redness, a state of angeiectasia or a vascular nævus.

(*b*) Changes of colour from aberration of *pigmentation* are commonly restricted to the rete mucosum, and range in hue from the whiteness of achroma, through the yellow and brown stains of lentigo and chloasma, to the deepest black of melasma. Altered pigmentation is also met with in the tissue of the corium; as in the yellow tints of xanthoma, the black deposits of melasma, the chemical stain of oxide of silver, and the mechanical colouration of tattoo.

Texture.—Alterations of texture of the skin are discoverable by the touch as well as by the eye. Infiltration of the cutaneous tissues communicates to the hand a feeling of density and thickness; this may always be observed in eczema, where it gives rise to slight swelling, but is most conspicuous in erysipelas, and in the tumescent forms of erythema. Similar infiltration, together with hyperæmia and hypertrophy, produces the various forms of pimples, tubercles, and tumours of the substance of the skin. We must, however, except from this cause the tubercles of urticaria, which are consequent on muscular contractility; and those of chronic syphilis, elephantiasis, lupus, lymphadenoma, and epithelioma, which are due to the formation of a new tissue. In chronic eczema, in the lepra of the Greeks, and in diffused lichen planus, the skin is sometimes found as hard and dense as leather, from infiltration; and in this state it not infrequently cracks and breaks, so as to produce chaps or rhagades. The skin is apt to be roughened in chronic eczema by hypertrophy and exfoliation of the epidermis, and most conspicuously so in lepra vulgaris;

while a state of congenital roughness of the skin is pathognomonic of xeroderma and ichthyosis. In alopecia universalis the skin is morbidly soft and smooth; and it is likewise smooth and thin, from defect of nutrition, in alopecia areata. The texture of the skin is also rendered abnormal by the prominence of the follicles of the skin in the form of papulæ, as in a cutis anserina resulting from vascular congestion and infiltration instead of from muscular spasm; by the production of vesicles and sero-pustules, the consequence of exudation; by surface exudation giving rise to crusts of various thickness—all of these states being common to eczema; by the hypertrophic laminæ of epidermis generated by the congested blotches of lepra vulgaris; and by the ulcers of lupus, syphilis, and elephantiasis. It is important, therefore, to discriminate between variation of texture due to alteration of the skin in its whole or in its parts. Thickness and condensation may proceed from infiltration solely, from infiltration with active hyperæmia, from infiltration with hypertrophy, or from the development of a new and abnormal tissue; it may be restricted to the derma proper, or it may spread to the subcutaneous tissues; or the alteration may be one involving separately the papillæ, the glands, or the fibrous or other tissues of the corium.

Sensibility.—Altered sensibility may present itself as an excess or defect of sensibility, itching, tingling, pricking, heat, chill, or actual pain.

DIAGNOSIS.—The diagnosis of cutaneous diseases is governed primarily by the physiognomy of the affection, aided by corroborative evidence supplied by the history, constitution, age, duration, cause, regional distribution, symptoms, &c.; in a word, by all the information which pathology and experience have brought to bear on the subject.

PROGNOSIS.—The prognosis of cutaneous diseases is in general favourable. They are vexatious to the patient, sometimes on account of their ugliness, at other times from the teasing itching, or even pain, by which they are accompanied; but they are rarely fatal. Indeed their gravity is regulated by their cause, and by the constitution of the patient, rather than by their own intrinsic qualities. The most universal of cutaneous diseases, eczema, originates in malassimilation; and its cure or persistency will depend on our powers of restoring assimilation to a healthy standard, and this again will be governed by the circumstances and position in life of the patient. Erythema, and especially urticaria, are due to a state of constitution, and in themselves are simply a symptom of constitutional disorder. Sufferers from pemphigus sometimes die, because pemphigus is often a symptom of asthenia and cachexia; and anthrax, which occasionally kills by pain alone, is, in general, only fatal from constitutional complication. In specific inflammation of the skin the prognosis turns upon the curability of the major disorder—of the rubeola, the scarlatina, the variola, the syphilis, or the elephantiasis; and these are all curable, saving accidental complications, except elephantiasis, which must be regarded as an incurable disease. In the dystrophic affections—the Greek lepra, struma, and epithelioma, medicine is placed at the mercy of a feeble constitution; and although we may do much to improve, we cannot profess to cure. The same may be said for the rest of the nutritive affections; we can cure some, such as ichthyosis, but we must fail signally in our attempts to cure others, because we possess no direct means of renovating a faulty constitution, or of giving strength and energy to a feeble organ, and thus restoring its normal function. The neuropathic affections, again, present to us the problem of cure of a disordered nervous system; if that disorder be simply functional or due to derangement of general health, we shall probably succeed; if the alteration in the nerve-tissue be organic, we must necessarily fail.

TREATMENT.—The treatment of cutaneous diseases divides itself naturally into constitutional and local. Sometimes the constitutional treatment is alone essential, as in non-ulcerative syphilis; at other times local treatment only is required, as in the chronic forms of eczema, termed psoriasis by Willan and Bateman; but in general a judicious combination of the two is necessary. The aim of therapeutical treatment should be to restore healthy function and normal vital power; and the recovery of these will frequently prove sufficient to accomplish the cure of the local affection, if the latter have been shielded in the meantime by soothing applications. Mild tonic aperients, succeeded by tonics, especially by quinine, iron, and arsenic, constitute the special treatment of the whole family of inflammatory affections of the skin. Where the restoration of the nutritive power of the skin is a primary indication, as in non-inflammatory lepra vulgaris, and in every instance in which the nutrition of the skin is to be amended, arsenic may be regarded as a specific remedy.

The local remedies for cutaneous diseases are alleviative, stimulant, and caustic. Alleviative remedies, such as the oxide of zinc ointment, are especially adapted to the inflammatory affections, headed by eczema; chronic eczema and lepra vulgaris or psoriasis require the stimulating help of the mercurial ointments and tar; while lupus and epithelioma necessitate the employment of caustics, such as nitrate of silver and potassa fusa. Besides these, which are the essential remedies, there are others adapted for special purposes, which are mentioned in connection with the different diseases to which they are applicable. They consist principally of absorbent powders and lotions; lotions to relieve pruritus; and sulphur applications for scabies.

The several diseases of the skin are fully discussed under their respective headings.

ERASMUS WILSON.

SKIN, BRONZED.—A form of pigmentary discolouration of the skin, embodying a reddish tint, in lieu of the yellow and green hues which are met with in lentigo and chloasma, and the absolute black of melasma. When the complexion is darkened by the action of the atmosphere and of the sun, it is said to be bronzed; and the term 'bronzed skin' has become familiar also in consequence of its application to the melasma of the skin in Addison's disease. Bronzed skin, again, calls to mind the copper colour of chronic syphiloderma, in which the melasma is modified by red and yellow. In alliance with Addison's disease, melasma must not be regarded as specific, but simply as the ordinary melasmic change of colour of the disordered skin, of which the 'bronze' tint is an accidental modification. *See* ADDISON'S DISEASE; and PIGMENTARY SKIN-DISEASES. ERASMUS WILSON.

SKIN, DISCOLOURED. *See* PIGMENTARY SKIN-DISEASES.

SKIN-BOUND DISEASE.—A popular synonym for Sclerema neonatorum. *See* SCLEREMA NEONATORUM.

SKODAIC RESONANCE.—A peculiar high-pitched resonance, found chiefly at the sterno-clavicular region of the chest, in some cases of pleural effusion. *See* PHYSICAL EXAMINATION.

SKOLIOSIS (σκολιὸς, crooked).—A synonym for curvature of the spine. *See* SPINE, Diseases and Curvatures of.

SKULL, Diseases and Deformities of.—SYNON.: Fr. *Maladies du Crâne*; Ger. *Krankheiten des Schädels*.—The principal diseases and deformities of the skull will be discussed in the following order:—1. Changes of shape; 2. Variations in size; 3. Meningocele and Hernia Cerebri; 4. Cephalhæmatoma; 5. Inflammation; 6. Rickets; 7. Craniotabes; 8. Syphilis; and 9. Tumours.

1. Changes of shape.–The shape of the skull not only varies much amongst the different races of mankind, but in each race variations are to be found, sometimes depending upon, sometimes independent of, disease in the individual. A glance at any extensive collection of crania is sufficient to indicate how much larger some skulls are than others, in proportion to their width; how in some the vertical diameter is proportionally great, in others small; how some have wide cheekbones, some depressed noses, and others projecting jaws. The old classification of Blumenbach has now been superseded by the numerous and minute observations of recent investigators. For a short account of the methods of craniometry now in use, and of the present transitional state of the science, the reader is referred to the ninth edition of Dr. Jones Quain's *Anatomy*, vol. i. p. 80, where he will also find references to most of the important works upon the subject.

The skull is seldom perfectly symmetrical; the asymmetry being usually more marked behind than in front. This is shown not only by a coarse examination of the exterior, but by referring to the differences between the sulci and foramina on the two sides, which are so commonly met with. A familiar illustration is afforded by the fact that the nose is rarely if ever exactly in the mid line of the body; but much more striking deviations from perfect symmetry may occur, as, for instance, in a case recently reported by Mr. Pearce Gould to the Pathological Society, in which one half of the cerebellum was absent, and there was a corresponding deficiency of the cerebellar fossa on the occipital bone. Many savage races produce abnormalities of the shape of the skull, by the application of external pressure during early infancy; and a similar result has been supposed to be consequent on the method of wrapping up the heads of children that is adopted in some parts of France. A marked asymmetry of the skull accompanies that rare disease, 'hemiatrophy of the face,' supposed by Mr. Hutchinson to be related in some way to morphœa. There are also recorded cases of hypertrophy of the bones of the face and skull. A remarkable instance of this disease, or rather of the development of enormous hyperostoses, was shown by Mr. Hutchinson, in his recent lectures on Surgical Affections of the Nervous System, at the Royal College of Surgeons. Here the hyperostoses appeared closely confined to parts which were supplied by branches of the fifth nerve. Some of these hypertrophic cases are, no doubt, examples of exostosis, others of inflammatory enlargement. An uniformly thickened skull, depending presumably, though not certainly, on the latter cause, may be either porous like cancellous bone, or dense and heavy like ivory. There is in the museum of the College of Surgeons an example of both varieties, each of which measures in many parts no less than ⅞ in. in thickness; in the porous variety the sutures are usually more or less completely ossified. The writer has seen a case in which, without apparent cause, the growth of one half of the lower jaw appeared to be arrested about the age of puberty, which gave a peculiar inequality to the face. Remarkable deformity of the skull may result from the constrained position in which the head is held by patients suffering from torticollis.

2. Variations in size.–The size of the skull is also subject to considerable variations in different races. It is somewhat larger, on the average, in men than in women. Amongst individuals also there are very great differences. Great intellects have sometimes been associated with large crania, but oftener there has been no such relationship, and not unfrequently the opposite has been the case. Far greater, however, are the modifications of size, which depend upon pathological conditions and defects of development. Some of these are briefly as follows:—

a. Microcephalic idiots.—Amongst this class of idiots, which must be made to include the cretins, the skull is remarkably deficient in size. Microcephalic skulls may be caused by a too early union of the sutures, in which case the want of development of the brain may be looked upon as a result of this synostosis; or there may be a normal condition of the sutures as regards union, but both the brain and the skull remain undeveloped. The low forehead and animal face which are characteristic of this condition, give a remarkably unpleasing appearance to the child. The amount of idiocy depends upon the size and structure of the brain, and the development of the convolutions. *See* CRETINISM.

b. Anencephalic monsters.—This class exhibits a more or less complete deficiency in the development of the cranial bones, as well as of the brain. The great variety of abnormalities which may be met with will be found described in the article BRAIN, Malformations of.

c. Hydrocephalic infants.—These infants have skulls of a size proportionate to the amount of fluid which is present, and they may thus sometimes reach enormous dimensions. *See* HYDROCEPHALUS, Chronic.

In this connection must be mentioned that extremely rare disease in children—hypertrophy and sclerosis of the *brain*, which involves a corresponding increase in the size of the skull. *See* BRAIN, Hypertrophy of.

3. Meningocele and Encephalocele.—Closely related also to hydrocephalus are the cases of meningocele and encephalocele. It may briefly be stated here that they involve the existence of a deficiency at some point of the skull, through which the membranes of the brain, containing cerebro-spinal fluid, or indeed some part of the brain itself, may protrude. The most frequent seat of this disease is the occipital bone, and the next in frequency the nasal part of the frontal bone, but tumours of this nature have been met with in other situations. It is of the highest importance to diagnose these two kinds of tumour from those developed in the bones of the skull or outside them; mistakes in diagnosis have not unfrequently led to most disastrous results, as, for example, when a meningocele has simulated a polypus of the nose, and its removal has been undertaken. If patients who have suffered from meningocele or encephalocele recover—a most rare occurrence—a small hole may remain in the bone which presented the deficiency, or the opening may be completely obliterated.

4. Cephalhæmatoma.—True cephalhæmatoma is a collection of blood between the periosteum and the skull. It occurs congenitally, usually on the right parietal bone, but often on the left, and as a rule varies in size from an inch to two inches in diameter; and it is surrounded by a hard, well-defined margin, which ultimately is composed of bone. It is probably in most cases, if not in all, the result of mechanical violence during delivery. An exactly similar condition is often seen as the result of a contusion in later life. If left alone a cephalhæmatoma generally disappears. If suppuration have taken place incision becomes necessary. *See* CEPHALHÆMATOMA.

The term cephalhæmatoma might equally well be applied to collections of blood between the dura mater and the skull. Such effusions are probably always traumatic, and result from the rupture of a meningeal artery or vein. If serious results do not immediately follow from pressure on the brain, considerable thickening of the dura mater may be set up, accompanied by the symptoms known as those of pachymeningitis. *See* MENINGES, CEREBRAL, Inflammation of, Simple Traumatic.

5. Inflammatory Diseases.

a. Inflammation of the diploë and its veins.—In cases of injury to the skull, whether of the nature of fracture or of simple exposure in a scalp-wound, inflammation of the diploic veins is not uncommon, if the wound be allowed to putrefy. Under such circumstances if the outer table be removed, the whole diploë and its veins are found to be filled with pus, or on applying a trephine to a bone thus affected, the pus may be seen to exude from the divided veins. The dura mater, under such circumstances, may be affected, or pus may collect between it and the bone. Pyæmia, with its characteristic concomitant symptoms, is the frequent, if not the invariable, result. It is not assumed that in this affection the outer and inner tables of the skull escape, but it is only in the diploë that the pathological process is obvious to the naked eye.

The only treatment that has been suggested—trephining—does not offer any hope of alleviating the symptoms.

b. Chronic osteitis.—This may affect the bones of the skull without apparent cause, but in the majority of cases depends upon the syphilitic taint. Sometimes all the bones of the skull become thickened and enormously massive, the surface being much roughened and often worm-eaten. At other times irregular hyperostosis may be the result. Considerable thickenings of some of the cranial bones, the result of an imperfect vascular osseous deposit, are found in some infants affected with congenital syphilis. These are mostly met with about the fontanelles, especially on the frontal and parietal, and sometimes the temporal bones. The irregular hyperostoses are mostly the result of local periostitis; in fact, they are ossified nodes. Chronic osteitis is the cause of the falling-in of the bridge of the nose or the massive condition of the same part, which gives such a characteristic appearance to a child suffering from congenital syphilis.

The treatment must be directed against the constitutional taint, if any is to be discovered.

c. Caries.—Chronic osteitis can hardly be considered apart from caries, which, again, in the majority of cases, depends upon syphilis, though more rarely on the strumous diathesis. It is usually caused by the penetration of a superficial ulcer into the deeper structures, or by the separation of the periosteum, resulting from periostitis. It is frequently associated with more or less chronic osteitis and necrosis. One of the most frequent seats of caries of the skull is the forehead, as a sequence of tertiary syphilitic ulceration (*corona Veneris*). Another common seat is the hard palate, which is often perforated as the disease advances. Caries may occur in the occipito-atlantal articulation (Pott's disease), followed by a train of symptoms which will be found discussed in other parts of this work. Caries of the temporal bone, either of the petrous or mastoid portions, frequently follows *otitis media*, and is not uncommonly the intermediate stage between this disease and meningitis or cerebral abscess.

Beyond precautions for maintaining cleanliness, little or nothing can be done to relieve this condition by the surgeon; and with regard to other cases of caries of the skull, whether considered pathologically or clinically, nothing can be added which does not apply to the same disease in other parts of the body. Caries of the occipito-atlantal articulation is well treated in the early stages by the actual cautery.

d. Necrosis.—Necrosis of the skull not unfrequently depends upon a traumatic cause, such as scalp-wounds or burns; but here again the syphilitic form is exceedingly common. It may also depend upon disease of the middle ear. Simple traumatic necrosis leads to the separation of a sequestrum in the usual way. Syphilitic necrosis often depends upon some form of ulceration, or upon periostitis, and may be accompanied by extensive caries and chronic osteitis. The separation of syphilitic sequestra is generally a remarkably tedious process; and they are, moreover, often surrounded by little or no reparatory callus, so that after their removal it is no rare occurrence to find the dura mater pulsating over a large area at the bottom of the wound. At the same time this rule is not invariable; it is common to find great thickening if necrosis of the bones of the orbit occur, which may cause permanent displacement of the eyeball. The writer has seen a large piece of the body of the sphenoid separated as a sequestrum, including the sella turcica, and removed through the nose without the slightest evil result to the patient.

Necrosis is not unfrequently met with affecting the bones of the face. Thus a part or the whole of the upper or the lower jaw may die, and be separated as a sequestrum. Necrosis of the jaws often depends on inflammation set up by carious teeth. Another cause, happily not now frequently met with, is the poisonous effect of the fumes of phosphorus in persons employed in the manufacture of this substance, and in that of lucifer matches (*see* Phosphorus, Poisoning by). The same remarks apply to the abuse of mercury. But besides these more special causes, necrosis of the bones of the face may depend upon those more general states which are supposed to stand to necrosis of other bones in the relation of cause and effect; such as fevers and the like. The amount of thickening round a necrosed upper jaw has not unfrequently led to its removal in mistake for a tumour; it is, therefore, of the highest importance to examine all swellings in this region with great care.

Treatment.—If the membranes be left exposed, some protection must be provided for the cranial contents; otherwise the treatment of necrosis of the skull must be conducted on general principles. Sequestra in the mastoid process or around the tympanum should be carefully dealt with, on account of the danger of setting up meningitis, which any surgical interference involves. In dealing with necrosis of one half of the lower jaw it must be remembered that, unless sufficient callus have been thrown out before the removal of the sequestrum, the other half will lose its support and assume an altogether unnatural and almost useless position, leaving the patient in a condition in which he can hope for but little relief from surgery.

e. Periostitis.—Periostitis of the skull has been already referred to. It may depend upon syphilis or struma—most commonly the former, and gives rise to what are known as *nodes*. The inflammatory subperiosteal effusion may be fluid or solid (*soft* and *hard* nodes); and it may undergo true or spurious suppuration or ossification, or may be completely absorbed. The most common position for cranial nodes is the frontal bone. As in the case of periostitis elsewhere, nodes are the seat of characteristic nocturnal pain, which is extremely distressing and exhausting to the patient.

Treatment.—The treatment in any case is by the administration of iodide of potassium; the effect of which is most marked, however, in syphilitic cases, the pain being usually removed in two or three days. If suppuration occur, incision is required.

6. Rickets.—In a rickety infant the skull looks large; though it may be questioned whether this does not depend on a deficient development of the bones of the face. The frontal and parietal eminences appear too prominent; the fontanelles remain patent much longer than in a healthy infant; and in some cases the anterior fontanelle may be unclosed as late as the fourth or sixth year. The skulls of rickety children have a peculiarly massive feel; they are sometimes long in proportion to their width, conforming to the shape known as dolicocephalic. For a more detailed account of this and other conditions see a paper by S. J. Gee, M.D., in vol. vii. of the *St. Bartholomew's Hospital Reports*, on 'The shape of the head looked at from a medical point of view.' The head of an adult who has been the subject of rickets in his childhood, has often a very characteristic appearance; an apparently large square skull, with a prominent forehead towering above a diminutive and pinched-up face, giving to the individual a decidedly intellectual aspect.

Craniotabes occurs occasionally in rickety skulls, but, as will be afterwards shown, we do not yet know how far, if at all, it depends upon the constitutional condition.

7. Craniotabes.—By this term is meant the occurrence of spots of remarkable thinness in the skull, such that an indentation may be produced by the pressure of the finger. True craniotabes, as opposed to the gelatiniform degeneration of the outer table (Parrot), attacks the inner aspect of the skull. For its production an undue softness of the bone appears to be necessary, together with the occurrence of pressure, either from within or from without. It is rarely found congenitally, and then affects the anterior part of the skull. It is common in syphilitic infants under one year of age, and then affects usually the posterior parts of the parietal bones. These positions, it will be noticed, are those most subjected to pressure under the two conditions mentioned. Craniotabes has been, by some observers, associated with rickets, but the relation of the one to the other is at present doubtful. It disappears as age advances, and requires no special treatment. *See* M. Parrot, *Revue Mensuelle*, 1879, p. 769; and Dr. Barlow and Dr. Lees, *Pathological Transactions*, 1880, p. 236, and 1881, p. 323.

8. Syphilitic affections.—From the foregoing observations it will be seen that syphilis, congenital or acquired, has much to account for amongst diseases of the skull. It may cause periostitis, with consequent nodes; chronic osteitis, with consequent hypertrophy, local or general; caries; necrosis; and craniotabes. As a general rule, it may be stated that syphilitic affections of bone are amongst the later manifestations of this disease. The inflammatory forms are usually accompanied by severe nocturnal pains, and they may be expected in most cases to yield to the administration of iodide of potassium.

9. Tumours.—It is necessary to refer in the briefest possible way to the tumours of the skull. Primary growths may spring from the diploë, or from the inner and outer tables of the cranial bones. Perhaps the most common are exostoses, and some of the various kinds of sarcoma, either of which may reach an enormous size. The former may assume various characters. A remarkable instance of one presenting the appearance of a horn will be found described in the *Path. Trans.* vol. iii. p. 149. These alone, and then only in certain cases, admit of removal by the surgeon. In connection with the bones of the face, tumours of the antrum or of the upper jaw, of various kinds, and tumours of the lower jaw, are not uncommon. In the latter position the various forms of epulis—myeloid, fibrous or malignant, and cystic tumours are frequently met with. Exostoses often grow from the jaws and the orbit, and in connection with the latter the different kinds of odontoma must be mentioned. Secondary tumours of all kinds may affect the skull; thus more than one instance is on record of a pulsating growth, occurring secondarily to a similar growth in the thyroid gland. Of these secondary affections the commonest are those which affect the skull by the direct extension of tumours from within or without; for example, the epitheliomata of the scalp or mouth, or rodent ulcer of the face.

R. J. GODLEE.

SLEEP, Disorders of.—SYNON.: Fr. *Troubles du Sommeil*; Ger. *Stöhrungen des Schlafes.*—A proper amount and kind of sleep is needful in order that the body may be maintained in a state of health. But the actual amount of sleep taken and necessary for persons in health varies, within wide limits, according to age, the soundness of the sleep itself, and individual idiosyncrasy.

Age is a very important modifying factor. Thus an infant may sleep for twenty hours out of the twenty-four, and young children up to the age of ten commonly sleep for fourteen or at least twelve hours. In children from ten to fifteen years old, the duration of sleep usually varies between twelve and ten hours. In persons from fifteen to twenty-five the period should not sink below eight hours; from the latter age on to fifty it may fall to seven hours; and after this age about the same amount of sleep is required by the majority of persons, though some find six hours sufficient, and a few can (without apparent injury) take habitually even as little as five hours' sleep. The instances in which a duration of sleep habitually less than this is needed, are altogether rare and exceptional.

Soundness of sleep, too, is subject to much individual variation. In childhood and in early life, sleep is commonly more profound than it is in adults, and much sounder than in old age. But over and above these variations incident to age, there are individual differences. Some persons are naturally 'light' and others 'heavy' sleepers. As a rule, those who can do with a small amount of sleep belong to the latter category. And similarly in regard to amount there are individual differences; some persons are able to do with a comparatively small amount, while others seem to require to sleep decidedly beyond the average periods above stated.

The disorders of sleep,—that is, the variations outside the above limits—belong to three principal categories, in the first of which may be ranged all those cases where sleep is *excessive* in amount; in the second those in which it is *defective* in soundness or in amount; and in the third those in which it is *unnatural in character*.

I. **Amount of sleep excessive.**—This occurs commonly in more or less demented persons or in idiots, whose brain-activity is below the usual level. Such persons, when their natural wants are satisfied, are apt, like the lower animals, to sleep away a large portion of their time.

But some individuals of notable intellectual power may occasionally, even in a state of health, though after greatly prolonged labours with previous deprivation of rest, continue to sleep soundly for twenty-four or even thirty-six hours.

In many brain-affections, and in some cases of blood-poisoning, a condition of unnatural sleep bordering upon stupor may be present for many days. Obscure cases in which sleep is prolonged for weeks, or even months, are occasionally met with in this country. This rare condition only supervenes in persons of an obviously 'nervous' temperament, and the state itself seems generally to be a kind of trance allied to catalepsy.

On the West Coast of Africa a curious endemic disease occurs known as the '*sleeping sickness*' (*see* Gore, *Brit. Med. Journal*, Jan. 2, 1875), the ætiology and pathology of which is altogether obscure. It begins with a swelling of the cervical glands, together with an increasing tendency to sleep. The somnolence becomes more and more constant, until at last the patient cannot even be aroused to take nourishment. The disease lasts from six to twelve months, and is generally fatal. *See* TRANCE.

II. **Amount of sleep defective.**—Under this head we have to do with two kinds of failure—a defect of quality (*disturbed* or *restless sleep*); and a defect in quantity (*wakefulness, insomnia, pervigilium*). These two defects often co-exist, though in many cases we may have the former condition existing alone.

(*a*) *Disturbed* or *restless sleep.*—This is a most common complaint, apt to occur in persons of all ages, and under the influence of many different causes, some of the most frequent of which are these:—indigestible food, or food of excessive or unaccustomed quantity, taken not long before going to bed; painful conditions of any kind; discomfort induced by undue cold or excessive heat; mental excitement or worry; prolonged overwork (mental); over-fatigue (bodily); febrile conditions; inflammations; gouty states of the system; imperfect action of the liver; excessive hæmorrhages; acute and chronic illnesses of various kinds; the state of convalescence from many acute diseases. Lastly, sleeping in a novel or uneasy condition, or in the midst of unaccustomed noises, may also be mentioned as a not unfrequent cause. Under any of these various conditions sleep may be fitful and disturbed, the persons often starting or turning about uneasily, dreaming much, and from time to time waking under the influence of dreams of a distressing or oppressive character. In one of the most extreme of the latter conditions, especially when it has been evoked by indigestible food, the state known as *nightmare* is induced. *See* NIGHTMARE.

TREATMENT.—The treatment of disturbed sleep must of course vary widely according to the nature of the influences under which it has arisen. These may at times be easily corrected, but in other cases where the disturbed rest is dependent upon pain difficult to annul, or upon some acute or chronic disease, it may be impossible or extremely difficult to ensure sound sleep, notwithstanding the best directed efforts to correct or neutralize the disturbing causes in operation. It may then be necessary to have recourse to the measures recommended under the next heading.

(*b*) *Insomnia or wakefulness.*—Under this head we may have either complete or partial insomnia. The condition is complete when the person gets no sleep at all for night after night, as in acute mania, delirium tremens, in those suffering from some very severe pain, or in persons under the influence of profound grief or mental anxiety. On the other hand we may have partial insomnia of different kinds. In the one set of cases the persons who suffer from it may lie awake for long periods (one to several hours) before being able to get to sleep at all, and then sleep may be more or less sound and continuous till morning. In other cases patients do not experience so much difficulty in getting to sleep, though after they have slept for one, two, or more hours they awake and cannot again fall asleep; they lie awake often in a state of mental depression, or even actually tortured by gloomy or horrible forebodings.

Various cases are on record in which absolute insomnia has lasted not only for days but even for weeks, interrupted only by mere snatches of sleep during brief intervals.

In this whole class of cases, however, the sufferers themselves are apt to form exaggerated estimates of the amount of their wakefulness, and to become more or less hypochondriacal upon the subject.

TREATMENT.—In many of these cases the art of the physician is very severely taxed. Whenever it is possible, insomnia should be corrected by a studious attention to the general health and habits of the patient, and by endeavouring to ensure the presence, as far as possible, of the physiological conditions which favour sleep. Mental repose, bodily comfort, a sufficient degree of warmth, a certain amount of fatigue, combined with perfect quietude, are essentials. To ensure the first of these conditions it may be needful to prohibit all study for some hours before retiring to rest. An evening walk, so as to induce a certain amount of bodily fatigue, is often beneficial where it can be had recourse to. A cup of warm beef-tea, gruel, or some weak stimulant just before going to bed may also have a salutary influence, and the former may be repeated, or taken preferentially, during the night. Monotonous sensorial impressions (sounds or gentle frictions); or a monotonous dwelling of the mind upon certain uninteresting imaginary sights or verbal repetitions are, again, not unfrequently found to act as provocatives of sleep.

Where such measures are unavailing, recourse must be had to hypnotics and sedatives, such as bromide of potassium, chloral, opium in one or other of its forms, morphia by mouth or subcutaneously, hyoscyamine, Indian hemp, &c., in doses appropriate to the age and condition of the patient. In the more urgent cases the doses of such hypnotics may have to be repeated till sleep is procured; but in many of these urgent conditions the sedative influence of packing in the wet sheet must not be forgotten. Where hypnotics are had recourse to, it is of great importance to see that their use is not continued after the need for them has passed. Abrupt discontinuance is often most inadvisable, but rather a gradual diminution of the dose, with or without the knowledge of the patient.

III. Sleep unnatural in character.—Under this head we have to do with various unnatural conditions, in which the abeyance of function characterising sleep is more partial than that which normally exists. In disturbed sleep the physiological condition pertaining to sleep is generally less profound than it should be, just as in other cases of unusually deep sleep (akin to stupor) such a condition is generally more profound than natural. In the cases to which we now refer, however, sleep is partial in its area; portions of the brain that are usually involved in the physiological condition peculiar to sleep remain exempt, so that the sleeper exhibits powers which sleep usually annuls. Hence we may have ***somniloquy*** or ***sleep-talking***; and ***somnambulism*** or ***sleep-walking***. In those who exhibit the former phenomena, dream-thoughts are capable of evoking correlative acts of speech, and such persons will sometimes allow a listener to hold a sort of conversation with them, of which in the waking state they recollect nothing. This dream-conversation may be more or less coherent. Dreams themselves, too, vary much in their coherency in different individuals. In some persons whose sleep is to that extent unnatural, powers are displayed which even surpass those of the waking state. Mathematical problems have been solved during such sleep; poems and music have been composed and written out, which have altogether surprised the same person when awake. The writer has recently seen a young lady liable to what may be termed 'singing fits,' in which she would lie for hours incapable of being aroused by ordinary means, singing without intermission songs, hymns, and portions of operas in promiscuous succession, but in a manner very decidedly excelling that of which she was capable when awake. In all these states we have to do with a morbid condition of sleep, partial in its area, and in which there is the further peculiarity that certain faculties are in a condition of exalted activity. The alliances here are intimate with the conditions that have of late been studied under the name of 'hypnotism,' but which were formerly included under the term animal magnetism (*see* MAGNETISM, ANIMAL). The same remark applies to somnambulism also. Here the morbid sleeper possesses an unwonted power of calling his muscles generally into activity in response to his dream-thoughts. Sight in relation to the dream may be good, though unrelated visual impressions are not taken cognizance of. Muscular sense-impressions also are freely acted upon, but the sleep-walker may be quite deaf to all ordinary auditory impressions.

TREATMENT.—These are to be regarded as distinctly morbid conditions, and the persons manifesting them may often be cured by attention to the general health, and the use of remedies calculated to give tone to, and allay the irritability of the nervous system. A line of treatment, in fact, not very dissimilar from that to which one would have resort in convulsions or epilepsy, will often suffice to cure these minor manifestations of nervous disorder.

Finally sleep may be disturbed by certain phenomena occurring to the person in this condition, which, though scarcely to be spoken of as disorders of sleep, ought at least to be mentioned under this head. One of minor significance is snoring, which at times may be so loud as to awaken the sleeper; but another of far greater significance is the tendency to the occurrence of convulsive or epileptic attacks, which in some patients occur only during sleep.

H. CHARLTON BASTIAN.

SLOUGH (Sax. *Slog*, a foul hole or hollow).—The dead material resulting from gangrene, ulceration, or low forms of inflammation of soft tissues. A slough may be in the form of a mass, as in gangrene; or in shreds, as in ulcers and unhealthy wounds, which are then said to be *sloughing*. *See* GANGRENE; and ULCERATION.

SMALL-POX.—SYNON.: Variola; Fr. *la petite Vérole*; Ger. *Blattern*.

DEFINITION.—An acute specific, infectious disease, characterised by sudden and severe fever, which after forty-eight hours is followed by an eruption of pimples on the forehead, face, and wrists, gradually passing over the body. This eruption is followed by a fall of temperature, and in from ten to fourteen days it passes through the stages of vesicle, pustule, and crust; it also appears on certain mucous membranes, and is sometimes complicated with hæmorrhage into the skin, and from the mucous surfaces.

ÆTIOLOGY.—When, where, or how small-pox arose is not known. It certainly appeared in Europe in the sixth century. It arises now from contagion and from inoculation. It affects all races of men, every age, and both sexes. No climate is free from its ravages. It rages with special virulence where it appears for the first time, and in such cases may carry off whole tribes. It is exceptionally severe among negroes and the inhabitants of warm climates generally. Its subjects are unvaccinated or badly vaccinated persons, extensive observation having shown that in proportion to the efficiency of vaccination is the rarity and mildness of small-pox. As a rule it attacks the same person once only, but there are exceptions to this rule. Some few—of whom Morgagni, Boerhaave, and Diemerbroek are said to have been examples—are insusceptible of small-pox.

ANATOMICAL CHARACTERS.—Small-pox is the result of a specific morbid poison, which, after a period of incubation of about thirteen days, possibly sometimes less, manifests itself by high fever and an eruption on the skin. The eruption is sometimes preceded by rashes of an erysipelatous, scarlet, or measly character, chiefly seen on the lower abdomen, the groins, and the upper and inner part of the thighs, along the sides of the chest and about the axillæ. Sometimes they are seen upon the face and neck, and occasionally they cover the body. They are distinguished from the hæmorrhagic rashes by the absence of blue-black spots, and are usually associated with the milder cases. 'As regards the skin-eruption, the papules are due, in the first instance, partly to punctiform hyperæmia of the cutis, over which the epidermic cells, and more especially those of the superficial portion of the rete mucosum, become swollen. By degrees, serous fluid is poured out into the substance of the affected epidermis, raising the horny layer from the swollen group of cells below, but detaching it imperfectly, so that a number of small irregular intercommunicating serous cavities are produced. But soon suppuration occurs in the subjacent rete mucosum, and the pus-corpuscles then rapidly diffuse themselves, and the pock is converted into a pustule. The umbilicated character which is so common is due to the presence either of a hair or of a sudoriparous gland, the connection of which with the subjacent true skin has not yet been destroyed. The suppurative process need not implicate the true skin below; but not unfrequently it involves and destroys it to a greater or less depth, and is prolonged inwards along the hairs or glands. Under the former circumstances the pustule leaves no permanent trace; under the latter a depressed cicatrix results, presenting numerous pits upon its surface.' (Bristowe, *Theory and Practice of Medicine*.)

Post-mortem examination shows nothing beyond external appearances, special to small-pox, except a trace of eruption on the larynx and vocal cords. The blood is in most cases imperfectly coagulated, and in black cases not at all. In the latter ecchymoses of the mucous and serous membranes will be found. Pleuritic effusions and pneumonic consolidations are sometimes found, but the most common lung-complication is broncho-pneumonia. In variola hæmorrhagica pustulosa hæmorrhage is generally found in the substance of the lungs, heart, kidneys, and liver.

SYMPTOMS.—Small-pox may be described under six forms:—(1) discrete; (2) confluent; (3) hæmorrhagic pustular; (4) malignant; (5) inoculated; (6) small-pox after vaccination and revaccination (modified).

(1) **Discrete.**—In the discrete form the disease begins with rigor, fever, lumbar pain, headache, and sickness, with copious perspirations; followed by an eruption on the forehead, face, and wrists. This is usually most abundant on these parts, next most abundant on the hands and feet, and least so on the limbs and trunk. The eruption is followed by a remission of the general symptoms, and a fall of temperature, which continues until about the eighth day, which, in this article, is always the day of disease. Between the third and the eighth days the pimples appear on the extremities and the trunk, and change into greyish-white vesicles, circular, flattened, depressed in the centre, and surrounded by a red ring. During this time also vesicles may be seen in the mouth and the upper part of

the pharynx and larynx, and there will be some soreness in these parts. On the eighth day some of the vesicles become pustular, lose their central depression, and become globular, whilst the redness which surrounds them becomes more marked. With this change the temperature rises, and the general symptoms return; but these are of short duration, for the pustules either dry up rapidly and form scales, or burst and form scabs; the temperature falls by about the tenth day; and the patient is then convalescent, fatal results being extremely rare, except in unvaccinated children under one year. When the crusts have fallen, and the desquamation which follows them is complete, there will often be pitting.

(2) **Confluent.**—In this form the initial symptoms are essentially the same as the former, but more severe. The eruption appears about the same time, and in the milder varieties is discrete until the disease has reached the vesicular or the pustular stage; but in the more severe forms it is confluent from the first, and instead of showing distinct closely packed papules, the whole face is swollen, presenting the appearance of a tense elastic mass. When the eruption is well out the temperature falls, and the general symptoms remit, but to a less extent than in the discrete variety, and this remission continues until about the eighth day. Up to this time more or less delirium is present in many cases, and it is sometimes maniacal and suicidal in character: drowsiness and stupor sometimes take its place, and occasionally alternate with it. On this day, the eighth, the vesicles begin to become pustular, the areola to deepen, the temperature to rise, and the general symptoms to return. At the same time the face becomes extremely swollen; the eyelids close from œdematous swelling; saliva flows copiously from the mouth; the glands, and the subcutaneous tissue of the neck and lower jaw enlarge; and the early delirium usually disappears. One of three things may now take place:—(1) the disease may go on regularly to the eleventh day; (2) the development of the pustules may cease, the face remaining flat, of an opaque white colour; or (3) hæmorrhage may take place into the skin beneath the vesicles, and from the mucous membranes, that is, may become hæmorrhagic pustular. In either of the last two events death is almost invariable, and often rapid. In the first the swelling of the face increases for the next three days, during which time the vesicles become pustular, and the hands and feet swell. There will be increased sore-throat, increased salivation, great thirst, sleeplessness, delirium, rising temperature, and occasionally laryngitis. On or about the eleventh day the temperature and the general symptoms will have reached their height, the pustules will discharge their contents, and crusts will form. After this, in favourable cases the temperature will begin to fall, and the symptoms of the so-called 'secondary fever' to decline. By the fourteenth day crustation will be complete on the face, where it is most commonly found, the general symptoms will have disappeared, the temperature will have become normal, and convalescence established. In unfavourable cases it is about this time, the eleventh day, that death usually occurs. It is preceded by low delirium, variable temperature, subsultus, involuntary motions, and occasionally hæmorrhage into the skin and the pustules. When the crusts, which in this form are often retained many weeks, fall off, and when the desquamation is complete, there is pitting, which, at first of a reddish-brown colour, in process of time becomes white.

(3) **Hæmorrhagic, pustular, or vesicular.**—This form of small-pox constitutes the connecting link between the confluent and the malignant. With the latter it is often confounded, and hence true malignant has sometimes been said to end in recovery. It is characterised by hæmorrhage into the skin beneath the vesicles or the pustules. There are generally petechiæ, sometimes ink-spots, and often subcutaneous hæmorrhage. Recovery is very rare. Death may take place in the vesicular or the pustular stage.

(4) **Malignant.**—Synon.: *Variola nigra; Variola hæmorrhagica*; Black Small-pox; *Purpura variolosa.*—This form is invariably fatal. Its distinguishing features are hæmorrhage into the *skin*, and irregularity in the form of the eruption. The illness commences with the ordinary symptoms, but accompanied by marked lumbar pain, præcordial anxiety, and coldness of the extremities. This is followed, about the third or fourth day, by ecchymosis into the conjunctivæ, and a purpuric or scarlatiniform rash, sometimes covering the whole body, but most marked over the lower abdominal region, and the upper and inner part of the thighs, in which rash large and small dark blue, deep violet, or black spots are seen. The ordinary eruption is sometimes entirely absent, or when present is very meagre and much modified. In the majority of cases it is limited to a few scattered vesicles, more often found on the fingers and toes than elsewhere. With these appearances there will often be found on the skin hard tumours, of variable size, of the same colour as the spots; and from one or more of the mucous surfaces there will be bleeding. Death sometimes takes place as early as the third day, most commonly on the fifth, rarely later than the seventh. The temperature usually fluctuates about 102° (Fahr.), sometimes reaches 104°, and is sometimes nearly normal during the whole course of the disease. The mind is almost always clear throughout. This form of small-pox has received so little mention of late years, although it is well described by Sydenham, that the writer thinks notes of a few cases will be useful:—*E. B.*, æt. 24, unvaccinated. Condition on fourth day:—Very restless, pulseless; losing blood from vagina; repeated vomiting; some papular eruption with ink-black spots; bruise about the size of a shilling over the insertion of the right deltoid. Mind clear. Fifth day:—Patient called the nurse, who had just left the bedside, on immediately returning to which she found the patient dead. *J. W.*, æt. 28. One fair vaccination-mark and one bad. Illness commenced with lumbar pain and vomiting. On the fourth day:—Face red and swollen; papular eruption on hands, and general erythematous rash, with spots like leech-bites; hæmoptysis; temperature 100·4°. Mind clear. Sixth day:—Left eye black; blue spots on face; hæmaturia; hæmoptysis; feeble pulse; temperature 99°; death. *J. L.*, æt. 23, three good vaccination-marks.

On fourth day:—Anxious and restless, with general scarlatinous rash, most marked over the groins and lower abdomen, of a brick-red colour, with many lead-coloured spots; face natural, except for conjunctival ecchymosis and bruised eyelids; lead-coloured spots on the sides of the trunk and borders of the axilla; petechiæ on legs; a few vesicles between the shoulders; mind clear; temperature 101°; continued much the same until the morning of the seventh day, when hæmoptysis occurred, and the patient died; temperature 98·6°. This form of small-pox occurs at all ages, and in both sexes. It is never found in well-vaccinated subjects under fifteen, nor in those who have been efficiently revaccinated about that age.

(5) **Inoculated.**—On the second day of inoculation a pimple rises, which by the fourth has developed into a vesicle, and by the seventh or eighth into a pustule, when the patient has rigors, swelling and pain in the axillary glands, and more or less fever, followed on the eleventh day by the ordinary small-pox eruption (Bristowe), which passes through the usual stages. The inoculated pustule attains full development on or about the eleventh day, and by the fourteenth there will be a crust. The characteristic of the disease thus induced is its mildness. It protects from small-pox in the same degree as first attacks of that disease protect from second attacks. The objections to it are (1) that small-pox so induced is infectious; and (2) that it is sometimes fatal.

(6) **Small-pox after Vaccination and Revaccination.** (*a*) *After vaccination.*—Speaking generally it may be said that *good* vaccination protects from small-pox, and that when it does not protect absolutely it renders the disease milder, the disfigurement less marked, and reduces the mortality directly as the efficiency of the vaccination and revaccination. Persons under fifteen years of age with two good cicatrices are very rarely the subjects of severe small-pox, and if they contract it, death is almost, if not quite unknown. After this age, however, certain, chiefly inefficiently vaccinated, persons become again susceptible, and the disease in some of these is occasionally severe. Post-vaccinal small-pox may be described under the following three forms:—(1) In one class of cases there is more or less feeling of illness, headache, slight fever, possibly some lumbar pain, followed on the third day by a sparse eruption of papules, which abort and soon disappear. (2) In another class there are severe initial symptoms, followed on the third day by an eruption of papules, and a remission of the fever. On the fifth day the papules will have become vesicles, which in a day or two dry up without any recurrence of fever, leaving the patient convalescent at the end of a week. (3) In a third class the initial symptoms are very severe, sometimes indistinguishable from those of confluent small-pox, and they last forty-eight hours, after which an abundant eruption comes out, the whole face swelling as in severe confluent. The temperature now falls, and the disease in some cases will abort at this stage; in others it will go on to the vesicular stage and then abort, the patient becoming convalescent about the end of a week, without any recurrence of fever. In the case of adults who have been vaccinated only in infancy, and in children who have been badly vaccinated, the disease may run an unmodified course and end fatally.

(*b*) *After revaccination* (successful). Small-pox, after this, is practically unknown. During the epidemic of 1871, 110 persons were engaged in the Homerton Fever Hospital in attendance upon the small-pox sick; all these, with two exceptions, were revaccinated, and all but these exceptions escaped small-pox. The experience of the epidemic of 1876-77 was of the same kind, all revaccinated attendants having escaped, whilst the only one who had not been vaccinated took the disease and died of it. So, in the epidemic of 1881, of 90 nurses and other attendants of the Atlas Hospital Ship (small-pox) the only person who contracted small-pox was a housemaid who had not been revaccinated. At the same time a single efficient revaccination about puberty is not, in the writer's opinion, an effectual protection, even against death, for all time.

COURSE, TERMINATION, COMPLICATIONS, AND SEQUELÆ.—In the discrete form of small-pox the great majority of cases recover; half of the confluent cases die about the eleventh day, and the malignant cases invariably die. In small-pox modified by vaccination the course of the disease will depend upon the quantity and quality of this, as shown by the marks. If these be of the best kind, three or four in number, and in a patient under fifteen, the disease is invariably mild. In some, however, who have passed puberty, the best primary vaccination loses in power; but nevertheless, it almost invariably modifies the disease, and when death occurs it is usually due to some accidental complication. Of complications, laryngitis, bronchitis, pneumonia, and in particular broncho-pneumonia, are the most common. Glossitis occurs occasionally. On two occasions the writer has met with cerebral symptoms, which were shown after death to depend upon cerebral hæmorrhage. Aphasia with right hemiplegia he has seen twice; and once a condition like dementia, shown after death to depend upon thrombosis of the basilar artery. In the cases of cerebral hæmorrhage the eruption was not fully developed, but at the time of death they did not seem likely to become cases of extreme confluence. One was in a girl twenty-one years of age, with two good vaccination-marks; and the other in a boy of eight with four fair marks. In both cases the event occurred in patients who suddenly became dangerously ill, and the seriousness of whose illness could not be ascribed to a small-pox which was by itself mild. It may be that this would be found to be the *immediate* cause of death in other cases, if post-mortem examination were more frequent and complete. It has been said that small-pox is occasionally complicated with scarlatina or measles; and Dr. Murchison, Professor Monti of Vienna, Dr. Theodore Simon of Hamburg, Mr. Marson, late of the London Small-pox Hospital, and others have published cases in support of this. There is no doubt that *eruptions* indistinguishable from those of scarlatina and measles, appear in many cases of variola; but whether the presence of such eruptions, which are but *one* symptom, constitute evidence upon which to maintain the co-existence of two specifically distinct diseases—an opinion which has the support of Trousseau (*Clinique Médicale*, vol. i. p. 32, edition 1868)—may be doubted. Pregnancy has been said to be a grave complication of small-pox. It is certain, however, that many pregnant women recover without injury; but abortion in confluent cases is often fatal, on account of the attendant bleeding. Of sequelæ the most common is pitting. Mania and dementia are occasionally seen. Erysipelas, abscesses, gangrene of the extremities, particularly the tips of the hands and feet, enlargement of the glands of the neck, conjunctivitis, iritis, perforating ulcer of the cornea, are not uncommon, and then occasionally one or both eyes may be destroyed. The specific small-pox eruption, however, never appears on the corneal conjunctiva. The changes which take place in the eye are late in the disease, and in all probability due to defective nutrition. Otitis, parotitis, orchitis, and ovaritis occur sometimes; and pyæmia occasionally.

Diagnosis.—This cannot be made with certainty until the eruption appears. Fever, headache, lumbar pain, and vomiting during the time of an epidemic of small-pox, should arouse suspicion; and should these be followed after forty-eight hours by an eruption of papules on the forehead, face, and wrists, the diagnosis may be considered certain. The difficulty of exact diagnosis depends on the fact that in many cases all the main features are not present together, and that one begins to trust to the existence of some one prominent symptom. Fever with headache, backache, and vomiting *may* occur in continued fevers; but the later appearance of the eruption, and the fact that it is not found in the situations in which that of small-pox occurs, ought to negative the idea of small-pox. Small-pox is occasionally preceded by eruptions which simulate those of measles, scarlatina, or erysipelas, and these eruptions are associated with fever and other symptoms of constitutional disturbance. If the disease be small-pox, the eruption will change within twenty-four or thirty-six hours, or will show signs of malignancy. Pyæmia, glanders, and acute rheumatism with a pustular eruption, may also be mistaken for small-pox, but attention to the *history of the case* will be enough to enable one to form a correct opinion. So far as eruption alone may lead to error, the point for diagnosis turns on the query, Could the eruption have reached, or would it not have gone beyond its existing stage, if the disease on which it depended were small-pox? Of eruptions unattended by general symptoms, syphilides, acne, eczema, erythema, and urticaria are most frequently mistaken for small-pox; but mistakes of this kind may in most cases be avoided by a careful consideration of the *history*. Lumbar pain is found with fever in pneumonia, but physical examination of the chest ought to settle the question; moreover, there is no eruption beyond occasional herpes. In lumbago there is no fever. Labour-pains are unattended by fever; moreover, they usually come on gradually and in the belly first, and are not constant. It must be borne in mind, however, that pregnant women, when suffering from small-pox, may have labour-pains and the initial symptoms of small-pox concurrently. Cases of black or malignant small-pox will present little difficulty; but if scarlatina, measles, and typhus prevail at the same time, there will be great difficulty in arriving at an exact diagnosis as to which form of malignant fever exists in the case under observation. The diagnosis from chicken-pox has been treated of in that article. *See* Chicken-pox.

Prognosis.—This will have been gathered from what has preceded. Small-pox is most fatal in unvaccinated children under five, and in adults over thirty. At these periods of life half or more may die. The lowest mortality in the unvaccinated occurs from ten to fifteen. The discrete form is rarely fatal in adults, but it is so occasionally when it occurs in unvaccinated children. Half of the confluent cases will die, and of the malignant all, and nearly all children under one year, whatever form the disease may assume. As regards vaccination in prognosis, it may be stated generally that the unvaccinated will die at the rate of about 50 per cent., the badly vaccinated at the rate of about 26 per cent., and the well vaccinated at the rate of about 2·3 per cent. *See* Vaccination.

Treatment.—There is no specific for small-pox, its complications or sequelæ, and the treatment is therefore to be conducted on general principles. The following are points of importance:—(1) The patient should be placed in a large, well-ventilated room. He should be fed at intervals on easily digestible food, such as milk, beef-tea, chicken broth, and eggs beaten up; and occasionally, according to habit, a little wine or spirit may be given. He should be permitted to drink iced water or iced lemonade as he pleases. He should have a feather-bed, the sheets ought to be of the softest material, and the coverings light; and there should be two beds in the room, in order that the patient may be changed daily. (2) Two competent nurses should be obtained, one to attend the patient by day, the other by night, and these should never *for a moment* lose sight of him. (3) The hair should be cut short. (4) Heat of skin should be relieved by cold-water sponging, and the swelling of the eyelids and other painful parts by the constant application of cold compresses. (5) To relieve itching olive oil may be used, or, what is better, vaseline, which applied as a dressing to the face will facilitate the removal of scabs; and to destroy the disagreeable odour, some kind of deodorant, such as sanitas powder, should be sprinkled about and over the patient's face and bed. (6) To procure sleep, opium; or some form of alcohol, diluted with warm water, may be given. (7) Salivation should not be interfered with, but the mouth should be kept clean, and sedatives avoided during its continuance. (8) When delirium is marked, in addition to the nurse there should be an attendant, one accustomed to deal with lunatics, and of some bearing if possible. Mechanical restraint should be avoided, and the 'strait jacket' and 'tying down' strictly forbidden. The patient ought not to be left for one moment alone, otherwise he may have to be looked for wandering along some street, or drowned in the nearest water-course. He should never be argued with, and never flatly contradicted. If he should imagine his attendants are bent upon injuring or killing him, they should be changed. If he be excited by the mere presence of others, as may happen in hospital wards, he should be treated by himself in a dark room. Should he persist in getting out of bed and putting on his clothes, in walking about his room, or in sitting over the fire, he should be permitted to do so, for to the fretted and fevered patient moving about is a relief. In maniacal delirium chloroform may be administered. (9) The eyes should be carefully watched, and in severe cases an ophthalmic surgeon should be consulted. (10) About the eleventh day laryngitis often supervenes, and for this tracheotomy should be performed when there arises distinct difficulty of breathing. Although in the majority of such cases the patient dies, the relief from suffering is so great that the operation should be performed. (11) When crusts begin to form about the nostrils they should be removed, and generally the patient should be kept in bed until suppuration under the crusts has ceased and the skin is healed. (12) Abscesses should be opened when they appear, and a water-bed should be ordered at the same time. (13) The patient may be discharged safely when the crusts and scales have disappeared, and not less than six baths have been given, at intervals of two days. Such is the general treatment of confluent small-pox; in the discrete kind little is needed; in the malignant none is of any avail.

The prophylaxis of small-pox is discussed under VACCINATION. ALEX. COLLIE.

SMELL, Disorders of. *See* NOSE, Diseases of; and OLFACTORY NERVE, Morbid Conditions of.

SNAKE-POISONS. *See* VENOMOUS ANIMALS.

SNEEZING, Excessive. — SYNON.: Fr. *Coryza spasmodique*; Ger., *Niesekrampf*.

DEFINITION.—An affection characterised by frequent and uncontrollable attacks of sneezing, out of all proportion to the nasal secretion.

ÆTIOLOGY.—The causes of excessive sneezing may be broadly classified as *extrinsic* and *intrinsic*. *Extrinsic* causes include especially various vegetable substances in the form of powder, of which tobacco-snuff is the type, and the pollen of certain plants (*see* HAY FEVER). The *intrinsic* conditions in connexion with which the affection occurs vary considerably. In some cases it is associated with whooping-cough and asthma, and it is not uncommon in gouty persons. It is sometimes a symptom of the hysterical condition, and not unfrequently associated with disordered menstruation, or some other derangement of the sexual functions. It has been met with in pregnancy, and even during more than one pregnancy in the same person, ceasing in the intervals, and has been supposed to replace morning-sickness (Barnes). In some persons a bright light or intense colour is sufficient to determine an attack of sneezing.

SYMPTOMS.—The morbid sneezing has no special characters. It is distinctly a reflex act, being excited usually by some slight impression on the fifth nerve. A slight catarrhal condition of the nasal mucous membrane is common. The secretion has been thought to be, in some cases, of a specific character, analogous to that of hay fever.

TREATMENT.—The attack itself may be usually cut short by a strong impression on some branch of the fifth nerve; when this fails, a mustard poultice to the back of the neck, or an emetic, may be employed. Atomised astringent nasal inhalations, or the vapours of creasote or iodine are useful. The immersion of the head in cold water has been recommended. Any irregularity in the functions of the genital or other organs must be attended to; and iron, quinine, and arsenic, if not otherwise objectionable, are useful in removing the liability to the complaint. *See* CATARRH; and HAY FEVER. W. R. GOWERS.

SNUFFLES.—A popular term for the condition in which a nasal discharge exists in children suffering from congenital syphilis. *See* SYPHILIS.

SODEN, in Taunus, Germany.—Common salt waters. *See* MINERAL WATERS.

SOFTENING. — SYNON.: Fr. *Ramollissement*; Ger. *Erweichung*.—A term of pathological significance, implying that an organ or tissue has a degree of consistence less than that which is natural to it. This is a condition which occurs in various organs or parts (1) as a result of pathological changes *during life*; and (2) as a consequence of different *post-mortem* influences.

(1) **Intra-vitam softening.**—With regard to the first order of changes, the brain and the spinal cord are the organs in which these conditions are most common, and in which it is apt to assume its most typical characters (*see* BRAIN, Softening of; and SPINAL CORD, Softening of). It occurs also in the osseous system (*see* BONES, Diseases of). The liver and spleen may likewise be softer than natural, and so may the mucous membrane of the stomach or intestines, or the tissue of the heart. In nearly all such cases the principal cause of this diminished consistence is a fatty degeneration or infiltration, associated with more or less of serous infiltration (*see* FATTY DEGENERATION, and the diseases of the several organs mentioned). This pathological condition is the reverse of those conditions of induration known by the name of *sclerosis* in some organs, and *cirrhosis* in others. *See* SCLEROSIS.

(2) **Post-mortem softening.**—The softening due to the definite pathological processes just referred to as occurring during life, has to be clearly discriminated from certain softenings which may supervene after death as a result of traumatisms or mere *post-mortem* changes. Thus the tissue of the brain or of the spinal cord, in some parts, may be diminished in consistence, and rendered more or less pulpy, owing to its having been bruised during the operations necessary for exposing these organs to view. The same organs likewise diminish in consistence by mere lapse of time after death, and the more quickly in proportion to the heat of the weather. In the stomach also *post-mortem* softenings are most prone to show themselves, should the organ contain gastric juice at the time of death. Here we get softening first, and afterwards solution of

the mucous membrane and other tissues of the organ. *See* Stomach, Softening of.

H. Charlton Bastian.

SOLIS ICTUS (Latin).—A synonym for sunstroke. *See* Sunstroke.

SOMNAMBULISM.—Sleep-walking. *See* Sleep, Disorders of.

SOMNILOQUY.—Sleep-talking. *See* Sleep, Disorders of.

SOMNOLENCE.—An unnatural drowsiness or disposition to sleep. *See* Sleep, Disorders of.

SONOROUS RÂLE.—A variety of dry *râle* or rhonchus, of a low-pitched character, resembling snoring and similar sounds, and produced in the larger air-tubes. *See* Physical Examination; and Rhonchus.

SOPOR (Lat.).—An unnatural deep sleep, from which the patient can only be roused with difficulty. *See* Consciousness, Disorders of.

SOPORIFICS (*sopor*, heavy sleep).—Synon.: Fr. *Soporifiques*; *Soporatives*; Ger. *Einschläfernde Mittel*.—A synonym for hypnotic agents. *See* Narcotics.

SORDES (Lat., filth).—Definition.—Crusts which form upon the lips and teeth of persons suffering from extreme exhaustion.

Description.—Sordes occur commonly in what is called the typhoid state, whether this be due to typhoid or puerperal fever, pneumonia, or any like disease. They appear first as thin, light-yellowish crusts upon the prolabia, generally in close proximity to the teeth; gradually increase in thickness and in area; and, changing their colour to brown, or even black, at length extend to the adjacent surfaces of the teeth. They seldom or never cover those portions of the teeth which are hidden by the lips, but spread over their exposed surfaces; so that, as the patient lies with slightly parted lips, they bridge over the interval in the form of a narrow band upon the middle of the incisors of the upper jaw. When the lips are more widely separated, the sordes do not extend, unless in conditions of extreme exhaustion, over the whole of the exposed surfaces of the teeth, but form two ridges, corresponding with the margins of the upper and lower lips.

Sordes are composed of various schistomycetes, mingled with *débris* of food and epithelium. Micrococcus occurs almost constantly; bacillus subtilis frequently; and the writer has found, each in a single instance, sarcina ventriculi and spirochæta plicatilis.

Pathology and Treatment.—These organisms, which are of constant occurrence on the papillary surface of the healthy tongue, are easily dislodged from the smooth lips and teeth. But in conditions of great prostration, especially when the prostration is associated with delirium, the slight frictions necessary for their removal are not made, and they obtain so firm a hold that they can only be removed by careful and repeated cleansing. Such cleansing may with advantage be performed with a piece of soft rag, or a brush dipped in a weak solution of Condy's fluid.

Henry T. Butlin.

SORE-THROAT.—A popular name for various affections of the pharynx, larynx, and tonsils. *See* Larynx, Diseases of; Pharynx, Diseases of; Throat, Diseases of; and Tonsils, Diseases of.

SOUFFLE (Fr.).—A soft, blowing sound. The term is applied either to the respiratory murmur heard over the lungs; or to certain murmurs heard in connection with the heart or blood-vessels. *See* Physical Examination.

SOULZMATT, in France.—Alkaline table-water. *See* Mineral Waters.

SPA, in Belgium.—Iron waters. *See* Mineral Waters.

SPAIN, Southern. *See* Malaga; and Climate, Treatment of Disease by.

SPANÆMIA (σπανὸς, rare, and αἷμα, blood).—A condition of blood, in which the amount of its solid constituents is below the normal, the blood then appearing thin. *See* Anæmia; and Blood, Morbid Conditions of.

SPAS. *See* Mineral Waters.

SPASM.—Synon.: Fr. *Spasme*; Ger. *Krampf*.

Definition.—A name given to abnormal contraction, occurring either in muscular organs, in single muscles, or in groups of muscles.

1. *Spasm of muscular organs.*—Concerning spasms of organs not much requires to be said here. We may cite as instances those spasms which occur in the pharynx in hydrophobia; the contractions of the œsophagus in œsophagismus and in some cases of hysteria; the painful contractions of the intestine which are presumed to occur in certain cases of colic; of the lower end of the rectum in tenesmus; of the bladder or of the urethra in certain cases of inflammation with irritability; of the vagina in vaginismus; of the uterus in rare cases of sudden abortion resulting from shock; possibly of the heart in certain diseases of that organ; of the vessels in various regions of the body, and on various occasions, from over-action of vaso-motor nerves; of the bronchial tubes in certain cases of asthma and hay-fever; of the glottis in laryngismus stridulus, and in pertussis; as well as of the gall-ducts or ureters under conditions of irritation, either direct or reflex. In reference to many of these conditions the reader may refer to special articles in which they are considered. All are due to excessive nervous stimuli, maintaining conditions of muscular contraction, which are unusual both in degree and in duration. These spasms are, therefore, tonic in type, and in almost all the cases cited it is involuntary muscular fibres that are involved.

2. *Spasm of single muscles or of groups of muscles.*—The next class of spasm is that which affects the striped or voluntary muscles. They are divisible into two main categories, that is, into *tonic spasms*, in which the contractions are uninterrupted, and *clonic spasms*, in which contractions and relaxations occur in quick succession; the former being typified by cramps, and the latter by convulsions.

Under *tonic* spasms, we may have cramps of brief duration, affecting a single muscle, such as

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the diaphragm in hiccup; or of prolonged duration, as in the sterno-mastoid in certain cases of wry-neck. The tonic contraction may affect several muscles at the same time, as in lock-jaw, or the painful cramps which occasionally occur in the calves of the legs, or in other parts of the body. Such local spasms occur also in the conditions known as tetany, in conjugated deviation of the eyes, and in writer's cramp; likewise in spasmodic spinal paralysis, in hysterical paralysis, and under various conditions of irritative organic disease implicating motor nerves, or motor centres or tracts, either in the spinal cord or in the brain. More general tonic spasms occur in catalepsy, in tetanus, and in strychnia-poisoning.

This whole class of tonic spasms is supposed to be due to irritation, mechanical or chemical (nutritive), operating *directly*, either upon motor centres or upon the fibres conveying motor incitations in some part of their course between the brain and the muscles. In other cases, however, tonic spasms are of *reflex* origin, and the cause of irritation operates in or upon sensory surfaces, nerves, or centres.

Clonic spasms are also of various kinds. They may be limited to single muscles, such as the orbicularis palpebrarum; or they may affect particular groups of muscles, such as those of one side of the face, or the muscles of the lower jaw on both sides, or certain of the abdominal muscles, or some of the foot muscles, as in ankle-clonus. In other cases clonic spasms may be more general, taking the form of unilateral or of bilateral convulsions. The latter also may be irregular or of co-ordinated type. *See* CONVULSIONS.

Where clonic spasms are much slighter in degree and in range, affecting some muscular fibres and that to a small extent, rather than entire muscles in a more marked manner, we have the production of *tremors*, which may be either fine or coarse, local or general.

Transition conditions exist, connecting all these various manifestations more or less closely with one another. They constitute, indeed, one great assemblage of related though apparently heterogeneous phenomena, which have mostly received separate consideration under their respective names. Though it is desirable that their fundamental relationship should have been thus briefly pointed out, no practical end would be achieved by dwelling further upon the group as a group, upon the physiological meaning or origin of the several forms of spasm, or on their therapeutic treatment, which will be found described under separate articles. *See* also MOTILITY, Disorders of.

H. CHARLTON BASTIAN.

SPASMODIC.—SYNON.: Fr. *Spasmodique*; Ger. *Krampfhaft.*—A descriptive epithet applied or applicable to conditions or diseases in which spasms, and mostly those of the tonic class, are met with as prominent or essential constituents; for example, *spasmodic croup*, *spasmodic asthma*, *spasmodic stricture*. *See* SPASM.

SPECIFIC.—When applied to a disease, the word specific signifies that such disease is produced by a special cause, and has special characters, for example, syphilis and the eruptive fevers. When applied to a remedy, it implies that the substance has a distinct and definite effect in the cure of a certain disease, such as mercury in syphilis, or quinine in ague; or that it acts upon a particular organ, as ergot upon the uterus.

SPECTACLES, Uses of. *See* VISION, Disorders of; and STRABISMUS.

SPECTROSCOPE IN MEDICINE.—As one of the instruments of research in practical medicine the spectroscope is of quite recent introduction; and, as yet, it can hardly be said to have taken a place amongst those of general application. It has been of service to the physiological chemist, in the analysis of the tissues of the body; and for the detection of blood-stains, and perhaps of poisons, it promises to be of value to the practising physician. It is towards a more complete knowledge of the nature of animal and vegetable pigments that it would seem to be of most use.

DESCRIPTION.—The application of the instrument depends on the principle that all matter, in whatever condition—solid, liquid, or gaseous—possesses the property of absorbing certain of the rays of light by which it may be illuminated, and reflecting others. This being granted, if the spectrum be taken, that is, the series of component colours into which a light—whether sun, gas, paraffin, or electric—may be split up in its passage through a prism; and if there be introduced between the source of light and the prism the material to be investigated, there will be produced certain definite and characteristic modifications of the spectrum, in the form of dark bands of various intensity and position. Such are called *absorption-spectra*, and are those referred to here.

The mechanical arrangement required to attain this object consists of (*a*) a *glass prism*, so placed as to give a minimum deviation of the refracted rays; between which and the observer is (*b*) a small *telescope* through which the refracted rays pass to the eye; and on the distal side of the prism, between it and the source of light, is (*c*) a *tube*, carrying next to the prism a double-convex *lens*, and at the other extremity (*d*) a slit, the margins of which are constricted by accurately and movably adjusted knife-edges. The length of this tube, called the *collimator*, is equal to the focal length of the convex lens. The whole apparatus may be carried on a stand, so arranged that the telescope may move round the prism as a centre, and the angle it makes with the collimator recorded on a scale. A simpler instrument has been constructed by Browning, which can be carried in the pocket.

By an ingenious arrangement the instrument has been adapted to the microscope, forming the *microspectroscope*, and is then applicable to the examination of very minute quantities. But in this case there is no telescope, the spectrum formed by the prism being viewed directly.

APPLICATIONS.—In the greater number of cases where the spectroscope is applicable to medicine, it is for the examination of fluids, although solids and morbid gases have also been investigated. For fluids it is sufficient to arrange the instrument so that the spectrum of a gas or paraffin flame is obtained, and then to place a test-tube (a flat one is best) between the slit and the light. Some practice is required in adjusting the instrument, regulating the size of the slit, excluding extraneous light, and obtaining the most suitable degree of dilution and thickness of stratum of the fluid to be examined. The positions of the absorption-bands are most conveniently recorded by referring them to the standard Frauenhofer lines of the solar spectrum.

Certain precautions require to be borne in mind in regard to the absorption-spectra. Thus it appears that every substance has not its own spectrum, entirely distinct from that of any other, but that many bodies, very different in nature, possess the same spectrum, as carmine and oxyhæmoglobin; it is by the behaviour of the spectra, under the treatment of the fluids with reagents, that the spectroscopic results come to be of definite value. Again, the same substance may give different spectra according as it is in a solid, fluid, or gaseous state; or solutions of the same body in different media may give different absorption-bands.

1. **Blood.**—Hæmoglobin, both in the oxidised and reduced condition, is easily recognised by its spectrum. The former shows the dark lines in the yellow and green regions of the spectrum, the one next D being darker and more strongly marked than the other, which is near to *b*. Reduced hæmoglobin, on the other hand, gives but one dark band, in a position between the two of oxyhæmoglobin. The spectrum of blood is identical with that of hæmoglobin, of which $\frac{1}{1000}$ of a grain may be detected by the spectroscope; but 'there does not appear to be any probability of our being able to decide by this means whether the blood is or is not human' (Sorby).

Carbonic acid and many other gases, such as carbonic oxide, or coal-gas which contains seven per cent. of CO, nitrous oxide (NO), and sulphuretted hydrogen (SH^2), and the cyanides of hydrogen, potassium, &c., nitrite of amyl, iodine, &c., all possessing an affinity for hæmoglobin, show characteristic absorption-spectra; and investigation by the spectroscope of blood treated with these reagents, helps to explain the poisonous characters that most of these bodies possess, and show it to be chiefly due to their combining so closely with the hæmoglobin that the latter ceases to be an oxygen-carrier; whilst CO^2 is very loosely combined, and is easily separated by mere exposure of the reduced hæmoglobin to the air.

The various derivatives of hæmoglobin, such as hæmatin, both acid and alkaline, hæmatoidin, and hæmin, all give characteristic spectra, by which they may be recognised.

It is necessary to be acquainted with the spectra of these bodies, as well as of oxy- and reduced hæmoglobin, since in many of the situations in which blood is sought for—as in urine, vomit, fluid of cysts, and stains on clothes—it has undergone changes into one or other of these derivatives. Ammonium sulphide is the most convenient agent for reducing hæmoglobin; and in examining any fluid for this body, it should always be employed, since it is by the behaviour of hæmoglobin under its influence that it may be identified and distinguished from carmine.

In the investigation of blood-stains, their age, as well as the character of the material in which they are found, must be considered. Distilled water, glycerine, or dilute solution of ammonia or nitric acid may be used to dissolve out the stain, with the result of giving a solution of hæmoglobin or hæmatin, which may be enclosed in an ordinary microscopic cell and examined with the microspectroscope.

2. **Bile.**—It is said that fresh human bile yields no spectrum, but that when diluted, or if hydrochloric or nitric acid be added, an absorption-band appears at F, which is due to a pigment known as urobilin. This spectrum may be regarded as a test for bile.

3. **Urine.**—Healthy urine gives a spectrum with an absorption-band at F, identical with that of urobilin, which behaves on treatment with reagents in the same manner as the spectrum of that pigment, and hence it may be regarded as a normal colouring matter of the urine, and absent in some diseases. Other pigments appear, from the spectra given, to be present in certain diseased states and in pregnancy. Sugar and albumen are not to be detected in the urine by the spectroscope.

4. **Fæces.**—On spectroscopic examination the band of urobilin is presented.

See *The Spectroscope in Medicine*, by Dr. MacMunn, and Dr. Thudichum's researches in the *Reports of the Medical Officer of the Privy Council*. W. H. Allchin.

SPECULUM (Lat.)—Synon: Fr. *Speculum*; *Miroir*; Ger: *Speculum*; *Spiegel*.

Definition.—An instrument adapted for exploring the several channels and deeper-seated parts of the human body. The chief of these are the ear, the eye, the nose, the mouth, the throat, the rectum, and the vagina. For each of these there are specially adapted instruments.

Description.—Specula are made of various materials, and in a variety of shapes. The speculum is intended not only to permit and facilitate inspection, but also to dilate the canals and to expose parts, in order that they may be treated surgically, or have medicaments applied to them. For this reason a cylindrical speculum will not always answer the purpose; we have, therefore, bivalve and trivalve specula, and many other forms. On account of the friability of glass, other material has not infrequently to be used, such as white polished metal or wood; the latter is objectionable, as it has no reflecting power; but when it becomes necessary to apply the actual cautery through a speculum, a substance must be employed that is a non-conductor of heat and non-friable, such as wood.

Varieties.—**Aural specula.**—Of these there are several forms, and some are known under the name of 'auriscopes.' Some have a trumpet-shaped opening, which facilitates the introduction of light, and greatly increases the illuminating and reflecting power. There are also bivalve aural specula with a screw lever, and others with handles attached so as to separate the blades.

Eye specula.—These are known by the name of *eyelid retractors* and *ophthalmoscopes*, both of which are really specula for examining the eye, though not generally classified as such. *See* OPHTHALMOSCOPE.

Nasal specula.—There are several of these, the great purpose they have to serve being that of dilating. One, known as Elsberg's, is three-bladed.

Throat specula.—Specula for examination of the throat are generally called *laryngoscopes*. *See* LARYNGOSCOPE.

Rectal specula.—These are cylindrical, bivalve, or trivalve. The cylindrical are made on the principle of Fergusson's vaginal speculum, but with an opening so as to expose the wall of the rectum at whatever part it be adapted to. The valvular forms are made of white metal.

Vaginal specula.—Of these there are many. Perhaps the most useful is that known as Fergusson's, which is cylindrical and made of glass, with a coating of mercury behind it, so as to give it reflecting power, and backed by vulcanized india-rubber. An improved variety of this is of a tapering form, so as to admit more light. *See* WOMB, Diseases of.

Sims' duck-bill speculum is of great use in retracting the perinæum and dilating the vagina, when space is required for operation, as in vesico-vaginal fistula. Then there are bivalve and trivalve metallic specula. Wooden cylindrical specula are always used when the actual cautery is applied, for reasons already mentioned. For the ordinary purposes glass is the preferable material, as it is unaffected by caustics.

The uses of specula will be found described in connexion with the diseases of the several organs to which they have reference.

CLEMENT GODSON.

SPEECH, Disorders of.—SYNON.: *Troubles du Langage*; Ger. *Stöhrungen der Sprache.*—Defects of speech are very various in their nature, degree, and mode of causation. They are capable of being classified from several different points of view. We shall not attempt to do more in the present article than point out the nature and relations of the several kinds of defects, which will, in almost all cases, be found to have received consideration under their own proper headings.

ÆTIOLOGY AND PATHOLOGY.—Disorders of speech may depend upon (1) *congenital*, or (2) *acquired* defects of the brain, or of certain of its nerves and sense-organs.

1. *Congenital defects.*—The most frequent and important of these defects is *deafness*, which entails mutism, so that the individuals thus afflicted are known as 'deaf-mutes.' It must, however, be borne in mind that this condition of mutism or dumbness may also be brought about by absolute deafness occurring from any cause after birth, but before the child begins to talk; or even after it has learned to talk, up to the fifth or seventh year. In cases of the latter type, the child soon, when without the accustomed guidance derived through the sense of hearing, forgets how to speak and becomes dumb. In addition to this class of cases, there are those of congenital idiocy without deafness, but in which the child never learns to talk or articulate in the proper sense of the term (*see* IDIOCY). There are also other cases allied to the last, in which, owing to some intra-cranial lesion occurring either before, during, or soon after birth, the child's subsequent mental condition is greatly impaired, as well as its motor power. In these most deplorable cases the child may never be able to speak in any distinct or articulate fashion, it may not be able to walk or even stand, or it may only be able to accomplish these latter acts imperfectly. In some of these children there is evidence of the existence of a hemiplegic condition, with arrest of growth of the paralysed limbs. Such patients are also frequently subject to one-sided fits; but it is not certain whether in these cases the inability to speak is especially prone to occur in those who are congenitally paralysed on the right side. In some of the less severe examples of this latter type which have come under the writer's observation, speech has been merely deferred—the child has not commenced to speak till the fourth, fifth, or even the sixth year. *See* DUMBNESS.

2. *Acquired defects.*—Among acquired defects of speech we have troubles of various degrees and kinds, which may come on at any period between infancy and old age, and which, as regards duration, may be temporary or permanent. The great variations in the extent and nature of these defects is due to the fact that the impeding condition or lesion may act (1) upon parts of the brain concerned with the genesis of thought, and of the will to speak, (2) upon some part of the nervous channels or centres concerned with the actuation of speech, or (3) upon the peripheral nerves and organs concerned with articulation and vocalisation. Thus it happens that acquired defects of speech may, in one set of cases, be associated with the most marked alterations in the intelligence or previous mental condition of the patient, whilst in others they may be represented by mere defective articulation or vocalisation. In briefly referring to the principal varieties, we will pass from the simple to the more complex types.

Proper vocalisation is essential for the production of normal speech; where it alone is defective we have to do with various kinds of aphonia, which may be due to very different causes (*see* VOICE, Disorders of). Again, articulation as a mere motor act may be interfered with or perverted in diverse modes. Where speech-movements are incoördinate, we have such common defects as stuttering or stammering (*see* STAMMERING); or else those less marked perversions of speech-movements which are met with in some cases of chorea. Again, where the movements concerned in speech are more simply defective, we have that indistinctness of articulation and blurred utterance which, in various degrees, is so commonly associated with different forms of paralysis due to cerebral disease. To this kind of defect the name 'Aphemia' is now commonly applied. It presents itself under many various conditions, and with different degrees of completeness. It may show itself in its most extreme form in 'labio-glosso-laryngeal paralysis, or in other forms of bulbar disease. This blurred or difficult articulation is also one of the signs met with in general paralysis of the insane and in disseminated cerebro-spinal sclerosis. Again, it occurs in association with hemiplegia caused by different lesions in various parts of the brain, between the medulla below and the cerebral cortex above. As a rule it is most marked and most persistent in hemiplegia due to disease of the pons Varolii, while in lesions higher up it is apt to be slight and more transitory, especially where such lesions exist on the right side of the brain. It is evident, indeed, that this kind of defect is specially prone to occur where there is damage to the first parts of the outgoing tract leading from the left cortical auditory word-centre, or to any lower parts of the same tract, or when there is damage to the actual motor centres for articulation situated in the medulla oblongata (see *Brain as an Organ of Mind*, 1880, p. 618). Damage to the upper part of these tracts, however, so long as it is situated above the level of the left corpus striatum, gives rise to a form of this aphemic defect which is commonly known as *aphasia* (*see* Aphasia). The writer's most recent investigations have led him to the conclusion that this condition may, in reality, and in full accordance with modern doctrines as to the strict localisation of cerebral functions, be induced by damage in parts of the cortex comparatively remote from the 'third frontal convolution' (*op. cit.* p. 685). Such forms of speech-defect may exist without obvious mental impairment, and it is worthy of note that they may sometimes be induced without coincident hemiplegia, by over-work, either literary or clerical, or under the influence of great excitement. Related to speech-disorders of this type are the other more complex and extremely varied defects of speech classed under the head of *amnesia.* These are often associated with grave mental and volitional defects. The writer has recently come to the conclusion that they are especially apt to occur in association with lesions involving the supra-marginal lobule, the angular gyrus, and the posterior part of the upper temporal convolution, that is to say, the convolutions which bound the upper end of the 'Sylvian fissure' (*op. cit.* p. 683). These are parts of the cortex which, according to Ferrier, have much to do with visual and auditory impressions. They would accordingly be concerned with the appreciation, on the one hand, of printed and written characters, and, on the other, of spoken words; and seeing that such parts of the cortex must also afford the starting-points for volitional incitations to acts of writing, reading, and speaking, it can easily be understood how much damage to the brain in these regions may interfere with intellectual 'appreciation,' as well as with intellectual 'expression.'

Finally, in this relation, reference should be made to certain forms of speechlessness occasionally met with in hysterical females, or in the insane of both sexes, in which there may be a deficiency of will to speak, dependent upon perverted cerebral action, either without or with a discoverable basis of actual morbid changes. In such cases, also, there may be no apparent motive; or the speechless condition may, in the insane, stand in direct or indirect relation to certain delusions.

Treatment.—The treatment of these various defects of speech will, of course, depend upon their causes and associated conditions. Reference must, therefore, be made to the several special articles in which the different forms of such defects are considered.

H. Charlton Bastian.

SPERMATORRHŒA (σπέρμα, seed, and ῥέω, I flow).—Synon.: Fr. *Spermatorrhée*; Ger. *Samenfluss.*

Definition.—A real or apparent discharge of seminal fluid, occurring without voluntary sexual excitement.

Two varieties may be recognised. (1) *True spermatorrhœa* is the discharge of spermatozoa from the urethra, or in the urine, at periods other than during sexual excitement. (2) *False spermatorrhœa*, or *prostatorrhœa*, is the discharge of a seminal-like fluid, destitute of spermatozoa.

Ætiology.—Local irritation, whether from masturbation or from some diseased or disordered condition of the genital organs, is the cause of spermatorrhœa in the first instance. Such morbid conditions are balanitis, phymosis, a long prepuce, urethral catarrh, irritability of the prostate, a tender spot in the urethra, spasmodic contraction of the levator ani, varicocele, rectal irritation, worms in the intestinal canal, constipation, and changes in the nerves or nerve-centres supplying the genito-urinary tract, inducing either hyperæsthesia or anæsthesia. Any of these states may give rise to masturbation, or masturbation may in turn cause most of them. Should the conditions that determine the irritation persist, the very smallest mental or local stimulus is sufficient to continue the disease indefinitely.

Symptoms.—The first symptom that alarms the subject of spermatorrhœa is the occurrence of frequent nocturnal emissions, at first with, and afterwards without, erotic sensation. These reduce his strength, render him weak and irritable, and gradually prey upon his mind; and if, as frequently happens, masturbation be practised, they induce a condition of extreme mental depression. When the patient reaches this state, the mere reference to sexual matters, the sight of anything lewd, the act of defæcation, or a chance irritation of the penis during walking, riding, or driving, is often sufficient to cause an abortive or, it may be, a complete emission. The discharge may, in advanced cases, find its way into the bladder and be passed with the urine; a condition which is regarded by the patient as the most serious of all. The discharge may be the ordinary seminal fluid; or it may be less in quantity, clearer, tenacious, more like the synovial fluid in appearance and consistence. In the latter case it seldom contains spermatozoa, and it is usually only the forerunner of the other more serious state, or it may intermit with it. These conditions combine to render the patient for the time being physically and mentally a wreck, sleepless, listless, nervous, anæmic, and with an old and insipidly anxious look upon his muddy or pimpled face. Connection becomes well-nigh impracticable, the discharge of semen occurring before the introduction of the organ; or erection may be impossible or imperfect.

Diagnosis.—In the diagnosis of the cause of spermatorrhœa, the condition of the external genitals must first be determined. The presence of a tender spot in the urethra, or the existence of hyperæsthesia or anæsthesia or stricture, can be made out by passing a catheter. The acorn-pointed bougie is the best for diagnosing the exact seat of such troubles. The discharge itself must be found and examined microscopically, the presence of spermatozoa establishing true spermatorrhœa. Glairy fluids, like that of prostatorrhœa, occur in the urethra during the last stages of a gleet, or in straining at stool, and also in stricture. The history of the case, and catheterism, readily clear up the cause of the discharge.

Prognosis.—In the generality of instances the patient gets quite well, either by ordinary care on his own part, or by medical treatment. In other cases, however, the development of some inherited disease manifests itself simply from the weak condition to which the patient is reduced. In some instances dementia or melancholia is induced, and the patient continues his impure habits even whilst under watch and ward in a lunatic asylum.

Treatment.—Should any local irritation appear sufficient to cause spermatorrhœa, it ought to be treated and removed, if possible. A long prepuce should be cut off, balanitis cured, a varicocele relieved, or rectal irritation removed. To prevent masturbation many plans have been tried, such as the application of iodine to the penis, or touching the parts with caustics, which, by the pain they cause, prevent the patient meddling with the organ. These measures, or such as these, combined with encouragement from the medical attendant, and resolution on the part of the patient, will help towards a cure. The situation of a tender spot in the urethra can be made out, either by a bougie—the acorn-pointed bougie, as above mentioned, being the best for such a purpose—or by pressure on the perineum. When discovered, the tenderness may be relieved by blisters on the perineum, or by applying caustics directly to the tender surface, either in substance or in solution. The solution chiefly used is one of nitrate of silver, varying in strength from ten to sixty grains to the ounce, and it is best applied by the silver syringe-catheter. The patient's digestion, and impaired physical and mental condition must be looked after. Stomachic and nervine tonics, such as gentian, strychnia, phosphates, and iron, are the most useful, and must be given for some time. To allay irritability of the genital organs, the bromides and belladonna may be given separately or in combination. For hyperæsthesia the extract of belladonna, in half-grain doses morning and evening, is especially useful; it may be given with the tonics recommended above. Should anæsthesia of the urethra and genitals exist, galvanism has been tried and proved successful. The patient should sleep on a hard bed, and get up the moment he wakes. Cold hip-baths morning and evening, walking exercise, and mixing in company as much as possible, are useful adjuvants to treatment. *See* Masturbation.

James Cantlie.

SPEZIA, Bay of, in Central Italy.—A calm, moist, moderately warm, equable, winter climate. Prevailing winds, S. and E. *See* Climate, Treatment of Disease by.

SPHACELUS (σφάζω, I destroy).—The process of mortification, or the dead mass resulting from this process. *See* Gangrene.

SPHINCTERS, Disorders of.—Synon.: Fr. *Troubles des Sphincters*; Ger. *Stöhrungen der Schliessmuskeln.*

From a practical point of view, it is here only needful to refer to disordered actions of the sphincters of the bladder and of the rectum. The disorders themselves are in each case of two kinds. We may have to do with *spasm* of the sphincter vesicæ or of the sphincter ani, leading to or, at least, aiding in bringing about, retention of urine and retention of fæces respectively; or, on the other hand, there may be *paralysis* of these sphincters, leading to incontinence of urine, and favouring incontinence of fæces.

Ætiology and Pathology.—These opposite modes of disordered function of the sphincters of the bladder and the rectum may be variously induced; but the causes may be ranged in three principal categories, according as they are—(1) of *peripheral* or *reflex*, (2) of *spinal*, or (3) of *cerebral* origin.

(1) *Reflex causes.*—These are not always distinct from those of the next category, and they more frequently reveal themselves as spasms than as paralyses. Retention of urine due to reflex spasm of the sphincter of the bladder is frequent enough, especially in stricture of the urethra or stone in the bladder. On the other hand, a weak action of the sphincter, with undue irritability of the bladder, may lead to nocturnal incontinence of urine in children. Temporary paralysis of both sphincters may occasionally be induced by a kind of cerebral reflex, under the influence of fright. Spasmodic conditions of the sphincter ani may be induced by the irritation of fissures or small ulcers just within the anus, and may tend greatly to increase the suffering of the patient during or after defæcation.

(2) *Spinal causes.*—The majority of the cases of disordered action of the sphincters will be due to this class of causes. They are incidents of functional or of structural diseases of the spinal cord, or of the nerves by which such sphincters are supplied. Here, too, we may have irritation of the spinal centres or of their nerves, causing spasms and corresponding retention of urine or of fæces; or we may have pressure upon or destructive lesions of the same parts, in and issuing from the lower lumbar region of the cord, leading to paralysis of the sphincters, and a corresponding incontinence of urine or of fæces. Irritation or destruction of the channels in the cord, by which voluntary incitations are conducted to these sacral centres, may also lead to spasm or paralysis of either of the sphincters (*see* Spinal Cord, Diseases of, § 9, 7, 8). In many structural diseases of the cord entailing paraplegia, paralysis of the sphincters (owing to its different sequelæ) becomes an important condition, which notably influences the gravity of the dis-

ease, and demands the exercise of great care in counteracting its effects, as far as this may be possible. *See* Spinal Cord, Softening of.

(3) *Cerebral causes.*—In cerebral disease, where the mind or consciousness is profoundly affected, there may be incontinence of fæces or of urine. Yet such events can scarcely be said to be due to a disordered action of the sphincters. If no restraining or inhibitive power be exercised by the cerebral hemispheres, then the spinal reflex mechanisms regulating the action of the detrusor muscles and of their related sphincters are called into play from time to time. The latter become relaxed coincidently with the contraction of the expulsor muscles of the bladder or rectum, when, from either viscus, a sufficiently powerful set of afferent impressions passes to the related spinal centre. So that in hemiplegia with mental impairment, in dementia, or in stupor or coma, we commonly meet with incontinence of urine and of fæces. Over-action or spasm of these sphincter muscles may also occur under various perverted cerebral conditions, especially in hysteria; thus occasioning an undue retention of the contents of the bladder or of the rectum, as the case may be.

The sphincter of the vagina is also liable to be affected by spasm, but this subject is considered in another part of this work. *See* Vagina, Diseases of.

Treatment.—The treatment of disorders of the sphincters must of course depend upon the nature of the cause, and upon the nature of the particular defect existing in each individual case. When the exciting cause is local, it must be remedied if possible. Where due to structural disease in the spinal cord or in the brain, the above disorders present themselves among many other morbid signs and symptoms, and in these cases we must always strive to correct, as far as it may be possible, the original and common cause of the morbid symptoms in question.

H. Charlton Bastian.

SPHYGMOGRAPH, The (σφυγμὸς, the pulse, and γράφω, I write).

Definition.—The pulse-writer; an instrument devised to record the form of the movements of the arterial pulse.

History.—The idea of this instrument is as old as Galileo, but it is only in recent years that it has assumed a practical form. The first registering instrument, for recording the movements of an artery, was used by Ludwig in 1847, ten years after Hérisson had devised his sphygmometer, by which he showed in a column of fluid the movements of the pulse. It was with this instrument that Chelius demonstrated the second wave, or dicrotism of the normal pulse.

Vierordt was the first to construct a sphygmograph which could be applied on man, utilising an idea of King's, who had previously demonstrated the pulsation of the veins in the neck by attaching to them a delicate lever. The instrument of Vierordt, however, did not record the form of the pulse-movements accurately, and for the most part registered only a series of uniform curves. This physiologist remarked that the problem was to place on the pulse a very delicate elastic spring, and by means of it to transmit the movements of the pulse to the writing lever. Marey succeeded in doing this by the invention of his sphygmograph, which became, after the publication of his work in 1863, forthwith applicable for clinical, as well as physiological, research. Its introduction gave the study of the pulse a scientific basis, by causing the arteries to write their autographs, and thereby restored to its first importance the neglected art of reading the pulse.

Description.—Although there are now several sphygmographs at work in the field of clinical inquiry, it will be necessary to describe only that of Marey, which is most commonly in use.

The essential part of the instrument is a delicate spring, armed at its free end with an ivory pad which rests upon the artery. The spring is fixed by its other extremity to the framework, and receives the pulse-movements, which are transmitted, amplified, and recorded by an arrangement of two levers. The lower lever is hinged to the steel spring, so that it can move up and down at its free end, which terminates in a vertical knife-edge considerably above the ivory pad, which rests on the artery. This knife-edge can be raised or lowered by means of a screw, and so adjusted and maintained in contact with the upper lever, near its centre of motion. This second or upper lever, which points in the opposite direction to the lower one, is very light, and carries at its free end a pen, which records, on a plate moved by clockwork, the vertical movements transmitted to it through the first lever, from the spring resting on the artery. By this arrangement of levers the movements originally received by the spring from the artery are amplified some fifty times in the record.

The tracing is called a *pulse-trace*, and consists of a series of pulsations, varying in number and form according to the frequency and the characters of the pulse. *See* Pulse.

The frame of the instrument, to which the spring is fixed, holds the clockwork by means of which the recording plate is made to travel.

The framework is also made so as to fit easily on the arm, and is retained in position by straps, the arm resting on a suitable pad or cushion.

The regulation of the pressure of the spring on the artery is one of the most important points in the application of the instrument. It requires to be accurately regulated and measured, in order to estimate the character of the pulse, and render a comparison of traces trustworthy, as was first pointed out by the writer. This is effected by a regulator screw connected with the steel spring, and furnished with a registering dial, which records the pressure at which the maximum rendering of the pulse is obtained. By this arrangement the tension of the pulse can be fairly estimated by the sphygmograph.

Application.—In the application of the instrument, the first important point to observe is accuracy of adjustment of the ivory pad of the spring over the radial artery. This can be best done by marking the position of the artery with ink, and then carefully adjusting the spring. Secondly, the pressure on the artery must be regulated by means of the pressure screw, so as to obtain the greatest amplitude of movement by the lever, and the record of all the waves of the pulse. Thirdly, the friction between the recording pen and the receiving plate, on which the trace is recorded, must be reduced to a minimum. Smoked glass and paper are the best receivers; pens that write with ink are apt to blur the finer features of the trace. The tracings on smoked glass or paper are fixed and rendered permanent by varnish; the tracing papers, which should be well enamelled, may be smoked by being held over burning paraffin or camphor, or even over an ordinary vesta match. When the traces are recorded, they may be fixed by varnish made of gum benzoin, or Burgundy pitch in methylated spirit (1 in 8), or ordinary tincture of tolu.

USES.—The applications of the sphygmograph to clinical inquiry are numerous and important. Precision is given to the study of the pulse, and by the aid of a graphic representation of its form the finger is taught what to feel. A pulse-trace (*see* PULSE) shows at a glance the rate, regularity, and equality of the heart-beats. Irregularities, and especially inequalities, that escape the finger, are registered; and indications as to pulse-tension and heart-strength, most important for prognosis and treatment, are obtained. In acute visceral inflammations, for instance, slight inequalities in the pulsations otherwise unrecognisable may be recorded, and the first signs of heart-failure, and the necessity for stimulants thus suggested. Again, the undulatory pulse of a ventricle, too weak to resist respiratory influences, is disclosed in the tracing; and prognosis and treatment may be correspondingly modified.

INDICATIONS. — The evidence yielded by the Sphygmograph mainly concerns:—1. the mode of the heart's contraction; 2. the condition of the peripheral circulation; 3. the state of the arteries and their coats; and 4. valvular diseases of the heart.

1. The mode of the heart's contraction.—The sphygmographic tracing shows this by the line of ascent. When the heart-muscle acts suddenly and vigorously, the line is vertical and lofty, and terminates in a pointed summit-wave. Unless the vessels are over-full of blood, there follow well-marked tidal and dicrotic waves. On the other hand, when the heart's contraction is feeble, the line of ascent is less vertical and lofty; the summit wave is less distinct; and the tidal and dicrotic waves are less, or the former is blended with the summit wave. The pulse, moreover, unlike the pulse of a vigorous ventricle, is easily obliterated by pressure. A note of the pressure at which the most perfect trace is collected should always be made, as it enables the observer to compare results at different times.

2. The condition of the peripheral circulation.—The easy or difficult passage of the blood through the arterioles and capillaries, causing low or high pulse tension, is estimated by the pressure required to develop or to obliterate the three waves, but more especially the tidal and dicrotic waves. Obstructed peripheral circulation is manifested by increase of the tidal wave, diminution of dicrotism, and lessened height of line of ascent and summit wave (fig. 74). The heart, apart from febrile or nervous excitement, contracts less suddenly under these conditions. On the other hand, in easy and quick capillary circulation, such as occurs in fevers, the sudden heart-contraction increases the height of the line of ascent, exaggerates the summit wave, lessens the tidal wave, and fully develops the dicrotic wave (fig. 75). In such conditions the fully dicrotous and hyperdicrotous traces are recorded (fig. 76). The rapid onflow of blood is, moreover, shown by the more sudden fall of the line of descent. It is by the comparative study of the three waves, and the pressure required to record them fully, that we obtain valuable indications as to heart-strength and pulse-tension in acute diseases, and in the earliest stages of some chronic affections.

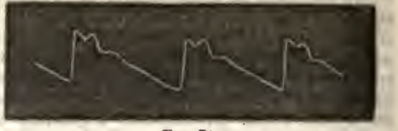
FIG. 74.

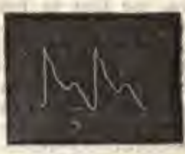
FIG. 75.

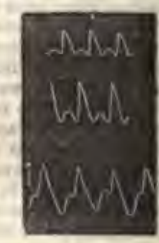
FIG. 76.

3. The state of the arteries.—There are three chief conditions of the arteries that modify the pulse:—(*a*) the state of the *muscular* coat; (*b*) *degenerative* conditions of the arterial walls; and (*c*) the presence of *aneurism*.

(*a*) When the *muscular* coat is contracted, the artery imparts to the finger a hard, wiry sensation, which shows in the trace by a short line of ascent, and the blending of the summit and tidal waves in an oblique line of descent, scarcely broken by dicrotism (fig. 77). In the opposite condition of relaxed arterial coats, the dicrotic and summit waves are enlarged, and the tidal waves lessened. These changes can be experimentally illustrated by the application of cold and heat to the surface of the body. The cold and hot stages of ague also show the two states.

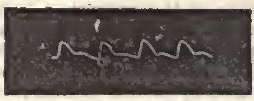
FIG. 77.

(*b*) *Inflammatory* and *degenerative* processes lead to rigidity of the arteries, whereby the medi-

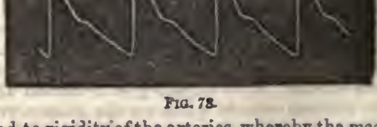
FIG. 78.

fying influence of their elasticity on the blood-movement is lost. The blood-wave in the radial artery consequently approaches more to that imparted by the heart's systole. In these conditions the pulse often beats visibly, so that we are prepared for the amplitude of the trace. The tidal wave is large, nearer to, and often blended with the summit wave, while the dicrotism which occurs early in the line of descent is badly marked. The presence of these peculiarities often leads to the early diagnosis of unsuspected atheroma of the great vessels (fig. 78).

(*c*) When the sac of an *aneurism* is seated on a main trunk after its origin from the aorta, it acts as an elastic bag, and so modifies the pulse-form by rendering the line of ascent oblique, diminishing or abolishing the summit wave, modifying the dicrotism, and more or less connecting the three waves into a simple curve. To the finger these changes mean retardation (oblique line of ascent), and diminution of force (loss of summit wave). Such peculiarities in the left radial artery are produced by an aneurism of the left subclavian, or in the right radial by innominate aneurism. When the aneurism is connected with the thoracic aorta in its ascending portion, there is frequently a dissimilarity between the two radial pulse-traces, which is persistent, one being smaller than the other, more vibratory, or more easily obliterated by increased pressure. The pulse usually more affected is the right, as the aneurism tends to implicate the innominate artery. In aneurism of the transverse portion of the arch, the left pulse is more commonly diminished in force and amplitude (figs. 79 and 80). In aneurisms of the descending thoracic and abdominal aorta, the dicrotic wave is often much increased in both pulses, while the right radial yields usually the more normally developed trace.

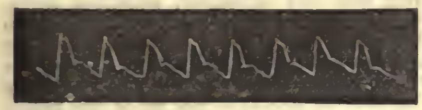

Fig. 79. Right Radial Tracing.

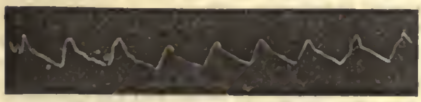

Fig. 80. Left Radial Tracing.

These signs may be more or less simulated by pressure of tumours on the arterial trunks, or by their partial obstruction by clots. The sphygmographic signs of aneurism, therefore, require to be confirmed by the use of the ordinary means of diagnosis. In some cases, however, the pulse-traces alone suffice to indicate the lesion and its seat.

4. **Valvular diseases of the heart.**—Valvular diseases of the heart generally influence the pulse-trace. In *aortic regurgitation* this is strikingly seen (fig. 81). The strong, dilated ventricle contracts suddenly on a large charge of blood, and consequently there is a lofty line of ascent, ending in a pointed summit-wave. The tidal wave is small in proportion to the trace; and the dicrotism, which occurs later than normal in the line of descent, is generally much diminished, on account of the leakage into the ventricle interfering with the rebound of the blood-column from the closed valves. The dicrotic wave, thus starved, is followed by a rapid fall in the tracing, showing the quick emptying of the artery. It is this contrast between the height of the summit wave and the rapid fall of the trace, unbroken by any *sustaining* wave, that gives the pulse its splashing and collapsing character. These features, the small dicrotism and the rapid fall, indicate the amount of regurgitation. In some cases of this valve-lesion the tracing shows a well-marked tidal, and a fairly-developed dicrotic wave; and increased pressure by the spring of the sphygmograph, instead of obliterating the trace as usual, shows that there is a fair amount of tension. Such features commonly occur in older persons, in whom the valve-defect is due to atheroma, and not to rheumatism, and the pulse-form is modified by the addition of the characters of the pulse of degenerated arteries. When such features are observed in rheumatic cases, they point to perfect compensation and small valve-defect.

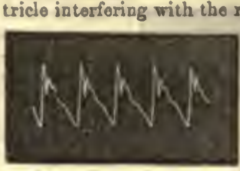

Fig. 81.

In *aortic stenosis* the trace testifies to the amount of the lesion. When the narrowing is extreme the summit wave is lost, the line of ascent becomes oblique and gradual, and the pulse is felt to be retarded. More commonly a break in the line of ascent marks the position of the summit wave, while above it rises the large tidal wave, due to the strong systole (fig. 82). In cases in which the obstruction is less in degree, the summit of the tracing may be forked by a sharp division between the summit and tidal waves. The dicrotic wave is lessened. The loss or checked development of the summit wave, followed by an exaggerated tidal wave, arising from a strong and often dilated ventricle, pushing a large blood-wave *gradually* into the arteries through the narrowed aortic orifice, are the characteristics of this lesion when pure. When it is associated with aortic regurgitation, the large tidal wave is still pronounced.

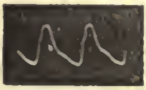

Fig. 82.

Mitral valve lesions, which are less immediately connected with the arterial blood-movement, present less decided characteristics.

In *mitral regurgitation* the tracing is often of the normal outline, and in such cases the compensation is fairly perfect. In some cases, in addition to great rapidity, the pulse is small and shabby, in striking contrast to the vigour of the impulse (fig. 83). The line of ascent is sloping, and the tidal and dicrotic waves poorly defined. In other cases, great irregularity is the chief feature of the trace, a series of small, ill-developed pulse-waves being succeeded by large and well-formed pulsations. On analysis, the series of small, ineffectual heart-contractions correspond to inspiration, and the fuller and more vigorous ones to the respiratory pause. In other conditions similar irregularities are caused by the same influences. Burdon Sanderson, who first referred these irregularities to their cause, says: 'The mechanical effect of inspiration is to augment the quantity of blood contained in the pulmonary circulation, and hence to increase the frequency of the contractions of the heart. This increased frequency depends on the distended state of the auricles, in consequence of which the ventricles fill more rapidly during their period of relaxation. In this way the length of the diastolic pause is diminished, and the hurried action of the heart satisfactorily accounted for; but the question still arises, Why are the rapid beats which occur in inspiration also ineffectual? Very probably because the mitral valve does not close; the heart being distended with blood, its walls are kept apart to such an extent that the curtains do not meet. The ventricle contracts, but much of its blood is discharged into the auricle, to be returned to the ventricle as soon as its contraction is over. It is not until the effect of inspiration in keeping the auricles full ceases, that the curtains get near enough to allow the heart to make an effort sufficiently effectual to send a full tide of blood into the aorta, and thus relieve the distended pulmonary circulation.'

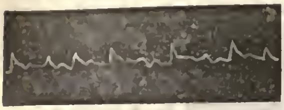

FIG. 83.

Similar peculiarities are occasioned by the same mechanism in tricuspid regurgitation and dilated heart.

In *mitral stenosis* the sphygmographic evidence is very important. The pulse-tracing shows irregularity in the line of descent, which often is greatly prolonged through a missed pulsation—a true intermission in the beat, and sometimes broken by the interpolation of a small, abortive pulsation (fig. 84). These abortive pulsations are due to over-distension of the auricle, causing premature auricular contractions, which propagate themselves to the ventricle, and so produce a ventricular contraction on a small charge of blood. They mostly occur during inspiration, from the causes above described. The rhythmical relations between the contractions of the auricle and the ventricle are thus disturbed, and hence the features above described.

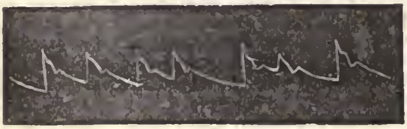

FIG. 84.

These are the special characters of the pulse of mitral stenosis. In some cases where the stenosis is not great and the compensation perfect, the pulse is regular in time and form, or nearly so; but in these cases characteristic irregularities can often be produced by vigorous exertion.

Finally, in therapeutical investigations the sphygmograph is indispensable as a means of discovering the influence exerted by a drug on the state of the vessels, on the condition of the peripheral circulation, and on the vigour of the heart. The modifications in the form of the pulse-trace above described enable the investigator to estimate these effects.

BALTHAZAR FOSTER.

SPINA BIFIDA (*spina*, the spine, and *bifida*, cleft).—SYNON.: Fr. *Hydrorhachis congénitale*; Ger. *Rückenspalte*.

DEFINITION.—A congenital malformation, with arrest of development, of some portion of the spinal column.

Generally there is a deficiency of two or three spinous processes and the laminæ; the rudimentary portions of the arches of the vertebræ being spread out and irregularly expanded. The spinal cord being thus left unprotected, its membranes protrude through the aperture posteriorly, forming a kind of hernial tumour.

ANATOMICAL AND CLINICAL CHARACTERS.—At birth the tumour in spina bifida is generally about as large as a walnut, and either spherical or oval in form. It may be met with in any part of the spinal column, but with rare exceptions it occurs in the lumbar or lumbo-sacral region. The tumour is filled with cerebro-spinal fluid, and is therefore always tense, with distinct fluctuation; its tension increases when the child cries, and may be diminished by pressure. The cutaneous covering of the tumour is generally very thin and attenuated, sometimes having the appearance of a transparent membrane, of a bluish or congested colour. In other cases the skin is of its normal thickness and colour. The nerve-trunks, forming the cauda equina, frequently traverse the interior of the sac in the median line, and after being reflected from the posterior wall of the sac, recross its cavity towards their normal distribution. The tumour is nearly always solitary, but cases in which a second tumour existed have been recorded.

DIAGNOSIS.—Difficulty in the diagnosis of spina bifida can hardly ever occur, and the characters above described will readily distinguish it from congenital tumours of a fatty, fibrous, or cystic character occasionally met with.

COMPLICATIONS.—Spina bifida is sometimes associated with hydrocephalus, with club-foot, or, it is said, with some paralytic symptoms; the latter complication probably occurring only in those cases in which the nerves of the cauda equina traverse the sac of the tumour.

COURSE AND TERMINATIONS.—The majority of cases of spina bifida terminate fatally, often within a few days or weeks of birth; the children dying from convulsions, frequently preceded by rupture of the sac, and the escape of its contents. When the fluid only oozes gradually, relief follows; and sometimes spontaneous and complete cure thus occurs, the tumour contracting to a small nodule, and the aperture in the canal closing more or less completely. In some cases, when the cutaneous covering is thick and normal, the tumour may gradually increase in size without material inconvenience, up to the adult period of life, attaining the size of a child's head, or even larger dimensions.

PROGNOSIS.—This must generally be unfavourable, especially when the tumour is of large size at birth, and its covering only thin, membranous, and vascular, with a broad base. When the base of the tumour is narrow, and its cutaneous covering thick and normal, the prognosis may be more favourable, especially if the malformation be situated on the sacrum.

TREATMENT.—The result of any treatment of spina bifida must be extremely doubtful, but in many cases the process of spontaneous cure has been successfully imitated by small tappings frequently repeated, and followed by light compression, covering the tumour with cotton wool or lint, and strips of plaster. Only a portion of the fluid should be allowed to escape at the time of operation; and the puncture should always be made at the side of the tumour, so as to avoid any possible injury to the nerve-trunks which may traverse the sac. Cases have been successfully treated by the injection of small quantities of iodine. Dr. J. Morton, of Glasgow, has used a solution made by dissolving 10 grains of iodine and 30 grains of iodide of potassium in an ounce of glycerine—half a drachm of which solution may be injected, without allowing the fluid contents of the tumour to escape, at intervals of a week or ten days. The writer has seen a case successfully treated in this way by Dr. Murray at the Great Northern Hospital. Other operative measures, such as compression of the neck of the tumour by means of a clamp or ligature, and also excision, have been employed, occasionally with success; but no such attempt should be made except under the most favourable circumstances, when the tumour has a very narrow base—more or less pedunculated, and is situated over the sacrum; otherwise death from convulsions or meningitis would probably follow any such attempts.

W. ADAMS.

SPINAL ACCESSORY NERVE, Diseases of.—The upper fibres of the spinal accessory nerve emerge from the surface of the medulla oblongata, below the pneumogastric. They arise from a column of nerve-cells adjacent to the nucleus of the hypoglossal, and continuous with the nucleus of the pneumogastric. The fibres join the latter nerve and innervate the movements of the larynx. Their share in the nerve-supply to the pharynx is unsettled, but it is probable that the levator palati is supplied by these fibres, since paralysis of the vocal cord, tongue, and palate is occasionally due to disease at the surface of the medulla in this region (Hughlings Jackson). The lower, spinal, fibres of the nerve emerge from the side of the cord as low as the sixth or seventh cervical nerves, and pass through the substance of the lateral columns, arising from the anterior cornua, in common with the motor fibres of the upper cervical nerves. This spinal part of the nerve ascends through the foramen magnum, and is connected with the bulbar portion for a short distance; the two parts then separate, the latter joining the pneumogastric, the former passing to the neck, and supplying the sternomastoid and the upper part of the trapezius.

1. **Paralysis.**—ÆTIOLOGY.—The nucleus of origin of the nerve may be diseased by slow degeneration of the motor cells, as in progressive muscular atrophy and chronic bulbar paralysis. In the former the upper part of the trapezius, supplied by this nerve, is usually affected later than any other muscle; it is the *ultimum moriens*, as Duchenne called it. The nucleus of origin, especially the bulbar portion, may be damaged by acute processes, softening or hæmorrhage (acute bulbar paralysis). The fibres of origin are sometimes damaged by injuries, such as fracture or dislocation of the upper cervical vertebræ; by narrowing of the foramen magnum; by tumours external to the cord; and especially by meningitis, syphilitic or simple, in this region. The spinal part of the nerve, from its long course, is especially liable to suffer. The nerve is rarely injured in fractures of the skull. The causes of paralysis of the vagal portion, after its junction with the pneumogastric, have been considered in the article on diseases of that nerve. The spinal part, in its course to the muscles, may suffer in rare cases from rheumatic inflammation, or from injury; may be compressed by enlarged glands; or implicated in abscesses in its neighbourhood.

SYMPTOMS.—Paralysis of the spinal accessory may be total, when the disease involves the nerve where both parts are united, but is much more commonly partial, on account of the extensive origin of the spinal portion, and the early separation of the two divisions. The symptoms indicating disease of the accessory part of the nerve, as loss of movement of the vocal cords, are described in the article on the pneumogastric nerve. The paralysis of the palate, which is so often associated, is best recognised by the defective movement in phonation.

The loss of function of the spinal portion of the nerve is shown by paralysis of the muscles which it supplies—the sternomastoid and trapezius. Unilateral paralysis of these muscles does not affect the posture of the head, but the head, when behind the vertical position, cannot be rotated to the opposite side. Paralysis of the trapezius, which may occur alone if the disease of the nerve is behind the sternomastoid, is confined to the upper part of the muscle, that proceeding from the occipital bone to the clavicle. The middle part of the muscle receives a sufficient nerve-supply from the cervical nerves to prevent conspicuous paralysis or wasting. The loss of the upper part alters the contour of the neck, and the shoulder is not raised in deep inspiration. The shoulder can, however, still be elevated voluntarily, this movement being effected by the middle part of the muscle. Abduction of the arm by the deltoid is interfered with, on account of the loss of the support afforded by the upper part of the trapezius, and the supplemental action of other muscles causes a slight rotation of the scapula. The paralysed muscles undergo wasting, which is usually rapid, and is accompanied by the reactions which characterise nerve-degeneration.

PROGNOSIS AND TREATMENT.—The prognosis and treatment of paralysis of the spinal accessory nerve are those of the morbid process causing the paralysis. In all cases, if the muscles waste and present loss of irritability, electricity should be applied, the voltaic current being in most cases required.

2. **Spasm.**—The muscles supplied by the spinal accessory nerve are frequently the seat of spasm, causing 'torticollis,' or 'wry-neck.' The spasm is due to an affection of the centres, probably above the nucleus of the nerve, and is described in a special article. *See* WRY-NECK.

W. R. GOWERS.

SPINAL CORD, Diseases of.—Though the spinal cord is commonly regarded as a single organ, it is one which is very composite in structure, and still more so in function. It is in part (1) a mere aggregate of connecting fibres between the body generally and the brain—that is, an accumulation of channels of conduction for sensory impressions of all kinds, both superficial and deep, on their way to the brain; and also for outgoing motor incitations from the brain to all voluntary muscles of the body, as well as to those pertaining to the viscera and their ducts, and to blood-vessels. In part, however, the cord also consists (2) of a serial aggregation of more or less fused ganglia having to do with the execution of voluntary and all sorts of reflex actions; with the functional activity of organs; and with the nutrition of tissues.

The structural bases for these two principal sets of functions are most intimately knit together; those of the second set are not wholly distinct from those of the first—to a considerable extent they are the same elements, capable of being called into play voluntarily, as well as in a reflex manner.

In order to facilitate references in the special articles on diseases of the spinal cord to the details set forth in this *Introduction*, it will be divided into a series of numbered sections.

§ 1. **General relations of the spinal cord.**—Continuous with the medulla oblongata above, the spinal cord begins at the level of the upper border of the body of the first cervical vertebra, whilst it ends in a narrow-pointed extremity opposite the upper part of the body of the second lumbar vertebra, or perhaps a trifle higher. Throughout the whole of this extent it is enclosed within the narrow spinal canal, and is invested by two membranes, the *pia mater* and the *arachnoid*. Beneath the latter and in the meshes of the looser pia mater there is situated (as over the cerebrum) a certain amount of cerebro-spinal or subarachnoid fluid. Enveloping the cord much more loosely, outside the arachnoid, is the firm spinal *dura mater*.

§ 2. ANATOMICAL DATA CONCERNING THE STRUCTURE OF THE SPINAL CORD.

The arrangement of the several anatomical components of the spinal cord is essentially similar throughout its extent. Its two halves are marked off from one another in front by the deep 'anterior longitudinal fissure' (fig. 85 A), and posteriorly by a median septum of connective tissue rather than by an actual fissure. Each half contains a central mass or core of grey matter, shaped something like a comma. The grey masses in the two halves of the cord are turned back to back, and are connected with one another by means of an intervening bridge of matter, answering to the 'grey commissure.' In front of this bridge of grey matter lie some white fibres, which constitute the 'white commissure.' Through the centre of the grey commissure there runs a fine central canal—the *canal of the cord*—which is lined with a layer of epithelium-like cells.

The thick anterior extremity of the grey matter in each half of the cord is known as the *anterior cornu*, and the much thinner posterior extremity as the *posterior cornu*. This latter approaches near to the surface of the cord in its postero-lateral region, and is here joined by the *posterior roots* of the spinal nerves. Their point of entry on each side divides the white substance of the corresponding half of the cord into posterior and antero-lateral columns. The portions of the white substance of the cord lying behind and between the posterior roots, constitute the two *posterior columns*, each of which is again subdivided by a slight superficial fissure into an external tract or *root-zone*, and an internal wedge-shaped portion, or '*column of Goll*.' The portions of the white substance which on each side lie in front of the posterior roots constitute the *antero-lateral columns*. The inner portions of the anterior columns border upon the anterior fissure, but there is no real line of demarcation to define the bounds of the anterior and of the lateral columns respectively, because the anterior roots are connected with the anterior cornua in a diffuse or scattered manner, and not in a compact bundle like that formed by the fibres of each posterior root.

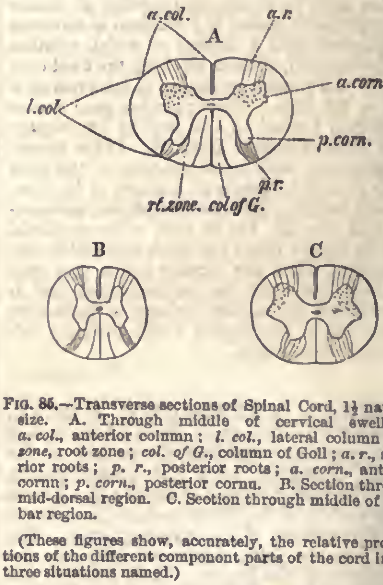

FIG. 85.—Transverse sections of Spinal Cord, 1½ natural size. A. Through middle of cervical swelling; *a. col.*, anterior column; *l. col.*, lateral column; *rt. zone*, root zone; *col. of G.*, column of Goll; *a. r.*, anterior roots; *p. r.*, posterior roots; *a. corn.*, anterior cornu; *p. corn.*, posterior cornu. B. Section through mid-dorsal region. C. Section through middle of lumbar region.

(These figures show, accurately, the relative proportions of the different component parts of the cord in the three situations named.)

For some particulars concerning the *blood-vessels* of the spinal cord, *see* § 6, (8) and (9).

§ 3. PHYSIOLOGICAL DATA CONCERNING THE SPINAL CORD.

In-going channels of conduction to the brain.—The paths for these impressions soon after their entry into the spinal cord by the posterior roots cross to the opposite half of the cord, decussating with their fellows of the other side.

Impressions of touch, pressure, temperature, and tickling travel in the main by the *posterior columns*—though probably some of them ascend in portions of the lateral columns.

Impressions producing pain, after passing with the nerve-roots through portions of the posterior columns, principally traverse the grey matter of the cord. Disease or damage of these posterior columns, as well as of the grey matter, often causes a more or less marked retardation in the transmission of such impressions.

The path traversed by impressions from muscles to the encephalon (so important for the regulation of movements) is not distinctly known—but it is to be found possibly in the posterior columns. These channels are said by Brown-Séquard to decussate in the pons Varolii, rather than soon after their entry into the spinal cord.

The path for the transmission of impressions from the 'genital centres' in the lumbar region of the cord to the brain, is also probably situated in the posterior columns.

The physiological anatomy of the cord in the lumbar region seems to be slightly different from what it is higher up in the dorsal and cervical regions, since in the former situation ordinary sensory impressions from the lower extremities are said to pass through the lateral, rather than through the posterior columns. Those from the pelvic region, the sexual organs, the perinæum and anal regions, however, are supposed to pass upwards through the posterior columns.

§ 4. **Outgoing channels of conduction from the brain.**—All that is certainly known concerning the paths for voluntary motor incitations is that, below the decussation of the pyramids, they are to be found mainly in the posterior part of the lateral column ('crossed pyramidal tract'). The fibres descend through these columns to different levels, according as their stimuli are destined to evoke the activity of different nerves and muscles; thus, if a movement of the arms is to be excited, they go only as low as to some part of the cervical enlargement; but if the movement is of the legs, as far as to the lumbar swelling. In each case such motor fibres then penetrate the grey matter (anterior horns), and come into relation with some of the great nerve-cells contained therein, whence outgoing fibres arise, which cluster together outside the cord and constitute the fibres of the anterior roots. The motor paths for the foot and leg, in the lumbar lateral column, are said to lie more towards the circumference of the cord than those for the thigh-muscles.

On the other hand, some (see p. 1460) of the pyramidal fibres of the medulla pass into and through the spinal cord on the same side, that is without decussating, and constitute the inner part of the anterior columns ('direct pyramidal tract'). Some of its fibres are thought to cross into the anterior horn of the opposite side, by means of the anterior or white commissure. Whence these fibres come, and what is their precise function in relation to those of the 'crossed pyramidal tract,' no one as yet seems to know. These are questions still unsolved; the only common point of agreement is, that these fibres of the 'direct pyramidal tract' are in some way concerned with movement rather than with sensation.

It is probably an error to suppose that there are any special routes for the conduction of reflex motor impulses from the brain, apart from those concerned with the excitation of voluntary movements.

Again, it is not known that any separate motor fibres are prolonged into the spinal cord from the cerebellum. But it seems highly probable that certain of the ingoing channels of conduction pass from the cord to the cerebellum, as well as to the cerebrum. Some of these may be situated in the posterior median columns, and some in the outer part of the lateral columns ('direct cerebellar tract' of Flechsig).

§ 5. **Spinal reflexes.**—The reflexes of purely spinal mechanism which are of importance (by their presence, absence, or variation) as indications of disease of the spinal cord in different longitudinal regions have been divided into (*a*) the superficial or *skin* reflexes, and (*b*) the deep or so-called '*tendon* reflexes.'

(*a*) *Skin reflexes.* The most important of these are tabulated below. The designation of the parts of the cord upon which they severally depend is based upon a very useful table published by Dr. Gowers.

Name of Reflex	Mode of Excitation.	Nature of Result	Level of Cord upon which Reflex depends.
Plantar reflex	Tickling sole of foot . .	Movements of toes; of these and foot; or of these and leg.	1st, 2nd, and third sacral nerves (lower part of lumbar enlargement)
Gluteal reflex	Irritation of skin of buttock .	Contraction of glutæi . .	4th and 5th lumbar nerves
Cremasteric reflex	Irritation of skin of upper and inner part of thigh	Drawing up of testicle . .	1st and 2nd lumbar nerves
Abdominal reflex	Irritation of skin of abdomen along edge of ribs, and above Poupart's ligament	Contraction of upper or of lower part of abdominal muscles	8th to 12th dorsal nerves
Epigastric reflex	Stroking side of chest over 6th and 5th intercostal spaces	A dimpling of corresponding side of epigastric region (contraction of highest fibres of rectus abdominis	4th to 6th or 7th dorsal nerves
Scapular reflex	Irritation of skin in interscapular region	Contraction of posterior axillary fold (teres), or of several of scapular muscles	6th or 7th cervical to 2nd or 3rd dorsal nerves

These skin-reflexes vary much in different individuals, as regards the facility with which they may be obtained. They are often more marked in children and in women than in men; though when the latter are of an irritable or nervous temperament, some or all of the skin-reflexes may in them be well-marked even in conditions of health.

In cases where extensive transverse lesions exist, situated higher up in the cord than the nerves upon which any of these reflexes depend, such reflexes are commonly supposed to be exaggerated in intensity. This, however, is not always the case. The fact that this or that reflex exists, shows not only that the afferent and efferent nerves, but that the track through the spinal cord at the corresponding level, is practically undamaged. It is not, however, necessarily true that absence of either of the reflexes is an indication of disease at the corresponding level in the spinal cord. It may be so; but it may also be that the disappearance of the reflex is dependent upon disease in some part of the afferent or of the efferent nerves, leaving the cord itself intact. Or it may also happen that the particular reflex is simply not to be obtained in the individual under examination. Or, again, with a complete transverse lesion in the lower cervical region, under certain conditions, all reflexes dependent upon lower portions of the cord may (though contrary to usual beliefs) be abolished. *See* **Spinal Cord, Softening of.**

Further, it must be borne in mind that in certain cases of hemiplegia (even where hemianæsthesia does not co-exist) these skin-reflexes are often notably diminished or even abolished on the paralysed side of the body; though the reverse condition of things will probably obtain in regard to the deep or 'tendon reflexes' next to be considered. It will probably be found, hereafter, that this repressing effect upon the skin-reflexes is associated with the existence of lesions in special parts of the brain, and not with lesions in other localities, though such several sites are at present very imperfectly known.

(*b*) '*Tendon reflexes.*' Much discussion has taken place as to whether these are 'reflexes' at all, in the proper sense of the term. Into this question we do not propose to enter. The phenomena themselves, to which alone reference will be made, are chiefly two in number, namely, *ankle clonus*; and that variously known as the *knee phenomenon*, *patellar tendon reflex*, *knee reflex*, or *knee jerk*.

There is a distinct difference in regard to these two phenomena. The 'knee jerk' occurs in health, so that it is its absence which is of principal significance in certain diseases. 'Ankle clonus,' on the contrary, is a phenomenon not to be obtained in a state of health, so that its presence is thought by some to be a positive sign of disease of the spinal cord. This is a view which requires limitations—and limitations of such a kind as to deprive the manifestation of ankle-clonus of much of its diagnostic significance. It may exist, for instance, after one-sided fits dependent upon disease of the cerebral cortex; and, again, it may exist to a well-marked extent where the antero-lateral columns of the cord are pressed upon at a certain level, even though (as in the condition above referred to) no lateral sclerosis of the cord has been developed.

Name of Reflex	Mode of Excitation	Nature of Result	Level of Cord upon which Reflex depends
Knee jerk .	By striking patellar tendon with edge of hand or with percussion hammer, whilst leg hangs loosely over fellow, or over forearm of operator. Also by striking quadriceps tendon, above patella	A single upward jerk of the leg and foot, slight or distinct	2nd and 3rd lumbar nerves
Ankle clonus .	With knee extended or very slightly flexed, by pressing quickly and firmly against anterior part of sole of foot (so as to stretch calf-muscles) and then keeping up the pressure	A series of clonic contractions at the ankle-joint, continuing as long as the pressure is maintained, and instantly ceasing when it is relaxed. If the condition is very highly marked it may spread to the whole limb, or even to that of the opposite side.	1st to 3rd sacral nerves (lower part of lumbar enlargement)

Both these physical signs have lately attracted much attention. Ankle clonus was originally described by Brown-Séquard in 1858; it was more particularly defined in the human subject by MM. Charcot and Vulpian in 1866; and its diagnostic importance has since been repeatedly enforced by these observers. In 1874 the mechanism of the knee-jerk, and the fact of its absence in certain spinal diseases, especially locomotor ataxy, began almost simultaneously to engage the independent attention of Erb and of Westphal, and subsequently of many other observers.

For a brief reference to the functional activity of the *vaso-motor centres*, and of their nerves emanating from the spinal cord, *see* § 9, (4) and (5).

§ 6. Pathological Data concerning the Spinal Cord. (General Ætiology and Pathology.) The spinal cord itself may be damaged by disease invading it *from without*—that is, taking origin either in the bony canal or in the enveloping membranes; or it may be the seat of *intrinsic* pathological changes. As the former conditions may and do constantly produce functional derangements or actual structural changes of a secondary order in the cord itself, we must take cognisance of them here, so that the various peculiarities as to their occurrence may be made known and considered side by side with those pertaining to the different causes of disease of intrinsic origin, from which they have to be distinguished at the bedside.

(*a*) **Extrinsic causes.**

(1) *Stabs or bullet-wounds* may involve limited regions and parts of the spinal cord.

(2) *Fracture with dislocation of some of the vertebræ* (as results of severe falls or other mechanical violence) exists as an occasional cause of an associated paraplegia, produced by the crushing of, or pressure upon, the spinal cord. This is most apt to occur in the cervical region, though the dorsal and lumbar regions are, to a less extent, liable to similar accidents.

(3) *Scrofulous caries of the vertebræ* may exist in either region, and may or may not be associated with *angular curvature* in a corresponding portion of the spine. The paraplegia or other result of interference with the functions of the cord in the majority of cases of this disease, is not due so much to its compression by diseased bone, as to the irritation and subsequent compression of the cord by inflammatory products.

(4) *Cancer of the vertebræ* occurs either as a primary or as a secondary affection. Such a new growth may involve the dura mater or not, and as it grows it may at first irritate and subsequently compress the spinal cord itself.

Other diseases of the spine are rare as causes of disease of the spinal cord. Still aneurysmal erosion of vertebræ with subsequent pressure upon the cord must not be forgotten, and rarely an aneurism bursts into the spinal canal. Exostoses and enchondromatous growths from the bones may also quite rarely compress the cord.

(5) *Cancer of the spinal meninges, or new growths of other kinds* (*see* MENINGES, SPINAL, Diseases of), may also involve irritation, and subsequently compression, of the anterior or posterior nerve-roots or of the spinal cord itself in one or other region. *Hydatids*, again, should be remembered as possible causes of spinal disease, especially where their existence has already been detected in the body in other situations.

(6) *Hæmorrhage into or upon the Meninges. See* MENINGES, SPINAL, Diseases of.

The foregoing groups of causes of disease of the spinal cord, give rise to sets of symptoms having a generic resemblance, because in each case *compression* acts upon the cord, or upon the spinal roots and cord, from without, in one or other direction.

(*b*) **Intrinsic causes.**

(7) *Hæmorrhage* occurs with extreme rarity in the spinal cord. This is due, in the main, to the firmer texture of the cord, and to the greater abundance of supporting connective tissue around its blood-vessels, as compared with those of the brain. When hæmorrhage, of idiopathic origin, does take place into the spinal cord, it almost invariably occurs in the softest portion of the organ, namely, its central core of grey matter—and in this region it may extend for some distance upwards and downwards. As a result of falls or blows, also, hæmorrhage into the substance of the cord is a rare event; still, under these conditions, it occurs occasionally—mostly in association with laceration of the substance of the cord. Of this latter kind of lesion, resulting from a fall from a height of about 25 feet, the writer has recorded a remarkable instance (*Med.-Chirurg. Trans.* vol. l., 1867), in which, although the cord was lacerated, there was no external wound and no fracture or dislocation of vertebræ.

(8) *Embolism* occurs with great rarity in the spinal cord, and is still more seldom recognised when it does occur. This is due to the fact of the small size of the arteries of the cord—the absence among them of any large trunk, like the middle cerebral, coming off more or less directly from one of the great vessels arising from the arch of the aorta. Emboli reach the brain much more rarely by way of the vertebrals than by way of the carotids; and the principal arteries of the spinal cord are either direct offsets from the vertebral (anterior spinal), or indirect branches from the same (posterior spinal)—the latter arising from the inferior cerebellar, which are twigs from the termination of the basilar artery. Apart from these vessels, the blood-supply of the cord comes from still smaller twigs, derived from the intercostal and lumbar arteries, which anastomose with and reinforce the anterior and posterior vessels, at intervals, along the whole length of the cord. All the principal vessels, small though they are, seem to anastomose freely with one another. Thus, even if embolism of spinal arteries should occur at times, as it probably does, its effects would be diminished in importance and obscured clinically as well as *post mortem*, by reason of these vessels not being 'end' arteries.

(9) *Thrombosis* would, however, be capable of occurring in diseased spinal *arteries*, as well as in those of other parts of the body. Subsequent observations may perhaps show that degenerative changes or endarteritis are particularly common in the spinal arteries, so that the occurrence of thrombosis in them would thereby be rendered all the more easy and likely to occur. A similar process may also take place in the peculiarly tortuous network of *veins* which surrounds the spinal cord on all sides—perhaps even with more facility than in the veins of other parts—when general and other local conditions favour its occurrence. Ollivier calls attention to the probably natural slowness of the blood-current through the spinal veins, and to the multiplicity of causes which, owing to their influence upon respiration and cardiac action, tend still further to retard it—such as violent emotions or efforts, and those diseases which greatly interfere with respiration, or with the force and regularity of the heart's action. He adds that he has often seen in elderly persons fibrinous clots filling the veins of the cord, as well as those which accompany its nerve-roots.

Thus one of the common causes of ordinary degenerative softening as it occurs in the encephalon, would also be operative in the cord.

(10) *White softening* of the spinal cord is very common; often implicating its whole transverse area for a variable extent. It differs in no respect in its naked-eye or microscopical appearances from the process as it is met with in the encephalon. It is altogether unreasonable to assume, in accordance with current nomencla-

ture, that this condition is mostly a result of inflammation and therefore to be spoken of as a *myelitis*, when the pathologists of our time have declared that the similar process in the cerebrum and cerebellum is mostly of degenerative origin.

(11) *Myelitis.*—The writer is far from denying that primary *inflammation* may involve areas of the cord, and entail 'softening' of its substance. He believes, however, that 'acute myelitis' is far more likely to occur as a secondary process, in connection with pressure upon and consequent irritation of some part of the cord, encroached upon by fractures or dislocations of the vertebræ, or otherwise wounded; also as an occasional sequela of scrofulous vertebral caries, of the direct pressure made upon the cord by some meningeal tumour, or of hæmorrhage into its substance. Yet he is far from believing that *all* the secondary softenings met with in the spinal cord are necessarily of inflammatory origin. Many of these also are due to degenerative rather than to inflammatory causes.

Processes of degenerative 'softening' are mostly brought about quickly, and they would, in the main, correspond with what is commonly spoken of as 'acute myelitis.' As for 'chronic myelitis' (in the commonly understood sense of chronic softening) the writer believes that no such disease should be any longer described. Many 'softenings' are in a certain sense chronic, as, though they may be more or less abrupt in their onset, they tend to last long rather than to kill quickly. Again, other maladies which the older physicians would have ascribed to 'chronic myelitis' or 'chronic softening,' are now known to partake more of the nature of chronic indurations, and to have as their bases processes of sclerosis.

(12) Processes of *sclerosis* are extremely common in the spinal cord. In nature they are over-growths of the connective tissue of this organ altogether similar to those occurring in other organs and tissues, under the name of 'fibroid substitutions' or 'non-inflammatory hyperplasias of connective tissue.' Yet here, again, certain pathologists would have us see results of inflammation, and they accordingly speak of such changes as examples of 'chronic myelitis.' Sclerosis occurs under various forms, and constitutes the basis of several distinct diseases, which are in all cases gradual and more or less slow in their onset, as well as in their progress. It may occur (*a*) as a *diffuse* general overgrowth (after the manner of a cirrhosis in other organs); (*b*) in the form of *bands* limited to particular columns of the cord (especially the posterior and the lateral); or (*c*) in an *insular* manner, so as to form islets of sclerosis, scattered altogether irregularly through the cord at different levels, as in 'disseminated sclerosis.'

(13) Tissue-changes allied to these in their results or later stages, though they have a peculiar history and course of their own at the commencement, are the so-called '*secondary degenerations*' which occur in certain regions of the cord as a result either of some previous damage or injury to this organ itself, or as a sequence of brain-disease.

These 'secondary degenerations' illustrate facts originally made known by Waller, but which were confirmed and extended by Phillipeaux and Vulpian, to the effect that when nerve-fibres are severed from their connections with ganglion-cells situated at one or other extremity, the white substance of Schwann gradually breaks up in the course of seven to fourteen days, and undergoes a process of fatty degeneration, by which it is ultimately resolved into a multitude of mere molecules and fat-particles. The white columns of the cord are composed of great aggregations of nerve-fibres running parallel with one another, so that when one of these columns is cut across, or when the continuity of its fibres is interrupted by some severe lesion occurring in their midst, a process of 'secondary degeneration' manifests itself simultaneously in all the fibres thus damaged; and the united result appears as a band-like tract of degeneration, running upwards or downwards in the particular column of the cord affected.

In order to deal as briefly with this subject as possible, it may be said that experience has hitherto shown that such band-like tracts of 'secondary degeneration' occur especially in each lateral half of the cord, in three situations, namely, (1) in the lateral columns; (2) in the inner portions of the anterior columns; and (3) in the posterior columns. The degenerations in the lateral and anterior columns take place in each in a direction downwards from the site of section or lesion of the fibres, at whatever level the damage may chance to exist; whilst those in the posterior columns take place in an upward direction, starting from the section or seat of destructive lesion by which these columns may be invaded.

The fibres that undergo the *descending degeneration* in the lateral columns are generally believed to be those which transmit volitional stimuli to the various voluntary muscles of the body, and which have been previously alluded to as coming into relation with motor cells in the anterior cornua at different levels. These different fibres are supposed to enter the lateral columns at the commencement of the spinal cord, passing into them, in fact, as a result of the 'decussation of the pyramids.' Thus, the motor tract continued downwards from one corpus striatum, let us say the *left*, continues along the crus and through the pons on the same side; thence passing into the medulla a considerable proportion of its fibres decussate with their fellows and thereby reach the right lateral column, down which they proceed as a compact group in the manner indicated. The remainder of the fibres of the left motor tract (those which do not decussate) pass down also in a compact body and occupy most of the inner half of the right anterior column.[1] Thus, if the whole of the left motor tract be seriously damaged or cut across in the corpus striatum or at any point above the 'decussation of the pyramids' we should have a small band of degeneration in the anterior column on the same side, and also a larger band of degeneration in the opposite (or right) lateral column (fig. 86, H)—that is, we should have the form of secondary degeneration associated with many cases of hemiplegia.

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[1] Though this is the rule, yet it would appear from the observations of Flechsig that developmental anomalies are apt to occur, so that the relative proportion between the decussating and the non-decussating fibres is subject to much variation in different individuals

But if there be complete section of or destructive disease involving the antero-lateral columns of one side of the cord itself, then we should have a band of degeneration in the anterior, as well as in the lateral, column of the same half of the cord. Or if either column be cut or damaged singly, then in such column a band of degeneration would be found extending downwards from the seat of lesion. Or if, as so frequently happens, we have to do with a total transverse lesion, represented for instance by a focus of softening extending through the whole thickness of the cord in the upper dorsal or in some other region (so that the patient suffers from complete paraplegia), we should then find large areas of secondary degeneration in each lateral column below, as well as smaller areas in the inner part of each anterior column (fig. 86, P). The areas in both situations become less extensive as they descend, and gradually wear themselves out in the lower part of the lumbar swelling (see *Med.-Chir. Trans.* vol. l., pl. x.). It was stated by Bouchard, and has been commonly repeated by succeeding writers, that the areas in the anterior columns do not appear beyond the mid-dorsal region, but this, as the writer pointed out in 1867, is certainly not the rule.

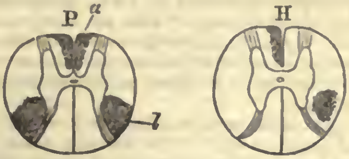

FIG. 86.—*P.* Showing descending areas of degeneration: *a.* in inner part of anterior columns; *l.* in lateral columns (mid-dorsal region). Case of *paraplegia*, from complete transverse softening in upper dorsal region.
H. Showing descending degenerations in case of *right hemiplegia*, from extensive softening of left corpus striatum. (Twice natural size.)

In such a case as that last cited, namely, one of paraplegia due to a total transverse lesion in the upper dorsal region, there would be found above the seat of lesion certain *ascending degenerations*—the principal of which would be situated in the posterior columns, though others smaller and less commonly known are to be met with in the outer part of the lateral columns (fig. 87, P). The ascending degenerations in the posterior columns are often strictly limited to the so-called 'columns of Goll.' Situated on each side of the posterior median fissure, they together constitute a median wedge-shaped patch, whose apex extends forwards to the commissure, and whose base is at the posterior surface of the cord. This band of degeneration reaches upwards to the medulla, though the exact course of its fibres through this region is uncertain. Nothing definite, indeed, is known as to the functions subserved by the fibres composing the 'columns of Goll.' It seems clear, however, that, under certain conditions, the areas of ascending degeneration in the posterior columns may be differently arranged, and not completely limited to the 'columns of Goll,' since in a case with a lesion of some kind in the mid-cervical region (whose nature is not known because, unfortunately, this part of the cord was not preserved) the writer long ago found such areas as are represented in fig. 87, Px, in the upper cervical region and in the medulla. He then, as he has since, found ascending areas of degeneration occupying the superficial portion of the lateral columns, which were traced upwards into the restiform bodies. It would seem possible that the fibres which undergo degeneration in this latter case correspond with those of the direct 'cerebellar band,' located by Flechsig in this situation. Such fibres would be afferent in function, but would probably only constitute a small part of the afferent fibres going to the cerebellum. (Nothing is known at present as to any band of efferent or motor fibres entering the cord from the cerebellum, and none such may exist. The cerebellar influence upon the motor tract—of whatever nature—may be expended upon certain centres situated in the pons varolii, or even in the corpora striata.)

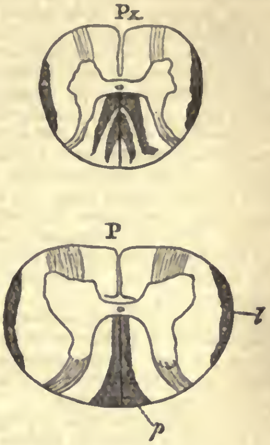

FIG. 87.—*P.* Showing ascending areas of degeneration: *p*, in columns of Goll; and *l*, along outer border of lateral columns, in middle of cervical swelling. Case of *paraplegia*, from complete transverse softening in upper dorsal region.
Px. Different arrangement of ascending areas in posterior columns in *upper cervical* region. (See *Trans. of Med.-Chir. Soc.*, vol. l., 1867, pl. ix.) (Twice natural size.)

In these areas of degeneration, in addition to the changes already mentioned as occurring in the nerves themselves, other processes take place. There is, for instance, a very distinct but secondary overgrowth of the connective tissue throughout the diseased area, as well as an abundant development of large granulation-corpuscles, precisely similar to those met with in ordinary foci of softened nerve-tissue. The granulation-corpuscles are closely packed amongst the meshes of the connective-tissue overgrowth and the atrophied nerve-fibres (see *Med.-Chir. Trans.*, vol. l. pl. xi. figs. 19, 20). In preparations which have been immersed in bichromates or in chromic acid, these corpuscles do not become stained to anything like the same extent as the healthy nerve-tissues; hence the areas containing them remain pale, and are consequently to be traced with the greatest ease in spinal cords which have been immersed for a week or two in these fluids, though when they were in the fresh state no such areas may have been detectable, even on the most careful examination, by the naked eye.

(14) *New growths* in the substance of the spinal cord itself are not very common, nor, on account of the limitations of space within the spinal canal, do they ever attain a very large size. For this situation a growth equalling a hazel-nut in bulk would be esteemed large. In regard to the nature of the growth, this is, of course, a matter of purely pathological interest, since the clinical signs and symptoms which a growth in the spinal cord is capable of causing would not vary with its nature, but would be wholly dependent upon its situation and its rate and manner of increase. *Cancer* occurs within the spinal cord almost solely as a secondary extension from a similar growth pre-existing in the dura mater or in the vertebræ, or possibly in more distant parts. In altogether exceptional cases it may occur primarily in the spinal cord. *Gliomata*, *sarcomata*, and *myxomata* may also occasionally be met with, either in pure or in blended types. *Tubercular* or *scrofulous* nodules are also apt to occur, either alone or in combination with a tubercular meningitis. *Syphilitic gummata* may likewise be found in the substance of the cord, though their presence in this situation is not so frequent as it is in association with the spinal meninges.

(15) *Atrophy with degeneration of ganglion-cells* is apt to occur as a secondary process with extreme frequency in portions of the grey matter of the cord which happen to be more or less implicated by other contiguous pathological changes. But in two or three distinct diseases the ganglion cells of the anterior cornua, in different parts of the cord, are prone to be suddenly overtaken by an ætiologically obscure and altogether inexplicable failure of nutrition, which speedily reveals itself by entailing an atrophy of the particular cells affected. This, for instance, occurs as the anatomical basis of 'infantile paralysis,' and of the similar form of paralysis now known to occur (though more rarely) in adults. In these diseases whole groups of contiguous and functionally-related cells are affected simultaneously, and as the atrophy progresses, there is generally evidence of a secondary overgrowth of the neuroglia surrounding such nerve-cells, in the anterior cornua. To assume that this process is inflammatory in type, as the terms 'cornual myelitis' or 'acute anterior polio-myelitis' imply, seems to the writer altogether unwarrantable. Inflammation does not limit itself to individual tissue-elements, and the slight overgrowth of the contiguous neuroglia may well be a secondary process of simple hyperplasia. This latter process is indeed less evident where, as in 'progressive muscular atrophy,' the initial and mysterious atrophy of individual ganglion-cells occurs more slowly and more sparsely. Cells, here and there in particular groups, undergo in this affection the atrophic process, leaving others around them for a time as healthy as ever. Yet, as the disease progresses, the ranks of the healthy cells become gradually thinned in an altogether irregular manner; and this atrophy of nerve-cells, as it occurs, speedily entails, for reasons to be set forth in the next section, a corresponding atrophy of functionally related muscular fibres.

§ 7. Trophic Relations between different Tissues and different parts of the Spinal Cord.—Irritation of the posterior cornua, or of the posterior roots of the spinal nerves, may give rise to various pustular or vesicular eruptions in related portions of the skin, often associated with neuralgic pains in these same regions. In other cases, with lesions in some parts of the grey matter, ulceration or actual sloughing of certain related tracts of skin are easily determined—especially under the combined influence of continued external pressure and frequent irritation from urine or fæces, as in some cases of paraplegia.

Degeneration or destruction in any way of the great ganglion-cells of the anterior cornua, or of the anterior roots of the spinal nerves (either within or outside the cord), gives rise, in the course of two or three weeks, to atrophy of the muscle-fibres with which such cells or nerve-roots are in relation. We thus get an atrophic paralysis, associated with the electrical 'reaction of degeneration.'

Certain diseases affecting the grey matter of the cord (in ways and sites which cannot be precisely defined) are also apt to be associated with chronic diseases of the joints. Sometimes comparatively unimportant, they lead in other instances to great atrophy of the articular ends of the bones, and possibly to dislocation with utter destruction of the joint, as in some cases of locomotor ataxy. Atrophy, with brittleness of bones, may also be met with in the same or in allied cases.

The fact of the existence of these trophic troubles in association with such lesions, may be admitted wholly irrespective of the explanation of their pathogenesis. Whether they are due to altered states or influences transmitted by ordinary motor and sensory nerves in relation with such tissues, or to altered influences through certain purely hypothetical 'trophic nerves,' lies altogether outside the fact of the mere co-existence of the several trophic troubles with the several lesions—which is the point of more immediate interest for the practitioner of medicine.

§ 8. General Symptomatology, and General and Regional Diagnosis.—Taking them in conjunction with some of the simpler principles of nerve-physiology, the practitioner has to make use of the various kinds of data above enumerated in the investigation of the precise nature of every case of disease of the spinal cord which comes before him. Under the word 'nature' we include, of course, both sides of the diagnosis that has to be made, namely, the *regional* and the *pathological*.

The practitioner is compelled to interpret the patient's symptoms, and the various signs he is able to recognise for himself, by the aid of such data when he attempts, for instance, to ascertain what parts of the cord are damaged, and in what order they have been implicated. He may wish to know whether the posterior or the lateral columns are specially involved; whether the grey matter is much damaged; and, if so, whether the damage more particularly affects the anterior cornua or other parts. Again, he may wish to know whether the anterior or the posterior spinal nerve-roots are specially involved; and, if so, whether they are merely irritated or more severely damaged, and whether they have been simultaneously or successively affected. For the present we shall concern ourselves with this aspect of the problem only, though it will subsequently be shown in our account of the several diseases of the spinal cord what light the coexistence of certain groups of these facts throws upon the other aspect of the problem, namely, upon the question of the pathological nature of the lesion.

Some of the facts already cited have, however, to be translated into their clinical equivalents, and to be supplemented by others derived more exclusively from the clinico-pathological study of spinal diseases, in order to form a series of data more immediately useful in the interpretation of the phenomena of diseases of the spinal cord in their regional relations.

Regional Diagnosis.—We already possess a number of valuable clinical data available for throwing light upon the regional side of the problem of diagnosis. It must be borne in mind, however, that the regional diagnosis of diseases of the spinal cord is itself a twofold problem. It involves a consideration: (*a*) of the *transverse area* involved; and (*b*) of the *longitudinal situation and extent* of the disease in such areas.

(*a*) **Diagnosis of the transverse area involved.**—The facts to be tabulated under this head may be set down in the order of their relation to different component parts or regions of the spinal cord.

(1) *Anterior roots of spinal nerves.*—Irritation of these may give rise to various forms of twitching or to tonic spasms in related muscles. Great pressure upon or destruction of the anterior roots will give rise to local paralysis in the related muscles, followed in the course of a week or two by marked atrophy, and the establishment of the electrical 'reaction of degeneration' (*see* PARALYSIS, Motor). There will also be an abolition of reflex excitability of these muscles in response to skin-irritation, or from blows upon or stretchings of their tendons.

(2) *Antero-lateral columns.*—Increasing pressure upon or disease of these columns gives rise to paresis, gradually deepening into motor paralysis of parts deriving their nerve-supply at or below the seat of lesion.

When the disease occurs in the lateral column more especially, there may be twitchings or startings in the muscles below, or well-marked spasms, and possibly painful cramps. There may also be great exaltation of the superficial and deep reflexes, if the manifestation of the latter is not hindered by pre-existing spasms. Motor paralysis exists to some extent, but without any appreciable impairment of sensibility. No marked wasting of muscles, or diminution in electrical reactions, usually occurs.

(3) *Grey matter.*—(*a*) *Of anterior cornua.*—Disease of these parts causes motor paralysis, with atrophy, loss of faradic excitability and of reflex excitability in related muscles—as in cases of disease of the anterior roots of spinal nerves.

(*b*) *Of posterior cornua and central parts.*—Damage of these regions of grey matter will, according to its completeness in transverse extent, cause more or less delay or defect in the transmission of painful impressions, and perhaps interfere also with other modes of sensibility.

Some trophic lesions in skin and joints may also be met with (*see* § 7).

⁂ At different levels in the cord special centres (represented in both anterior and posterior regions of grey matter) in connection with definite functions, may be interfered with by morbid conditions implicating the grey matter (*see below* § 9 [1–10]).

(4) *Posterior columns.*—The results of disease confined to this situation (more especially to the 'root-zones') will be—ataxy or signs of incoordination of movements; interference with impressions of touch, pressure, temperature, and of 'muscular sense'; abolition of knee-reflex; and diminution or loss of sexual desire.

(5) *Posterior roots of spinal nerves.*—From irritating lesions there will arise lancinating or other pains in the skin and deeper textures of related portions of the limbs, and possibly trophic skin-lesions. Pressure or destructive lesions will give rise to loss, in various degrees, of different modes of sensibility, superficial and deep; and diminution or abolition of the superficial and deep reflexes in related regions of the body.

§ 9. (*b*) **Diagnosis of the longitudinal situation and extent of the lesion.**—This is a consideration distinctly secondary to the other, since at whatever longitudinal level the disease may be situated, its clinical characters will always be qualified by the part or parts of the transverse extent of the cord that may be involved. Here we have to depend in the main upon the signs indicative of the *implication of particular sensory and motor nerves*, whose exact relations with different portions of the spinal cord are, of course, known. Such signs may consist of some excess or defect of sensibility, of motility, or of reflex action.

We are accustomed also to obtain information of a more general kind from the fact that *special centres* in connection with different viscera and functions situated at different longitudinal levels in the cord may be more or less deranged. To this portion of the subject it will, indeed, be found most convenient to give attention in the first place.

Evidence from perverted activity of spinal centres.

(1) The lateral columns in the upper cervical region contain the motor paths for the muscles of respiration, so that section or disease of them at a lower level interferes with the movements of respiration on the same side of the chest (thoracic muscles); whilst, if the lesion reaches as high as the fourth and third cervical nerves (the origin of the phrenic) the diaphragm itself also becomes paralysed, and the movements of respiration must therefore almost cease.

(2) Again, the upper cervical region of the cord, if it does not contain actual centres connected with the excitation of the heart's action, is at all events traversed by certain channels for the transmission of cardiac stimuli (whose point of exit from the cord is, with sympathetic fibres, lower down).

Thus different lesions in this upper cervical region of the cord may, according to their nature and extent, greatly interfere with the heart's action, as well as with the respiratory movements. The frequency of the pulse may be either notably accelerated or retarded; whilst the respiratory movements may be slower or much quicker than natural, and also extremely irregular and perverted in rhythm.

(3) The lower cervical and upper dorsal regions of the cord also contain the so-called 'ciliospinal centre,' or the fibres emanating from it. These pass outwards with the fibres of the anterior roots in the above-named regions, and thence into the cervical sympathetic. Irritation of them causes dilatation of the pupil on the same side, whilst section or other destructive lesion causes contraction of the pupil.

(4) The vaso-motor nerves for the side of the head and neck arise in similar regions of the cord, and leave it in the same manner. Irritation of them produces contraction of the blood-vessels; section, severe compression, or destruction causes dilatation of the blood-vessels of these regions. *See* SYMPATHETIC SYSTEM, Disorders of.

(5) Generally it may be said that section of one half of the cord or destruction of it for any extent longitudinally, causes at first paralysis of blood-vessels in the lower parts of the body on the same side—this vaso-motor paralysis carrying with it in the same parts an increase of temperature and an exaltation of sensibility. In a short time, however, the vaso-motor paralysis (and with it the increase of heat and sensibility) passes away, owing to the vaso-motor centres in parts of the spinal cord below, and to the peripheral vaso-motor centres, adapting themselves to act independently of those in higher parts of the cord and of the supreme regulating centre in the medulla oblongata. (As a rule the higher vaso-motor centres control those lower down, but after temporary paralysis even the peripheral vaso-motor centres seem to resume control over related blood-vessels.)

(6) The movements of the stomach and intestines generally are certainly influenced by the cord in different regions, so that in various cases, under perversions of this normal spinal influence, we may get vomiting, diarrhœa, or obstinate constipation—as direct results, that is, of morbid changes in certain parts of the cord in which intestinal sympathetic fibres have their roots. The exact situations of these centres and paths of stimulation are, however, only vaguely known.

In the grey matter of the lumbar swelling of the cord there are aggregated a number of centres having to do with important functions, which may be variously interfered with by disease. These centres are those which regulate—(7) the evacuation of the rectum; (8) the evacuation of the bladder; (9) erection and ejaculatio seminis; and (10) the contractions of the uterus.

In each case the spinal centre constitutes an independent reflex centre, provided with its afferent and efferent nerves, but in each case also there is more or less of connection between the spinal centre and others in the cerebral hemispheres. There must therefore be double sets of internuncial fibres for each centre traversing the whole length of the spinal cord and medulla; partly for the transference of afferent impressions from each centre to the brain, and partly for the conduction of efferent impressions in the reverse direction. In the case of the uterine centre these cerebral connections are of comparatively slight importance; since, with a complete transverse lesion in the cervical or even in the upper dorsal region, the process of parturition may still be successfully accomplished. So long as the spinal mechanism is complete and perfect, parturition may take place without the need of cerebral co-operation. Our subsequent remarks will, therefore, refer principally to the other three lumbar centres.

Complete transverse lesions occurring in any part of the dorsal or cervical regions will, of course, entirely cut off all the above-mentioned lumbar spinal centres from connection with, and therefore from any voluntary control by, the cerebral hemispheres. But various limited local lesions in particular transverse areas of the cord (though such areas cannot at present be definitely specified) may produce similar results, so far as the cerebral control of any one or two of the lumbar centres is concerned. According as the severance of these lumbar spinal centres from cerebral correlation and control is complete or partial, one or other of the following results would be produced:—

Name of Centre	Complete Severance from Cerebrum	Incomplete Severance from Cerebrum	
	Afferent and Efferent Internuncial Fibres	Afferent Internuncial Fibres Only	Efferent Internuncial Fibres Only
Rectal centre	Unconsciousness of need, and inability to prevent evacuation *Result.*—Constipation, with incontinence of fæces after an aperient	Unconsciousness of need and therefore no attempt to restrain evacuation	Consciousness of need to evacuate, with no ability to restrain the act
Vesical centre .	Unconsciousness of need, and inability to prevent micturition *Result.*— Reflex evacuation in gushes at intervals	Unconsciousness of need and therefore no attempt to restrain micturition	Consciousness of need, but inability to restrain micturition
Sexual centre .	Diminution or absence of sexual desire. Erections and emissions, if they occur, wholly dependent upon the spinal reflex mechanism	With simple destruction of fibres, nearly same results as set down in previous column; but with *irritation* of afferent fibres there might be great increase of desire (satyriasis or nymphomania)	Feelings of desire, but no erection in response. Erection and emissions, if present, purely through spinal reflex. But with *irritation* of efferent fibres there may be persistent erections, mostly without desire

The *rectal* and the *vesical spinal centres* are each composed of two parts with their separate afferent and efferent nerves—one in relation with a sphincter muscle, and the other in relation with detrusor or expulsive muscles in functional opposition with the former. These several nerve-fibres, both afferent and efferent, are probably all contained in the sacral nerve-trunks—that is, they both reach and leave the lumbar swelling as constituents of these nerve-trunks. Destruction or irritation of either of these sets of fibres, or of one of the centres, will necessarily interfere to some extent with the working of this particular centre, so that its functions may be interfered with in several different ways. There may be various degrees of irritability of the bladder or rectum, or various degrees of paralysis of these organs.

In cases of paralysis of the bladder, especially when owing to lesions implicating its spinal centre, the urine soon becomes fœtid and alkaline, and inflammation (alone or with ulceration) is most apt to be set up in its mucous membrane.

The details as to the modes of disturbance of the *genital* function, where disease implicates its lumbar centre or the afferent and efferent nerves in connection therewith, are both less known and of less clinical importance than where it involves the internuncial fibres between this centre and the cerebrum. Again, should the lumbar portion of the cord become affected in a pregnant woman so as to involve the *uterine centre*, unless the contents of the womb were thrown off during some initial period of irritation, this organ would be quite incapable of expelling the fœtus and its accessories.

Evidence from implication of particular sensory or motor nerves.

§ 10. The more precise indications concerning the longitudinal implication of the spinal cord are, as already stated, derivable from the level at which alterations in sensibility or in motility (either voluntary or reflex) are to be detected. The more closely the lesion approaches to what is called a 'total transverse lesion,' the more distinctly will signs of this order reveal themselves. It is important, too, to recollect that the fibres of different sensory roots are to some extent dispersed through cutaneous surfaces overlying the muscles supplied by the corresponding motor roots.

In regard to *sensibility*, the upper limit at which the trunk is affected is often sharply defined by the presence of a feeling of constriction, of pain, or of numbness ('girdle sensation') encircling the body. This sensation is generally supposed to be due to irritation of the roots of the nerves as they traverse the posterior columns (or perhaps outside them) at the upper level of the lesion. This symptom may of course be absent, but in many cases of paraplegia it is well-marked.

Then again the muscles which are paralysed can generally be pretty well defined, so that a reference to the nerves by which they are innervated will also enable us to fix upon the region of the cord from which they proceed. Thus we obtain indications as to the upper level of disease in the *motor* tracts.

These latter indications are, however, by no means so distinct as many might suppose, because the majority of limb and trunk muscles receive fibres from more than one motor root, as Preyer and Krause showed long ago. And the view subsequently indicated by E. Remak that functionally related or synergic muscles are represented together in the anterior horns of the spinal cord has been confirmed and extended by Ferrier and Yeo (*Proceed. of Royal Soc.*, March 24, 1881, p. 12), by their experiments on the functional relations of the motor roots. They find that stimulation of individual roots of the brachial and crural plexuses result, not in mere unrelated contractions of various muscles, but in highly co-ordinated synergic contractions, leading to definite movements. But as the 'muscles thrown into action by each root are innervated in most cases by several nerve-trunks,' the result 'of section of each motor root would therefore be paralysis of the corresponding combination, not necessarily, however, of the individual muscles involved . . . . whilst *weakened*, they might yet act in other combinations in so far as they were supplied by other roots.' Different combined movements which have been found to be dependent upon particular motor roots are cited by the authors in this valuable paper.

The integrity of those *reflex* actions which can be elicited either in health or in disease, depends, of course, upon the integrity of the entire nervous arcs concerned (that is, upon integrity of in-going fibres, centres, and out-going fibres). Thus though the impairment of a reflex *may not necessarily* be due to central causes, its presence, on the other hand, clearly shows that the grey matter and other regions of the cord which must be traversed by its stimuli are not impassable; whilst its exaltation will indicate the probable existence of some central change, by which the grey matter in question is rendered more excitable, or else by which it is cut off from cerebral inhibitory influences.

§ 11. For practical purposes it will be well here to group together the various indications as to longitudinal localisation to which we have referred—classifying them as they are related to one or other of four imaginary segments of the spinal cord.

(*a*) **Cervical region of the cord.**—*This corresponds externally to the space between the occiput and the upper border of the 7th cervical spine (8th cervical nerve).*

The 1st, 2nd, and 3rd cervical spinous processes are respectively opposite the origins of the 3rd, 4th, and 5th cervical nerves. The phrenic nerve (motor nerve of the diaphragm) arises from the 4th, or from the 3rd and the 4th cervical nerves. Opposite the 3rd cervical spine (level of 5th cervical nerve) the cervical swelling of the cord begins; whilst it ends opposite the 7th cervical spine (level of 1st dorsal nerve).

Disease of this region may involve interference with respiration, and possibly weakness of voice; interference with the heart's action—pulse very frequent, or the reverse; flushing or pallor of the head and neck; continued priapism (with crushing lesions); augmentation of temperature in the body generally (hyperpyrexia); and marked contraction or dilatation of the pupil.

The innervation of the shoulder, arm, and hand muscles is derived from spinal nerves between the 6th cervical and 1st dorsal inclusive; those supplying the ulnar side of the hand and forearm arising from the lower level, that is, from the upper part of the next region.

(*b*) **Upper half of the dorsal region of the cord.**—*This corresponds externally to the space between the 7th cervical spine (1st dorsal nerve) and the 4th dorsal spine (6th dorsal nerve).*

The results of disease here are apt to be these:—The 'scapular reflex' may be abolished, calling into activity as it does the last two or three cervical and the first two or three dorsal nerves; the intercostal muscles are paralysed at different levels; a 'girdle sensation' is felt at different levels; there may be prominence of certain vertebral spines, and possibly tenderness on pressure or on tapping over them; the 'epigastric reflex' may be abolished, depending as it does upon the spinal cord at the level of the 4th to the 6th or 7th pairs of dorsal nerves; and priapism (with crushing lesions) may occasionally be met with.

(*c*) **Lower half of the dorsal region of the cord.**—*This corresponds externally to the space between the upper border of the 5th dorsal spine (7th dorsal nerve) and the lower border of the 10th dorsal spine (space below 12th dorsal nerve).*

Disease here may give rise to the following symptoms:—The 'abdominal reflex' may be abolished, depending as it does upon the integrity of the cord between the levels of the 8th dorsal and the 1st lumbar nerves. Paralysis of lower intercostal muscles or of abdominal muscles may possibly occur, in addition to paralysis of the lower extremities. 'Girdle sensation' may be felt at different levels (the umbilicus corresponding with the 10th dorsal nerve, and the 'ensiform area' with the 6th and 7th dorsal nerves). There may be prominence of certain of the lower dorsal spines, with possible tenderness.

(*d*) **Lumbar region of the cord.**—*This corresponds externally to the space between the lower border of the 10th dorsal spine (just below 12th dorsal nerve), and the upper border of the 2nd lumbar vertebra.*

Here the symptoms are:—Paralysis, not implicating the abdominal muscles, but limited to more or less of those of the lower extremities. No 'girdle sensations' around the trunk. Three superficial reflexes may be abolished, namely, the 'cremasteric,' which depends upon the integrity of the cord in the upper lumbar region; and the 'gluteal' and the 'plantar,' both of which seem to be dependent upon the integrity of the lower part of the lumbar region of the cord. A deep reflex may also be abolished, namely, the so-called 'knee-jerk,' which is dependent upon the upper lumbar region of the cord. 'Ankle-clonus' may be met with when disease affects the upper or mid-lumbar regions of the cord, but not where the lower lumbar region is implicated. Loss of sensibility about the perineum and anus (if not due to disease of nerve-trunks), is indicative of disease of the posterior columns in the lower lumbar region. Absolute paralysis of the bladder and rectum may be present, with tendency to inflammation and ulceration of the former organ.

In the clinical data above given are included the majority of the facts upon which the *regional diagnosis* of diseases of the spinal cord must in all cases be based. In them also will be found the explanations, so far as they can be given in moderate compass, of the *symptoms* met with in different diseases of the spinal cord. An obvious advantage will be found to have resulted from this somewhat lengthy preliminary discussion, if, as it ought to do, it tends to give the practitioner a more thorough insight into the nature and relations of the several diseases of the spinal cord, at the same time that it aids him in their diagnosis.

Although it is true that the groups of symptoms presented in different diseases of the spinal cord, considered individually and collectively, afford the materials upon which a *regional* diagnosis must be founded, it is no less true that a part of the symptomatology (namely, that comprised in the mode of origin and the mode of establishment of the disease, together with what may be gathered from the patient's state generally, from his family history and from his personal history) constitutes the basis upon which a *pathological* diagnosis has to be arrived at. Again, although the arrival at a regional diagnosis is often spoken of, and may seem to be a process altogether distinct from that involved in the arrival at a pathological diagnosis, yet, as a matter of fact, in the investigation of many individual cases of spinal disease, it will be found that the one problem is not settled first, and the other afterwards, but that both are tentatively considered more or less simultaneously. Thus, certain empirically known pathological conditions may afford at once a ready explanation of a given group or sequence of symptoms, as in 'infantile paralysis,' in 'locomotor ataxy,' or, in a more general sense, in angular curvature of the spine. Here, therefore, the pathological diagnosis goes hand in hand with the regional diagnosis, and in working them out each gathers additional confirmation from the establishment of the other. Sometimes, however, as in the case of traumatic injuries (including stabs, and fractures with dislocations of vertebræ), the pathological diagnosis is at once obvious, and the regional diagnosis alone requires to be settled in detail.

For the above reasons it has been necessary to tabulate in this article certain '**Pathological data concerning the Spinal Cord**' (§ 6), though it would not be found specially advantageous were we to follow out this part of the subject further, and attempt here to set down the more general *clinical data and deductions of pathological import*, necessary to be borne in mind for the arrival at a pathological diagnosis, in order to form a series of facts and deductions comparable with those already given in elucidation of the problems of regional diagnosis (§§ 8–11). These other problems will be dealt with, as far as possible, in the descriptions of the several diseases of the spinal cord.

H. Charlton Bastian.

SPINAL CORD, Special Diseases of.—In order that the mutual relations of the different diseases of the spinal cord may be the more readily appreciated, their names are here set down in groups, and they will be severally considered in the same order, which is one based upon their causes and nature, rather than upon alphabetical considerations. This list will, therefore, in addition serve as an index to the present article. The names of the different diseases now to be described are printed in block type; while the names of those diseases which are discussed separately in different parts of the work (to which the reader is referred), are printed in small capital letters.

I. Diseases of the Spinal Cord dependent upon known organic changes:—

1. Concussion of the Spinal Cord; 2. Punctured or Gun-shot Wounds of the Spinal Cord; 3. Sudden Crushing Lesions of the Spinal Cord; 4. Slow Compression of the Spinal Cord; 5. Anæmia of the Spinal Cord; 6. Hyperæmia of the Spinal Cord; 7. Inflammation of the Spinal Cord; 8. Hæmorrhage into the Spinal Cord; 9. Softening of the Spinal Cord.

10. INFANTILE PARALYSIS; 11. Acute Spinal Paralysis of Adults; 12. Acute Ascending Paralysis; 13. Chronic Spinal Paralysis; 14. PROGRESSIVE MUSCULAR ATROPHY; 15. PSEUDO-HYPERTROPHIC PARALYSIS.

16. LOCOMOTOR ATAXY; 17. Spasmodic Spinal Paralysis; 18. Amyotrophic Lateral Sclerosis; 19. Multiple or Disseminated Sclerosis.

20. Tumours and New Formations of the Spinal Cord; and 21. Malformations of the Spinal Cord.

II. Diseases dependent upon unknown or imperfectly known organic changes:—

22. TETANUS; 23. TETANY; 24. TORTICOLLIS; 25. WRITER'S CRAMP; 26. SPINAL IRRITATION; 27. Reflex Paraplegia; 28. Intermittent Paraplegia; 29. Hysterical Paraplegia; 30. Paraplegia dependent on Idea; 31. Neurasthenia Spinalis; and 32. Toxic Spinal Paralysis.

In addition to these diseases, dependent upon changes limited to the spinal cord, other affections should here be mentioned, in which the spinal cord is implicated (in modes more or less known) together with the cerebrum in one or other of its regions. These *cerebro-spinal* affections are as follows:—1. GENERAL PARALYSIS OF THE INSANE; 2. CEREBRO-SPINAL SCLEROSIS; 3. PARALYSIS AGITANS; 4. HYDROPHOBIA; and 5. CHOREA.

For an account of the diseases dependent upon morbid changes in the membranes of the spinal cord, *see* MENINGES, Spinal, Diseases of.

1. Spinal Cord, Concussion of.—SYNON.: *Commotio Medullæ Spinalis*; Fr. *Commotion de la Moelle Épinière*; Ger. *Erschütterung des Rückenmarks.*

ÆTIOLOGY.—This condition is met with principally in persons who have fallen from a height, or in those who have been present in a railway collision. In these cases the brain is apt to suffer as well as the spinal cord, and it is not always easy to unravel the respective symptoms due to shock of this or that great segment of the cerebro-spinal system.

ANATOMICAL CHARACTERS.—In many of these cases there are, in all probability, no morbid changes that would be discoverable. In others, however, minute extravasations of blood, or actual ruptures of the nerve-tissue, may occur—and this sometimes even to a marked extent, as in a case seen by the writer. An example of slighter lesions is recorded by Sir Wm. Gull, in which small extravasations of blood were found in the anterior and posterior cornua as well as in the posterior columns of the cord. In neither of these cases was there any external or visible injury; but in each paraplegia was produced immediately after the fall that determined the lesions in the cord. In addition to hæmorrhages into the substance of the spinal cord itself, there is in these cases the possibility of the occurrence of meningeal hæmorrhages, pressing upon the cord or its nerve-roots; and within a day or two after the occurrence of the concussion itself, there is the possibility of some local and subacute inflammation being set up in the membranes of the cord.

SYMPTOMS.—In the great majority of these cases no complete paralysis is induced, even at first. There may at most be paresis of one or more limbs, general prostration, nausea with occasional vomiting, a rapid and possibly irregular or intermittent pulse (especially after the least exertion), with occasional startings and twitchings of the limbs, whose sensibility may be diminished, exalted, or unaffected. The temperature will probably be at first depressed, as a result of shock, though subsequently a febrile elevation may continue for some days. The tongue may be furred, the appetite bad, the bowels constipated; whilst in regard to micturition there may be either some delay and difficulty, or, on the contrary, an irritability of the bladder, with difficulty in retaining its contents after the desire to micturate is once felt. With this there is often general restlessness, nervousness, and insomnia.

In more severe cases of concussion, even where there is no complication resulting from appreciable lesions, the shock to the system (*see* SHOCK) may be more profound, and there may be paralysis of limbs, lasting perhaps for some days, and then rather suddenly disappearing.

DIAGNOSIS.—The questions to be determined are, whether, looking to the symptoms presented by the patient, there is likely to be any organic lesion or change in the spinal cord or its membranes; or whether we have to do with mere functional perturbations induced by the shock or blow to which the patient has been subjected. In the absence of definite paralysis, or even with its presence for the first few days, the answer to this preliminary question will often be shrouded in doubt. To come to a definite opinion as to the precise nature of the change which a spinal cord, deemed to be damaged in some way after a concussion, has undergone, lapse of time and several examinations of the patient are often required.

In many cases in which compensation for an injury is claimed a further complication appears. Here it is that the difficulty arises as to how much the symptoms experienced, or said to be experienced, may be due to an excited imagination, and how much to causes independent of the imagination, whether voluntarily or involuntarily aroused. It must be conceded that symptoms of injury are undoubtedly feigned by unscrupulous persons; and it seems also equally clear that, even unknowingly to the patient, the excitement consequent upon the accident, the details heard concerning the injuries of others, combined with the inquiries of doctors and of sympathising friends, tend to keep up and to exaggerate symptoms in many nervous patients, over and above those which may have resulted from the shock. Such patients also may make a more speedy recovery subsequent to trial and compensation, than they had been making before the trial, and yet they *may* not have been in any sense impostors. It is true that such persons, however, do not recover quite so quickly as those others who for their own unscrupulous ends have been previously exciting their imaginations in a voluntary manner.

Prognosis.—In only the severest cases of concussion or shock is there actual danger to life (*see* Shock). Where, however, great prostration is induced, and especially in those who may previously have been suffering from heart-affections, or from a very excitable nervous system, life may be speedily brought to a close; or at most such patients may not survive a severe concussion more than a day or two.

Severe concussions of the cord may also form the starting-points of many and varied deviations from health, which may not begin to show themselves for weeks, or perhaps even months, after the initial shock. Among such sequelæ, which have come under the writer's notice, may be mentioned the following:—Loss of flesh with general failure of nutrition, epileptiform fits, progressive muscular atrophy, lateral sclerosis of the spinal cord, a slowly increasing paraplegia (of uncertain pathological basis), and caries of vertebræ followed by angular curvature and paraplegia.

In other and slighter cases, time and rest, with suitable medical treatment, may be expected to lead to perfect recovery, sometimes speedily, but sometimes only after protracted periods of impaired health.

Treatment.—In the first instance, symptoms of shock have to be combated by the employment of warmth and stimulants. In subsequent stages, rest in the recumbent position must be enjoined for a time. It is of the first importance to make sure that the patient does take complete rest, and is kept free from excitement during the first few days after any concussion accident, and that he gets sound sleep at night, under the influence of bromide of potassium, or of this together with chloral. If the condition of restlessness, with disturbed sleep, can be checked, then a mitigation of other symptoms may be expected to follow. The application of ice to the spinal column may at times be desirable; or pain must be relieved by the subcutaneous injection of small doses of morphia. Later on tonics, with a simple nutritious diet and plenty of fresh air, together with rest, will be needed for the complete restoration of the patient.

2. Spinal Cord, Punctured or Gun-shot Wounds of.—Synon.: Acute Traumatic Lesions of the Spinal Cord; Fr. *Plaies et contusions de la Moelle Epinière*; Ger. *Rückenmarkszerreissungen.*

Ætiology and Anatomical Characters.—Punctured or gun-shot wounds of the spinal cord are commonly made with knife, dagger, sword, or bullet.

In each set of cases, the wound in the spinal cord will be associated with perforation or rupture of some of the membranes, and also with hæmorrhage, either between them or into the substance of the cord. The arches of the vertebræ or their articular processes and some of the ligaments connecting them may be more or less damaged, and a wound commonly exists through the contiguous skin and muscles. In the cord itself, there may be either a clean-cut wound through certain of its columns and parts, or a broader crushing lesion. In each case more or less blood may be effused upon and below the cut surfaces of the cord. At later stages, there may be signs of inflammation of the membranes, as well as of local inflammatory softening of the substance of the cord.

Symptoms.—The signs and symptoms consequent upon wounds of this kind are subject to endless variations, in accordance with the different regions of the cord involved, the actual extent of the wound in its substance, and the possible presence of varying amounts of effused blood. These wounds often involve only a portion of the transverse area of the cord. It is indeed in this class of cases more especially that *hemiplegia spinalis* and *hemiparaplegia* are met with. Thus where a unilateral lesion exists in the mid or upper cervical region, both arm and leg are paralysed, so that the state known as *hemiplegia spinalis* is produced; but where it occurs in the dorsal region, the one leg only is paralysed, and we have what is known as *hemiparaplegia.*

The essential peculiarity in the latter cases is that on the side of lesion there is complete motor paralysis in the limbs or limb below; whilst on the opposite side, the limbs or limb, and the trunk up to the middle line, are more or less completely anæsthetic—sensitiveness to impressions of touch, pain, temperature, and tickling being alike abolished.

Other minor peculiarities are these:—On the side of *motor paralysis*, there is also vaso-motor paralysis, which carries with it, as consequences, (*a*) an elevation of temperature (from 1½° to 2° Fahr.), and (*b*) a hyperæsthesia for all modes of sensibility (owing in part to hyperæmia in the limb and cord). Surrounding the body, at the level of the upper margin of anæsthesia on the side of sensory defect, there is usually a narrow girdle of hyperæsthesia; whilst below this level, on the side of the lesion, there is a half band of hemianæsthesia—whose depth varies with the longitudinal extent of the lesion. (The complete zone of hyperæsthesia is probably due to hyperæmia of nerve-roots, and of the grey matter of the cord immediately above the lesion; while the half-zone of anæsthesia is dependent upon destruction of the nerve-roots, and of the spinal cord for a certain extent.)

If bed-sores occur, they are met with on the side of sensory paralysis; whilst in one or two cases signs of a joint-affection (in the knee principally) have occurred on the side of motor paralysis. There seems no reason for expecting any special muscular atrophy or diminution of faradaic irritability on the side of motor paralysis, except in those muscles whose nerve-supply comes from the portion of the anterior cornua actually destroyed by the lesion. In many cases, especially at first, there is paralysis of the bladder and of the rectum, or there may be incontinence of urine. Later on these troubles tend to diminish. Nothing definite is known in regard to the condition of the skin-reflexes and tendon-reflexes in these states.

Where anomalies exist in regard to the extent of decussation of the pyramids (Flechsig), the above-described effects of unilateral lesions of the cord would also undergo corresponding variations.

In gun-shot wounds, whether occasioned by pistol or rifle, splinters of bone may be depressed at times, so as to compress and irritate the cord, and thus the symptoms may be made to approximate more closely to wounds of the next category.

After a few days the symptoms may be complicated by those of spinal meningitis, or extended by the spread of an inflammatory softening of the cord above and below the seat of lesion.

DIAGNOSIS.—The primary cause of the patient's condition is generally only too obvious. It may be clear that we have to do either with a punctured or with a gun-shot wound in some region of the spine; but subsequently many, and often very difficult, questions require to be solved. It is of first importance to learn whether the cord itself is really damaged, or whether the symptoms are in the main caused by epi-dural or sub-arachnoid hæmorrhages (*see* MENINGES, SPINAL, Hæmorrhage into). In the former case there will be evidence of complete or partial interruption of conduction in the cord, to or from all parts below the seat of lesion, and not of a mere local implication of nerve-roots. If it seem probable that the cord itself is damaged, we have to determine whether it is completely cut across, or only partially damaged—and if the latter to what extent. These questions must be decided in the main by reference to the signs given in Introduction, § 8.

Should the case be seen for the first time several days after the injury, an exact diagnosis as to the amount of damage to the cord itself is often greatly obscured by the existence then of certain secondary pathological conditions—more especially localised inflammation of the meninges, or secondary inflammatory softening, extending perhaps above or below, or in both directions, from the original wound. A process of softening may also extend transversely through the whole substance of the cord, even where only a unilateral lesion had previously existed.

PROGNOSIS.—This, as a rule, is bad in all cases of traumatic injury of the spinal cord; and the gravity of the case is usually the greater the higher the wound happens to be situated in the cervical region. Wounds of the dorsal or lumbar region of the cord are rather less serious, so far as life is concerned.

The degree of recovery from paralysis of limbs will greatly depend upon the nature and extent of the wound. A clean-cut wound may be filled up by the growth of a kind of cicatricial tissue; but it has not yet been accurately determined whether the nerve-substance of the cord can be reproduced in man. There seems, however, reason for supposing that some amount of reparation of nerve-tissue may take place in the cut spinal cord even of man—especially in early life.

TREATMENT.—Absolute rest, with cold applications, and possibly local blood-letting, will be needed in the first instance.

Subsequently, when immediate danger from shock and from the spreading of local inflammation has passed away, the patient must be treated upon the general principles applicable to all cases of paraplegia—which principles will be found set forth in (9) **Spinal Cord, Softening of.**

3. Spinal Cord, Sudden Crushing Lesions of; Fr. *Compressions brusques de la Moelle Épinière*; Ger. *Rückenmarksquetschungen.*

ÆTIOLOGY AND ANATOMICAL CHARACTERS.—The above form a class of wounds sufficiently distinct to need separate treatment. This kind of damage to the cord may be produced by the sudden giving-way of a carious vertebra in any part of the spinal column; more rarely from a heavy blow on the back, which does not fracture the spine; or, in a modified form, from the bursting into the spinal canal of an aortic aneurism. after its erosion through the vertebræ. But in the majority of cases such wounds of the spinal cord are the results of forms of external violence which cause fracture and dislocation of vertebræ, in some portion of the spinal column between the upper cervical and the upper lumbar region. When this occurs displacement of vertebræ, even to a slight extent, especially in the dorsal region, in which the spinal canal is narrowest, is sufficient to produce severe pressure upon, or crushing of, the spinal cord. The membranes may not be torn across, but the substance of the cord itself may be greatly compressed or reduced to a blood-stained semi-fluid mass of pulp. After some hours there are obvious signs of a commencing inflammatory reaction in the membranes; and above and below the seat of lesion similar changes are apt to be set up in the spinal cord itself, which may go on to the production of a variable amount of inflammatory softening. The patient may die, however, before any of these latter changes have been established.

SYMPTOMS.—These vary much, according to the region of the cord involved. Still, in spite of differences thus dependent upon the seat of injury, there is a certain general similarity in the symptoms produced by all crushing lesions of the spinal cord. They are usually of this nature:—Complete paralysis, both motor and sensory, of parts below the seat of lesion; in addition to severe pains in the back, girdle pains surrounding the body at the upper limit of sensory and motor paralysis; increased heat or possibly undue coldness of the body throughout the paralysed parts; complete paralysis of bladder with retention of urine, gradually giving place to incontinence; paralysis of intestine, extremely obstinate at first, but subsequently complicated with involuntary evacuations after the administration of purgatives; extinction of all reflex actions at first.

In the course of two or three days, if the patient should survive, other general symptoms become well-marked, owing to the establishment of a local meningitis, together with some amount of traumatic myelitis. Amongst these we have general fever, with an increase of the 'girdle sensation,' and of pains in the limbs; twitchings in the limbs or in particular muscles; and also a general increase in reflex actions for a time.

The above-mentioned complicating pathological processes may gradually subside, but there will still be danger to life from the supervention of severe cystitis or of extensive bed-sores, together with one or other of the various sequelæ to which such conditions are apt to give rise.

The additional symptoms and variations met with, according as the crushing lesion occurs in different regions of the cord, are as follows. (They increase in number the higher the lesion occurs in the spinal cord. *See* Introduction, § 11.)

When it is situated in the *lumbar swelling* we have, in addition to the limitation of the paralysis to the lower extremities, and a more or less complete extinction of related reflex actions, the appearance of rapid atrophy in the paralysed muscles, together with the manifestation of the electrical 'reaction of degeneration.' The bladder and rectum are apt to be completely paralysed.

With the lesion in some part of the *dorsal region* we have sensory and motor paralysis of the trunk up to a certain level, with an absence of the rapid atrophy and before-mentioned electrical reaction in the muscles of the lower extremities, though some atrophy and the presence of this reaction may occur in one or more of the trunk muscles. In addition (and notably with the lesion in higher parts of the dorsal region) there may be some weakness of voice, some interference with the movements of respiration (especially with those of expiration), as well as marked and continuous priapism. The superficial and deep reflexes may be depressed or exalted, according to the condition of the grey matter below the seat of lesion.

With the lesion in the *lower cervical region* the upper extremities are partly paralysed, both as regards sensation and motion; the movements of respiration are much more gravely interfered with (expiration especially), whilst inspiration is of a purely abdominal type; the voice is notably weak and feeble. Continued erection of the penis is more frequently met with; and in some cases a remarkable hyperpyrexia supervenes, in which the temperature before death may rise to 108°–112° Fahr. Should death not occur in this way, it is very apt to supervene in the course of a few days, by gradual failure of respiration, which grows worse than it was in the early days of the affection, owing to the secondary myelitis which becomes established, implicating the cord and nerve-roots at a level higher than the original wound. The pulse is often much interfered with, but variously; it may be slower or much more frequent than natural; it may be small, irregular, and frequent; or full, regular, and infrequent in its beats. There may also be signs of paralysis of the sympathetic vaso-motor nerves supplying the neck and head, perhaps to a more marked extent on one side than on the other.

Where the lesion occurs in the *upper cervical* region of the cord complete paralysis of the trunk and of all four extremities may be recognised, if death does not occur too suddenly to allow even this to be observed. The sudden death, so apt to occur in these cases, is due to the fact that in them the diaphragm is paralysed, as well as the other respiratory muscles. Where the lesion does not involve the whole of the roots of the phrenic nerve, and where the shock has not been too abrupt and violent, life (with extremely difficult respiration and almost complete loss of voice) may be prolonged for a few hours.

An admirable series of cases illustrating these crushing injuries to the spinal cord is to be found in Ollivier's work (3me ed., t. i., p. 253 *et seq.*).

Diagnosis.—If the existence of fracture and dislocation of vertebræ can be substantiated, the probabilities are always in favour of the presence of a crushing lesion in the spinal cord. Otherwise after a very severe fall or blow upon the back, doubts may be at first entertained as to whether we have to do with the effects of concussion alone, or with this *plus* some amount of crushing of the cord or of hæmorrhage upon or beneath its membranes. The subsequent course of the symptoms may, however, in a day or two, enable us to resolve these doubts.

Prognosis.—The prognosis in lesions of this kind, as already indicated, is much graver than in the case of mere punctured wounds of the cord—these being oftener slight and partial in their transverse extent. Death may occur immediately; or at any time during the first week; in the main from failure of respiration and of the heart's action. It is only in exceptional cases, and where the lesion is in the dorsal or lumbar region, that life is prolonged for several weeks or months. Such lesions are probably too severe to admit of anything like thorough repair with proper nerve-tissue. Paralysis, therefore, of a more or less complete kind, is lasting. But even where life is prolonged for a few months, it is ultimately lost, owing to the establishment of sloughing bed-sores and ulcerative cystitis, followed perhaps by blood-poisoning, extensive meningitis, or other complications.

Treatment.—In many of these cases treatment is useless and death inevitable. In those which are of a less urgent nature, the possibility (faint though it may be) of bringing about some slight relief by trepanning, with the view of elevating any depressed fragments of the vertebral arches, should not be lost sight of. Except, indeed, for the fact that parts surrounding the cord are damaged, so that rest in one position is often indicated, the treatment of these cases after the first urgent symptoms have abated does not differ from that which is appropriate in other well-marked cases of paraplegia, where there is a tendency to the formation of sloughing bed-sores, and to the establishment of cystitis. *See* (9) **Spinal Cord, Softening of.**

4. Spinal Cord, Slow Compression of.

SYNON.: Chronic Traumatic Lesion of the Spinal Cord; Fr. *Compression lente de la Moelle Épinière*; (in part) *Paraplégie douloureuse des cancéreux*; Ger. *Langsame Compression des Rückenmarks.*

ÆTIOLOGY AND ANATOMICAL CHARACTERS.—The most frequent causes of the set of symptoms grouped under this head are to be found in diseases of the vertebræ, and especially simple inflammatory or scrofulous caries of the bodies of the vertebræ (leading to *angular curvature*, or 'Pott's Disease'). Still, other kinds of disease of the vertebræ may also be productive of slow compression of the spinal cord, and of that form of localised softening of the organ which is so commonly met with in this class of cases (the so-called 'compression myelitis'). Among these may be mentioned *cancer* of the vertebræ, either primary or secondary; also *exostoses* projecting into the spinal canal, or more irregular thickening of the bones in this situation. In cases of vertebral caries, a tough, yellow, scrofulous growth often infiltrates the posterior vertebral ligament, and thence spreads to the dura mater, here producing thickening and irregular fungosities which may press injuriously upon the spinal cord—more especially upon its antero-lateral columns. In these cases the organ may be distinctly softened opposite, and perhaps for a very short distance above and below, the site of compression. At first such softening is principally apparent in the columns above mentioned; but in cases of longer duration it may involve the whole thickness of the cord, and be followed by the usual ascending and descending 'secondary degenerations (§ 6, [13]).' The softened matter itself is an almost bloodless fluid or semi-fluid pulp, either of a whitish or dull yellowish-white colour, and there is generally no undue vascularity of the immediately adjacent portions of the cord.

In certain cases of slow compression no such softening of the cord is produced; there is rather a slow atrophy or disappearance of the nerve-substance as the pressure increases, together with a sclerosis of what remains. This may occur, for instance, where the cord is pressed upon by some exostosis, or by irregular growth and thickening of the inner surface of the spinal canal, such as occurs occasionally in one or other of the cervical vertebræ.

It has long been known that no constant relation exists between the amount of angular curvature and of paralysis in different cases of vertebral caries. Paralysis may be absent where curvature is most marked. On the other hand, with no curvature and with only a slightly marked projection of one or two vertebral spines, paralysis may yet exist to a well-marked degree. This is due to the fact, that in such cases the cord is only very rarely compressed by the bones, whilst it is frequently more or less pressed upon by the yellowish growths which protrude from the inflamed or carious vertebræ, or which produce thickening and infiltration of the dura mater at the seat of disease, and changes of this sort may be well-marked even where no angular curvature is appreciable.

Again, where angular curvature is present, the posterior surface of the bodies of the vertebræ, corresponding with the angle, is often bent, rough, and eroded, and the cord over it is apt to become softened, though there may be no compressing growths or thickenings of the membranes.

Thus it happens that the paralysis in these cases may be variously produced. And seeing that it is often due to pressure by inflammatory products rather than to pressure or irritation from the diseased bones themselves, we may the better understand the fact that occasionally a great improvement may set in and become established in regard to the paralysis, although the angular curvature of the spine, and therefore the distortion of the spinal canal, remains as obvious as it ever has been.

In addition to slow compression of the cord resulting from diseases of the bones of the spine, a somewhat similar condition may be induced by the various kinds of tumours of the meninges, or by hydatid growths implicating these parts (*see* MENINGES, SPINAL, Diseases of; Tumours). Confined within the narrow limits of the spinal canal, such tumours, even though of small size, may soon come to exercise a very injurious amount of pressure upon the spinal cord.

SYMPTOMS, COURSE, AND TERMINATIONS.—We shall point out some of the distinguishing characteristics of the paralysis which is often associated with vertebral caries, and afterwards refer to the peculiarities met with where meningeal tumours exist.

In *vertebral caries* with commencing pressure upon the spinal cord, the symptoms will be different, according to the part of the column implicated. The affection is frequently ushered in by an abiding pain in the spine and parts adjacent, often supposed to be 'rheumatic' in nature. Such pains commonly disappear when the patient is in the recumbent position, except during the acts of sneezing or coughing. They are commonly induced by particular kinds of movements, which are more or less difficult on this account. There is also some weakness in the lower part of the body and in the lower extremities. The mere 'weakness' may continue for weeks or even months before there is anything like actual paralysis; though at last this may show itself somewhat abruptly. The patient now becomes unable to stand, though he can still move his legs slightly whilst lying in bed. At this stage sensation is little, if at all, interfered with; but there may already be some increase in the readiness with which the knee-reflex manifests itself, and ankle-clonus may also be easily attainable. Next there may be startings of the limbs, and commencing rigidity of the muscles when passive movements are attempted; followed after a time by a more marked rigidity (which, when present in the calf muscles, will prevent the manifestation of ankle-clonus and of the knee-reflex). Later, if pressure increases, and especially where a complete transverse softening becomes established, sensibility in its various modes becomes implicated. At this period the exaltation of the reflexes often diminishes. For a time the degree of impairment of sensibility and the freedom with which knee-reflex and ankle-clonus may be obtained fluctuates. Meanwhile, painful spasmodic contractions of the legs (with flexion of hip and knee joints) become habitual, persisting through day and night with only rare intermissions.

Although there is some general wasting of the muscles, together with a flabby condition when they are relaxed, they still react almost normally to the faradic current. The skin is often dry and scurfy. The temperature of the limbs is generally slightly lower than normal.

At the first onset there may be for a few days a difficulty in voiding the urine, but this power soon returns and often continues long after the limbs have become powerless. The bowels are perhaps somewhat constipated, but there is no incontinence of fæces, unless diarrhœa supervenes from any cause, or except when the reflex activity of the bowel is greatly exalted under the influence of aperient medicines.

The above condition of things may last long without much variation. But after a time there will be a gradual mitigation of the symptoms, or the reverse. In the latter case loss of voluntary control over the bladder and rectum appears; and (especially when sensibility of the body and limbs becomes impaired) the tendency to the formation of sloughs and gangrenous bed-sores becomes increased. With these conditions other complications, such as cystitis, blood-poisoning, &c., may appear and greatly aggravate the condition of the patient, helping to bring about a more speedy termination.

In the case of *tumours arising from the meninges*, the onset of the affection may also be very gradual at first, though, perhaps, rather suddenly intensified at last. Here, however, the pressure very often comes upon the cord from behind, or it may at the same time implicate one or both lateral regions of the cord. At first, therefore, we commonly get variously-impaired sensibility and neuralgic pains, or pains mixed with startings and cramp-like contractions in certain muscles, occurring in those particular regions of the body or limbs which are in relation with the nerve-roots slightly pressed upon and irritated by the new growth. Great differences exist in different cases in regard to the degree and persistence of the initial pains. Subsequently these same nerves and the cord itself may become more severely pressed upon, and then loss of sensibility over the field of distribution of the nerve-roots is met with, together with loss or impairment of sensibility in all or some parts of the body whose nerve-supply is from the cord below the compressed region. With this a minor amount of motor paralysis also occurs, which, however, subsequently becomes more marked, and ultimately complete. When this takes place we have all the signs and symptoms met with in a case of total transverse softening of the spinal cord at the level implicated (*see* **Spinal Cord, Softening of**). This change is, in fact, commonly established by the persistence and increase of pressure due to the new growth.

These are the broad outlines of the symptoms met with in such cases, which, of course, are subject to innumerable variations in individual cases, in accordance with differences in the region of the cord affected, together with the rate of growth, mode of incidence, and size of the tumour.

In *cancer of the vertebræ*, also, we have much the same grouping of symptoms; the preliminary pains being here especially severe (*see* Charcot's *Leçons*, t. II., ed. 3, p. 86).

Diagnosis.—In the paralysis associated with *vertebral caries* the diagnosis depends upon the recognition of this causal condition, which, in the early stages, is often a matter of some difficulty. Much will depend upon the existence of pain in particular regions of the spine, or radiating therefrom; of pain which is relieved by the recumbent position, and greatly aggravated by coughing, sneezing, or stooping movements of different kinds (see H. Marsh in *Brit. Med. Journ.*, vol. i. 1881, p. 913). And yet in the absence of signs of caries, or of a scrofulous habit of body or history, or of an exciting cause for caries, in cases where there may be little or no prominence of vertebral spines, and even no pain from firm pressure or the application of a hot sponge, we may be helped in our diagnosis of the existence of caries by the distinctive characters of the paralysis itself, namely, its implication of motility principally, the exaggeration of the tendon-reflexes, the more or less marked rigidity of the legs, and the continuance of control over the bladder and rectum.

In cases of the latter type, or where there is only a slight prominence of two to four vertebral spines, it may be difficult, however, to establish a diagnosis between caries and *cancer* of the bodies of the vertebræ. It is true that a rounded prominence of several vertebral spines is met with in cancer more frequently than the angular projection commonly associated with caries; yet this single character will not always aid us; we must look also to the presence or absence of severe pains, to the clinical grouping of symptoms generally, and to the history of the patient.

The diagnosis of the other causes of slow compression of the cord to which reference has been made (exostoses or meningeal tumours), is usually a matter of extreme difficulty. We must be guided by probabilities based upon other associated states or conditions that may be recognisable in our patient, and also by the mode of onset of the affection.

Prognosis.—We can only speak in general terms concerning the prognosis of the rather miscellaneous conditions which form the subject of this article. Cancer of the vertebræ or of the dura mater, compressing the cord, is the most serious of them all. The progress of such cases is usually both rapid and extremely painful, so that the end comes inevitably before many months have expired.

In vertebral caries associated with compression of the cord, the prognosis is extremely uncertain. Under suitable treatment many of these cases practically recover more or less fully. The process of caries is arrested, the spoiled vertebræ are strengthened and bridged over by growth of new bony tissue (though, of course, the angular curvature of the spine remains), whilst recovery from the paralysis may be more or less complete. This latter kind of recovery takes place occasionally even after paralysis, with almost persistent contractions of the lower extremities, has existed for from twelve to eighteen months or even longer.

In other cases, of exostosis, hydatids, or meningeal tumours, compressing the spinal cord, the prognosis will depend upon the part of the cord involved, upon the rate of increase of the symptoms of compression, and upon the extent to which a secondary myelitis or softening is established. The disease in these cases, in spite of stationary periods, or even those of slight improvement, is more or less continuously progressive, though it may last for many months, or, occasionally, even for a year or two. Some of the complications or accidents incident to the paraplegic condition ultimately bring the patient's life to a close.

Treatment.—Rest in the recumbent or in the prone position is, of course, absolutely essential in cases of vertebral caries or of cancer of the vertebræ. In addition to this in many cases of vertebral caries, some form of Sayre's jacket may be needed, in order more effectually to secure absolute immobility of the affected portion of the spinal column. This, however, would have to be reserved for the more chronic cases or stages—for those in which local treatment was no longer considered to be necessary or desirable.

In cases of paraplegia associated with vertebral caries, the patient's general health requires the utmost attention during the period in which we are endeavouring to check the disease by the influence of rest. Good nutritious food and cod-liver oil will be required, combined with steel wine or the syrupus ferri phosphatis. In some cases iodide of potassium (together with iodide of iron or small doses of bichloride of mercury) seems to do good.

In regard to local measures, counter-irritation of some kind is generally had recourse to, either in the form of flying blisters near to and on each side of the portion of the spinal column which is affected, or else by the renewed application of moxas or the actual cautery to these regions. The latter more severe measures are still recommended by some authorities, though the experience of others, amongst whom was the late Sir Benjamin Brodie, is against their employment, as being of little or no use, and therefore adding needlessly to the sufferings of the patient. The writer is strongly inclined to think that all the good which moxas or the actual cautery are intended to bring about, may be as effectually achieved by the aid of flying blisters applied to the spine from time to time.

In the case of an hydatid tumour pressing upon the spinal cord, and also situated in part outside the vertebral spines, tapping might bring much relief. In the majority of the other conditions comprised within the limits of this article, little can be done to cure the condition which is the cause of the spinal disease, so that it would only remain for us to treat the paraplegia and its attendant conditions upon the general principles applicable to them, which are fully considered under (9) **Spinal Cord, Softening of.**

5. **Spinal Cord, Anæmia of.**—Anæmia is not to be considered as the basis of any ordinary or common disease of the cord; or, in other words, there is no definite group of symptoms the existence of which is likely to be recognised more than once in a lifetime in any actual present patient, which would justify the diagnosis 'anæmia of the cord.'

First, the writer would repudiate the notion that *anæmia* or *chlorosis*, as a mere blood-disease, is capable of producing, on the side of the spinal cord, any set of symptoms which can be marked off from those characterising the condition as a whole. In these diseases the functions of all the organs are impaired by reason of the impoverishment of the blood. The brain and spinal cord, on account of the delicacy of their functions, will, of course, suffer to a notable degree; and when general debility is extreme, a paresis of the lower extremities may be notable beyond that of other parts of the body, because the legs in standing or in walking have to support so great a weight. Where anything more than such paresis exists—that is, where there is actual paraplegia, such symptoms are not to be explained by a mere anæmia of the cord. Other causes are to be looked for. Jaccoud's whole group of *paraplégies dyscrasiques* will probably disappear before a more thorough knowledge of the actual mode of causation of these and many other obscure forms of paraplegia.

Secondly, *embolism* and *thrombosis* of spinal arteries will produce temporarily, and in quite limited regions of the cord, a condition of anæmia. Such local anæmia would probably soon be rectified by the establishment of a collateral circulation; and in the event of this not taking place, local 'softening' of the organ would ensue. A paralysis owning such an origin would not, therefore, be spoken of as resulting from 'anæmia of the cord.'

Thirdly, *pressure* upon parts of the cord will occasion anæmia and ultimately softening, but the symptoms in a case of this sort will depend mainly upon the pressure itself interfering with the functions of the nerve-tissue thus affected.

Beyond the conditions above referred to, there is the possibility that definite groups of paralytic symptoms may be occasioned by anæmia induced by mere functional *spasm of the arteries* in certain regions of the cord—spasm, that is, which persists day after day. This is supposed by Brown-Séquard to be the condition existing in the cases of so-called 'reflex paralysis' (*see* 27, **Reflex Paraplegia**). If such a condition of persisting arterial spasm be possible, and an actual cause of paralytic symptoms, we may well ask whether it too ought not after a time to lead to actual softening of the cord.

There will still remain a very few exceptional cases, in which a condition of real anæmia of the spinal cord is brought about in man, just as it has been brought about in some of the lower animals whose abdominal aorta has been tied or compressed. When the blood-supply is thus suddenly cut off from the lumbar region of the cord in animals, their hinder limbs become paralysed almost immediately, and continue paralysed as long as the blood-supply of the cord happens to be arrested. But if, after a mere brief interval, the blood is again allowed to take its natural course, the temporary paralysis disappears completely in a very short time. A condition of this kind seems to have occurred in a patient, formerly under the care of Sir W. Gull, who suddenly became paraplegic, apparently owing to an abrupt arrest of the blood-current through the abdominal aorta, as was indicated by the cessation of the femoral and other pulses in the lower extremities (see *Guy's Hospital Reports*, 1857, p. 311). The man continued paraplegic for months, and only recovered when the collateral circulation became, after a time, pretty fully established. In a very few other cases referred to by Erb, in which paraplegic symptoms were associated with an obstruction of some kind in the abdominal aorta he thinks that these symptoms, supervening as they did rather less suddenly, may have been in great part due to the deficient blood-supply to the muscles and nerves of the lower extremities, rather than to anæmia of the cord—to a peripheral, that is, rather than to a centric anæmia.

6. Spinal Cord and its Membranes, Hyperæmia of.—This condition again is more frequently talked of than it deserves, looking to the small amount of positive knowledge we possess upon the subject.

Hyperæmia of the cord must be either passive or active, that is, it must be a result of *mechanical congestion* or of *arterial determination*.

Mechanical Congestion.—In obstructive heart-disease extreme congestion of the spinal cord may exist for months without producing any distinct symptoms of disease of the spinal cord. A constantly congested spinal cord would doubtless perform its functions in a less vigorous manner than natural, but such effects would be slowly evolved and comparatively obscure. After a long time the effects might become more marked, owing to the overgrowth of connective tissue within the organ. We may indeed have the starting-point of a general sclerosis of the spinal cord under such conditions; but this secondary change, when only slightly marked, may, even in the spinal cord, produce no definite symptoms.

General mechanical congestion of the cord is probably more frequent and more easily brought about than a congestion involving parts of the organ. From various causes there may be undue pressure upon certain veins, which directly or indirectly convey blood away from special regions of the cord and its membranes. Such an event cannot, however, be regarded as a likely cause of a congestion productive of morbid spinal symptoms, if we consider the absence of distinct symptoms resulting from extreme general congestion of the cord; and also the fact of the very free anastomosis of all the spinal veins.

Active hyperæmia may in its origin be of two kinds—'reflex' or 'inflammatory.'

'Reflex' hyperæmia of the cord and its membranes is possibly a phenomenon of great frequency, manifesting itself locally in certain regions —the seat of the process varying according to the conditions under which it arises. It might be immediately caused by vaso-motor paralysis, implicating certain vessels of the cord and their branches; and would thus involve an increased afflux of blood to the tissues contained in the corresponding vascular territories. We know that such an increased afflux of blood may exist in other tissues for some time without inducing tissue-changes of an appreciable kind (Brown-Séquard). It is fair to suppose, moreover, that any symptoms induced by such increased afflux of blood to certain regions of the cord would be indicative of exalted rather than of depressed function (for example, hyperæsthesia, actual pains and spasms, or increased reflex excitability, rather than their opposites).

In weak and irritable states of the nervous system it is quite possible that such vaso-motor paralysis, and also vaso-motor spasms inducing localised anæmias, may manifest themselves in spinal vessels, as they do in cutaneous vessels by familiar flushes or pallors. If occurring in the skin, however, these would be temporary phenomena, and not capable of producing the symptoms of an abiding disease. How frequent such reflex local hyperæmias (whether brief or prolonged) may be in the spinal cord, and in what precise manner they are excited, we do not know. Suppression of the menses or of hæmorrhoidal fluxes, the presence of worms in the intestine, the prolonged incidence of cold and wet, or severe concussions of the spine, any or all *may* operate in this particular manner—but for proof that they do, as matter of fact, we may look for evidence in vain.

The subject of 'inflammatory hyperæmia' will be briefly considered under the next heading. In this case, in addition to changes in the vascular system, the effects of the inflammatory process as a whole have to be taken into account. Even in the first stage of inflammation something prior to and beyond the mere 'active' congestion has to be thought of.

From what is said above, it may be seen how shadowy is our present knowledge concerning the existence of any definite sets of symptoms which can be ascribed to non-inflammatory hyperæmia of the cord and its membranes, either general or local.[1]

7. Spinal Cord, Inflammation of.—SYNON.: Myelitis; *Myelitis Acuta*; Softening of the Spinal Cord (in part); Fr. *Myélite*; *Myélite aiguë*; *Inflammation de la Moelle Epinière*; *Ramollissement de la Moelle Épinière* (in part); Ger. *Myelitis; Rückenmarksentzündung*; *Erweichung des Rückenmarks* (in part).

NATURE, ÆTIOLOGY, AND PATHOLOGY.—To speak definitely on this subject, in the present state of knowledge, is extremely difficult. This is due to several causes. In the first place, it is owing to the fact that so much uncertainty exists in the minds of many eminent pathologists and physicians as to what ought rightfully to be included under this term; and, secondly, because by a very large number of writers the term is understood and used in the vaguest manner, but with a manifest tendency to comprise under it the largest possible number of affections of the spinal cord. Critical discrimination seems to have been, and still to be, in abeyance with many who describe or report cases of disease of the spinal cord. They set down as instances of 'myelitis' not only all cases in which the substance of the spinal cord is softened, but still more all those in which it is indurated—and, no less impartially, those in which it is merely degenerated.

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[1] The view in regard to congestion as a cause of definite morbid symptoms on the side of the brain and of the spinal cord has been entertained for the last sixteen years at least by the present writer, and the above article (6) has been *in manuscript* for nearly three years. It seems necessary for him to make this statement to prevent further misunderstanding arising from the fact that his name appears as one of the authors of a paper on 'Congestion of the Brain,' in Dr. Reynolds's *System of Medicine*, in which a much more important *rôle* is attached to Congestion as a producer of definite morbid symptoms. The present writer was, however, only the author of the sections on 'Pathology' and 'Morbid Anatomy' in the above-mentioned article, and was not, previous to its publication, aware of the views entertained by the accomplished editor of the work in question in regard to the supposed great clinical significance of Congestion when it exists in the brain.

(1) The notion that common 'softenings' of the spinal cord are of inflammatory origin has persisted with little alteration, although for nearly twenty years pathologists have been interpreting altogether differently the mode of production of apparently similar 'softenings' of the cerebrum and cerebellum. Can it be that 'softening' as it occurs in the majority of cases in these latter organs is of non-inflammatory origin; while in the majority of apparently similar cases occurring in the spinal cord, the process is really inflammatory in its nature?

(2) Then, again, without adequate cause, the very localised changes occurring in and around the great ganglion-cells of the anterior cornua, in 'acute' and 'chronic spinal paralysis,' and in 'progressive muscular atrophy,' have been set down as inflammatory in their nature, and new names have been given to these affections, tending to ratify this view as to their origin. Thus they are spoken of by some as cases of *anterior polio-myelitis*, or more briefly, and, so far, better, as cases of *cornual myelitis*. But localisation of an inflammatory process to great ganglion-cells and their immediate surroundings, at present constitutes a rather unintelligible process to many pathologists. And mysterious as these particular changes are, from the point of view of their ætiology, on any hypothesis that has yet been started, it is at least simpler, and more harmonious with the nature of the observed conditions themselves, to regard them as of a degenerative type. If the slower and more isolated changes characteristic of 'progressive muscular atrophy,' are to be placed in this category (and in regard to them there is absolutely no evidence either clinical or pathological that can be adduced in favour of an inflammatory origin), then also it becomes easy to believe that under some at present imperfectly defined conditions, a change of the same kind may set in more rapidly in these the most specialised of all the anatomical elements met with in the spinal cord, so as to produce the more acute affections above referred to. The slight secondary overgrowth of neuroglia often occurring around the degenerated ganglion-cells, does not in the least militate against this view as to the pathology of the process; a similar secondary change occurs also in the process next to be referred to, and will be found to be easily explicable without the necessity of having recourse to the ever-ready and fashionable hypothesis of inflammation.

(3) 'Secondary degenerations' of the spinal cord have indeed, in spite of their name, and of what is known as to their origin, been erroneously regarded of late by some writers as inflammatory changes (Ziemssen's *Cyclopædia*, vol. xiii. p. 769). When nerve-fibres are cut across, those portions which are severed from their connection with certain ganglion-cells are no longer able to preserve their nutritive integrity. Simultaneously throughout their whole length fatty degeneration affects their white substance. Myeline breaks up, and becomes disintegrated as it does in non-inflammatory softenings in the brain; and very speedily granulation-corpuscles begin to form abundantly throughout the changing area. But though fatty degeneration thus occurs simultaneously in all the cut fibres of the band, the vascular supply of this tract of tissue has not been altered. Since the blood in the diseased area is not utilised by the nerve-tissues proper, except to a very small extent, a large excess of nutriment is placed at the disposal of the neuroglia, and this undergoes a well-marked hyperplasia. Thus a band of tissue-change is produced in which some of the characteristics of softening are blended with those pertaining to a patch of sclerosis. In brief, we have effects resulting from a primary fatty degeneration of the nerve-fibres, and a secondary hyperplasia of the neuroglia; and from first to last there is not the least reason for believing in the existence of an inflammatory process.

(4) If we turn now to 'sclerosis' of the cord of primary origin, we again meet with processes which are commonly regarded and described as forms of '*chronic myelitis*.' This nomenclature is objectionable as applied to the processes in the spinal cord, just as it is in its application to like processes occurring in other organs, as the liver, the lungs, or the kidneys. Fibroid overgrowth, which forms the basis of so many examples of 'cirrhosis' or 'sclerosis' in different organs and tissues of the body, is a process pathologically intermediate between inflammation, on the one hand, and degeneration on the other. Thus, what were formerly named 'interstitial inflammations,' are now the 'non-inflammatory hyperplasias' of some pathologists, and the 'fibroid degenerations' of others. It would seem that the view as to the inflammatory nature of such processes is erroneous, if we look either to what is known concerning their modes of initiation, or to the actual nature of the changes themselves (which agree in every particular with those of infiltrating new growths); it would seem, moreover, not less erroneous if we look to the clinical history of the affections themselves in which these scleroses occur. It conveys, therefore, an altogether erroneous implication to speak of such mere fibroid overgrowths as so many instances of 'chronic myelitis.'

Thus, it will be seen that the writer attributes to inflammation a far more restricted *rôle* in the production of morbid conditions of the spinal cord than is customary. The various forms of so-called 'chronic myelitis' he would exclude from that category. He would do the same for the set of changes known as 'secondary degenerations'; and also for those which are characterised by more or less acute atrophic processes implicating the great ganglion-cells of the anterior cornua.

Of the processes above referred to in order, there remains, therefore, only the class of 'softenings' of the spinal cord. That many of these are of a simply degenerative type (due to disturbances of blood-supply), and that, in the great majority of cases, these are the instances in which 'softening' appears to occur as a primary process, the writer feels assured. On the other hand, it seems clear that in many cases changes, truly inflammatory in their origin and progress, may terminate in the production of states of 'softening' of the cord, which are indistinguishable by naked eye from the softenings of degenerative type, and which can as yet also be very imperfectly discriminated by the microscope.

These latter *inflammatory softenings* very rarely occur as primary pathological states; they are met with rather as *secondary* changes.

Thus we may get inflammatory softenings spreading (*a*) around and from wounds or other traumatic lesions of the spinal cord; or (*b*) starting from some blood-clot or tumour situated in or pressing upon the substance of the cord. It is not by any means clear, however, that all the forms of softening which arise in the latter manner should be regarded as of an inflammatory nature; and much room for doubt also exists as to the real pathogenesis of many cases of so-called 'compression myelitis' (p. 1471).

Another cause of true inflammatory changes in the spinal cord (*myelitis peripherica*) is to be found (*c*) in spinal leptomeningitis (*see* MENINGES, SPINAL, Diseases of; *Leptomeningitis*).

Suppuration is clearly a process of inflammatory origin, and might therefore be expected to occur occasionally in the midst of 'softenings' which result from inflammation. In the light of what has been said above, the following statement by Erb is of considerable interest. 'Actual suppuration occurs very rarely,' he says, 'in acute myelitis. When abscess of the cord does form, it is generally secondary to a severe traumatic lesion or to suppurative meningitis. In spontaneous myelitis, on the other hand, suppuration is exceedingly rare, and has only been observed in a very few cases.' Thus suppuration is met with just in those forms of softening ('myelitis') which are undoubtedly of inflammatory origin; and, on the other hand, it is not met with in the ordinary cases of primary or spontaneous softening, here assumed to be of non-inflammatory nature.

In instances other than those above mentioned, suppuration rarely occurs in the spinal cord. Small disseminated abscesses may, however, be found in pyæmic cases, as they are in the brain and in other organs.

One other condition requires to be referred to here, and that is the so-called *acute central myelitis*, described originally by Albers, and afterwards studied by Hayem (see *Archives de Physiologie*, 1874, p. 603). These are cases in which apparently spontaneous 'softening' is met with, implicating in the main the central grey matter, and that often through a considerable extent of the cord. At times, however, the softening extends beyond the grey matter, so as to involve more or less of the surrounding white substance, when it has been termed *myelitis diffusa*. Considerable obscurity still prevails in regard to the ætiology of these affections. In some cases, such a change has been met with as part of an infective process, in which minute vessels in the grey matter of the cord have been found obstructed with micrococci. Occasionally, moreover, in certain at present imperfectly known conditions, minute thromboses may, as Dr. J. Hamilton has shown, occur throughout the spinal cord, and more especially in its grey matter, and thus lead on in the main to the production of a central softening (see *British and Foreign Review*, April 1876, p. 447). In this latter case, the patient was suffering from pyelitis, and it is supposed that there may have been some blood-poisoning. Still it was not ascertained that the multitudes of minute thrombi were either associated with or caused by micrococci in the vessels. It appears probable, however, that if from any cause minute widespread obstructions of small vessels occur in the spinal cord, softening would take place principally in the grey matter, owing to its greater vascularity. We should thus get that particular distribution of this change which is met with principally in cases of so-called 'acute central' or 'diffuse myelitis.'

A careful study of the two cases of this disease recorded by Hayem has by no means sufficed to convince the writer that they ought to be regarded as having had an inflammatory origin. Neither the symptoms nor the mode of onset of the disease lend any distinct support to this view; nor do the results of the elaborate examination, to which the spinal cords were submitted by this accomplished observer, at all satisfy the writer that the pathological conditions met with were inflammatory either at their commencement or in their subsequent progress. *See* **Spinal Cord, Softening of.**

SYMPTOMS, COURSE, AND TERMINATIONS.—From what has been said it will be seen that true inflammatory conditions of the cord are only with extreme rarity of primary origin, and that they occur, for the most part, as secondary complications in association (*a*) with wounds or injuries of the cord; (*b*) with foreign bodies in its substance; or (*c*) with spinal leptomeningitis, either simple or tubercular.

The supervention of a real myelitis in the course of either of these diseases of the spinal cord would perhaps be associated with an exaggeration of the already existing febrile condition; with an increase in the amount of paralysis, and in the degree of interference with sensibility; possibly also with more pain, restlessness, and spasms.

Myelitis may become associated with more or less of distinct suppuration, and almost certainly goes on to the formation of well-marked foci of softening. These may remain limited in site, but occasionally they have a distinct tendency to spread above and below the original seat of injury or disease. Such dépôts would probably undergo subsequent changes, very similar in kind to those prone to occur in foci of non-inflammatory softening.

DIAGNOSIS.—All that can be said under this head has been referred to above in connection with the symptoms characterising the supervention of myelitis.

PROGNOSIS.—The gravity of any wound or lesion of the spinal cord, or attaching to the presence in it of blood-clot or tumour, is, of course, greatly increased by the supervention of inflammatory changes about their immediate confines. Again, the fact that an inflammation of the spinal meninges is complicated with similar changes in the substance of the spinal cord itself, cannot fail greatly to aggravate a case of simple spinal leptomeningitis. For, even should recovery from the acute affection take place, the actual degree of abiding paralysis, ataxy, or impairment of sensibility would much depend upon the degree in which the substance of the spinal cord had been itself implicated.

TREATMENT.—The amount of power that we possess in controlling an inflammatory condition of the spinal cord is probably not great. Little if anything is at present to be done with mere drugs. The patient should, if possible, lie in the prone position, or, failing this, on his side, with absolute rest. The advisability of abstracting blood locally by cupping or leeches should be entertained, and must depend much upon the amount of local pain or tenderness. In some cases it seems to be of service. Or we may trust rather to the application of cold externally, in the form of ice-bags, along the spine. At the same time the patient should be kept upon spoon diet, with a sparing amount of stimulants; and the bowels should be relieved by the aid of copious warm enemata, which may also act usefully as derivatives. The limitations circumscribing our efforts at direct therapeutics must be compensated as far as possible by attention to the state of the general health, and by the most careful and assiduous nursing, in the hope that the morbid process may after a time abate, and that, in the absence of collateral complications, the patient may make a more or less complete recovery.

8. Spinal Cord, Hæmorrhage into.—SYNON.: *Hæmatomyelia; Hæmatorrhagia Medullæ spinalis*; Spinal Apoplexy; Fr. *Hématomyélie; Apoplexie de la Moelle Épinière; Des hémorrhagies intrarachidiennes*; Ger. *Rückenmarksapoplexie; Spinalapoplexie.*

ÆTIOLOGY AND ANATOMICAL CHARACTERS.—Hæmorrhage into this organ is a comparatively rare event. It occurs under three different conditions, namely—(1) as a result of concussion or violence; (2) as a secondary event, consequent upon a definite pre-existing morbid condition; and (3) as a primary event, or local pathological accident.

We are here specially concerned with hæmorrhages into the spinal cord belonging to the third of these categories, and may in a few words dismiss the other two.

(1) Traumatic hæmorrhages, small in extent, may, as already stated, occur in almost any region or part of the cord as a result of some severe concussion (*see* **Spinal Cord, Concussion of**). Again it may occur in the grey matter, and even in the white substance to a smaller extent, close to and as an appanage of wounds of the cord. In each of these cases symptoms due to the hæmorrhage itself would probably be obscured by the general set of symptoms resulting from the concussion or injury.

(2) Secondary hæmorrhages are, however, more closely connected, from the point of view of symptomatology, with those forming the special subject of this article. During the growth of certain soft tumours in the cord, a rupture of some of their vessels may take place, so as to cause hæmorrhage either into the growth itself, or else into contiguous regions of the cord. Such an event would be signalised clinically by the sudden exacerbation of the symptoms previously existing. But a combination of greater importance, though one of considerable obscurity, consists in the co-existence of a 'central myelitis' of the grey matter of the cord through more or less of its extent, together with a central hæmorrhage of nearly similar extent. The existence of any such 'central myelitis' as an independent disease of the cord seems to the writer very doubtful. It is at least equally probable that the hæmorrhage has been primary, and that the 'myelitis' or softening is of secondary origin around the blood-clot. It need not be denied, of course, that in other cases hæmorrhage does occur occasionally into the midst of a focus of softened tissue in the spinal cord, just as it occurs occasionally under similar conditions in the midst of softened brain-tissue.

(3) Primary hæmorrhages differ as regards the amount, the site, and the distribution of the blood effused, in different cases. In connection with scorbutic states, and also independently of these, small hæmorrhages may occasionally occur into the substance of the cord, without producing any distinct symptoms. But, at other times, a comparatively large quantity of blood may be effused into the cord, and then it occurs almost invariably into the central regions of the grey matter, through which it may extend for a variable distance. When the quantity is smaller, the blood may be effused into the grey matter of one side only.

Though this kind of hæmorrhage is, in contradistinction to the others, spoken of as primary, yet it is almost invariably preceded by some pathological changes in the vessels of the cord. These constitute the predisposing conditions, and the actual rupture takes place, rarely, when the person is at rest, or, more frequently, under the influence of some distinct exciting cause—such as muscular exertion of one kind or another.

Primary hæmorrhage, though rare, is most prone to occur in persons between the ages of twenty and forty, and not with increasing frequency as age advances. This constitutes a further notable difference between hæmorrhages into the brain and those of the spinal cord.

SYMPTOMS.—These are necessarily subject to great variations, according as the hæmorrhage takes place into the cervical, the dorsal, or the lumbar region. The kind of variation thus induced may be gathered by reference to the Introduction, § 11.

Here it is of importance to set forth the peculiarities (both as regards mode of onset, and nature of the symptoms) which belong to hæmorrhage as compared with other pathological conditions of the cord. First, its tendency is to take place suddenly and without warning; and, secondly, for the blood to be effused into the grey matter for some distance, thus giving rise to a characteristic grouping of symptoms. There may, therefore, be a sudden onset of pain in the back (possibly severe); followed almost immediately by complete motor and sensory paralysis of the legs and trunk up to a certain level, together with complete paralysis of the bladder and rectum. At first there may be an abolition of all reflexes, and possibly a lowering of temperature in the legs; though after a day or two—should the injury be in the dorsal or lower cervical region of the cord—there may be increased heat of legs, owing to vaso-motor paralysis, and a return with some exaggeration of various reflexes. Rapid atrophy, with the appearance of the electrical 'reaction of degeneration,' occurs in all muscles that are in immediate functional relations with the portions of the cord damaged. Cystitis, together with sloughing bed-sores and all their consequences, tend to occur early, and that often in spite of all precautions that may be taken.

Where the hæmorrhage invades pretty fully, but is limited to, the grey matter of one half of the cord, we may have groups of symptoms that take the form of *hemiplegia spinalis* or *hemiparaplegia*. *See* (2) **Spinal Cord, Punctured or Gun-shot Wounds of.**

Diagnosis.—The absolutely sudden onset of the paralysis, which may be complete in the lower extremities in the course of a few minutes; (especially when associated with a sudden painful sensation in the back, or one which radiates into the limbs); as well as the almost complete and sudden loss of sensibility in the paralysed parts, form a group of symptoms which are typically distinctive of hæmorrhage into the grey matter of the cord.

The condition most likely to be confounded with it is a large *hæmorrhage outside the dura mater*, causing compression of the cord. Here the onset would also be sudden, but almost invariably associated with some mechanical injury or shock. The paralysis of motion too would generally be much more marked than the interference with sensibility. The subsequent progress of such a case would further tend to separate it from a case of intra-medullary hæmorrhage, since (even with a severe meningeal hæmorrhage in the cervical region) if the patient should survive the first effects of the lesion, the symptoms might be expected soon to grow less and less urgent, and recovery may be more or less complete. No such amelioration is, however, to be expected in the case of a well-marked hæmorrhage into the grey matter of the cord, in the cervical region or elsewhere.

On the side of the brain *embolism* is capable of initiating paralytic symptoms with as much suddenness as a hæmorrhage, but in the spinal cord, for reasons previously stated, this does not occur (see Introduction, § 6 (8)).

It does, however, happen occasionally that a process of softening—probably caused by *thrombosis*—has its occasioning conditions initiated suddenly. When this occurs paraplegia sets in almost as abruptly as if it were occasioned by hæmorrhage; but then it is usually an incomplete paraplegia, and, for a time at least, unaccompanied by loss of sensibility. In the course of a few days, in such a case, sensory paralysis may supervene, and the motor paralysis may become more complete. In the exceptional cases of paraplegia of sudden onset due to this cause, there is generally no initial pain in the back, though there may be pains and burning sensations in the limbs.

Prognosis.—Where the hæmorrhage is at all large, so as to extend through the grey matter for the distance of an inch or more, the prognosis is always grave. Very few of such cases recover. They are, in fact, liable to be aggravated by the establishment of a secondary process of softening in the grey matter, which may slowly extend both above and below the blood-clot as well as around it. Should this softening reach far into the cervical region, or should the hæmorrhage itself implicate this part of the cord, the patient may not survive more than a few days. But if the primary and secondary pathological changes are limited to the lumbar or to the dorsal region of the spinal cord, the fatal event is usually brought about more slowly, after an interval of weeks or perhaps even of months—and then commonly from the occurrence of sloughing bed-sores, together with cystitis and other accompaniments of a severe paraplegia.

In the case of small hæmorrhages limited to some fractional part of the transverse area of the cord, and of slight longitudinal extent, the prognosis is of course much more favourable, and there is no reason why partial recovery, at least, may not occur.

Treatment.—In the treatment of a case of spinal hæmorrhage, should the patient be seen immediately after its occurrence, absolute quietude, with rest in the recumbent or prone posture, should be ensured.

Bleeding, either local or general, is useless. Purgatives also are contra-indicated.

Should the pulse be full, and the heart's action excited, decided benefit may be derived from ten-minim doses of tincture of digitalis, in combination with 15 or 20 grains of bromide of potassium, given for the first three doses at intervals of three or four hours, and subsequently every six or eight hours for two or three days. These drugs will also favour sleep, and exercise a general calmative influence.

Position and rest are perhaps the means to be principally relied upon to prevent a recurrence or continuance of the hæmorrhage; such measures may be supplemented by warm applications to the feet and calves of the legs; though the patient should in other respects be kept perfectly cool. Ice to the spine may be applied, but is of doubtful utility. Spoon diet should be strictly enjoined for a few days at least.

The patient's urine will require to be drawn off by catheter, and extra precautions ought to be taken to ensure its antiseptic cleanliness. After a day or two, if the bowels have not been moved, a laxative should be administered, since, as in many other forms of paraplegia, there may, at first, be obstinate constipation rather than incontinence of fæces.

Subsequently, the case requires to be treated in all respects like any other very bad case of paraplegia—extra precautions being observed throughout, in order, as far as possible, to guard against the onset of bed-sores and cystitis. Fuller details concerning such treatment will be found under the next article, **Spinal Cord, Softening of**, since this is by far the most common cause of paraplegia.

9. Spinal Cord, Softening of.—Synon.: Non-inflammatory, white, or simple softening; *Myelomalacia*; *Mollities Medullæ spinalis*; Acute Myelitis (in part); Compression Myelitis (in part); Fr. *Ramollissement de la Moelle Épinière*; Ger. *Erweichung des Rückenmarks.*

Nature of Change.—The writer has already intimated (*see* Myelitis) his opinion that far too large a share is assigned to inflammation in the pathogenesis of diseases of the spinal cord. This mistake is particularly obvious in regard to acute inflammations. It has long been the fashion to speak of almost every focus of 'softening' that occurs in the spinal cord as being the result of an 'acute myelitis'; and we find even Erb (in Ziemssen's *Cyclopædia*, vol. xiii.) putting forward, as characteristics of an inflammatory softening, peculiarities which certainly ought not to be regarded in such a light—and this although he seems otherwise strongly inclined to hold a similar opinion to that above expressed. Whilst admitting that a true myelitis is not distinguishable macroscopically, in the great majority of cases, from a simple or non-inflammatory softening, Erb adds a statement to the effect that the 'microscopical examination can alone furnish conclusive evidence.' In the opinion of the writer, however, such evidence as that which is cited by Erb (*loc. cit.* p. 470) is quite inconclusive.

It is evident, indeed, that we are still almost as destitute of microscopical as we are of macroscopical characters, of a trustworthy description, for enabling us to decide whether any given focus of softening has been of inflammatory or of simple non-inflammatory origin. Such researches as those of Hamilton (*Quart. Journ. of Micros. Science*, Oct. 1875) and others must be prosecuted further and multiplied before any certain means of deciding such a question will exist.

In the present state of knowledge, therefore, it would appear that the 'non-inflammatory softenings' of the cord are represented by the primary and apparently idiopathic 'softenings' which frequently occur in this organ.

Ætiology and Pathogenesis.—Concerning the ætiology of non-inflammatory softening of the spinal cord, it is impossible to speak positively. The disease presents itself as a spontaneous or idiopathic affection, sometimes without apparent cause or definite antecedent conditions of any kind, but at others as a sequence of one or other of various known and common antecedent conditions.

Thus in certain cases the symptoms set in more or less suddenly after some great bodily fatigue; in others after extreme sexual excesses; or they may occur during the period of convalescence from certain acute fevers, such as variola, typhus, and other exanthemata, or after rheumatic fever. During the first week or two after childbirth there is likewise a liability to such symptoms; and also in the later stages of syphilis. These different conditions may act very variously in contributing to bring about a focus of softening in the spinal cord, and nothing more than conjectures can be advanced in regard to its pathogenesis in the several cases.

Again, the symptoms indicative of a primary softening of the cord may set in after the action of other conditions, regarded by some as exciting rather than as predisposing causes. Of these the following may be enumerated:—Prolonged exposure to cold and wet; sudden suppression of the menses or of other accustomed fluxes; violent emotional disturbances; or the existence ot some inflammation in one or other of the pelvic organs, such as the uterus or the bladder and urethra (instances of the latter class being some of the cases formerly supposed to be of 'reflex' origin). In regard to these 'exciting causes,' all that is certainly known is, that softening of the cord seems to set in not unfrequently in persons who have been subjected to one or other of them; but in what precise mode either of them is related to the subsequent softening, nothing very definite can be said. Something, nevertheless, may be advanced by way of suggestion—with the view more especially of giving some direction to the investigations needful for clearing up this subject.

Spinal and cerebral softenings probably own a similar mode of origin. Of the obstructions of vessels which so largely determine cerebral non-inflammatory softenings, it is those due to thrombosis rather than to embolism which intervene in the main for the production of corresponding conditions in the spinal cord (*see* Introduction, § 6, (8) and (9)).

It is well known that the causes of thrombosis are principally three, and that in different cases, now one now another of them may be most influential; whilst in other instances two or more of these causes may co-operate. These three causes are (*a*) thickenings, irregularities, or degenerations of the inner coats of the vessels; (*b*) slowness of blood-current; (*c*) peculiarities in the chemical composition of the blood, rendering it more than usually prone to coagulate.

The thrombosis may take place in the arteries or in the veins, and the plexiform arrangement of the spinal vessels which exists, together with the slowness of their blood-current, may favour the occurrence, as well as the spread of the process when it has once been initiated. Thus a process of coagulation, beginning, perhaps, in some very small vessel, may gradually extend so as to involve larger and larger branches, and thereby increase the area of the cord which is deprived of its proper blood-supply. And it is especially worthy of note, in this connection, that the blood-supply of the lower end of the cord (where primary softenings are most common) is peculiar and easily interfered with. To this important point Dr. Moxon has recently called attention (*Brit. Med. Jour.* vol. i., 1881). In short, the anatomical conditions existing in the cord, both on the arterial and on the venous side of its circulation, are probably of a kind distinctly to favour the occurrence of thrombosis; and, if there were space for it, we might attempt to show something as to the respective modes of action of the very different exciting and predisposing causes which have been previously enumerated, as seeming to be in relation with primary softening of this part of the nervous system.

Anatomical Characters.—In regard to their distribution or extent in the cord many varieties of softening exist. These have been commonly recognised, though they have been mostly described under corresponding designations as so many varieties of 'myelitis.' Thus, we may have a 'complete transverse softening,' involving the entire thickness of the cord for a variable longitudinal extent, either in the lumbar, the dorsal, or in the cervical region. Or the softening may be more limited to certain subdivisions of the cord in one or other of these regions—and then constitute an 'incomplete transverse softening.' Thus it may, in one set of cases, principally affect the anterior columns and grey matter; in another set the posterior columns and more or less of the grey matter. Or the softening may be central, and almost confined to the grey matter through a considerable extent of the cord, as in 'diffuse central softening;' when this change involves the white columns as well as the grey matter for a considerable extent, we have what is called 'diffuse softening' of the cord. When a small focus of softening exists which only involves part of the transverse area of the cord, and that for a very limited extent, we have a 'circumscribed softening' of the cord; and where many of these small foci are scattered through different parts and regions of the organ, we have what is known as 'disseminated softening.'

An accidental damage during the opening of the spinal canal must not be confounded with the results of pathological change. In a spinal cord bruised in the manner indicated the nerve-substance may be softened and diffluent, and somewhat resemble a patch of real pathological softening. Examination with the microscope, however, would show, amongst the fragments of myeline from the broken nerve-tubules in the former case, an entire absence of the large granulation-corpuscles, which are, on the contrary, invariably present in a patch of real pathological softening. If there were, after such an examination, still room for doubt, this might be resolved by the fact that the softened nerve-matter in a patch of real softening of the cord, has its specific gravity lower by 3–5 degrees than that of other healthy portions of the organ, whilst in the patch of merely bruised nerve-substance it would not be appreciably lower than normal. The normal specific gravity of the spinal cord varies commonly from 1033–1041 in different individuals—the higher figures being most frequently met with in elderly persons. The modes of estimating the specific gravity have been discussed by the writer in *Journ. of Ment. Science*, vol. xi. 1866.

Where the process of softening has gone on to its final stages—in a case, for instance, of 'complete transverse softening'—the whole substance of the cord in the affected site is reduced to a rather dirty-looking milky fluid, which, when the membranes are cut across, flows out so as to leave a complete gap in the cord-substance for an extent, it may be, of one to three inches.

Symptoms, Course, and Terminations.—The symptomatology of this disease presents an extremely wide range, in accordance with the varying extent and sites of the softening in the cord, as existing in different patients.

In 'circumscribed' and 'disseminated softening,' for instance, the symptomatology would be excessively variable in different patients, and, especially in the latter class of cases, it might be extremely difficult to arrive at a diagnosis. The symptoms could, in fact, only be interpreted by the light of the general principles applicable to the regional and pathological diagnosis.

Again, in cases of 'diffuse central softening' the symptoms—except for the fact that they set in gradually rather than abruptly—would bear a close resemblance to those of hæmorrhage into the spinal cord, where the blood is effused into the central grey matter for a certain extent (*see* No. 8, **Spinal Cord, Hæmorrhage into**). There is some doubt, indeed, whether these latter cases may not occur principally as epiphenomena sequential to a primary central softening.

The symptomatology of 'incomplete transverse softenings' of the cord, is for the most part exemplified by the second stages of various forms of so-called 'compression myelitis'—cases, that is, in which the anterior regions of the cord more especially are, in one set of cases, principally pressed upon either by tumour, or by the inflammatory products associated with vertebral caries ('Pott's Disease'); whilst in another set the posterior columns and posterior grey matter may undergo a similar softening, under the influence of the pressure of a new growth impinging upon the cord from behind. Cases of this type, however, may easily and do often merge into 'complete transverse softening' (commonly known as 'complete transverse myelitis'). Both complete and incomplete forms also often occur in the cord, quite independently of pressure.

Of these states it will be well, for the sake of brevity, to confine our attention principally to '*complete transverse softening*.'

In a case of *complete transverse softening* involving the mid-dorsal region, the temperature in the axilla usually varies between 98° and 100°F., though with an extension of the pathological process, or towards the close of the disease, it may rise to 101°, 102°, or even higher. Meanwhile the lower extremities themselves are often distinctly cold to the hand—the temperature being in some cases more or less subnormal. It is important to note this, because it might have been supposed that hyperæmia and a slightly elevated temperature would exist, owing to the vaso-motor nerves of the limbs being paralysed.

The motor paralysis of the lower extremities is absolute, and the abdominal muscles are also powerless. The feet, as the patient lies in bed, are extended and often inverted, so that the great toes cross one another. The skin after a time tends to become dry and scurfy. The muscles feel flabby to the hand, but they waste only to a slight extent, and continue week after week to show only a small amount, if any, of diminution in the degree of their irritability to faradaic and to galvanic currents.

The sensibility of the limbs is completely abolished both for tactile and painful impressions, as well as for differences of temperature and tickling. A like abolition of sensibility exists over the trunk up to the level of the 'ensiform area' whilst above this level the sensibility becomes quite natural. Though the upper limit of anæsthesia may be quite sharply defined, yet in these cases of complete transverse softening there is often no distinct 'girdle-sensation.'

The muscles of the lower extremities may show some slight irritability when they are forcibly tapped, and when the soles of the feet are strongly tickled there may be very slight movements of the toes; but beyond this there is often an entire absence of all reflex movements—there is no ankle-clonus, no knee-reflex, and a similar absence of the cremasteric and abdominal reflexes.[1] In the initial stages of the affection, however, and especially when the softening is not completely transverse, all these reflexes may be extremely well-marked for a time, though they tend gradually to diminish.

For the first ten days or a fortnight there is often complete retention of urine, but after this time, when the lumbar region of the cord again becomes capable of manifesting to some extent its centric functions, the initial retention gives place to incontinence of urine. This fluid may be discharged at intervals of two to three hours in small quantities, owing to the occurrence of reflex contractions of the bladder whenever it attains a certain degree of fulness. The passage of a catheter, however, in these cases will often show that the bladder is never completely emptied—two to four ounces remaining after the reflex contractions. Unless special precautions are taken, the urine, in such patients, speedily becomes ammoniacal, and more or less loaded with mucus.

The bowels are usually constipated, and relieved only after the administration of aperients or enemata. At these times there is generally incontinence of fæces—the patient having no power of controlling the reflex actions concerned in defæcation when they have once been strongly excited. The actual passage of the motion is moreover often unfelt.

Under the irritative influences emanating from the seat of softening during the period of its establishment, a small bed-sore may begin to form, often amenable to treatment. Later on, sloughs are apt to form upon the heels, over the malleoli, and in other situations habitually exposed to continuous pressure. But the most frequent site for intractable sloughing bed-sores is over the sacrum. Inflammation of the mucous membrane of the bladder is at last set up; and the inflammation may extend up one or both ureters, so as to implicate the pelvis of the kidney, when minute abscesses may also form in the kidney itself.

Under the influence of these various conditions the patient's appetite and strength gradually fail; emaciation proceeds; and death after a time may come from sheer exhaustion, aided, perhaps, by some intercurrent inflammatory affection of the lungs. Other modes of death are pointed out in the section on Prognosis.

Diagnosis.—The recognition of this disease at the bedside often presents considerable difficulties. We must be guided partly (*a*) by the patient's history and state; partly (*b*) by the mode of onset of the disease; and partly (*c*) by the symptoms of the fully established affection.

(*a*) The points in regard to previous history which are of principal significance are referred to under the head of Ætiology. In regard to (*b*) mode of onset, this is usually not abrupt and sudden; there is rather a slow increase of paralysis during a week, ten days, or a fortnight. Still, it is a fact that softening of the cord (apparently due to thrombosis) does occasionally cause a sudden incomplete paralysis, though such paralysis increases subsequently in the manner above stated. Such a case must not therefore be confounded with hæmorrhage into the cord, merely by reason of its absolutely abrupt onset.

The extent to which the diagnosis turns upon (*c*) the nature of the symptoms of the fully-established affection, cannot be very definitely defined except in some cases. When the softening is slight and partial, it gives rise to no distinctive symptoms; but where there are clinical signs of the existence of a complete transverse lesion, the chances are that the lesion itself is, if not a primary, at all events a secondary softening.

In regard to the regional diagnosis of softening of the spinal cord, the following points require to be borne in mind:—

The indications as to the transverse area involved, and as to the upper limits of the change in the spinal cord, are wholly derivable from the presence or absence of the various signs and symptoms which have been set forth in the Introduction, § 8, (*a*), and § 11.

The attempt to ascertain the lower level of the lesion, and consequently its longitudinal extent in the cord, is always difficult, and often cannot be achieved with any success. The indications are all obscure, uncertain, and apt to fail. This is especially the case if we attempt to base an opinion on the fact of the existence or absence of superficial reflexes (*see* § 5, (*a*)). Thus, complete transverse softening may exist in the upper dorsal region, and extensive secondary degenerations may have been produced, yet for week after week there may be a complete absence of all the reflexes (superficial and deep) dependent upon the cord below the upper dorsal region. This the writer has lately ascertained by repeated clinical examinations of cases whose nature has been subsequently verified *post mortem*.

Prognosis.—The prognosis in a case of paraplegia must always involve a twofold problem:—(1) as to the duration of paralysis, or the probability of recovery; (2) as to the danger to life.

(1) The chance of ultimate recovery from paralysis would vary inversely with the size or extent of the lesion existing after the first ten days or a fortnight—that is, by the time softening has been unmistakably established, and when the chance of such an event being warded off by the establishment of a collateral circulation no longer exists. But where a reinstatement of blood-supply does take place, all symptoms of paralysis may gradually disappear in the course of some weeks, or, it may be, months.

(2) Danger to life is brought about in many ways, and a fatal result may be entailed (*a*) by a gradual extension upwards of the process of

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[1] In one recent case in which paraplegia had existed for over three months, in consequence of a complete transverse softening in the upper dorsal region (with the above-mentioned clinical signs), the writer was much struck with the extremely pallid appearance of the grey matter through the whole length of the cord below the seat of softening. The absence of the reflexes may be in part due to such condition of the grey matter, and this itself may be caused by a spasm of its vessels in some way induced by the lesion above. Some amount of spasm may also exist in the vessels of the limbs, whose temperature is often rather sub-normal.

softening (especially where it exists in the lower cervical or upper dorsal region) so as to involve paralysis of the diaphragm, or an extreme interference with the heart's action. (*b*) Inflammation of the bladder, followed by implication of other portions of the urinary tract, may lead on to death after the paralysis has lasted for some months. (*c*) About the same period extensive bed-sores may form, and the patient may, after a time, die exhausted, or from blood-poisoning. (*d*) The supervention of an intercurrent pneumonia may lead on to a fatal result; or (*e*) the end may come from the extension inwards of the process of sloughing, so as to lead to the establishment of a rapidly fatal spinal meningitis. Still, in some cases the patient may remain paralysed for a very long time before a fatal termination is brought about.

Treatment.—Our power to deal with the softened condition itself of the spinal cord is extremely small, whether it may have been caused by thrombosis or by compression. During the early stages probably the less that is done in the way of active interference the better. The principal indications are that the patient should have absolute rest in bed, and for the first few days at least a rather sparing diet; spoon diet being desirable where distinct elevation of temperature exists. The secretions should be regulated, and the urine, if necessary, drawn off by a thoroughly clean catheter smeared with carbolised oil. Sedatives, such as bromide of potassium, either alone or in combination with chloral, may be needed at night, for a time, so as to ensure sound and refreshing sleep.

Should the patient's general health be weak or deranged, as is so often the case, every effort must be made to improve it by means of an easily assimilated but generous diet, gradually increased, and by the exhibition of suitable tonics, with or without small doses of cod-liver oil. It is far better to trust to such general means than to the supposed influence of phosphorus, or any other drug. To expect any of them to have a direct influence in restoring softened nerve-tissue is vain; and any good that may be achieved by drugs alone is probably brought about either by their power of regulating some of the principal functions of the body, or by improving its nutritive processes generally.

Still scarcely any morbid condition exists in which more constant care and vigilance are needed than in the *paraplegic state*, in order to correct or ward off its numerous incidental troubles or complications.

One of the first points claiming attention in the early stages of a case of paraplegia is to take such measures as will stave off the occurrence of bed-sores as long as possible. These precautions are especially needful where the paraplegia is complete, and where loss of sensibility exists. The patient should at an early stage of the disease be placed upon a water-bed; and those forms are most suitable in which there is a canal through the centre for the passage downwards of the evacuations. The patient must be kept scrupulously clean and dry; and no folds of the bed-clothes must be permited to press against the skin. If possible, the patient should not be allowed to lie habitually upon his back, but occasionally in a prone or lateral position. The skin over the sacrum especially must be carefully watched, and on the least sign of a patch of undue redness there, it should be rubbed once or twice a day with a mixture of equal parts of olive-oil and spirits of wine. If it becomes actually abraded it should be dressed with zinc ointment, smeared over a piece of soft lint.

For the first fortnight or more there may be complete retention of urine, which then requires to be drawn off night and morning by catheter. During this period great care should be taken in regard to the cleanliness of the catheter employed, and only instruments which have been smeared with carbolised oil should be used. Carelessness in this respect will tend to bring on cystitis at an early date, with alkalinity of urine, and may thus quite prematurely aggravate the bladder-troubles. As soon as the bladder begins to empty itself again, in a reflex manner, at intervals throughout the day, the use of the catheter may be discontinued as long as the water which comes away continues to be clear and acid. During this period of incontinence it will be necessary to draw off the urine from time to time for the purposes of examination. As before stated, the bladder never completely empties itself. After this state of things has continued for some weeks, the urine at last generally becomes alkaline, ammoniacal, and more or less mixed with mucus. At this stage the bladder should again be emptied once or twice daily, and washed out each time with 6 to 8 oz. of quinine solution (2 grains to the ounce, with enough of dilute sulphuric acid to dissolve it); or with a 1–2 per cent. solution of the new drug, 'resorcin.' This will prove the best means of warding off or of mitigating inflammation of the bladder; and thus perhaps of preventing its extension to the ureters and kidneys.

In regard to the bowels, purgatives will probably be required from the first, as without their use there will be no evacuation. Sometimes a simple enema will suffice. Scybalæ tend to accumulate in the large intestine, unless its contractility can be aroused occasionally by a large injection, consisting of three pints of warm thin gruel, together with half an ounce of spirits of turpentine and an ounce of castor oil.

Where the disease has reached the chronic stage, and when death is not inevitable, the muscles should be faradised or galvanised three times a week, with a view to maintaining their nutrition, and in old and extreme cases of this sort, good results seem occasionally to have been obtained by passing fine needles through the skin into the muscles, and then connecting these needles, one after another, with the negative pole of a voltaic battery of suitable strength, the positive pole being applied at the same time to the back, or to the limb above the transfixed muscle, by means of a damp sponge, in the usual way. This method, recommended especially by Dr. J. E. Morgan, is only suitable where there is also loss of sensibility.

When in the final stages of paraplegia large and sloughing bed-sores have formed, they will require the most constant care and attention. Poultices may be at first needed till the sloughs have separated, and afterwards the wounds must be variously dressed according to their condition. An ointment composed of ten grains of carbolic acid to one ounce of vaseline may be employed; or more stimulating applications may be needed. Sometimes the iodide of starch paste forms a suitable dressing.

10. **Infantile Paralysis.** *See* INFANTILE PARALYSIS.

11. **Acute Spinal Paralysis of Adults.**—SYNON.: *Poliomyelitis Anterior Acuta*; Acute Inflammation of the Grey Anterior Horns; Acute Atrophic Spinal Paralysis; Fr. *Paralysie spinale atrophique aiguë*; Ger. *Poliomyelitis Anterior Acuta*; *Acute Spinallähmung bei Erwachsenen*.

This is essentially the same disease as that known as infantile paralysis (*see* INFANTILE PARALYSIS), though presenting certain differences from the fact of its occurring in adults. Its existence, however, was not distinctly recognised till about the year 1865, when illustrative cases were published almost simultaneously by Duchenne and Morritz Meyer. Now that observers have been on the look-out for it, it has proved to be one which is by no means uncommon, although it is very much rarer than the similar affection in infancy or early childhood. The disease is more difficult to recognise in adults, because in them other affections occur with which it is quite possible that it may be confounded.

ÆTIOLOGY.—The ætiology of this affection in adults is just as obscure as it is in children. Sometimes it manifests itself without any assignable cause; whilst at other times there is the possibility that exposure to wet and cold, some shock or blow, or some antecedent acute febrile illness may have had to do with its origin.

SYMPTOMS.—It will principally be necessary in this place to point out the manner in which the group of signs and symptoms characteristic of the disease in infancy becomes modified when it occurs in the adult.

The first set of differences is due to the minor irritability of the nervous system in the adult, as compared with that of the young child. The initial febrile symptoms may be so slight as to escape notice; convulsions have never been met with; and preliminary head-symptoms are generally very slight. Some headache, or mental dulness, may be present; and vomiting occurs not unfrequently.

Paralysis then sets in speedily—it may be within a few hours—and is more or less widespread. The muscles are flaccid; reflex actions are abolished or greatly diminished. In the course of a few days, generally, improvement as regards motor power sets in, and very slowly progresses. It may go on continuously to complete recovery in the course of a few months; or, as often happens, such recovery is only partial. In the latter case certain muscles or groups of muscles remain paralysed, and in them a rapid atrophy occurs. When tested electrically, these muscles exhibit the 'reaction of degeneration.' The affected parts are cold, and sometimes more or less cyanotic. There is no impairment of sensibility; and no interference with the functions of the bladder or rectum.

All the characters mentioned in the last paragraph accord with those which present themselves in infantile paralysis, but later on differences again show themselves. One of the characteristic features in the child is arrest of growth in the parts affected, so that the limbs or parts of limbs paralysed remain more or less abortive. This, of course, cannot occur in the adult; and also owing to the fact that the joints are stronger, the secondary deformities (often so serious in the child) are not met with to the same extent in adults.

PROGNOSIS.—This is not a disease dangerous to life. Complete recovery not unfrequently takes place, and that too, as the writer has recently seen, where the paralysis may have been widespread, affecting all the limbs for a time, and leading to marked atrophy in the muscles of the lower extremities. In other cases, there is left in particular parts a chronic remainder of paralysis with atrophy, just as we find to be the case in children.

DIAGNOSIS.—The mode of origination of the disease; the fact that the paralysis is purely motor, and accompanied by no interference with sensibility; the fact that after the first few days at least the functions of the bladder and rectum are not interfered with; and also that in later stages there is atrophy of muscles, and the existence of the electrical 'reaction of degeneration'—these constitute a group of conditions which, taken as a whole, is thoroughly distinctive.

The disease with which it is most liable to be confounded is that about to be described, namely, (13) **Chronic Atrophic Spinal Paralysis.** The points of distinction will, therefore, be given under it. 'Progressive muscular atrophy,' if we bear in mind its very chronic onset, is much less liable to be confounded with the present disease, as also if we recollect that in it atrophy makes its appearance before paralysis rather than after, and that the electrical reactions are notably different.

The fact of the absence of spasms, the diminution of reflexes, the non-interference with sensibility and with the sphincters, together with the abrupt origin of the disease, suffice to separate the acute spinal paralysis of adults from all other affections of the spinal cord.

TREATMENT.—This disease must be dealt with on precisely the same principles as those which are applicable to the corresponding affection in young children. Repetition is, therefore, here unnecessary. *See* INFANTILE PARALYSIS.

12. **Acute Ascending Paralysis.**—SYNON.: *Paralysis Ascendens Acuta*; Landry's Paralysis; Fr. *Paralysie ascendante aiguë*; Ger. *Paralysis ascendens acuta.*

DEFINITION.—A mysterious affection of the spinal cord, first definitely described by Landry in 1859; characterised on its clinical side by the existence of a progressive paralysis, advancing rapidly from below upwards, so as finally to implicate parts dependent for their innervation upon the medulla oblongata; characterised also on its anatomical side by the most puzzling absence of any appreciable pathological change.

On account of the latter peculiarity, the disease ought not to be described in the present place, but rather to constitute the first of Class II.

But this disease, together with 'acute spinal paralysis' and 'chronic spinal paralysis,' have such an amount of similarity from a clinical point of view, that it seems very desirable for their descriptions to follow one another, so that mutual alliances as well as differences may be the more distinctly appreciated.

Ætiology and Pathology.—The causes and pathogenesis of this affection are just as obscure as those of the disease last referred to. Exposure to cold, and emotional disturbances (with or without suppression of menstruation in the female) have been observed occasionally as precursors. Occasionally, too, this disease has supervened during convalescence from some previous acute febrile malady. Syphilis is thought by a few (but on no sufficient evidence) to have something to do with the pathogenesis of this affection. Westphal, again, is inclined to believe in the possibility of some toxic influence—though this also is little more than a mere supposition. The disease seems principally to occur in persons between the ages of twenty and forty, and to be decidedly more frequent in males than in females. Although the brain and spinal cord of those who have died from this affection have now been frequently examined by skilled observers, the results have hitherto been entirely negative, so far as morbid anatomy is concerned.

Symptoms, Course, and Terminations.—About the prodromata there is nothing distinctive—they may be absent. When present there may, for a few days, or even for a few weeks, be a slight febrile condition from time to time, with a sense of weariness, and more or less numbness in the limbs, especially in the tips of the fingers and in the feet.

The disease then more definitely declares itself by a marked weakness of the lower extremities; soon to be followed by actual paralysis, which, as in the 'subacute and chronic spinal paralysis,' shows itself first in the distal portions of the limbs, and gradually approaches the trunk, so that in the course of two or three days the paralysis of the lower extremities becomes complete.

The trunk muscles are next and soon implicated in a similar manner. The patient can no longer sit up or turn in bed. Respiration becomes more and more affected, and defæcation is interfered with, through weakening of the abdominal muscles.

Next, though sometimes after a distinct interval, the upper extremities become implicated; though here again the paralysis first involves the distal portions of the extremities, and thence gradually spreads (after a period in which mere paresis exists), till the whole limbs become completely powerless.

The paralysed limbs, both upper and lower, are lax, and show no trace of contraction. Though the muscles are flaccid, they *do not undergo* a *marked* amount of *atrophy*, as is the case in 'acute spinal paralysis.'

In accordance with this latter peculiarity, there is the further striking characteristic that the *electrical reactions of nerves and muscles continue perfectly normal.* This seems now to be a well-attested fact, and it has been verified by good observers even after complete paralysis (without atrophy) has existed for several weeks.

Sensibility is scarcely, if at all affected; nor, as a rule, are pains complained of in the paralysed parts.

The nutrition of the skin is not impaired, so that there is no tendency to the formation of bedsores. Coldness and cyanosis do not seem to be characteristics of this affection.

The sphincters are usually not at all affected. Constipation is often marked, and defæcation may be rendered difficult owing to paralysis of the abdominal muscles.

In regard to reflex actions, these—especially the skin-reflexes—may not be much affected at first, but may be abolished later on. Existing information is defective concerning 'tendon-reflexes' in this affection, and the writer has made no observations on the point himself.

As a rule there is no febrile elevation of temperature.

At the stage above indicated, in nearly one-third of the recorded cases, or it may be even before the arms have become much implicated, the disease becomes arrested, and after a brief interval recovery of power begins to manifest itself—usually in a reverse order, so that power is regained first over the arms, then over the trunk, and subsequently (in the course of several weeks) over the lower extremities.

But in the remaining two-thirds of the cases, after the arms have become paralysed, the disease still progresses so as to affect the cervical muscles, the diaphragm, and finally the muscles innervated by the motor nerves of the medulla. Thus, in its later phases the disease is characterised by a greatly increasing difficulty in respiration; great weakness in voice; extreme rapidity of pulse; and possibly by inequality of the pupils. Finally, increasing paralysis of the muscles concerned with articulation and deglutition sets in; and, owing to the augmenting difficulties of respiration, death may arrive at any moment by asphyxia. This climax of the disease may be reached in the course even of three or four days; on the other hand, it may not be reached until as many weeks have elapsed. Whenever the disease has advanced so far as seriously to implicate the medulla, recoveries are comparatively rare.

In quite exceptional cases the disease may pursue a reverse order throughout; implicating the nerves of the medulla first, then those of the cervical region of the cord, and so on. The celebrated Cuvier is said to have died from the disease, progressing in this very unusual manner.

Prognosis.—Nothing can be added concerning prognosis beyond what has been above indicated in speaking of the course and terminations of the disease. It seems the rule that, the more rapid the progress of the disease, and the earlier the medulla is affected, the more is a fatal termination to be feared. Still, even in the most acute cases, improvement *may* take place.

Diagnosis.—So far as the established disease is concerned, we have in this affection, in 'acute spinal paralysis of adults,' and in subacute forms of 'chronic spinal paralysis' maladies that present certain well-marked points of similarity. In each we have to do with simple motor paralysis, with no fever, no tenderness or pains in the spine, no pains in the limbs or contractions, and with no incontinence of urine or fæces, or tendency to the occurrence of bed-sores.

'Acute ascending paralysis' differs from both these affections, however, in the important fact that rapid atrophy does not set in in the paralysed muscles, and that the electricial reactions in no way differ from those met with in healthy nerves and muscles. In the very acute cases, of a few days' duration only, these distinctions would be worthless, as sufficient time would not have elapsed to make it possible for either of them to occur. In such rapid cases, therefore, the distinctly *progressive* character of the disease is that which will serve to distinguish it from the more severe cases of 'acute spinal paralysis,' in which the paralysis sets in simultaneously throughout the whole of the parts affected, and often with a pretty distinct initial febrile disturbance. Then, again, there is the fact that this latter disease has no tendency to involve the medulla, and is only very rarely fatal.

It is in the diagnosis of the more slowly evolved forms of 'acute ascending paralysis,' from the similarly progressive cases of 'chronic spinal paralysis,' that the development of rapid atrophy of the muscles, together with the 'reaction of degeneration' comes to be distinctive of the latter affection. Then, again, in 'acute ascending paralysis,' there is a longer persistence of reflex actions, and a far greater tendency to the manifestation of symptoms showing that the medulla oblongata is involved.

TREATMENT.—The absence of any known pathological substratum for this disease makes it extremely difficult to lay down any directions for treatment. It would appear that we have to do with a simple alteration of the molecular condition of the spinal motor nerve-centres, unaccompanied by any known inflammation or irregularity of vascular supply.

Under these circumstances, the patient should be put upon a nutritious but easily assimilable diet, with a fair amount of stimulants; and, further, we may endeavour to induce a change in the nutritive and functional activity of the spinal cord, by having recourse to frictions of the skin or gentle shampooing of the limbs, together with brief daily applications of weak faradic currents to many of the affected muscles.

From drugs, perhaps the best chance of beneficial results may be looked for from combinations of iron and arsenic, or from the cautious use of small doses of strychnia. Iodide of potassium would probably be useless. Sulphur baths should be had recourse to in the more chronic cases.

13. Chronic Atrophic Spinal Paralysis.

SYNON.: Subacute and Chronic Inflammation of the Grey Anterior Horns; *Poliomyelitis Anterior Subacuta et Chronica*; Fr. *Paralysie générale spinale antérieure subaiguë*; Ger. *Subacute Spinallähmung Erwachsener; Subacute Spinalparalysie.*

NATURE, ÆTIOLOGY, AND PATHOLOGY.—This disease was described by Duchenne in 1853, and then again more completely in 1872, as a more or less rapidly advancing motor paralysis, associated with atrophy of the muscles affected, and loss of their faradic excitability. He believed the disease to be dependent upon a chronic degeneration occurring in the grey anterior horns, and this view is supported by the few examinations as yet made of persons who have been the subjects of this affection. The pathological changes in the anterior horns have been associated with atrophy of the anterior nerve-roots.

The causes of the malady are at present almost wholly unknown; but it occurs principally in individuals between the ages of thirty and fifty years. As with other chronic spinal affections, so here, there has often been one or other of the following events occurring some little time before the onset of the disease:—Exposure to cold and damp, some shock or concussion, venereal excesses, or great fatigue induced by other causes. But what share the pre-existence of one or other of these conditions may have had in initiating the disease cannot at present be defined.

SYMPTOMS.—In the subacute cases, paralysis may become developed (usually in the lower extremities first) in the course of a few days or weeks; at the same time there may be some very slight initial febrile disturbance, and possibly some shooting pains in the back and limbs.

In the more chronic cases, the latter symptoms may be absent, and the onset of paralysis is very much slower. There may be at first mere paresis, felt most in the ankles and knees; but gradually (often after many months) this deepens into distinct paralysis of certain groups of muscles, or of the entire limbs. The muscles are flabby and progressively waste; at the same time they cease to respond well or even at all to the faradic current, and become more sensitive to the voltaic. There may also be notable fibrillar twitchings in the muscles undergoing this atrophic process.

Sensibility is unaffected. Skin and tendon reflexes are abolished. The temperature of the affected limbs is lowered; and the feet especially are apt to be cold and cyanotic.

Soon the arms become affected in a similar manner, and here the paralysis may first affect either the extensors or the flexors. It may remain more or less limited to certain groups of muscles, or may gradually extend so as to implicate the whole limb. The distal parts are usually, however, more completely involved than the proximal. In the arms the same kind of phenomena occur as in the lower extremities, and there is a similar absence of rigidities or contractures.

There is no tendency to the formation of bed-sores, and the nutrition of the skin seems to be unimpaired.

The rectum, the bladder, and the sexual organs are usually quite unaffected.

After a time, the excessive reaction of the wasted muscles to the galvanic current decidedly diminishes; though in the earlier stages of this affection the electrical 'reaction of degeneration' exists with all its characteristic details.

PROGNOSIS, COURSE, AND TERMINATIONS.—In the subacute cases, after a month or two, improvement may gradually begin to manifest itself; and in exceptional instances this may go on slowly, but steadily, to complete recovery. In

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other of these cases, however, certain muscles or groups of muscles do not undergo the same improvement as the others; they may continue paralysed, and become more and more atrophied.

In the more chronic cases, recovery is scarcely to be looked for; though after the symptoms have developed to a certain extent, it occasionally happens that no further advance is made. Such patients may remain in much the same condition for years.

In another class of cases the malady proves more continuously progressive, so that after implicating the upper and lower extremities severely, the morbid process may extend to the upper cervical region of the cord, so as greatly to interfere with respiration; or it may even extend to the medulla, so as to involve the tongue and pharyngeal muscles, and more or less interfere with the functions of articulation and deglutition. In such cases death is liable to occur through asphyxia or slowly progressing exhaustion.

In the majority of cases of this disease, more or less complete recovery occurs, though it may be only after two to four years.

Diagnosis.—This malady bears a closer resemblance to the 'acute spinal paralysis' of adults than to any other affection. The two diseases are naturally distinct in their modes of initiation, but as established diseases (that is, in their later phases) they would be very difficult to discriminate from one another in the absence of definite information as to modes of onset—and such information is often not to be obtained. It is the abrupt commencement of the paralysis over a wide area of the body that is met with in, and which is so distinctive of, 'acute spinal paralysis'; whilst in the subacute forms, and more especially in 'chronic atrophic spinal paralysis,' we have to do with a distinctly progressive spread of the disease from part to part.

In regard to the discrimination of these subacute and chronic forms of spinal paralysis from some other varieties of spinal cord disease, the reader may refer to what has been said concerning the grounds on which the diagnosis of 'acute spinal paralysis' is to be made (*see* (11), **Acute Spinal Paralysis of Adults**).

In 'amyotrophic lateral sclerosis' the upper extremities may be paralysed, wasted, and flaccid as they are in 'chronic spinal paralysis'; but then in the former disease there would be the characteristically different combination of paralysis without wasting, but with more or less rigidity in the lower extremities.

For the distinguishing characters of 'acute ascending paralysis' see the account of that affection, in the preceding article.

Treatment.—Possibly counter-irritation to the spine in the early stages may do good, and should certainly be tried. Local bleeding would probably be useless. A nutritious and easily digestible diet, tonics, and rest are essential in the early stages, together with a thorough supervision of the general health. Later on, electrical treatment by the voltaic current must be had recourse to, and must be perseveringly continued for long periods, until the muscles again begin to respond to the faradic current. The electrical treatment is what is principally to be relied upon, and except in the subacute cases it may be commenced almost from the first, should the patient happen to come under observation during the early stage of the malady. Sulphur or brine-baths seem at times to do much good.

14. Progressive Muscular Atrophy. *See* Progressive Muscular Atrophy.

15. Pseudo-hypertrophic Paralysis. *See* Pseudo-hypertrophic Muscular Paralysis.

16. Locomotor Ataxy. *See* Locomotor Ataxy.

17. Spasmodic Spinal Paralysis.—Synon.: *Paralysis spinalis spastica*; Primary Sclerosis of the Lateral Columns; Idiopathic or Primary Lateral Sclerosis; Fr. *Tabes dorsal spasmodique* (Charcot); Ger. *Spastische Spinalparalysie; Primäre Sklerose der Seitenstränge des Rückenmarks; Primäre Lateralsklerose des Rückenmarks.*

This is one of the most recently-recognised of the diseases of the spinal cord. It was described first by Erb in 1875, and within a few months of the same time in a thorough and independent manner by Charcot. Although these observers indicated with precision the probable pathology of the disease, they were not able to verify their anticipations by the examination of any patient who had died from (or whilst suffering from) this complaint. This last step has been recently accomplished in this country by Dr. Dreschfeld.

But even before the disease was distinctly described, its probable existence and principal features were in part anticipated by Türck and by Charcot—both of them being guided more especially by the clinical effects produced by 'secondary degenerations' in the lateral columns, as occurring in association with hemiplegia.

Ætiology and Pathology.—The disease is distinctly more common in males than in females; it occurs in the majority of cases in adults from twenty to fifty years of age. Erb and others have also described spasmodic forms of paralysis occurring in children, which may possibly be instances of this disease. The writer has met with it once in a child of about ten years of age, but then the lateral sclerosis seemed only to form a prominent part of what was really a 'multiple sclerosis' of cerebro-spinal type.

In some cases the disease appears independently of any appreciable predisposing or exciting causes; but, in other instances, falls or other traumatic influences seem to be distinctly connected with its origin. On rare occasions exposure to wet and cold has seemed to have had some influence over the genesis of this, as well as over so many other forms of spinal disease.

Anatomical Characters.—In the only undoubted case which has yet been investigated *post mortem*, namely, in that of Dr. Morgan, where the spinal cord was examined by Dr. Dreschfeld (*British Medical Journal*, January 29, 1881, p. 152), the following pathological conditions were observed:—'The cord, when examined in the fresh state, showed to the naked eye no abnormality, except softening in the lowest dorsal region. After hardening in bichromate of ammonia, sections of the cord showed already to the naked eye one light-coloured patch in each lateral column'—and this throughout the cervical, the dorsal, and the lumbar regions of the cord. This band of morbid tissue, presenting all the typical characters of a sclerosis, occupied the greater portion of the lateral columns, but without implicating the grey matter or extending quite to the surface of the cord. The anterior and the posterior columns were perfectly healthy. The microscopical characters of primary sclerosis in the spinal cord are briefly described in the article on 'multiple sclerosis.' *See* (19) **Multiple Sclerosis of the Spinal Cord.**

The occurrence of the slight softening in this case was an accidental complication, otherwise the lesions actually found agreed very perfectly with Charcot's scientific predictions as to the probable pathological changes peculiar to this affection of the spinal cord.

SYMPTOMS.—This disease often sets in almost imperceptibly, and the symptoms continue to develop themselves in a very slow and gradual manner.

Patients begin to complain first of mere weakness of the lower extremities, and this continues to increase till a well-marked condition of paresis exists. There is great difficulty in getting upstairs, and the feet begin to drag even when the patient walks on level ground. This paresis may soon be associated with more or less of muscular twitchings, often more marked in the morning, but sometimes more especially at night, and of a painful character. Soon an actual stiffness of the muscles of the legs begins to manifest itself, which becomes apparent principally when passive movements are attempted, or even when the patient seeks himself to move the limbs. At last some amount of rigidity of muscles may be more or less continuously present, so as greatly to interfere with locomotion, or in some cases even to prevent it altogether.

In the early stages of the disease, ankle-clonus can be elicited with the greatest ease, and the knee-jerk is found to be distinctly exaggerated on both sides. When one of these patients is in the sitting posture, commencing pressure on the toes of one foot, as in the act of rising, will at once initiate the characteristic tremors of ankle-clonus. All such signs, however, will probably diminish as the rigidity becomes more marked.

Whilst the patient is able to walk he often exhibits a typical 'spastic gait.' The legs are generally kept close together, owing to a spasmodic contraction of the adductors of the thighs; the toes trail or are dragged along the ground; and then, when the heel is beginning to be brought down, a spasmodic contraction of the calf muscles may take place, tending to raise the patient upon his toes and almost throw him forward. In this way a mixed and very irregular kind of walking is necessitated, partly to be accounted for by mere powerlessness, and partly by the occurrence of strong muscular spasms. In some instances, either owing to variations in the amount of the spasms, or it may be to the great weight of the patient, this spastic walk is not well-marked. In all cases, however, it is quite different from the ataxic gait; and when standing with feet close together, no increase of unsteadiness or feeling of vertigo is occasioned when the patient closes his eyes.

Sensibility is little, if at all, affected; still, in some instances it is apt to be slightly impaired. In one case, at present under the writer's care, ability to recognise differences of temperature was for a time greatly lessened; and although tactile sensibility is scarcely at all interfered with, the patient has frequently complained of a diminished power in appreciating the exact positions of his legs. Skin-reflexes are often normal, but occasionally they may be slightly increased.

The muscles do not atrophy, and their electrical reactions continue to be almost normal; whilst, according to Erb, that of the nerves is slightly but distinctly lowered to both currents. Sexual desires are not affected, but sexual disability may be occasioned to a variable extent—partly owing to weakness or actual paralysis, and partly to mere spasms of muscles. Micturition is often scarcely at all interfered with; there is nothing like incontinence of urine or of fæces, though there may be an obstinate amount of constipation.

No vaso-motor or trophic disturbances in the limbs are usually present.

As the disease progresses (it may be very slowly, and in the course of years) the muscles of the trunk become affected, so that weakness and spasms (often of a very painful character) occur in the abdominal and back muscles. After a time the arms also may become implicated, and in the same fashion as the legs, excepting that when permanent contractions of the muscles come on, they mostly fix the arm to the side, whilst the forearm is pronated and half-flexed, and the fingers and wrist are strongly flexed.

In rare cases the disease is limited to one side of the body, beginning, for instance, first in one leg, and then extending to the arm on the same side, so as to present a kind of hemiplegic distribution. Just as rarely, too, the disease may first affect the two upper extremities, and then extend down the trunk, so as ultimately to involve the lower extremities.

During the development of the disease shivering fits, affecting the muscles of the jaws as well as almost all the muscles of the body, may occur from time to time, lasting for half an hour or more, and though quite unaccompanied by any changes of temperature, they may, nevertheless, be provoked by cold. Sometimes, however, such attacks occur spontaneously; or they may spread from some accidentally initiated ankle-clonus, or other well-marked spasm.

Persons suffering from this disease often remain in an almost stationary condition for a series of years, at any particular stage of the disease that may happen to have been attained. Ultimately, however, there is a tendency to complete paralysis of the parts affected, with permanent contractures—the legs at this stage being often immovably fixed in a condition of rigid extension. As a rule, pains are not complained of at any stage of the disease, though some patients suffer much from painful cramplike contractions, occurring either in the lower extremities, or else in some of the abdominal muscles.

COMPLICATIONS.—So long as the morbid process remains limited to the lateral columns, no other symptoms present themselves. Should it, however, invade the grey matter in particular regions of the cord, then characteristic complications are apt to arise, and it may also be said that the gravity of the disease becomes very distinctly increased. The way for a fatal termination may then be paved through the gradual increase, for instance, of bladder-troubles; or through the occurrence of severe bed-sores, and collateral events to which they may give rise.

Another possible extension of the sclerosis is to the posterior columns, so that we may get a variable mixture of the symptoms pertaining to 'spasmodic spinal paralysis,' and to 'locomotor ataxy.' It should be borne in mind, however, that such a complicated clinical grouping sometimes develops in the reverse order.

Usually in patients suffering from this disease, there is no association with cerebral symptoms, nor is there any tendency to the springing up of cerebral complications. Still, in one case under the writer's care a subacute maniacal condition became developed; whilst in another case diabetes to a slight but tractable extent has manifested itself. In both instances, however, there happens to have been a marked hereditary predisposition to the occurrence of insanity and of diabetes respectively.

Prognosis.—As hinted above under the head of complications, so long as the disease-process remains limited to the lateral columns, as it does in the great majority of cases, 'spasmodic spinal paralysis' carries with it no danger to life. Such patients may survive for an indefinite time, even though for years after permanent contractures have become established they may have been absolutely confined to bed. Still Erb speaks of two cures, and of decided improvement in some other cases, and is inclined to think that this affection may prove a little more amenable to treatment than some of its congeners.

Diagnosis.—The grouping of symptoms met with in this disease is so characteristic, that there ought to be no difficulty in recognising it. In no other affection of the spinal cord have we the combination of a gradually progressive paralysis beginning in the lower extremities, associated with muscular twitchings and rigidities; greatly exalted tendon-reflexes; no impairment of sensibility and no pains; no wasting of muscles or other trophic changes; and no interference with the functions of the bladder and rectum.

The real difficulty arises in the recognition of the complex forms of the disease, or of combinations of this disease with others, then coming under observation for the first time. This, for instance, is the case where we have to do with a combination of posterior and lateral sclerosis, in which, in order to arrive at a diagnosis of the existing condition, the observer must be able to recognise the respective effects or modifications that may result from the combination of the two diseases. Another difficulty of the same kind arises when the symptoms of the disease are complicated by extension of the sclerosis to the grey anterior horns, the characters of which will be next described under the head of *Amyotrophic lateral sclerosis*.

Again, when 'multiple sclerosis' affects in the main the lateral columns, the real diagnosis can only be arrived at by the recognition of symptoms which could not be produced by a mere affection of the lateral columns. Thus the writer has at present under his care a little girl, ten years of age, first brought to him on account of head-symptoms, which suggested the possibility of intracranial tumour, but in whom, after a few months, signs of lateral sclerosis have become developed in a very typical manner. She now presents the most characteristic spastic gait, being frequently raised quite upon the points of her toes as she walks. There is also great exaggeration of the tendon-reflexes, and no impairment of sensibility. The case seems clearly one of 'multiple' or 'cerebro-spinal sclerosis.'

Treatment.—In the treatment of 'spasmodic spinal paralysis,' as in that of locomotor ataxy, we must use such means as are most likely to be of avail in checking the causal process of sclerosis in the columns of the cord. The general health of the patient, and the regulation of his mode of life, must receive our most careful attention. Sound sleep must also be ensured, as far as possible.

Nitrate of silver has been praised by some; but the writer believes that, on the whole, more good is to be obtained from iodide of potassium in eight- or ten-grain doses, either with or without liquor arsenicalis. Small doses of cod-liver oil also seem to do good. There is no particular indication for electrical treatment in this disease: but stimulation of the skin and subjacent parts, by frequent frictions and shampooings, may be of service, and so also may sulphur baths. There are mostly no pains to be allayed; but occasionally painful cramp-like contractions of the muscles cause much distress to patients suffering from this disease. These pains are difficult to relieve, though good may be done, in some cases, by the extract of calabar bean in increasing doses. For the rest, any accidental accompaniments of the malady must be treated upon the general principles applicable to the management of other spinal affections. 'Nerve-stretching' might be beneficial, as in certain cases of locomotor ataxy, though there is room for doubt on this point.

18. Amyotrophic Lateral Sclerosis.—Synon.: Fr. *Sclérose latérale amyotrophique.*

This is an extremely interesting and rare affection, which might perhaps be regarded as a mere variety of the ordinary lateral sclerosis; still it is a variety which pursues a very distinctive course, and constitutes a disease much more formidable than its prototype, since it seems almost invariably to lead to a fatal termination in two or three years.

Pathology, and Anatomical Characters.—The peculiarity of this form of lateral sclerosis lies principally in the fact that it commences in the cervical region, and soon spreads to the contiguous anterior horns of grey matter; thence, after more or less of an interval, it extends in two directions:—(*a*) downwards, so as to involve the dorsal and lumbar lateral columns, and also the contiguous anterior cornua of grey matter; and (*b*) upwards, so as to implicate the upper cervical region of the cord and the medulla oblongata in a similar fashion.

Thus it will be seen that there are three peculiarities about this form of lateral sclerosis; (1) that it begins in the cervical region of the cord, and subsequently affects the lumbar portion; (2) that it does not remain limited to the lateral columns, but soon spreads to the contiguous anterior cornua, where it leads to destruction of the great motor ganglion-cells; and (3) that it almost invariably extends upwards also, so as to involve the medulla oblongata, and thus to gradually bring about the death of the patient.

Symptoms, Course, and Terminations.—Being marked by the anatomical characters above described, it will be easily understood that patients suffering from this disease present an admixture of such signs and symptoms as may be met with separately in 'lateral sclerosis,' in 'progressive muscular atrophy,' and in 'bulbar paralysis.' We have, in fact, the following typical grouping and sequence of symptoms:—

1. Paresis, gradually increasing to actual paralysis of the upper extremities, and soon associated with distinct muscular atrophy, fibrillar twitchings, &c. Any movements that can be executed are weak, and associated with tremors. More or less marked rigidity of muscles, and finally actual contractures occur, in which the arms are fixed close to the sides of the body; the forearms are semi-flexed and pronated, whilst the hands and fingers are strongly flexed.

2. After an interval of some months, a similar group of symptoms becomes developed in the lower extremities. Again, we have paresis gradually increasing, with muscular tensions, exaggerated tendon-reflexes, and an increasing amount of rigidity of the lower limbs, which are usually fixed in the extended position. At a later period in the lower extremities, as compared with the arms, a process of muscular atrophy sets in, with development of the 'reaction of degeneration,' and fibrillar twitchings in the affected muscles.

During the whole of this time, there is little or no interference with sensibility. There is usually no implication of the sphincters, and no tendency to the formation of bed-sores.

3. In the last stage of the disease, there is evidence of extension of the morbid process upwards to the upper cervical region and the medulla. Signs of bulbar paralysis present themselves in the usual way, by paralysis with atrophy of the tongue and lips, and by progressive weakening of the muscles of the palate, pharynx, and larynx. The phrenic nerve has also generally become involved, and when weakness of the diaphragm is added to weakness or actual paralysis of the other muscles of respiration, this all-important function becomes more and more impaired, and thus a fatal termination may at any time be easily brought about. Increasing difficulty of articulation and deglutition may have existed for some months before death.

Prognosis.—As already indicated, the prognosis is bad; the disease usually advances to a fatal termination in from one to three years.

Diagnosis.—In the early stages, when amyotrophic lateral sclerosis affects the arms only, it is characterised by its gradual, painless onset, the absence of impairment of sensibility, the fact that weakness sets in first, and that twitchings and tensions of muscles soon declare themselves, either before or after the muscular atrophy becomes very obvious. This combination is already sufficiently distinctive, in the absence of pain in the back, tenderness over the spine, or any other evidence of vertebral disease.

When the disease advances to its second and third stages, the picture becomes gradually more and more distinctive, and easily to be separated from all other affections of the spinal cord: especially if we are duly impressed by the negative symptoms, namely, the absence of sensory impairment, of bladder-troubles, and of bed-sores.

Treatment.—Little success has hitherto attended the treatment of this disease. The indications are to endeavour to arrest the process of sclerosis, partly by the most assiduous attention to the general health, and partly by the administration of iodide of potassium, either alone or in combination with arsenic or small doses of bichloride of mercury. In the early stages faradisation should be had recourse to; sulphur or mineral baths may be tried; and, if possible, residence in some high and bracing health-resort, or at all events in a climate where much time may be spent in the open air. In later stages little can be done, except by general treatment.

19. Multiple Sclerosis of the Spinal Cord. Synon.: Disseminated Sclerosis; Insular Sclerosis; Multilocular Sclerosis; Fr. *Sclérose en plaques disséminées*; Ger. *Multiple Sklerose des Rückenmarks.*

Nature and Ætiology.—Nothing approaching to an adequate recognition of the characters and importance of this disease was made anterior to the year 1866. Then, and in the two or three subsequent years, the malady may be said to have been identified and characterised by Vulpian and Charcot, but more especially by the latter and his pupils.

It is a disease produced by the development of patches of sclerosis (overgrowths of neuroglia) of varying size and shape, throughout the spinal cord, and also in different parts of the brain. Clinically the disease is met with under the most diverse forms, according to the different sites and sizes of the patches of sclerosis occurring in different cases. These different forms of the disease are divisible into three partially distinct types, according as the morbid changes and symptoms occur in and are referable (1) to the spinal cord alone (*spinal type*); (2) to the cerebrum alone (*cerebral type*); or (3) to the brain and spinal cord (*cerebro-spinal type*). As the dominant symptoms of the disease are often those of the spinal type, even where there is also an extension of the morbid process to the cerebrum, it will be most convenient to speak here in the main of the 'cerebro-spinal' type. It is, moreover, both more frequent and a more characteristic malady than either of the simpler forms.

In regard to the ætiology of the disease, little can be said. It may occur with or without the predisposing influence of a neurotic tendency. It is at least as common in females as it is in males; and though rarely occurring in children under ten years of age, it is perhaps most common between the ages of ten and thirty years. Beyond the age of forty it again becomes excessively rare.

Amongst the exciting causes, exposure to wet and cold would seem to take the first rank. After this come traumatic influences of various kinds, mental shocks or troubles, great fatigues from mental or bodily labour, and finally the state of convalescence from several acute diseases, such as typhus, cholera, variola, or other specific fevers. It has, indeed, been said to occur sometimes as a sequence to severe and long-continued hysteria; but in some of such cases at least it would seem to be far more probable that the early and obscure symptoms connected with this affection were those which were regarded as hysterical. 'Hystéria' may be produced or simulated in many ways, but as itself a producer of organic changes its *rôle* is assuredly open to grave doubts.

Anatomical Characters.—The patches of sclerosis which constitute the anatomical basis of this disease, do not differ in their essential nature or in their appearance (macroscopic or microscopic) from the similar overgrowths of the neuroglia that occur in locomotor ataxy and in primary lateral sclerosis.

On the cut surface of the spinal cord, medulla, or other portion of brain, the foci of sclerosis mostly reveal themselves as greyish, greyish-red, or semi-gelatinous yellowish patches, differing principally by reason of slight contrasts in colour, from the dead white of the more healthy columns of the cord, and from the natural appearance of the grey matter. The tissue of the patches may either be level with, project slightly above, or sink slightly beneath, the general cut surface of the cord. The same differences also exist in regard to those patches which involve the external surface of the cord—they may at times, when the new growth is excessive, rise slightly above the surface; whilst later on, when shrinking has occurred in the cirrhotic patch, some amount of superficial depression may be met with.

The patches vary much in size; in the spinal cord they range from a mere pin's head to that of a large pea, or of a bean; whilst in the cerebrum or in the cerebellum they may attain still larger dimensions. In the spinal cord the patches occur in all parts of its longitudinal extent, and they may occupy very variable portions of the transverse area of the cord. Some involve principally the lateral, others the anterior or the posterior columns of the cord; or portions of the grey matter, either alone or in conjunction with one or more of these columns, may be implicated for a variable extent, transversely and longitudinally. Patches of different sizes, and varying in their transverse extent, occupy different levels of the cord, and may thus occur in an irregular series throughout the organ.

These spinal foci of sclerosis, again, may be associated with patches of the same kind distributed through the medulla, pons, and cerebral peduncles, in part superficially and in part within their substance. Similar patches may be found in variable number, and quite irregularly distributed, through other parts of the cerebrum, as well as through the cerebellum.

In regard to the *microscopical characters* of these foci of sclerosis, certain differences are met with in different cases, principally dependent upon the age, or stage of formation, of the patches. Without going into minute details, it may be said that there is in all cases a hyperplasic overgrowth of the neuroglia which naturally exists around and between the nerve-elements. The nature of this change becomes quite distinct when properly prepared sections of the cord have been tinted. The new tissue takes the staining fluid freely, and when the circumference of a patch (especially some small one) is examined, it becomes obvious that numerous thickened processes of neuroglia connect it with the healthy tissue around. It is by the hypertrophy and gradual fusion of these circumferential prolongations that the morbid growth progressively encroaches upon the previously healthy portions of the cord. As this mere intermediate tissue grows, it presses upon and constricts the nerve-fibres and nerve-cells, so as to cause atrophy of the latter and a partial atrophy of the former. For there is reason to believe that the nerve-fibres do not wholly disappear; in these patches of primary sclerosis (as in the case of 'secondary degenerations') it is the white substance of Schwann which disappears, whilst the axis-cylinders, or a considerable number of them, persist. In the new tissue itself we find the usual granular or very finely fibrillar matrix, containing minute spherical or ovoidal plastides, also branched cells, and occasionally a few granulation-corpuscles. The latter are met with especially during the earlier stages of a patch of sclerosis; just as corpora amylacea or colloid bodies may be found in older patches. The walls of the capillaries as well as of arteries and veins are generally greatly thickened, and the vessels in a patch of this kind may be both numerous and large; in other cases, however, the number of vessels existing in the patch is by no means so conspicuous. It is well known that the adventitia or outer coat of the vessels in these patches is specially apt to become thickened, and that this sort of over-growth may extend inwards, so as to cause fibroid degeneration of the middle coat and even of the intima. It is probable that proliferation also takes place from the inner surface of the intima (an endarteritis), and that occasionally, owing to this cause, a thrombosis may be brought about. Certain it is that the writer has on several occasions found the larger vessels of a patch of spinal sclerosis blocked by an old and firm thrombus.

Pathogenesis.—With reference to the starting point of a patch of sclerosis something may be attributable to general causes or tendencies, such as exist in scrofulosis, in syphilis, or in other cachectic states of the system. Still, a general tendency of this kind to hyperplasia can only be adduced as a very partial explanation, since not unfrequently disseminated sclerosis may be met with in the absence of any cachexia; and, moreover, patches of sclerosis may occur in the nervous system only, or to no notable extent in other organs of the body. This, therefore, would indicate the existence of something, or of some process, of an abnormal kind taking place in the spinal cord and brain, and again not uniformly through them, but in foci situated here and there. It is no explanation, as some seem content to suppose, merely to say that the abnormal processes are 'chronic inflammations'; since whether it is or is not advisable to speak of the changes by this name, we should still have to ask what is the cause of such local departures from healthy nutrition. Does the process begin in the connective-tissue elements themselves? or is there some primary change in the small vessels (possibly of the nature of endarteritis) leading to obstructions and a sequential overgrowth of the neuroglia? It would seem pretty certain, at all events, that the change in the nerve-elements proper follows the overgrowth of the neuroglia—as certain, indeed, as that throughout a band of 'secondary degeneration' the order of these changes is exactly reversed. There fatty degeneration and atrophy of the nerve-fibres are the first events, and these are followed by hyperplasia of the neuroglia. *See* Introduction, § 6, (13).

One of the most interesting facts, in connection with these patches of primary sclerosis, is to be found in the circumstance that they themselves rarely lead to bands of descending 'secondary degeneration' in the anterior or lateral columns, or of ascending degeneration in the posterior columns. The fact itself has been long observed, and always regarded as rather surprising. The writer believes it to be explicable by the fact previously mentioned, that the bulk of the axis-fibres remain, so that the nerve-fibres below the seat of lesion (or above in the case of the posterior columns) are not absolutely cut off from the nerve-cells which exercise a 'trophic' influence over them. Some nerve-tremors may still pass along the damaged fibres in the sclerotic patch,[1] and thus the nerves in the parts beyond do not degenerate as they would do if the fibres had been absolutely cut across. Some fibres may be completely strangled and then absorbed, and in such a case the continuations of these nerve-fibres would degenerate. In the final stages of a sclerotic patch this kind of sequence is apt to occur; so that towards the end there may be the tendency to the occurrence of some amount of secondary degeneration, even though the degenerated fibres may not constitute a very compact band.

SYMPTOMS.—It can easily be understood, from what has already been said, how much the symptomatology of this disease is liable to vary in different cases, according to the varying situation, extent, and order of evolution of the morbid patches. That it is possible to assign anything like a definite symptomatology for this affection, is due to the fact that there are certain seats of election in which the patches of sclerosis are specially apt to occur. The sites affected with special frequency are the lateral columns of the cord, the medulla, and the pons; and it is with the occurrence of patches of sclerosis in these situations that we have the following set of correlated symptoms pertaining to the 'cerebro-spinal' type of the disease.

A slowly ensuing paresis of the lower extremities begins, first in one limb and then after a time it involves the other. During this time the paresis develops into a more and more marked paralysis, though the sensibility of the limbs remains almost completely unaffected — nothing more than a temporary numbness being complained of in the majority of cases, whilst lightning-like pains and girdle-sensations are altogether absent. After an interval, first one and then another upper extremity may become weak and subsequently more or less paralysed. During these early stages of the disease more or less distinct remissions of symptoms may occur from time to time.

Meanwhile a most typical sign soon shows itself in the paretic or semi-paralysed limbs, in the form of a marked trembling or shaking of those muscles or parts of a limb which are called into voluntary action with any intensity, although these phenomena immediately subside when the voluntary exertion ceases. The involuntary movements consist either of extremely well-marked tremors, like those met with in some cases of paralysis agitans, or else of movements of greater range, more resembling those of chorea.

Later some paresis of the trunk-muscles may occur, as well as of those of the neck; and this may be followed by a similar affection of the tongue, lips, and facial muscles—possibly, also, of those of the palate, pharynx, and larynx. When a patient affected in this manner, who has been previously lying perfectly still in bed, is told to endeavour to sit up, shakings and tremors begin in almost all parts of the body, and the scene is strangely changed until all voluntary efforts cease and the recumbent position is again assumed. The same kind of thing is seen when movements of particular parts of the body are attempted: thus when, in the sitting posture, the patient attempts to hold up one leg, tremors of it immediately begin; ask him to take hold of something or to squeeze a dynamometer, and the upper extremity called into action at once begins to shake; request him to put out his tongue, and immediately irregular protrusions of the organ occur, associated with twitchings about the angles of the mouth and even in other parts of the body. The act of walking may cause, in more or less advanced cases, tremors of the legs, arms, trunk, head, and neck—all at the same time.

Movements of slight intensity occasion either no shakings or merely tremors of a very fine kind. The latter are seen in the early stages of the disease, when writing is attempted. Almost each letter registers a number of fine tremors, mixed here and there with greater irregularities. In more advanced cases, however, the movements are so disorderly that writing becomes either impossible or wholly illegible.

Just as there is no loss of ordinary sensibility, so we find that patients remain fully conscious as to the positions and movements of their limbs, and that closure of the eyes occasions no increased uncertainty of their movements; nor, when in the standing position, are they rendered more giddy or more unsteady by such a proceeding.

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[1] In support of this, there is the fact mentioned by Charcot, that an optic nerve which was affected through its whole thickness by sclerosis was yet capable of performing its functions.

Up to this stage there may be no distinct interference with the functions of the bladder or the rectum. The tendon-reflexes are, however, generally distinctly exaggerated; ankle-clonus may be obtained with readiness, and the knee-jerk is often more pronounced than usual. There is no tendency to the formation of bed-sores; no wasting of muscles; nor is any alteration in their electrical excitability met with.

After variable and often long periods, the affected lower extremities, which have become more and more paralysed, may in some cases show signs of commencing bar-like rigidity. The limbs, as the patient lies in bed, are closely drawn together, and in a condition of rigid extension, which is generally increased when any attempts to move them are made. At first this condition of the limbs ensues from time to time, in the form of paroxysms lasting for an hour or two. But, after a time, the attacks are both more frequent and longer, so that ultimately the condition of rigidity becomes permanent. Contractions of the arms are less common, and when they occur they become fixed at times in a different position from that met with in simple lateral sclerosis (*see* **Spasmodic Spinal Paralysis**); that is, like the lower extremities, in a condition of extension, and closely drawn to the sides of the body. At this period ankle-clonus can often be elicited with the greatest ease, and the movements of the one leg may extend to the opposite lower extremity, and may indeed set up more or less of general tremor throughout the body. Exposure to cold, or irritation of the skin in various ways, will also often suffice to set up this general tremor, which, as Brown-Séquard showed, may commonly be caused to cease instantly by a forcible flexion of one of the great toes. With the cessation of the tremors consequent upon this manœuvre, the limbs may also be left for a time in a supple and flaccid condition.

The manifestation of tremors of the tongue, lips, and face is of course a sign that the medulla oblongata is affected; and when this occurs, simultaneously, or very soon after, other evidences of the implication of the medulla and of contiguous portions of the cerebrum may be met with. Articulation may become more or less affected, the speech being rendered slow, hesitating, and measured, syllable by syllable; or it may be jerky in character—becoming especially thick and blurred in the later stages of the disease. The power of swallowing is less frequently impaired, but in advanced stages it is apt to be affected.

Nystagmus is very frequently met with. Diplopia, or actual paralysis of the ocular muscles, is rare. Amblyopia not unfrequently exists; perhaps, in one eye only. Actual blindness is very rare.

Vertigo, sometimes to a marked extent, is no uncommon symptom; and as the cerebrum becomes more and more affected, a condition of well-marked hebetude, or actual dementia, gradually becomes pronounced. This betrays itself externally by a blank, expressionless aspect of the face; the patient becomes childish in manner, his memory fails, he takes interest only in trifles, laughs constantly also at the merest trifles, or, on the other hand, is very easily moved to tears.

During this condition of things a subacute maniacal condition may supervene; or the patient may develop 'delusions of grandeur' precisely similar to those met with in 'general paralysis of the insane'—examples of which the writer has recently seen in two of his own patients. In other cases persons suffering from this disease may lapse into a profoundly melancholic condition.

At this stage, too, apoplectiform or epileptic form attacks are particularly apt to occur from time to time. After such attacks, of whichever kind, the limbs on one side of the body and the face are left more or less paralysed; and where the attack has been epileptiform in character, the convulsive twitchings are often limited to this one side of the body. As Charcot has pointed out, these attacks are precisely similar to those which occur in general paralytics, or in cases of old hemiplegia with descending sclerosis. They answer to the so-called 'congestive attacks,' but, as Charcot contends, they do not seem to be associated with any new appreciable lesions of a 'gross' order. Such epileptiform attacks may be brief, or they may last for hours; or, off and on, even for days. In all of them the temperature begins to rise almost at once—without any initial period of depression—and may even reach 104° in a few hours, or in a day or two. The temperature then begins to fall again; or should it continue to rise to a still higher point, the attack is very apt to terminate fatally.

Every attack of this kind leaves the patient in a manifestly worse condition, both bodily and mentally; and perhaps in one of them at last death may occur.

VARIETIES.—The symptomatology of this disease is likely to be considerably modified in different cases, but principally in two directions, productive of complications of the same kind as those which are also apt to occur in 'spasmodic spinal paralysis.' In each disease there may in some cases be a special affection of the posterior columns, in one or other region of the cord, bringing with it more interference with sensibility, and an admixture of other symptoms pertaining to locomotor ataxy. It is, perhaps, principally in these cases that the '*crises gastriques*' (pains, vomiting, and occasionally diarrhœa) are also met with. In other instances there may be an extension of the sclerosis to the grey matter of the anterior cornua in one or other region (as well as to other parts of the grey matter), leading, amongst other phenomena, to muscular atrophy in related regions of the body. In either of these ways the symptoms of the original disease may be complicated, and, to a certain extent, obscured.

Many other differences also present themselves in special cases, owing to the varying situations in which the morbid patches make their first appearance. In a fair proportion of the cases the disease seems to reveal itself first in the brain rather than in the spinal cord.

TERMINATIONS.—After pursuing a very slow course for years (often five to ten), the miserable sufferers from this disease may at last be carried off in various ways. Death may take place in one of the apoplectiform or epileptiform attacks, occurring either in patients who are merely slightly demented, or in those who are otherwise actually insane; or, at last, in cases in which there is great interference not only with articulation but also with deglutition, the functions of the heart or of respiration may also become affected, and may thus lead on to a fatal termination.

In other cases, after the disease has lasted for years, and when the grey matter of the cord has become seriously involved, accidents may supervene similar to those which occur in the final stages of many cases of paraplegia. The bladder may become paralysed, and after a time inflammation and ulceration may be set up, followed by secondary inflammation of the ureters or kidneys. Or bed-sores may form, sloughing may go on extensively, and the patient may at last die exhausted, or from the supervention of blood-poisoning or some acute inflammatory disease.

Diagnosis.—In its early stages the diagnosis of this disease may present very considerable difficulties. This is especially the case when the morbid process begins in the cerebrum. Here for a time there may be nothing distinctive, and we have to wait for the further development of the disease before anything like a positive diagnosis is possible. Similarly, where the disease begins only with spinal symptoms, it is often extremely difficult to diagnose it with certainty in its very early stages. The important characters in the more typical forms of the disease are the youth of the patient, the paresis gradually increasing, first in one and then in the other lower extremity, with no alteration in sensibility or in the electrical irritability of the nerves or muscles. When ankle-clonus becomes easily obtainable, and when, moreover, the peculiar tremors and disordered movements on voluntary excitation of the muscles are met with, together with the absence of any such tremors in the condition of rest, and some amount of paresis or of similar symptoms in one or both upper extremities, the diagnosis of the 'spinal' type of this disease can be no longer difficult or doubtful.

By far the most typical cases, however, are those of the 'cerebro-spinal' type, in which, with such symptoms as are above indicated, there are also some others due to disease of the medulla or pons—such as have been indicated in speaking of the symptomatology of the disease. In these cases the disease is really quite distinctive; so that even when the patient is seen at this stage for the first time, the malady ought to be easily recognised. Chorea is the affection with which it is most apt to be confounded; but the absolute cessation of all tremors and disordered movements in multiple sclerosis when the patient is at rest, and their immediate re-initiation (mainly in the parts moved, but also often to some extent in others) on the occurrence of voluntary efforts, is a thoroughly distinctive characteristic.

Paralysis agitans ought to be distinguished from disseminated sclerosis with even more ease. It is scarcely ever met with in persons under the age of thirty-five, just as multiple sclerosis is only rarely met with in persons beyond such an age. The movements of paralysis agitans are only to a slight extent exaggerated by voluntary exertion of the parts; and such movements, in the form of fine tremors, do not cease to anything like the same extent under conditions of rest. There is generally no shaking of the head and neck in paralysis agitans.

Mercurial poisoning with tremors can be easily distinguished, on inquiry into the history of the patient, and the mode of onset of the disease.

In those more irregular cases of multiple sclerosis, in which there is either an implication of the posterior columns of the cord, or of the grey matter in some region or regions, the diagnosis of the complex nature of the affection must be based upon the general principles applicable to the regional diagnosis of spinal cord disease.

Prognosis.—Absolute cure of this disease is scarcely to be hoped for. The most that has been done, hitherto, as a result of treatment, has been to bring about more or less distinct remissions, and also to delay the progress of the disease. Death usually occurs in from five to ten years, in one or other of the modes already indicated.

Treatment.—Many drugs have been tried, but hitherto with little or no positive result, in the treatment of this affection. Nitrate of silver has seemed to do good in some cases, especially in the early stages. But the writer is much more disposed to trust to iodide of potassium in eight- or ten-grain doses three times a day, with or without moderate doses of perchloride of mercury or of liquor arsenicalis; combining the use of those drugs with cod-liver oil and a good nourishing diet. From time to time, however, the above medicines should be omitted, and simple tonics taken in their place. In the early stages of the disease, sulphur baths and shampooing of the limbs may be of service; and in all cases it is of great importance to see that the patient obtains sound sleep, since in this, as in all other chronic spinal diseases, the patient's downward course is sure to be greatly hastened where refreshing sleep is not obtained.

No distinct indications exist for the treatment of this affection by electricity, and no advantages have as yet been recorded from its use. The complications of the disease, which may occur in its later phrases, must be treated in accordance with the general principles applicable for this as for other spinal affections. Every effort must be made to preserve the general health of the patient, as this will probably be found to be the surest means of arresting or holding in check the progress of the disease.

20. **Spinal Cord, Tumours of.**—Synon.: Intra-medullary Tumours; Fr. *Tumeurs de la Moelle; Tumeurs rachidiennes*; Ger. *Krankhaften Geschwülste des Rückenmarks.*

Ætiology and Anatomical Characters.—Tumours originating in the substance of the spinal cord may be regarded as belonging to two classes, according as they represent (*a*) mere *local* accidents in the form of perverted tissue-changes; or (*b*) such local accidents developing under the influence of a distinct *general state*, such as syphilis or scrofulosis.

(*a*) Of the purely *local* overgrowths, the most typical, and perhaps also the most frequently occurring are *gliomata*. The consideration of these growths comes in natural sequence to that of *sclerosis* affecting different regions of the cord. In such a tumour we have an exuberant overgrowth, as Virchow and most other pathologists suppose, starting from the neuroglia of a certain portion of the cord. At first the growth infiltrates and substitutes itself in the place of a certain amount of nerve-tissue; but it soon grows excessive in quantity (spreading in area perhaps at the same time), and thus comes to exercise a more and more marked compression upon the remaining tracts of nerve-tissue composing the cord at the same level, within the narrow and unyielding boundaries of the spinal canal. These gliomata are oftentimes extremely vascular. They are liable to undergo a certain amount of central softening; and into their substance, especially in the softened foci, hæmorrhages are very apt to occur. Softening of nerve-tissue may also, at a certain stage, take place around the growth, and thence may extend for a variable distance above and below.

Other tumours of an allied nature, such as *sarcomata* and *myxomata*, also at times develop, either in their pure types or with blended characters, within the spinal cord. They present few intrinsic peculiarities in their manner of affecting the cord. They rarely attain any large size; indeed the limitations of the spinal canal only permit of much increase in one direction. And elongated growths are occasionally met with. To a considerable extent, such tumours have an infiltrating mode of growth, though their boundaries are apt to be rather more defined than are those of gliomata.

In regard to the causes of these tumours, almost nothing more definite can be said than that they seem, at times, to find occasion and conditions suitable for their initiation after some blow upon the spine or concussion of the spinal cord.

(*b*) Of the growths which tend to occur in the spinal cord (as occasionally in other parts of the body) under the influence of some *general* disease or diathetic condition, two are especially to be named. These are *scrofulous growths* ('tubercular'), and *syphilitic gummata*. The former are generally small, varying in size from a mustard seed to a pea, and only very rarely attaining the dimensions of a hazel-nut. Next to gliomata they are the new growths most frequently met with in the substance of the spinal cord. When small, they may occur in association with a cerebro-spinal tubercular meningitis; but at other times they are found, and especially the larger growths, existing independently of any acute inflammation of the meninges. In this latter case, the tumours may be combined with a certain amount of adjacent and secondary softening of the substance of the cord.

Syphilitic gummata, originating in the cord itself, occur only with the greatest rarity. They are more frequently found starting from the meninges, and then they may press upon or actually grow into the nerve-substance.

Cancer is believed not to occur primarily in the substance of the spinal cord, though it may grow into its substance, or seriously press upon it, when originating either in the meninges or in the vertebræ.

Symptoms, Course, and Terminations.—The difficulties of diagnosis are almost always very great in the case of tumours of the spinal cord, because in their early stages, and occasionally for prolonged periods, they are associated with slight and somewhat vague symptoms.

Independently of the variations in different cases, consequent upon the longitudinal situation or level of the tumour in the spinal cord, the symptoms to which they give rise in various parts of the body may be more or less vague anomalies of sensibility in different regions, associated with a certain amount of weakness, often not amounting to actual paralysis.

Growths from the meninges, or from the vertebræ, pressing upon the spinal cord, are not quite so apt to run a latent course for any length of time, since they are rather more prone to involve the anterior or the posterior roots on one or on both sides—at first irritating them, and subsequently causing paralysis from pressure. Thus localised numbness, pains, or anæsthesia, either alone or associated with twitchings, cramps, or paralysis, confined to certain parts of the body, are rather more common incidents during the growth of extra- than of intra-medullary tumours. Still the diagnosis between these two classes of tumours may be impossible.

Sclerosis, in its 'insular' form, especially when the patches are few or close together, may also present symptoms almost inseparable from the first stage of some intra-medullary tumour. The important fact is, however, that sclerosis in the cord tends to become more and more generalised, and thus gives rise to a proportionately widening range of symptoms; or else it limits itself to special columns, and thus becomes associated with more special sets of symptoms.

With any of these tumours of the spinal cord, the symptoms are, after a time, liable to undergo a sudden and grave increase, owing to the occurrence of a hæmorrhage into its substance and perhaps into adjacent regions of the spinal cord, or else owing to the commencement of a process of secondary transverse softening. Beyond these possibilities of sudden grave augmentation of symptoms, the course of intra-medullary tumours is also apt to be marked by peculiar exacerbations and remissions from time to time, in association with periods of altered growth or vascularity of the tumour itself.

Diagnosis.—The very gradual onset of the symptoms in cases of tumour of the spinal cord, is a point of great importance in the diagnosis of these conditions. Thus, for instance, we eliminate arachnoid or intra-medullary hæmorrhages, and also the numerous class of cases of softening of the spinal cord, with other affections having a more or less abrupt origin. The diagnosis of tumour of the cord as distinct from its compression by disease of vertebræ (where there is also generally a slow evolution of paralytic symptoms), must be based in part upon the absence of any evidence of vertebral disease. The diagnosis from meningeal tumours has already been referred to under the head of symptoms; and so also has the diagnosis from mere sclerosis of the spinal cord, in which the connective-tissue overgrowth is not sufficiently bulky to amount to an actual tumour.

If the arrival at a diagnosis as to the existence of a tumour of the spinal cord is a process beset with difficulties, these by no means cease when, passing from the primary, we have to approach the secondary question as to the *nature* of the growth presumed to exist. But little is possible in this direction. It is true that, with a history of pre-existing syphilis, even without the evidence of other simultaneous manifestations, we should be warranted in assuming it to be even more than possible that an existing growth was syphilitic in nature, and in treating the patient accordingly; and that all the more because this is about the only kind of new-growth as to which we have distinct evidence of its amenability to the influence of remedies. The presumptions in favour of the tubercular or scrofulous nature of a supposed new-growth in the spinal cord, would rarely carry with them more than a moderate amount of cogency. Still, occasionally the general habit of the patient, together with the fact of the existence of scrofulous enlargement of glands, or of some forms of phthisis, might give more or less probability to such a conclusion. Beyond this not much can be done in the way of diagnosing special kinds of tumours. We might be guided in our opinion as to the possible existence of a sarcoma by the presence of one or more of such growths in other parts of the body; or failing this, we may recollect that primary cancer affecting the spinal cord is almost unknown, and that gliomatous tumours are, next to the tubercular or scrofulous, those which are most frequently met with in the cord itself.

Prognosis.—The prognosis in all these cases is bad. Life, it is true, may last for months or even years, but the tendency is for the primary affection to set up other secondary accidents, in the form either of hæmorrhage or of softening. Thus, paralysis is rendered more complete, and the way is paved for an ultimate fatal termination, through the intervention of cystitis and renal mischief; by way of bed-sores with exhaustion and blood-poisoning; or by extension of softening upwards to the cervical region and the supervention of respiratory paralysis.

Treatment.—In the case of the existence of a syphilitic tumour in the spinal cord, we may attempt (and with some expectation of success) to treat the causal morbid condition with large doses of iodide of potassium, either alone or in combination with bichloride of mercury. But in almost all other cases little can be done in this direction, and we are reduced to the necessity of dealing with the paraplegic state, and its attendant conditions, as best we can, and also of attending to the general health, with the view of arresting the progress of the disease, and keeping its possible complications in check. *See* section on Treatment, in **Spinal Cord, Softening of.**

21. Spinal Cord, Malformations of.—Various conditions are comprised under this head which are of little or no interest to the practitioner. The spinal cord may be absent, imperfectly developed, or double. Again, cases occur in which the spinal cord is either unduly long or unduly short, or in which it may present some trifling lack of symmetry. One of the most interesting of these latter conditions is due to the fact recently discovered by Flechsig of the possible non-uniform distribution of the pyramidal tracts upon the two sides of the cord, so that the amount of decussation of the motor fibres, not only in different individuals but also in the two halves of the same cord, may be quite unequal. In the latter case an asymmetrical development of the antero-lateral columns on the two sides would be met with.

Congenital dilatation of the central canal of the Spinal Cord (*Hydrorrachis interna*, or *Hydromyelus*), though an interesting pathological condition, does not reveal itself by any distinct symptoms during life.

Confusion is, however, apt to arise between this mere unimportant congenital anomaly, and the existence of cavities in various parts of the grey matter of the cord, more or less centrally situated, which are to be regarded as remainders or products of some pre-existing pathological changes. These latter conditions have received much attention, and the various forms have been described under the name, originally given by Ollivier, of '*Syringomyelia*.' Here, again, we have to do with matters of exclusively pathological interest.

Congenital dilatation of the central canal in its most developed form is apt to be connected with *spina bifida*. *See* Spina Bifida.

II. Diseases of the Spinal Cord dependent upon Unknown, or very imperfectly-known, Organic Changes.

22. Tetanus. *See* Tetanus.

23. Tetany. *See* Tetany.

24. Torticollis. *See* Wry-Neck.

25. Writer's Cramp, &c. *See* Writer's Cramp.

26. Spinal Irritation. *See* Spinal Irritation.

27. Reflex Paraplegia. Synon.: Urinary Paraplegia (in part); Fr. *Paraplégie reflexe*; *Paraplégie fonctionnelle*; Ger. *Reflex Paralysis spinalis.*

General Remarks.—Some practitioners believe that paralyses of various kinds are brought about purely by reflex influences. They would include under this category some of the cases of paralysis of separate muscles, such as the ocular; some cases of paralysis of one or both arms; or some of the cases of paralysis of one or both lower extremities. It is the latter class of cases with which we are now specially concerned, though much of what is to be said in the present article may, *mutatis mutandis*, be considered applicable to the whole class of so-called 'reflex paralyses.'

Those who believe in the frequent existence of this form of paralysis are considerably less numerous than they were twenty years ago, when the notion of its frequency and importance was warmly espoused by Brown-Séquard (*Lects. on Paral. of Lower Extremities*, 1861), and when the morbid anatomy of the spinal cord was still very imperfectly known. The number of competent observers was smaller, whilst the difficulty in detecting morbid changes in this organ was much greater then than it is now that we are accustomed to employ more elaborate methods for its preservation and for its examination. Yet one of the strongest of the arguments brought forward in favour of the existence of 'reflex paraplegia' was the absence of discovered lesions in the spinal cord in a class of cases reported upon by Stanley in 1833 (*Med.-Chir. Trans.*, vol. xviii. p. 260) in which paraplegia was associated with various morbid conditions of the urinary organs—cases, in fact, of the so-called 'urinary paraplegia.' And the main support for the opinions of those who still believe in the existence of a class of reflex paraplegias, now also lies in the absence, in certain cases of paraplegia terminating fatally, of any actually-discovered lesion.

ÆTIOLOGY AND PATHOGENESIS.—The interpretation of the paralyses of this class put forward by Brown-Séquard is as follows:—That an irritation, operating upon certain sensory nerves, produces impressions which, after impinging upon the properly related grey matter in the spinal cord, are thence in part reflected along vaso-motor nerves regulating the calibre of certain blood-vessels which supply either (*a*) the portion of the spinal cord in relation with the paralysed parts, or else (*b*) the great nerves or the muscles themselves of the paralysed parts. In either case this reflection of impressions resulting from irritation of sensory nerves, upon such special groups of vaso-motor nerves, is supposed to lead to a persistent spasm of the vessels which they innervate, so as to cause a continuous anæmic condition, either of certain vascular territories in the spinal cord itself, or else of the related nerve-trunks and muscles. In either case, too, the nutrition of the parts involved in this anæmia is supposed to suffer—so that their functions can no longer be carried on or only in a very imperfect manner—and thus a more or less complete paralysis results, which is capable, however, of being mitigated from time to time, of actually intermitting, or indeed of being abruptly cured, according as temporary diminutions or a complete disappearance of the original exciting cause may lead to a diminution or to an actual cessation of the supposed profound anæmia produced by the supposed spasms of vessels. These are the theories upon which the doctrines of 'reflex paraplegia' are based.

Among the sources from which the initial irritation is supposed to proceed, almost all parts of the body, internal as well as external, are included. Thus irritative impressions, it is thought, may emanate from almost any part of the urinary tract—from the urethra to the kidney; in other cases similar impressions may emanate from some portion of the female genital organs; in others from the intestinal canal, owing to the presence of worms or some such persistent causes of irritation; in others from some portion of the thoracic organs; or, as it seems to be held, from irritated sensitive nerves in almost any part of the body, whether situated near the surface or deep amongst the tissues.

The assemblage of symptoms supposed to characterise these forms of reflex paralysis presents nothing like a distinctive mode of grouping. And of the several components of the group put forward by Brown-Séquard in 1861 (*loc. cit.*, p. 33), as pertaining to one of the most typical varieties, viz., 'urinary paraplegia,' none can now have any pretensions to be regarded as distinctive, excepting the alleged tendency of the paralysis to vary in degree with variations in the malady on which it is supposed to depend, together with its tendency to spontaneous or easy cure coincidentally with or soon after the cessation of the urinary troubles, whatever they may have been. In harmony with this latter character also are the alleged facts that speedy cures have been brought about of cases of paraplegia, especially in children, after the expulsion from the alimentary canal of tape-worms or round-worms; or, of cures of the same disease in adult females after the cessation of some uterine inflammation; or of cures of a paralysis of ocular muscles after the removal of some carious tooth which had previously been exercising an irritative influence upon branches of the dental nerve.

It would be improper and useless to deny the existence of such cases; they are theoretically possible. On the other hand, the writer is compelled to believe, after a very extensive experience, that, if they exist, they can only occur as extremely rare events.

Although it is theoretically possible that an irritation of a sensory nerve may be reflected on vaso-motor nerves, so as to lead to arterial spasms in certain territories of the spinal cord or in certain groups of muscles, neither proof nor even analogy exists in favour of the view that such a condition of spasm could be maintained for days or even weeks. Nor, if it could occur for these prolonged periods, and to such an extent as to annul some of the most important functions of the spinal cord during this time, is it at all clear that the nutrition of the cord in the affected regions would not be seriously interfered with by such prolonged anæmia; and if so the assumed speedy resumption of healthy functions after the disappearance of the vascular spasms would constitute another difficulty, since such speedy recovery would be incompatible with the theory upon which the explanation of the disease is based.

Again, it is almost certain that many of the cases formerly supposed to belong to this category of 'reflex paralysis' had no right to figure therein. Cases of diphtheritic paralysis have been proved to belong to a different category; and there is good reason to believe that in other instances the morbid conditions really existing as causes of the paralysis have simply been overlooked, either because the appreciable changes were only slightly advanced at the time of the patient's death, owing to the brief duration of the illness, or because of the want of a thorough examination of the cord, conducted with all needful aids, care, and expenditure of time.

It seems clear, therefore, that the opinions of those who believe in the existence of 'reflex paralysis,' and of 'reflex paraplegia' in particular, stand much in need of further support. Well-observed and well-recorded instances of the disease are urgently wanted, if reflex paraplegia is to retain its claim to a place in our nosology.

28. Intermittent Paraplegia.—Synon.: *Intermittent Spinal Paralysis*; Fr. *Paralysie Spinal Intermittente*; Ger. *Intermittizender Paralysis Spinalis.*—Very few cases of paraplegia of this type have been recorded, and it must also be a condition of extreme rarity.

The earliest recorded example was made known by Romberg, and as this, both in its nature and its course, seems to have been a typical instance, it may be cited here. 'A woman, sixty-four years of age, after being quite well the day before, was suddenly attacked with paralysis of the lower extremities and of the sphincters. Sensibility was unchanged, consciousness clear, the temperature cool, pulse 80, small and empty, no pain in the spinal cord. The next day there was an astonishing change in the condition. The patient could walk again and void urine voluntarily, and only complained of weakness in the legs. The following morning there was paraplegia again, which had set in at the same hour as it had done two days before. A third paroxysm was awaited, which also set in at the appointed time, although without paralysis of the sphincters. Quinine effected a rapid cure.'

Two other cases are cited by Erb. In one of them there were also three attacks before cure took place under the influence of quinine; but in the other, observed by Hartwig, attacks of intermittent paralysis seem to have gone on for many months. It is worthy of note that in the two former cases there is no statement that the patient had previously suffered from ague; whilst in that of Hartwig, although the man had been afflicted with tertian intermittent fever five years previously, for a few weeks, there is no mention made of the recurrence of any other symptoms of this type, even during the period that the patient continued subject to the attacks of intermittent paraplegia.

We know absolutely nothing as to the real cause or intimate pathology of such attacks. Any future cases, therefore, deserve to be observed and recorded with the greatest care. Meanwhile it should be remembered that the cases already observed seem to have proved extremely amenable to the influence of quinine and of arsenic.

29. Hysterical Paraplegia. *See* Hysteria.

30. Paraplegia dependent on Idea.—Nature and Ætiology.—This is a form of paralysis, of purely 'functional' type, occasionally occurring in neurotic impressionable persons, and yet not dependent upon any ordinary hysterical condition. Attention was first called to such cases by Dr. Russell Reynolds, who cited, amongst others, a typical instance in which a young lady, whilst attending to a paraplegic father, amidst the additional anxieties consequent upon straitened circumstances and the fatigues incident to teaching in order to obtain the bare necessaries of life, became at last, under the influence of long-continued strain, together with an abiding fear (inspired by actual physical weakness) that she herself was becoming paralysed, reduced *de facto* to this condition, as the final outcome of a slowly-increasing weakness (see *British Medical Journal*, November 6, 1869).

Pathology.—Such a condition may occur quite independently of hysteria, and be just as free from anything like conscious simulation or desire to exaggerate. We cannot say positively that the state is induced by what is called 'inhibition,' or by definite vascular spasms such as are supposed to form one of the pathological bases of the class of so-called 'reflex' paralyses, and yet both these modifying influences over the functional activity of the spinal cord *may* be in part operative when imagination, continuously excited in some one direction, has a tendency to pervert the functional activity of this portion of the nervous system.

The same conditions that exist as more lasting states in these cases, probably exist temporarily, under the influence of suggestion, in hypnotised persons. *See* Magnetism, Animal.

Symptoms.—There is a paralysis of motion in the lower extremities, more or less complete, often partial, and generally without implication of sensibility. There is unabated control over the bladder and rectum.

Dr. Reynolds points out that, while such patients may be wholly incapable of lifting a foot from the bed, they often find themselves able to turn or sit up without any assistance. And in slighter cases, though they may be unable to stand for a moment, such patients may yet be able to move the legs in any direction while in the recumbent position.

Diagnosis.—The character of the paralysis, and its limitation in range, is thought to be of importance. But still more important is the establishment of the fact of the pre-existence of long-continued fears or fancies (in a person of delicate or neurotic temperament), of such a nature as to be in accordance with the patient's now-present condition, combined with the absence of all signs positively indicative of any structural defect in the spinal cord.

Where such a condition exists (as it may) as a mere complication of an actually existing structural disease, the diagnosis becomes either impossible or extremely difficult. It is, in fact, only possible after prolonged observation and experience as to the course of the symptoms.

Prognosis.—The prognosis is extremely good if the nature of the malady be divined, and a right course of treatment adopted. Under such circumstances, an almost complete cure may easily be brought about in a week or ten days; but, failing this recognition, the morbid condition, may, it is said, under ordinary treatment, persist for an almost unlimited period.

Treatment.—The practitioner must inspire the patient with confidence that the malady is curable, and surround her (or him) with cheerful, hope-inspiring attendants and influences. At the same time, with the view of supporting her confidence (if for no other reason), he should faradise the muscles of the apparently paralysed limbs daily, or have recourse to frictions or shampooings combined with passive movements. He must make the patient attempt to stand or walk, with the necessary support; administer opiates, or bromide of potassium with chloral, to procure sleep, if necessary; and carefully seek to restore the patient's general health and nutrition. In this class of cases especially, it would seem probable that the influence of 'suggestion,' if hypnotism could be induced according to Braid's method, might be capable of producing an almost immediate cure. *See* BRAIDISM.

31. **Neurasthenia Spinalis.**—SYNON.: Functional Nervous Weakness of the Spinal Cord.

NATURE AND ÆTIOLOGY.—Under this name, descriptions have been given of a combination of symptoms not unfrequently met with in males as well as females, but more especially in the former. They are supposed to represent a condition of extreme nervous debility, coming on obscurely, or at all events not as a sequence of some previous severe illness or shock. Still the symptoms met with often approximate closely to those pertaining to a state of convalescence from some serious febrile illness; and are not at all unlike some of those which may follow concussion of the spinal cord.

Such symptoms when occurring independently are most prone to show themselves in those who are naturally of a neurotic temperament. They may be excited by over-fatigue of various kinds, especially when this has been coupled with disturbed sleep for some time. Prolonged exercise or over mental work may have been the particular exciting causes of fatigue; though perhaps much more frequently this is to be found in sexual excesses (of a natural or unnatural order), either extending in the form of habitual indulgence over a considerable period, or as more isolated but marked excesses. At other times, symptoms of neurasthenia spinalis set in without obvious provocatives of either type.

PATHOLOGY.—Concerning the actual cause of spinal neurasthenia little or nothing can be said. Sometimes there may be the co-existence of distinct cerebral symptoms of an analogous type; though on other occasions the symptoms are more purely spinal. This malady is perhaps capable of being induced by mere altered molecular states and actions of the tissue-elements of the spinal cord. A kind of persistent 'fatigue condition' exists, so that their nutrition cannot be properly maintained. Although some may imagine the existence of some more than usually anæmic condition of the spinal cord, of this, as a fact, there is no evidence. To speculate upon other modes in which such a set of symptoms might be brought about, would in the present state of our knowledge be of little service. There is, however, the possibility that this morbid condition may be due in the main to a functional disease of the cerebellum—especially if the views of Rolando, Luys, and others, as to the functions of this great organ, should prove correct even in part.

SYMPTOMS.—A feeling of utter weakness and prostration induced by even the smallest amount of muscular exertion, is the central symptom, though this is usually associated with coldness, and more or less numbness of the extremities. Pains, too, may be felt in the muscles of the limbs and in some parts of the back, though there is commonly no tenderness over any part of the spine. These symptoms may be unusually distinct after any activity of the genital function, and they may then be associated with extreme wakefulness, or sometimes with protracted inability to sleep. Occasionally, and especially when this latter symptom is not present, the patients may present a florid and fairly healthy appearance, strangely at variance with the extreme debility complained of.

DIAGNOSIS.—The points of greatest importance are the existence of extreme weakness, with no evidence of anything like actual paralysis, or indeed of any symptoms which would indicate an actual structural disease of the spinal cord. This being so, and diabetes being also eliminated, we may oftentimes (and especially where the existence of one or other of the above-mentioned exciting causes has been established) pretty confidently conclude that we have to deal with what is here named 'neurasthenia spinalis.'

PROGNOSIS.—A relief of this condition is ultimately to be looked for under the influence of rest and suitable treatment; but in regard to the rapidity with which any such amelioration of the patient's symptoms is to be brought about, great differences exist in different cases. Weeks, months, or even years may be required before a natural amount of vigour is restored.

TREATMENT.—Rest, especially in the direction of previous excesses, is the first and indispensable requisite. Every effort should be used to obtain regular and sound sleep. The action of these potent restoratives should be supplemented by a generous and easily assimilable diet, together with a moderate amount of stimulants. Hypophosphites of the alkalies with iron and small doses of strychnia (which may be conveniently given in the form of a syrup) often prove decidedly beneficial. An abundance of fresh air is desirable, and especially that of elevated and bracing mountain situations. Daily frictions and shampooing, aided by stimulating saline baths, may also prove to be of much use.

32. **Toxic Spinal Paralysis.**—Under this name it will be right to refer to a class of cases of paraplegia produced by poisons of various kinds. It constitutes a somewhat heterogeneous group, concerning which our knowledge is still very defective—in the main, because such cases are happily of rare occurrence.

Of the toxic agents taken into the body, and capable of entailing a paraplegia, some are minerals, such as arsenic and lead; others are of vegetable origin, such as aconitia, conia, veratria, prussic acid, ergot, and alcohol; whilst others again are of animal origin. In the majority of cases, their action as 'causes' is not sufficiently potent to lead to paralysis as anything like an invariable effect. They need the concurrence of other favouring circumstances, probably in the main intrinsic; but under the combination of conditions thus resulting, a paraplegia may be induced—in actual modes, however, that may differ considerably among themselves. It is only in this attenuated sense that the above-mentioned poisons are to be regarded as 'causes' of paraplegia. They ought perhaps, from this point of view, to be considered as predisposing rather than as exciting, and in no case as proximate, causes of paraplegia.

This holds good, for all that we know, concerning the fitful and irregular manner in which arsenic, lead, or alcohol (and probably to a similar extent other toxic substances) give rise to paraplegic symptoms in those who have taken them to excess. Thus, according to Tanquerel des Planches, out of 200 cases of lead-poisoning, in only fifteen did the paralysis implicate the lower extremities; and in only one of these did it occur as a distinct paraplegia. This case might, therefore, have been due to a fortuitous combination of conditions—in short, it might have been a coincidence rather than a definite result of the taking of lead. Again, in regard to arsenic, it is true that in certain cases Orfila observed paraplegic conditions in dogs which had taken large quantities of this drug; but such symptoms would seem to be met with only occasionally as a result of acute arsenical poisoning in man, and perhaps with equal rarity in those who habitually consume large quantities of this substance.

Probably the mode of action of alcohol as a cause of paraplegia is very nearly as general and ill-defined, yet Dr. Wilks goes so far as to speak of an 'alcoholic paraplegia,' resulting from excesses in spirit-drinking. Alcohol, like many poisons, when taken in undue quantity, may deteriorate the nutrition of the body generally; it may spoil the integrity of its more delicate tissues, and thus interfere with the discharge of some of its finer functions. In this way, through general spoiling and degeneration, the way may be led on to the development of special changes favouring paralysis, now in this and now in that part of the nervous system. If either one of a group of possible morbid changes, induced upon such a basis, chances to affect principally the lower part of the spinal cord, a paraplegia may be induced. The principal justification, however, for speaking of such a state as an 'alcoholic paraplegia,' probably lies in the fact that here (as indeed in all cases of toxic paralysis) the first therapeutic indication is to be found in the renunciation of the harmful agent.

The notion has recently been advanced by Moxon, that a certain class of poisons, which own the common property of being 'depressants of the circulation,' have a tendency to paralyse the hind legs rather than the fore legs of animals. In this group are included aconitia, conia, and—doubtfully—veratria, chloral, and prussic acid. He is of opinion that these drugs act by causing further impediments 'to the exceedingly and peculiarly difficult blood-supply of the caudal end of the spinal cord' (*British Medical Journal*, April 2, 1881, p. 498). It should be borne in mind that extreme feebleness of blood-current is of itself a common cause predisposing to the occurrence of thrombosis both in arteries and in veins, and that such a condition may intervene in some of these cases of poisoning, and lead to the development of paraplegia. This would enable us to account for the otherwise inexplicable fact of the maintenance of the paralysis long after other effects of the poison have passed away. H. Charlton Bastian.

SPINAL IRRITATION.—Synon.: Rachialgia; Fr. *Rachialgie*; Ger. *Rückgratschmerz*.

Definition.—Notwithstanding the doubts that have been entertained by many authorities, both British and foreign, spinal irritation is an affection which has a real existence and deserves a special name. Although spinal irritation may be, like other affections, allied with, or caused by, various organic or functional nervous diseases, the name ought to be kept for a special spinal complaint, chiefly characterised by a morbid excitability of the sensitive nerves of the spine, manifesting itself by spontaneous pains, and by tenderness under pressure, or when the affected parts are moved.

Ætiology.—Rachialgia is more common in certain countries than in others—more so, particularly, in Great Britain, Ireland, and the United States than in Continental Europe. This probably accounts for the fact that this affection was first studied and described by a number of Irish and American writers. Sex is an important ætiological element: out of 304 cases collected by the two Griffins and by Hammond, there were only forty-two men. The writer has seen it in three men only out of more than fifty cases. It occurs chiefly in girls between fifteen and twenty-five. As regards other causes the most important are:—excessive walking or driving; violent movements of the spine, or a blow upon it; abuse of sexual intercourse; masturbation; and severe diseases, such as typhoid fever, scarlatina, fever and ague, dysentery, and diphtheria.

Anatomical Characters and Pathology.—In simple rachialgia there is no organic alteration that the naked eye can see, or the microscope can show. At most a congestion is sometimes found. Still organic affections of the spine and its fibrous tissues may give rise to the functional affection we are now studying, so that a necropsy may show pathological alterations of various kinds in the fibrous and bony tissues of the spine. As regards the physiological pathology of spinal irritation, the symptoms belong to two distinct groups, one composed of local morbid manifestations, and the other of those which are distant. As regards the first of these groups, it includes tenderness and the various kinds of pain; there is, in a measure, similitude between the symptoms and those of neuralgia. The tenderness especially is often similar to that which is detected in some points of a nerve attacked with neuralgia. Still there are differences (especially as regards the kinds of pain) which prevent a complete assimilation of rachialgia with a common neuralgia. The group of symptoms appearing at a distance from the spine, is composed of reflex or direct effects of irritation of the spinal nerves. Among these symptoms we find referred sensations, muscular spasms, increased tonicity, contraction of blood-vessels, trembling, alterations of secretion and nutrition, inhibition of the heart, &c.

Dr. Quain communicates to the writer his conviction that spinal pain and tenderness exist more often as transmitted or referred phenomena connected with morbid states of the mucous membrane than is generally recognised. Thus he finds pain present over the posterior cervical region in cases of congestion or follicular disease of the mucous membrane of the pharynx and adjacent parts. In the dorsal region the like pains and tenderness are constantly found in cases of gastrodynia, associated, it may be, with morbid states of the mucous membrane of the stomach. In the lumbar and sacral regions similar conditions are traceable in connexion with disordered states of the mucous membrane of the intestines, or of the urinary and genital organs. As we find extreme sensitiveness of the retina in cases of disease of the conjunctiva—or as we find pain at the end of the penis in cases of stone in the bladder—so may we have many of these other reflex or referred troubles in connection with distant disorders.

SYMPTOMS.—*Spinal tenderness.*—This is the essential and only constant feature of rachialgia. Its existence, however, might not be found out if questions were merely asked, or a cursory examination were made, as the symptom may be slight and localised in one vertebra, and the patient may not be aware of its presence. It may be found in any part of the spine, and correspond to only one, to many, or even to all of the vertebræ. When very limited, tenderness exists more frequently at the lower part of either the dorsal or the cervical regions, less often in the latter. The symptom is elicited in two ways —by pressure or movement. When the tenderness is slight, pressure will succeed in showing its existence, while a movement might prove ineffectual. It is essential to be extremely cautious in making pressure, as not only a considerable and lasting pain may result from sudden and great pressure, but very serious convulsive paralytic or psychic manifestations may be produced. The writer has seen cases in which attacks of catalepsy, of tonic, clonic, or choreic movements, of temporary (and in one case of prolonged) paralysis of the lower or upper limbs, of exophthalmos with mental disorder, &c., had been caused by heavy pressure on the cervical or dorsal vertebræ. Usually the place where pressure gives rise to the greatest pain is the spinous process. Sometimes, however, the disorder is unilateral, and then the seat of greatest tenderness is the transverse process. Very frequently myalgia co-exists with rachialgia, and then the muscular masses so attacked, on one or on the two sides of the spine, are very tender under pressure. There is often hyperæsthesia of the skin itself, and the writer found this so great in one case that any unexpected touch, or even a gentle breath of air on the skin, made the patient (a strong and courageous man) scream out. The tactile hyperæsthesia in that case was so great that the two points of the æsthesiometer, which on the spine are felt by a healthy person only when distant one from the other at least an inch and a half, were distinctly recognised when distant less than a line, that is, when almost touching each other. In a number of cases sensibility is morbidly increased in every nerve-fibre of all the tissues of one or more vertebræ and of the neighbouring parts. There is no absolute relation between the pain caused by pressure and the constant spontaneous pain existing in many cases, as there may be considerable tenderness without any, or with very little, spontaneous pain, and there may be only moderate tenderness although a constant or almost constant severe pain is complained of.

Tenderness is often discovered by movement of the spine performed voluntarily or involuntarily by the patient, or produced, for diagnosis' sake, by the physician. Generally, however, the pain thus generated is somewhat different from that due to pressure on the spinous processes, and is chiefly, if not only, an increase of the constant spontaneous pain.

Pains referred to the periphery of the body, or to internal organs, are often associated with local tenderness developed by pressure. These transmitted pains, as well as the local pains caused by pressure, may last for hours—nay, for days, showing how carefully the examination for tenderness should be made. It is well, when we have to deal with hysterical or timid patients, to judge of the degree of tenderness more from the sudden and involuntary movement of the spine, when we press upon it, than from the patient's statements as regards the degree of local or referred pains felt. The amount of blushing of the face when a tender spine is pressed upon, is also a means of appreciating the degree of tenderness, especially when the affected part is in the lower third of the cervical region, or the upper third of the dorsal region.

Spontaneous spinal pain.—This symptom is less important than tenderness, because it is not constant, and also because it often exists in organic spinal complaints. It is increased in most cases by pressure on, or by movement of, the spine. According to Dr. Hammond's observation it is found in about one case out of three of spinal irritation. The writer believes that its frequency is much greater. It is quite variable in its character and degree. It may consist only or chiefly in a feeling of heaviness, of coldness, of heat, of pricking, or of itching. In many cases it increases, and in some it decreases, when the sitting or standing posture is assumed. Lying flat on the back usually diminishes, but sometimes increases it. Its seat is generally at the point where the spinal nerves emerge from the spine, resembling in this respect a neuralgic pain.

Visceral functional disturbances.—Rachialgia is often followed or accompanied by various functional disorders, more or less directly caused by it. The stomach and the heart are the parts chiefly affected; but other viscera (the liver, the kidneys, or the bowels) are also sometimes affected.

Vaso-motor disturbances.—These may appear anywhere, but the face exhibits them more often and more intensely than other parts. They consist chiefly in alternations of great paleness and flushing.

Motor disturbances.—A fixed contraction of some muscles, especially in the fore-arm, has been pointed out by Mr. Teale. Dr. C. B. Radcliffe says that this contraction does not disappear during sleep. This slight rigidity increases when an effort is made to loosen it. A great variety of other motor disturbances may appear in this affection, as will be mentioned hereafter.

The symptoms of rachialgia necessarily vary with the different regions of the spine.

1. **Cervical Region.**—Spinal irritation in very frequent in this region, although less so than in the dorsal. Of 304 cases collected by the two

Griffins, and by Dr. Hammond, the affection was confined to the cervical region 71 times, and it occupied parts or all of the cervical and dorsal regions in 82 cases. More than elsewhere, pressure on the spine, when the disorder is in the neck, will produce referred sensations. For instance, pressure on the two upper vertebræ may cause pain in the forehead; pressure on the third and fourth vertebræ a pain in the pharynx; and on the last cervical a pain behind the sternum. According to the best observers, especially Stilling and the two Griffins, the following symptoms have been noticed in cases of cervical spinal irritation: vertigo, headache, psychical disturbances, insomnia, nightmare, neuralgic pains in the head, face, neck, shoulders, chest, and upper limbs, contraction of flexor muscles in the fore-arms, clonic spasms, fibrillary movements in the shoulders and arms, disturbances in phonation and deglutition, dyspnœa, spasmodic cough, fainting, and palpitation of the heart.

2. **Dorsal Region.**—This is the region most frequently attacked, although the united statistics of the brothers Griffin and Dr. Hammond do not clearly establish this point. The stomach is the principal seat of disturbance in dorsal rachialgia. It shows its irritation by pain, pyrosis, eructations, nausea, and vomiting. Palpitation of the heart is not rare; but dyspnœa and cough are less frequent than in cervical rachialgia. So are neuralgic pains, involuntary movements, and tonic spasms.

3. **Lumbar Region.**—Rachialgia is rarely localised in the lumbar region. Dr. Hammond has seen it fifteen times, and the two Griffins thirteen times. The writer has only seen it four times out of more than fifty cases. It manifests itself or is accompanied by the following symptoms: neuralgia in the lower limbs, myalgia in the lumbar and abdominal regions, painful spasms of the vesical or anal sphincters, uterine and ovarian pains, with or without menstrual disturbances, disorders of motility, such as tonic or choreic movements in the lower limbs, pseudo-paraplegia, &c.

4. **General Rachialgia.**—It is assuredly quite rare to find every vertebra tender. The writer has seen it but twice. But it is not so rare to find cases in which almost every part of the spine is affected. The two Griffins have seen it in fifteen cases out of a hundred and forty-eight. Hyperæsthesia is then usually greater than in localised rachialgia. The pains produced even by the gentlest pressure on one spinous process usually extend to the whole vertebral column. The various symptoms pointed out as due to localised spinal irritation are present here together, and show themselves in the four limbs, the head, the neck, the trunk, and the internal organs—especially, however, in the heart and the stomach.

Diagnosis.—The symptoms of spinal irritation are so characteristic that it is only in cases of complication of this affection with another that doubts might arise. A sprain of the spine, intense congestion of the cellular tissue and of the muscles, and inflammation of the parts close to the spine, involving the fibrous tissue binding together the vertebræ, and due to some traumatic cause, will certainly give origin to the local and sympathetic symptoms of spinal irritation, together with those due to inflammation or considerable congestion. There cannot be a mistake. Two distinct morbid states, then, follow a blow or some other traumatic agency on the spine. In the same way we find hysteria co-existing with spinal irritation. Indeed, it is extremely rare to find that hysteria, beginning by any symptom, will not soon be accompanied by some degree of spinal irritation; and, on the other hand, in almost all cases of genuine spinal irritation, more or less marked hysterical symptoms will appear, so that these two affections almost always are, at least partly, blended together. The singular and rare affection described by Trousseau under the name of *tetany*, can hardly be mistaken for rachialgia, not only because the most important symptoms of spinal irritation are absent or very slight in tetany, but also because in this last affection the muscular contraction is generally accompanied by trembling, anæsthesia, and a feeling of great fatigue. Tetanus, and the organic affections of the spinal cord and its meninges may be put aside, as although there may be spinal tenderness in some of those affections, especially in meningitis, the other symptoms clearly establish their existence, and not that of mere rachialgia. The same may be said of Pott's disease, or other morbid structural alterations of the vertebræ.

Prognosis.—It is impossible to agree with those physicians who take a light view of spinal irritation. If an American practitioner has, as he states, cured 133 patients out of 156, he has been exceptionally fortunate. Although a cure can often be obtained, and sometimes very quickly, this affection, when at all powerful, will frequently resist treatment, or reappear after a temporary cure. The writer would say, however, that many patients refuse to submit to the most energetic means of treatment, and that, therefore, we cannot know what would have been their fate under better means than those used. Still, death is never caused in a direct way by this affection. Its worst feature is that it renders the patient most miserable from pains, weakness, and the various functional disorders it produces.

Treatment.—In this affection, as well as in all functional disorders, anæmia exists so frequently, and participates so certainly in the production, or at least in the persistence, of the symptoms, that the writer can easily accept the statement of some physicians, that certain remedies, such as iron, quinine, the mineral acids, alcoholic stimulants, cod-liver oil, arsenic, and nux vomica, have been used successfully against rachialgia. Indeed, some of these means—one or another, according to special circumstances—ought almost always to be used. The writer's own experience does not confirm that of Dr. Hammond as regards the beneficial effects he attributes to zinc. Internal remedies taken by the mouth are certainly less important than external ones, or medicines used by subcutaneous injection. As regards this last means there is no doubt that injections of morphia or atropia under the skin, especially when made near the focus of pain or tenderness, are of great service, not only for a time against

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these symptoms, but also frequently against the affection itself. The writer employs with more benefit the following substances together than one of them alone in such cases, as well as in cases of neuralgia: sulphate of morphia, from $\frac{1}{3}$ to $\frac{1}{2}$ a grain, sulphate of strychnia, from $\frac{1}{35}$ to $\frac{1}{25}$ of a grain, and sulphate of atropin from $\frac{1}{50}$ to $\frac{1}{40}$ of a grain, beginning with the minimum dose, and reaching quickly the maximum one, if the increase can be borne. When the pain or tenderness is localised in a small part of the spine, the writer has obtained great relief from the use of an ointment of aconitia, two grains; veratria, four grains; and lard, two drachms. Every counter-irritant, including galvanism (if we can look upon it in such a way), has been used with benefit in some cases. Applications of ice and of the actual cautery will be found to be the best. Ice may be employed, finely pounded, as a kind of poultice, applied on a large surface and on the bare skin, or in frictions on the two sides of the spine, and by either process only for three to six minutes, twice a day. If there be no success by these means, the application of a very hot piece of flannel on the principal seat of pain is advisable, followed after five minutes by the application of ice according to one or other of the two above methods. When the whole spine is tender or painful, each of its three regions should be treated, one after the other. Next, if not first in importance, is the use of the actual cautery, after the following rules:—First, the instrument must be at *white* heat; secondly, it must have a very small surface; thirdly it must be applied quickly although firmly; fourthly, it must make, on each day of application, three or four cauterisations on each side of the spine, and these irritations must extend over two or three inches in length; fifthly, the operation is to be repeated every day for eight or ten days, care being taken that the instrument be passed each time on unaltered skin. The writer uses a Paquelin cautery, with which there is, on account of the above rules, neither great pain nor a sore produced. The outer layer of the skin dries up and becomes brown, but there is no blister or ulcer or purulent discharge. This is a most valuable means of treatment, especially when the pain and tenderness of the spine are intense. If all the means already mentioned have failed, or even when they have not been tried, and when the patient is attacked in a great extent of the spine, and is quite submissive and willing to do as she is told, *absolute rest* of the tender and painful parts is to be employed. In Hilton's valuable work on *Rest and Pain*, the rules are given which must be followed in such cases. The words *absolute rest* express exactly what is needed. It would be worse than useless to make a patient with spinal irritation lie down, and stay in bed for two, three, or four weeks, if he or she were allowed to turn in bed, or to move the spine at all at the affected part. If the rest of the part is really absolute and constant, a cure is almost always obtained after a few weeks. So long as the difficult treatment lasts, every attention must be paid to the nourishment, to the state of the bowels, and to the occupation of the mind of the patient. It need not be said that other means of treatment (especially subcutaneous injections against pain), are to be used during the period of rest. Fresh air must be admitted to the room as far as the season allows. The muscles of the limbs (which are to be left without voluntary movement) are to be gently galvanised several times a day, so as not only to improve their nutrition, but to act also on the general circulation of the blood. On getting out of bed, when it is ascertained that both pain and tenderness have disappeared from the spine, the patient must for a time (a week or more) be most careful to avoid moving the parts much which have been affected. The writer cannot conclude this article without referring the reader to a lecture of one of the ablest physicians of our time, Dr. S. Weir Mitchell, of Philadelphia, in which rules not essentially different from the above are given. *See* 'Rest in the Treatment of Nervous Disease,' in *A Series of American Clinical Lectures*, vol. i. No. 4, New York, 1875.

C. E. Brown-Séquard.

SPINE, Diseases and Curvatures of.—Synon.: Fr. *Maladies et Courbures du Rhachis*; Ger. *Krankheiten und Krümmungen des Rückgrates.*

General Remarks.—The vertebral column is a complex anatomical structure, consisting of large masses of bone, chiefly cancellous, forming the bodies of the vertebræ; large flat discs of fibrocartilage placed between the bodies of the vertebræ; and connecting ligamentous structures. On either side of, and behind the vertebral canal, in which the spinal cord is placed, are the oblique articulating, and the spinous processes, with which are connected the large group of muscles, whereby the various movements of the spinal column are regulated, and the erect position of the body maintained.

All these structures are liable to special forms of disease, such as are met with in other parts of the body where similar structures exist. Hence a certain analogy may be traced between the most ordinary forms of disease which occur in the spinal column, and the joint-diseases of the extremities; but the absence of articular cartilage and synovial membrane between the bodies of the vertebræ, destroys much of the analogy Nevertheless, in the ordinary form of disease of the spinal column, or 'Pott's disease,' we have as its chief characteristics, *caries* and *necrosis* of bone, with *ulceration* of the intervertebral cartilage, accompanied by *suppuration*. The ligaments are, as in other parts of the body, especially liable to the *rheumatic* form of inflammation. The muscles are especially liable to *paralytic* and *spasmodic* affections, such as occur in the muscles of the extremities, and other parts of the body. The spine is also very liable to various forms of *curvature*. Other forms of disease, such as *tubercular deposits*, *cystic* and *malignant growths*, are occasionally met with, but do not require special description in connection with the spinal column. The diseases of the spinal cord and its membranes are described in other articles. The only affections, therefore, which demand special consideration in this place are (1) **Pott's Disease**; and (2) **Lateral Curvature.**

1. **Pott's Disease of the Spine.**—Synon.:

Spinal caries; Fr. *Mal vértebral de Pott*; Ger. *Pott'sche Krankheit.*

Definition.—A destructive disease of the spinal column, depending upon ulceration of the intervertebral cartilages; generally associated with caries and necrosis of the bodies of the vertebræ; and named after the distinguished surgeon Percival Pott, who first described its pathological characters.

Anatomical Characters.—The disease may commence either in the intervertebral cartilages, or in the bodies of the vertebræ. In the majority of cases ulceration of one or more intervertebral cartilages occurs, as the result of subacute inflammation; and the adjacent surfaces of the bodies of the vertebræ become destroyed by caries and necrosis. When the disease commences in the bones, primary necrosis occurs in one or more of the bodies of the vertebræ, as it is observed to do in other situations where cancellous bone exists in large masses. In a later stage, the osseous and cartilaginous structures are all involved in the destructive process, and a chasm is formed in the anterior part of the spinal column, which subsequently becomes bent upon itself, the spinous processes projecting posteriorly so as to produce the distortion described as *angular curvature of the spine.* The angular form of the projection is most marked in the dorsal region, in consequence of the natural curve of the spinal column in a posterior direction, and also from the length of the spinous processes. In the cervical and lumbar regions an opposite condition obtains, and an obtuse posterior, rather than angular, projection occurs; and this may be absent, even in cases of extensive disease.

If the case proceed favourably towards a curative termination, the destructive processes become arrested, and a healthy reparative process is established, terminating in bony anchylosis between the bodies of the vertebræ, which have become approximated after the loss of structure. Ossification also proceeds along some of the ligamentous structures passing between the laminæ, as well as between the spinous processes. Thus the resulting angular, or posterior, projection becomes a persistent deformity—a deformity essential to the cure of the case.

Ætiology.—Pott's disease of the spine may be either of *local* or of *constitutional* origin. When *local*, it results from injury, and the violence may be either *direct* or *indirect.*

Cases traceable to *direct violence* are of more frequent occurrence in adult life, for instance, the fall of earth from the roof of a tunnel upon the back of a man, in the stooping position; the fall of a sack of wheat upon the back of a person passing under it; or a fall from a ladder. The evidence of direct injury is not so easily obtained when the disease occurs in childhood, but occasionally we see spinal curvature developed in robust and healthy children, who have never had any previous illness, and whose family history is unexceptionally good. In such cases we can hardly doubt that some slight accident, met with in boisterous play, must have been the immediate cause of the disease; and, in some instances the writer has obtained undoubted evidence to this effect. The immediate symptoms are slight and transient, but in the course of a few months conclusive evidence of the existence of disease is developed.

Indirect violence frequently gives rise to Pott's disease of the spine, and in all probability lays the foundation of the mischief in the greatest number of cases, although the accident, as a producing cause, cannot be traced in every instance, especially when the disease occurs in childhood, as it most frequently does. The kind of accident alluded to is a rick or twist of the spine, as, for example, when a child imitating the clown in a pantomime, turns head over heels, or when a boy is taken up by the arms, and swung round by a man on to his back in play. The latter occurred to a boy who was for several years under the writer's care; the immediate symptoms were not severe, and passed off in a short time, but disease of the spine was gradually developed, with external abscess, through which portions of necrosed bone came away; the boy ultimately recovered. A fall out of bed has frequently been known to lay the foundation of spinal disease, and in many of these accidents there is no evidence of direct injury to the spine. In young adults, a rick or twist of the spine received in wrestling, and in the rough game of foot-ball, or by a fall from a horse, has been known to precede the development of disease without any direct blow upon the spine. In all these cases, the injury done to the articulation is in all probability by laceration of the ligaments, just as in severe sprains at the knee and ankle-joint; and when such an injury occurs in a person of marked strumous constitution, the destructive inflammatory processes of ulceration and caries usually follow, as they do at other articulations, when both local and constitutional causes are combined.

When of *constitutional origin*, disease of the spine is generally developed in children in whom we have sufficient evidence of a strumous constitutional condition, frequently associated with a consumptive family history; still cases are often met with where we have no such indications, but in which the disease has been developed during a condition of induced constitutional debility, that is, after an attack of scarlet fever, measles, or whooping-cough. In this class of cases we have the absence of any history of a local injury, either direct or indirect, and the disease appears to depend essentially upon the constitutional condition of the patient.

Symptoms and Diagnosis.—1. **Early stage.** During the early stage of Pott's disease of the spine, that is, before the production of angular curvature—a stage which usually occupies a period of from six to nine months—the symptoms are often so ill-defined, that an accurate diagnosis cannot be formed. Two symptoms, namely, pain on motion, and pain on percussion over the spinous processes, have been too generally relied upon as indicating the existence of disease; but both these symptoms are frequently absent when disease exists, and are also present in an exaggerated form when there is no disease, so that their diagnostic importance is uncertain. Still, when present in conjunction with other symptoms, they are often of material diagnostic value. A certain amount of fixity in a portion of the spinal column, that is, a want of flexibility in the stooping position, is of importance as showing a condition of reflex muscular contraction, similar to that which exists at the hip- and knee-joints, in the early stage of disease.

There are some *regional peculiarities* of importance in reference to diagnostic symptoms; and the special symptoms present, with more or less distinctness in different regions, may be grouped in two classes, namely—

(*a*) Pain occasioned by certain movements, in which particular muscles attached to the vertebræ which are the seat of disease, are called into play; and pain occasioned by percussion over one or more spinous processes.

(*b*) Attitudes assumed by the patient to avoid pain on motion.

In the *upper cervical region*, a constrained and fixed position of the head, to avoid pain on motion, always exists in the early stage of spinal disease; and the child finding a difficulty in keeping the head in the erect position, acquires the habit of supporting the chin by the hands, the elbows frequently resting on a table or chair. This attitude is of great diagnostic value. Occasionally in this region the disease is ushered in by obscure cerebral symptoms, resembling those of subacute meningitis.

In the *lower cervical and upper dorsal regions* there are no very distinctive symptoms, but in children there is not unfrequently a troublesome cough, sometimes supposed to be a mild form of whooping-cough, probably depending upon irritation of the recurrent laryngeal nerve.

In the *middle dorsal region* the absence of symptoms in the early stages of Pott's disease is most marked, probably from the comparative immobility of this portion of the spinal column, motion in any direction being very limited; and probably also from the absence of any muscular attachments to the bodies of the vertebræ. Local pain, and pain on percussion, are sometimes present. The patient moves about slowly and cautiously, and sometimes sits with the arms extended, the hands resting on a chair, to relieve the spine of the superincumbent weight and the effect of pressure at the seat of disease, as well as to assist in breathing.

In the *lower dorsal and upper lumbar regions*, the early stage of disease is characterised by pain experienced in the various movements in which the psoas muscles are brought into play, such as the stooping position, putting on stockings, lacing boots, or lifting even a light weight from the ground; the act of going up and down stairs; any attempt to rise suddenly from the horizontal to the sitting or standing position, especially in the morning after a night's rest; any attempt to twist the body round suddenly when lying down, as in the act of turning suddenly from the back to the stomach. In this region also may be mentioned as a diagnostic symptom the attitude assumed by the patient in the sitting position, as described in the cervical and upper dorsal region.

2. **Advanced stage.**—In the second stage of Pott's disease, that is when angular curvature is developed, any previous difficulties of diagnosis which may have existed are cleared away, and we know the disease has existed probably from six to nine months, and that a loss of substance in the intervertebral cartilage and bone has occurred. But exceptional cases, in which diagnosis may be doubtful, occasionally occur in two situations, namely, when a posterior projection of the spinous processes takes place, either of the seventh cervical and first dorsal vertebræ, or of the eighth or ninth dorsal vertebræ—situations in which it may be said that a spurious form of angular curvature may exist, as an exaggerated condition of the naturally prominent spinous processes existing in these situations. The projection of the spinous processes may be accompanied with such symptoms as local pain on pressure or percussion, pain extending along the shoulders and down the arms, leading to the suspicion of the existence of disease. When occurring in girls, the symptoms in these cases are generally due to hysteria; but as in some cases disease is subsequently developed, the diagnosis should be cautiously given, and any treatment based upon it cautiously followed out. The projection of the spinous processes of the seventh cervical and first dorsal vertebræ may often be traced to a natural conformation and family peculiarity, as we see in some short-necked and round-shouldered girls. This condition often occurs, in a more marked degree, in adults, and is increased by a thickening and hypertrophied condition of the cellular tissue, possibly also by fluid in a bursa; in such cases the neuralgic pains which accompany it are due to a gouty or rheumatic-gouty tendency.

COURSE, DURATION, AND TERMINATIONS.—The progress of Pott's disease of the spine is extremely variable, but as a general rule, within a period of from six to nine months from the commencement, angular curvature is produced. If the case proceed favourably, without external abscess or paralysis, the disease becomes arrested, and bony anchylosis takes place in about three years. When abscess and paralysis occur, the period of recovery is frequently prolonged to five or seven years. The subject of psoas and lumbar abscess will be found treated of elsewhere. *See* LUMBAR ABSCESS; and PSOAS ABSCESS.

Recovery from the incomplete form of paralysis which occurs in these cases, usually takes place in about two years. When the disease does not terminate favourably in bony anchylosis, death occurs; usually preceded by abscess, paralysis with meningitis, and inflammatory softening of the cord. In children the mortality is probably about one in twenty, and in adults about one in five cases.

PROGNOSIS.—The prognosis in Pott's disease of the spine will be much more favourable in children than in adults, but in both it will be unfavourable in proportion to the rapidity with which the disease pursues its course, and also in proportion to the evidence of a strumous or tubercular diathesis; a large proportion of cases occurring in children and young adults having a phthisical family history.

TREATMENT.—The treatment of this disease must be both *constitutional* and *local*. The *constitutional* treatment is of importance, because in a large number of cases in which this disease occurs, there is evidence of a strumous or tuberculur diathesis, indicating the exhibition of cod-liver oil with hypophosphite of lime, iron, and other drugs of the same class.

The *local* treatment, especially, varies very much according to the age of the patient and the region in which the disease is seated, the principles being essentially recumbency, counter-irritation, and mechanical support. With regard to the local treatment *in the first stage*, that is, previous to the production of angular curvature, a stage which usually lasts from six months to a year, if the disease can be diagnosed, absolute recumbency should be insisted upon; and counter-irritation in some form or other, such as by blisters, the actual cautery, issues, or moxas, is also generally useful. Mechanical support to the spine in any form is not indicated in this stage.

In the *second stage* of the disease, that is, when angular curvature has taken place, absolute recumbency should still be insisted upon for a period of from one to two years from the probable date of the commencement of the disease. This is more especially necessary when disease occurs in the cervical or upper dorsal regions, as there is not only a greater tendency to paralysis, and danger to life in this situation, but when disease takes place in the upper dorsal region, and recumbency is not carried out, the ultimate deformity is always much greater than it need be. Absolute recumbency contributes not only to the arrest of disease, but to a diminution of the ultimate deformity.

When this disease occurs in infancy, or in young children, in any region, absolute recumbency must be insisted upon, the child living and being carried about in a spinal tray made of basket-work with a mattress inside. When disease occurs in the cervical or upper dorsal region, extension by the head may be combined with absolute recumbency, and this was first introduced by Mr. Fisher, who used a rack-and-pinion extension movement. The writer has adopted this principle with great advantage in a case of cervical caries, with partial paralysis, but he employed the weight and pulley attached to the upper extremity of the plane on which the patient was kept day and night.

As the case improves, in the course of one or two years, partial recumbency with mechanical support, that is, recumbency for about half the day, may be substituted for absolute recumbency, and this is especially applicable to cases of disease occurring in the middle and lower dorsal regions, when the disease is not extensive, and appears to be running a slow or chronic and favourable course. As to the kind of support, a piece of thick gutta-percha applied and moulded to the back, whilst the child is lying on its stomach, and retained by a bandage passed round the body, answers very well for hospital practice. A better kind of support is made of thick leather, blocked on a plaster of Paris cast of the back, with elastic in front. The plaster of Paris jacket applied during suspension, introduced into this country by Professor Lewis Sayre of New York in 1877, is very useful, especially in hospital practice, where any rules laid down are certain to be disregarded. The principle of applying a form of support to the spine during the progress of disease, whilst the patient is suspended by the head, is novel, and has been very useful, but must be employed with caution. It secures immobility, relieves undue pressure, and diminishes the consecutive or compensating curves, in many cases to a greater extent than can be accomplished by horizontal extension; and plaster of Paris is a very useful material for the purpose, easily obtained, and can be applied by any surgeon. The disadvantage, however, of not being able to remove it for washing purposes is very great, and the liability to the production of sores from pressure and friction, is also an objection to its use. The material which has now to a great extent superseded the plaster of Paris is the poroplastic felt, which is applied, when softened by steam, whilst the patient is suspended, and being buckled on in front, can be removed as often as required.

Partial recumbency with mechanical support, in some modified form, must be continued in all cases occurring in childhood, long after disease has ceased; and in some cases, in which the resulting deformity threatens to be considerable, even until the completion of growth.

2. **Lateral Curvature of the Spine.**—Definition.—A deformity or contortion of the spine, in which the bodies of the vertebræ deviate laterally in a horizontal direction, with or without a corresponding deviation of the apices of the spinous processes.

Ætiology.—The causes of lateral curvature are both local and constitutional, and as one or other of these causes may predominate, so the cases admit of being arranged in three classes.

Class 1.—Cases in which the constitutional largely predominate over the local causes.

Class 2.—Cases depending upon constitutional and local causes in about equal degrees.

Class 3.—Cases essentially depending upon local causes acting mechanically, so as to disturb the equilibrium of the spinal column.

In cases belonging to the *first class* the spinal curvature generally occurs under twelve years of age. Occasionally it is met with as a congenital affection. Many cases occur in infancy or early childhood, that is, under three or four years of age; but the majority between seven and ten years of age. When congenital, spinal curvature is sometimes associated with osseous malformation, but it also occurs without any such complication. The cases included in the first class can frequently be traced to an hereditary predisposition, lateral curvature occurring in two or three generations, and several members of the same family are frequently affected. The children usually exhibit signs of constitutional debility, and the local causes of curvature cannot be traced, except in infancy, when the children are nursed always on one arm.

In the *second class* the spinal curvature generally occurs between the ages of twelve and sixteen. Hereditary tendency is not usually traceable. These cases may be arranged in two subdivisions, (*a*) *cases depending upon induced constitutional or general debility, combined with local causes acting mechanically*; and (*b*), *those clearly of a ricketty character.*

(*a*) The local causes are the long continuance of certain bad positions, such as standing or one leg; the long continuance of the sitting and stooping position; sitting cross-legged; occupations which render the long continuance of some particular position necessary, such as needlework, book-folding, ironing, nursing children, and carrying heavy weights.

(*b*) The second series includes cases of lateral curvature of a rachitic character, associated with the general rachitic conformation of the skeleton.

In the *third* class spinal curvature generally occurs previous to the completion of growth. These cases are essentially unconnected with any constitutional affection or hereditary predisposition, and frequently co-exist with the natural amount of muscular strength. As local causes, in addition to habits and occupations above referred to, may be mentioned the effects of a wooden leg, and inequality in the length of the legs from any cause, such as would disturb the equilibrium of the spinal column.

Anatomical Characters.—In the so-called lateral curvature of the spine, the spinal column does not yield in a purely lateral direction, as a flexible column would bend, but presents the appearance of a spiral twist, owing to the bodies of the vertebræ turning round in a direction of *horizontal rotation*, so that their anterior surfaces are directed laterally along the convexity of the curvature. In a severe case this rotation commonly extends to a quarter of a circle in the centre of the curve, and diminishes from this point to the two extremities, so that the vertebræ, unequally turned upon themselves, cease to correspond in their natural relations to each other. This deviation of the bodies of the vertebræ does not necessarily correspond to, nor is it always indicated by, any lateral deviation of the apices of the spinous processes, although such deviation generally exists to some extent. In all cases, however, the internal deviation of the bodies of the vertebræ is much greater than the deviation externally of the apices of the spinous processes.

In all cases of confirmed lateral curvature, whether slight or severe, structural changes exist, varying in degree according to the severity and duration of the curvature. The structures affected are the intervertebral fibro-cartilages, the bodies of the vertebræ, and the oblique articulating processes. All these suffer simply from mechanical pressure, arising from the unequal distribution of the weight of the body. The fibro-cartilages and the bodies of the vertebræ suffer from unequal compression in the concavity of the curve, and become more or less wedge-shaped. The articular facets on the oblique articulating processes, which form the only direct articular connections between the separate bones of the vertebral column, undergo important structural changes at an early period of the formation of lateral curvature, that is, as soon as it becomes confirmed. These articular facets become altered in their direction and aspects, according to the extent of the lateral deviation, or rotation, of the bodies of the vertebræ. In the lumbar region, where the articular facets are naturally nearly vertical in direction, looking inwards and outwards respectively, they gradually assume, in a severe case of lateral curvature, an oblique direction, looking obliquely upwards and downwards. Mr. Alexander Shaw first directed attention to these changes in the oblique articulating processes which, as he observes, receive the weight of the body in the act of leaning to one side, and are the only bony structures which check the lateral movements of the trunk; and when any such position is long persisted in, the articulating processes, which are soft and imperfectly formed at the age of puberty, become wasted by absorption, as the result of unequal pressure. The joints of the articulating processes being situated posteriorly as well as laterally, the spinal column cannot yield in their direction, without wheeling partially round. Hence the rotation of the bodies of the vertebræ becomes confirmed, together with the other structural deviations described.

The ligamentous structures, including chiefly the short ligamentous bands passing between and connecting the bodies of the vertebræ and the intervertebral cartilages, and also the short articular ligaments connected with the oblique articulating processes, become adapted to the alterations in the bones, and in the articulating surfaces. It is an error to assume that in confirmed curvature the ligaments are relaxed, and elongated on one side, and contracted on the other, as generally described; although in the physiological condition described as 'weak spine,' with an inclination to lateral curvature, a condition of muscular debility and general ligamentous relaxation undoubtedly exists.

The muscles have not been shown to exhibit any structural changes in the early stage of lateral curvature of the spine, except in those rare instances in which the curvature depends upon partial paralysis. In the late stages, or in adult cases of long standing, the spinal muscles have been found much wasted, pale in colour, and in more or less advanced stages of fatty degeneration. In the early stages of curvature an increased prominence of the spinal muscles is observed on the convexity of the curve, whether in the dorsal or the lumbar region; but this does not depend upon any spasmodic or active muscular contraction. The muscles are simply displaced, or pushed outwards, by the angles of the ribs in the dorsal region, and the transverse processes of the vertebræ in the lumbar region, which are thus displaced as a part of the rotation movement described.

Other structural changes exist in the ribs, which become distorted and altered in shape, so as to lead to deformity of the chest, characterised by a prominence and flattening of the ribs, which become bent at their angles on the side of the convexity—usually on the right side, and a depression of the ribs on the side of the concavity.

Anteriorly, the symmetrical form of the chest is completely destroyed; the sternum becomes very oblique, its lower extremity projecting; and the cartilages of the ribs corresponding to the side of the concavity of the curve—usually the left—are prominent, and bent upon themselves. The oblique diameter of the chest, therefore, is increased, but its capacity is altogether diminished, causing considerable disturbance in the relative position of the heart and lungs, and giving rise to functional derangement of these organs.

The pelvis also becomes distorted in lateral curvature, but only in one class of cases, namely, those of rachitic origin, in which the evidence of general rickets is unmistakably present. In all other cases of lateral curvature of the spine, the pelvis is of its full natural size, and well-formed.

Symptoms and Diagnosis.—Lateral curvature of the spine is generally supposed to be indicated by a lateral deviation of the apices of the spinous processes, but such deviation may exist either as a functional or as a structural condition. It may be seen in a case of weak spine with muscular debility and ligamentous relaxation, such as is frequently met with in quickly growing girls; or it may co-exist with rotation of the bodies of the vertebræ in confirmed lateral curvature. The evidence of rotation of the bodies of the vertebræ precedes the lateral deviation of the apices of the spinous processes in many cases, whilst in others the two conditions co-exist, and appear to take place simultaneously; but rotation of the bodies of the vertebræ may proceed to a considerable extent, the bodies moving horizontally through a quarter of a circle, with only very slight deviation laterally of the apices of the spinous processes. It is therefore the evidence of rotation we must look for in cases of commencing structural curvature, and not the lateral deviation of the apices of the spinous processes. Rotation of the bodies of the vertebræ is always evidenced by a posterior projection of the angles of the ribs on one side, and depression on the other, in the dorsal region; and a corresponding posterior projection of the transverse processes of the vertebræ on one side, and depression of the other in the lumbar region. Upon these conditions alone can the existence of rotation of the bodies of the vertebræ be determined.

Course, Duration, and Terminations.—The progress of lateral curvature is extremely variable, tending naturally towards a process of spontaneous arrest in some cases, and in others to a progressive increase, with proportionate deformity. The course depends very much upon the form and situation of the curvature, especially whether it assumes the character of the so-called 'single' or 'double' curve; descriptive terms which, though not anatomically accurate, are sufficiently so for practical purposes. The cases which naturally lead to spontaneous arrest are those in which a double curvature exists, one in the dorsal, and the other in the dorso-lumbar region, the two curves being about equal in length; whilst the cases in which a progressive increase of curvature and deformity is certain to occur, are examples of the so-called long single curve, frequently involving the whole of the dorsal, together with a portion of the lumbar region, or the whole of the lumbar and a considerable portion of the dorsal region. In cases of double curvature with a marked irregularity in the length of the curves, increase will also certainly occur, but to a less extent than in the long single curves. With regard to the duration and terminations of lateral curvature, these have already been described in the observations made in reference to the course.

Prognosis.—The prognosis will be unfavourable in proportion to the early age at which the spinal curvature commences, and the evidence of constitutional causes with hereditary tendency; and also in proportion to the inequality in the length of the curves, when double, or in cases of so-called long single curves. The prognosis will be favourable in proportion to the absence of these conditions.

Treatment.—For practical purposes all cases of lateral curvature of the spine may be arranged in three classes:—1. *physiological curves*; 2. *commencing structural curves*; and 3. *confirmed structural curves.*

1. With regard to the treatment of cases in the first class, *physiological curves*, no mechanical treatment by any form of spinal support should be given, but reliance placed entirely upon physiological means, such as gymnastic exercises, partial recumbency, and attention to the general health. In some cases an elastic brace attached to stays may be of use.

2. In the second class, *commencing structural curves*, these form the only curable cases of lateral curvature, and in their treatment the writer recommends a combination of mechanical support, gymnastic exercises, and partial recumbency. By this combination of physiological and mechanical means, the further progress of curvature will be arrested, and the best opportunity afforded for recovery from such slight structural damage as may have already occurred.

3. In the third class, *confirmed structural curves*, mechanical support of some kind must be resorted to, and continued during the period of growth, with the hope of preventing increase, and obtaining some improvement in the curvature; but confirmed lateral curvature, whether slight or severe, with its adapted series of structural changes, is essentially an incurable affection. The most efficient retentive spinal support is that form of instrument made with a pelvic belt, and spring plates attached to vertical bars at the back, without any mechanism requiring alteration by the surgeon. In some favourable cases, the stronger spinal instrument, with steel plates attached to levers, and adjusted by rack-and-pinion movements, may be used with advantage. Sayre's plaster-of-Paris jacket has been largely employed in these cases; but, from what the writer has observed in the practice of others, he disapproves of its application, on the following grounds: that it fails as a curative agent, the gain in height by extension being quickly lost; that it weakens the spinal muscles by its constant use, and hinders gymnastic exercises; that it restrains respiratory movements, and prevents active exercise; that it is an unnecessary restraint at night; and that it interferes with bathing and cleanliness. Another form of support has been recently introduced—the poroplastic jacket, which when softened by steam is applied in the same way as the plaster-of-Paris jacket during suspension, and is free from the disadvantages of the latter, as it can be removed at night, or at any time, for the purpose of gymnastic exercises. It acts as an efficient and light retentive support in many cases of incurable curvature. In this class of cases mechanical support, in whatever form it may be employed, must be combined with partial recumbency and gymnastic exercises during the period of growth; but after this period little good will be derived,

except from mechanical support, when a disposition to increase of curvature exists. When there appears to be no disposition to increase of curvature, all mechanical support should be discontinued, attention being paid only to the general health. WM. ADAMS.

SPIRILLUM (dim. of *spira*, a twist, a curl). This is the name given to the most important of the genera belonging to the tribe of Spiral Bacteria (*Spirobacteria*, Cohn). The three genera of this tribe are closely related to one another, as may be gathered from the citation of the characters by which, according to Cohn, they are to be severally distinguished. He describes them as follows:—*Vibrio*, 'filaments short, light, sinuous'; *Spirillum*, 'filaments short, spiral, rigid'; *Spirochæte*, 'filaments long, spiral, flexible.' The alliances between the two latter genera especially are found to be so strong that many naturalists sink the latter generic name, and include all such species under the one genus *Spirillum*.

The interest attaching to these organisms, from a medical point of view, is due to the fact that one of them, as originally discovered by Obermeier, is very frequently found in the blood of relapsing fever patients, during the first paroxysms of the disease (*see* RELAPSING FEVER). This organism is generally known as *Spirillum Obermeieri*, though some speak of it by the name of *Spirochæte Obermeieri*. In length it equals the breadth of 2–5 red blood-corpuscles (*see* Fig. 88). It is quite indistinguishable in size, in general conformation, and in the character of its movements, from another form originally described by Ehrenberg as *Spirochæte plicatilis*, which is to be found in some infusions, in stagnant fresh or salt water, and (as Cohn has discovered) in the mucus about the teeth of some persons wholly free from fever of any kind (*see* SORDES). Some regard the presence of *Spirillum Obermeieri* in the blood as clear evidence that it is the cause of relapsing fever; others look upon its existence there as a mere epiphenomenon—believing, as the writer is inclined to do, that it appears as a consequence rather than as a cause of the morbid processes constituting the fever.[1]

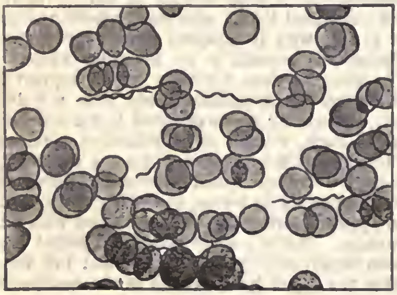

FIG. 88. *Spirillum Obermeieri*, amongst red blood-corpuscles. (After Koch.) × 700.

H. CHARLTON BASTIAN.

SPIROCHÆTE. *See* SPIRILLUM.

SPIROMETER (*spiro*, I breathe, and μέτρον, a measure).—SYNON.: Fr. *Spiromètre*; Ger. *Spirometer*.

DEFINITION.—An instrument for measuring the vital capacity of the chest.

DESCRIPTION.—The object of the several instruments that have been designed for this purpose, is to measure the total amount of air expelled from the chest by the deepest expiration following upon the deepest inspiration.

All our knowledge of spirometry is derived from Dr. Hutchinson's exhaustive paper in the *Medico-Chirurgical Transactions* of 1846. The instrument designed by Hutchinson consisted of a mouthpiece and tube communicating with a gasometer of registered and graduated capacity, into which the patient breathed.

A very convenient and accurate spirometer has within the last few years been introduced by Mr. Lowne, which works on the principle of the anemometer. The advantage of this instrument is its portability.

Dr. Waldenburg describes and figures, at page 202 of his work *Die Pneumatische Behandlung, &c.*, a spirometer identical in principle with Hutchinson's, but more elaborate, and capable of being employed for the purpose of inhalation of compressed or rarefied air.

RESULTS.—The chief results of Dr. Hutchinson's labours may be thus summarised. The vital capacity varies according to *height*, *weight*, *age*, and *disease*.

(1) *Height*. There is an increase of 8 cub. in. in vital capacity for every inch in height between 5 ft. and 6 ft. Thus the vital capacity of a healthy person at 5 ft. to 5 ft. 1 in. being 174 cub. in., at 5 ft. 4 in. it would be $174 + 32 = 206$ cub. in.; at 5 ft 8 in. 238; &c.

(2) *Weight*. Excess in body-weight is associated with diminished capacity in the proportion of about 1 cub. in. per lb. excess.

(3) *Age*. From thirty to sixty years the vital capacity decreases nearly $1\frac{1}{2}$ cub. in. per year.

(4) *Disease*. The spirometer furnishes a very accurate standard of health or of the extent of disease, as regards the chest, the vital capacity in lung-disease diminishing from 10 to 70 per cent. R. DOUGLAS POWELL.

SPITTING OF BLOOD.—A popular synonym for hæmoptysis. *See* HÆMOPTYSIS.

SPLEEN, Diseases of.—SYNON.: Fr. *Maladies de la Rate*; Ger. *Krankheiten der Milz.*—In the *Nomenclature of Diseases* published by the Royal College of Physicians of London, in 1869, the diseases of the spleen are classified under diseases of the digestive system. But the spleen, which is the largest of the structures known as 'ductless glands,' is not immediately concerned with the processes of digestion, and its developmental origin shows it to be unconnected with the digestive organs, although it lies in the abdomen. Its diseases ought rather to be classified with those of the other 'ductless glands,' namely, the thyroid, the thymus, and the supra-renal capsules. It is now generally admitted that the functions of the spleen are intimately connected with the work of sanguification, through certain special chemical processes (metabolic) giving rise to an assemblage of transformations of proteids, associated in some way, still unknown, with the metamorphoses of the blood-corpuscles. The spleen is most probably one of the seats of formation of the white blood-corpuscles, and of destruction of the red. It is in fact a blood-lymph-gland; and the most important indications of splenic disease are derived from the constitutional state due to extreme anæmia. This anæmia is characterised by the mucous membranes appearing pale and bloodless, the complexion and general surface waxy, earthy-like, or sallow; there is great debility and gradual wasting, characteristic dyspnœa, a tendency to hæmorrhages, general anasarca and dropsy,—phenomena which are due to the poverty of the blood, justly referable to some morbid condition of the spleen, and now generally recognised by the name of *splenic cachexia*. Another important function of the spleen, in connection with the other ductless glands, ought not to be lost sight of in the study of its diseases, namely, that it acts as a diverticulum for the accommodation of a relatively large quantity of the blood, upon which those active metabolic processes take place which constitute a special function of the spleen. Its anatomical structure eminently fits it for this. After every meal it is in a state of more or less congestion or hyperæmia, which reaches its maximum about five hours after the taking of food, and it then returns to its normal bulk. Its yielding capsule and its veins, remarkable for their large calibre and great distensibility, even when the distending force is small, sufficiently explain the rapid physiological and morbid congestions with which the organ is affected, as well as the rapid subsidence of splenic enlargements. The ductless glands, and especially the spleen, vary so much in magnitude within healthy limits, that it is difficult to state their usual weight and dimensions. The spleen may, however, be stated to range in weight in the adult from four to ten ounces avoirdupois; but in cases of enlargement weights as high as 18 lbs., 20 lbs., and even 40 lbs. are on record. In atrophic states the writer has weighed it as low as half an ounce. In relation to the body its normal weight is about 1 to 350 or 400 up to the age of forty; and as age advances, the relation becomes as 1 to about 700. It usually measures about 5 inches in length; 3½ inches from the front to the posterior edge; and 1½ inches in thickness. Its bulk averages from 9¾ to 15 cubic inches; and its specific weight is about 1·060.

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[1] Dr. Vandyke Carter of Bombay has of late succeeded in reproducing the disease by inoculation, in certain small monkeys. But, for such a method, there was a large proportion of failures, viz. six, in twenty-one trials. Dr. Carter, in reference to this, says (*Medico-Chirurg. Trans.*, 1880, p. 125):—'The discrepancies indeed, in my experiments are marked enough to render it doubtful if the spirillum itself does represent the contagion proper, and not rather some other agency which at certain periods is associated with it.' A similar doubt was expressed by Dr. Murchison, who, when referring to the disappearance of the organisms from the blood before the crisis of the fever, their absence during the intermission, and their reappearance with the relapse of fever, said (*Path. Trans.* 1875, p. 317): 'It seems difficult to account for their appearance and annihilation twice over, except on the supposition that the soil was suitable for their development during the febrile process and unsuitable when the febrile process was complete.'

In the following paragraphs the diseases of the spleen will be shortly noticed mainly in the order in which they have been named in the nomenclature of the College.

1. **Acute Inflammation.**—Synon.: *Splenitis*. As a *primary* affection acute inflammation of the spleen is of rare occurrence in this country. It has been known, however, to result from blows, or other kinds of accidental violence; but such injuries are more apt to cause rupture of the organ. It is mainly to the occurrence of hæmorrhagic infarctions that splenitis is due, with more or less consecutive suppuration. These infarctions occur during the course of contagious fevers; in blood-poisoning, such as pyæmia; and in valvular diseases of the heart, where vegetations of fibrin form on the valves, leading to embolism. Such infarctions are generally well-defined accumulations of fibrin in more or less rounded masses when limited and in the substance of the organ, but generally wedge-shaped when involving larger portions. The base of the wedge is towards the periphery, where it may cause an elevation of the capsule, the apex being directed towards the hilus of the spleen. The infarctions vary in size from a pea to a hen's egg; and are at first of a dark brown or brownish-red colour, and quite hard. Colour, however, is soon lost, and they become yellowish-white. A margin of acute inflammatory reaction is often well-marked round their boundaries. Under such circumstances the spleen is enlarged, and of a deep purple colour; its tissue so soft as to be easily broken down—about the consistence of coagulated blood. Pus may form, generally in one or more abscesses containing each a variable quantity; or the whole spleen may be converted into a bag of pus. Splenic abscesses have been known to open externally, into the left thoracic cavity, the stomach, the transverse colon, and the cavity of the peritoneum, where circumscribed peritonitis generally forms a limiting sac for the pus. Splenitis may also terminate by the infarction caseating, or becoming a mass of fibro-cellular substance, which, gradually shrinking up, leaves a cicatrix-like contraction on the capsular surface, in which calcification may occur. These fibrinous infarctions in the spleen correspond to the areas which mark the terminal divisions of the branches of the splenic arteries, commencing to deposit beyond where they break up into the hair-pencil-like small twigs known as *penicilli*. *Secondary splenitis* is generally the result of pyæmia or blood-poisoning, ending in abscess. Such pyæmic blocks or infarcts resemble the simply fibrinous infarcts in shape, but they are more irregular, because the process tends to extend beyond the limits of the area of the terminal twigs of the blood-vessels; and they rapidly proceed to suppuration, with inflammation of the capsule of the spleen which covers the base of the infarct, and probably due to its very septic properties. In such cases there seems to be some spontaneous local coagulation of the blood in the splenic vessels—the blood itself being morbid, as in contagious fevers such as typhus—without any evidence of embolism.

Symptoms and Physical Signs.—The symptoms and physical signs of splenitis are mainly due to the presence of, and changes associated with, infarcts. The hyperæmia and inflammation cause the whole gland to swell. In cardiac diseases, with embola from valvular vegetations, these infarcts are generally numerous, and the swelling is therefore proportionally great, with tumefaction and some pain in the left side; and probably there is ascites and dropsy. Such splenitis may go on even to suppuration, without marked local symptoms. The enlargement of the spleen—sometimes called 'splenic tumour'—can generally be recognised by palpation, aided by percussion. Its form is that of the spleen exaggerated; and the lobulation or notching of its swollen anterior edge can sometimes be felt through the wall of the abdomen, if the patient be thin. The enlarged gland, growing, as it were, out from beneath the ribs on the left side, can sometimes be traced extending low down, as far as, and even into, the pelvic region, well over beyond the right side of the *linea alba*, and backwards towards the spine, where its margin can be separated from the mass of dorsal muscles. Its lower end can also generally be felt as a rounded edge. The tumour is movable in all directions by manipulation, change of posture, and by the act of respiration, when adhesions do not fix it. Weight and uneasiness, rather than local soreness, are present. The splenic cachexia exists; and there may occur hæmorrhages from the stomach and bowels towards the fatal end of such cases, often so profuse as rapidly to hasten dissolution.

Diagnosis.—The diagnosis of enlarged spleen, resulting from splenitis due to one or other of the causes referred to, requires the exclusion of lardaceous disease; malignant or other tumours about the cardiac end of the stomach or tail of the pancreas; such swollen conditions of the spleen as exist in Hodgkin's disease; an enlarged left lobe of the liver; and renal, omental, or supra-renal growths.

2. **Hypertrophy.**—Simple enlargement of the spleen occurs under a great variety of circumstances; but true hypertrophy, uncomplicated, and in its simplest form, is a rare occurrence, in which nothing abnormal is to be seen in the spleen or in the blood. Enlargement with hyperæmia (congestion of the spleen) occurs as a result or concomitant of pyrexia in many specific fevers—notably in enteric and malarious fevers, erysipelas and puerperal fever, pyæmia, and acute tuberculosis. The capsule of a spleen so enlarged appears very tense. The gland feels plump and elastic; but on section its substance is generally soft, pulpy, almost liquid, very full of blood, and of a dark colour. Sometimes, however, it is so firm that a more or less smooth or coarsely granular surface is shown on section, with an abundant new formation of small lymph-cells and nuclei, many of them contained in large mother cells (compound splenic corpuscles), and seen especially in the splenic pulp and vein. This condition constitutes the nearest approach to true hypertrophy, in which, with an increase in the quantity of diffuse granular matter, the enlargement is due less to hyperæmia simply than to increase of normal structural constituents. Thus the organ may attain two or three times its natural size; but the enlargement is only temporary, and subsides as the pyrexia subsides. Such simple hypertrophy sometimes results from long-continued or mechanical hyperæmia, following any obstruction to the portal circulation, or obstructive valvular disease of the heart.

The hypertrophy consequent on malaria being fully described in another article (*see* Malaria), there only remain to be noticed two special forms of splenic hypertrophy, one named by the College of Physicians as a subvariety—namely (*a*) *leucocythæmia* or *leukæmia*; and the other (*b*) a peculiar enlargement originally described by Dr. Hodgkin, but which has not been named by the College as a substantive disease. It is, however, an affection which presents such very striking peculiarities, that it requires a distinct appellation and description.

a. Leucocythæmia.—Leucocythæmia is fully described under its own heading; but a brief account may be given of the disease in the present article. It has a much more extended pathology than is implied by a mere hypertrophy of the spleen, although the enlargement of the spleen is almost constant. The disease is one *sui generis*, in which the number of the white corpuscles of the blood is greatly increased, with a simultaneous diminution of the red. It is generally brought about by chronic exhausting diseases, exposure to cold and wet, or such serious acute diseases as typhus fever, pneumonia, puerperal fever, or affections of the lymphatic glands; and it is almost always attended by enlargement of the spleen. The condition is generally associated with cough, diarrhœa, epistaxis, hæmorrhagic effusions, and furunculous or pustular eruptions. The increase of the colourless corpuscles of the blood, which with the enlargement of the spleen are the prominent characteristics of this disease, does not seem in any case to have occurred alone. Other and variable morbid states are always associated; or some change-producing event in the constitution, such as happens during the period of gestation and the process of parturition, precedes or coexists with the augmentation of the colourless blood-cells. The largest spleens are found in connection with this disease. There is a true hypertrophy of the organ in all its parts, so that its substance on section appears to be quite natural, although sometimes paler than usual (as all the organs are), and sometimes having a peculiar smooth lustrous appearance. Lymphatic structures also are to be sometimes seen in separate or conglomerate masses in its substance. These are composed mainly of adenoid tissue, like a congeries of splenic corpuscles or Malpighian bodies. The liver is frequently enlarged and pale. Affections of the lymphatic glands sometimes also predominate; especially in such cases as Virchow has described, where a lymphatic *diathesis* prevails, and there is a progressive inclination of the lymphatic system to the formation of lymphatic elements, while lymphatic gland-tissue tends to grow beyond its pre-existing boundaries. The liver, in such cases, as well as the spleen, contains numerous accumulations in whitish granules, or some kind of lymph tissue. This constitutes *lymphæmia*, or the lymphatic form of leucocythæmia; the other being the splenic. It may also be associated with an increase in the medulla of the bones. The causes which bring about this form of hypertrophy of the spleen, with its attendant changes in the blood, are yet obscure; still there is sufficient evidence to show that some acute inflammatory processes may lay the foundations of the morbid state. The writer has seen the lymphatic form of the disease follow so conspicuously after exposure to cold and wet, as to leave no doubt of the relation of the disease to the exposure in the connection of effect and cause, the inflammatory swellings of the lymphatic glands commencing immediately after the exposure. There is also evidence to show that the disease may exist in a latent, masked, or subacute form for an unknown period, till the occurrence of some more acute disease, or change-producing period like child-birth, unmasks the constitutional state, after which the disease rapidly proceeds to a fatal issue. In females four cases out of ten have had their first beginnings rendered obvious after pregnancy.

SYMPTOMS.—In the majority of cases intense 'splenic cachexia' prevails, with the usual physical signs of splenic tumour. Weight and fulness of the abdomen are the chief subjective local sensations; but transitory pains are frequently experienced there. Ascites and anasarca are usually also present. The surface of the body is pale; vomiting, diarrhœa, or constipation may prevail by turns; and jaundice is not infrequent; but diarrhœa to a considerable amount is by far the most frequent and dangerous complication, and the most difficult to arrest or control. Hæmorrhage occurs generally as epistaxis, or from the gums. The course of leucocythæmia is usually chronic, and an extreme degree of emaciation is the result; but it is not till towards the fatal issue that febrile phenomena set in, the type of which is usually hectic. In the *diagnosis* of this disease it is necessary to examine the blood microscopically, in order to demonstrate the varied increase of the colourless blood-corpuscles and diminution of the red. A single drop of blood is sufficient for this purpose, most conveniently obtained by a needle puncture of the patient's finger, the resulting drop of blood being examined under a magnifying combination of at least 250 diameters. The colourless corpuscles will then be seen to form at least a sixth, a fourth, or nearly a half of the whole number of corpuscles. A proportion of one white to ten red, or even as many as one to three, is not uncommon—an increase which gives to the blood a paler and more opaque appearance than is natural. In splenic leukæmia the white corpuscles are larger and more granular than normal. The red corpuscles may be reduced to one half, or one quarter, of the normal amount. As leukæmic blood decomposes, Charcot discovered that it contained microscopic, colourless, elongated, octohedral or spindle-shaped crystals, insoluble in water, but soluble in acids and alkalies, which he and Vulpian regarded as proteid bodies.

PROGNOSIS.—Hitherto no instance of cure is known. All the cases have progressed to a fatal termination in about fourteen months—the minimum duration being about three months, and the maximum about four years. Death takes place gradually by asthenia and exhaustion; or rapidly from hæmorrhage or diarrhœa.

b. Hodgkin's disease.—The other form of splenic hypertrophy is that which has been described by the name of 'Hodgkin's disease.' It is also known as lymphadenoma. It is characterised by a peculiar white deposit or growth in the spleen, in addition to mere hypertrophy; which is sometimes also seen in the liver, kidneys, and lungs. An enormous enlargement of the lymphatic glands throughout the body, accompanied during life by a remarkable anæmia and disposition to subcutaneous œdema, are usually the earliest phenomena. The groups of glands in the order of their most frequent involvement are the cervical, axillary, inguinal, retro-peritoneal, bronchial, mediastinal, and mesenteric. The new growth is at first limited to the glands, but eventually advances beyond their capsules, so that the enlarged glands become confluent in lobulated masses, which may invade and infiltrate adjacent tissues. The disease differs from leucocythæmia in this respect, that there is no marked increase in the white corpuscles of the blood; nor has it anything to do with lardaceous disease. The enlargement of the lymphatic glands appears as the primary affection, and consists in a general hypertrophy of every part of the glands; but the exact nature of the defined white bodies which pervade the spleen is not clearly made out. Their growth commences in the Malpighian bodies. They are similar to what are found in the liver, lungs, and kidneys; and are composed mostly of lymphoid or adenoid cells imbedded in the stroma, similar to the structure of a lymphatic gland. *See* LYMPHADENOMA.

SYMPTOMS.—These are indicative of general ill-health—paleness and sallowness of complexion preceding all other signs. Weakness gradually increases, the patient begins to totter on his legs, and at last is unable to walk. Sexual appetite is lost; and emaciation progresses, with marked anæmia, a pale sclerotic, and a feeble pulse. The legs finally become œdematous.

PROGNOSIS.—The disease is eminently malignant, death usually taking place through derangement of the functions of the lymphatic system.

3. **Lardaceous Disease.**—Albuminoid disease is rarely limited to the spleen, but usually also affects the liver, kidneys, and sometimes the intestinal villi in the same patient. The trabecular interspaces, but more commonly the Malpighian sacculi, are filled with the new material, so that each corpuscle looks like a sago-grain. The spleen so affected is usually enlarged, and is specifically as well as absolutely heavier than in health. *See* ALBUMINOID DISEASE.

A lardaceous spleen implies a long-standing cachexia, and in its most intense form is seen after protracted caries and necrosis of bone, especially when associated with scrofula or syphilis; or even after external injury which leads to protracted bone-disease. Hence the question is still undecided whether lardaceous disease arises from such local sources, or is a constitutional or general disease.

4. **Cancer.**—Cancer of the spleen is extremely rare as a primary lesion. It chiefly occurs as an infective process, following generally cancer of the stomach or other viscus; or as generally disseminated encephaloid growths.

5. **Rare Diseases.**—Here it is only necessary

to mention hydatid disease, tubercle, and the splenic enlargement occasionally occurring in congenital syphilis.

Treatment.—Treatment of these diseases of the spleen by medicinal remedies is extremely uncertain, as can readily be understood from what is known of their pathology. All sources of mechanical congestion must if possible be removed or relieved. Saline purgation may be useful for this purpose; also compound jalap powder, with rhubarb, and sulphate of iron may be taken in such quantities as will produce three or four stools in the twenty-four hours. The iodides and bromides of potassium have also been recommended. The biniodide of mercury, in the form of an ointment, rubbed into the skin, has also had a beneficial effect in reducing simple splenic enlargement when not otherwise complicated. In the chronic hypertrophies, such as leucocythæmia and Hodgkin's disease, improvement of the general health is all that can be arrived at, by the employment of tonics, change of air, and attention to the hygiene of the patient. *See* Leucocythæmia; and Lymphadenoma.

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SPLENIC FEVER. *See* Pustule, Malignant.

SPLENIZATION.—A morbid state of the lung, in which it somewhat resembles the spleen in colour and consistence. *See* Lungs, Compression of.

SPORADIC (σπείρω, I scatter).—This term is used in connection with the occurrence of diseases occasionally, and in an isolated manner, amongst individuals; as distinguished from those diseases which appear endemically or epidemically. *See* Disease, Classification of.

SPORADIC CHOLERA. *See* Choleraic Diarrhœa.

SPOTS.—A popular name for eruptions on the skin. *See* Eruption; and Maculæ.

SPOTTED FEVER.—A popular name for typhus fever. *See* Typhus Fever.

SPRAYS, Therapeutical Uses of. *See* Inhalations.

SPUTUM (*spuo*, I spit.) *See* Expectoration.

SQUAMÆ (*squama*, a scale).—Scales. A synonym for scaly diseases of the skin. *See* Scaly Eruption.

SQUINTING. A popular name for strabismus. *See* Strabismus.

STADIUM (Latin, a stage).—A period or stage in a disease, as in fever; for example, *stadium incrementi, stadium convalescentiæ*.

STAGNATION OF BLOOD.—Local arrest of the circulation. *See* Circulation, Disorders of; and Inflammation.

STAINS.—This word, as applied to the skin, is synonymous with 'maculæ.' *See* Maculæ.

STAMMERING.—Synon.: Fr. *Bégaiement*; Ger. *Stottern.*

Definition.—Under the head of stammering, in its broadest sense, are included many different forms of defective articulation, such as the inability, congenital or acquired, to pronounce certain letters or certain combinations of letters, the tendency to hesitate or stumble in utterance or to transpose letters or syllables, and the habit of interjecting meaningless sounds or words into the pauses which occur in the course of continuous speech. But the term is generally used, at any rate in English, as synonymous with *stuttering*, to imply a spasmodic affection of the organs concerned in speech, in virtue of which the enunciation of words becomes suddenly checked, and a painful pause ensues, not infrequently marked by a prolongation, or a repetition in rapid sequence, of the particular literal sound at which the check arises.

Ætiology.—Stammering is to some extent hereditary, although a large number of stammerers are certainly free from hereditary taint. It is sometimes imitative. The defect rarely, if ever, shows itself before the age of four or five years. Usually it comes on from this time up to the period of puberty. But it may originate at any age; sometimes after febrile disorders; sometimes in connection with nervous affections, such as epilepsy, hysteria, and tabes dorsalis; sometimes it attends mere temporary failure of health; sometimes it appears in connection with soreness or irritation of the mouth; sometimes it is induced by simple nervousness or excitement. In many of these cases the stammering is temporary only, and disappears with its cause. And as a general rule confirmed stammerers have their infirmity aggravated under similar circumstances. Occasionally, on the other hand, stammering ceases during the presence of illness. It is a curious fact that men stammer in much larger proportion than women. Cases of persistent stammering, arising in childhood, sometimes recover in the course of time; and, as a general rule, some improvement takes place after the attainment of maturity, and especially as age advances.

Description.—It has often been maintained that stammering occurs only in connection with the enunciation of the explosive consonants, that it never attends the utterance of the vowels, and that it never manifests itself during the acts of whispering and of singing. All these statements, however, though founded on fact, are more or less inaccurate. For though it is at the explosive consonants *b*, *p*, *d*, *t*, hard *g* and *k*, that stammerers for the most part come to grief, stammering is by no means uncommon during the articulation of the continuous consonants, such as *v*, *f*, *th*, *z*, *s*, *sh*, *y*, *w*, *m*, *n*, and even occurs when vowel-sounds are being produced; and though it is certainly rare for patients to stammer when whispering or singing, there are exceptions to this rule.

When stammering takes place in connection with the explosive consonants, the barriers by whose sudden opening after complete closure the several consonantal sounds are produced, instead of separating, as they should do, remain spasmodically closed; and the patient struggling to overcome the spasm, either remains, for a variable but short time, absolutely voiceless, or overcoming the resistance fitfully, utters the consonantal sound in a series of two or more successive puffs. In the utterance of *b* and *p* it is the lips which remain closed; in the utterance of *d* and *t* it is the barrier formed by the tongue, whose tip is pressed against the superior incisors or anterior part of the palate; in the production of hard *g* and *k* it is the barrier formed by the pressure of the dorsum or root of the tongue against the posterior part of the palate.

In pronouncing the continuous consonants, the barriers at which the distinctive sounds are produced are not in absolute or uniform contact; and the consonantal sounds are continued during the passage of air through the constricted oral channel or through the nose. When, therefore, stammering attends their pronunciation, it is not due to any spasmodic closure of the parts engaged, but rather to their fixation in the natural position they have assumed, and to the frequent association therewith of more or less rhythmical attempts to close them or to separate them more widely from one another. The resulting sounds therefore either come to a full stop, or are simply prolonged or drawled, or are repeated.

In the utterance of the vowels the mouth and its appendages play only a subordinate part, and a free passage is maintained for the passage of air through the mouth. It is at the rima glottidis that the fundamental sound is produced, and it is mainly to spasm of this part that vowel-stammering is due.

But the hitch in utterance may also originate in the respiratory apparatus, and not infrequently stammering depends on a sudden inspiration or expiration, or on an arrest of the respiratory movements.

It will thus be seen that stammering may be caused by spasm of either of the three mechanisms concerned in the mechanical production of speech; namely, the mouth, wherein words are articulated; the larynx, where phonation is effected; and the respiratory apparatus, which regulates the supply of air to the organs of speech and of music. At the same time there is no doubt that stammering is far more frequently connected with spasm of the muscles of articulation than with spasm of the larynx or of the respiratory muscles, and that, of the three, respiratory spasm is the least common. Not infrequently, however, the different varieties of spasm are associated in a greater or less degree.

The degree and character of stammering differ largely in different cases. Sometimes it is nothing more than a scarcely perceptible hitch in the enunciation of a particular letter; sometimes it is so severe and continuous that the patient becomes almost unintelligible. The most distressing cases are those in which the spasm extends to parts unconnected with speech, it may be to nearly the whole muscular organism. In such a case the spasm commences, let us assume, at the base of the tongue; the mouth opens widely, and remains in that position; the muscles of expression work convulsively; the glottis contracts; respiration becomes arrested; the face becomes congested and the veins dilated; violent spasmodic movements involve the trunk and limbs; and only after some time, either when the patient becomes exhausted or he resolutely restrains his attempts to articulate, does his paroxysm come to an end. A stammerer of this kind is a truly pitiable object. Fortunately for him, however, these severe paroxysms are not always present; they increase in number and intensity under excitement or nervousness; and, on the other hand, may be replaced to a large extent in ordinary quiet conversation by merely slight hitches or drawls or reduplications of letters. A condition allied to stammering, to which the name *Aphthongia* has been given by Fleury, has been occasionally observed. It seems to be the product of intense excitement, and of temporary duration only; and to be characterised by powerful spasm of the muscles supplied by the hypoglossal nerves, including the sterno-hyoid, sterno-thyroid, and thyro-hyoid muscles, which comes on whenever an attempt to speak is made, and totally prevents speech.

PATHOLOGY.—The pathological explanation of stammering is obscure. There is no reason to believe that it depends on any discoverable material lesion, either of the organs concerned in speech, or of the nervous mechanism which controls them. It appears to be allied to a series of spasmodic affections, which have been especially studied by Duchenne, in which complex co-ordinated movements (facility in the execution of which is only attained by long practice) are concerned; such, for example, as scrivener's palsy, and the recurrent spasms which occasionally compel the skilful pianist or violinist, and the practised swordsman, to give up their pastime or avocation. Speech is pre-eminently an act of this kind. It is slowly and laboriously learnt in early childhood; and ease and accuracy of articulation are the result only of long and continuous practice. We are born with the capacity for speech, but articulate speech itself is the outcome of careful education. For its successful performance it is necessary that three distinct and complex mechanisms—the respiratory, the phonetic, and the articulatory—shall act with precision and in exact concordance; that the lungs shall be expanded at suitable intervals, and to a suitable degree, and that the force of expiration shall be regulated with nicety; that the rima glottidis shall be opened or closed according as surd or sonant letters are to be produced, and that the tension of the cords shall be accurately adjusted to the pitch of the musical tones required to be produced; and that the movements of the lips, jaws, tongue, and soft palate shall be accurately adjustable for each literal sound, and capable of passing from one set of adjustments to another with rapidity and smoothness. Of all these co-ordinated movements, those connected with articulation are the most various in their grouping, the most rapid in their changes, and the latest learnt. It is natural, therefore, that the hitch or spasm interrupting speech should occur mainly in connection with these, and mainly, if not exclusively, at the instant of passing from one literal sound to another; that is to say, at the moment of transition from one set of muscular combinations to another set. It is natural too that the laryngeal or the thoracic spasm should occur rather in association with articulation than at other times; inasmuch as the movements are more various and intricate during articulation than they are during ordinary respiration, or even than they are in the production of musical notes, as in singing. In the last case the laryngeal changes, though extremely delicate and exact, are mainly of one kind only, dependent, namely, on variations of tension in the vocal cords.

Treatment.—In dealing with cases of stammering it is necessary in the first place to counteract, or cure, if possible, any affection of the mouth or throat, or any general disorder that may be present, which are frequent causes of temporary stammering, or of aggravation of habitual stammering. Assuming, however, that the patient is in other respects in absolutely good health, what can be done? Many kinds of medical treatment have been practised, and even operative measures; but, as far as the writer knows, without beneficial result. The only methods, indeed, of any real efficacy, are educational methods. The patient should be taught to practise slow and deliberate utterance, and whenever the tendency to stammering occurs in connection with any letter, to check himself momentarily by voluntary effort, and then to try again, rather than to struggle against his defect. He should, moreover, be taught to accustom himself so to regulate the admission of air into his chest during speech, that his utterance may never fail for want of breath. Further, considering that excitement and nervousness always aggravate stammering, he should learn, as far as possible, either to avoid speaking under these conditions, or to restrain excitement and nervousness, or so to control himself as to speak with special care and deliberation when he is thus affected. These measures should not only be observed in ordinary conversation, but be habitually and systematically practised in reading aloud; and especially those sounds, or those combinations of sounds, or those transitions from one sound to another, which are most difficult for him, should be made the subject of careful and constant study. By such means habitual stammering is occasionally cured, or if not cured, so far kept in abeyance that an occasional momentary pause in speech is the only surviving indication of it that the practised ear can detect. More frequently, however, the stammerer remains a stammerer, either because he has never had the patience and determination which are necessary to carry out the line of treatment above indicated, or because his infirmity is one for which treatment is unavailing. By taking advantage of the well-known fact that stammering almost always disappears during singing, many stammerers have been able to counteract their defect by intoning. This method has proved of special efficacy in the cases of clergymen and other public speakers.

J. S. Bristowe.

STAPHYLOMA (σταφυλή, a bunch of grapes).—Synon.: Fr. *Staphylôme*; Ger. *Staphylom.*—This word was applied by old writers, in the jargon which was once supposed to be scientific, to any limited protrusion of the tunics of the eyeball. It was first used to denote the protrusion which occurs in the circum-corneal sclerotic zone, as a consequence of localised inflammation of this region. The tissue affected by the inflammation in such a case becomes softened, yields to the intra-ocular tension, and projects; but being restrained by bands of lymph, or by thicker portions of its own structure, from projecting uniformly, the prominence becomes more or less sacculated; and the most prominent portions, being thinner than the rest, and permitting the dark pigment of the interior of the eye to show through, present an appearance which may be compared to that of a miniature bunch of purple grapes—a real or fancied resemblance from which the term 'staphyloma' was derived. This form has more recently been termed 'staphyloma of the sclerotic,' to distinguish it from 'staphyloma of the cornea,' which is the protrusion left when the corneal tissue has been destroyed by ulceration, either wholly or in part, and the resulting cicatrix, formed of iris-tissue coated over by lymph, yields to the pressure of the fluids within the eye and becomes prominent. *Corneal staphyloma* is described either as partial or complete, according to the amount of cornea which is replaced by cicatrix.

Staphyloma posticum is a phrase applied to that protrusion of a circumscribed portion of the sclerotic, in the immediate vicinity of the optic nerve, which occurs in some cases of myopia; and which, by increasing the elongation of the eyeball, increases also the degree of the short sight. It would be highly desirable to abandon the term 'staphyloma' in favour of 'protrusion,' with such appended words as might serve to indicate the place and nature of the change. *See* Eye and its Appendages, Diseases of.

R. Brudenell Carter.

STARVATION (Sax. *Stearfian*, to perish). This term is generally applied either to deprivation of food, or to the series of phenomena to which such want gives rise. The word is often used synonymously with *fasting*, which, however, may be more accurately applied to voluntary starvation. *See* Fasting.

STASIS (στᾶω, I stop).—Local arrest of the circulation. *See* Inflammation.

STATISTICS, Medical.—This term signifies the collection of numbers respecting healthy and morbid processes, and respecting disease and death; the application of arithmetical and algebraical operations to such numbers; and the deduction of conclusions therefrom.

But little use of statistical methods was made in medicine before the present century; and much of the progress that science has recently made is largely to be ascribed to the direct use of such methods in pathology, ætiology, and therapeutics, and to the indirect influence they have had in promoting accuracy of thought.

The value of statistics depends upon the complete uniformity of the facts observed, and upon the accuracy with which the observations are made. It may be well here to remember the words of Rousseau, quoted by M. Louis: '*Je sais que la vérité est dans les choses et non dans mon esprit qui les juge, et que moins que je mets du mien dans les jugements que j'en porte, plus je suis sûr d'approcher de la vérité.*'

In England much use of statistics has recently been made in the investigation of the causes of disease among communities. *See* Morbidity;

Mortality; Periodicity in Disease; and Public Health. G. B.

STEARRHŒA (*στέαρ*, fat, and *ῥέω*, I flow).—Synon.: Steatorrhœa.

Definition.—A flux of the fatty secretion of the skin. By an ungrammatical combination of the Latin *sebum* with the Greek verb, it is sometimes written *seborrhœa*.

Ætiology.—An ill-nourished or debilitated condition of the skin must be regarded as the cause of this affection; the debility being sometimes temporary, as in young persons, and sometimes permanent, as in the elderly.

Description.—Like other secretions, that of the sebum of the sebaceous glands and follicles is liable to excess. It is sometimes diffused over the surface, forming a greasy stratum, and sometimes accreted in laminæ of various extent. This is the *stearrhœa simplex*, an affection most commonly met with on the face.

The excessive secretion in its normal state is colourless, but occasionally it is stained with melanic or biliary pigment; hence the terms *stearrhœa nigricans* and *stearrhœa flavescens*. Sometimes, as in elderly persons, the epithelial element of the secretion prevails over the fatty element, and in that case it is apt to adhere closely to the epidermis. In the latter case the concretion may be accompanied by excoriation, and sometimes by asthenic ulceration, of the skin.

Diagnosis.—Stearrhœa is so obvious in its nature as to be unlikely to be confounded with other affections of the skin. It is sometimes associated with acne; and, in certain cases of excessive accumulation, has been denominated 'ichthyosis.'

Prognosis.—Stearrhœa is an affection which admits of immediate relief, and is generally curable. In elderly persons, however, it is sometimes the precursor of epithelioma of the skin, or of rodent ulcer.

Treatment.—The abundant use of soap as a detergent, followed by the application of a lotion of lime-water with oxide of zinc and calamine, very speedily exerts a favourable influence on the skin. Concretions may be softened previously to removal, by pencilling with olive oil, or by inunctions with vaseline. And where the encrusting laminæ are incorporated with the epidermis, a cold starch-poultice, made as starch is ordinarily prepared, may advantageously precede other curative operations.

In both young and elderly persons it will be necessary to improve the general health, which is usually defective. And it may be found desirable to conclude the treatment by the administration of three minims of liquor arsenicalis three times a day, as a neuro- and nutritive tonic. Erasmus Wilson.

STEATOMA (*στέαρ*, fat, and *δμὸς*, like).—Synon.: Fr. *Stéatome*; Ger. *Steatom*.—An atheromatous cyst. *See* Cysts.

STEATOZOON (*στέαρ*, fat or sebum, and *ζῶον*, an animal).—The terms *Steatozoon* and *Entozoon folliculorum* were given by Sir Erasmus Wilson to the microscopic animalcule called by Gustav Simon *Acarus folliculorum*, and by Owen *Demodex folliculorum*. *See* Acarus.

STENOSIS (*στενόω*, I constrict).—A constriction, narrowing, or stricture of an opening or a tube; for instance, *mitral* or *aortic stenosis*, in the heart; and *stenosis of the œsophagus*.

STERCORACEOUS (*stercus*, dung).—Fæcal; a term generally applied to vomited matter, when it presents the characters of fæces. *See* Vomit.

STERILITY IN THE FEMALE.—Synon.: Barrenness; Fr. *Stérilité*, Ger. *Unfruchtbarkeit*.

Definition.—Want of the power of reproduction in the female.

Frequency.—In the general community the proportion of childless marriages seems to be about 1 in 8, or 8·5; among members of the peerage 1 in 6·11. Whether Kehrer be correct in estimating that the husband is in fault in at least one-fourth of the cases of *sterilitas matrimonii* remains to be proved. Doubtless he is nearer the truth than those who attribute the sterility in nine cases out of ten to some fault in the wife, because whilst the comparatively rare cases of male impotence are readily enough recognised, and also the rarer cases of *aspermatism*, the cases of *azoöspermatism*, where an azoic semen is ejaculated, are for the most part altogether overlooked. The possibility that the cause of the childlessness may be found in the male must, therefore, always be borne in mind. But we confine ourselves here to the consideration of sterility in the female. *See* Impotency; and Sterility in the Male.

Ætiology.—For generation the essential product in the female is the ovum; and in her reproductive apparatus we find (i.) *oviparous organs* for its production; (ii.) *oviducts* for its transmission; (iii.) an *ovigerent organ* or nest in which the ovum is hatched; and (iv.) *copulative organs* for the reception of the semen, the spermatozoa of which constitute the essential contribution of the male. In a married woman in whom the generative function is in abeyance, the sterility may be primitive or acquired. In the former case we have to do with a female who has never borne a child; in the latter the woman may have borne one or more children, but has for some years ceased to conceive. In either case we search for the fault in one or more of these four planes of her sexual apparatus.

I. **Faults in the ovaries.**—The ova are developed in the ovaries, and the conditions which interfere with ovulation—that is, the regular ripening of an ovisac, and the discharge of an ovum—diminish or destroy the possibility of conception. Such conditions are found in:—

1. *Absence* or *imperfect development.*—Cases of absence or defective development of the ovaries are rarely met with, except in women in whom the rest of the sexual apparatus is also anomalous.

2. *Displacements.*—One or both ovaries may be found displaced. Instead of lying at the level of the pelvic brim, they have fallen into the pouch of Douglas. In this position, though the ripening and dehiscence of the ovisacs may be

duly taking place, the discharged ova are not received into the free extremity of the Fallopian tube. The displaced ovary, moreover, is extremely likely to be the seat of some degree of inflammation.

3. *Inflammation.*—Oophoritis, acute or chronic, lessens the conception-power in various ways. It may lead, 1st, to destruction of the follicles, so that no ova are produced; 2ndly, to condensation of the stroma, so that the regular ripening of the ovisacs is impeded; 3rdly, to deposits on the surface, which prevent the dehiscence of the ovisacs; or, 4thly, to adhesions of the ovary, in situations which hinder the entrance of the discharged ova into the oviducts.

4. *Degenerations.*—The neoplastic degenerations to which the ovaries are most liable are the cystic; and all the varieties of cystomata, as well as the fibromata, the sarcomata, and the carcinomata, are commonly attended with sterility. Where both ovaries are affected the sterility is absolute, from the complete loss of function in the organs; and even where only one is affected, the disturbance in the relations of the pelvic organs, caused by the growing mass, is likely to prevent impregnation. *See* OVARIES, Diseases of.

II. **Faults in the oviducts.**—The Fallopian tubes or oviducts serve not only for the reception of the discharged ova, and their transmission downwards to the uterus; they serve also for the upward transit of the spermatozoa. In most cases it is probably somewhere in their canal, perhaps towards the free extremity, that the male and female elements come into union.

1. *Absence.*—Defective development of the Fallopian tubes is usually associated with other abnormalities of the sexual apparatus, especially with rudimentary conditions of the uterus.

2. *Inflammation.*—Inflammatory changes may be found affecting either the external serous covering, or the internal mucous lining. In the former case sterility results from adhesions, which lead to displacements of the free extremities, so that they are not in a position to receive the ova discharged on the bursting of an ovisac; or from bands which constrict the tubes, and so occlude their canal. In the latter, changes in the secretion may prejudice the vitality of the spermatozoa or ova; or the thickenings, polypoidal or other, may obstruct the canal; or complete atresia may be produced, and their permeability be thus entirely lost. *See* FALLOPIAN TUBES, Diseases of.

3. *Degenerations.*—The tubes are rarely enough the seat of neoplasms; but when such do develop in their walls, occlusion of their canal and consequent loss of function may ensue.

III. **Faults of the uterus.**—In the process of reproduction, the uterus serves as the receptacle or nest, in which the fertilised ovum is carried during the period of incubation. In its proliferating mucous membrane the chorionic villi take root; through its expanded blood-vessels the fœtal blood is brought into relation with the maternal; its walls grow in correspondence with the increase in size of the ovum; and its largely developed muscular fibres are the main agents in the expulsion of the ovum when it is finally hatched. It plays such an important part in the female economy that the name of it is often used as synonymous with the sexual apparatus; and some of its morbid conditions are among the commonest causes of sterility.

1. *Defective development.*—First, it may be *absent* altogether, or represented merely by a fibrous nodule. Secondly, it may be *small*, having undergone arrest at some stage of its growth, and remaining infantile, juvenile, or adolescent. Thirdly, it may be *bicornuous*—retaining the trace of its original duplicity by the presence of a septum running through the body alone, or running through both body and cervix, perhaps through the vaginal canal as well. Fourthly, it may be *unicornuous*—only one of the halves of the organ having been developed, while the other tube may be obliterated, or attached as a rudimentary byhorn to the better developed tube. Fifthly, a more frequent malformation is found in a *conical* form of the *cervix*, which is not infrequently complicated with, sixthly, *narrowness of the os*. This last condition may exist by itself, forming a well-recognised cause of sterility, and furnishing some of the cases in which a most satisfactory cure can be accomplished.

2. *Displacements.*—First, *descent* of the uterus is found as the predominant morbid condition in some cases of sterility, but this is more frequently associated with the deviations anteriorly or posteriorly. Of these, secondly, the *antroversions*, flexion and version, are very frequent among women who have never conceived at all; thirdly, the *retroversions*, flexion and version, are more common in women who have given birth to one or more children, and have subsequently remained sterile. The flexions, in particular, form a very clearly recognisable and often remediable cause of sterility.

3. *Changes in size.*—The retrogressive changes which occur in the uterus after labour sometimes go on morbidly, and in one group of cases leave the organ in a condition of, first, *super-involution*. The uterus may be reduced to a little tube which only admits the sound for half an inch. Even when the degree of super-involution is less, and it still measures two and a quarter inches in length, it is apt to cause amenorrhœa and sterility. In another group of cases the uterus remains hypertrophied in a condition of, secondly, *sub-involution*, which is inimical to conception; and when conception does take place in such a uterus, abortion is liable to occur.

4. *Inflammation.*—Among the commonest causes of sterility must be ranked the inflammatory changes to which the uterus is so liable, whether the process have affected mainly the external, middle, or internal coat; and in many of the cases where some other condition tending to sterility is present, inflammatory changes come in to increase the difficulty, and to cloud the prospects of recovery. First, *perimetritis* is usually only an element of a more general pelvic peritonitis, which often leaves behind it fixations and displacements of the uterus, preventing conception or promoting early abortion. Secondly, *mesometritis*, leading to thickening of the walls of the organ, produces an expansion of its cavity and disturbance of its function. It is rarely possible to dissociate it from, thirdly, *endometritis*, which is attended also with dilatation of the cavity, but which is further mischievous from the deleterious influence of its abnormal secretions on the life

and progress of the spermatozoa, and from the difficulty with which a fertilized ovum gets healthily engrafted on its surface. Moreover, in certain cases of long standing, some of the uterine orifices may become more or less occluded, a result which is more especially apt to ensue in the external orifice when caustics have been applied to the cervical canal.

5. *Degenerations.*—First, *myomata*, or fibroid tumours, are found in a considerable proportion of barren women. Whether sub-peritoneal, intra-mural, or sub-mucous, they interfere in many ways with conception, and give a proclivity to miscarriages or dangerous, labours when conception has occurred. Secondly, *sarcomata* have usually their seat in the uterine cavity, and seem to be an absolute bar to impregnation. Thirdly, *carcinomata* have been sometimes met with in the pregnant uterus; but these are commonly seated in the cervix, and it is usually only in an early stage of the mischief that conception can occur. *See* WOMB, Diseases of.

IV. Faults in the external organs.—In various ways the organs which serve for the reception of the spermatic fluid may be so affected that their copulative function is disturbed or destroyed, and the patient remains sterile.

1. *Malformations.*—Occlusions of the labia are rare; but the vaginal canal may be imperrious, firstly, from abnormal conditions of the *hymen*; secondly, from *atresia* in some part of its course; or, thirdly, from complete *absence*. Even it will be found that in certain cases where the rest of the generative apparatus seems to be well-developed, a preternatural *shortness* of the canal is found in some sterile women, from whom the semen escapes immediately after it is thrown into the cavity.

2. *Injuries.*—The injurious influences of a bad labour on the reproductive power of a woman may be found, first, in an undue *patency* of the canal, usually from extensive rupture of the perinæum; secondly, more frequently from *atresia*, partial or complete; or, thirdly, from *fistulous* formations, leading to communication with the neighbouring cavities.

3. *Inflammation.*—In its acute stages, inflammation of the pudenda and vagina produces, first, *dyspareunia*; in its more chronic forms it may be productive of, secondly, *unhealthy discharges*, which endanger the vitality of the spermatozoa; or it may lead, thirdly, to *occlusions* of the labia, or of the vaginal orifice or canal. Partly of inflammatory origin is the condition, fourthly, of *vaginismus*, which is not an uncommon cause of impossible connection.

4. *Degenerations.*—The various neoplasms occur with rarity in the vaginal canal; but in the pudenda—sometimes from their bulk, sometimes from their sensitiveness—they interfere with connection, as in cases of elephantiasis labiorum or of urethral caruncle.

DIAGNOSIS AND PROGNOSIS.—Investigation into a case of sterility may require that we satisfy ourselves as to the fertilizing powers of the male, and the due fulfilment of the marital function. Occasionally some concurrent disturbance in the functions of the sexual apparatus of the female, or of the neighbouring organs, may enable us to make a close guess at the cause of her barrenness; but we can only arrive at a true conclusion by a careful physical examination, having in view such a *vidimus* of causes as we have given. Some of the conditions, such as the more pronounced malformations, or imperfect development, make us regard her as hopelessly sterile: others, such as uterine flexions and stenosis, and some vaginal occlusions and injuries and tenderness, we may undertake to treat with good hope of fruitful result. *See* VAGINA, Diseases of.

TREATMENT.—In commencing the treatment of any case we must bear in mind that morbid conditions may be present in more than one of the planes of the sexual system, and that we must begin with the removal of the obstacle that lies nearest the surface. Urethral caruncles and other sensitive structures in the vulva must be cut off or cauterised. Contractions of the vaginal orifice or canal must be stretched; and where there is complete atresia an aperture must be formed and kept patulous. Stenosis of the uterine orifices may be overcome by temporary dilatation with a tangle-tent, which the writer has more than once seen followed by impregnation. Where such dilatation fails, the os may be dilated more permanently, by tearing it with an instrument like a pair of long dressing-forceps, the blades of which are forced apart after it has been passed into the cervix; or by dividing the cervix at both sides, or in one or other lip, with a hysterotome. The deviations of the uterus must be rectified; versions, after replacement, being usually retained by some modification of Hodge's pessary; flexions demanding in addition the use of an intra-uterine stem. The stem-pessary of zinc and copper introduced into the interior, is the best means of stimulating to its full function the imperfectly developed uterus, and the uterus which has withered from super-involution. Morbid conditions in the interior of the uterus require direct applications to its cavity. And, as in a large proportion of the cases, some inflammatory mischief complicates the other morbid condition, it is often helpful to the cure to make the patient use hot douches and baths, and the internal remedies which tend to remove the effects of inflammatory action. It is to the beneficial influence which the waters of Ems, Aix, Kissingen, and other spas exert on chronic metritis, that their reputation for curing sterility is mainly due. In cases where the natural method of getting spermatozoa brought into relation with the ova has failed, success is said to have followed the introduction of seminal fluid by means of a fine syringe and tube into the cavity of the uterus—a line of treatment legitimate, it may be, but only to be followed in quite exceptional circumstances.

ALEXANDER RUSSELL SIMPSON.

STERILITY IN THE MALE.—SYNON.: Fr. *Stérilité chez l'homme*; Ger. *Unfruchtbarkeit des Mannes.*—Sterility in the male has been confounded with impotence, no distinction having been drawn between inability to procreate and incapacity for sexual intercourse. A man may, however, be subject to *sterility*, independently of *impotence*. *See* IMPOTENCE.

DESCRIPTION.—Sterility may arise from the following causes:—1. malposition of the testicles;

2. obstruction in the excretory ducts of the testicle; 3. impediments to the ejaculation of the seminal fluid; or 4. *aspermatismus* or non-ejaculation.

1. *Malposition of the testicles.*—A testicle which does not pass into the scrotum is nearly always small in size, and often undeveloped, not having undergone the enlargement and change in structure which takes place at puberty. A testicle thus detained fails in some animals, as well as in man, to secrete a fertilising fluid; and a male with this defect on both sides, though often potent and efficient for sexual intercourse, is incapable of impregnating the female. Many striking cases illustrating this point have come under the notice of the writer, cases of persons with retained testes, who have married without their wives becoming pregnant, and in whom the fluid emitted in coition has been destitute of spermatozoa—*azoöspermatism.*[1] The facts which have been adduced as opposed to the conclusion that cryptorchics are sterile, are chiefly instances in which they are reputed to have procreated children; but it is remarkable that as yet no case has been found in which a retained testicle has been fully proved to be capable of secreting a fertilising fluid. Spermatozoa have been found absent in every case of retained testicle, without exception, in which search has been made for them.

2. *Obstruction.*—The lymph exuded in the cavity and walls of the excretory duct of the testicle in epididymitis, is liable to produce obstruction of the canal. This may be only temporary, the lymph becoming absorbed under treatment. Where the obstruction is complete and permanent, an induration is left in the tail of the epididymis; and when this exists on both sides, sterility is the result. Many curious cases of sterility from this cause have fallen under the writer's observation.[2] They show the great importance of steadily prolonging the treatment of epididymitis, until the enlargement and induration of the part have disappeared. The excretory duct of the testicle is liable also to be interrupted by tubercular deposits in the epididymis. Sterility from this cause in persons with double tubercular disease of the epididymis is not uncommon.

3. *Urethral impediments.*—A close stricture in the urethra so completely interrupts the passage of the seminal fluid, that in ejaculation it regurgitates into the bladder, where it mixes with the urine. This is a condition which is remediable by the cure of the stricture.

4. *Aspermatismus.*—Sterility sometimes arises from a cause which has been expressed by the term *aspermatismus.* Thus, it is essential to the complete performance of the sexual act, that the local excitement should culminate in the reflex action of expelling the collected semen. Unless this takes place coition is unsatisfactory and fruitless. There are cases of men who never experience ejaculation, even after prolonged coitus, though they are subject to nocturnal emissions. This appears to arise in some instances from defective sensibility in the glans penis, which the writer has endeavoured to correct by the application of the acetum cantharidis to the glans, and by electro-magnetism. In one case of non-ejaculation, the nerves proceeding to the glans appear to have been destroyed by a syphilitic ulcer on the dorsum penis, or to have been compressed in its cicatrisation.

CONCLUSION.—The question may arise whether a man who has the inclination and power to copulate, but who is nevertheless sterile, is justified in contracting marriage. That a man who is unable to fulfil the command, 'to be fruitful and multiply,' is right in disappointing the hopes and perilling the happiness of a woman cannot, in the writer's opinion, be maintained; and he has felt it his duty to give advice in accordance with this opinion.

T. CURLING.

STERNUTATORIES (*sternuo*, I sneeze).

SYNON.: Errhines; Fr. *Sternutatoires*; Ger. *Niesmittel.*

DEFINITION.—Remedies which cause sneezing, and produce an increased secretion from the mucous membrane of the nose.

ENUMERATION.—The principal sternutatories are Tobacco Snuff, Veratrum album, Euphorbium, and Ipecacuanha.

ACTIONS AND USES.—The action of these drugs is simply one of stimulation and irritation of the part to which they are applied; and the slight amount of gentle excitement furnished by snuff has ensured a very wide popularity for this preparation of tobacco.

White hellebore causes almost uncontrollable sneezing when incautiously inhaled, and powdered ipecacuanha-root is well known to cause excessive irritation in exceptional cases. No use is now made of these therapeutical actions, and it seems hardly necessary to retain the term sternutatories any longer in our nomenclature.

R. FARQUHARSON.

STERTOR (*sterto*, I snore).

—SYNON.: Fr. *Sterteur*; *Ronflement*; Ger. *Schnarchen*; *Röcheln.*

DEFINITION.—A term commonly applied to sounds in the throat resembling snoring, which occur in the apoplectic and like conditions. In this article the writer would extend the name to other sounds formed in any part of the respiratory passages or mouth by the movements of the air, under the like circumstances.

VARIETIES.—Several varieties of stertor may be recognised, as follows:—

1. *Nasal.*—Nasal stertor arises from approximation of the alæ nasi towards the septum by the ingoing air, as in the act of sniffing.

2. *Buccal.*—This form of stertor is due to vibrations of the lips, and puffings and flappings of the cheeks during inspiration or expiration.

3. *Palatine.*—Arises from vibrations of the soft palate, whether the breath passes through the mouth or the nose.

4. *Pharyngeal.*—Pharyngeal stertor is caused by the lolling back of the base of the tongue into near contact with the posterior wall of the pharynx.

5. *Laryngeal.*—This variety is referable to vibrations of the chordæ vocales.

6. *Mucous.*—Mucous stertor is a term which

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[1] For detailed evidence on this subject, see *Treatise on Diseases of the Testis*, by the writer.

[2] *Vide lib. cit.*

may be given to the bubbling of air through mucus in the trachea or larger air-tubes.

Ætiology.—One or more of the varieties of stertor, in varying degrees of intensity, may occur in any of the following morbid conditions, namely:—Suffocation; epilepsy; convulsions in children; the death-agony; fractures of the skull, and concussion of the brain; bronchitis—particularly that of the old, sudden œdema of the lungs, and large hæmorrhages from the lungs; great exhaustion; chloroform-poisoning, drunkenness, and opium-poisoning; drowning, and all conditions in which mucus or fluid exists in the lungs; and all forms of sopor, whether natural or the result of accident or disease.

Description.—The general phenomena of stertor are those of suffocation.

A patient may be found lying in a state of complete unconsciousness, with a congested, turgid, and expressionless face; usually dilated and fixed pupils; insensitive conjunctivæ; a hot and perspiring skin; throbbing arteries; a full and bounding pulse; and, lastly, noisy breathing, the direct result of mechanical interference with the passage of air into or out of the lungs, whether arising from contractions of the orifices, and vibrations of the soft parts of the nose, lips, cheeks, palate, pharynx, and larynx, or from mucus in the trachea and bronchial tubes. When the obstruction to the breathing is only slight, but long-continued, the face may be of a dusky pallor, and there is an entire absence of turgidity and congestion.

Pathology.—All the varieties of stertor, whether manifested singly or in combination, have been usually regarded, especially in the case of apoplexy, as symptoms essentially and mysteriously connected with the primary disease. This is not the true account of them. Whatever may be the original cause, these symptoms only indicate a varying amount of obstruction to respiration, sometimes so great as to be fatal in itself, but only as a secondary and, so to speak, accidental consequence of the primary disorder. Stertor is, in fact, 'suffocation.' In its effects it may be compared with croup, and being equally dangerous it may equally require relief. But even buccal stertor, which many authors have looked upon as of so grave importance, may not unfrequently be observed in ordinary sleep; and the writer has seen recoveries from apoplexy, in which at different times all the forms of stertor have been present. Stertor in apoplexy being, then, apoplexy *plus* suffocation, the whole subject, as regards diagnosis, prognosis, and morbid anatomy, must be approached from a new point of view. The congested and turgid face, the noisy breathing, the râles in the chest, the throbbing arteries, and the full and bounding pulse, which are the generally received symptoms of sthenic apoplexy, and which have been regarded as indicating the adoption of venesection and active remedies, are neither more nor less than signs of suffocation. Immediately upon the removal of obstructions to the breathing, all these symptoms disappear, and with them the necessity for active treatment. Long ago Heberden and Fothergill questioned the propriety of bleeding in such cases, and the latter thought that these violent symptoms arose from an exertion of the *vires vitæ* to restore health; whereas they really indicate a struggle to overcome an impediment to respiration and circulation. Directly this impediment is removed, all is quiet in apoplexy, and the practitioner is enabled to judge of the real state of the case—which side is paralysed, whether the nerves are losing or recovering their power, and what evidences exist as to greater or less interference with the functions of organic life.

Treatment.—In stertor, as in strangulation, we must proceed at once to remove the impediment to free respiration.

Nasal stertor.—This may be relieved by pressing upwards the tip of the nose, or by keeping the nares open by the handle of a common salt-spoon.

Laryngeal stertor.—This never appears dangerous enough to warrant tracheotomy, which alone would remove it.

Buccal, pharyngeal, palatine, and mucous stertor.—These varieties of stertor are readily treated by placing the patient comfortably on one side, and affording support by well-arranged pillows. In this position the buccal and palatine stertor, if any remain, will be too feeble an impediment to require further attention. The tongue drops to the side of the pharynx, and leaves plenty of room for the ingoing air. The mucus or fluid, too, whether resulting from these or other forms of stertor, drains away into the lowermost lung, thus preventing the formation of large foam-vesicles in the trachea (the 'death-rattles'), which are always dangerous respiratory impediments. Care should be taken to keep the neck rather straight, as, if the chin be brought too near the sternum, the thyroid cartilage presses upwards and backwards, and pushes the base of the tongue towards the back of the pharynx. In the management of mucous stertor it must be observed that, after a time, varying from one day to three or four, the lower lung becomes filled with mucus, though the patient is still breathing quite placidly. If at this stage the patient be turned over on the other side, the mucus begins travelling across the trachea into the opposite lung; is caught on its passage by the ingoing air; and is whipped into foam, which at once blocks up the larger air-tubes of the only lung that can work, and so instant distress and danger result. If the life of the patient be not at once destroyed, still the additional shock reduces very much the chances of ultimate recovery. Under these circumstances change of position should always be tentative, and time for some return of nerve-vigour should be allowed before it is attempted. This warning applies with equal force to all cases where mucus or fluid obstructs the air-passages, as in drowning and bronchitis. In drowning, it may be remarked that the water, on entering the lungs, becomes quickly inspissated with mucus, forming a milky foam, which can only be slowly evacuated by the application of Dr. Marshall Hall's or other process of artificial respiration. *See* Artificial Respiration; and Resuscitation.

Robert L. Bowles.

STETHOGRAPH (στῆθος, the chest, and γράφω, I write).

Definition.—An instrument for recording the movements of the chest.

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The indices in stethometers are adapted to record maximum expansion at any one point. Dr. Sanderson's 'recording stethometer,' described and figured in the *Handbook to the Physiological Laboratory*, consists essentially of a tympanum, on one side of which a knob is fixed, for application to the chest-surface. This tympanum is in communication with a second tympanum by means of an air-tube, and the fluctuations of the second tympanum are recorded by a writer upon a revolving surface of paper. By means of this instrument, properly adjusted, the respiratory movements of the chest at any point can be recorded, as regards both depth and rhythm.

R. Douglas Powell.

STETHOMETER (*στῆθος*, the chest, and *μέτρον*, a measure).—Synon.: Fr. *Stéthomètre*; Ger. *Stethometer*.

Definition.—An isntrument for measuring the mobility of the chest, and of its several parts, during respiration.

Description.—Various forms of stethometer have been designed. Dr. Sibson's 'chest-measurer' consisted of a simple arrangement by which a rod, attached by a movable rack to an index, might be applied vertically in succession to different parts of the chest (*see Sibson's Collected Works*, vol. ii.) Dr. Quain's stethometer consists of a cord attached to an index working on a graduated dial (*London Journal of Medicine*, Oct. 1850). Expansion on the two sides may be measured and compared by means of the double tapes, or the soft metal cyrtometers, held so that the ends overlap in the median line. A more elaborate instrument is that of Dr. Ransome, who has with it made valuable observations on the respiratory movements (*Med.-Chir. Transactions*, vol. lxiv. p. 185).

R. Douglas Powell.

STETHOSCOPE (*στῆθος*, the chest, and *σκοπέω*, I examine).—Synon.: Fr. *Stéthoscope*; Ger. *Stethoscop*.

Definition.—An instrument employed as a medium for the conduction of sound, between the ear and the chest or other parts, in auscultation.

Description.—Stethoscopes are of various patterns. They are commonly made of a thin, cylindrical piece of wood, perforated through its length, which is of about 6 in. to 8 in.; expanded at one end to a somewhat trumpet-like extremity, for convenient application to the chest; and at the other end provided with a flat, broad surface, to which the ear can be comfortably applied. Some practitioners prefer a solid stethoscope—that is, one in which there is no central canal. Others prefer the stethoscope to be made of metal; others, again, of vulcanite. An instrument made of cedar wood, with a perforation of about $\frac{2}{10}$th in. in diameter, a chestpiece about $1\frac{2}{10}$ in. in diameter, and a slightly concave earpiece $2\frac{1}{4}$ in. to $2\frac{3}{4}$ in. in diameter, is perhaps the best adapted for auscultation.

Some auscultators at the present day use the *binaural stethoscope*, which consists of a short hollow chestpiece, of an elongated conical shape, from which two flexible tubes, formed of wire coils covered with felt, extend, terminating in metal tubes tipped with ivory, to fill the meatus of the ear on each side. This instrument has some advantages. It can be more readily applied to different parts of the chest without the observer being obliged to adopt constrained postures; and by occupying both ears whilst the chestpiece is applied, it excludes extraneous sounds, and considerably intensifies the chest-sounds. The disadvantages are, that sounds produced in the mouth and throat of the patient, which would be recognised by the disengaged ear of an observer using the ordinary stethoscope, are apt to be mistaken for modified pulmonary sounds. Again, with the aid of the ordinary stethoscope impulses of various kinds, cardiac or aneurismal, not recognisable on ordinary palpation, are very appreciable by the ear, which might escape attention with the binaural instrument. Intensification of auscultatory signs, also, whilst perhaps an advantage in the common run of practice, is not so to persons learning auscultation, and whose hearing is not defective.

The *differential* stethoscope, which is a binaural stethoscope having the tube connected with each ear attached to a separate chestpiece, is useful in some cases of heart-disease, and for simultaneously comparing the two sides of the chest—provided the two ears of the observer are of equal auscultatory power. Finally, some practitioners prefer a single flexible tube, with an earpiece fitting into the meatus, and a chestpiece. It has been attempted to apply the telephone, and even the microphone, to stethoscopy, but as yet without success.

R. Douglas Powell.

STHENIC (*σθένος*, strength).—This term is applied, first, to individuals when they are vigorous and strong; and, secondly, to inflammatory diseases, when they assume an active character, such as *sthenic pneumonia*, as distinguished from *asthenic*. *See* Disease, Classification of.

STIFF-NECK.—A popular name for muscular torticollis. *See* Rheumatism, Muscular.

STILLICIDIUM (*stilla*, a drop, and *cado*, I fall).—The falling of a fluid drop by drop. The term is used to express the flowing of the tears over the lower eyelid in obstructions of the lachrymal passages; also the dropping of the urine in strangury (*see* Eye and its Appendages, Diseases of; and Strangury). As a therapeutic method of application, stillicidium signifies the dropping of a fluid upon a part. *See* Cold, Therapeutics of.

STIMULANTS (*stimulo*, I stir up).—Definition.—A stimulant is anything which increases the natural function of a part, or which causes a slight degree of superficial irritation.

Enumeration.—Stimulants may be divided into *general*, *cardiac*, *vascular*, and *cerebral*, as Alcohol, Ether, Opium, and Ammonia; *spinal*, including Nux vomica, Strychnia, Phosphorus, Morphia, Ergot, and Belladonna; and *stomachic*, as Ginger, Capsicum, Mustard, and other so-called carminative substances.

Actions.—Taking the term stimulant in its widest sense, we are bound to admit that it has very close ties of relationship with almost every other therapeutical group. Thus a drastic purgative is a stimulant to the intestinal mucous membrane; and cholagogues promote the secretion of the liver. So we have stimulating diuretics, diaphoretics, and emetics, and drugs which directly stimulate certain organs or glands, as when ergot evacuates the contents of the womb, or jaborandi causes a copious salivary flow. It is quite sufficient for our present purpose, however, merely to direct attention to these bearings of the subject, which will receive fuller notice in other articles, and the enumeration already given shows within what limits we must proceed.

General Stimulants.—The agents which are sometimes called 'general stimulants' act, in the first instance, on the nervous structures of the heart, improving the tone and vigour of the circulation; and, as a result of the increased quantity of blood sent to the brain, the intellectual functions seem to be temporarily augmented. Alcohol in small quantity undoubtedly makes the pulse fuller and firmer; gives rise to a pleasant glow and sensation of general warmth; and appears to lend rapidity and freedom to the cerebral operations. Opium, in small doses, has much the same effect. But pushed beyond this point, or given in larger quantity, both these drugs enter upon their sedative and narcotic phase; dulness succeeds the briskness of excited function; and a semiparalysed condition of nervous energy ensues, ending in sleep. Diffusible stimulants, as they are called, such as ether, and ammonia, stimulate perhaps less actively in the first instance; but their effects pass more speedily away, and are not succeeded by any prolonged or well-marked period of subsequent depression.

Vascular Stimulants.—Cardiac and cerebral stimulants are included in what has just been said, but a special division of vascular stimulants is supplied by those drugs which seem to brace up and give tone to weakened vessels. It is thus, no doubt, that we may explain the influence of opium in lending a healthier action to indolent or spreading ulcerations; or to the faculty which quinine seems to possess in some degree of arresting localised suppuration.

Spinal Stimulants.—The best type of spinal stimulant is strychnia, which powerfully excites the reflex functions of the cord, and whose tetanising action is somewhat imitated, in the lower animals at least, by morphia and thebaia. Under this heading we may also include belladonna and carbonate of ammonia, which have a well-marked stimulating influence over the respiratory centre, situated in the medulla oblongata.

Stomachic Stimulants.—Stomachic stimulants run closely on a parallel with tonics, and probably act by gently irritating the mucous membrane, and supplying a sensation strongly resembling the natural physiological craving or desire for food, which constitutes hunger.

Uses.—Whatever views we may hold regarding the propriety of recommending stimulants to persons in full health, the urgent necessity for their administration in certain diseased conditions is one of the fundamental principles of medicine. True although it be that we may often treat acute illness very successfully without alcohol, it is no less an acknowledged fact that, under well-recognised conditions, we are bound to give it to our patients with no sparing hand. When the tongue is becoming dry and brown; when the pulse is weak, soft, rapid, and irregular; when the first sound of the heart is low and muffled; and when muttering delirium is setting in—then we know that the time for wine or spirit has arrived, and that under its judicious use the tongue will moisten, the pulse become slower and firmer, and the sufferer may sink into a refreshing sleep. Good whisky or brandy, or the effervescing wines, are best suited for these emergencies, and must be given at regular intervals and in carefully-measured doses, according as the progress of the disease and the condition of the patient seem to render their administration necessary. In convalescence also a little stimulant will promote the appetite and increase the general tone; and good port, Burgundy, or Madeira, or some of the lighter beers, will act well, in virtue of their tonic properties.

Although it seems to be now generally acknowledged that stimulants are not required by the strong and robust, many dwellers in large towns, frequently pursuing unhealthy occupations, subject to much mental strain and worry, and suffering perhaps from depression and want of appetite, derive great benefit from a little sound wine or beer. Under the influence of the stimulant, the secretion of gastric juice is augmented, and more food can be taken and digested, the only caution being that the dose shall be strictly moderate in quantity, and invariably taken with the meals. *See* ALCOHOL.

The diffusible stimulants also have their place in the treatment of disease, when we wish to produce a slighter and more transient effect; and carbonate of ammonia is of especial service in the advanced stages of bronchitis, from its stimulating influence on the respiratory centre.

Nux vomica and strychnia are occasionally used with benefit in spinal disorders when the more acute symptoms have passed away, and when loss of function from sheer debility seems to be the principal obstacle to the recovery of the patient.

The stomachic stimulants find their application in cases where the appetite flags, and when the desire for food requires to be promoted by artificial means. Dwellers in tropical climates make greater use than ourselves of cayenne and other fiery additions to the dietary; and it seems probable that by thus attracting an increased flow of blood to the stomach, more gastric juice may be secreted, and the individual be justified in consuming the greater quantity of food which the increased development of appetite seems to render necessary. R. FARQUHARSON.

STING: STINGING PLANTS AND ANIMALS.—SYNON.: Fr. *Aiguillon*; Ger. *Stachel.*

DEFINITION.—A sting is an abnormal sensation, partly painful, and partly itching in character, usually caused by the introduction beneath the skin of some poison of an animal or vegetable origin. Either increment of the sensation may predominate, and the stung surface may be simply painful and tender, or the itching may be intense, and lead to considerable scratching for its relief.

In the widest acceptation of the word, the effect produced by the application to the skin of such substances as mustard, cantharides, strong carbolic acid, and the like, may be denominated as stinging; but here it is proposed to consider only the wounds inflicted by stinging plants and animals. The subject of venomous animals is separately discussed. *See* Venomous Animals.

Ætiology.—The severity of the sensation and of the local constitutional effects of stinging, depends, not only on the quality and quantity of the irritant, but also on individual susceptibility; in some persons the effect may be extremely mild and transient, in others severe symptoms may ensue.

In respect to the peculiar susceptibility of the person attacked, the greatest difference is observable amongst individuals, and even in the same person at different times. In many of the recorded fatal cases, the victim had been previously stung and had suffered severely. There seems, however, reason to believe that the system becomes more resistant to the effects after repeated stingings, as is seen to be the case among bee-keepers, and those continually exposed to mosquitoes. Some variations in the violence of the poison, whether of animal or plant, occurs with the season of the year.

Stinging Plants.—These are almost entirely limited to the order *Urticaceæ*, of which the following species are the most important: *U. urens*, *U. dioica* (British), *U. crenulata*, *U. stimulans* (Indian), *U. ferox* (New Zealand), *U. gigas* (New South Wales), (which forms lofty trees), and *U. urentissima* (Java). A few species of the order Malpighiaciæ also possess stinging properties.

In the nettles the urticating organs consist of unicellular hairs tapering towards the free end, which terminates in a bent knob, and swelling out at the attached extremity, where it is received into a cup-shaped depression of a cellular pedicel. The acrid fluid, the nature of which has not been determined, but is supposed to be an acid similar to malic or acetic acid, is regarded as being secreted by the pedicel and stored in the stinging hair, from which it escapes into the integument when the brittle knobbed tip is broken off by contact. The hairs in the Malpighiads are peltate and not tapering.

Stinging Animals. — Urticating organs, known as *trichocysts*, *cnidæ*, or *thread-cells*, similar in function only to the stinging cells of nettles, are found in many animals, such as the Infusoria, some Annelida, and several Nudibranchiate mollusca. They are, however, best developed and most characteristic in the Cœlenterata, of which the jelly-fishes or sea-nettles are the best known. These organs consist of cells, containing an acrid fluid, and prolonged into a long filament which presents numerous modifications of barbs and serrations. The filament is usually spirally coiled within the cell, from which it is everted on contact, conveying the fluid into the surface that it penetrates. Great variety exists in the form, size, and disposition of these organs; in many of the Actinozoa or sea-anemones they are arranged in rope-like clusters, enclosed in fine tubes, within the body-cavity.

The power of stinging is possessed very generally by members of the articulate sub-kingdom, such as spiders and scorpions among the Arachnida; bees, wasps, mosquitoes, and ants among the Insecta. The bite of the flea or bug produces itching rather than a sting. In all cases of true stinging an irritant fluid, thought to be of the nature of formic acid, is introduced beneath the skin by some penetrating organ, which may be connected with the trunk or with the terminal segment of the abdomen.

Effects.—The introduction of the poison of a stinging vegetable or animal is followed, either immediately or within a very short time, by erythema of the affected part, the surface being red and swollen. If a mucous membrane, as of the mouth, have been the seat of the wound, the swelling is intense, the tongue cannot be protruded, and swallowing becomes difficult or even impossible. Nor are the results limited to the locality of the sting, the erythema often spreading to a considerable extent, from the hands or face, which are obviously the most frequent starting-point, to the arms, neck, and trunk. Associated with the local manifestations, general symptoms, often of a most severe and even fatal character, have been known to occur. Well-authenticated cases of death from the stings of bees, wasps, scorpions, and even some species of tropical nettles, have been placed on record.

In the majority of such cases the poison has brought on a state of syncope; severe prostration, pallor, and pulselessness being the most general symptoms; and death has been known to occur within a quarter of an hour, or from that to a few hours. When the case does not prove fatal, recovery is generally rapid and the patient is quite well in a day or two; but this is not always so, and the effects of some nettles (for example, Urtica urentissima, the Devil's leaf of Java) are said to last for years.

Treatment.—(*a*) *Local.*—Innumerable applications have been suggested as specifics in cases of stinging. Among those most generally resorted to are alkalies, such as liquor ammoniæ, or a solution of bicarbonate of soda or of potash. If applied to the stung surface directly they are undoubtedly efficacious. Carbolised oil (1 in 20) has been successfully employed for the stings of bees and wasps. Lint soaked in chloroform, and laid over the seat of the bite, is recommended; and ipecacuanha applied externally is said to be most beneficial. The writer has found nothing so successful for the relief of mosquito-bites as the oil of pennyroyal, which has the further effect of most completely keeping away these insects.

(*b*) *General.*—When constitutional symptoms are produced, stimulation with brandy, ammonia, and ether is an absolute necessity, and one or other of these should be administered without stint, as life undoubtedly depends on counteracting the cardiac depression.

W. H. Allchin.

STITCH.—A sharp catching pain in the side, generally associated with pleurisy, pleurodynia, or intercostal neuralgia. *See* Pleura, Diseases of.

STOMACH. Diseases of.—Synon.: Fr. *Maladies de l'Estomac*; Ger. *Krankheiten des Magens.*—The stomach is a widely expanded gland, exceeding in activity of function any other secreting structure in the body. When its surface is examined with a microscope of low power, it presents, in every part, small superficial pits or depressions, which are surrounded by slightly elevated ridges. Into these pits open a number of the tubes which form the secreting structure of the organ. The whole of the surface of the mucous membrane, as well as the depressions just mentioned, is covered by a layer of conical epithelium, whose office it is to secrete mucus, as well as to shield the sensitive textures beneath it. When a vertical section of the walls of the stomach is made, the whole of the glandular portion is seen to be composed of tubes, placed perpendicularly to the surface. In the infant the tubes are arranged in groups, which are separated from those near them by a sparing amount of fibrous tissue, along with blood-vessels and nerves; but in the adult this method of arrangement is much less clearly seen. The tubes vary in form in different parts. As a rule they are single, and placed side by side; but in the pyloric region they are wider, and occasionally give off cæcal prolongations towards their lower ends. The writer has sometimes suspected that these apparent projections from the tubes were the result of the sections not being carried quite perpendicularly through the membrane. Each tube is, on the average, about $\frac{1}{24}$ of an inch in length, by $\frac{1}{400}$ to $\frac{1}{500}$ of an inch in breadth; but there is considerable variety in this respect in the different parts of the stomach. In the cardiac portion they are generally shorter, and in the pyloric wider, than in the middle region. Each tube is formed externally of a transparent, structureless membrane, named the basement membrane. The upper portion of its length is lined for a variable distance from the pit into which it opens by conical epithelium, whilst the remaining part is filled with the true gastric cells. The gastric cells are round or oval in shape, and about $\frac{1}{1200}$ part of an inch in diameter. They present a prominent central nucleus, along with fatty and albuminous granules. These cells appear to secrete and contain the pepsin, on which the digestive power of the gastric secretion depends. In the pyloric region we meet with numerous tubes which are entirely filled with conical epithelium, and others in which only their lower ends present true gastric cells. Some authors have asserted that the tubes in the pyloric region are entirely devoid of cells containing pepsin. Although such appears to be the case in some of the lower animals, it is not true as regards the human subject. The tubes are retained in their position by fine fibres, that pass up between them from the sub-mucous tissue to the surface. The arteries perforate the muscular structure, and send up branches between the tubes. In this position they give off fine branches, which communicate freely with the neighbouring vessels. Arrived at the surface they again increase in size, and form a dense network of capillaries which occupies the ridges of the pits into which the tubes open. From this network the veins pass downwards between the tubes, and eventually pour their contents into the larger venous trunks situated in the submucous tissue. The lymphatics are arranged in two sets: one situated immediately beneath the peritoneum; and the other between the mucous and muscular layers. They communicate with glands chiefly situated near the lesser curvature. The nerves are derived from the sympathetic and pneumogastric nerves. In the submucous tissue their branches form a plexus, and are connected with numerous ganglia.

Such being an outline of the structure of the stomach, its diseases will now be considered, and in alphabetical order. Several important subjects, intimately associated with disorder or disease of the stomach, are discussed separately under their own headings. *See* Digestion, Disorders of; Digestive Organs, Diseases of; Eructation; Flatulence; Pylorus, Diseases of; and Pyrosis.

1. Stomach, Abscess in the Walls of.—This is a rare disease, and appears to occur under two distinct forms. In one the walls of the stomach are the seat of cancer or of fibroid thickening. In cancer inflammation occasionally takes place in the newly-formed structure, and the pus resulting from it bursts through a number of openings in the mucous membrane. A similar condition occasionally occurs in fibroid thickening. Some have supposed that the thickening in such cases is the result of the inflammation that produced the pus; but more probably the suppuration is an acute change supervening on a chronic morbid condition.

Still more rarely, general suppuration occurs in the submucous tissue of the stomach. In most of the cases of the kind which have been recorded the patients have died of pyæmia, and in all probability the suppuration is secondary. In the cases of localised suppuration that have come under the notice of the writer there were no distinctive signs likely to attract the attention of the practitioner. Dr. Brinton describes the symptoms of this form of gastritis as 'violent pain, and tenderness in the region of the stomach, attended by severe and frequent vomiting, and by high febrile reaction. The pain and vomiting increase in severity, and the tenderness becomes so excessive as to suggest peritonitis, the more so that it is often accompanied by some tympanites, which however, like itself, sometimes differs from that of general peritonitis in being limited to the epigastrium. By-and-by jaundice may come on. In any case the febrile excitement rapidly merges into prostration, which is associated with delirium, and ends in death in from forty-eight hours to a few days from the commencement of the attack.'

Treatment.—The treatment of such cases, where they can be recognised during life, must be the same as that required for the general affection of which they form a part.

2. Stomach, Albuminoid Disease of.—Albuminoid, waxy, or lardaceous disease not unfrequently affects the mucous membrane of the stomach and bowels. It is always associated with a similar condition of the liver, spleen, or kidneys, the writer not having met with any case where the digestive tract was alone the seat of this morbid change. The mucous membrane presents a pale and bloodless appearance, and affords, with iodine, the well-known brownish-red reaction. In some cases the surface of the stomach is much congested, tough, and thickened from the co-existence of chronic catarrhal gastritis. Dr. Wilson Fox states that 'in some instances all traces of the epithelial cells are destroyed, and the contents of the tubes are converted into the refracting, homogeneous, irregular masses, into which the histological elements of the tissues are always changed in cases of this disease.' From its constant association with a similar condition of important organs, it is difficult to assign to this affection of the mucous membrane any characteristic symptoms. In all probability, the diarrhœa that accompanies lardaceous disease originates from a similar affection of the intestinal tract; and the vomiting that more rarely presents itself may be a consequence of a morbid condition of the stomach.

3. Stomach, Atony of.—There are numerous cases of indigestion in which the most careful inquiry fails to ascertain any structural change in the stomach. These are usually classed under the head of 'atonic dyspepsia,' and the symptoms seem to arise either from an imperfect secretion of gastric juice, or from the muscular movements of the organ being so enfeebled that the food is allowed to remain an undue length of time in the first part of the digestive canal.

Ætiology.—A feeble state of the digestion may occur at all ages, but more especially in the decline of life. The stomach, like all other glands, loses its power of secretion as age advances, and, consequently, we find dyspepsia a common complaint amongst the old. Females are more liable to it than males, who are more apt to suffer from inflammatory changes in the gastric mucous membrane. It cannot be too much impressed upon the mind of the practitioner, that an enfeebled condition of the stomach is a constant result of gastritis, and, in like manner, a diminution in the power of the digestion predisposes to attacks of inflammation. Atonic dyspepsia may be an hereditary disease, and when this is the case the symptoms usually manifest themselves at an early period of life. So long as the growth of the body continues, little trouble is experienced in such cases; but from twenty to thirty, when the necessity for great activity of the nutritive powers ceases, the patient feels himself incapable of digesting his food as easily as before. It is not, however, necessary that the child should experience the same form of gastric disorder as his parent, for one may suffer from mere feebleness of digestion, whilst the other may have been liable to the inflammatory form of dyspepsia. It is, perhaps, scarcely necessary to observe that there is no complaint so liable to be excited by errors in diet. A stomach, which, although it performs its functions feebly, may be able to digest as much food as is requisite for the maintenance of health, may be incapable of disposing of enough to satisfy the desires of a person who seeks his pleasure in the gratification of his palate. Consequently, one of the most common causes of atonic dyspepsia, more especially amongst the richer classes of society, is to be found in the undue frequency of meals. Every practitioner is consulted by persons complaining of dyspepsia produced by food, in some shape or another, being taken every two or three hours, under the supposition that they are suffering from debility. In reality, the feeling of exhaustion from which they suffer arises from the stomach never being allowed a sufficient period of repose. It is called into renewed activity by the introduction of fresh food before the last meal has been passed into the duodenum. Imperfect digestion is the necessary consequence, and only a small portion of what is eaten is dissolved and reaches the blood. On the other hand, atonic dyspepsia constantly arises amongst the poor from an imperfect supply of food, or from the food not being of a nutritious nature. The out-patient rooms of our public institutions are daily frequented by females who are existing on tea and a scanty supply of bread, and who could be readily cured by a more generous diet. An immoderate use of alcoholic liquors seems chiefly to favour the production of inflammatory gastritis; but the writer has constantly seen those who had habituated themselves to such indulgence become the victims of feeble digestion as soon as they have abandoned the use of stimulants. It is, however, much better that persons who are unable to take stimulants in moderation should suffer from dyspepsia than subject themselves to the innumerable other evils arising from drunkenness. Imperfect mastication is a common cause of this complaint. The writer has found that only 19 per cent. of those who were not dyspeptics confessed to the habit of eating very quickly, whilst amongst the sufferers from gastric disorders ·51 per cent. were in the habit of imperfectly masticating their food. Persons who live chiefly on liquids, such as tea and soup, are more liable than others to feeble digestion. In all probability the mucous membrane becomes relaxed, and the gastric juice is too much diluted to dissolve the food with the requisite rapidity. Insufficient exercise is another very common cause of the complaint, and those who lead indolent and luxurious lives pay the penalty in the shape of dyspepsia. Constipation is another common cause of this form of indigestion, and it is partly by producing this symptom that sedentary occupations exercise such a prejudicial influence. As the gastric fluid is secreted from the blood, it is evident that a normal amount and quality of the latter must be necessary for the perfect performance of the digestive process. Consequently, we find that the digestion becomes feeble in all cases of anæmia, however this condition may have been produced. Numbers of cases are constantly presenting themselves in the out-patient department of every hospital in which the symptoms of atonic dyspepsia are maintained by long-standing leucorrhœa or other discharges. The nervous system controls, not only the secretion of the gastric fluid, but also the muscular action of the organ. Any deviation, therefore, from its normal state is apt to be attended with an alteration in the secretion and motions of the stomach. In the more acute disorders of the brain we often have an excess of acid secreted; but whenever the nervous system is enfeebled, the functions of the digestive canal are weakened in a corresponding degree.

SYMPTOMS.—The invasion of atonic dyspepsia is always gradual, and in a large proportion of the cases the symptoms replace those of acute or chronic gastritis. There is seldom any severe pain, but the patient often complains of a feeling of fulness and distension after meals, which begins shortly after eating, and lasts for an hour or two. In other instances there is a sensation of constriction, produced by flatulence, which affects the lower part of the chest, and is relieved by eructation. Occasionally, the pain radiates to the shoulders, or passes down the left arm and hand, so severely as to simulate angina pectoris. It is distinguished from that complaint by its coming on shortly after food, and not after exertion. In other cases the constriction is accompanied by dyspnœa, arising, no doubt, from the movements of the diaphragm being impeded through its being pushed upwards by the distended stomach. In men of advanced age who are inclined to obesity there may be considerable embarrassment of the pulmonary and cardiac functions from this cause, especially where any unusual exertion is undertaken after a meal. It is, perhaps, unnecessary to say that in hysterical persons, and in those whose nervous systems have been unduly excited by alcohol, there is often a shrinking from the slightest touch upon the skin. In these conditions the tenderness is general; it is not increased by deep pressure, and is often most loudly complained of when the hand is applied to a part distant from the stomach. Vomiting rarely presents itself, excepting as the result of some temporary error in diet, or as an accompaniment of hysteria or phthisis. Eructations are generally complained of; but, instead of the acidity that accompanies catarrhal inflammation of the stomach, only gas or small portions of undigested food are returned. The appetite is generally deficient; in some cases there is a craving for various indigestible substances, but this is not so common as in the inflammatory affections of the stomach. Sometimes there is an aversion to all food. The tongue is usually broad, flabby, indented by the teeth, but not red, pointed, or injected, as in gastritis. Thirst as a rule is absent. The large intestine corresponds in the feebleness of its functional power. The bowels are consequently constipated, the stools disordered, and, in many cases, they contain large portions of undigested food. The most common appearance is of pieces of fibre-like tissue that have escaped the action of the stomach, often mistaken by patients for worms. The urine is usually pale and of low specific gravity. If it deposits lithates, the sediment is pale in colour; more generally oxalates or phosphates make their appearance. A long continuance of imperfect digestion produces loss of flesh and strength, but this is never to the extent that occurs in the organic affections of the stomach. The pulse is slow and feeble. The heart is especially apt to be affected with palpitation. Often the patient complains of a sudden tumbling sensation, as though the heart had turned over; at other times the palpitation comes on after exertion, and relief is obtained by stooping, or some other change of posture. Some are chiefly tormented at nights. They are awakened at two or three o'clock in the morning with violent and irregular palpitation. Such cases occur most frequently in the old, and often indicate a fatty condition of the organ. The skin is cold and clammy; and irregularities in the circulation, producing coldness of the hands or feet, are constant sources of complaint.

The nervous symptoms constitute the most distressing manifestations of the disease, more especially when the affection itself arises from an exhausted condition of the nervous system. The patient awakes at two or three in the morning, and is unable to sleep for many hours, when perhaps he falls into a troubled and unrefreshing slumber. There is often great irritability of temper, gloom obscures the mind, or the patient is incapable of concentrating his mental powers, or he becomes feeble and irresolute in character.

DIAGNOSIS.—Atonic dyspepsia is not likely to be confounded with the painful affections of the stomach—namely, ulcer and cancer. It is, however, a point of great practical importance to distinguish it from an inflammatory affection of the mucous membrane. This is the more difficult because these conditions so often replace each other in the progress of a case of chronic dyspepsia. The chief differences are as follows. In atonic dyspepsia there is no epigastric tenderness, which is usually present in gastritis. There is no pain excepting what may easily be referred to flatulent distension; and acidity and heartburn are much more rare in the former. Vomiting, again, is unusual in atonic dyspepsia; common in gastritis. The tongue is broad, flabby, and tolerably clean, and forms a striking contrast to its injected tip and edges, and thick coating in the latter affection. The urine is pale, depositing oxalates or phosphates, in a feeble state of the stomach; high-coloured, and loaded with lithates, when the organ is inflamed.

TREATMENT.—The first and most important point is to remove, as far as possible, all the causes of the disease. It is evident if a patient is eating too frequently, or masticates his food imperfectly, or leads an indolent and luxurious life, all drugs must be unavailing to remove his disease, so long as he maintains it by an erroneous system of living. Again, the food should be of such a nature as will require the least possible exertion on the part of the stomach. Thus, lightly-cooked mutton, chicken, or game is more easily digested than beef, pork, or lamb. Roast meat is more digestible than boiled. Soups and broths should be avoided, as well as any large quantity of hot tea or coffee. In bad cases vegetables had better be omitted from the dietary for a time; but as soon as the patient improves they should be again employed. Great mischief is often done by forbidding for a length of time all vegetable food; for, although the flatulence and other symptoms may be thereby relieved, the general health soon suffers. In many cases it will be found useful, where we are forced to forbid vegetables, to order one or two tablespoonfuls of lemon juice daily. This may be either taken diluted with water, or squeezed from the lemon over the meat. When there is much tendency to acidity, light puddings and farinaceous food must be sparingly used, but otherwise they generally agree well. Pastry and new-baked bread should be avoided in all cases.

When a person of middle age and inclined to obesity is troubled with feeble digestion it is better that he should avoid potatoes, spirituous liquors, sweets and fatty substances; and that he should use dry toast instead of bread, and a simple but varied diet. A dinner-pill of rhubarb, ipecacuanha, and ginger may be given to aid digestion, accompanied by a nervine tonic, such as strychnia or tincture of nux vomica, combined with nitro-hydrochloric acid.

Innumerable remedies are recommended for this form of indigestion, but in order that they should be usefully employed, it is necessary to ascertain the cause from which the imperfect secretion of gastric juice has arisen. In a large proportion of the cases the feeble condition of the mucous membrane has resulted from previous inflammation. There is a second class where, although the gland-structure is normal, the blood is deficient in quantity, or is abnormal in quality. In a third the defect originates with an exhausted condition of the nervous centres. Each of these states requires a separate medicinal treatment, and, although one often merges into, or is associated with, another condition, yet the features of one or other appear more prominently in each case that comes under our notice.

Where the feeble digestion has arisen from a relaxed state of the mucous membrane produced by previous inflammation, the tonic should be of an astringent character. It is in such cases that the nitric, nitrohydrochloric, or phosphoric acid, either alone or in combination with bitter infusion, is required. Acids are best given when the stomach is empty, so that they may directly affect the vascular system of the organ. If metallic preparations are preferred, the perchloride of iron may be used. Notwithstanding the adverse opinions of many authors, the writer has often found pepsin very valuable in these cases. The pepsina porci is the best preparation, and it may be given along with capsicum or ipecacuanha before, not after, meals. One reason why pepsin so often proves inefficacious is that it is not administered in sufficient doses. In cases of feeble digestion in young children or aged persons, much benefit will sometimes result from the addition of pepsin, in larger quantities than usually prescribed, to milk, warmed and left to stand a short time before being taken; or peptonised food may be ordered in some cases. *See* Peptonised Food.

Where the dyspepsia arises from anæmia, recourse must be had to iron. If it is connected with excessive menstrual discharge or leucorrhœa, the writer has often found the phosphate of iron and manganese a useful preparation. In other cases it may be combined with quinine. The saccharo-carbonate and the ammonio-citrate are very valuable and unirritating salts. It is a good plan in these cases to alternate the steel with other tonics, and as liberal a diet should be given as can be easily digested.

Where the nervous system is chiefly in fault, preparations of nux vomica and phosphorus, or those of zinc and arsenic, are chiefly of use. Zinc may be given as a valerianate along with quinine, or as a superphosphate in combination with iron. It is in this class of cases that preparations of silver, such as the nitrate and oxide, are chiefly valuable.

The colon is usually as atonic as the stomach, and therefore the bowels require attention in almost every case that comes beneath our notice. All severe purgatives should be avoided; for nothing so increases the feebleness of the digestion as the indiscriminate employment of this class of drugs. Salines, such as the sulphate of magnesia and the various mineral waters, must be especially prohibited. The most useful aperients are rhubarb pill, combined with nux vomica or belladonna. When there is no affection of the rectum, the extract of aloes answers well; or if this part is irritable some mild aperient, such as senna electuary, may be employed. Where a slight amount of acidity is present the compound rhubarb powder of the pharmacopœia, or an occasional dose of soda and rhubarb, is most suitable.

4. Stomach, Atrophy of.—Analogy would lead us to expect that the structure of the stomach would be liable to atrophy, since this change is so often met with in the kidney, liver, and other glandular organs; and this expectation would be strengthened if we considered the great functional activity of the gastric mucous membrane, and its especial liability to inflammatory changes. We find that atrophy of portions of the gland-structure of the stomach is exceedingly common, although sufficient usually remains intact to enable the organ to perform its functions. From his own investigations the writer is led to believe that a certain amount of anatomical change occurs in every person after he has reached the middle period of life, when the necessity for a superabundant supply of nutriment has ceased. It takes place first in the pyloric region, and tends gradually to extend as age advances. Caution is required in the investigation of such changes in the case of the stomach, lest the effects of *post-mortem* digestion should be mistaken for those of disease. In both the mucous membrane is attenuated, and the structure destroyed; but in the former it is soft, and can be readily detached by the slightest pressure of the finger; in the latter it is firm, adherent, and usually pale and anæmic. Microscopically, in *post-mortem* solution, the surface is uneven; in atrophy it is smooth, and the openings of the tubes are sharp, defined, and often enlarged. On a section being made, in the former the tissue is seen to be reduced to a mere mass of cells and fat; in the latter the lower ends of the tubes are often enlarged and loaded with cells.

Anatomical Characters.—In atrophy of the stomach the mucous membrane usually escapes *post-mortem* digestion; it is thin, smooth, and firmly adherent to the subjacent coats. Microscopically, in the earlier stage of the disease the solitary glands are enlarged, and filled with cells and nuclei. The gastric tubes, and sometimes the subjacent muscular fibres, are displaced by these bodies, which are scattered everywhere through the membrane. The tubes adhere firmly to each other, but they still contain normal cells. Later in the disease the solitary glands appear empty in their centres, but surrounded by thick layers of nuclei; the tubes can no longer be traced throughout their whole extent, but can only be recognised as bulbs filled with fatty cells, or as lines of cells, whilst the whole tissue is obscured by fatty and granular matters. In the last stage the solitary glands have disappeared, and the tubes are replaced by fibres. In some cases observed by the writer, although the mucous membrane was very thin, it was so fatty that 33 per cent. was removed when digested in ether. These anatomical changes seem to produce a concomitant decrease in functional power. *Post-mortem* digestion seldom occurs, even in the summer, and in one case in which the writer performed artificial digestion with the whole mucous membrane, only sixteenths of a grain of albumen was dissolved, and in two others the albumen was only softened. When a similar experiment was performed with the stomachs of persons who had died of other diseases, four grains of albumen was the average amount dissolved, the remainder being softened and translucent.

SYMPTOMS AND CAUSES.—Atrophy of the stomach presents itself clinically in three different forms:—

1. We find it combined with inflammation of some of the other coats of the organ, and proving fatal by the exhaustion of the patient. A man, thirty-nine years of age, was admitted into the London Hospital, under the care of the writer, in 1873. Some enlarged lymphatic glands of the axilla had existed for twelve months, and for six months he had suffered pain immediately after eating, attended by vomiting shortly after meals. When admitted, the vomiting occurred daily, and he brought up an intensely acid fluid. This gradually subsided, but he lost flesh and strength, and died from exhaustion. On *post-mortem* examination, all the organs proved to be healthy, excepting the stomach, the coats of which for some distance from the pylorus were greatly thickened, whilst the mucous membrane was extensively atrophied throughout the whole organ. Cases like this are mentioned by most authors on diseases of the stomach, and are usually quoted to show how slight may be the anatomical changes sufficient to produce death. But when the microscope is brought to bear upon the point, the atrophy of the glandular structure is found to be very extensive, so much so that if an equal amount of morbid change were to present itself in a closely-packed glandular organ, as, for example, in the kidney or liver, it would be at once recognised and its importance acknowledged.

2. The second class includes a large number of the cases known as 'idiopathic anæmia,' and, in all probability, the morbid alterations result, not from inflammation, but from degeneration. The writer has met with some marked cases corroborating this statement. Dr. Handfield Jones quotes a case of 'extreme anæmia,' in a man aged sixty-two, in which there was general atrophy of the stomach (*Morbid Conditions of the Stomach*, p. 108). Sappey mentions the case of a young man, aged thirty-two, who had died in a state of marasmus, in whom almost all the pepsiniferous glands had been destroyed, excepting those in the pyloric region. It is evident from these cases that a considerable proportion of those suffering from idiopathic anæmia are really the subjects of atrophy of the stomach. There is not much emaciation, for the pancreas, liver, and absorbing apparatus of the intestines are capable of digesting and taking up the fat. But the heart, like the other tissues, becomes loaded with fatty matter; and it has therefore often happened that the general feebleness and evident want of blood have been attributed to this state of the centre of the circulation, and the patient has been said to have died of 'fatty heart.'

3. There is a third class of cases in which atrophy of the stomach occurs, without any very especial symptoms during life pointing to the organ thus seriously diseased. The writer carefully examined the structure in fifty-seven persons who had died of cancer affecting various organs of the body. Fifteen of these were females, who suffered from cancer of the breast, and of these 75 per cent. presented well-marked atrophy of the glandular structure of the stomach. In twenty-four there was disease of the uterus, and gastric atrophy was present only in three of these; whilst no case occurred amongst persons affected with malignant disease of the glands, bones, or skin. It is evident, therefore, that the atrophy of the stomach only accompanies certain forms of cancer. In those cases of cancer of the breast where the microscope disclosed atrophy, the mucous membrane was much attenuated and its weight diminished; in one case it only weighed 360 grains, the average weight in females dying from other diseases being 720 grains. The amount of pepsin contained in the gland-structure was, in every case in which it was tested, remarkably deficient. The diminution in the weight of the mucous membrane in these cases was not the result of a general wasting of the body, for in cancer of the uterus the average weight was 660 grains. The co-existence of this serious disease of the stomach with cancer of the breast, supplies us with an explanation of the fact, that many cases die some time after an operation has been performed, in whom there has been but a trifling reappearance of the malignant growth, and no great amount of discharge or of bleeding, to account for the gradual loss of flesh and strength. The writer has seen different cases of this kind, and has remarked that the cancerous tumour is usually slow in its growth, liable to contract, and that eventually nodules form in different parts of the skin. The dyspeptic symptoms are limited to failure in appetite, often a disgust for animal food, and flatulence, accompanied by a gradual loss of flesh, strength, and colour.

DIAGNOSIS.—Atrophy of the stomach can only be diagnosed by the exclusion of all other diseases that tend to produce anæmia. Hæmorrhage and other discharges must, of course, be strictly inquired for, and it must not be forgotten that bleedings may be going on in the digestive canal without having attracted the observation of the patient. It must be also remembered that anæmia very often occurs from merely temporary failure of the digestive powers, at the commencement and termination of the catamenia. When we meet with a case of progressive anæmia in a person of middle life, we should also examine the blood in order to exclude leukæmia. In this disease, as is well known, the white blood-cells are greatly increased in number, whilst the writer has found in atrophy of the stomach a diminution in both kinds of cells. Where we find the above diseases absent, no discolouration of the skin, and no signs of malignant disease, we may fairly suspect the presence of gastric atrophy. This suspicion would be strengthened if the patient were affected with cancer of the breast, or a hard malignant tumour of any other organ.

Treatment.—The most important point in treatment is the regulation of the diet. As there is usually a great distaste for animal food, the ingenuity of the practitioner is often severely taxed to discover some form of food likely to furnish albumen to the system which the patient can be prevailed upon to take. The articles of diet that usually agree best are mutton, fowls, game, soles, whiting, haddock, and oysters. It is often necessary to order that the meat should be beaten up, or minced, so that it may be swallowed quickly. Milk and eggs, where they agree, are invaluable, and in the later stages soups and animal broths may be substituted for solid food. The writer has often recommended specially prepared beef-tea, which may be composed of extract of beef that has been digested by means of pepsin. Some patients object greatly to the taste of it, and it is a useful plan to give it mixed with ordinary beef-tea or chicken-broth, or with a proportion of invalid turtle-soup. In some cases gluten bread and gluten chocolate answer well. Other articles of diet, composed of starch and sugar, are usually more readily taken, and more easily digested.

As regards medicines, steel in all shapes is beneficial. It may be combined with strychnia, quinine, or other bitters, according to the circumstances of the case. Arsenic may be used with advantage, but it will be found a good plan to alternate it with other tonics. Pepsin is often prescribed, but it does not produce much benefit. Acids are often valuable, the most useful being the hydrochloric and phosphoric. They are best given, it is said, shortly after a meal.

Change of air, travelling, and freedom from the cares of business, are generally of more use in retarding the progress of the disease than any drugs we can prescribe.

5. **Stomach, Cancer of.**—Malignant disease of this organ is much less common than simple ulceration, but nevertheless the stomach is more frequently the seat of cancer than any other organ in the body, with the exception of the uterus. It is almost always primary, unless it arise from an extension of disease from some neighbouring organ. Secondary malignant affections of the stomach are exceedingly rare.

Ætiology.—The tendency to gastric cancer increases with the age of the individual. Dr. Brinton collected 600 cases, and found the average age at death to be fifty; the greatest liability being between sixty and seventy. It is very rare below thirty, and up to forty the liability is scarcely equal to one-fifth of the whole. Males seem to be twice as liable to gastric cancer as females, and although the accuracy of this statement has been called in question, the writer's own experience tends to confirm it. In a large number of cases there is a history of hereditary transmission, and so completely is this established, that the mere fact of more than one member of a family having suffered from cancer, would lead us to diagnose its presence in a doubtful case. Neither anxiety, poverty, nor intemperance seems to influence the development of the disease.

Anatomical Characters.—All the varieties of cancer of the stomach are here met with, but scirrhus is by far the most common. According to the researches of Dr. Brinton, it constitutes 72 per cent. of all the cases. Next in order of frequency he places the medullary form, which amounts to 18 per cent. Colloid cancer is much more infrequent, excepting when in combination with scirrhus. These different forms are, however, very often combined with each other. Thus we meet with scirrhus combined with medullary or colloid cancer. Microscopically the new growths present the ordinary appearances characteristic of the forms of the disease to which they belong. Cancer seems generally to begin in the submucous tissue, and spreads from thence to the other coats. The muscular structures vary in appearance in different cases. In some the normal tissue has been completely destroyed, and what appears to the naked eye as muscle proves to be, under the microscope, a mass of cancer cells and fibres. In other cases we find, even at some distance from the disease, the muscular bundles much increased in thickness, and the contractile fibre-cells greatly enlarged, with very prominent nuclei. Again, the pressure of the new growth puts a stop to nutrition, so that the muscular bundles seem to be reduced to a mere mass of fibrous threads. Of equal interest are the changes produced in the mucous membrane. Over the tumour the glandular tissue is generally destroyed, and nothing but cells and fibres represent the original texture. But in every case examined by the writer extensive disorganisation of the glandular structures has been found at a distance from the original disease. This is most marked in scirrhus, where we meet with the intertubular spaces filled with fibres, the tubes being atrophied, and often reduced to mere bulbs filled with fatty cells. Where the softer varieties of cancer form the main portion of the disease, the tubes are everywhere apparent, but are unusually loaded with cells, whilst between and below them nucleated cells are everywhere profusely scattered. This destruction of the glandular structure in cancer of the stomach is in marked contrast to what we find in cases of simple ulcer, for in this the normal condition of the tubes can be readily seen at a very short distance from the edge of the sore. Cancer tends in the majority of cases to attack the orifices of the stomach, and here again is another point of difference between it and simple ulcer. Its most frequent seat is at the pylorus; according to Dr. Brinton 60 per cent. of all the cases being located in this region. In 13 per cent. it affected the cardiac orifice, the fundus being scarcely ever primarily attacked. It always has a tendency to spread in a transverse direction, so that an annular stricture is a common result. When it affects the pylorus, it scarcely ever implicates the duodenum; and, on the other hand, it seldom appears at the cardiac orifice without spreading to the lower end of the œsophagus.

Symptoms.—The symptoms of gastric cancer usually show themselves very insidiously. The patient complains of slight disturbance of digestion, acidity, flatulence, or want of appetite. It has been stated that in the majority of cases there has been no previous liability to dyspepsia. No certain rule can be laid down respecting this point. In many of the cases observed by the writer, dyspepsia has been present for years, whilst in others there have been no symptoms of gastric derangement, and the first signs of the cancer have occurred whilst the patient seemed in perfect health. In some the fatal illness has been ushered in by hæmatemesis; but this is uncommon. Pain is one of the most prominent symptoms. At first it is only slight, and is often described as a dull, gnawing sensation, but, as the complaint progresses, it assumes a more neuralgic character. Generally, it is referred to the epigastrium; in other instances to the back, or to the hypochondrium. It is ordinarily increased during digestion, but, unlike the pain of ulcer, it is often equally severe when the stomach is free from food. The pain of cancer has been said by some authors to be occasionally of a colicky character. This, probably, arises from a co-existing atony of the colon, for the writer has seen cases where this kind of pain was quite relieved when proper attention was directed to the large intestine. There is generally tenderness on pressure over the seat of the cancer, but it is not so localised, nor so severe, as in simple ulcer. Unless the pylorus is obstructed, there is rarely much complaint of acidity or flatulence. This arises from the fact that the absence of appetite prevents the patient from indulging in any large amount of food. When the growth affects the pylorus, the same symptoms are produced as in obstruction of this opening from any other cause (*see* Pylorus, Diseases of). Vomiting is a very general symptom, having occurred, according to Dr. Brinton, in 87 per cent. of his cases. It varies greatly, according to the part of the organ affected. In disease of the cardiac orifice it is almost always present, and arises partly from the co-existing affection of the œsophagus. When the body of the organ is alone implicated, it may be entirely absent, but in pyloric contraction it usually takes place at a lengthened interval after food. Loss of appetite is almost always present, and it shows itself, not only in the later stages, but at a comparatively early period in the disease. The loss of appetite is most marked in scirrhus, and it often forms a useful diagnostic sign, for in simple ulcer the appetite is generally unaffected. The tongue is usually dry, but thirst is seldom much complained of. The bowels are often confined in the earlier stages, from the imperfect muscular action of the upper part of the canal, but as the disease progresses diarrhœa frequently occurs, and tends to enfeeble the patient. The most striking feature of the disease is the steady and often rapid loss of flesh and strength that accompany it. We meet in the *post-mortem* room with no other examples of such extreme emaciation as are encountered in bodies after death from this disease. No case ever runs its whole course without this symptom manifesting itself. The lips become pale, and the skin often of a greenish, or slightly jaundiced hue. How are we to explain this cachexia, which seems always to occur in gastric cancer, although it is often not even marked in the malignant affections of other organs? No doubt, where there is a rapidly growing tumour, the wasting of the blood and the co-existing dischage from the seat of the disease, are sufficient to account for it. Where, as in scirrhus, these conditions are often absent, the chief cause of the loss of appetite, the failure in strength, and the change in colour, is the atrophy of the glandular structure of the stomach, which, as already pointed out, usually accompanies the disease. The pulse is ordinarily soft and feeble, for in this, as in other forms of cancer, an enfeebled condition of the heart, arising from a softened, fatty state of its muscular tissue, is commonly present. If fever is excited by the occurrence of any local inflammation, the pulse is, for a time, increased in force and frequency. Although the above are usually the symptoms of gastric cancer, the practitioner must not expect them to be always present. He may be called to a middle aged or elderly man, in whom a rapid loss of flesh, strength, colour, and appetite are the only indications of the fatal disease under which he labours. The patient may assert that he has neither pain, nausea, flatulence, nor, in fact, any symptom pointing to a derangement of his gastric functions. The mere loss of appetite and strength in an elderly person should be sufficient to awaken suspicion, and demand a most careful exploration of all the abdominal organs.

Course and Duration.—Cancer of the stomach destroys life more rapidly than a similar affection of almost any other organ in the body, and it has been calculated that the average duration of the disease is about one year, the maximum being thirty-six months, whilst the shortest period in which life is destroyed from the first symptoms being noticed is only one month. The encephaloid form is most rapid in its course, because its growth is quicker, and the neighbouring organs, such as the liver and lymphatic glands, are more often implicated. Colloid cancer is the slowest in producing death, and most of the more chronic cases have consisted of this form of malignant tumour Severe hæmorrhage is more rare than in simple ulcer, but there is a greater tendency to a constant oozing of blood from the ulcerated surface. The blood, thus slowly effused, is acted upon by the gastric juice, and when vomiting occurs, it is rejected like 'coffee grounds.' This appearance of the vomited matter used to be considered as pathognomonic of cancer, but it is now known that it only arises from the blood being slowly effused, and may, therefore, present itself in other forms of gastric disorder. Peritoneal perforation is more rare than in simple ulcer; but we more frequently meet with communication between the stomach and other organs, such as the colon. In such a case there may be stercoraceous vomiting, or diarrhœa may be excited by the gastric contents finding their way into the large intestine. Marked relief of the symptoms of cancer may be temporarily afforded by such a perforation, although this is not common. In still more rare cases adhesions occur between the stomach and the parietes of the abdomen, and an external opening is produced. As the disease progresses, other symptoms are generally observed. In some cases ascites occurs; in others œdema of the legs; in others jaundice is produced by the pressure of the enlarged glands on the gall-ducts, or by the implication of the liver itself.

Physical Signs.—The chief and most important physical sign presented by gastric cancer, is the presence of a tumour. Dr. Brinton calculated that it is present in 80 per cent. of all the cases, and probably this estimate is not far from the truth. It is usually well-defined, hard, and nodular; and not unfrequently isolated nodules can be felt in its neighbourhood. The sound on percussion is generally more or less tympanitic. The tumour is usually found in the epigastrium, or in the right hypochondriac region, more rarely near the umbilicus. As a rule, it is fixed, and does not move downwards with the respiration; but in some instances, where adhesions had not formed, it has been dragged downwards by the weight of the stomach, and has presented itself as low as the hypogastrium. It is most readily discovered when the pylorus, or the smaller curvature, is the part affected. Where the cardiac orifice is the seat of the mischief, the growth may be so deeply situated that, unless it is of large size, it may elude discovery. There are certain chances of error as regards a tumour caused by gastric cancer, against which we should be on our guard. Thus the swelling may arise from a feculent collection in, or from disease of, the colon. Again, cases are given where the stomach was found filled with string, hair, or cocoa-nut shavings, and in each case a tumour existed during life. The rectus muscle, when in a state of tension, may give rise to the sensation of a tumour, and it is only by altering the position of the patient that the mistake can be obviated.

The size of the stomach in gastric cancer varies according to the orifice affected, and in this way may prove a useful aid in diagnosis. When the pylorus is obstructed, the organ is usually enlarged; when the cardiac orifice is narrowed, the organ becomes decreased in size, and we derive less assistance from the examination of the vomited matters than might be expected. In dilated stomach they are in a state of fermentation, and contain sarcinæ and torulæ. Occasionally there are portions of cancerous masses, but, as a general rule, these are too much decomposed to afford satisfactory evidence. In one case observed by the writer, a number of particles of the intestine, with the villi attached, were discovered by the microscope in the rejected fluids, showing that the cancerous mass had invaded the duodenum. In some instances of doubtful cancer, the fluids vomited become quite solid when boiled with liquor potassæ; and this may prove a useful indication in certain cases.

Diagnosis.—In the earlier stages, and before the existence of ulceration, gastric cancer may be readily overlooked. We are apt to consider a person who complains of pain at the epigastrium, flatulence, and other symptoms of indigestion, as merely suffering from dyspepsia. The loss of appetite is, however, generally a more prominent symptom in the early stages of cancer than in dyspepsia, and if the patient be a person of middle age, and is rapidly losing flesh, the progress of the case should be most narrowly watched, and the abdomen frequently explored for any appearance of tumour. The chief difficulty in diagnosis is to distinguish cancer from simple ulcer; and it is often requisite to watch the case for some time before a decided opinion can be formed. As a general rule, the pain is more severe, more increased by food, and more relieved by vomiting, in cases of ulcer than of cancer. On the other hand, it is less fixed to one spot, and is more neuralgic in cancer. The vomiting is more immediate after food, when the cardiac orifice, and is longer delayed, when the pylorus is affected by cancer than in cases of simple ulcer. The fluids rejected in chronic ulcer contain no fragments of mucous membrane, although these may be present in acute cases, and the rejected matters do not solidify when boiled with liquor potassæ, as they sometimes do in cancer. In one doubtful case the writer ventured on the diagnosis of a simple ulcer, from finding in the fluids vomited a short time after eating a large amount of peptones. The patient, against all expectation, perfectly recovered. Severe hæmatemesis should lead us to suspect ulcer, frequent 'coffee-ground' vomit incline us to the diagnosis of cancer. Loss of flesh and strength, although present in both cases, is much more rapid and decided in cases of cancer; and, in like manner, where we can find no evidence of hæmorrhage from any organ, great pallor of the lips and throat should lead us to suspect it. Again, as cancer seldom appears in those below thirty-five years of age, and quickly destroys life, we should decide in favour of simple ulcer if the symptoms occurred in a young person, and had lasted for many years. The presence of a tumour, in case proper precautions have been used to prevent mistakes on this point, will settle the question in favour of cancer.

In doubtful cases, the distinction between a tumour of the stomach and colon may be sometimes assisted by the plan adopted in the following case. A patient was admitted into the London Hospital with a hard tumour below the left hypochondrium. As his symptoms did not definitively point to gastric cancer, there was much difference of opinion as to the nature of the disease. The lowest edge of the tumour was first marked out with ink on the skin, when a considerable quantity of soap and water, well frothed, was injected by the rectum. The edge of the tumour was raised two or three inches, but its note on percussion was not clearer than before. As soon as the bowels had acted freely, the patient was requested to drink a pint of effervescing liquid, and now the edge of the tumour descended considerably, and the note on percussion became more tympanitic. From the injection into the colon raising the tumour, it was plainly not connected with the intestine, whilst from the percussion note becoming clearer after the drinking of the soda water, it was evident that it overlay, or was in some way connected with, the stomach. In all doubtful cases the stomach-pump should be used.

Prognosis.—The prognosis of any case of gastric cancer is always unfavourable. It is bad in proportion to the rapidity of the progress of the case; the early occurrence of the vomiting; the frequency of hæmorrhage; and the evidence that other organs, such as the liver, are also implicated.

Treatment.—There is not much to be expected in the treatment of this disease. Inasmuch as we are unable to check the progress of the malady, all our efforts must be directed to the relief of symptoms, and to support, as well as we can, the strength of the patient. Good and well-selected food, rest, and a fair supply of stimulants, often, for a time, appear to afford new strength to those overpowered by the disease. If the body of the stomach be the part affected, the indications for treatment are the same as in simple ulcer. When the pylorus is narrowed, the same plan must be pursued as when stricture of that opening has occurred from any other cause. Cardiac obstruction often brings with it the greatest misery to the patient. He is tormented with hunger which he is unable to appease, and death gradually approaches by starvation. In such cases the writer has in vain tried the application of ice-bags, belladonna externally and internally, and the hypodermic injection of morphia. So long as nutritive enemata can be borne they should be given, and if diarrhœa is produced by them small doses of laudanum may be mixed with them. In a case of this kind in the London Hospital, great relief was afforded by the passing of a narrow gum elastic tube into the stomach, and pouring through it liquid food. After the tube had been used for a little time the patient was able to take liquids, and gained considerably in weight; but eventually the opening became so constricted that the tube could not be made to enter the stomach.

6. Stomach, Concretions in.—Concretions in the stomach are composed of various indigestible substances that have been swallowed, such as hair, paper, cotton, cocoa-nut fibre, &c. They chiefly occur in idiots and lunatics. In some of the cases recorded a tumour has been observed during the life of the patient. Concretions of this kind may give rise to perforation, but more generally they set up inflammation of the mucous membrane, followed by peritonitis.

7. Stomach, Contraction of.—Contraction of the stomach may be general, or confined to one part. When general, the stomach is uniformly reduced in size. This condition is the result of long-continued abstinence from food. Thus, in disease of the œsophagus or of the cardiac orifice of the stomach we meet with it, and sometimes to such an extent that the organ is contracted to the size of the intestine. Again, when vomiting has been excessive and long-continued, as in acute gastritis, a diminution in capacity is observed. In all these cases, although the organ appears to be so much reduced in size, it readily assumes its normal dimensions when artificially distended. The stomach may be generally lessened by the contraction of a cancer or ulceration situated in the smaller curvature. The lessened capacity may be partly due to the small amount of food that could be retained on account of the constant vomiting, but it is chiefly owing to the drawing together of the orifices, which in extreme cases may be separated from each other by a very small space. Partial contraction of the stomach may result from the puckering up of the coats of the organ by the cicatrisation of an ulcer. Cases are recorded in which the stomach was divided, by the contraction of a cicatrix, into two distinct pouches, communicating with each other by a very narrow canal. Where the contraction occurs in the pyloric region, the contents of the stomach cannot be forwarded into the duodenum, and hypertrophy of the muscular structure, together with dilatation of the fundus of the stomach, is generally the consequence. *See* Pylorus, Diseases of.

8. Stomach, Dilatation of.—This may occur either in an acute or chronic form.

(1) Acute dilatation.—This form is exceedingly rare, and has attracted but little attention until of late years. The earliest case on record is that of a lady mentioned in the fourth volume of the *Pathological Transactions*, by Dr. Miller and Dr. Humby. She had been under treatment for piles shortly before her illness, and the abdomen had been observed to have increased in size. She was attacked with vomiting of immense quantities of fluid. The vomiting ceased four days afterwards, and the abdomen was found to be greatly enlarged. After death the cause of the abdominal distension proved to be the stomach, which was so much dilated that it was capable of holding 10 pints of liquid. Dr. H. Bennett, of Edinburgh, relates a similar case, and attributes the dilatation to a large quantity of effervescing liquid the patient had swallowed to allay his thirst. Dr. Hilton Fagge, in the *Guy's Hospital Reports* (vol. xviii. Third Series), describes two cases that had fallen under his notice, and also mentions that two similar cases had been observed at Guy's Hospital during fourteen years.

Diagnosis.—The signs of the dilatation, according to Dr. Fagge, are:—'1. A rapidly increasing distension of the abdomen, which is unsymmetrical, the left hypochondrium being full, while the right hypochondrium is comparatively flattened. 2. The existence of a surface-marking descending obliquely towards the umbilicus from the left hypochondrium, and corresponding with the dragged-down lesser curvature of the stomach, this line appearing to descend with each inspiration. 3. The presence of fluctuation in the lower part of the abdomen. 4. The occurrence of splashing when the distended part of the abdomen is manipulated. 5. The presence of a uniformly tympanitic note over a large part of the distended region, when the patient lies flat on his back. Above the pubes, on the other hand, there may be dulness on percussion, simulating that of a distended bladder.'

Treatment.—There is no doubt that the treatment recommended, and in one case employed, by Dr. Fagge is the proper one, namely, to empty the distended stomach as quickly as possible with the stomach-pump; and to maintain life by nutrient and stimulating enemata.

(2) **Chronic dilatation.**—Ætiology.—The most common causes of dilated stomach are conditions that prevent the egress of the digested food into the duodenum. 1. Cancer affecting the pylorus is the most usual cause. It may produce obstruction at the duodenal opening, either by the formation of a hard scirrhous ring, or by the projection inwards of fungoid growths. 2. The narrowing of the pylorus arises in some cases, not from malignant disease, but from fibroid thickening taking place below the mucous membrane; or more rarely thickening of the mucous membrane alone suffices to narrow the opening into the duodenum. 3. A simple ulcer near the pylorus, or the cicatrix of a healed ulcer, may cause the obstruction. 4. The pressure of tumours upon the pylorus or duodenum externally may prevent the due evacuation of the contents of the stomach. The tumours are usually of a malignant nature, but, more rarely, the same effect may arise from enlarged scrofulous glands. 5. The stomach may be displaced by adhesions, or the pylorus so dragged downwards that dilatation results. 6. The stomach may become dilated from paralysis of its muscular coat, produced, as in a case given by Dr. Wilks, by injury to the splanchnic nerves; or, as in an instance which occurred to the writer, from a fibroid change in the muscular coat. A certain amount of dilatation is by no means uncommon as a result of chronic catarrhal gastritis.

Anatomical Characters and Pathology.—When we lay open the abdomen, the stomach is found to be greatly increased in size, often so much so that it appears to fill the whole cavity. The greater curvature lies below the umbilicus, in extreme cases even as low as the pubes. The position of the pylorus varies according to the nature of the co-existing disease. Sometimes it is tied down by adhesions to its original site; at others it has been dragged downwards by the weight of the enlarged organ, and is situated at a much lower level. When the stomach is laid open, it is found partially or wholly filled with a dark-coloured frothy fluid, the amount of its contents being often enormous. The rugæ are effaced by the constant stretching, and the mucous membrane presents a level surface, which is generally more or less softened by the action of the acid contents upon it after death. Microscopically, the glandular structure is found to have suffered from the long-continued stretching. In one case the writer found the tubes visible, but widely separated from each other, the gastric cells being large and fatty. In another case the destruction had proceeded still further; a large proportion of the tubes had been destroyed, and were replaced by fibrous tissue, the muscular tissue being also thin and fibrous. In other cases the muscular structure proves to be in a state of hypertrophy, this condition being usually most distinct in the pyloric region.

Symptoms.—As, with the rare exceptions before noticed, where the dilatation occurs suddenly, the stomach only slowly enlarges, the symptoms manifest themselves very gradually. They are preceded by those of the malady which gave rise to the dilatation. Thus, the patient may for many years have suffered from the severe pain after food and vomiting indicative of ulceration; or frequent attacks of waterbrash, or flatulence and acidity, may have led to the suspicion of fibroid degeneration of the pylorus. Unless cancer should co-exist, there is seldom much complaint of pain, but a sensation of weight and fulness is usually experienced. More generally, attacks of heartburn present themselves, and a scalded feeling of the stomach and œsophagus annoys the patient. In some, there is a constant sense of craving referred to the epigastrium. Vomiting is almost always present, although it may be absent for considerable intervals. It does not occur, as in gastric ulcer, shortly after food, nor is there usually any complaint of nausea. The patient feels full and uncomfortable, often has a sensation as if fermentation were going on in the abdomen for two or three days, until he gets relief by the evacuation from the stomach of an enormous quantity of liquid. In other cases, the vomiting occurs more frequently, most generally at night, or towards the morning. He experiences great relief for a few hours or days, as the case may be, until the fluid again collects in sufficient quantity to produce discomfort. There is no great amount of straining during the attacks of vomiting, and if the abdomen be examined as soon as the act is terminated, the stomach is still found to be full. It seems, indeed, as if the contents were only partially pumped off by the action of the diaphragm and the abdominal muscles, the stomach itself being quite passive. In some cases hæmatemesis occurs, but this is rare, unless cancer be also present. The characters of the vomited matter are peculiar; usually they are of a more or less dark brown colour, very sour, edging the teeth and scalding the throat of the patient. When the liquid is allowed to stand, it soon becomes covered with a thick scum, and deposits a thick brown sediment. Chemically, it is found to contain various acids produced by the decomposition of the food. Microscopically, we meet with sarcinæ and torulæ in great abundance, intermixed with particles of partially digested food, and with mucus. In a few cases, bile is evacuated, but this is an uncommon circumstance, and especially where there is a narrow stricture at the pylorus. Acid eructations are very common, and often more distressing to the patient than any other symptom. Thirst is usually complained of, and an excessive secretion of saliva is frequently remarked. The tongue has nothing characteristic. The appetite is bad where cancer co-exists, but in other cases it is good, often voracious. The bowels are almost always constipated, and the stools hard and knotty. The urine is usually acid, and often deposits an abundant sediment of lithates. The nutrition of the patient soon suffers, and loss of flesh and strength always accompanies the disease. Death eventually takes place by exhaustion, being not unfrequently preceded by swelling of the feet and legs.

Physical Signs.—The abdomen is perhaps distended, and covered with enlarged and tortuous veins. The shape is characteristic, the upper curvature of the stomach being visible as it stretches across between the false ribs, the epigastrium being hollow instead of prominent, and the abdomen much fuller on the left than on the right side. When, as is so often the case, the muscular coat is in a state of hypertrophy, the vermicular movements may be seen through the stretched and attenuated integuments. The movements are slow and gradual, proceeding usually towards the right side of the body. They are almost constant, but can be quickened by the application of cold or by galvanism. Too great stress must not be laid upon this symptom. Vermicular movements are visible in the parts above the stricture, whenever any portion of the gastro-intestinal tube is contracted. The sounds on percussion vary as the dilated stomach is full of air or of fluid. The tympanitic sound is best heard when it is only partially full. By changing the position of the patient, we are enabled to show that the fluid gravitates in the enormously dilated organ. By lowering the head and raising the hips and legs, we may generally define the lower boundary of the stomach, by the clear sound which is thus exchanged for a dull one on percussion. Bamberger asserts that, by placing the stethoscope over the stomach whilst the patient is drinking, we can hear the fluid fall into the distended cavity. This, in the writer's opinion, is of little value, for he has distinctly heard the passage of food through a stricture of the cardiac opening, where the stomach was smaller than normal.

Diagnosis.—With ordinary care, a dilated stomach is not likely to be confounded with any other abdominal disease. The chief points to bear in mind are—the large extent over which there is a tympanitic sound; the irregular distension of the abdomen; the hollowness of the epigastric region; the fulness of the left side of the abdomen; the vermicular motion apparent over the dilated organ; the peculiarity of the vomiting; and the large amount of fluid thus evacuated of an acid character, presenting under the microscope torulæ and sarcinæ. The diagnosis of the cause of the dilatation must be determined by the history of each case.

Treatment.—The indications for treatment are sufficiently evident, but unfortunately they are most difficult to meet.

a. It is evident that it is a matter of the first importance to keep the stomach as empty as possible, so as to allow of its contraction. This can only be effected by giving small quantities of liquid food at a time, and frequently. But it must not be forgotten that if the patient fails to fill the long-distended organ, a sensation of faintness and craving will be induced that will tempt him to set at defiance all our directions. Consequently, we may be often obliged to give way to his solicitations, and allow food of a solid character. The main point, however, is, as much as possible, to restrict the supply of food. In bad cases the writer finds it a good plan to order nutrient enemata, as well as small quantities of food by the mouth. *See* Enema. The plan of washing out the stomach, by means of a stomach-pump, with Vichy water or a strong alkaline solution, has not been so successful in the hands of the writer as he expected. In one case it had no appreciable effect in giving relief; and in another the patient complained so much of it that he was forced to abandon its use.

b. The muscular action of the stomach must be as much as possible facilitated. The writer has used galvanism, but with no ultimate benefit. Elastic abdominal belts may afford support to the overloaded organ. What, however, is always more or less beneficial is to keep up a free action on the large intestine by enemata. Injections of gruel and barley water, mixed with castor oil and turpentine, answer the purpose best.

c. Symptoms must be relieved as they arise. The subcutaneous injections of morphia are invaluable for the relief of pain. In some cases chloral answers better, but, on the whole, it is inferior to preparations of opium. One of the most distressing symptoms is acidity. This is best relieved by a combination of bismuth with magnesia or soda, or by lime-water given frequently. Sir William Jenner recommends the hyposulphite of soda to relieve the acidity. Others have recommended carbolic acid and creasote. The plan the writer has often adopted with success is, to restrict the patient to a diet from which all starch and sugar are carefully excluded. Thus, at breakfast we may give weak coffee, dandelion coffee without sugar or milk, and lime-water, always with gluten bread. The other meals, which should be frequent and very sparing, may consist of soup or animal broths, or—if it be thought advisable to allow solids—of mutton, game, chicken, or fish. No vegetables should be permitted, and the patient should be restricted to gluten bread or almond cake instead of wheaten bread. With such a diet, assisted by cod-liver oil, patients for a time may improve greatly, and gain both flesh and strength. In persons affected with dilated stomachs from atrophy of the muscular coat, lasting benefit may be obtained; especially if the complaint be recognised, and treated in a decided way.

9. Stomach, Fibroid Thickening of.—This condition has received various names, such as 'cirrhosis of the stomach,' 'sclerosis,' 'plastic linitis,' &c. Allusion has been made in another article to thickening of the coats of the stomach of a similar nature to that affecting the pylorus, and usually producing hypertrophy of the muscular layer, narrowing of the opening into the duodenum, and eventually dilatation of the organ (*see* Pylorus, Diseases of). Such cases, although not common, are every now and then met with, and in many instances the thickening of the submucous tissue extends for some distance from the pylorus, producing a tough, leathery condition of the coats. More rarely the thickening occurs in other parts than at the pyloric end. Thus, in one case of caries of the spine, the stomach was attached to the spinal column by a dense layer of connective tissue, which also involved the coats of the organ. Over the mass was a large ulceration with thickened base and edges. But apart from these local thickenings, we occasionally meet with a form of the disease, in which the coats of the whole organ are immensely hypertrophied.

ÆTIOLOGY.—Males seem to be more liable to this complaint than females, and it occurs at an earlier period of life than cancer. Dr. Brinton states that, whilst the average age of cancer is fifty, that of fibroid thickening is only thirty-four. Mechanical injury seems in some instances to have produced this disease.

ANATOMICAL CHARACTERS.—On opening the abdomen, there are almost always found signs of general peritonitis, either acute or chronic. In some cases a thick layer of lymph overlies and unites the various organs; in others only fluid, mixed with flakes of lymph, is discovered. The stomach is round or oval in shape, smooth on the surface, firm to the touch, and forming a tumour in the epigastric or hypochrondriac region. When cut into, its walls do not collapse; and its cavity is often so much reduced in size as to be capable of containing only a few ounces of fluid. The thickness of the walls varies greatly, but in some instances they have been described as upwards of an inch. As a general rule, they are thicker at the pylorus than elsewhere, but the opening into the duodenum is not necessarily constricted, although such is not infrequently the case. The coats are of a dirty grey colour, but the distinction between them can be readily made out. The chief seat of the thickening seems to be in the submucous tissue; but the muscular layers, as well as the connective tissue between the muscular bundles and the subserous structure, are all much increased in thickness and density. The mucous membrane is thrown into folds or elevations, or studded over by small projections, most of these appearances being probably the result of the diminished capacity of the organ. Microscopically, the mucous membrane is usually found healthy. All those who have examined such cases have come to the same conclusion, namely, that the connective tissue alone is universally increased in thickness, and that there is an absence of any indication of cancer.

SYMPTOMS.—In a case observed by the writer the symptoms followed immediately after the receipt of an injury to the epigastrium; but usually they have come on insidiously. There is generally pain in the epigastrium, increased by food, in some instances shooting into the back and shoulders. The tumour formed by the thickened stomach is almost always tender on pressure, but not remarkably so, unless peritonitis is present. Vomiting is a general symptom; in some it occurs directly after food, in others the fluid rejected is thin, like saliva. Towards the close of the disease vomiting of blood is not unfrequent, but, unless ulceration occur, there is an absence of the coffee-ground fluid so constantly marked in cancer. The appetite is always bad, and decreases as the disease advances; the bowels are usually confined. There is loss of flesh and strength; the pulse is feeble towards the end of the case; dropsy, both of the peritoneum and lower extremities, generally shows itself; and the patient dies from exhaustion, or is cut off by the occurrence of peritonitis. The duration of the malady varies greatly. In some cases it has been known to last for many years, whilst in others the patient has died in a few months.

Physical Signs.—In almost every instance a tumour has been observed during life. It is generally situated in the epigastrium, but may present itself in either hypochondrium. In one patient it was supposed, from its situation, to be a cancer of the spleen. It is smooth upon the surface, more or less tender to the touch, and usually movable from side to side. On percussion, the sound is not perfectly dull, as in the case of a solid tumour.

DIAGNOSIS.—This complaint may be confounded with cancer, or with foreign bodies in the stomach. It must be most difficult, if not impossible, to diagnose the more acute cases from cancer. The smoother surface of the tumour, and the non-affection of the liver or other organs, are the most likely points on which stress may be laid, to distinguish between the two diseases. In the chronic cases of fibroid thickening, the long duration of the illness, the less constant pain, the vomiting directly after food, the less frequent occurrence of coffee-ground vomiting, and the absence of the history of a family predisposition to cancer, may afford some grounds for a diagnosis. To distinguish these cases from foreign bodies in the stomach, we must remember that the latter are found chiefly in idiots and in the insane, or in hysterical females. The writer has long been in the habit of distending the stomach in all doubtful cases, by making the patient drink freely of soda water; and in one instance where the coats of the stomach were much thickened, he succeeded by so doing in proving the case to be one of fibroid disease. The note on percussion became more tympanitic, and the lump descended, but in the case of a foreign body in the stomach no change would be effected by such a manœuvre.

Thickening of the walls of the stomach may, as just said, closely simulate cancer. It is necessary therefore that we should be on our guard against such a mistake. Although fibroid thickening of the stomach is very rare, yet we should not be too hasty in giving a settled opinion until the presence of a tumour, attended by other general and physical signs, leaves little doubt as to the correctness of the diagnosis.

TREATMENT.—Careful attention to diet is the most essential point in the treatment of this disease. The diminution in the size of the stomach is sufficient to show that only small quantities of food can be retained, and the impaired condition of the motor apparatus indicates the necessity that the nourishment should consist only of liquids. Milk and animal soups seem best fitted for such cases. Opium is almost the only medicine likely to be of value; but occasional leeches, and small blisters, frequently repeated, to the epigastrium, tend to relieve the sufferings of the patient.

10. Stomach, Gangrene of.—It is supposed by many modern authors that ulcerations of the stomach are produced by the solution, by means of the gastric juice, of small patches of the mucous membrane that have been deprived of their vitality, and become gangrenous. Such may no doubt be the case, when the morbid condition is confined to merely isolated patches of the stomach; but where acute gastritis coexists, there is a complete suspension of the secretion of gastric juice, and the writer has in such cases seen the edges of the sloughing tissue still remaining attached to the neighbouring healthy structures. Where there has been great depression of strength we occasionally meet with sloughing, to a considerable extent, of the mucous membrane of the stomach, both in the inferior animals and in man. Cases of sloughing of the stomach occurring in the human subject have been recorded by various authors. Dr. Habershon mentions one in which, along with diseased kidneys and pneumonia, there were several sloughs at the lesser curvature of the stomach, 'the longest two inches in length and about one in breadth, black and slightly raised; a section showed that the slough was situated in a sort of cup of slightly thickened tissue. Two smaller sloughs were situated near to it.' The most ordinary form of gangrene of the stomach is where it occurs in cancer of the organ. A large mass of sloughing tissue is found connected with a malignant ulceration, often of large size, and generally situated towards the pyloric end of the organ.

Treatment.—Gangrene of the stomach is beyond treatment.

11. Stomach, Hernia of. *See* Stomach, Malpositions of.

12. Stomach, Hyperæmia of.—The mucous membrane of the stomach is frequently found to be congested after death, where there has been but little evidence of disease during life.

Ætiology and Anatomical Characters.—Gastric hyperæmia may arise from different causes. If an animal be killed when fasting, the lining membrane of the stomach is found to be pale and anæmic; but if death should occur whilst digestion is going on, the vessels are seen to be filled with blood. The same thing is observed in the human subject, and serves to explain the frequent occurrence of a congested state of this organ after death. In other instances the increased vascularity is the result of a lavish employment of alcoholic stimulants during the later hours of life. The most extreme degrees of hyperæmia of the stomach are met with in cases of diseased heart, more especially when the mitral valve has been constricted. When we open the stomach we are at once struck with the dark, purple condition of its lining membrane, the appearance of congestion being most evident in the pyloric region, and terminating abruptly at the end of the œsophagus. The rugæ seem thick and prominent, and the whole surface is covered with a layer of tenacious mucus. Spots of extravasated blood present themselves, some being softened on their surface, as though they had been acted upon by the gastric juice. There is, however, seldom any of the general softening characteristic of the action of the gastric juice after death, and the surface looks raw and uneven after the removal of the adherent mucus. The whole stomach has a thickened, fleshy feeling, and is, in reality, considerably increased in bulk. In three males who died of heart-disease the average weight of the gastric mucous membrane was found to be 1,026 grs., and in three females it amounted to 800 grains. As the average weight in fifteen males, who had died of other diseases, was 864 grains, and in thirteen females 530 grains, it is evident that the bulk is greatly increased in hyperæmia. Microscopically, sections of the stomach have an opaque appearance, from the quantity of blood and serum they contain, but, after being for some time macerated, they are more transparent. In some cases the tubes can be readily separated from each other, and are normal; but in others they are of unusually large size, and distended with cells and granular matter. The blood-vessels are always enlarged, and in long-standing cases the coats of the veins are thickened. The capillaries surrounding the orifices of the tubes, where the backward pressure of the blood must be chiefly felt, on account of their want of support, are especially dilated and engorged with blood. Long-continued congestion produces the same effect in reducing the secretion of the stomach, as it does on that of the kidneys and other glandular organs. The secretion of acid is evidently lessened, for in some instances phosphates have been found in the contents of the stomach, and, as a general rule, the mucous membrane does not present the appearance of *post-mortem* solution. But the formation of pepsin is also impaired. The writer made an artificial gastric juice from the mucous membrane of three males dying of heart-disease, and found only 2·9 grains of albumen were, on the average, dissolved, whilst the average amount digested by the mucous membrane of persons who had died of other maladies was 4 grains. In the case of three females a still smaller amount of solvent power was displayed. In one only 2 grains were digested, and in the other two scarcely any effect was produced upon the albumen. There can be, therefore, no doubt that long-continued congestion of the gastric mucous membrane not only produces anatomical changes, but also diminishes the characteristic secretion of the organ. The question may be asked why hyperæmia is more intense in the pyloric than in the more actively secreting portions of the organ? In all probability it arises from the fact that the vessels of the stomach perforate the muscular coat obliquely, before they pass upwards between the tubes to the surface. The circular fibres must compress these vessels during their contraction; and the veins, from the greater tenuity of their coats, and from their not being protected by surrounding fibrous tissue, must feel the effects of the compression more than the arteries. But the transverse muscular fibres are comparatively thin and weak in the larger portion of the stomach, and become firmer and stronger as we approach the pylorus. Consequently, the veins are more liable to compression during the more energetic motions of this region, and the effects of the congestion are here more appreciable.

13. **Stomach, Hypertrophy of the Walls of.** *See* Stomach, Fibroid Thickening of.

14. **Stomach, Inflammation of.**—Synon.: Gastritis; Fr. *Gastrite*; Ger. *Gastritis*.

All the coats of the stomach may be simultaneously inflamed, but this is rarely met with, and the cases in which it occurs are referred to under other headings (*see* Stomach, Fibroid Thickening of). Usually the mucous membrane is alone the seat of the disease, and it has of late years been the custom to describe this as 'gastric catarrh.' This term is objectionable, as catarrh is so generally applied to the inflammation of mucous membranes of a much more simple anatomical structure. It should be borne in mind that the mucous membrane of the stomach is in reality an expanded gland, the elements of which have a greater functional activity than those of any other secreting structure in the human body. The injuries inflicted upon it by disease are therefore in no way analogous to those suffered by an ordinary lining membrane, but tend to lessen or altogether destroy the function of an organ of primary importance to the well-being of the individual. In addition to this, the anatomical changes are not always of the same character, but seem to the writer in certain cases quite distinct from those ordinarily produced by catarrh. Inflammation of the mucous membrane of the stomach will therefore be described under two forms, namely, (1) *Catarrhal*; and (2) *Erythematous* gastritis. It will be also necessary to consider the disease according as it occurs in an *acute* or *chronic* form.

(1) **Acute Inflammation—Acute Gastritis.** Ætiology.—Acute *catarrhal gastritis* is most common in persons of middle and advanced age, and it more frequently affects females than males. Sometimes it occurs in gouty and rheumatic subjects, and is relieved when the disease appears in the joints. Again, it presents itself in those who suffer from disease of the heart, emphysema of the lungs, cirrhosis of the liver, and other disorders that have a tendency to keep up a congested condition of the digestive tract. Under these circumstances it often proves very dangerous, and snaps the feeble thread by which the patient clings to life. The most common causes are, however, errors in diet; various indigestible substances, such as cheese or shellfish, being especially liable to produce it. Above all, an immoderate indulgence in spirituous liquors is apt to set up this form of inflammation, not infrequently laying thereby the foundation for other and more serious morbid changes.

Acute *erythematous gastritis* is more generally met with in children and in young persons, and constitutes a considerable number of the so-called 'gastric' and 'remittent' fevers, so common at this period of life. It also presents itself in scarlet fever and other eruptive disorders, and although it usually passes off without provoking any local symptoms during the fever, it nevertheless constantly leaves a liability to a frequent recurrence of the disorder. Considering how often the recurrence takes place, it is strange that so little attention has been attached to the circumstance. A similar morbid condition of the stomach often makes its appearance in the last stage of phthisis and other exhausting disorders, and adds greatly to the danger and sufferings of the patient.

Anatomical Characters.—In *catarrhal gastritis* the stomach is usually contracted and empty. The lining membrane is covered with a tenacious or thready mucus, beneath which it appears irregularly congested. It is softer than usual; and often presents numerous small hæmorrhages. These are most commonly met with in the pyloric region, are round or oval in shape, and frequently superficially ulcerated. Microscopically, the pits on the surface of the membrane are found to be swollen, prominent, and their vessels are much congested. On section, the gastric tubes are seen to be greatly distended with large granular cells, which, by their increased size and number, bulge outward the basement-membrane, so as to produce an irregular outline. The solitary glands are greatly enlarged.

We meet with the most perfect examples of acute *erythematous gastritis* in scarlatina. In the earlier stages there is no increased secretion of mucus, and often but slight injection of the surface, whilst at a later period the mucous membrane may be even paler than usual. Microscopically, the gastric tubes are much distended by granular and fatty matters, so that the cells are quite obscured, and in many cases these seem to be reduced greatly in number. Casts of the tubes are in some instances met with in the contents of the stomach. It will be observed that the morbid appearances, which are strictly analogous to those of the skin in scarlatina, differ from those produced by catarrh, in the amount of mucus not being increased, and in the tubes being distended by an albuminous fluid, instead of by an increased growth of the cells themselves. It is therefore analogous to an erythematous affection of the skin, with which, indeed, it is associated in scarlatina; whilst the catarrhal form is analogous to the eczematous and other inflammations of the cutis, which are characterised by a more abundant formation of the cellular elements.

Symptoms.—The *catarrhal* form of gastritis is sometimes preceded for a few days or hours by a feeling of general weakness; in other cases the attack comes on without warning. There is seldom any complaint of pain in the region of the stomach, although a sense of fulness and uneasiness is not uncommon. Vomiting is always present, and constitutes one of the most characteristic signs of the disease. At first any remains of the previous meal are rejected, but afterwards a thick, glairy mucus is expelled, attended with violent retching. The tongue is foul, and the breath often offensive, from the coexistence of oral catarrh. There is an absence of appetite, or a positive aversion to all food. The bowels are confined; the urine, which is often pale and copious before the attack, becomes scanty and high-coloured during its continuance. The pulse is rarely quickened, and the temperature of the skin unaltered. There is almost always headache, the pain chiefly affecting the forehead and eyes, and being accompanied by intolerance of light and sound.

In *erythematous* gastritis, on the contrary, pain at the epigastrium is a prominent symptom, excepting when the disease accompanies eruptive fevers. It usually comes on directly after food, sometimes shooting into the shoulders, or down the left arm. In phthisical cases a feeling of rawness in the œsophagus and stomach is more generally complained of. The pain is associated with tenderness on pressure over the pit of the stomach. In children there is usually an absence of pain, but the tenderness is well-marked. Vomiting is as general as in the catarrhal form, but the matters rejected seldom contain much mucus. Nausea is present where vomiting is absent, and in the slighter cases forms the chief ground of complaint. Thirst is almost always troublesome; the tongue is at first red and injected, but in a day or two is apt to become dry and glazed. Diarrhœa generally accompanies the disease, the stools being fœtid and unhealthy. The pulse is quick, often out of all proportion to the severity of the other symptoms. The temperature of the skin is increased, especially in children.

Both these forms of gastritis generally subside, but in other cases the disease shows a tendency to become chronic. In both there is a diminution, or entire cessation, of the secretion of the stomach. This does not arise from any deficiency in the amount of pepsin in the tubes, for the writer has found the mucous membrane after death capable of forming an active artificial gastric juice. In all probability, the secretion of acid is arrested, or its flow into the stomach prevented, by the swelling of the orifices of the tubes or of the pits into which they open. The result, however, is that fermentation occurs in any food that may be placed in the organ; the inflammation is thereby kept up; and large quantities of torulæ, mixed with food or mucus, are rejected by vomiting.

Diagnosis.—The vomiting of acute catarrhal gastritis, attended, as it so frequently is, by headache, is apt to be confounded with the gastric irritability of brain-disease. In affections of the brain the vomiting occurs more directly after food, and is often unattended by nausea. The tongue may be clean, whilst the pulse is quick, the skin hot, the bowels obstinately confined, and other symptoms are present pointing to some brain-lesion. In gastritis the nausea is more complained of: the tongue is foul; the pulse, in the catarrhal form, but little quickened; the skin comparatively cool; the bowels often relaxed; and there is a history of previous attacks, or of some dietetic error or co-existing visceral disorder. Acute erythematous gastritis may at first closely simulate typhoid fever, especially in children. It is, however, distinguished from it by the gastric symptoms being prominent from the onset; by their sudden occurrence; by the rapid, not gradual, rise of the temperature; by the red, injected tongue; and by the spleen not being enlarged. The fall in the temperature, and the absence of eruption and of diarrhœa, serve to prevent mistakes after the first week of the illness.

Prognosis.—When gastritis is uncomplicated, the prognosis is favourable, but it is otherwise if it take place in the course of some serious chronic disorder.

Treatment.—The general principle to be kept in view is to afford the stomach as perfect physiological rest as possible. In severe cases, therefore, it is best to let the patient abstain entirely from all food for twenty-four or forty-eight hours, allowing him to suck only a little ice, in order to allay thirst. If there be much exhaustion, or if the attack be a protracted one, the strength may be supported by nutrient enemata. Sometimes the subcutaneous injection of morphia assists in giving rest to the inflamed organ. In acute catarrhal gastritis, especially when it is attended with portal congestion, or has arisen from excessive indulgence in spirituous liquors, we can often put a stop to the attack by calomel. Five grains may be placed on the tongue, and be followed by a saline aperient, or a second dose may be administered the following day. When there is diarrhœa or much exhaustion, it is a good plan to give a grain every few hours. In the slighter attacks effervescing liquids often give great relief to the patient. In the earlier stage of erythematous gastritis, nitrate of potash or muriate of ammonia, along with hydrocyanic acid, is generally of benefit; the bowels being at the same time relieved by some mild aperient, or by an enema.

In both forms the practitioner should be on the watch, lest the symptoms should be kept up by fermentation. This is readily determined by placing a drop of the vomited matters, mixed with a weak solution of iodine, under the microscope. Torulæ, if present, will be detected by their brown colour, round or oval shape, and their tendency to the formation of chains of cells. In case of fermentation, carbolic acid, creasote, or sulphurous acid may be prescribed. The glycerine of carbolic acid, in doses of ten or twelve drops, is to be preferred, combined with tincture of belladonna or solution of morphia. In other cases the sulphurous acid seems to answer better.

Occasionally the vomiting appears to persist from exhaustion. When this is suspected to be the case, stimulants must be had recourse to, and the writer has seen champagne stop sickness at once, when all other remedies had been fruitlessly tried. It is in such circumstances that the hypodermic use of morphia is so valuable; a single dose often giving sleep, and allowing the stomach sufficient repose to recover its normal tone.

When there is much epigastric tenderness, the application of a few leeches is often of great value. This is chiefly the case where the attack has occurred as a complication of some other gastric disorder, such as ulcer. In obstinate cases of catarrhal gastritis, dry-cupping may be used with benefit. In the erythematous form we always find warm external applications useful, such as poultices of linseed meal, with or without mustard, hot fomentations, and in some cases stimulant or opiate liniments.

When it is considered advisable to allow food, it should be in the form of liquid. It should be given in small quantities at a time, and be often repeated. In catarrhal gastritis all saccharine and starchy fluids should be avoided, on account of their tendency to ferment. It is best to restrict the patient to chicken-broth, or mutton or beef-tea, or milk mixed with soda, Vichy, or Seltzer water. In the erythematous form, where there is less tendency to fermentation, barley-water, arrowroot, or other farinaceous food mixed with milk, may be used. It often happens that condensed milk is tolerated where cow's milk is rejected.

(2) **Chronic Inflammation ; Chronic Gastritis.**

This is, perhaps, the most common disease met with in practice, and comprises all the forms of chronic gastric derangement usually described under the head of 'inflammatory dyspepsia.' It is almost always of a catarrhal nature, for when signs of erythematous gastritis present themselves, it will generally be found that the latter affection is an acute attack supervening on chronic changes of a catarrhal nature.

Ætiology.—Men are more subject to chronic gastritis than females; and amongst the working classes, the writer found it was most frequent in men between forty and fifty, and in women between fifty and sixty. In a large proportion of the cases that occur in early life it is an hereditary disease, and the mother is much more apt to transmit it than the father. It often results from attacks of acute inflammation. Persons of a full habit of body are more especially liable to chronic gastritis, and it is in such that the complaint usually proves especially rebellious to treatment. Of all causes, errors in diet are most apt both to induce it, and to maintain it when once it has been lighted up. Thus, a too free supply of animal food is one of the most potent causes, and equally so is the habit of too frequent repetition of meals, without allowing a sufficient interval between them. This habit of eating too frequently is greatly kept up by the craving which is so common a symptom of the disease. Imperfect mastication is another common cause; but, above all, the immoderate use of alcohol occupies a prominent place. It is strange how frequently we discover signs of chronic gastritis after death, where no particular complaint has been made of any derangement of the digestive organs. This is more especially the case where cirrhosis, chronic congestion of the liver, diseased heart, and other disorders tending to obstruct the portal circulation, are present. In like manner, it is apt to occur whenever any excretory organ is performing its office imperfectly, as in chronic diseases of the kidney, or when constipation, or inactivity of the skin exists. It is very common in gouty subjects, and in females who suffer from catamenial derangements. It is often met with in persons who have died of phthisis and other wasting disorders.

Anatomical Characters.—The mucous membrane of the stomach is covered with a layer of greyish white, tough, transparent mucus, which firmly adheres to the surface. On its removal an abnormal amount of vascularity becomes apparent, the veins being large and prominent. The surface is often of a grey or slate colour, and not unfrequently numerous hæmorrhagic erosions present themselves. This is more especially the case where long-continued congestion has been kept up by cardiac or hepatic disease. In other cases the surface is strikingly uneven, being studded over with numerous little prominences, separated from each other by shallow furrows. This condition is named 'mammillation.' More rarely, small polypoid formations project from the membrane. The whole membrane is firm and tough, and can be stripped away from the subjacent structures in flakes of considerable size. These anatomical changes are more common in the pyloric region than in the more actively secreting portions of the organ.

Microscopically, in the slighter cases the anatomical changes may be limited to enlargement and thickening of the small pits on the surface, together with dilatation and congestion of the blood-vessels. But when the disease has been of long standing, a section shows the glandular structure itself to have participated. The secreting tubes are closely united together, and to the subjacent coats; their basement-membrane is greatly thickened; and they are distended with cells and granular matters, which often project like little lumps from their orifices. At a later stage the tubes become atrophied, and only a few fatty cells remain to point out their former site; or their free ends are obstructed, whilst their lower ends are dilated into a flask-like form. The grey pigment may be deposited either between the tubes or in the cells themselves. The solitary glands are generally enlarged, and tend to atrophy the tubes by their pressure. Patches of thickened layers of epithelium may remain attached to the surface, showing that a condition may exist in the stomach analogous to squamous diseases of the skin.

Symptoms.—There is a great difference amongst authors as to the symptoms produced by chronic catarrhal gastritis. This, no doubt, in part, arises from the fact that simple and uncomplicated cases are so rarely fatal, and that we have, therefore, but few opportunities of verifying the diagnosis by *post-mortem* examination. But it also depends on the symptoms of other co-existing affections being so often described along with those arising from the deranged stomach. There is seldom much complaint of pain, excepting it be a sense of fulness and oppression at the epigastric region after food. When there is acidity, the patient often experiences a severe burning from the stomach to the throat. In such cases temporary relief may be afforded by food or stimulants, on account of the introduction of fresh aliment exciting the stomach to increased action, so that the decomposing remains of the previous meal are either neutralised or hurried through the pylorus. There is generally a certain amount of tenderness at the pit of the stomach, which is most evident in the cases in which congestion of the liver is also present. The appetite is variable, being usually lessened, but in other cases a craving for food is experienced. Nausea is a common symptom, but vomiting, in the ordinary run of cases, is not so frequent as might be expected. When the affection has been induced by drunkenness, a rejection of mucus in the early morning takes place, and in gouty subjects this forms a most distressing symptom. Acid eructations, and a sour taste in the mouth, are commonly complained of. These probably arise from particles of undigested food remaining entangled in the mucus, setting up acetous fermentation in the saccharine and starchy articles of diet. The writer prevailed upon a number of patients who were suffering from this symptom to excite vomiting in the early morning by drinking warm water. In every case a quantity of thick, ropy mucus was rejected, and intermixed with it were portions of partially digested food. In some the amount of fluid rejected was so large that the conclusion could not be resisted that the muscular coat had been enfeebled by the inflammation, and had been thus unable to completely expel its contents. Thirst is often present, and, as a general rule, is most complained of towards evening. The bowels are usually confined, but where the catarrhal condition has extended to the intestines, frequent attacks of diarrhœa take place. The urine is high-coloured, depositing lithates; but as the inflammatory condition subsides, it may become of low specific gravity, alkaline or slightly acid, and may deposit pale-coloured lithates or phosphates. Where the oral cavity is, as is usually the case, also inflamed, the throat presents a red, congested appearance. The tongue is large, indented with the teeth, and if the liver is simultaneously congested, is coated with a thickened epithelium of a brown or yellow hue. If the catarrh have extended to the salivary glands, the surface of the tongue becomes dry, or is covered with a white, creamy mucus. If the duodenum be affected, the patient is liable to jaundice from obstruction of the biliary passages; more generally the results of imperfect lacteal absorption are shown in the loss of flesh, dryness and harshness of the skin, and imperfect nutrition of the hair and nails. The pulse is ordinarily slow, full, and regular. A short cough is often complained of, from coexisting laryngeal irritation. The temperature is seldom increased, excepting towards evening, and the patient often complains of coldness in the extremities. The nervous system almost always suffers. There is great watchfulness, or the patient wakes after a few hours of broken and disturbed slumber. Attacks of headache are frequent, the pain affecting chiefly the forehead and eyeballs.

It is necessary to notice two important varieties of the complaint, both on account of their practical importance, and also from the little attention they have received from authors. In one class of cases the prominent symptom consists in the rejection of an enormous quantity of mucus. This may occur almost constantly, vast amounts of glairy or of blood-stained mucus being rejected. In other instances the vomiting occurs only every few days, mostly after breakfast; and, from the quantity expelled, it would almost appear as if a gradual accumulation took place between each attack, until the stomach was excited to get rid of it. There is often no nausea preceding the vomiting, and but few gastric symptoms between the attacks. This form of gastric catarrh is most apt to occur in females, but it may also affect the other sex. The second variety appears to be an eczema of the stomach; at any rate, the catarrh of the mucous membrane replaces a similar catarrhal condition of the skin, and is often relieved as soon as the latter reappears. In many cases the condition may be attributable to a gouty diathesis, of which both the skin-affection and that of the stomach are but the expressions. Still, this alternation between the disorder of the skin and stomach is not infrequently witnessed in practice.

Diagnosis.—The only disease likely to lead to mistakes in diagnosis is atonic dyspepsia; but we may meet with very rare cases of chronic catarrhal gastritis that are difficult to distinguish from ulceration and cancer of the stomach. Where, as occasionally happens, a certain amount of hæmatemesis presents itself, the diagnosis between this disease and ulceration requires care. But in catarrh, there is usually some co-existing disease of the heart or liver, or some disorder of menstruation; there is an absence of pain, or, if pain be present, it is relieved, not increased, by food, as in the case of ulcer. Again, the vomiting is less excited by food; the epigastric tenderness is slight and diffused, not confined to one particular spot, as in ulcer. Cases are sometimes mistaken for cancer. The pain, however, in gastric catarrh is slighter; the tenderness comparatively trifling; and the hæmatemesis never excessive or long-continued, as in cancer. On the other hand, in the latter disorder there is a more rapid loss of flesh and strength, and more pallor of the lips and complexion. The discovery of a tumour in the epigastric region, or in some other organ, would remove all doubts as to the real nature of the malady.

Treatment.—The first point in treatment is to discover, if possible, the cause of the disease. It is useless to attempt to relieve an inflammation of the stomach, so long as the veins of the organ remain in a state of congestion produced by a disease of the heart or lungs. Cases that had been ineffectually treated for months with purgatives and tonics, yield at once to rest and digitalis, prescribed on account of the discovery of a dilated heart. In other instances, chronic Bright's disease, by preventing the due elimination of the effete matters, gives rise to the gastritis; and, under such circumstances, treatment directed to the relief of the original affection yields more satisfactory results than that which would be ordinarily prescribed for inflammatory dyspepsia. Constipation will be often found to have preceded the gastric symptoms, which have been produced by the food being too long retained in the stomach, from the diminished muscular activity of the whole canal. Here a regular action of the bowels is the main indication for the relief of the gastric catarrh. There is often, as before mentioned, a craving for food every two or three hours, set up by the presence of mucus in the stomach. Numbers of cases prove rebellious to treatment, because the patient persists in seeking temporary relief by frequently cramming the stomach with food, or because he keeps the mucous membrane in a state of excitement by stimulants, taken under the idea that debility is the cause of his sufferings. In the majority of very obstinate cases, one or other of these habits requires to be overcome, before other treatment can be made available. The mere removal of the cause producing the disease is often sufficient to ensure its cure, but in other instances we are forced to employ other means. The chief indication in the ordinary run of cases is to take off any increased pressure upon the venous circulation. In any glandular structure we can only effect this object by lessening the amount of blood flowing to it, or by increasing the rapidity of the circulation through the organ by stimulating its secretion. The first of these objects in the case of the gastro-intestinal tract is accomplished by purgatives, which drain away a large quantity of the liquid portions of the blood which has to pass through the vena portæ. In young and vigorous subjects, therefore, salines, such as the sulphate of magnesia, the tartrate of soda, or the mineral waters of Pullna or Friedrichshall, may be employed. These may be assisted by small doses of mercurials, given every second or third night. The salines should not be too long continued alone, as they are apt to enfeeble the muscular powers of the canal. After a short period, it is necessary to combine them with a tonic, such as quinine or calumba, or with sulphate or phosphate of iron. In more feeble subjects, or in those who have previously suffered from atonic dyspepsia, it is better to relieve the congestion by stimulating the biliary secretion. For this purpose, taraxacum or chamomile may be employed, assisted by a pill each night, containing podophyllin or blue-pill. In another set of cases, where the patient is not robust, both objects may be attempted at once—by the administration of soda and rhubarb in the day, assisted by an occasional dose of blue pill at night, or by a course of the Carlsbad water every morning.

It has been before remarked how readily fermentation is set up, whenever the secretion of the gastric juice is lessened or arrested. This circumstance must be borne in mind in the treatment of this as well as of other gastric disorders. As soon as the more urgent symptoms of chronic gastritis are subdued in any case, tonics, such as iron, calumba, or quinine, along with acids, may be used to obviate the enfeebled state of digestion that always results from the long continuance of the inflammation.

The treatment of cases where immense quantities of mucus are vomited must be conducted on a different principle. Here the venous system is in a state of passive congestion, and no active inflammation of the mucous membrane is in progress. We must use astringents, the best of which are bismuth, nitrate or oxide of silver, oxalate of cerium, kino, tannin, and opium. Purging makes the patient worse. In order to obviate the ill-effects of the astringents it is necessary to give each night a pill of podophyllin and creasote, or of nux vomica and aloes, or some other similar preparation. The disease has been relieved by placing around the abdomen a fold of flannel dipped in dilute nitro-hydrochloric acid, and covered with india-rubber cloth.

Eczema of the stomach is most difficult to treat satisfactorily, probably because it depends on the general state of health. It is best relieved by moderate doses of solution of potash, taken a little before the time when the scalding pain is expected, assisted by a pill, every night, of podophyllin and creasote. As soon as the urgent symptoms have been overcome, benefit may be expected, either from the compound iron mixture, or from quinine combined with ammonia. Flannels dipped in a solution of common washing soda, and covered with india-rubber, may be applied over the epigastrium with benefit; or a liniment of croton oil may be employed. The latter must be used with great caution, as, from the unusual irritability of the skin, the eruption is apt to be very severe.

Theoretically, it might be expected that a farinaceous diet would not be suitable in these cases; inasmuch as it is apt to set up fermentation. It is better to confine the patient to sparing meals of mutton, chicken, game, or fish along with bread. Vegetables and fruit should be at first avoided, but may be freely used as soon as the more urgent symptoms have subsided. The breakfast is the most difficult meal to manage, for tea and coffee are apt to disagree and increase the mischief. Dandelion coffee is often very useful in such cases. It is made by boiling the roasted and dried root of the taraxacum with a quarter of its weight of the best coffee. Where this cannot be readily obtained, the succus taraxaci of the Pharmacopœia may be taken, along with weak coffee. If milk does not disagree, it may be used, mixed either with lime-water, Seltzer, or Vichy water. Alcohol should be avoided, but if from long habit or other circumstances its use is necessary, a small quantity of weak spirit and water should be substituted for wines.

15. **Stomach, Malposition of.**—The stomach may be displaced congenitally; or as a result of accident or disease.

In congenital displacement the stomach may be situated on the right side of the body, the fundus pointing to the right hypochondrium, the pylorus to the left. But, as in such cases it will be also found that there is a similar malposition of the heart, liver, and spleen, no mistake in diagnosis is likely to occur. As a congenital condition, the stomach may occupy the left pleura, through a partial arrest of development of the diaphragm. It may be also situated in the left pleura, owing to a rupture of the diaphragm. It is said that such a state has given rise to a mistake in diagnosis between it and pneumothorax of the left side. In both there is a clear sound on percussion, and a gurgling produced by motion of the body. Besides this, the pressure of the distended stomach has been seen to displace the heart, and produce dyspnœa. Bamberger has pointed out that in protrusion of the stomach into the left pleura the respiratory sounds can be heard in the upper part of the left lung; the clear note on percussion becomes duller after food; and any metallic sounds that may present themselves are unconnected with the breathing of the patient. The dyspnœa of congenital displacement is only occasional, not persistent, and it will be found to have existed for years, instead of occurring suddenly, as in pneumothorax. When the hernia has resulted from an accident, it is usually accompanied by vomiting of fluid containing sarcinæ, and by other signs indicating that the stomach does not get freely emptied of its contents. The organ may be displaced downwards by the weight of a tumour situated in its coats. This is more especially the case with the pylorus, which is generally the seat of such a morbid change. Under these circumstances, the pylorus may be so depressed as to occupy the right iliac region, or it may have fallen still lower, and be united by adhesions to some of the pelvic viscera. In some cases the stomach is found in the contents of large umbilical and scrotal herniæ. An interesting case of this nature is recorded by the late Mr. Moore (*Transactions of the Medico-Chirurgical Society*, vol. xlvi.), where a stomach, so enlarged as to be capable of containing a gallon and a half, was situated in the sac of an umbilical hernia. There were several sloughs on its inner membrane, and in one spot a perforation had taken place, the size of a sixpence. When a stomach is much dilated, in case no adhesions have been formed between it and some of the neighbouring organs, it is displaced downwards by the weight of its contents. As a result of this, the umbilical region is much distended, whilst the epigastrium is hollow and sunk inwards, so that a distinct prominence can be often discovered, stretching between the lower part of the left hypochondriac region and the other side.

16. **Stomach, Morbid Growths in.**—The stomach is liable to all the forms of morbid growth that are met with in the other structures of the body. Excepting the breast and uterus, no part is so frequently the seat of malignant disease. All the varieties of cancer attack this organ, and not unfrequently they are combined. Thus we meet with scirrhus and encephaloid, or scirrhus and colloid, in the same tumour.

Scirrhus is by far the most common, constituting, according to the researches of Dr. Brinton, three-fourths of the whole number. Its most usual seat is the pylorus or the lesser curvature, and here it forms a tumour that rarely invades the duodenum, but tends to surround the organ. When a section is made at an early period of the disease, the distinction between the different coats is readily seen. The peritoneum and the tissue directly beneath it are thickened, the muscular structure is of a grey colour, and much increased in bulk, the bundles of fibres being divided from each other by firm septa of connective tissue. The mucous membrane covering the tumour may appear to the naked eye to be healthy. Sooner or later ulceration takes place, and a deep excavation results, with thickened elevated edges, and with a base not unfrequently covered with fungoid projections. Microscopically the tumour presents the ordinary appearances of scirrhus. The muscular structure is usually in a state of degeneration near the cancerous structure, even when it has not been invaded by the disease. The mucous membrane has been more or less diseased in all the cases the writer has examined, even at a distance from the tumour. The tubes were generally united to each other, and were, in many places, in a state of atrophy or of fatty degeneration.

Encephaloid cancer has affected the stomach in about one-tenth of the cases recorded, according to the inquiries of Dr. Brinton. It forms soft, quickly-growing nodules, which project below the peritoneum, or elevate the mucous membrane. It seems generally to commence, as scirrhus does, in the submucous tissue. When ulceration occurs, numerous fungoid masses, which are often very vascular, project upwards. The muscular coat is more completely destroyed in the neighbourhood of the tumour than in scirrhus, and the mucous membrane is generally diseased in all parts of the organ. The tubes are not, however, so much atrophied as in the harder form of cancer, but are usually distended with cells, and the subtubular and intertubular spaces are occupied by cells of various sizes.

Colloid cancer is generally associated with scirrhus. The structure feels softer than when scirrhus is present alone, and consists in part of a gelatinous material contained in round or oval spaces bounded by connective tissue. Dr. Brinton calculates that only 9 per cent. of all the cases of cancer of the stomach are composed of colloid uncombined with scirrhus.

Villous cancer presents a mass of elongated processes, which, under the microscope, seem to be composed of fibrous tissue loaded with cancer-cells, each usually possessing a loop of blood-vessels. All the villous projections that are found on the mucous membrane of the stomach, are not, however, necessarily malignant, some being of the nature of *fibrous papilloma*. *See* Stomach, Cancer of.

Lipoma, *sarcoma*, and *adenoma* are also occasionally met with in the stomach.

Tubercle is very rare, and only found where there has been general tuberculosis.

17. **Stomach, Neuroses of.**—The subject of *gastric neuralgia* has been already partially discussed (*see* GASTRALGIA), and it has been pointed out that it rarely occurs independently of symptoms indicating some disorder of the digestion. The writer has, however, met with it as a periodical affection unattended by any gastric disease. These cases occur chiefly in females of a nervous temperament, are worse at the catamenial periods, and yield to treatment of a tonic character.

Hyperæsthesia of the stomach is a very common accompaniment of various gastric disorders. Its presence in a measure accounts for the very great degree of suffering experienced in many cases of ulceration, and it often confers upon a case of atonic dyspepsia an amount of pain that leads the practitioner to suspect his patient is affected with some grave organic disease of the organ. This increased sensibility of the stomach often leads to mistakes in the treatment of gastric ulcer, by inducing us to persevere with liquid diet and opium long after the sore has completely healed. In hyperæsthesia of the stomach iron occupies the most important place as a remedial agent, and may be combined with quinine, strychnine, or other bitters. Arsenic, in doses of three or four minims of Fowler's solution, gradually increased and given directly after food, is often exceedingly useful. The nitrate and oxide of silver are favourite remedies with many practitioners, but the writer has found them less useful than the tonics before mentioned. As soon as it can be borne, porter or bitter ale will be found beneficial. In the majority of cases change of air and a carefully regulated diet are more efficacious than drugs.

Spasm.—Spasm of the stomach is a frequent complaint, and chiefly occurs in females who are subjects of atonic dyspepsia. The attacks mostly occur after a meal of an indigestible character; but in other instances a single mouthful of food, taken after a long fast, may produce it. In the former case the painful spasm probably arises from the stomach becoming overdistended with flatus, which it has been unable to expel, on account of a spasmodic contraction of the cardiac orifice. In the latter the organ is most likely distended by flatus, and the entrance of food excites a contraction which the exhausted muscle is unable fully to execute. During the attack relief may be obtained either by a subcutaneous injection of morphia, or by a draught containing opium combined with chloroform or ether, or with some essential oil, such as mint or cinnamon. The treatment between the attacks must be conducted on the principle laid down for atonic dyspepsia. *See* Stomach, Atony of.

Paralysis of secretion.—It now and then occurs that the power of the stomach to secrete appears to become paralysed, just as we occasionally find to be the case with the kidney, and probably with other organs of the body.

Vomiting.—One of the most important of the neurotic affections of the stomach is where vomiting is habitually present, without any other signs leading us to suspect disease of the stomach itself. Reference is not made here to the cases where the vomiting accompanies pregnancy, or uterine or brain disease, but where it occurs without any nausea. It chiefly presents itself in hysteria and phthisis, and in the latter disorder is, according to the writer's observation, most frequently met with where the apex of the right lung is chiefly affected. Hysterical vomiting comes on whilst the patient is eating, or almost immediately after the meal is finished. A person will leave the table suddenly, reject what has been taken, and often complain again of hunger. What is vomited is not sour, and seems to consist only of food in the state it had been in just before being swallowed. There is no pain, and although the flesh and strength are reduced, it is not to the extent that might have been expected. In all probability, therefore, only a part of what is taken is returned, for in severe cases the symptom is present whenever an attempt is made to take food. Various methods of treatment have been put in force, and in many cases without any success. Electricity has been strongly recommended, whilst morphia, hydrocyanic acid, aconite, bismuth, oxalate of cerium, nitrate of silver, and innumerable other remedies have been employed. According to the writer's experience the most useful plan is to administer a dose of morphia and solution of potash a few minutes before food. In other cases, he has tried ice for the same purpose. The food should be of a digestible nature, but solids agree better than liquids, although instances are given where the irritability of the stomach has been overcome by small quantities of liquid food given every half-hour. In very obstinate cases all food must be abstained from, and life supported for a few days by nutritive enemata.

Cases occasionally present themselves in which symptoms of disease of the spinal cord follow affections of the stomach. In such cases vomiting has been excessive and frequently recurring; pains, evidently of a neuralgic character, have first attacked the feet and extended upwards; and as the pains have subsided, paralysis has gradually crept on. The treatment found most successful has been the employment of sedatives so long as the pain continued severe, followed by the use of electricity and mineral tonics when the paralysis alone remained. The valerianate of zinc combined with quinine is often very efficacious in restoring the patient to health. In other cases strychnia, quinine, and iron have been employed, either alone or in combination.

18. **Stomach, Perforation of.**—With the exception of a few rare cases where the coats of the stomach have been penetrated by mechanical injuries, or by the extension of disease from some of the neighbouring organs, perforation is the result of simple or cancerous ulceration. In the majority of the cases of ulceration, the peritoneal covering of the stomach inflames as the disease approaches it, and the organ becomes attached to some of the adjoining parts. In this way a barrier is formed against an opening being made into the peritoneal cavity; and, as the ulceration deepens, its base is formed of the structures to which the coats of the stomach adhere. It has been calculated by Dr. Brinton that 70 per cent. of the simple ulcers situated at the posterior surface, are closed in by union with the pancreas or liver. But when this safeguard does not exist, the extension of the ulceration outwards finally reaches the peritoneum, this thin membrane sloughs, and a portion of the contents of the stomach escapes into the peritoneal cavity. Sudden and violent peritonitis is immediately set up, which is almost always followed by fatal consequences. In some cases, instead of the contents escaping from the stomach, a mere leakage occurs through the peritoneum, which is sufficient to produce inflammation of the serous membrane. Hence it may happen that, instead of general peritonitis, circumscribed inflammation is set up by the perforation, and an abscess follows, bounded by the neighbouring organs, which have become closely united to each other and to the stomach. Some cases are recorded, where an abscess thus formed was evacuated through the lungs by perforation of the diaphragm, the pus exciting in its passage gangrenous pneumonia or pneumothorax. The writer has known the gush of pus from the abscess produce sudden death by suffocation; and in a few cases placed on record an external opening has taken place, and a gastric fistula has been established. Occasionally, the stomach adheres to the colon, or even to a coil of the small intestine, and an extension of the ulcer

brings about a communication between these organs. Ulcerations situated in the anterior surface of the stomach are most apt to perforate the peritoneum, as the greater mobility of this region lessens the chance of adhesions taking place. Simple ulcerations are more apt to penetrate the serous sac than those of a cancerous nature, as adhesions are much more apt to occur in the case of the latter. Perforation again takes place more readily in the young than in those of more mature age, and it is especially liable to affect females. More than half the cases amongst females occur between the ages of fourteen and thirty, but in the other sex the effects of age are not so strongly marked.

Symptoms.—In cases of chronic ulcer, the symptoms produced by the perforation are preceded, for a more or less lengthened period, by pain, vomiting, or hæmatemesis. But in young persons the occurrence of perforation often takes place with startling suddenness, and the pain comes on when the patient believes herself to be in perfect health. In most cases careful inquiry shows that there has been previously slight uneasiness after food, flatulence, or other signs of disordered digestion. It is, however, important to recognise the fact, that this terrible accident occasionally occurs where there has been no previous complaint of ill-health, and that any sudden and severe pain in the abdomen in a young person should never be treated lightly. In a large proportion of the cases admitted into a hospital, purgatives or stimulants have been previously given, and it has occasionally happened that castor oil, or some other medicine, has been detected in the peritoneal cavity on examination after death. The first symptom of peritoneal perforation is a sudden and severe pain in the abdomen, and this is not necessarily referred to the region of the stomach. It is quickly followed by retching or vomiting; and when the patient is seen by the practitioner, the symptoms of general peritonitis are present in a marked degree. The patient lies upon his back, with his knees raised, dreading to make the slightest motion, speaking only in a slow and guarded manner, and breathing quickly and carefully, lest the action of the diaphragm and abdominal muscles should increase his suffering. The face is pale, and expressive of pain and anxiety; the whole abdomen tense, and so excessively tender that the slightest pressure is dreaded; the pulse is quick, small, and compressible; the extremities are cold; and the bowels obstinately confined. The patient may either sink in the stage of collapse, or the pulse may recover its strength, the extremities regain their warmth, and death may occur from peritonitis some days later. One well-authenticated case has been recorded where recovery took place; and, on the patient subsequently dying from a fresh perforation, the results of the former penetration of the abdominal cavity were observed. Several cases which are related as recoveries from perforation, have been recorded of late years in the public journals; but the evidence that they really were so seems to be insufficient. When perforation of the colon takes place, the pain is often very severe, from the co-existence of peritonitis; and the sudden appearance of fæces, or of fœtid gas in the vomited matters, indicates the presence of an opening into the large intestine. In other cases, the communication between the organs appears to be of a valvular kind, so that severe diarrhœa may occur from the entrance of the gastric contents into the gut, without any appearance of fæculent matters in the fluid rejected from the stomach. Where perforation of the diaphragm has occurred, there has usually been severe febrile action, with great pain in the side or epigastrium, followed, after an interval of some time, by the symptoms and physical signs of pneumothorax or gangrenous pneumonia.

Diagnosis.—Peritoneal perforation is most apt to be confounded with colic, or the passage of a biliary or renal calculus. In all these cases there is the occurrence of sudden and severe excruciating pain of the abdomen, often attended by vomiting, and all may be accompanied with great depression. In perforation, however, the patient lies in the recumbent position, with the legs drawn up; whilst in the passage of calculi or colic he is restless and tosses about. In the former, the pulse is rapid, and there is intense abdominal tenderness; in the latter the patient often seeks, by pressure over the seat of the pain, to relieve his suffering, and the pulse is but little quickened. In perforation, there is often a history of symptoms indicating gastric ulcer; in colic, not infrequently, an account of previous attacks of a similar description.

Treatment.—The only chance the patient has of escape from death is in the most perfect rest, both of the whole body and of the digestive canal. Food and drink of every kind must be forbidden, and even enemata should be avoided. A full dose of opium must be administered, as much as 2 grains, and a smaller quantity repeated every three or four hours subsequently. Cold applications externally have been recommended, but it will be generally found that warm fomentations give more relief. If improvement take place, it will be better to support the strength of the patient for some time by nutrient enemata, than by food given by the mouth.

19. Stomach, Softening of.—There are few stomachs examined after death, more especially during the warmer months of the year, that do not show some signs of softening. When this change is only slight, the surfaces of the rugæ alone seem softened, and have a semitransparent appearance. When it is more extensive, the whole of the lining membrane covering the fundus has a smooth, thin, translucent appearance, and is either readily detached by the finger, or forms a slimy mucus overlying the subjacent coats. Where the process has proceeded still farther, the muscular and peritoneal layers are soft and pulpy; and occasionally the organ is perforated, and the contents are found in the cavity of the peritoneum. More rarely still, the softening affects the neighbouring organs, the œsophagus or diaphragm being perforated; and the gastric contents may be found in the left pleura. The nature of this process has given rise to no small discussion. John Hunter, who first remarked its occurrence in healthy persons who had been killed by accidents, attributed it to the action of the gastric fluid upon the stomach after death. Some pathologists of eminence, whilst admitting that softening may result from *post-mortem* solution, contend that certain forms of this condition occur during life, and differ in their character from cadaveric changes. Rokitanski distinguishes two primary forms of softening: one a disease of infant life, called *gelatinous* softening, in which the whole fundus is converted into a greyish, transparent jelly, and which is usually an accompaniment of brain-affections. The other, in which the parietes of the stomach are converted into a dark-brown pulp, occurs either in brain-diseases, or as a sequela of typhus, pyæmia, acute tuberculosis, acute cancer, and other diseases. One chief cause of difference in the appearances of these forms is the state of the blood-vessels. In the first the pallor arises from the anæmic condition of the lining membrane; whilst in the latter the dark-brown colour is probably dependent on the action of the acid upon the blood contained in the distended veins and capillaries. Notwithstanding the authority of the distinguished pathologist just named, it is generally believed at the present day that all the various forms of softening are merely the result of *post-mortem* digestion, and that the differences in appearance between them are but the effects of the varying amount of acid that may exist in the stomach at the time of death.

Certain circumstances have been found to favour the occurrence of *post-mortem* softening of the stomach:—1. The condition of the atmosphere at the time of death is one element. It was in summer that the cases occurred that first attracted the attention of Hunter, and it is found that the extent of softening which occurs in cold weather is comparatively trifling to what is observed in the warmer months of the year. This is what might have been anticipated, for we know that heat is requisite in order that artificial digestion should proceed quickly. 2. The amount of the contents of the stomach exercises a considerable influence. When death has occurred whilst the stomach is empty, little or no softening occurs, but if it contain food the mucous membrane is sure to present some indications of change. 3. The nature of the contents of the stomach is still more important in determining the amount of softening. It is well known that the presence of an acid in the gastric juice is requisite for the performance of digestion, and we consequently find that there is the greatest extent of change where there is a large amount of acid in the contents of the stomach at the time of death. This fact has been ingeniously used to explain why the *post-mortem* changes are so extensive, as remarked by Rokitanski, in brain-disease and in the case of children. It is believed that an unusual amount of acid is secreted in cerebral affections, as we know is the case in certain irritations of the liver and kidney; and as the food of children is mostly composed of milk, it is assumed that the lactic acid resulting from its decomposition, united with the pepsin contained in the stomach, forms a digestive fluid possessing great activity. 4. The condition of the stomach as regards the amount of pepsin stored up in it exercises a considerable influence upon the chance of its softening. It has been elsewhere shown that in typhoid fever, chronic atrophy, and chronic hyperæmia, the amount of pepsin stored up in the gastric mucous membrane is very small, and it is in these disorders that we meet with very little alteration in the organ after death. 5. Another point, which has not attracted sufficient notice, is that the texture of the organ varies in different cases, and that some more readily yield to the solvent action of the gastric juice than others. To prove this the writer placed in an artificial digestive fluid equal portions of three human stomachs. The first was normal; the second in a state of fatty degeneration; whilst, in the third, the tubes were replaced by fibrous tissue, and the blood-vessels were much congested. After a few hours' digestion the first piece was found reduced to a pulp; the second was gelatinous, and of a yellow colour; the third formed a black, opaque mass, quite unlike the others. Here, it will be observed, the colour and appearance of the different specimens varied; and in many cases, as for example in children, the softness of their healthy mucous membrane greatly determines the rapidity and completeness with which the gastric fluid acts upon it. To ascertain if this was correct the writer placed in some artificial gastric fluid four pieces of stomach. The first was taken from a healthy dog and was soft; the second from a healthy human subject; the third and fourth from females who had died from cancer of the breast, and the mucous membranes of whose stomachs were extensively atrophied. After three hours' digestion at 100°, the first broke up into fragments; the second was reduced to a pulp; whilst the third and fourth showed only a little softening on their surfaces, but were in other respects unaltered. The completeness with which the first two were dissolved was found, from other experiments, to have partly arisen from the acid being imbibed by the tissue, and coming into contact with the pepsin stored up in the gastric cells, which were absent in the diseased structures of the third and fourth specimens. But the question arises, whether softening of the mucous membrane of the stomach ever occurs without *post-mortem* solution? This must be answered in the affirmative. During the continuance of the cattle-plague the animals affected were killed, and in some cases the stomachs were immediately removed and brought to the writer. In each case the mucous membrane was very soft, and presented, under the microscope, the usual appearances of gastritis. Again, in certain disorders—as, for example, in cancer of the uterus—the writer has always found the gastric mucous membrane very soft, where there was no appearance of cadaveric change. This softness probably arises from imperfect nutrition, and is analogous to the fatty heart so commonly met with in such cases. Fatty degenerations of the stomach are by no means uncommon—for instance, the whole membrane has been found in this state in a case of gastric ulcer; and we can scarcely suppose that an organ in such a condition can have the same firmness as when the glandular texture is in a perfectly healthy state.

20. **Stomach, Ulcer of.**—Ætiology.—The age of the individual is allowed by all observers

to be one of the chief predisposing causes of gastric ulcer. Where the functions of the stomach are most actively performed, as in childhood, it is scarcely ever met with, Dr. Brinton having been only able to find two cases out of 226 in children below ten years of age. It becomes gradually more frequent as age advances. Females are more liable to the disease than males, in the proportion of three to one. The chief preponderance of liability amongst females occurs at the commencement and the cessation of the catamenia. In both sexes, want of food, mental anxiety, and other depressing conditions, have been referred to as tending to produce the disease in question. Many authors regard intemperance as one of the most potent causes. Although the writer has certainly seen the symptoms of gastric ulcer follow a too free use of alcohol, yet he has been greatly surprised to find how rarely the stomach has presented any signs of disease, beyond those of catarrhal gastritis, in a considerable number of persons who had died of delirium tremens. Some have affirmed that tuberculosis is a common predisposing cause, whilst Dr. Brinton has remarked that persons affected with phthisis are not more liable to gastric ulcer than other persons. The writer has found the ordinary ulcer rare in such cases, but superficial ulcers near the pylorus are by no means infrequent, and are probably the result of the acute erythematous gastritis, to which attention has been directed, as tending to complicate the later stages of pulmonary disease (*see* Stomach, Inflammation of). If we sum up the chief causes, we find the conclusions confirmed to which morbid anatomy directs us. Advanced age, which gives rise to fatty and fibroid degenerations, both of the tissues and the blood-vessels, is the chief predisposing influence of gastric ulcer. In like manner, syphilis and tubercular affections, which lead to ulcerations of the skin, by diminishing the reparative powers of the system, seem also to induce gastric ulceration. In addition to these all conditions that lead to chronic catarrhal gastritis, such as uterine affections, and diseases of the heart and liver, have also a decided tendency to set up the disease.

Anatomical Characters and Pathology.—Ulcerations in this organ are of frequent occurrence, being present, according to the researches of Dr. Brinton, in about 5 per cent. of the deaths arising from all causes. The ulcers are usually round or oval, varying in size, as a general rule, from the diameter of a fourpenny-piece to that of a half-crown. They have been found to destroy life when so small that the most careful search was necessary to ascertain their existence, and, on the other hand, they may be met with many inches in diameter. When of recent formation, the edges are sharp, and the sore looks as if a portion of the mucous membrane had been punched out; but when it has lasted for some time, the edges are hard, callous, and adhere to the subjacent tissue. The diameter of the ulcer usually lessens from above downwards; so that in case the peritoneum has given way, the perforation may be a mere chink. The base of the ulcer may be formed either of the muscular coat or peritoneum, or of some of the neighbouring organs—such as the pancreas, liver, or spleen—which have become attached to the stomach by adhesions. Microscopically, in recent cases the writer has generally found the tubes around the ulcer healthy, with the exception that a few blood-globules are extravasated amongst them. In older cases, the surrounding tissues are matted together, and the tubes are compressed and atrophied, whilst the newly-formed fibrous tissue closely unites the edges of the lesion to the parts below and around them. But the mischief is always confined to the neighbourhood of the ulcer, and we never discover a general atrophy of the secreting structures of the stomach, as in malignant disease. At the most, the mucous membrane presents the signs of fatty degeneration, or the usual appearances of acute or chronic catarrhal gastritis. Where the ulceration is spreading, the tubes immediately around it may be seen to be more or less emptied of their secreting cells, whilst their basement membranes have fallen together. Still further off may be remarked tubes only partially filled with cells, and the mucous membrane is consequently thin and soft.

Gastric ulcers are most common in the pyloric region, being chiefly situated on the posterior surface, and near the smaller curvature. When two are present, it is not unusual to find them opposed to each other, as though they had been both produced by the same irritation. When an ulcer exists in the duodenum, it is very common to find one also in the stomach.

There has been much difference of opinion as to the method by which gastric ulcers are produced. Some authors are fond of pointing out that sores of this character are confined to the stomach and duodenum, where an acid secretion comes in contact with the tissues; whilst in the remaining parts of the small intestine they are rarely discovered. Hence it has been assumed that they are dependent, in some way or another, upon the solvent action of the gastric juice. But it should be remembered that the ulcerations are very rare where the power of secretion is most active, and where it remains longest in contact with the mucous membrane—namely, at the fundus; and also, that they are extremely uncommon in childhood, when the gastric functions are most energetically performed. Instead, therefore, of the presence of the gastric juice being the cause of the stomach being so especially liable to ulceration, may not the rarity of ulcerations in the small intestines be rather due to the greater development of the lymphatic system in them, which obviates the ill-effects of any temporary congestion, and to the fluid nature of the contents of this portion of the canal? We have not here space to discuss the various hypotheses that have been invented to account for the production of gastric ulcers; but we may fairly allow that, like ulcerations on the exterior of the body, they must originate from very different causes.

1. They may be produced by the sloughing of portions of the mucous membrane arising from general debility. Such cases have been discovered in persons broken down by syphilitic disease, kidney-affections, and other exhausting maladies. We see analogous cases of sloughing

of the mucous membrane of the oral cavity in a similar state of health.

2. The death of small portions of the mucous membrane has been attributed to embolism of the arteries of the stomach. Against this, as a common cause, is the fact that the gastric ulcer is generally single, and that we constantly fail to discover ulcerations where numerous emboli can be proved in the vessels of the other principal organs of the body. It is probable, however, that some rare cases are to be attributed to this cause.

3. The perforating ulcers so commonly met with in young persons were attributed by Rokitanski to hæmorrhagic erosions of the mucous membrane, produced by catarrh. His opinion seems to be supported by the fact, that these ulcers are most frequently present where catarrh is most common, namely at the pyloric region; and also that their occurrence is usually preceded only by symptoms indicating a slight attack of catarrhal gastritis.

4. Dr. Copland pointed out how often the arteries of the stomach were diseased, where an ulcer was present, especially in old people. The truth of this remark the writer can confirm, from the microscopic examination of a number of specimens; and to this circumstance we must also attribute much of the difficulty experienced in the cicatrization of gastric ulcers. Where the arteries are healthy, it will be often found that the veins are thickened and tortuous, and it need not be pointed out that the effect of a similar condition is daily seen in the production of ulcerations of the lower extremities.

5. Probably not less powerful in setting up these ulcers in the aged are the fatty and fibroid degenerations of the mucous membrane, so often discovered on microscopical examination. It seems reasonable to suppose that in tissues thus altered, a slight irritation would be sufficient to set up an ulcerative process.

When a small and superficial ulcer of the stomach heals, only a slight scar is left; but where it has been of large size, and has penetrated more deeply, the organ may be puckered up by the cicatrix, and considerable change of shape may be produced. The ulceration may, on the other hand, produce death by laying open a blood-vessel; by perforating the peritoneum or some of the neighbouring organs; or, in more rare cases, by giving rise to abscess of the liver.

Symptoms.—Pain is by far the most constant and prominent symptom of ulcer of the stomach. At first, it is only a feeling of uneasiness after food, but as time goes on it increases in constancy and severity. It commences shortly after food, and persists during the whole period of digestion, or until the contents of the stomach are rejected by vomiting. In some cases it begins as soon as food has been taken, but more generally an interval of fifteen or twenty minutes elapses before it is complained of. The pain is usually relieved by the recumbent position, but in some the patient finds relief by bending the body over a chair or by lying on one side. The writer has seen cases of large ulcers, in which there was little or no pain, the sore being apparently insensible to irritation, as is sometimes seen to be the case in old ulcers of the legs. The pain is referred to one spot, which is usually situated in the epigastrium, but more rarely it affects the left hypochondrium or the umbilical region. In a considerable number pain is experienced in the back, usually at a place between the last dorsal and the first lumbar vertebræ, or rather a little to the left side of this region. It is not uncommon for the pain to increase for a few days, and then gradually to subside. These exacerbations the writer has chiefly observed in very chronic cases. They probably point to an extension of the ulceration, for they not infrequently precede hæmorrhage and perforation. In almost every case we meet with tenderness on pressure over the seat of the sore. This may be so great that the patient is unable to wear his clothes moderately tight; in others it requires a careful search to discover the sore spot. The tender part is, as a rule, opposite the place to which the pain is referred, and can often be covered by the finger-end. General tenderness is no test of an ulcer, as it is often present in congested liver, gastric catarrh, and other complaints of the epigastric region. It is necessary to be careful in testing for the existence of a gastric ulcer by the finger, for a very slight pressure often suffices to bring on a paroxysm of pain, even when the stomach is empty of food. The tender spot may be situated in the epigastrium, in the hypochondrium, or near the umbilicus, but it is most generally in the first-mentioned locality.

Vomiting, although often present, is a much more variable symptom. It seldom occurs directly after food, as is often the case in cancer, because the cardiac orifice is rarely the seat of simple ulcer. It is preceded by nausea, not infrequently by a copious flow of saliva, and it relieves the pain by freeing the stomach of its acrid contents. The tongue may be perfectly clean, or may be thickly coated. As the abnormal appearances of the tongue in dyspepsia arise from an extension of gastric catarrh to the mucous membrane of the mouth, a perfectly clean tongue is present, if the ulcer is unattended by gastritis. Flatulence is not a common symptom, inasmuch as the amount of food taken is limited, on account of the pain produced by it. Extreme acidity occasionally presents itself, but it is not so common as the statements of some authors would lead us to imagine. The appetite is seldom much affected, especially in the young. Patients often remark that they could and would eat freely, were it not for the dread of the pain. The bowels are generally confined. The stools are knotty, and in many cases contain mucus. There is nothing characteristic about the urine. It is usually clear, and is passed frequently, and in unusually large quantities. Whenever the disease has lasted for some time there is a loss of strength and energy, arising from imperfect nutrition, from the frequent attacks of pain, and from the vomiting. The duration of gastric ulcer varies greatly. In some cases the sore seems to heal rapidly; whilst in others the symptoms often subside and reappear, so that the patient remains an invalid for years. Chronic cases in old people are often very difficult to cure, and great patience and perseverance are required in order to obtain even an alleviation of the symptoms. The symptoms produced by hæmorrhage and perforation are elsewhere described. *See* HÆMATEMESIS; and Stomach, Perforation of.

Physical Signs.—In a recent case of gastric ulcer we can expect no assistance from physical signs, but where the disease has lasted for some time evidence of adhesions may be detected. Adhesions may be suspected, when it is found, by auscultation and auscultatory percussion, that only a small portion of the stomach is in apposition with the abdominal walls, and more especially if this part is the tender spot, and does not vary its position with different states of distension of the organ. Again, if the stomach is found to be of considerable size when empty, and its extent not increased by food, we may suspect that its motions are trammeled by adhesions. The microscope affords but little assistance in the detection of gastric ulcer, because the extension of this disease is usually very slow, and we therefore have little chance of discovering portions of the mucous membrane in the vomited matters.

TREATMENT.—The main indication, where the symptoms of ulcer of the stomach are urgent, is to give to the affected organ as perfect a state of rest as is possible. The patient must be placed in the recumbent position, unless it produce pain, and must retain it strictly. In the more chronic cases, or when the more severe symptoms have subsided, a limited amount of exercise may be permitted, lest the general health become deteriorated by confinement. In urgent cases mere position is not enough, and physiological rest must be insured. It is, therefore, often necessary to interdict the use of all food, and to keep up the nutrition of the body by nutritive enemata. In less severe cases it is only necessary to confine the patient to liquid food, taken in small quantities and frequently. Milk must form the basis of diet, and it can be either taken alone, or, if there be much acidity, mixed with lime-water or with Seltzer or Vichy water. In some cases buttermilk agrees, where sweet milk produces vomiting. In others the concentrated Swiss milk is more readily digested. But sometimes milk in all forms disagrees, unless it be mixed with some farinaceous material, such as arrowroot, sago, tapioca, or corn-flour. As the patient improves a more nutritious diet may be prescribed, such as beef tea, mutton broth, chicken broth, eggs, maccaroni, or light puddings. Where the patient is young and otherwise healthy, leeches are often of great service. Some practitioners have objected to their use, but the writer has often seen them of signal benefit. It is seldom necessary to apply more than six at a time, and they may be repeated from time to time, as the case requires. In others dry-cupping answers a good purpose. Where there is reason to object to the effects of the leeches, a bladder filled with ice and applied to the part often affords relief; but, in general, hot poultices and fomentations are more useful. In long-standing cases great benefit is often derived from repeated small blisters, or from the application to the epigastrium of tartar-emetic ointment or croton oil. The most valuable remedy in all cases is opium. It relieves pain, controls the action of the muscular coat, and restrains the secretion of the stomach. It is best given in doses of one or two grains, once or twice a day, shortly before food. It is a common practice to apply morphia hypodermically, but this in some cases produces vomiting, and must, therefore, be used cautiously. Besides this, it must be remembered that the sedative, when taken by the mouth, is more directly applied to the ulcerated and tender surface. The vomiting is a most distressing symptom, and tends to prevent the healing of the sore. The fluids rejected should be often examined by the microscope. If torulæ or sarcinæ are present, recourse must be had to carbolic acid, creasote, or sulphurous acid; at the same time a small blister should be applied to the epigastrium. When a large quantity of mucus is discharged, the case is best treated with full doses of bismuth, magnesia, and morphia, or with oxalate of cerium. As soon as the more active symptoms subside, it is necessary to administer tonics. Some preparation of iron may be selected; the saccharo-carbonate or citrate answers the purpose best.

When the case is still more chronic, preparations of silver, copper, and zinc have been recommended. The nitrate of silver is, in the opinion of most authors, to be preferred, whilst others have looked upon it as inert in the doses usually given. The writer has certainly seen great benefit from both it and the sulphate of copper; but, on the other hand, he has seen mischief result from the administration of these salts at too early a period. As the bowels are almost always confined in gastric ulcer, it is necessary to promote their action by castor oil, small doses of aloes, or enemata. In the more acute stage of the disease all irritating aperients must be, of course, carefully avoided, and the bowels should be relieved only by injections.

21. Stomach, Vessels of, Diseases of.—The blood-vessels of the stomach are frequently diseased, and their morbid conditions no doubt play an important part in the production of anatomical changes in the other structures of the organ. Dr. Copland, many years ago, drew attention to an atheromatous state of the arteries as frequently present along with gastric ulcer, and the same remark has since been made by Virchow. From repeated examinations of cases of chronic gastric ulcer with the microscope, the writer can confirm the truth of these statements. He has constantly found the arteries thickened and enlarged in the neighbourhood of the ulcer. Not unfrequently the vessels, as well as the other textures of the organ, are in a state of fatty degeneration, the condition being in some degree analogous to what is observed in fatty degeneration of the heart, in connexion with obstruction of the coronary arteries. Where the arteries are healthy in gastric ulcer, the veins of the mucous membrane are generally thickened and dilated, displaying a state like that so constantly remarked in the veins of the lower extremities where ulcers have been long existing. In cancer of the stomach the smaller arteries in the neighbourhood of the malignant growth have been often found greatly thickened. This condition seems to be an important one in determining the future progress of the malignant growth, as leading to its being imperfectly supplied with blood, and its consequent sloughing. But an abnormal state of the smaller arteries of the stomach is also met with where there is no other disease. There has been much dispute whether a similarly thickened condition of the arteries in contracted kidney is a result, or merely a co-existing state, of other morbid changes. The occurrence of thickened arteries in the stomach without, as well as with, other structural alterations, seems to show the opinion of those to be correct who hold that the arterial changes in atrophy of the kidney are not necessarily the result of the other abnormal states. Affections of the veins of the mucous membrane of the stomach are constantly present in heart-disease, and in cirrhosis of the liver. In such complaints we usually find the vessels much dilated and the coats thickened. SAMUEL FENWICK.

STOMACHICS (στόμαχος, the stomach). SYNON.: Fr. *Stomachiques*; Ger. *Magenmittel.*

DEFINITION.—Substances which increase the functional activity of the stomach.

ENUMERATION.—The most important stomachics are Alcohol, Acids, Alkalies, Aromatics, Bitters, Arsenic, Pepsin, and Strychnia or Nux Vomica.

ACTION.—In the act of digestion the stomach has the threefold function of secretion, movement, and absorption. By an abundant secretion of gastric juice some of the albuminous constituents of the food are quickly digested; and this digestion is aided by the movements of the stomach, which mingle the gastric juice with the food, and aid solution by breaking up the particles. From the stomach, also, absorption of some of the products of digestion goes on. Some stomachics, such as alcohol and dilute alkalies, increase the secretion of gastric juice; possibly also bitters, and small doses of arsenic. Dilute acids, given after meals, and pepsin supply the essentials of gastric juice when secretion is deficient. It is not improbable that the peristaltic movements of the stomach are increased by strychnia and nux vomica. We want experiments on the action of drugs which increase absorption. It is also probable that some of the good results of bitters are due to their preventing abnormal processes of fermentation in the stomach. T. LAUDER BRUNTON.

STOMATITIS (στόμα, the mouth).—SYNON.: Fr. *Stomatite*; Ger. *Mundschleimhautentzündung.*

DEFINITION.—Inflammation of the mouth.

VARIETIES.—Stomatitis is chiefly met with in infants and young children. It presents itself under three varieties:—1. *Follicular*; 2. *Ulcerative*; and 3. *Gangrenous.*

1. **Follicular Stomatitis.**—This form of inflammation of the mouth is very apt to arise when children are recovering from the eruptive fevers. But it may also be met with in comparatively strong children, both in connection with severe dental irritation, and also originating in a true herpes of the mouth, analogous to, and sometimes associated with, *herpes labialis.*

Follicular stomatitis has its origin in the follicles of the mucous membrane, which become inflamed, and exhibit spots of white exudation. There is, however, no breach of surface. The name of *aphthæ* is often, though incorrectly, given to simple, or follicular, stomatitis; and the term *thrush* is popularly applied to both complaints (*see* APHTHÆ; and THRUSH.) Follicular stomatitis is not a serious complaint, though it indicates a weak state of health and a faulty nutrition. The little patient swallows with difficulty. There is an increased flow of saliva; the mouth is hot and tender; the sub-maxillary glands are swollen; and the bowels are disordered.

2. **Ulcerative Stomatitis.**—This is merely an advanced form of the preceding variety. The inflamed follicles break and form small ulcers, covered with a greyish or yellowish slough. These ulcers may remain separate and distinct, or several may coalesce to form one larger ulcer. Sometimes the ulcerative process spreads rapidly. This is especially apt to be the case when the disease is situated on the gums. In a severe case the bases of the teeth and the alveoli may be exposed.

TREATMENT.—The treatment of these two varieties of stomatitis must be conducted on the same principles, and may, therefore, be given under the same head. It is necessary to put the child in a favourable hygienic condition, and to regulate its diet. If it be at the breast, inquiry should be made as to whether it is fed regularly, and only at proper intervals. This should be insisted upon. If the milk evidently disagree, the infant must be weaned. In some cases, however, it may be enough to supplement the mother's milk with some suitable food. With older children attention must be directed to the nutritious quality of their food, and to the regularity of their meals. If it be possible for the child to have a change of air, this alone will often have a most beneficial effect. Small doses of grey powder, or of rhubarb and magnesia, should be given to regulate the bowels; while at the same time chlorate of potash and bark should be prescribed. Subsequently a course of cod-liver oil, or of the syrup of the iodide of iron, or of Parrish's chemical food, will be useful.

Locally, the mouth should be washed with some simple detergent. Borax is the most valuable; but when, as not unfrequently happens, there is some fœtor of the breath, a little tincture of myrrh, or Condy's fluid, may be used with advantage.

3. **Gangrenous Stomatitis.**—SYNON.: *Cancrum oris*; *Noma.*—Occasionally, but very rarely, we meet with a much more formidable variety of stomatitis, arising out of the ulcerative form, and supervening upon measles, or some other debilitating blood-disease. In *cancrum oris* one cheek, generally near the angle of the mouth, becomes swollen, red, brawny, and shining. The whole thickness of the cheek is affected by an acute inflammation, which runs on rapidly to gangrene. The internal surface is the seat of a deep foul ulcer, and the little patient can hardly open his mouth. Gradually the redness passes into lividity; and a black point appears, which is soon the centre of a large slough. When this separates,

the teeth and the interior of the mouth are exposed to view.

TREATMENT.—Everything must be done to support the patient's strength by milk, beef-tea, wine, and stimulant medicines. The mouth should be syringed frequently with warm water, or with a disinfectant mouth-wash. The cheek must be covered with a poultice or a fomentation until the slough separates, and then the raw surfaces must be dressed with a stimulating lotion—for example, of carbolic or nitric acid, or of sulphate of zinc. If the gangrenous inflammation threaten to spread, the edges must be thoroughly touched with strong nitric acid. Indeed some consider it well to treat the ulcer inside the cheek in this manner from the commencement. In order to do this effectually it will be necessary to administer an anæsthetic. But, in spite of all that can be done, gangrenous stomatitis is a very fatal disease.

W. FAIRLIE CLARKE.

STONE.—A popular name for calculus. *See* CALCULUS.

STOOLS, Characters of.—The physical, chemical, and microscopical examination of evacuations from the bowels, or 'stools,' have been fully considered in the article FÆCES. There remain to be described here certain characters which the stools possess in special diseases. Owing to the extreme variety in appearance, quantity, consistency, colour, and composition which healthy motions present, their characteristics in disease are of doubtful significance, and it is but rarely that a diagnosis depends on their investigation, unless it be for the discovery of such bodies as entozoa, gall-stones, pins, or other objects accidentally swallowed, and occasionally pus or blood.

In a few diseases only do the evacuations present features of sufficient constancy to be in any way distinctive, and even then it is rather as an element in the diagnosis, than as being actually pathognomonic, that they are to be considered. As might be expected, these maladies are amongst those in which there exists some serious lesion of the gastro-intestinal tract, or of its tributary glands. The following may be referred to in this category:—

Cholera.—During the stages of the onset, crisis, and reaction of Asiatic cholera, the stools present a successive series of changes in colour, consistency, and composition. During the preliminary diarrhœa the contents of the bowel are voided in a semi-formed, pappy, and increasingly fluid condition, with a progressive alteration in colour from the normal tint to almost colourlessness. During the algid stage about 50 to 100 ounces are discharged, in 10 to 20 portions, of a rice-water or whey-like appearance, inodorous, and wholly wanting in bile-pigment. The excreta on standing deposit whitish flocculi, consisting of epithelium, fungi, granular débris, and crystals of salts, chiefly phosphates; occasionally a few blood-corpuscles are seen. The supernatant fluid is alkaline; and it contains a large proportion of chloride of sodium, and a little albumen. When the stage of reaction sets in, the stools become coloured, at first greenish, and they then generally assume the normal colour and consistency as the diarrhœa becomes less profuse. In this stage they are sometimes very fetid.

Dysentery.—In this disease, more than in any other, are the stools diagnostic, especially if with their appearance their odour be taken into account, as they are peculiarly fetid, or even gangrenous. The frequency of the stools is very great, amounting sometimes to hundreds in the day, but a few drachms being voided on each occasion. Considerable variation is met with, dependent on the severity, type, or stage of the case; but the first discharges, and perhaps the only ones in mild cases, consist of pale yellow masses of glairy mucus, often specked with blood, and with or without a small quantity of pale, feculent matter. The microscope reveals a few leucocytes and free nuclei, with blood-corpuscles, enclosed within the structureless mucus. In later stages, when there is suppuration of the mucous membrane, small red lumps, of an appearance like raw washed meat, are seen in yellowish or reddish albuminous fluid. These masses consist of red blood-corpuscles, imbedded in a stroma of viscid mucus, with pus and epithelial cells and granular débris. Sometimes the stools consist chiefly of blood; at other times pus predominates; and when the disease is of a very malignant character, large gangrenous portions of the bowel are voided with a brownish serous fluid. The mucus is sometimes expelled in a form resembling masses of boiled sago. It is said that a partial diagnosis of the extent of the disease may be made by a study of the characters of the stools.

Enteric fever.—Previous to the establishment of the intestinal ulceration in typhoid fever, the stools consist of brownish masses, more or less formed; but subsequently what is often regarded as a characteristic appearance is presented, namely, pale yellow semi-fluid pea-soupy evacuations, of an alkaline reaction, and offensive odour. On standing, the motions deposit a yellow flocculent sediment of particles of food, granular *débris*, fungi, epithelial cells, and crystals of triple phosphates. The fluid has a sp. gr. of 1015; and contains 4 per cent. solids, chiefly albumen and chloride of sodium. Not infrequently blood is found, and sometimes portions of Peyer's patches that have sloughed off. The diagnosis between typhoid and tubercular ulceration of the bowels is not to be made with any certainty from the appearance of the stools. For although the above description applies to the evacuations in many cases of enteric fever, in others they are much more consistent, and even clayey. Identical discharges are met with in tubercular disease of the intestines.

Pancreatic disease.—In those morbid conditions where the pancreatic juice is not secreted, from destruction of the gland, as in cancer, or when the secretion is prevented gaining entrance into the bowel from occlusion of the duct, it has long been known that the stools are liable to contain fat in variable quantity, occurring in the form of loose drops, or lumps, or smeared over the fæces, or discharged free from feculent matter, constituting a stearrhœa. This condition is much more likely to be met with when the bile is prevented from flowing into the duodenum, although the existence of such obstruction is not a necessity. And further, it must be admitted that fat has been found wanting in the stools when there has been marked pancreatic disease. It must not be forgotten that healthy evacuations contain a small quantity of fat, which may be considerably increased if the amount ingested be excessive. Hence fat in the stools cannot be regarded as absolutely indicative of disease of the pancreas, though very often associated with it. Owing to the frequent association of diabetes with disease of the pancreas, such as cancer or atrophy, fatty stools are often met with in that disease.

Hepatic disease.—It is only in affections of the liver in which there exists some interference with the flow of bile into the intestine, that the stools present a characteristic appearance, namely, a want of colour, varying from a pale yellow to a whitish-clay tint, in proportion to the degree of exclusion of the bile. Such evacuations are almost always unformed and of 'porridge-like' consistency; rarely in the form of pale scybala. From want of bile their odour is invariably offensive; and they may be even putrid in cancer of the liver. Since hæmorrhage from the mucous surface frequently complicates icterus, the fæces are sometimes blackened from blood. In a few recorded cases of hepatic disease, where the pancreas has been unaffected, fat has been found in the stools, sometimes in large quantities.

Fever.—In the general febrile state, when there is no primary affection of the digestive organs, the motions are diminished in quantity, and as a rule drier, though very frequently unformed. The colour is generally darker, due probably to the increased destruction of blood-corpuscles, and increased elimination of bile-pigment; and the odour is more offensive than in health.

Other diseases.—In other affections of the chylopoietic viscera the characters of the alvine discharges are so variable in quantity, colour, consistency, odour, and composition, that no general remarks can be made and no diagnostic indications recorded. Sometimes in grave diseases the motions are not to be distinguished from those in health, whilst a trifling change in diet or habitation, or a slight catarrh, may be accompanied by the discharge of fæces differing in many respects from the normal. The fact is that no standard can be taken, so numerous and frequent are the disturbing causes.

Severe constitutional diseases of a chronic character, as rickets and scrofula, where the general nutrition is seriously affected, and the blood much altered in quality, are very frequently characterised by stools which are pale in colour and fetid in odour. The deteriorated quality of the intestinal secretions, and consequent imperfect digestion of the contents of the bowel, will account for this.

The significance of blood in the motions has been explained in the article MELÆNA.

Pus in any considerable quantity, and especially if free from admixture with fæces, may be taken to indicate the rupture into the bowel of an abscess, since the inflammatory conditions of the canal, such as enteritis and dysentery, are not accompanied with very extensive pus-production. The contents of pericæcal or perirectal abscesses are usually extremely ill-smelling. *See also* Nothnagel, *Zeits. f. Klin. Med.*, iii., p. 241.

W. H. ALLCHIN.

STRABISMUS.—SYNON.: Squint; Fr. *Strabisme*; Ger. *Strabismus*; *Schielen.*

DEFINITION.—A condition in which the two eyes are not directed to the same point in space.

DESCRIPTION.—Squint is commonly either (1) *convergent*, or (2) *divergent*; but (3) there may be a deviation either *upwards* or *downwards*. When one eye appears to be normally directed, and the other to deviate, it is convenient to distinguish the former as the *working*, and the latter as the *squinting* eye.

The extent or degree of strabismus, or, as it is more usually called, the *magnitude* of a squint, is expressed in terms of millimètres. In convergent or divergent squint it is customary to measure the distance between an imaginary vertical line bisecting the palpebral fissure, and another imaginary vertical line bisecting the pupil of the deviating eye. In an upward or downward squint, the distance between the horizontal diameter of the pupil, and an imaginary horizontal line bisecting the palpebral fissure, would give the measurement required.

1. **Convergent strabismus.**—This is seen under two principal forms; (*a*) that which depends upon *paralysis* or paresis of one of the external recti muscles, permitting the antagonist internal rectus to exert a preponderating influence upon the position of the eye; and that which depends upon *excessive development* of both interni, in consequence of an error of refraction, whether (*b*) *hypermetropia*, or (*c*) *myopia.*

(*a*) *Paralytic convergent strabismus.*—This form of strabismus is met with in all degrees, from the slightest weakening of the affected external rectus to complete paralysis.

ÆTIOLOGY.—Paralytic convergent strabismus is primarily a nerve-affection, in which, however, the muscle concerned will after a time be liable to undergo degenerative changes. The strabismus usually commences somewhat suddenly, in persons of adult age, and often rapidly increases in degree; the paralysis, which at first was only partial, becoming complete. In the great majority of cases it is associated with syphilis; but it is also met with as a result of impaired nutrition or degenerative change in the nervous centres, consequent upon anxiety or overwork. In some of the syphilitic cases, it appears to be due to central mischief, such as gumma or arterial occlusion; in others to pressure upon the trunk of the sixth nerve by periosteal thickening or other morbid growth.

DIAGNOSIS.—In pronounced cases, the diagnosis is easy; and depends upon the fact that, even when the working eye is closed or covered, the squinting eye cannot be directed outwards by voluntary effort. If the paralysis, although considerable in degree, is not complete, the eye cannot be directed outwards as far as usual; if the paralysis is complete, the pupil cannot be carried external to the middle line of the palpebral fissure. When the affected muscle is only slightly weakened, the nature of the condition may not be at once apparent from the limitation of movement; and the degree of deviation may be so slight that it is not easy immediately to pronounce which eye is affected. This doubt may be removed, and the existence of paresis made manifest, by the following tests. The surgeon should stand in front of the seated patient, and should hold up before him, in the middle line, and at a convenient reading distance, some small object, telling him to look at it steadily. By his own hand, or by a piece of ground glass, the surgeon then cuts off the view of the object first from one of the patient's eyes and then from the other, watching their movements as he does so. When the object is concealed from the squinting eye, the other one, being already rightly directed, will remain stationary to continue the act of seeing, and the squinting eye will also remain stationary; but, when the object is concealed from the working eye, the other, or squinting eye, being wrongly directed, and not receiving the image of the object upon its yellow spot, will make a slight outward movement in order to take up correct fixation. At the same moment, the working eye, behind the obstruction, will execute an inward movement of somewhat greater amplitude than the outward movement of its fellow. Let it be supposed that there is slight weakening of the right externus, producing slight inversion of the right eye. When the object is screened from the right eye, the left still sees it clearly and sharply, and both eyes remain at rest. When the object is screened from the left eye, the right receives the image upon a point of its retina internal to its yellow spot, and sees it only indistinctly. The right eye, therefore, makes an excursion outwards, sufficient in amount to bring the image of the object upon its yellow spot, and to enable it to see better; but the motor impulse by which the necessary movement of the external rectus is called forth, is conveyed at the same time to the internal rectus of the left eye, as a result of the habitual association of the two eyes and of their muscles in the act of looking towards the right; and the sound muscle, under a given motor impulse, contracts more vigorously than the weakened one. The result is that the excursion inwards of the working eye is larger than the excursion outwards of the squinting one; and in this way the fact of paresis of the right externus is rendered manifest.

This form of strabismus is at first attended by distressing double vision, which often produces giddiness, but which diminishes in time, as the patient learns to neglect or mentally to suppress the image of the squinting eye. The smaller the deviation, the more distressing will be the double vision; because, the nearer to the yellow spot is the image of the squinting eye, the more definite will it be, and the less readily will it be distinguished from that of the other. In cases of very slight deviation, the equality of the double images renders it difficult to tell the true from the false, and leads the patient into frequent error with regard to the position of the object looked at.

TREATMENT.—The treatment of paralytic strabismus is primarily that of the syphilis or of the nerve-exhaustion upon which the paralysis depends; but it is also necessary to endeavour to minimise the inconveniences of the double vision while it continues, and to provide against permanent degeneration of the paralysed muscle from disuse. The former indication may be fulfilled by covering the squinting eye with a patch, or with an opaque glass in a spectacle frame; and, as the double vision is only troublesome when the eyes are directed to the side of the affected muscle, it is often sufficient to render opaque, by grinding or otherwise, the outer half of the glass which covers the affected eye. The nutrition of the muscle may be preserved, when the paralysis is incomplete, by systematic voluntary endeavours to call it into action; these endeavours being made three or four times a day for a few minutes at a time. For this purpose, the working eye should be closed or covered, and the squinting eye should be directed as much as possible towards the outer side. When the paralysis is complete, so that the eye cannot be carried beyond the middle line of its eyelid-opening, it is necessary to exercise the affected muscle by localised electric currents, after the manner of Duchenne. In cases where there is no response to induced currents, those of a cell battery will sometimes be found effectual. The exercise by electricity should be repeated at short intervals, such as every two or three days, until the nerve-function is beginning to be restored, so that the muscle can again be exercised by the will.

In cases of paralytic strabismus of old standing, it is sometimes necessary to have recourse to tenotomy of the contracted internus, before the eye can be restored to its correct position. It may be laid down as a general principle that every case can be cured, by combined tenotomy and volitional or electrical exercises, as long as the paralysed muscle will respond, in however small a degree, either to the will or to one form or other of electric current; but that, where the eye does not move outwards in obedience to the will, and where neither induced nor battery currents produce contraction of the paralysed muscle, no good is to be expected from either operative or medicinal treatment.

(*b*) *Convergent strabismus due to excessive development of both interni.*—ÆTIOLOGY.—As a result of errors of refraction, about 90 per cent. of this class of cases are due to flat-eye or *hypermetropia*. The flat formation of the eye requires, for acute vision of near objects, a strenuous accommodation-effort; and this, by the intimate association which exists between the nerve-centres governing the accommodation muscles, and those governing the interni, produces a corresponding effort of convergence. As soon as a child who is born with flat eyes begins to take careful notice of near things, his accommodation muscles and his internal recti are both called into frequent and energetic exercise; and the consequence is that the interni become excessively developed in relation to their antagonists, the externi, so that the normal, or resting position of the eyes, instead of being one of parallelism, becomes one of convergence. The result of this is that the child would receive double images, of equal intensity, of all objects situated either nearer to him, or farther from him, than the point at which the convergent optic axes would meet if prolonged. Let us suppose that this point is one foot distant from the eyes; and that the child wishes to look at an object which is eighteen inches distant. He cannot do this with both eyes, because the externi are unable to overcome their more powerful antagonists. If, however, he combines the right externus with the left internus, as in the act of looking to the right with both eyes, he becomes able to fix the object correctly with his right eye; and if he combines the left externus with the right internus, as in the action of looking to the left with both eyes, he becomes able to fix the object correctly with his left eye. But as, in either case, both eyes start from a position not of parallelism but of convergence, the effort which carries the right eye from its convergent state to the middle of its palpebral fissure will carry the left from its convergent state to one of much greater convergence, and *vice versâ* with the left eye; so that, while one eye is directed to the object of vision, the other is rolled far inwards. In this way, the image is received upon the yellow spot of the working eye, and upon so peripheral a portion of the retina of the squinting eye that it is easily neglected by the consciousness, and ceases to be a source of confusion or embarrassment.

Diagnosis.—The state of things in an ordinary case of squint beginning in childhood is the following. In a state of rest, as when the attention is not directed to any object, or during sleep, or under an anæsthetic, the eyes are equally convergent; but as soon as any object is looked at, one eye fixes this object and the other rolls inwards. If the degree of flatness is alike in both eyes, and if the muscles in both are of equal power, sometimes one will be the squinting eye and sometimes the other; and in most cases this condition obtains for a time. The squint is then said to be 'alternating.' Generally speaking, however, it is for some reason easier to work with one eye than with the other; either because it is flat in a less degree, or because its accommodation muscle or its external rectus is stronger than the corresponding muscle of its fellow; and then this eye is used in preference to, and gradually supersedes, its fellow; becoming always the working, while that is always the squinting eye. The squint is then said to be 'permanent.'

Treatment.—It would appear at first sight, from the rationale of the affection, that the squint which depends upon flat-eye could always be prevented, or even cured, by the habitual use of convex spectacles; but, as a matter of fact, the balance of power between the externi and the interni becomes deranged at so early a period of life, that spectacles could not be applied until too late. In every pronounced case of strabismus, it is necessary to perform tenotomy of the interni, sometimes only of one but far more frequently of both; and the only question to be considered is that of the time most favourable for the operation.

In determining this question, the points chiefly to be taken into account are the state of vision, and the age of the patient. When a squint becomes permanent, the vision of the habitually squinting eye frequently becomes impaired, apparently as a result of the continued mental suppression of the image which it receives; and in a person who is suffered to grow up to adult age squinting, this impairment of vision often falls little short of blindness, and admits of no remedy. No change is discoverable, generally speaking, by the ophthalmoscope; but the power of responding to impressions upon the retina seems to be lost. On the other hand, as long as the squint is alternating, and each eye is used by turns, the sight does not usually suffer.

The immediate effect of tenotomy of one or both interni is to release the eyes from their position of enforced convergence, and to diminish the power of the interni to rotate them inwards. The divided muscles soon acquire new attachments farther back upon the eyeball than their former ones, so that their power is permanently diminished, and this diminution may even be in excess, so as to leave an undesirable preponderance of the externi, and a corresponding tendency to eversion. The surgeon, even by the best planned operation, cannot absolutely determine the future position of the eyes. That determination has to be effected by the muscles themselves under the guidance of vision; and a perfect result after a squint operation, by which is meant the restoration of parallelism when at rest, without impairment of the power of volitional convergence, can only be obtained by an instinctive re-arrangement of the muscular forces concerned, a re-arrangement mainly brought about by efforts to avoid double vision, which is often the immediate result of an operation. While, therefore, it is always possible to remove by tenotomy a coarse and manifest malposition, it is only possible to obtain a perfect result when the recti muscles are well-developed, when the acuteness of vision is equal or nearly so in the two eyes, and when the power of attention to visual impressions is sufficiently active to render double images distressing. The muscular development and the power of attention are both deficient in early childhood; and hence, so long as vision does not suffer, it is better to defer operating for squint until about eight years of age. As long as the squint is alternating, there is no fear that the vision will suffer, and it is then safe and desirable to wait; but, as soon as the squint becomes permanent, it is necessary to test the vision of the squinting eye from time to time, and to provide for this eye being exercised every day, by keeping the other closed or covered for short periods. If, in spite of such exercise, the vision of the squinting eye is found to be undergoing progressive deterioration, the operation should be performed without delay, at however early an age; and the parents should be warned that it may perhaps be necessary, for the attainment of perfect harmony of movement between the two eyes, to operate again at some future time.

It will sometimes happen that a child is first brought for advice at an earlier age than eight, in whom the squint has already become permanent in one eye, and in whom the vision of that eye has already begun to suffer. In such cases, it is best to devote a few weeks to endeavours to improve the vision of the squinting eye by compulsory exercise; and if these endeavours should be in any degree successful, to continue them as long as improvement under their employment is perceptible. If no improvement should be produced, the operation should be performed without further loss of time.

(*c*) *The convergent squint of short-sighted people.*—This is not a very common affection, and depends upon the fact that, spectacles to afford distant vision not having been worn, the externi, which produce the approximate parellelism of the optic axes required for distant vision, have not been exercised; while the interni have been constantly exercised in producing convergence for the vision of near objects. The former muscles, therefore, have been suffered to fall into a condition of feebleness from disuse, while the latter have undergone abnormal development. In such cases the eyes are usually equally convergent, such a position giving single vision of near objects; while double vision of distant ones is not irksome, on account of the indistinctness with which they are seen.

TREATMENT.—When the convergent squint of of a short-sighted person is of small magnitude, it may sometimes be cured by wearing glasses which correct the short-sight for distance, and call upon the external recti to take up their proper function. More frequently, however, they fail to respond; double vision is produced; and tenotomy, followed by the use of the spectacles, is required. Such cases usually turn out perfectly well.

2. **Divergent squint.**—This is nearly always a consequence of defective vision of the squinting eye, which wanders outwards for want of guidance from visual impressions. It may also follow from unskilfully performed or excessive operations for the cure of convergent squint.

TREATMENT.—The operation for divergent squint is not a mere tenotomy, but requires the shortening of the internal rectus of the squinting eye, or its advancement to a point of attachment nearer to the corneal margin; and the results of such an operation are less under command than those of tenotomy. The muscle may not attach itself firmly in the new position, or the connecting medium may stretch after a short time. The operation may be undertaken more hopefully, the better the vision of the divergent eye; and it is often very successful. It is nevertheless most prudent, in every instance, to prepare the patient for the possibility of failure, or of only partial success. It is in no case likely that the defect will be increased by failure of the operation; and, as the chief motive for its performance is usually the improvement of appearance, it may be undertaken with propriety in almost every case.

3. **Complex squint.**—The forms of strabismus in which the deviation is either upwards or downwards are not sufficiently numerous to be brought under any general rule. They depend either upon spasm of the muscle producing the deviation, or upon paralysis or paresis of its antagonist; and every case must be investigated and treated upon its merits, by tenotomy or electrisation, or both combined, according to the particular circumstances. Various irregular forms of strabismus are also seen, in the course of certain acute and chronic diseases of the nervous system, which entail loss or impairment of muscular co-ordination, such as meningitis and locomotor ataxy; but such forms are usually easily to be distinguished as symptoms of the general disorder, requiring no treatment or consideration apart from it. In chronic diseases, such as locomotor ataxy, it may be conducive to comfort to exclude the squinting eye from vision, for the purpose of obviating the inconveniences incidental to double images.

R. BRUDENELL CARTER.

STRANGULATION (*strangulo*, I choke). In pathology this term is employed to express either the process or the condition of constriction of a tube, when it is so complete that the passage of the contents is prevented. *See* HERNIA; and INTESTINAL OBSTRUCTION.

STRANGULATION as a Mode of Death (*strangulo*, I choke).—SYNON.: Fr. *Strangulation*; Ger. *Erwürgung.*

DEFINITION.—The act and effect of constriction of the neck and air-passages by means of a ligature or manual pressure (throttling). Death results essentially from asphyxia.

ÆTIOLOGY.—Strangulation is chiefly homicidal, but it may be suicidal or accidental. Accidental strangulation may occur in a variety of ways, as in the case of a child from tightening of a cravat round the neck, from the end catching in the wheel of a perambulator; in the case of a drunken woman by fixation and tightening of her bonnet-strings; and in the case of a cripple by a rope attached to a weight accidentally becoming tightened in front of the neck.

It was at one time doubted whether suicide could be effected by strangulation, owing to the fact that the hands relax when insensibility comes on, rendering it impossible to keep up sufficient tension on the ends of the ligature. But when the ligature is wound more than once round the neck, or some method is adopted by which the ligature can be tightened like a tourniquet, as by the insertion of a piece of stick which catches behind the ear or elsewhere, it is quite possible; and numerous instances are on record of suicide so effected. In most cases, however, the presumption is in favour of homicide, and in all cases of strangulation by manual pressure this may be looked upon as certain.

SIGNS.—In addition to the general indications of asphyxia (*see* ASPHYXIA), there are special signs of strangulation which vary with the degree of force employed, and the amount of resistance offered by the victim.

To strangle an individual of normal strength, and in full possession of all his faculties, is barely possible, without causing evident signs of violence on various parts of the body. The existence of injuries of this kind is valuable evidence of the mode of death. Very often cranial injuries are found, from the individual having been first knocked down by a blow on the head. Ecchymoses, abrasions, and other signs of mechanical violence are generally to be found in various parts of the body. If the strangulation has been effected by manual pressure, the front or sides of the neck exhibit bruised marks, corresponding to the thumb and fingers, with, perhaps, curved excoriations corresponding to the nails. The relative size of the marks produced by the thumb and fingers, and the direction of the nail-marks, indicate the way in which the pressure has been exerted, and whether with the right or left hand.

When a ligature has been employed, a mark is left on the neck, which varies with the nature of the ligature, and the way it has been disposed. Usually it is a transverse, shallow furrow; single, double, or multiple, according to the number of folds; and continuous, or interrupted in places. The bottom of the groove is generally pale, and not parchmented as in hanging, owing to the pressure not being kept up so long as to lead to dessication. Ecchymoses in the course of the groove are met with more frequently than in hanging, owing to the great violence frequently exerted.

Very commonly punctated ecchymoses are visible on the conjunctivæ, face, neck, and chest. They are considered by Tardieu to be more frequent in strangulation than in asphyxia from other causes, or from overstraining, which likewise may lead to them. In the subcutaneous cellular tissue, and in the fasciæ of the muscles above and below the hyoid, extravasations are frequently found, as well as on the external surface of the thyroid cartilage and trachea. The lungs vary as regards their vascularity, but on the surface it is common to find pseudo-membranous patches, which are due to the rupture of some of the superficial air-cells and collection of air-bubbles under the pleura. In the substance of the lungs congested patches, or apoplectic extravasations, are often found, varying in size, according to Tardieu's description, from half a franc up to a five-franc piece—extravasations, therefore, much larger than those usually found in suffocation.

Treatment.—The treatment of asphyxia from strangulation is that of asphyxia in general. *See* Artificial Respiration; Asphyxia; and Resuscitation.

D. Ferrier.

STRANGURY (*στρὰγξ*, a drop, and *οὖρον*, urine).—Synon.: *Stillicidium urinæ*; Fr. *Strangurie*; Ger. *Harnstrenge.*

Definition.—A condition characterised by a frequent and urgent desire to pass the urine, which is voided in drops or in very small quantities, with a sense of painful spasm in the perineum, and often with no feeling of relief.

Ætiology.—Strangury occurs under such a great variety of circumstances that it can be regarded only in the light of a symptom. It is found in nephritis or intense congestion of the kidney, however induced; and thus becomes a symptom after the administration of large doses of turpentine, or the use of cantharides, either internally or in the form of a blister. It likewise occurs in acute or chronic inflammation of the bladder, prostate, and urethra; in hypertrophy of the prostate; in cancer and other tumours, and in stone of the bladder; and in advanced stricture of the urethra.

Treatment. 1. *Preventive treatment.*—Strangury may be prevented from following the application of a blister to the surface of the body, by allowing it to remain on but for a short time, following it by a poultice, or by sprinkling the skin of the part with powdered camphor.

2. *Curative treatment.*—Regarding strangury as but a symptom of some other morbid condition, we must consider it as we should cough, headache, or dropsy, and treat it with a view to removing the condition on which it depends. With regard to relieving the more urgent local symptoms, warm hip-baths and fomentations, hypodermic injections of morphia, and suppositories of morphia or of belladonna, may be used with advantage.

STRATHPEFFER, in Ross-shire.—Sulphur waters. *See* Mineral Waters.

STRICTURE (*stringo*, I bind).—A contraction of a tube, duct, or orifice; for instance, of any part of the alimentary canal or of the urinary passages. *See* Urethra, Diseases of.

STRIDOR: STRIDULOUS (*strideo*, I creak).—Stridor is the name given to a peculiar noisy form of breathing, produced in the larynx; varying greatly in its character—being either harsh, musical, or crowing; and due to various forms of obstruction. The term *stridulous* is applicable to the respiration, the cough, or the voice, when they possess the characters of stridor. *See* Larynx, Diseases of; Pneumogastric Nerve, Diseases of; and Voice, Disorders of.

STROKE.—A popular synonym for an attack of apoplexy or sudden paralysis; but also used in the compound words, *sun-stroke*, *heat-stroke*, and *wind-stroke*, to indicate the effects of these agents.

STRONGYLUS (*στρογγύλος*, cylindrical). Synon.: Fr. *Strongle*; Ger. *Pallisadenwurm.*—A genus comprising many species of nematoid worms. The large kidney-worm, sometimes called *Eustrongylus gigas*, has only once been found in the human body. The case was undoubtedly genuine, and the specimen is still preserved in the museum of the Royal College of Surgeons. *See* Sclerostoma.

STRONGYLUS DUODENALIS. *See* Sclerostoma.

STROPHULUS (*στρόφος*, a twisting of the bowels, or colic).—Synon.: Fr. *Strophulus*: Ger. *Schälknötchen.*

Definition.—A papular eruption of the skin in infants; referable, as the derivation of the word implies, to derangement of the bowels.

Description.—The eruption is a lichen, a form of folliculitis, rarely extensive, and unassociated with constitutional symptoms. Its principal seat is the face, but it may also be dispersed over the trunk of the body and limbs. Its duration will be influenced by the nature of its cause.

Some variety in colour, duration, and cause has given rise to several names applied to the eruption. It is sometimes ephemeral, and has been termed *S. volaticus*; sometimes the pimples are pale or shining, hence *S. albidus* and *S. candidus*. More frequently they are red and inflammatory, and either dispersed or aggregated, *S. confertus*; and occasionally an interpapular hyperæmia or inflammation gives rise to the variety known as *S. intertinctus*. When associated with dentition this trivial rash is termed 'red gum' and 'white gum'; whilst under conditions of aggravation it is prone to run into eczema.

TREATMENT.—The treatment of strophulus is one of attention to the general health and condition of the infant. A few doses of magnesia and rhubarb, and even a grain of calomel, may sometimes be found useful, but in general a discreet attention to the food, with rest and warmth, will be all that is necessary. Locally, the rash should be dusted over with fuller's-earth powder, or sponged with a lotion of lime-water and oxide of zinc, with or without calamine.

ERASMUS WILSON.

STRUCTURAL DISEASES.—Diseases attended by recognisable anatomical changes, as distinguished from *functional* diseases. *See* DISEASE, Classification of.

STRUMA } **STRUMOUS** } (*struma*, a scrofulous swelling.)—Synonyms for scrofula and scrofulous. *See* SCROFULA.

STRYCHNIA, Poisoning by.—SYNON.: Fr. *Empoisonnement par la Strychnine*; Ger. *Strychninvergiftung.*—The seeds of *Strychnos nux vomica*, commonly known as *nux vomica*, as well as several other plants, owe their powerful toxic (excito-motor) properties to an alkaloid, *strychnia*; and in a minor degree to another alkaloid, *brucia*, which is said to produce the same physiological effects as strychnine. Strychnia is a white crystalline substance, very sparingly soluble in aqueous liquids, to which, however, it communicates an intolerably bitter taste. It is more freely soluble in acid and alcoholic liquids. When mixed with flour and sugar, and coloured by admixture with either soot or Prussian blue, strychnia forms the basis of several well-known forms of 'vermin-killer.' Spite of its repulsively bitter taste, strychnia has been administered with homicidal intent in such liquids as infusions of tea and cocoa, and in other media.

ANATOMICAL CHARACTERS.—The anatomical characters after death by strychnia-poisoning are very ill-marked, and at most consist of some congestion of the vessels of the spinal cord; and even this may be wanting.

SYMPTOMS.—Except when taken in the form of pill, strychnia and all substances containing it produce an immediate and intensely bitter taste, which is also at the same time of a quasi-metallic character, and is very persistent. Since the fatal dose—half a grain of the alkaloid—is small, and the poison is readily soluble in the acid gastric fluid, its physiological effects are, as a rule, not long delayed. They may be unmistakable after the lapse of two minutes; but commonly they are not well-marked till five, ten, or even twenty minutes after administration. They begin with a stage of restlessness, excitement, and a vague sense of impending peril. The special senses, too, are often preternaturally sharpened. A feeling of choking or impending suffocation ensues; then there is a trembling of the whole body; jerkings of the head; and often, in a moment, the whole body becomes stiff and rigid, assuming a bow-like form, (opisthotonos), *i.e.*, arched forwards and resting perhaps on the head and heels only. The muscles even of the chest and abdomen are tense and fixed, so that respiration is impeded, giving rise to more or less cyanosis. The feet are either incurvated or excurvated. The angles of the mouth are drawn down, so as to give rise to the well-known *risus sardonicus* of tetanus. Attempts to administer medicine by either cup or spoon have been known to result in the patient's biting the cup or spoon in two, in consequence of a violent spasmodic closing of the jaws. During the paroxysm, and indeed throughout the intoxication, the cerebral faculties are unimpaired, and the convulsions are purely of spinal origin. The pupils are dilated. In a few minutes, and often in half a minute, the muscular tension relaxes, and there is a complete remission of the spasms. The patient lies exhausted, and bathed in perspiration; the rapid pulse of excitement falls in frequency; respiration becomes more normal; and the dusky lividity of the countenance passes off. This remission is, however, of no long duration. A gentle touch, a footstep, even a breath of air impinging on the patient, results in a new crisis; and often with a wild, despairing cry, a renewed convulsion, similar to but more intense than the preceding one, is ushered in. The patient rarely dies during the first or second paroxysm, but the alternation of convulsions and quiet is repeated again and again till death ensues, usually in half an hour or an hour; or in non-fatal cases the fits become less and less frequent, less intense, and eventually cease. Death takes place commonly during a paroxysm, from asphyxia; but it may also occur in the intervals between the paroxysms, from exhaustion.

DIAGNOSIS.—The characteristics of strychnia-convulsions are so well-marked, as already described, that there is little likelihood of the nature of the case being overlooked; and the only disease with which strychnia-poisoning can readily be confounded is tetanus—traumatic, idiopathic, or hysterical. In the hysterical form of the disease, as described by some writers, the well-marked hysterical symptoms, the closed or half-closed eyes, the desire to be fanned, and the incomplete remissions of spasm, serve for diagnosis. Except in the history there is nothing to distinguish between the traumatic and idiopathic forms of the disease, so that what is here stated with regard to the diagnosis between strychnia-tetanus and traumatic tetanus, applies also to the idiopathic form. In traumatic tetanus the muscular symptoms begin with pain and stiffness of the neck and jaws, gradually passing into spasms; and the jaw is one of the earliest parts affected. The strychnia-symptoms, on the other hand, develop rapidly, and begin in the extremities, or a general convulsion at once seizes the whole body. Moreover, the jaw is usually last affected, and its muscles relax first. The strychnia-relaxation is complete, or rarely almost complete; whilst in traumatic tetanus there is permanent muscular rigidity, and no complete remission of spasm. Strychnia-tetanus is an affair of minutes, or at most of half a dozen hours; whilst traumatic tetanus never kills within twelve hours, and generally extends over a few days. In strychnia-poisoning the most trivial movement or touch will set up a convulsion; whilst during the spasms firm grasping of the hands, and hard rubbing of the rigid muscles, will often afford grateful relief. This distinction is not marked in traumatic tetanus. An analysis of the urine by Stass's method, which often affords certain indications of strychnia, and may be made in a few minutes, will, in doubtful cases, at once remove all uncertainty as to the nature of the disease.

Prognosis.—The prognosis is at all times doubtful. The patient's life cannot be considered safe till the convulsions clearly exhibit marked decrease, both in frequency and intensity.

Treatment.—Should the convulsions have already set in, the use of the stomach-pump is out of the question. An emetic of warm water with mustard, or carbonate of ammonia, should be given without a moment's delay. The patient should be touched as little as possible, and absolute quiet observed in the sick-room. Excellent results have ensued from the administration of large doses of bromide of potassium; even half an ounce in one dose has been given. The salt serves the double function of rendering the poison insoluble, and counteracting its physiological effects. The gastric irritation produced by such large doses of the bromide as are necessary militates against its use. Chloral in full doses, and the anæsthetic administration of chloroform vapour, are the best remedies. The free use of chloroform not only alleviates the pain and allays the spasms, but allows time for the elimination of the poison from the system. Nitrite of amyl has been recommended by Dr. Barnes. Strychnia-poisoning more often ends fatally either from the lateness with which remedies are applied, or their non-application, than from their inefficient character.

Thomas Stevenson.

STUPE (*stupa*, tow.)—A synonym for a fomentation. *See* Fomentation.

STUPOR (Lat.).—Synon: Fr. *Stupeur*; Ger. *Stupor*; *Stumpfsinn.*—A partial loss of consciousness. *See* Consciousness, Disorders of.

STUTTERING. *See* Stammering.

STYPTICS (*στύφω*, I constringe).—Definition.—In former years this term was held to include internal astringents, like the famous Ruspini's styptic, of which gallic acid was the principal ingredient, but we now limit its use to substances locally used to arrest hæmorrhage.

Enumeration.—The chief styptics are Cold, the Actual Cautery, Perchloride of Iron, Tannin, Matico, strong Acids, Alum, Acetate of Lead, and Collodion.

Actions and Uses.—One class of styptics encourages the coagulation of the blood, by supplying a rough material around which fibrin may be deposited, in obedience to a well-known physiological law; the principal of these being matico, tannin, and the old-fashioned cobweb. Others, in addition to their primary action in favouring the formation of a clot, coagulate the albumen of the tissues, or, like acetate of lead, cause the bleeding mouths of the smaller vessels to contract. The use of styptics is usually limited to the general oozing which is observed occasionally to follow the application of leeches, or the infliction of small wounds by accident or for surgical purposes, and may render essential service under a great variety of circumstances. If ice, pressure, or posture fail to check bleeding, we may have recourse to some of the more potent applications.

R. Farquharson.

STY (Sax. *steigan*, to rise up).—Synon.: *Hordeolum*; Fr. *Compère-Loriot*; *Orgelet*; Ger. *Gerstenkorn.*

Definition.—A boil on the margin of the eyelid.

Description.—A sty does not differ in any essential respect from a boil in any other situation, but it is usually of small size, and commences in the follicle of an eyelash. Sties are most common in young people, especially in anæmic girls, and are often very troublesome by frequent recurrence, in which case they may create a certain amount of permanent disfigurement by destroying hair-bulbs, and producing bald gaps in the eyelid margins. They are mostly associated with some obvious derangement of the general health, which should be made the subject of treatment.

Treatment.—An individual sty, if seen sufficiently early, when it is as yet only a small pimple, may often be rendered abortive by pulling out the eyelash which passes through it, and touching the spot with a fine point of nitrate of silver; but, when the time for this method has passed away, there is nothing to be done locally beyond the application of a fomentation or poultice, and a touch with a sharp lancet as soon as pus can be seen. Pain is at once relieved by the incision, and the swelling speedily subsides.

R. Brudenell Carter.

SUBACUTE.—A term applied to a disease when it has characters intermediate between acute and chronic, whether in *course* or in *intensity*. *See* Acute; Chronic; and Disease, Duration of.

SUBCUTANEOUS INJECTION. *See* Hypodermic Injection.

SUBSTITUTION.—This word is used in pathology in connection with degeneration, when a newly-formed tissue, inferior to the original in organisation or functional activity, takes the place of the normal structure. *See* Degeneration.

SUBSULTUS TENDINUM (Lat.).—A twitching movement of the tendons, caused by sudden momentary contractions of the muscles to which they belong. This is especially apt to show itself in the tendons about the wrist in the later stages of many low fevers. It manifests itself principally in states of great prostration, and is often associated with delirium or other signs of cerebral irritation. *See* Typhus Fever.

SUCCUSSION (*succussio*, a shaking).—A method of physical examination, which consists in suddenly shaking the trunk of the patient, so that certain sensations or sounds may be produced, which are indicative of the presence of gas and fluid in a hollow space, such as the pleural cavity. *See* Physical Examination.

SUDAMINA (*sudor*, sweat).—Synon.: Fr. *Sudamina*; Ger. *Schweissbläschen.*—This term is applied to minute vesicles of the cuticle, associated with a relaxed and perspiring state of the skin. In size they have been compared to a millet-seed, *milium*; and when they occur in considerable numbers they constitute the eruption known as *miliaria* (*see* MILIARIA). In some instances they would seem to be produced by rupture of the sudoriparous ducts, and escape of the sweat into the rete mucosum of the skin. *See* SUDORIPAROUS GLANDS, Diseases of.

ERASMUS WILSON.

SUDORIFICS (*sudor*, sweat, and *facio*, I make).—A synonym for diaphoretics. *See* DIAPHORETICS.

SUDORIPAROUS GLANDS, Diseases of.—SYNON.: Fr. *Maladies des glandes sudoripares*; Ger. *Krankheiten der Schweissdrüsen.*—The perspiratory, sudoriparous, or sweat glands are subject to varieties of development and growth; and likewise to changes resulting from a low degree of inflammation, or of congestion, of their capillary blood-vessels.

1. **Atrophy and Hypertrophy.**—We may recognise both atrophy and hypertrophy of the sudoriparous glands, but they are very rare affections.

2. **Subacute Inflammation.**—SYNON.: *Hydroadenitis.*

This disease of the sweat-glands originates with hyperæmia, which renders the glands visible through the cuticle, and in rare instances passes into the formation of a minute quantity of pus, and pustulation. Another affection of the perspiratory glands, beginning with congestion and disintegration of the epithelium of the excretory duct, and resulting in the formation of minute globules of transparent fluid, which either remain in the deep stratum of the epidermis, or are developed into isolated single or multilocular vesicles, followed by exfoliation, is limited to the fingers and hands, particularly their palmar surface. This affection has received the names of (1) *dysidrosis* (Tilbury Fox), from the presence of a mechanical impediment to the escape of the sweat; and (2) *cheiropompholyx* (Hutchinson), from the association of clusters of vesicles, which occasionally form a multilocular bleb of moderate elevation, and of about half an inch in breadth. Occasionally the bleb may become in appearance a real pompholyx, and cover the whole of the palm of the hand, in which case the fluid which it contains is remarkable for its putrid odour.

DIAGNOSIS.—Dysidrosis is distinguished from eczema by the absence of superficial inflammation and exudation; by the apparent depth within the epidermis of the sero-globules; by their tendency to resorption; by their limitation to the hands and occasionally the feet; and by the absence of eczema on other parts of the body. From a certain resemblance, the sero-globules of dysidrosis have been compared to sago-grains. It is not a grave affection, but is undoubtedly troublesome, and is usually met with in persons of delicate health, especially females, and during or after a hot season.

TREATMENT.—In disorders of the sudoriparous glands the general health predisposing to such affections is chiefly to be considered. This is especially the case in dysidrosis, which calls for the use of tonic remedies, and a generous diet. Locally, the best remedies, in all stages of the complaint, are lotions of oxide of zinc or prepared chalk with lime-water. In other cases painting with liquor plumbi has proved very successful.

ERASMUS WILSON.

SUFFOCATION (*suffoco*, I stifle).—SYNON.: Fr. *Suffocation*; Ger. *Erstickung.*

DEFINITION.—The term suffocation is sometimes employed synonymously with asphyxia. In the strict medico-legal sense it signifies asphyxia induced by obstruction of the respiration otherwise than by direct pressure on the neck (hanging. strangulation), or submersion (drowning).

ÆTIOLOGY.—Death by suffocation is usually the result either of *accident* or of *homicide*, rarely of *suicide.*

Suicide by suffocation is not, however, unknown. Cases of suicide by immurement in a box or trunk, or by thrusting a pad or other obstruction down the throat, have been reported; and it has been averred that slaves, both in ancient and modern times, have committed suicide by rolling the tongue back into the pharynx.

Accidental suffocation is very common by diseases causing occlusion of the air-passages; by the impaction of pieces of food or other obstacles in the pharynx; by the entry of foreign bodies into the larynx, as a seed, coin, or food in cases of bulbar or general paralysis, or matters vomited in a state of insensibility; by mechanical pressure on the chest and abdomen, as in crowds, or in falls of earth or heavy bodies; by various diseases preventing the expansion of the lungs; by diseases of the lungs themselves; or by obstruction of the pulmonary circulation. Suffocation of new-born children by smothering under bedclothes, non-removal of maternal envelopes, or overlying, may happen from carelessness as well as from intent. *See* OVERLYING.

Homicidal suffocation is resorted to chiefly in infants, or in the case of persons feeble and infirm, or rendered powerless or insensible by intoxication or narcotics. Closure of the mouth and nostrils by the hands, or obstruction of the mouth and nostrils by a pillow, mattress, or the like, perhaps combined with pressure on the chest, is the method usually adopted. Formerly suffocation by mechanical pressure on the chest was a judicial punishment—the *peine forte et dure.*

SYMPTOMS AND SIGNS.—The mode of death, and the general *post-mortem* indications are those of asphyxia (*see* ASPHYXIA). The special indications of suffocation, and the way in which it has been brought about, may be evident from the place where the body is found, and its surroundings; or foreign bodies, or disease obstructing the air-passages or respiratory mechanism, may be clearly evident on *post-mortem* dissection; or there may be marks of violence and indications of pressure on the chest, flattening of the nose, &c., pointing to homicidal violence. The absence of marks of constriction of the neck excludes strangulation and hanging.

But in the absence of all such indications as have been enumerated above—and they may all be absent, especially in cases of infanticide—the question is whether any trustworthy conclusion can be formed as to asphyxia by suffocation.

The condition of the lungs is of especial importance in this relation. The lungs may be

Trinity Medical College.

congested, or pale, or congested only posteriorly; but the surface is often uneven, owing to an emphysematous condition of some of the superficial air-cells; and in particular the lung looks as if it had been sprinkled with minute drops of a dark purple fluid. These spots, not much larger than a pin's head, are known as 'Tardieu's spots,' and are due to minute capillary extravasations under the pleura. They are not, however, confined to the surface of the lungs, but are found also in considerable numbers on the thymus gland, the base of the great vessels, under the parietal pleura, and also under the pericranium. Tardieu, who first called special attention to these spots, considered them absolutely diagnostic of death by suffocation, as distinguished from other modes of asphyxia. But numerous other observations have shown that this cannot be accepted as correct, inasmuch as similar extravasations have been found in cases of hanging, strangulation, drowning, and deaths from cerebral injuries. It seems, however, fairly well established that they occur most frequently, and in largest number, in suffocation, especially in infants. Their formation depends on excessive vascular tension during the asphyxiating process. Similar spots have been found in the lungs of still-born fœtuses, conditioned by obstruction of the placental circulation; and in the lungs of new-born children perishing from other causes, extravasations of a like nature have been observed. It would, therefore, be unsafe to rely absolutely on Tardieu's spots as indications of suffocation, though, in the absence of other causes of death, and in presence of these spots in large numbers and in clusters, the opinion of death by suffocation would be fairly justified.

Treatment.—The treatment of impending suffocation is that of asphyxia. *See* Artificial Respiration; Asphyxia; and Resuscitation.

D. Ferrier.

SUFFOCATIVE BREAST-PANG.—A synonym for angina pectoris. *See* Angina Pectoris.

SUFFOCATIVE CATARRH.—A synonym for asthma. *See* Asthma.

SUFFUSION (*suffundo*, I pour down).—The process or the result of the unnatural pouring out of a fluid into the tissues; closely analogous to effusion and extravasation. *See* Extravasation.

SUGGILLATION (*suggilo*, I make black by beating).—The appearance produced by extravasation or ecchymosis of blood. The term is limited by some authorities to the appearance of livid spots on the body after death.

SUICIDAL INSANITY. *See* Insanity, Varieties of—*Impulsive insanity*; and Melancholia.

SULPHUR WATERS. *See* Mineral Waters.

SUNSTROKE.—Synon.: Insolation; Heatstroke; Fr. *Coup de Soleil*; Ger. *Sonnenstich.*

Definition.—Certain pathological conditions resulting from exposure to solar or artificial heat.

Three well-marked varieties of sunstroke are recognised, namely:—1. Exhaustion and failure of the heart's action in *syncope*; 2. A condition like shock, in which the nerve-centres, and especially the *respiratory*, are affected, causing rapid failure of the respiration and circulation; and 3. Intense *pyrexia*, due to vaso-motor paralysis, and to the nerve-centres being over-stimulated and then exhausted by the action of heat on the body generally.

Ætiology and Pathology.—These morbid conditions, being due to heat alone, are not peculiar to any country or climate, and are liable to occur wherever persons are exposed under any circumstances to great heat, whether solar or artificial. Soldiers marching or fighting, when oppressed by weight of clothing and accoutrements, are apt to suffer either from simple heat-exhaustion, or that form of insolation which results from direct action of the sun on the head and neck. This is common enough in India during the hot season, in other tropical countries, and in America; and is not unknown in Europe or even in England, during the heat of summer. Workmen, artificers, and stokers, and other persons in heated rooms, hospitals, barracks, tents, and even ships, especially in hot climates, are liable to suffer from heat-exhaustion, which may pass into the dangerous condition of fever or insolatio.

But the most frequent cases are those which come on in houses, barracks, tents, ships, by night or in the day, away from the direct solar rays. A form of disease sometimes described as 'ardent fever' in India, is this condition supervening on the ordinary phenomena of ephemeral fever. It seems pretty well understood that heat alone is the effective cause of the so-called sunstroke. Malarial and certain hygrometric or barometric states of the atmosphere have no special influence, beyond that which they may exert on the general vigour of the constitution, or in rendering a person more or less susceptible to heat, and so far predisposing him to suffer from it.

A dry air, such as that of North India, with hot winds, is much better tolerated at a high temperature, than the damp atmosphere of Bengal at a much lower one; for the dry hot air favours evaporation, and thus keeps the body cool, whilst in the damp, heavy atmosphere the natural cooling function is almost in abeyance. Vigorous, healthy persons of moderately spare frame, possessing sound viscera, and leading temperate and regular lives, can tolerate a great amount of heat, in an otherwise pure atmosphere, and are much less liable to suffer from it than those in whom these conditions do not exist. Acclimatisation has also considerable influence in conferring toleration. New arrivals are more prone to suffer than those who have become accustomed to the climate. It is well known that the native can bear an amount of sun on his shorn head, neck, and half-naked body with indifference if not pleasure, that would very soon prostrate a European. But to a temperature of the air rising above a certain standard, all succumb; and the natives of India suffer like others, and die in numbers every year from *loomarna* or 'hot wind stroke.'

The exact amount and duration of toleration of a high temperature depend to a great extent, therefore, on the vigour of constitution and the present state of health. The natural refrigerating powers of the body, when in health, are such as to enable men to support very high temperatures, much above that of the normal state of the body. Thus in the hot dry winds no inconvenience beyond discomfort is felt, so long as transpiration and perspiration are free, which cool down the body, enabling it to resist the great heat. It is obvious that in this there is a great expenditure of force, and when it fails suffering soon ensues. Disordered health, dissipation, over-fatigue, anything in fact that depresses nerve-power, reduces the normal physiological capacity, and consequently renders a man more liable to succumb.

ANATOMICAL CHARACTERS.—In cases where death has taken plate suddenly, as from *shock*, there is no very remarkable appearance. The heart may be found firmly contracted, but not always so—it may be flaccid. The lungs and the brain and its membranes may be found somewhat congested, but not invariably. As in cases of shock, the venous trunks—specially those of the abdomen and the right side of the heart, may be found too full of blood, and the pulmonary vessels may be over-loaded with blood. The blood itself is dark and grumous, and is found effused in patches of ecchymoses, and indeed rendering the body more or less livid; the coagulability of the blood is also impared and it is wanting in oxygen.

In death from ordinary cases of *thermiofever* the lungs and pulmonary system are often deeply congested; the heart is firmly contracted, from coagulation of myosin; the whole venous system is engorged; and the body even before death is marked by petechial patches, or extensive ecchymoses of a livid appearance. The blood is generally more fluid and grumous than natural; its coagulability is impaired; and it is acid in reaction. The globules, though generally presenting no abnormal change, are somewhat crenated, and have less tendency to form rouleaux than natural; and the quantity of oxygen is much diminished. The body for some time after death retains a high temperature; when first opened the viscera feel pungently hot, and the incisions drip dark blood. *Rigor mortis* comes on very rapidly, from early coagulation of myosin.

The brain and membranes may be found congested, and in some cases there may be evidence of meningitis. Serous effusions into the ventricles, or hæmorrhage into the brain-substance, may have occurred, and are not improbable in the congested condition sometimes existing in the head; but the cause of death is asphyxia, not apoplexy, and the most important changes are found in connection with the thoracic viscera.

SYMPTOMS—(1) **Syncopal form.**—SYNON.: Heat-exhaustion.—Simple exhaustion and syncope may occur under great fatigue or over-exertion, or depression from any cause, during exposure to a high temperature. There is depression of nerve-force, and prostration of muscular power; the skin is pale, cold, and moist; and the pulse is quick and feeble. Death may occur rapidly in the state of collapse from failure of the heart. Complete recovery is frequent.

(2) **Asphyxial form.**—SYNON.: Sunstroke proper.—Asphyxia and apnœa may come on very rapidly, after certain premonitory symptoms of depression and weakness, though occasionally without prodromata, during exposure, especially of the head and spine, to the direct rays of a powerful sun, when the atmosphere is much heated, and the nervous energy has been depressed by over-fatigue, dissipation, or illness. The brain and nerve-centres, especially the respiratory, are overwhelmed by the sudden elevation of temperature; and respiration and circulation fail, the failure of the latter being probably due to the inhibitory influence of the vagus. When death takes place, as it does sometimes, very suddenly, during great excitement or exertion, it has been attributed to rapid *ante-mortem* coagulation of the cardiac myosin. This, however, though it may occur occasionally, is generally a *post-mortem* change, the heart's action being brought to a close by the heat; in the same manner as it has been shown by Claude Bernard and Lauder Brunton that the effect of high temperature on animals is first to accelerate and finally to stop the heart, and especially the ventricles, in a state of contraction. Recovery is frequently complete, but sometimes tedious, and in many cases imperfect, ending in serious impairment of health or intellect, indicative of structural changes caused in the nerve-centres. The symptoms of this form of insolation, the real *coup de soleil*, are those of sudden and violent injury to the nerve-centres—unconsciousness and cold skin, feeble pulse, all the symptoms of depression; death resulting from rapid failure of the respiration and circulation. If not fatal, reaction may result in a variety of conditions indicative of the injury done to the cerebro-spinal system.

(3) **Hyperpyrexial form.**—SYNON.: Heat-fever.—An intense state of fever, the result of the influence of heat on the nerve-centres, and through them on the vaso-motor nerves, and of the heating of the body generally, by the direct action of either artificial or solar heat, may occur, quite independently of the immediate operation of the sun's rays. It comes on as frequently at night, or in the shade, as in the day or in the sunshine, especially in persons who are exhausted by fatigue, overcrowding, depression from any cause, such as dissipation, want of rest, present or recent illness, and notably when the atmosphere is impure from overcrowding or want of cubic space.

The temperature of the body rises to 108°, 110° Fahr., or higher. The brain, medulla, and cord, the nerve-centres generally, and especially the respiratory, suffer from over-stimulation, followed by exhaustion. Respiration and circulation fail; there is dyspnœa, with hurried, gasping breathing; great restlessness; thirst; fever; frequent micturition; and a pungent burning heat of skin, which is sometimes dry, sometimes moist. The pulse varies; in some it is full and laboured, in others quick and jerking. The face, head, and neck are congested to lividity, and the carotid pulsations are visible. The pupils, contracted at first, may dilate widely before death. Delirious convulsions, frequently epileptiform in character, coma, relaxation of the sphincters, and suppression of urine come on, and are frequently the precursors of death, which is due to asphyxia. Recovery not unfrequently partially occurs, to be followed by relapse and death; or secondary consequences, the result of over-heating, end in meningitis or cerebral changes, which may destroy life or intellect at a later period, or permanently compromise the whole health or that of some important function.

The premonitory symptoms of this form of insolation often manifest themselves for some hours, and it may be days, before they culminate in the dangerous condition just described. These premonitory symptoms are general malaise; disordered alvine or other secretions; profuse and frequent micturition; restlessness; sleeplessness, and apprehension of impending evil; hurried and shallow breathing; præcordial anxiety; giddiness and headache; occasionally nausea or vomiting; thirst and anorexia; and feverishness, which soon amounts to a pungent heat of skin with high temperature. These symptoms vary considerably, but they point to a profoundly disturbed state of the cerebro-spinal nerve-centres, and to pathological changes in the organs or structures whose functions have been so gravely disturbed. Death results from asphyxia and apnœa. Recovery is often incomplete; or is followed by permanent impairment of health, and generally by intolerance of heat and exposure to the sun.

Terminations.—The mortality from sunstroke is about 45 to 50 per cent.; but of those who recover many are permanently injured, and remain invalids for the remainder of life, which is often shortened by the changes induced. There may be some weakness, due to obscure structural change in the cerebrum, or to a chronic form of meningitis which affects the sufferer in various degrees of intensity; or epilepsy, impairment of memory, great nervous irritability, headache, insanity, partial paraplegia, partial or complete blindness, and extreme intolerance of heat—especially of the sun's heat, rendering the person utterly incapable of serving or living in a hot climate, or of enduring exposure to the sun. Or it may gradually end in complete fatuity, insanity, or meningitis—which accounts for the intense cephalic pain; or, in a lesser degree, in disordered innervation and derangement of the functions generally, thus seriously compromising the general health.

Treatment.—(1) In cases of *simple exhaustion* simple treatment is all that is needed. Removal to a cooler locality, the cold douche (but not too much prolonged), or the administration of stimulants may be beneficial. Tight or oppressive clothing should be removed, and the patient treated as in syncope from other causes. *See* Resuscitation.

Rest and freedom from exposure to over-exertion, fatigue, or great heat should afterwards be enjoined.

(2) In that form of sunstroke where the person is *struck down* suddenly by a hot sun, the patient should be removed into the shade. Here a douche of cold water must be allowed to fall in a stream on the head and body, from a pump (or as in India from the mussuck, or other similar contrivance), the object being twofold—to reduce the temperature of the over-heated centres, and to rouse them into action. During the assault on the White House picquet in the last Burmese war, numbers of men were struck down by the direct action of the sun during the month of April. They were laid out perfectly unconscious, in their red coats and stocks (worn in 1852), but were recovered by the cold douche freely applied by the mussuck over the head and body. In some cases flagellation with a broom was added; and all recovered with the exception of two cases, both of which had been bled on the spot where they fell. Mustard plasters and purgative enemata may also be useful.

If recovery be imperfect, and followed by any indication of injury to the nerve-centres, or by the supervention of meningitis, other treatment may be necessary, according to the indications. Much exposure to the sun should be carefully guarded against; and unless recovery be complete and rapid, the sufferer should be removed to a cooler climate, the most perfect rest and tranquillity of mind and body enjoined, and the greatest care observed with regard to extreme moderation in the use of stimulants.

(3) In the cases of *thermic fever*, heat being the essential cause of the disease, the object is to reduce the temperature of the body as quickly as possible, and before tissue-changes have resulted. As the hyperpyrexia is due not only to the direct operation of heat, but to fever set up, remedies such as may influence this disturbed condition have been suggested. The results have appeared in some cases to justify the theory, and the hypodermic injection of morphia or quinine has been considered to produce good results, by its influence on the vaso-motor nerves, and its power in retarding tissue-change.

Bleeding has now happily been almost abandoned. The congested livid surface, coma, and stertor, which formerly suggested it, are not now so treated. There are cases in which it may still be practised with advantage; but they are the exception and not the rule. In cases where venesection has appeared first to give relief and mitigate the symptoms, the improvement has been often transient, and been followed by relapse into a more dangerous condition, which has terminated fatally. At the same time no absolute rule can be laid down in this disease with reference to the abstraction of blood; and it is quite possible that greater immediate danger to life may exist in an over-distended right heart than in the loss of an amount of blood which might have tided the patient over that state of peril. Each case must in this respect be treated on its merits. The treatment generally consists in the judicious use of cold, either by affusion or by the application of ice to the surface; the reduction of temperature being watched with a thermometer in the axilla, mouth, or rectum.

Care should be taken not to continue the cold application too long, as danger arises from depressing the temperature below the normal standard. The bowels should be relieved; and blisters may be applied to the calvaria and neck.

In the epileptiform convulsions that occur so frequently, the inhalation of chloroform or of ether may be of benefit, but their administration must be carefully watched. The earliest and

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most severe symptoms having subsided, the febrile condition that follows is treated on ordinary principles—salines and aperients being given, but not to the extent of depressing the patient. The diet must be carefully regulated, and be of the blandest and most nourishing nature.

As improvement progresses, other symptoms may supervene, indicative of intra-cranial mischief. Where they are indicative of meningitis, iodide of potassium and counter-irritants may be used with advantage. Removal to a cooler climate is essential. As a general rule, it is desirable that the sufferer should not, for a long period at least, return to a hot or tropical climate; and he should be guarded against all undue exposure to heat, work, or mental anxiety of any kind.

The sequelæ of sunstroke are frequently from such causes most distressing, rendering the patient a source of suffering to himself and of anxiety to his friends.

The less severe symptoms—those, probably, indicative of the slighter forms of meningitis, or of abnormal change of the brain or nervous system—occasionally pass away after protracted residence in a cool climate; but they not unfrequently also cause much suffering, and shorten life. As they point to permanently disturbed, if not structurally injured, cerebro-spinal centres, the treatment required is as varied as the symptoms presented. JOSEPH FAYRER.

SUPPOSITORY (*suppono*, I place below). SYNON.: Fr. *Suppositoire*; Ger. *Stuhlzäpfchen*.—A suppository is a solid mass, which is introduced through the anus into the rectum for certain therapeutic purposes. The material of which it is made should be capable either of being dissolved, or of melting at the temperature to which it is exposed in the rectum. Suppositories are *simple* or *medicated*. The former may be exemplified by pieces of soap or tallow-candle, which are popularly used as suppositories. The British Pharmacopœia recognises seven medicated suppositories; and they are cast into moulds of a conical or pastille shape, so as to facilitate their introduction into the bowel. It may be well to give a list of these officinal preparations, according to the following plan, with the proportions of their active ingredients:—

1. Suppositories made with white wax, oil of theobroma, and benzoated lard, each weighing 15 grains:—(1) S. Acidi Tannici, 3 grains; (2) S. Hydrargyri, 5 grains of mercurial ointment; (3) S. Morphiæ, ½ grain of hydrochlorate of morphia; (4) S. Plumbi, 3 grains of acetate of lead and 1 grain of opium.

2. Suppositories made with glycerine of starch, curd soap, and starch:—(1) S. Acidi Carbolici cum Sapone, 1 grain of carbolic acid; (2) S. Acidi Tannici cum Sapone, 3 grains of tannic acid; (3) S. Morphiæ cum Sapone, ½ grain of hydrochlorate of morphia.

Besides these officinal suppositories, others are often prepared and used, containing belladonna and other agents; and the practitioner may employ many drugs in this way with advantage, according to his own judgment.

APPLICATION.—A suppository must be introduced well into the rectum, beyond the sphincter ani. At first this should be done by the practitioner, or by a competent nurse; but subsequently many patients learn to use suppositories themselves without any difficulty. The suppository should be oiled and passed in gradually and gently, without any undue force. It may be necessary to keep the finger applied for a moment, until the tendency to expulsive action on the part of the rectum has subsided.

USES.—A suppository may be used for the following purposes:—(1) As a mere aperient, by exciting the expulsive action of the bowel through local irritation, which also has a reflex effect upon the intestine above. (2) On the other hand, to subdue excessive action of the bowel, and thus check diarrhœa. (3) To bring medicinal agents in contact with the rectum in a suitable form, in order to affect some local disease. Astringents may be thus used. (4) To influence adjacent organs, the active ingredients of the suppository being absorbed. For instance, a morphia suppository will often produce a marked effect upon the bladder and generative organs. (5) To produce the general effects of a drug upon the system. This of course occurs only after absorption, and may be exemplified by the effects of morphia or mercury.

FREDERICK T. ROBERTS.

SUPPRESSION.—The complete stoppage of a natural secretion or excretion, such as the urine; or of a normal discharge, as of the menses. The word is used in contradistinction to *retention*, which signifies that these fluids merely remain in the body unexpelled.

SUPPURATION.—The formation of pus. *See* ABSCESS; and INFLAMMATION.

SUPRA-RENAL CAPSULES, Diseases of.—SYNON.: Fr. *Maladies des Capsules surrénales*; Ger. *Krankheiten der Nebennieren*.

Of the morbid conditions of the supra-renal bodies by far the most important is that connected with Addison's disease, which is described separately. *See* ADDISON'S DISEASE.

Other morbid changes producing neither pigmentation nor asthenia, belong to two categories, namely (1) those beginning *within*; and (2) those originating *without* the supra-renal bodies. Some of the latter may, however, give rise to the symptoms of true Addison's disease, as when the mischief seems to begin in caries of the spine, and ends in the characteristic form of supra-renal changes commonly associated with that malady. The bodies may be otherwise extensively diseased, and yet no special pigmentation and no special asthenia make their appearance. Thus there may be the usual *anomalies of development*, amounting even to what has been called total absence, but this probably depended on defective examination. Certainly the bodies may be *hypertrophied*. Both the organs themselves and their coverings are liable to *inflammation*, especially if the structures connected with the kidney be likewise attacked, and the process spread from them. They may also be the seat of various forms of *degeneration*, but here again we are on doubtful ground, for the earliest change in the bodies in Addison's disease is what was invariably called by the older pathologists *lardaceous*, whilst the secondary change is a form of *fatty degeneration*. With regard to *tubercle*, some authorities would have the anatomical change in Addison's disease to be of this nature. *Cysts* sometimes occur, but the exact mode of their origin is not quite clear. They may be compensatory, like one variety of emphysema, or they may be destructive.

We are on surer ground when we speak of *hæmorrhage* and *malignant disease*. One case of what may fairly be described as *thrombosis* is reported by Klebs from Lücke's *clinique*. There can be no doubt about the not unfrequent occurrence of hæmorrhage, however arising. Neither is there any question as to the existence of malignant disease in certain cases, sarcoma being more common than carcinoma; but in most cases these do not originate within, but without, the supra-renal bodies. As a rule, all these changes give rise to no characteristic symptoms during life; and are either accidentally discovered after death, or by careful clinical search. The important point to bear in mind is that not one of them gives rise to the symptoms of Addison's disease.

ALEXANDER SILVER.

SURGICAL KIDNEY.—DEFINITION.—This term, although open to many objections, may be conveniently employed to group together the various morbid conditions which arise in the kidney as the result of diseases of the lower urinary tract.

PATHOLOGY.—Diseases of the lower urinary tract react on the kidney in three ways:—(*a*) by obstructing the passage of urine, and so causing abnormal tension throughout the whole urinary tract above the obstruction; (*b*) by causing repeated disturbances of the circulation in the kidney, through the medium of the nervous system; (*c*) by decomposition of the secretions spreading from without to the bladder, and extending to the pelvis and even into the tubules of the kidney.

(*a*) Obstruction to the free passage of urine may occur in the ureters from congenital malformation; from impaction of a calculus; or from pressure of a tumour growing in the neighbourhood. It may occur at the vesical orifice of the ureter, from the thickening of the wall of the bladder in hypertrophy; from the thickening and induration of the submucous tissue, and the swelling of the mucous membrane in chronic cystitis; or from the growth of villous or cancerous tumours round the orifice. Obstruction of such a nature as to cause secondary renal affection also occurs in any disease in which the bladder is unable to empty itself, and is consequently in a permanent state of greater or less distension, as in hypertrophy of the prostate or atony of the bladder. Stricture of the urethra and stone in the bladder cause obstruction at the vesical orifices of the ureters, by the chronic cystitis to which they give rise. There is no reason to believe that the valvular orifices of the ureters ever become incompetent, so as to allow of regurgitation from the bladder to the pelvis of the kidney. The only force concerned in producing the remarkable degree of dilatation so often met with in the ureter and pelvis of the kidney is the force of secretion. The abnormal tension thus produced extends, therefore, equally from the point of obstruction to the closed extremities of the urinary tubules.

(*b*) Diseases or injuries causing irritation of the lower urinary tract, especially of the trigone of the bladder and the prostatic, membranous, and bulbous portions of the urethra, react on the kidney in a reflex manner, through the medium of the nervous system. The effect produced is a disturbance of the renal circulation, probably a temporary arterial contraction with anæmia, followed by dilatation with hyperæmia. Such disturbances tend to aggravate any inflammatory process which may be going on in the kidney as the result of other sources of irritation. If the kidney be already much diseased, the circulation may become completely arrested by choking of the vessels during the stage of hyperæmia, and total suppression of urine may result, terminating in some cases fatally. The evidence of this reflex disturbance of the renal circulation is derived from the following facts. 1. Many cases have been recorded of death from total suppression of urine occurring as a consequence of operations involving some mechanical irritation of the parts above mentioned. In such cases the kidney has always been found intensely congested. 2. It is a matter of common surgical experience that operations on the urinary organs frequently prove fatal by inducing acute inflammation of the kidneys. This is (as will be presently shown) often the result of the introduction of the causes of decomposition into the bladder, followed by extension of decomposition to the kidney. But cases frequently occur in which the patient before the operation was suffering from cystitis, with putrid urine, and had been so suffering for some time, and in these it is evident that the final acute attack is the direct result of the irritation of the operative procedure. 3. By direct observation of the urine passed after such an operation as forcible dilatation of a stricture, evidence of a disturbance of the renal circulation may be obtained. In the most typical cases there is temporary suppression of urine, probably corresponding to a period of anæmia of the kidney, with contracted vessels. This may last from one to three hours. It is followed by a gradual increase in the quantity of urine, which now frequently becomes uniformly tinged with blood, the amount of blood often increasing for some hours, and then slowly diminishing. This blood cannot be supposed to flow at so late a period from a lacerated wound, such as is produced by forcible dilatation; it is uniformly mixed with the urine, and free from clots. The presumption is, therefore, that it comes from the kidney. In most cases the period of suppression is too short to be noted, and in others an immediate increase in the flow of urine has been observed. The rigor which frequently occurs within a few hours of an operation on the lower urinary tract is, in many cases, doubtless due to this disturbance of the renal circulation.

(*c*) The final fatal inflammation of the kidney is, in most cases, due to extension of decomposition of the urine from the bladder to the pelvis and kidneys. The balance of evidence is now so greatly in favour of the view that decomposition of urine is due in all cases to the introduction of microscopic organisms from without, that it may be almost looked upon as definitely proved. These organisms may find their way into the bladder, either by being carried thither by instruments introduced by the surgeon, or by spreading inwards by multiplication in the layer of ropy mucus or other discharge which adheres to the walls of the urethra in acute inflammation of the bladder, in chronic cystitis accompanying stricture or stone, in gonorrhœa, or injury. As no regurgitation takes place in any case from the bladder to the ureters, the decomposition may remain long limited to the bladder, but when, from the other sources of irritation, a catarrhal condition of the pelvis of the kidney is induced, ropy threads of mucus come to lie with one end in the ureter and the other in the foul bladder, and by means of these the organisms find their way into the ureter, and there multiplying may extend far into the kidney-substance. In such cases the microscope frequently shows the tubules of the pyramids completely plugged with micrococci. The effects produced by the extension of putrefaction to the kidney will be described with the form of kidney it gives rise to.

ANATOMICAL CHARACTERS.—There are four forms of renal affection which may result from the foregoing sources of irritation.

I. *Chronic interstitial inflammation, followed by absorption of the medullary portion, and later on by stretching and thinning of the cortex, without pyelitis.*—This condition is the uncomplicated effect of obstruction to the free flow of urine and of the consequent increased urinary pressure. It is most frequently met with in cases of pressure on the ureter from without. In diseases of the bladder and urethra it is almost always complicated by an acute attack of interstitial inflammation, which is the immediate cause of death, and which more or less conceals the appearances about to be described. In the early stage there is slight dilatation of the ureter and pelvis of the kidney. The kidney itself is increased in size; the capsule separates without difficulty, but may leave the surface somewhat wanting in its natural smoothness. The venous stars on the surface are often clearly marked, the cortical substance being of a pale pinkish white or sometimes yellowish colour. On section the cortex is found to be wider than natural; sometimes considerably so. The medullary portion is usually pale, like the cortex, but the large veins at the cortico-medullary junction are often distended with blood. The kidney-substance is tougher than natural. The Malpighian bodies can usually be clearly seen, sometimes as red dots. Microscopic examination shows an overgrowth of the interstitial connective tissue. Between the tubules, and especially around the Malpighian bodies, are crowds of small round cells. In consequence of this new growth, the kidney is somewhat squeezed within its capsule, and as soon as the heart's action ceases the smaller vessels empty themselves. Hence the distended condition of the veins, and the anæmic appearance of the cortex. The epithelium shows no change. The next stage observed is commencing absorption of the medullary portion; the ureter, pelvis, and calices become still more distended; the papillæ are first flattened, and then the pyramids become hollowed out. This is a process of pure absorption, there being no ulceration. The cavity formed by the dilated calyx, and the hollow left by the disappearance of the pyramid, are lined by a continuous smooth layer of opaque white mucous membrane. In the final stages the cortex in its turn becomes thinned and stretched, until at last the whole kidney may be dilated into a large sac, one side of which is smooth, being formed by the thickened walls of the dilated pelvis, and the other is deeply sacculated, each sacculus corresponding to a lobe of the kidney. On this side the wall is formed of the thinned and stretched cortex, sometimes no thicker than a shilling, to which the capsule, now thickened and opaque, is firmly adherent. In the later stages the microscope shows the same abundant small-cell infiltration, with the development of a greater or less amount of fibroid tissue. The Malpighian bodies show marked changes. The capsules, instead of being delicate and membranous in structure, become greatly thickened, apparently by dense fibroid tissue formed round them in concentric layers. As this change progresses the vessels may become strangulated and finally obliterated, and the corpuscle then shrivels, and comes to be represented by a circular body almost homogeneous in the centre, but marked by a few curved lines indicating the situation of the obliterated vascular tufts. Round this centre is a concentrically laminated layer, formed by the thickened capsule. Even in the most advanced stages the epithelium of the convoluted tubules shows remarkably little change beyond being somewhat flattened.

If at any stage obstruction to the free flow of the urine be removed the process ceases. The new tissue between the tubules undergoes development into dense fibroid tissue, the process being accompanied by great contraction. The kidney, from being increased in size, may thus become much smaller than natural, excessively tough and puckered, and irregular in form. If the distension have reached the most extreme stage before the primary disease is relieved, the kidney may come to be represented merely by a small nodule of dense fibroid tissue.

II. *Acute diffuse interstitial nephritis without suppuration.*—In this variety both kidneys are usually affected. The kidney is increased in size, and the surrounding fat is sometimes œdematous and adherent to the capsule. When removed the capsule separates without difficulty, but often leaves the surface coarse; it is somewhat opaque, and often marked with ramifying vessels. The surface is usually of a pale, yellowish-white colour, often mottled with dark red, or in some cases the red may greatly predominate. The mottling often corresponds to the bases of the lobules of the gland, some of which are paler than others, in consequence of the more advanced condition of the interstitial inflammation. On section the cortex presents the same colour and mottled appearance as the surface, and is evidently swollen. The pyramids may be pale, but are often dark red, contrasting strongly with the paler cortex. The Malpighian bodies are usually clearly visible, and may show on the cut surface as red dots. The consistence of the kidney-substance is unnaturally soft, unless previous to the acute attack it has been indurated by the chronic process first described. The pelvis may be merely dilated, its mucous membrane opaque, and its contents free from decomposition, but more commonly it is marked by ramifying vessels, and presents evidence of chronic congestion, in pigmentation and thickening with induration. In other cases it is intensely injected, and sometimes covered with a membranous exudation mixed with phosphatic deposit. In these cases the urine and mucus it contains are in a state of decomposition. In consequence of the pallor of the kidney sometimes met with as a result of the emptying of the vessels after death, this form of kidney may, without the microscope, be confounded with the large white or the fatty kidney.

On microscopic examination the following conditions are found. Between the tubules is a very abundant accumulation of small round cells. These are especially abundant round the Malpighian corpuscles. So far it is merely an intensification of the condition described as resulting from increased urinary pressure. The change is not uniform; every field of the microscope varies. In one part the renal structure may appear almost normal, and close by the new cells may be heaped up to such an extent as nearly to conceal the tubules. In the pyramidal portion a similar condition is met with. The renal epithelium throughout is slightly more cloudy than natural, and somewhat swollen, but the nuclei of the cells are readily to be seen in sections prepared in the ordinary way. The adhesion of the epithelium to the membrana propria is somewhat lessened, so that unless considerable care be taken it will wash out in preparing the specimen. Fibrinous casts may be seen here and there in the tubules, and occasionally small round cells resembling those outside the tubule may be seen within it. Signs of previous chronic change are often met with, such as dilatation of some of the straight tubules, and obliteration of some of the Malpighian corpuscles.

III. *Acute interstitial nephritis with scattered points of suppuration.—Suppuration of the kidney, Suppurative nephritis, or, when accompanied by pyelitis, Pyelo-nephritis* (*Rayer*); *Uroseptic kidney* (*Dickinson*); *Parasitic kidney* (*Klebs*).—This form of surgical kidney is by far the most common. It is the usual cause of death in fatal cases of disease of the bladder or urethra, in which putrefaction of the contents of the bladder has occurred. It thus comes to be one of the most common fatal complications in cases of injury or disease of the spinal cord, with paralysis of the bladder. It has been frequently stated that it is invariably associated with putrid urine in the pelvis of the kidney and septic pyelitis; but cases are undoubtedly occasionally met with in which the condition is well-marked, and yet the pelvis is free from inflammation, and its contents are healthy. The naked-eye appearances of acute suppurative nephritis are the following. The surrounding fat may be œdematous and unnaturally adherent to the capsule. The whole kidney is considerably swollen, and its substance soft. The capsule is opaque and thickened, and marked by fine ramiform injection. It separates easily, but tears the kidney-substance in so doing. As it peels off, yellowish-white spots, surrounded by a red zone, come into view. Some of these are minute drops of pus escaping from the small abscesses as the capsule is stripped off, others are on the point of breaking down into pus, but are still solid. These abscesses are grouped together in areas corresponding to the bases of the lobes of the kidney. If the veins can be recognised, the abscesses will often be seen to correspond to the points at which the interfascicular veins appear on the surface. On section the cortex is seen to present much the same appearance as in the last form of kidney, but in addition yellowish streaks are seen passing from the points of suppuration deeply into the cortex, and often into the medullary portion. These streaks correspond to the course of the interfascicular vessels. They differ from embolic infarcts in their great length compared to their breadth. The pelvis is usually in a condition of most intense inflammation, and the mucous membrane is often covered with a layer of exudation mixed with phosphates. Its contents, composed of urine, blood, and mucus in a state of decomposition, are excessively foul. Cases, however, do occur in which a similar condition of suppuration in the kidney is met with without pyelitis.

Occasionally the kidney is found to be surrounded by a large abscess, arising from a perforation of the pelvis. More frequently one of the superficial abscesses in the cortex bursts beneath the capsule, and gives rise to a large collection of pus separating the capsule from the kidney.

The microscope shows the small-celled infiltration between the tubules in a still more intense form than in the varieties before described. In the areas of suppuration the kidney-substance has entirely disappeared, and its place is occupied by leucocytes packed closely together. In the central parts of these accumulations of small round cells the intercellular substance has softened, and the formation of pus has taken place. The amount of general interstitial change varies considerably; sometimes between the areas of suppuration the kidney-substance is almost healthy, in other cases there is a very marked general interstitial inflammation. The epithelium appears to take no part in the formation of the new cells. It is cloudy and swollen, but undergoes no proliferation. In the straight tubules it is often found to have been thrown off. Many of the tubules, even in the convoluted part, are found choked with micrococci. Klebs describes these as entering into the epithelium, and subsequently finding their way into the intertubular lymph-spaces, where he believes they cause the interstitial inflammation and suppuration. This has not been confirmed by other observers, but it seems highly probable that the micrococci do play an important part in causing the inflammation. Possibly the exact part they take may be more clearly demonstrated by the improved methods of observation lately introduced. It may safely be affirmed that wherever they are to be seen immediately after death, septic processes were taking place during life, and it is highly probable that even if they do not themselves pass out of the tubules, the septic products they give rise to soak out into the lymph-spaces, and thus cause a diffuse inflammation of the intertubular tissue. The lines of inflammation, as before stated, follow the course of the interfascicular veins, and the lymphatics also follow the same direction. In the pyramidal portion thrombosis of the small veins is occasionally met with, but this is probably merely secondary.

If such an acute condition as is above described be set up in a kidney already altered in form by dilatation from increased urinary pressure, the appearances will, of course, correspondingly differ.

IV. *The cicatricial kidney.*—This is the result of recovery from one of the preceding conditions, probably only from one or both of the first two, as, if the disease reach the stage of suppuration, the patient is hardly likely to survive. The kidney is shrunken, irregular in form, and marked by deep cicatrices. The substance is excessively tough, and the capsule firmly adherent. Small cysts may be scattered through its substance, which are supposed to result from strangulation of the tubules. The microscope shows a great excess of dense fibroid intertubular substance, and numerous obliterated glomeruli are met with.

The varieties of kidney here described may be combined in various ways. Thus a dilated kidney may suffer from acute diffuse interstitial inflammation, with or without suppuration; or a cicatricial kidney may, from a return of the primary disease, again suffer from an acute attack. It seems probable that increased urinary pressure, combined with considerable reflex irritation, is quite sufficient to give rise to a degree of interstitial nephritis which is incompatible with life, and may possibly even culminate in suppuration. The extension of decomposition of urine from the bladder to the pelvis of the kidney is alone a sufficient cause for disseminated suppuration of the kidney; but both the extension of decomposition and its more serious consequences are greatly predisposed to by the effect produced on the kidney by the two first causes of irritation; in fact, it is comparatively rare to meet with cases in which septic suppuration occurs in a kidney previously perfectly healthy.

SYMPTOMS.—Simple chronic interstitial inflammation, with dilatation of the kidney from increased urinary pressure, gives rise to but few symptoms, and is very difficult to recognise. The most important signs are, that the quantity of urine secreted is increased, and its specific gravity lowered. To avoid error, the whole urine passed in twenty-four hours should be collected, and the specific gravity taken. Single observations are open to numerous fallacies. There may be a trace of albumin, or it may be entirely absent. In one very marked case discovered after death at University College Hospital, the urine had a specific gravity of 1·009, and was free from albumin. A few hyaline casts may be present, but they are by no means constant. The exact state of the urine is often concealed by the mucus, blood, and pus from the lower urinary tract. It is surprising how much urine is secreted by a kidney which is reduced to a mere sac, with no pyramids and a cortex no thicker than a shilling. In a case that came under the observation of the writer, there had been no diminution in the secretion, and the specific gravity was 1·008. In some cases the distended kidney may be recognised by palpation, but this is not common. There are, in fact, no definite symptoms, either subjective or objective, accompanying this form of renal disease. It is not accompanied by hypertrophy of the heart, nor by marked increase of the arterial tension.

Subacute interstitial nephritis gives rise to more marked symptoms. It runs an irregular course, often lasting for weeks or even months, and terminating either in recovery or in a final acute attack with suppuration. If the disease arise as the direct result of some operation on the lower urinary tract, its commencement is usually marked by a rigor; in other cases it comes on more gradually, with frequent chills but no actual rigor. The temperature is high at night, reaching 101° to 102° Fahr., but it falls towards morning, so that if it be only taken at that time, the elevation may be completely overlooked. The patient becomes weak and languid, and emaciates rapidly. He loses appetite, and there may be nausea or occasional vomiting. There may be diarrhœa, but this is by no means constant. The mouth becomes clammy, and the tongue foul, with a tendency to dryness. In severe cases the tongue becomes dry and brown, and sordes form on the teeth and lips. The skin is usually moist and clammy, and there is not the dryness so frequently met with in other forms of renal disease. There is no œdema. In some cases the swollen kidney may be felt by palpation in the loin, and tenderness may be elicited on deep pressure, but this is by no means constant. The patient may complain of pain in the lumbar region, but this symptom is of little value, as it is often absent, and may arise from many other causes than renal disease. The pulse presents nothing characteristic. The patient frequently sinks into a drowsy state, somewhat resembling the effect of an overdose of opium, but true coma is rarely, if ever, present, and convulsions never occur. The urine is passed in fair quantity, often in excess of the normal amount. The amount of albumin is never very great, but it is usually difficult to estimate accurately how much is renal, and how much is derived from blood or pus from the lower urinary tract. Microscopic examination may show hyaline casts, or occasionally pus-casts; renal epithelium is also frequently met with; but all microscopic examination is rendered difficult by the presence of mucus and pus from the lower urinary tract. If the primary disease either be removed or relieved by treatment, the symptoms gradually subside; if not, they remain without much change till the patient gradually dies exhausted, or an acute attack rapidly leading to suppuration of the kidney puts an end to the case.

Acute interstitial nephritis with suppuration most frequently forms the fatal termination of the variety of disease just described, but it may occur without any previous symptoms. The invasion is marked by a severe rigor, often occurring within a few hours of some operation on the lower urinary tract. The rigor is accompanied by great elevation of temperature, and followed by profuse perspiration, during which the temperature falls, perhaps below normal, but it soon rises again, and remains slightly raised, with evening exacerbations. The rigor may be repeated during the progress of the case at irregular intervals. The general symptoms resemble in every respect those just described as indicative of subacute interstitial nephritis, but they are increased in intensity. The strength rapidly fails, there is great emaciation, the pulse becomes feeble, and the tongue 'like a piece of broiled ham.' There may be occasional vomiting and diarrhœa. As the fatal termination approaches, the temperature falls often considerably below normal, the skin becomes cold and clammy, and the patient sinks into a drowsy condition, seldom deepening into actual coma. Although the patient is often said to be dying of 'uræmia,' there are none of the uræmic symptoms observed in acute Bright's disease. There are no convulsions or actual coma, and no œdema. The urine is usually so foul as to defy accurate examination, either chemically or by the microscope. It is secreted in fair quantity to the end of the case. Pus and blood are always found in it, but it is impossible to say whether they come from the kidney or from the lower urinary tract. Renal epithelium and pus-casts are occasionally met with.

It will be seen from the above description that the symptoms closely resemble those of septicæmia, and it is very probable that blood-poisoning, from absorption of the putrid matter in the pelvis of the kidney and lower urinary tract, is, in fact, an important factor in the disease.

Suppression of urine following operations on the lower urinary tract is a well-recognised, but fortunately rare, cause of death. In such cases the kidney is always found to be intensely gorged with blood, and the microscope reveals the signs of previous chronic interstitial inflammation.

Urethral fever is a name given to the febrile disturbance, accompanied by a rigor, which so often follows operations on the lower urinary tract. It is impossible to discuss here the innumerable theories which have been put forward from time to time to explain its origin and nature. It is most probable that it is due to a passing congestion of the kidney arising as a reflex phenomenon, as described in the earlier part of this article.

Diagnosis.—As before stated, the diagnosis of the more chronic secondary renal conditions is frequently impossible. A careful observation of the case for a few days will usually suffice to determine the presence of subacute consecutive renal inflammation. The acute form with suppuration may resemble *pyæmia*. From this it may be distinguished by the absence of secondary inflammations in the joints, subcutaneous tissue, and lungs; by the lower temperature, falling towards death; and by the early and excessive dryness of the tongue. Pains 'all over the body' are often complained of in pyæmia, while in suppurative nephritis the patient is usually free from pain, except such as may arise from the local disease. With the greatest care in observation, however, the diagnosis may remain doubtful till death. From *septicæmia* it often cannot be distinguished, for doubtless blood-poisoning from absorption of the putrid matter in the kidney is an important element of the disease in many cases.

Prognosis.—This depends, in the chronic or subacute form, entirely upon the possibility of removing or relieving the primary disease. After suppuration has commenced in the kidney, it is very doubtful if recovery ever takes place. If decomposition has extended from the bladder to the pelvis of the kidney, the patient's chance of recovery is much reduced. It is sometimes possible to ascertain this in the following way. Wash out the bladder carefully with diluted Condy's fluid until the solution as it comes out of the bladder retains its purple colour. Then leave the catheter in for a few minutes, and examine the first drops that flow from it. If these are clear and acid, it is evident that the decomposition is still limited to the bladder.

Treatment.—The most essential element of the treatment is to remove the cause if possible, but the act of doing so is seldom unaccompanied by the danger of increasing the disease, involving, as it often does, severe operations upon the urinary organs, as lithotomy, lithotrity, internal or external urethrotomy, &c. These operations would of course, if possible, be avoided if the renal symptoms were at all marked. The fatal termination being in almost all cases associated with putrefaction of the urine in the bladder, and extension of the putrefactive process to the pelvis of the kidney, it is needless to point out that our best hope of preventing consecutive renal inflammation lies in the prevention of decomposition in the bladder, by scrupulous attention to cleanliness in the instruments used. This cannot be too much insisted upon in the management of cases of paralysis of the bladder from injury or disease of the spinal cord. Actual cleanliness can only be obtained by the use of antiseptics. For this purpose all catheters should be washed in some powerful antiseptic lotion, and when used should be greased with carbolic oil (1 to 10) or some other antiseptic preparation. Perhaps the best preparation is that recommended by Mr. Lund, composed of carbolic acid, 1 part, castor oil, 4 parts, olive oil, 12 parts. If decomposition should occur in the bladder, antiseptic lotions must be injected, in order, if possible, to restore the healthy condition before extension has taken place to the kidneys. The best solutions for this purpose are quinine, gr. iij; dilute sulphuric acid, ♏iij, water ad ℥j; Condy's fluid, ʒj ad ℥x; and thymol solution (saturated). Carbolic acid is rather too irritating, as also is chloride of zinc.

If the symptoms of subacute interstitial nephritis are present, the patient will frequently derive much benefit from a pure milk diet. At the same time small doses of opium seem to promote the action of the skin, and so to relieve the kidney without producing the dangerous effects so much to be feared in Bright's disease. The action of the skin may at the same time be still further promoted by vapour baths. The bowels should be kept freely open. Counter-irritation, either by dry-cupping or mustard poultices over the loins, followed by hot fomentations, is frequently of use. If the urine is foul, it may be greatly improved by the administration of benzoate of ammonia or benzoic acid in ten-grain doses every six hours. When the symptoms of the acute form are well-marked, operations to relieve the cause only hasten the fatal event. By careful nursing, and the treatment above described, the symptoms may be so far reduced in intensity as to render an operation for the removal of the cause justifiable.

Marcus Beck.

SWEAT GLANDS, Diseases of.—*See* Sudoriparous Glands, Diseases of.

SWEATING, Disorders of. *See* Perspiration, Disorders of.

SWELLING.—Synon.: Fr. *Gonflement*; *Tuméfaction*; Ger. *Schwellung.*—This term, when employed in medicine, is applied both to the process and to the condition of increase in volume of any part of the body. In a small number of instances swelling is a normal process, and may be periodical; for example, the swelling of the mammæ at puberty, during menstruation, and in pregnancy; of the uterus during gestation; and of the penis during erection. As a rule, however, swelling is a morbid process or condition, and many examples of it are afforded by disease. These may be broadly classified as—(A) *Local* or *circumscribed*; and (B) *General* or *diffused* swelling.

(A) *Circumscribed.*—The most important varieties of this kind of swelling are:—1. Simple *hypertrophy*, as of the thyroid gland in some forms of goitre; 2. Swelling due to *disorders of the circulation* or *inflammation*, as in congestion of mucous membranes, and in ordinary abscess; 3. *Œdema*, and certain other rarer exudations into the connective tissues; 4. *Extravasations* of blood, urine, gas, and other products; 5. *Dilatation* or *distension* of natural cavities or vessels, as of the serous sacs and joints by effusions of any kind, of the stomach and bowels by gas, of an artery in aneurism, and of the jugular veins in tricuspid disease; 6. *Disturbed relations* of parts, as in dislocation of the joints, and in hernia; 7. *Retention* and *accumulation* of natural secretions and excretions, as of urine in the bladder, and fæces in the bowels; and 8. *New growths* or tumours proper, including cysts and parasites. Inflammatory enlargements and new growths constitute by far the most common causes of local swelling.

(B) *Diffused.*—Infiltrations of the subcutaneous connective tissue constitute the principal varieties of swelling that fall under this head. Such are anasarca, myxœdema, general emphysema, and the much more uncommon cases of general swelling of the body which result from the stings of certain plants and animals, and the use of poisonous food.

'*Cloudy swelling*' is a term applied in morbid histology to a condition of the cell in which it appears at once enlarged and finely-granular, as in parenchymatous degeneration or inflammation (*see* Degeneration). '*White swelling*' (*tumor albus*) is a popular synonym for scrofulous disease of a joint, usually of the knee.

The *treatment* of swelling depends entirely upon its cause. J. Mitchell Bruce.

SWINE-POX.—A form, possibly, of modified small-pox, in which the pock completes its development imperfectly. It forms a pustule, but the pustule neither umbilicates nor maturates. Willan termed this kind of pock *varicella globularis*; whilst popularly it has also been called 'hives.' *See* Chicken-pox.

SYCOSIS (*σῦκον*, a fig).—Synon.: *Mentagra*; Fr. *Sycose*; Ger. *Feigwarzenflechte.*

Definition.—A folliculitis affecting the hair-follicles of the face, and particularly those of the chin and whiskers.

Ætiology and Pathology.—The most frequent cause of sycosis vulgaris is a cold temperature: we meet with it usually after the patient has been exposed to inclement weather. But any other cause, whether local or constitutional, capable of setting up inflammation in those very important cutaneous structures, the follicles, and especially the follicles of the larger hairs, may be an excitant of the disease. It has been assumed that the hairs may have some share in keeping up the disease; but we must recollect that the seat of the pus-formation is the sub-epithelial surface of the true skin, and consequently that the hair is not bathed in the pus, but is separated from it by the epithelium. The microscope has shown that those phytiform cell-structures which are to be met with wherever epithelium is in a state of softening and decay, and which have been spoken of as parasitic fungi, are present in the softened epithelium of the follicles in this disease; and the opinion has been ventured that the disease may be of a parasitic character, and therefore contagious. And just as the disease is supposed to originate sometimes in the use of a bad razor, so also it has been assumed that the disease may be propagated by shaving. Indeed the term *sycosis contagiosa* has been applied to it under this suspicion. *See* Tinea.

Description.—Sycosis is known by the presence of a crop of pustules, each perforated by a hair, and more or less acuminated, developed on a ground which is red and inflamed, and more or less swollen and infiltrated. The pustules break and form prominent crusts; and a successive crop of pustules makes its appearance every day, thus prolonging the disease for weeks, months, and even years. Essentially the disease is an inflammation of a chronic and aggravated character; and is attended with burning heat, stiffness, and considerable pain and suffering.

Varieties and Complications.—Sycosis may be simple—*sycosis vulgaris*—and vary only in degree; or it may be complicated with lupus erythematosus. The former will present a variety of appearances referable to the constitution of the patient, or to the care or neglect of the disease. When neglected, the crusts will accumulate amongst the hairs, and increase the local irritation; so that the integument may be projected in the form of hard tubercular masses, by the Latins called *fici*, and by the Greeks *σῦκα*; and a veritable sycosis may be the consequence. In this way a mild form of the disease would be a mentagra, and a severe form a sycosis.

The lupoid form of the disease is accompanied by atrophy of the papillary layer of the skin;

the elimination and destruction of the hairs, and the production of cicatricial tissue, which converts the diseased part into a huge scar, either perfectly smooth, or roughened by an interlacement of bands of white fibrous tissue.

Diagnosis.—The diagnosis of sycosis is self-evident; no other affection of the skin answers to the definition of a pustular inflammation of the hair-follicles, limited to the hairy regions of the face.

Prognosis.—Sycosis is obstinate and troublesome, even in its mildest forms; whilst its more severe or more chronic forms are apt to last for months, or even years. The lupoid variety has all the tediousness of lupus erythematosus superadded to the follicular disease.

Treatment.—Whenever any derangement of general health can be detected, this must receive our considerate attention; but very constantly the disease is unaccompanied by symptoms of disorder of constitutional function, and we are constrained to rely chiefly on local treatment. In the earlier stages or more acute forms of the affection the local treatment should be *palliative*; and in a chronic stage *stimulant* in various degrees. Fomentations with decoction of poppy-heads, water-dressings, and especially cold starch poultices, relieve the heat and local suffering, and are extremely beneficial. In less severe cases the cold starch poultice, which consists of starch (without blue) made in the usual way and allowed to cool, may be applied at night, and the oxide of zinc ointment or calamine ointment during the day. The acetate of lead ointment is likewise very useful in some cases. Considerable benefit is also obtained by epilation of such of the hairs as are loosened by the suppuration of the follicles.

In chronic forms of the disease the iodide of sulphur ointment, diluted with two-thirds of benzoated lard or vaseline, is an excellent remedy; so likewise are ointments of the yellow and red oxides of mercury; while in the lupoid forms of the affection, pencilling the congested portions of the skin with the liquor plumbi is to be preferred.

Erasmus Wilson.

SYMMETRY, in Relation to Disease.—Certain diseases and degenerations manifest themselves in changes of structure which are arranged symmetrically in correspondence with the symmetrical construction of the body. They appear most frequently in bilateral symmetry in corresponding parts of the right and left sides. More rarely, they appear, not only in this bilateral symmetry, but in an arrangement accordant with the homologies of parts in their relations to the longitudinal vertebral axis of the body, as the soles and palms, the knees and elbows.

The most marked symmetry is found in the group of senile degenerations; as in thinning of the hair and baldness, in wasting and wrinkling, and the arcus senilis. It is scarcely less complete in the less simply degenerative changes of atheromatous arteries, and the wasting and increasing fattiness of senile bones. In atheromatous arteries also, the homologous symmetry, as well as the bilateral, is often seen; the changes in the radial corresponding with those in the peroneal, and those in the ulnar with those in the anterior tibial.

Among symmetrical diseases the best examples are seen in chronic rheumatic arthritis or osteo-arthritis, rickets, psoriasis, ichthyosis, pityriasis, neurotic pigmentations, the eruptions of secondary syphilis, and those produced by iodide of potassium and some other medicines or poisons.

Chronic rheumatic arthritis shows the best instances of symmetrical changes coincident in many different structures; for instance, in the fibrous degeneration and wasting of cartilage, the thickening and fringed growths of synovial membrane, the nodular formations on the bones. In psoriasis, whether syphilitic or not, there are often good examples of the coincident homologous and bilateral symmetries.

Instances of symmetrical diseases less marked or less constant than these are seen in the deformities of gouty hands and feet, in the thickenings and contractions of palmar fasciæ, in scrofulous lymphatics of the neck or groin, in scrofulous hands and feet, in many cases of eczema, in symmetrical gangrene, and in cartilaginous tumours of the hands and feet.

Significance.—The chief interest of the study of symmetrical degenerations and diseases is in their illustration of some principles of pathology.

The symmetry of senile degeneration is an indication and result of the exact and perfectly maintained uniformity of bilateral changes occurring in the natural life of each symmetrical body. As the two lateral halves, from the embryo state onwards to the state of fullest vigour, pass through changes which are, in each half, progressive at the same rate and in the same method, so that (speaking generally) the two halves are always alike in size, structure, and composition, so is it in decay or degeneration. From beginning to end of normal life the two lateral halves keep time in their similar and equal changes: the changes which are symmetrical are as exactly synchronous. Thus, the senile or timely degenerations of structures are in accordance with the laws of healthy life; and their uniformity is the more notable because they indicate, as do some symmetrical diseases, that the two lateral halves of the body are more alike in method of life and probably in composition, than they are in size and shape. The corresponding limbs are very often unequal in length and circumference. The difference in the lower limbs is often sufficient to give an appearance of spinal curvature. And in faces exact symmetry is very rare: one eyebrow is commonly higher than the other; the septum of the nose is rarely median; the mouth often not horizontal, especially in emotional movements; or one half of the lower jaw is less nearly rectangular than the other, and that side of the face is the smaller or the more oblique. Yet, in parts thus unlike in shape or size degeneration may appear in perfect symmetry. It is in the exact similarity of composition and method of life, thus shown to exist in corresponding parts of the two halves of the body, that we find the explanation of most of the symmetrical diseases.

In the list of those diseases which has been given, and which includes the best examples of the group, some may, perhaps, be regarded as instances of 'monstrosity by excess,' deviating very widely from the normal type. Such may be the irregularly symmetrical cartilaginous tumours of the hands and feet. The rest may very probably be ascribed to alterations in the blood or in the nervous force, or in both.

Among the conditions necessary to the normal state and life of each part, are the due relations between it and the nutritive materials supplied to it in the blood. In symmetrical and exactly similar parts these relations are exactly the same; and as the healthy blood equally supplied to any two symmetrical parts enables them to maintain their similarity in health, so an unhealthy blood may produce in them an equal similarity in disease. It may often be impossible to find what is really the morbid condition of the blood in symmetrical disease; but the existence of such a condition is nearly proved in the eruptions produced by iodide of potassium, in many cases of urticaria, in lead-poisoning, and in cases of gouty and syphilitic eruptions.

Similar considerations may show that symmetrical disease is due to an altered state of the nervous force. A certain healthy state of this force is a necessary condition of the healthy nutrition of every part; and as the cerebro-spinal nervous system and the ganglionic nerves associated with it are arranged in a bi-lateral symmetry, so it may justly be held that, as a rule, the nervous force is in all symmetrical parts present in exact likeness. A general disturbance of the nervous force, or any central disturbance transmitted along symmetrically arranged nerve-fibres would, therefore, generate symmetrical disease; and this, whether we believe that there are special trophic nerves and nerve-centres, or that the trophic nervous influence is exercised through some special condition of the vaso-motor or other nerve-fibres. In either, or in any case, as a healthy nerve-force in the parts is a necessary condition of their healthy symmetry, so may or must a morbid nerve-force produce a symmetrical disease.

The instances of such diseases in which the disturbance of nervous force is most clear are the symmetrical gangrenes of fingers, preceded by intense neuralgia, and the neurotic pigment-marks of the face and forehead. It is not yet possible to tell whether the disturbance is of vaso-motor or of trophic influence, or whether (unless in a few instances) it is of central origin, or reflected from some previously existing peripheral disease, or be even due to some affection of peripheral nerves. But the facts of symmetrical diseases are among the chief of those proving the influence of the nervous system in the production and method of organic disease; and they are mutually illustrative with those of unilateral diseases, such as herpes zoster, whose distribution accords with that of certain nerves, whose disturbance is further indicated by neuralgia.

There thus appear to be among the symmetrical diseases some which may be ascribed to morbid states of blood, and some due to morbid states of nerve-force. But it is probable that in yet more, if not in all, both blood and nerve-force are at fault, the latter chiefly determining the localities, the former chiefly the method and obvious characters, of each disease. The phenomena of many of the diseases may be thus explained better than by referring them to only one disturbing force. There are, indeed, few diseases in which the respective shares taken by blood and by nerve-force in morbid processes can be better studied; few, from the study of which we may more justly hope to attain the means of reconciling the often antagonistic doctrines of a humoral and a neural pathology.

JAMES PAGET.

SYMPATHETIC (σὺν, with; and πάθη, feeling).—This term implies that a part or organ suffers in sympathy with some other part or organ which is diseased. Many disorders which seem, and are popularly supposed, to arise in this way can be traced to obvious pathological causes. Thus, a morbid process may extend directly along blood-vessels, lymphatics, or other tissues; or a morbific agent may be conveyed by the blood or lymph from one part to another; or a secondary lesion may be produced by direct nervous influence. There are other cases, however, in which the connection is not so evident, but it is quite intelligible that organs which are physiologically related may be sympathetically disturbed in pathological conditions. The sympathetic disturbance may be indicated by mere pain or other subjective sensation; by functional derangements, as of secretions or actions; or by positive organic lesions. The occurrence of such phenomena in corresponding parts on both sides of the body, when a disease has commenced on one side, is sometimes very curious, especially as regards organic lesions. As illustrative of the associations in which the word 'sympathetic' is employed may be mentioned *sympathetic pain*, *sympathetic headache*, *sympathetic cough*, *sympathetic vomiting*, *sympathetic bubo*.

FREDERICK T. ROBERTS.

SYMPATHETIC SYSTEM, Disorders of.—SYNON.: Fr *Maladies du Nerf sympathique*; Ger. *Krankheiten der Nervus sympathicus*.

INTRODUCTION.—This subject can only be treated in a brief and tentative manner, owing to the fact that a wide basis of positive knowledge does not exist. The physiology of the different departments of the sympathetic system of nerves is now only beginning to shape itself, whilst on the side of pathology and morbid anatomy there is even still less of definite knowledge. Thus it happens that for the most part only conjectures, often very insecurely based, are current, or can be said to exist, in regard to the dependence of definite sets of symptoms, or distinct diseases, upon disordered actions or morbid changes occurring in one or other part of the sympathetic system of nerves. These problems are now, however, receiving the attention of many workers, so that before long it is to be expected that our knowledge on this important subject will have become both more extensive and more definite. We shall, therefore, in the present article, confine ourselves to some general remarks concerning the anatomical relations and the functions of the sympathetic system of nerves; to the modes in which disorders of its several parts may arise; and to little more than a mere mention of the various morbid conditions, which may be principally or in part occasioned by defective or otherwise abnormal activity of one or other department of this great system of nerves. We shall thus be enabled to indicate some of the best established facts or relations in this direction which have already acquired a clinical importance, and also to indicate the directions in which further advances are to be looked for.

Whilst the sympathetic system of nerves, with its double gangliońated cord and great ganglionic plexuses, is to a certain extent an independent nervous system, its roots nevertheless penetrate deeply into the cerebro-spinal axis. The two nervous systems are connected, on each side of the spinal column, by means of double sets of filaments, passing between each of the sympathetic ganglia and the respective anterior spinal nerves with which they correspond, as well as with most of the nerves attached to the medulla oblongata. The fibres in all these filaments of communication are partly afferent and partly efferent. Thus, just as ingoing or centripetal impressions, instead of being reflected from some of the sympathetic ganglia, may pass on to spinal and medullary centres, so may motor or inhibitory impressions pass outwards from these cerebro-spinal centres, so as to modify the subordinate motor or secretory influences, emanating from some one or other of the sympathetic ganglia themselves.

From the ganglionated cord on each side of the spinal column, numerous internal branches are given off, which unite with one another, with those of the opposite side, and often with filaments of the pneumogastric nerves, so as to form great plexuses with or without well-marked ganglia, with which the various glandular organs and hollow viscera of the body are in connection by means of afferent and efferent fibres. On the course of these visceral nerves many smaller ganglia, constituting subordinate centres, are to be found.

The sympathetic nerves are conducted to and come from the viscera, principally upon and along the course of the blood-vessels.

Some of the nerve-fibres on the visceral blood-vessels, and a much larger proportion of those on vessels going to other parts of the body, belong to a special set of the sympathetic fibres, which, from the nature of their functions, are known as *vaso-motor* nerves. Some of these fibres must have 'afferent' functions for the conveyance of impressions to vaso-motor centres; while others of them will transmit 'efferent' impulses; the two sets together serving to regulate the calibre of the blood-vessels, and consequently the amount of blood flowing through the different vascular territories. These vaso-motor nerves are connected with small ganglia distributed along the length of the blood-vessels, from which, in response to afferent impressions, motor stimuli may issue to such vessels and their branches. Such peripheral ganglia are, however, in subordinate relation with spinal vaso-motor centres, situated along the whole length of the cord, and these in their turn are dominated by a still higher regulating centre, situated in the medulla oblongata (near the lower extremity of the fourth ventricle), which appears to be in relation with all the vaso-motor nerves throughout the body. Modern observations would seem to show that there is another vaso-motor centre in the cerebral cortex; and this is believed by Benedikt, Meynert, and others to be situated in the hippocampus-major. The nature of its relations with the medullary centre are as yet uncertain.

Other fibres of the sympathetic system are mixed up on the vessels with those having a vaso-motor function. These others vary in function and in numerical proportion, according to the nature of the organ to which the vessels are proceeding. Thus to and from the liver, the pancreas, the salivary glands, and other allied organs, would proceed nerve-fibres, regulating the secretory and other vital actions taking place in the tissue-elements of the several organs; also from and to such organs there would proceed afferent and efferent fibres for rousing and regulating the activity of the contractile tissues in their respective gland-ducts. Again, there would lie on intestinal arteries, in addition to vaso-motor fibres, many other sympathetic fibres for the innervation of the muscular layers of the intestine, and many also for the different glandular elements of its mucous membrane. Lastly, in such an organ as the bladder, vaso-motor nerves, and nerves for the supply of its own proper muscular tissues, would exist in abundance, while those in relation with glandular elements would be comparatively scarce.

Whether over and above these different kinds of sympathetic fibres, others exist of the so-called 'trophic' type, seems at present to be extremely doubtful.

If, therefore, we consider the functions of the sympathetic system of nerves as a whole, we find that it has to do with the degree of contraction of the pupil; with the calibre of the blood-vessels generally; with the activity of all the glandular organs; with the movements of all the hollow viscera, and gland-ducts; and possibly in some special manner with the nutrition of all the tissues. And inasmuch as the nerves pertaining to this system, if not both the nerves and ganglia, are to be found in all parts of the body, it is to be expected that its functions may be more or less locally deranged, or its structure more or less damaged, by almost every form of disease, be it local or general. Every local inflammation must be associated with a perverted activity and deranged structure of sympathetic nerve-fibres in the inflammatory focus; whilst every fever will entail widespread and varied perversions in the functions of this system of nerves throughout the body. Owing, however, to the fact of the intimate structural relations existing between the sympathetic and the cerebro-spinal nervous system (*see* NERVOUS SYSTEM, Diseases of), it is more especially in diseases of the spinal cord and of the brain that we are accustomed to meet with definite sets of signs and symptoms referable to disordered or arrested action of portions of the sympathetic system. In the present article, therefore, the disorders of the sympathetic system will be very briefly considered as they occur: (1) in association with diseases of the spinal cord and brain; and (2) independently of affections of the cerebro-spinal nervous system.

1. **Diseases of the sympathetic system in connection with the cerebro-spinal system.**

(*a*) *The spinal cord.*—Lesions of the *cervical* region of the spinal cord may be associated with extreme contraction or extreme dilatation of the pupil on one or both sides; with increased heat and redness, or the reverse, of the head and neck; with perverted respiration; with perverted action of the heart; and possibly with an exalted febrile heat of the whole body (*see* SPINAL CORD, Diseases of, § 9). Though we regard these phenomena as signs of disease in this particular portion of the spinal cord, it is none the less true that such phenomena are due to altered activities in those root-portions of the sympathetic system of nerves which take origin in, or traverse, this region of the cord. This is shown by the fact that similar sets of symptoms are produced by injuries, tumours, or other morbid processes implicating the cervical sympathetic itself.

It will be well to cite here the phenomena commonly associated with *irritation* or *paralysis* of the cervical sympathetic nerve, on account of their importance as diagnostic indications.

The signs dependent upon *irritation* of the cervical sympathetic in its *oculo-pupillary* fibres are—dilatation of the corresponding pupil with sluggish action, widening of the palpebral fissure, prominence of the eyeball, feeling of tension in the eye (as in glaucoma), and a scanty secretion of tears and mucus; whilst in its *vaso-motor* fibres they are—lowering of temperature of the side of the face and head, diminution of sensibility, an absence of perspiration, with (if the irritation continue) a tendency to slight atrophy of the side of the face. The signs of *paralysis* of the cervical sympathetic in its two sets of fibres are the direct opposites of those above cited, so that it is not necessary to enumerate them. Of these signs, those dependent upon irritation or paralysis of the oculo-pupillary fibres are usually much more constant and durable than those which depend upon irritation or paralysis of the vaso-motor fibres. These latter signs are, for reasons at present unknown, often transitory and fitful. Sometimes there may be signs of paralysis of oculo-pupillary fibres co-existing with signs of irritation of the vaso-motor fibres, or *vice versâ*. It has been definitely determined that injury in the lower cervical region of the cord, and as far down as the level of the *second dorsal* nerve, may give rise to the oculo-pupillary signs of one or other kind; and, on the other hand, that damage to the cord in these same parts, or as low down as the *fourth dorsal* nerve, may give rise to the above-mentioned vaso-motor signs.

When the *dorsal* and *lumbar* regions of the spinal cord are the seats of disease, other groups of phenomena will doubtless, after a time, be more fully recognised as results of irritation or paralysis of those roots of the sympathetic system which have their origin in or which traverse these particular regions of the spinal cord. It is therefore important to bear in mind the place of origin and the distribution of the different internal branches from the lateral sympathetic cords, which proceed from these regions to the different glandular organs or hollow viscera. Diarrhœa, sickness, obstinate constipation, sexual defects, and bladder-troubles, are among the symptoms which have such an origin, as well as undue heat or unnatural coldness of the lower extremities.

(*b*) *The brain.*—In different portions of the brain some of the signs and symptoms of disease are also referable to direct or indirect interference with the functions of the sympathetic system of nerves; but they constitute (apart from vaso-motor derangements, which are very common and often well-marked) far less distinctive aggregates, owing to the fact that the sympathetic system of nerves has a much less extensive relation with the brain than with the spinal cord. In this direction, however, and in connection especially with diseases of the medulla oblongata, we have to bear in mind the occasional occurrence of diabetes, polyuria, or albuminuria; also of some cardiac and respiratory derangements.

2. **Diseases of the sympathetic system proper.**—Where disease exists in the ganglia of the sympathetic system itself, or where it involves them, we get groups of symptoms more clearly referable to disordered activity of this system of nerves alone.

These will differ in particular cases, according to the nature of the morbid change, that is, according as it is destructive or merely irritative; and according to the number or particular combinations of ganglia and fibres affected. The ganglia and related plexuses may either be implicated by *intrinsic* morbid processes, or may be variously involved *from without* by morbid processes having their origin in other adjacent tissues.

a. Intrinsic changes.—The principal intrinsic morbid processes which have been hitherto recognised *post mortem* in some one or other of the sympathetic ganglia are:—pigmentary degeneration; cirrhotic overgrowth of their connective tissues, with or without secondary atrophy (the ganglia in such cases being either smaller or larger than natural); a highly congested and varicose state of their blood-vessels; effusion of blood into their substance; new growths starting from their substance; and fatty degeneration, with more or less marked atrophy. It is unnecessary to repeat here the statements relating to the pathology of such changes, which have been made under NERVOUS SYSTEM, Diseases of.

b. Extrinsic disease.—Different parts of the sympathetic system may become involved in new growths or in abscesses; or they may be simply pressed upon by aneurismal or other tumours occurring in contiguous regions of the body.

Besides the pathological conditions already enumerated, it should be borne in mind that in altered blood-states, whether cachectic or of febrile origin, we commonly have, and especially in the latter class of cases, a greatly perverted activity of the sympathetic system throughout the body—as evidenced by the altered vascular conditions, increased tissue-metamorphosis and body-heat, together with the perverted activity of most of the glands in the body. *See* FEVER.

But to what extent the actual structure of glandular or blood-making organs may be perverted by primary or secondary morbid changes in related portions of the sympathetic system, we have yet to learn. Waxy degeneration of the liver or spleen may, for instance, be a result of certain perversions of the normal life-processes taking place in the elements of these organs, primarily induced by changes in the quality of the blood, such as occur in many cachexias. But whether this altered blood acts directly upon the tissue-element, and brings about the structural change known as waxy degeneration; or whether cachectic states of the system entail upon the sympathetic centres a perverted nutrition, and a consequent perverted influence upon the tissue-elements of related organs, whereby they, being at the same time fed only by impoverished blood, lapse into those lower modes of vitality which result in the degenerative change above-mentioned, are unsettled questions, well worthy of consideration. These remarks, with suitable modifications, are applicable as regards the possible instrumentality of related portions of the sympathetic system, in causing other varieties of morbid change in other organs of the body.

The principal disorders other than those due to structural diseases of the cord and of the brain, in which derangements of the sympathetic system of nerves exist, or are believed to exist, and in which such derangements have either wholly or in part a causal relationship to the principal signs and symptoms of the respective disorders, are as follows:—epilepsy; convulsions; migraine (hemicrania); exophthalmic goitre; unilateral hyperidrosis; progressive facial hemiatrophy; angina pectoris; asthma; diabetes; Addison's disease; gastralgia; enteralgia (colic); neuralgia cœliaca; neuralgia spermatica; and uterine neuralgia. (See '*Phys. and Pathol. of Sympath. Syst. of Nerves*' by Eulenberg and Guttmann, 1879.) Among the affections more doubtfully or partially related to disorders of the sympathetic we may mention glaucoma; neuro-retinitis; progressive muscular atrophy; pseudo-hypertrophic paralysis; locomotor ataxy; diphtheritic paralysis; and so-called 'reflex paralysis.' In the special articles on most of the first group of affections, the reader will find references to the dependence of such conditions upon disorders in one or other department of the sympathetic system.[1]

H. CHARLTON BASTIAN.

SYMPTOM
SYMPTOMATOLOGY } *See* DISEASE, Symptoms and Signs of.

SYNCOPE (συγκοπή, a faint).—SYNON.: Fainting; Fr. *Syncope*; Ger. *Ohnmacht*.

DEFINITION.—A state of suspended animation, due to sudden failure of the action of the heart.

ÆTIOLOGY.—Syncope may be due to any condition which interferes with the action of the heart, whether acting (*a*) *intrinsically*; (*b*) through the *nervous system*; (*c*) through the *blood*; (*d*) through *more than one* of these channels.

(*a*) Syncope due to *intrinsic* cardiac conditions is chiefly seen in organic diseases of the heart, especially fatty degeneration. Amongst other examples of this class of causes, may be mentioned compression of the heart by diseased conditions, or by tight articles of dress; excessive heat, whether natural or artificial, as in sunstroke and the warm-bath; lightning; and certain drugs and poisons, including chloroform.

(*b*) The most common *nervous* causes of fainting are of an emotional kind, such as fear, grief, or joy, in nervous or hysterical women. Sudden injury of the central nervous system, as in concussion of the brain, has partly the same effect. In a larger number of instances the nervous causes of syncope act reflexly, and are to be found in conditions of the stomach or intestines (corrosive and irritant poisoning, indigestion, worms, scybala); in the liver, kidneys, or uterus (injuries, calculi, displacements); or in the limbs or body generally (painful injuries of any kind). Spasm of the arteries, due to reflex irritation of the vaso-motor nerves (cold and certain poisons), may also lead to syncope.

(*c*) Of the causes of syncope connected with the *blood* the most frequent is hæmorrhage. Chronic anæmia, as seen in idiopathic and pernicious cases, or accompanying chronic constitutional diseases, is a common cause of serious fainting.

(*d*) In a large number of instances, however, the causes of syncope are *complex*. Thus in fainting from hunger and exhaustion the heart is depressed directly, as well as through the nervous system, and through the blood; and in severe injuries, such as railway accidents, there may be a combination of depressing causes, including fear and grief, hæmorrhage, painful lesions, cerebral concussion, and shock. Fainting in a hot, impure atmosphere appears to be due partly to the direct effect of heat upon the circulation; and partly to the interference with respiration, and indirectly with the heart, produced by carbonic acid.

In a person subjected to any of the predisposing causes of syncope already mentioned, the occurrence of fainting may be determined by a very slight exciting cause. It is thus that in serious cardiac disease, in hysterical subjects, and in persons suffering from anæmia, the smallest excitement or exertion, unpleasant sights or smells, or exposure to an impure and heated atmosphere, may cause faintness, and in some instances even fatal syncope.

ANATOMICAL CHARACTERS.—In death by syncope the organs generally are found to be anæmic; and if hæmorrhage have occurred, this condition is particularly marked. The state of the heart varies with the cause of its failure, the ventricles being either dilated and full of blood, or empty, as in cases of fatal hæmorrhage, and possibly contracted.

SYMPTOMS.—A syncopal attack presents three stages, namely: (1) *a period preceding loss of consciousness*; (2) *a condition characterised by insensibility*; and (3) *a period of recovery* from the fainting state.

(1) A person about to faint is observed to turn suddenly pale; he staggers, or leans against the nearest support; the eyes roll upwards,

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[1] See also Long Fox on 'The Influence of the Sympathetic on Disease,' *Med. Times*, Sept. 2, 1882.

whilst the eyelids tremble or close; and consciousness and general sensibility are impaired. The pulse fails, generally becoming weak, small, and frequent; in other instances it is infrequent, irregular, or intermittent. The respiration is irregular and feeble. Vomiting may possibly occur.

At the same time the patient has a number of subjective sensations. The most urgent of these are a sense of 'sinking' in the epigastrium, a feeling of increasing debility, 'giddiness' in the head, and a tendency to fall. Vision becomes indistinct; the hearing is usually impaired, rarely more acute, or tinnitus is present. Mentally there is a rapid fading of sensory impressions and of consciousness; whilst in cases of fainting from loss of blood there may be restlessness, agitation, and delirium.

(2) The phenomena of the first stage are now complete. The muscles are relaxed; the patient falls; and consciousness is completely lost. The surface is pallid, and possibly cold and clammy; the eyes are closed, and the pupils dilated: the pulse and the cardiac impulse and sounds are nearly or quite imperceptible; respiration is indistinguishable, or occurs as occasional weak sighs; and the vital functions generally appear to have ceased. In cases of syncope due to severe hæmorrhage general convulsions may occur.

(3) Recovery from syncope is marked by signs of gradually returning consciousness, increase of the pulse at the wrist, and restoration of the functions generally. The first obvious signs of improvement are usually slight movements of the hands and features, and deep sighing. Thereupon the pulse becomes more distinct; the cardiac impulse and sounds are found to be stronger; the senses of sight and hearing can be excited; colour returns to the face and lips, and warmth to the extremities; and intelligence is gradually restored. Very shortly the patient may be able to resume the sitting posture; and the seizure is at an end.

Duration and Terminations.—The duration of the several stages of syncope varies greatly, from a few seconds even to hours. In many instances the attack does not pass beyond the first stage; in rarer cases insensibility may last for an almost indefinite time. The most common termination is in recovery; but syncope is one of the ordinary modes of death, especially in hæmorrhage and organic disease of the heart. In nervous subjects partial recovery may be quickly followed by the return of the fainting state, the patient being said to 'pass out of one faint into another.' Where referable to organic disease or to hysteria, syncope may recur at intervals for many years.

Pathology.—Syncope consists essentially in sudden failure of the action of the heart, originating in any of the causes already mentioned, and leading to the condition of acute general anæmia. Whether from some affection of the heart itself, from sudden interference with the nervous impulses which regulate its action, from failure in the regularity of the supply of blood within its cavities and in its substance, or from a combination of such causes, the systolic contraction suddenly becomes short and feeble. If there have been no hæmorrhage, the result is distension of the cardiac cavities with blood, and further embarrassment; but if profuse hæmorrhage have occurred, the heart may be deprived of blood, and thus of the natural stimulus to contraction. In either case fatal cardiac paralysis may be the result, unless the contractile power be speedily restored.

The acute general anæmia which is the result specially affects the central nervous system. In the erect posture the circulation fails first within the cerebrum, producing rapid disturbance and then loss of consciousness, and depressing the centres that regulate the heart, vessels, respiration, and stomach. The general muscular paralysis which occurs at the same time is also partly of central origin. Similarly, the convulsions which may ensue in cases of hæmorrhage are probably referable to sudden circulatory disturbance within the basal ganglia and cord. The senses are further obscured by anæmia of their special organs; the heart is more depressed by failure of the coronary circulation; the paralysis of the muscles is increased by want of blood within them; and the temperature falls from failure of the circulation generally.

In non-fatal cases recovery naturally occurs by restoration of the cerebral circulation in the recumbent position, and consequent stimulation of the cardiac centre. Other circumstances favour the recovery of the general circulation, such as the relaxation of the arteries, and the partial restoration of the respiratory and other functions, which quickly react upon the heart.

Diagnosis.—Syncope has to be diagnosed from other conditions in which loss of consciousness is a prominent symptom; and chiefly from epilepsy, 'apoplexy' from any cause, concussion of the brain, shock, and from poisoning of many kinds, including suffocation by certain gases and drunkenness. From such of these conditions as commence in the brain, and from poisoning (unless the poisons act as cardiac depressants) syncope is readily distinguished by the characters of the pulse. The diagnosis of shock, which usually produces a degree of syncope, is described in the article on that subject. *See* Shock.

Prognosis.—The prognosis of syncope depends upon its cause, and upon the practicability of immediate treatment. If due to organic disease of the organs of circulation, or to serious injury, acute poisoning, excessive heat, or profuse hæmorrhage, the case is serious, and may prove fatal unless treatment be instantly applied. If, on the other hand, the cause of the faintness lie in an excitable nervous system, momentarily depressed by some passing emotional disturbance, or by impurity of the atmosphere, the attack may be pronounced free from danger, although liable to recur.

Treatment.—In the treatment of syncope two indications are equally urgent, namely, removal of the cause of faintness, and restoration of the action of the heart. If the patient should not have fallen, he must be immediately laid flat on his back; the atmosphere should be rendered as pure as possible by throwing open the windows and doors, by removal to the open air, and by preventing people from crowding around; and the dress should be loosened about the neck, chest, and abdomen. If hæmorrhage occur, means must be taken to stop it. Cardiac stimulants, direct or indirect, must then be employed. The most available and powerful of these is alcohol, in the form of brandy or other spirit; and this may be given either pure or in water, and in an amount which will vary with the individual case, as estimated by the immediate result. Sal volatile, ether, eau de Cologne, if available, are equally valuable cardiac stimulants. Should the patient be unable to swallow, these substances, as well as warm liquids, must be given at once as enemata; or ether may be injected under the skin of the præcordium. Carbonate of ammonia ('smelling salts') and other strong smelling compounds, including perfumes, fanning, cold douches, and refrigerant applications of eau de Cologne or other spirit to the temples and hands, are other ready methods of exciting the heart reflexly through the nervous centres. If these measures fail after a fair trial the condition of the patient is very serious. The systematic employment of efficient means of resuscitation must then be had recourse to, including friction of the limbs and trunk, galvanisation of the region of the heart, and even transfusion of blood. *See* RESUSCITATION (A.).

In cases ending favourably the patient must be careful not to assume the erect position too hastily, or to undergo much exertion, until some rest have been obtained or some stimulant or nourishment administered.

The occurrence of syncope is sometimes the first indication of the existence of serious organic disease of the heart or other organ; and it should suggest a careful examination of the patient, and the adoption of measures likely to prevent the return of such a dangerous symptom, that is, the avoidance, as far as they are avoidable, of the principal causes already mentioned.

J. MITCHELL BRUCE.

SYNOCHA (*συνοχέω*, I carry with).—SYNON.: *Febris continua.*

SYNOCHUS (*συνέχω*, I hold or keep together).—SYNON.: *Febris continens.*

Synocha and synochus are now obsolete terms, which were used for many centuries as epithets of two distinct types of fever, but in different senses at different periods. A complete history of their varying meanings would occupy much space; a few illustrations of it only need be given. *Synocha* does not occur in Galen's extant writings; and *Synochus* is by him contrasted with πυρετὸς συνεχὴς, and defined to be a fever whose course is steady and uniform from its beginning to its end. Under it, in his *Method. Medend.*, lib. ix., cap. iii. he admits three varieties, namely, 1, when the temperature remains steady; 2, when it rises steadily; and 3, when it falls steadily, during the whole course of the fully established disease. The meaning of the term has no reference to the duration of the fever. πυρετὸς συνεχὴς, on the contrary, is a fever with paroxysms and remissions. Galen, *Definit. Med.*, 186-7.

In the second edition of Stephen Blancard's *Lexicon*, A.D. 1717, from which the etymology given above is taken, synocha is a continued fever, of several days' duration, with paroxysms and remissions, attended by remarkable heat, and sometimes putrid. It may be either quotidian, tertian, or quartan. By this he seems to mean that exacerbations may take place on those days, but the fever is remittent not intermittent. Synochus is a continuous fever (*febris continens*), often lasting several days, unattended by serious symptoms, and is either simple or putrid, according to its severity.

Linnæus, in 1763, and De Sauvages, in 1768, both define synocha to be a fever not lasting more than a week, synochus one not lasting more than two or three weeks.

Cullen, in 1785, dissatisfied, he says, with the previous use of the words, gives to them a special meaning of his own. In his nosology synocha is a fever with very high temperature; a frequent, strong, hard pulse; red urine; and very little disturbance of the sensorium. Synochus is a contagious disease, in which the fever combines the symptoms of synocha and of typhus; beginning as synocha, towards the end it becomes typhus.

With this variety of meaning it is not surprising that the same disease is placed under synocha by one author, under synochus by another. As the further use of these terms, apart from their incongruity with modern systems of classification, can only perpetuate this confusion, they may be allowed to become obsolete.

JAMES ANDREW.

SYNOVIAL DISEASES. *See* JOINTS, Diseases of.

SYPHILIS (etymology uncertain. Perhaps from *σὺν*, with, or *σῦς*, a swine, and *φιλέω*, I love; or from *σιφλὸς*, crippled, maimed).—SYNON.: Vulg., Pox; Fr. *Vérole*; Ger. *Lustseuche.*

DEFINITION.—A specific contagious non-infectious disease; communicable by contact of the poison with a breach of surface, or by hereditary transmission. Syphilis is characterised by a period of incubation; and (except in the case of inheritance) by certain changes at the seat of contagion, and in the proximate lymphatic glands. These are followed by an eruption on the skin and mucous membrane, and sometimes by lesions of the deeper tissues and viscera.

HISTORY.—The origin of syphilis is unknown. In India and China there is little doubt that the disease existed centuries ago; but the time at which it first appeared in Europe has given rise to much discussion, and is still the subject of dispute. Some writers maintain that syphilis was introduced by the followers of Columbus from the West Indies, on their return from the discovery of Hayti in 1493. Others again hold that it first broke out among the French soldiers during the siege of Naples in 1494–5. There can be no doubt that syphilis of a very severe character was prevalent in Southern Europe towards the close of the fifteenth century, when indeed it seems to have been first clearly recognised and described; but it is also probable that the disease had existed even in Europe long before that time.

ÆTIOLOGY.—There is but one cause of syphilis, namely, the absorption of the virus into the blood, and its gradual diffusion throughout the body. It was formerly taught—a doctrine for which John Hunter was largely responsible—that syphilis, the soft chancre, and gonorrhœa were due to one virus. This was more or less generally accepted until 1838, when Ricord's researches confirmed the conclusions arrived at long before by Balfour (1767), and Benjamin Bell (1793), to the effect that gonorrhœa had nothing whatever to do with the other two disorders. The next step was completed in 1852, by the publication of Bassereau's evidence, based on the comparison of a large number of cases of venereal sore with their source of contagion. The results of these observations tended to show that the 'soft chancre' was a local affection, quite distinct from the general disease syphilis. This is the view most generally held at the present day, and those who hold it are now called *dualists*. A smaller number of authors, however, still maintain that syphilis and the soft sore are products of the same virus, and to such the term *unicist* is applied. The discussion of *unity* and *duality* does not come within the scope of this article. It is sufficient, therefore, to state that it is from the more generally accepted or *dualist* point of view that the present account is written. Consequently, when the term syphilis is used, the constitutional disease is always to be understood. The local suppurating sore or soft chancre is described elsewhere. *See* VENEREAL SORE.

One attack of syphilis usually affords protection against a second throughout the lifetime of the individual. In the rare instances in which a person suffers more than once, the second attack is, as a rule, modified by the previous one.

Besides being capable of contaminating others by direct contact, the subject of acquired syphilis is also liable, during a variable period, to transmit the taint to his offspring; but whether the inherited form of disease be further transmissible to the next generation remains doubtful.

It is probable that many persons, though exposed to contagion, escape syphilis as they escape other contagious diseases, from want of susceptibility. On the other hand, some persons appear to be particularly susceptible to noxious influences, and suffer more than once from the same contagious disorder. The reason of such peculiarity is not yet understood.

PATHOLOGY AND ANATOMICAL CHARACTERS.—The essential nature of the syphilitic poison is unknown. Certain elements have been reported as found exclusively in the blood or tissues of syphilitic persons; but not on conclusive evidence. The recent views on this subject of Klebs, Aufrecht, and Birch-Hirschfeld will be found in the *Lancet* for August 26, 1882, p. 316. Whether syphilis is a special disease or to be classed among the exanthemata, need not be discussed here. It will be sufficient to point out that while it resembles the acute fevers in having a period of incubation, in the development of an exanthem, and in the protection commonly afforded by one attack against subsequent ones, it yet differs from them in its long duration and liability to relapse, in the non-infectious nature of its poison, and in its capability of being greatly influenced by certain remedies.

When the syphilitic poison has been absorbed, it multiplies until the whole system becomes pervaded by it. How soon this absorption takes place is not known. Some believe that the virus remains localised at or about the seat of inoculation during the incubation-period. Hence, of late years excision of the initial lesion has been again extensively practised by Auspitz and others, with the object of preventing further development of the disease. The results of these experiments, however, have not, so far, proved that the removal or destruction of the initial manifestation at any stage of its development can prevent general infection.

The changes which syphilis produces in the tissues are chiefly of an inflammatory nature. The process, which is essentially the same in the primary induration and in the later manifestations of the disease, begins by the production of numerous small round cells, which are situated chiefly in the outer portion of the sheath of minute blood-vessels, and imbedded in a delicate stroma. Thus the growth is of the nature of granulation-tissue, and does not present any elements peculiar to syphilis. It is at first a highly organised tissue, rich in blood-vessels; but subsequently shows a marked tendency to vascular thrombosis and consequent degeneration.

The new growth may develop in a diffused infiltrating form, involving a greater or less extent of the invaded tissues; or in the circumscribed masses known as gummata. Any of the structures of the body may be attacked, most commonly, perhaps, the subcutaneous connective tissue; but bone, muscle, the blood-vessels, the placenta, and the internal viscera are all liable to suffer; and although the morbid growth is essentially the same wherever it is developed, it of course presents differences in appearance, according to the particular tissue or organ affected.

It is, however, the circumscribed swelling or *gumma* that is most characteristic of syphilis. In its typical form it appears as a yellowish, tough, somewhat elastic, and sharply circumscribed mass, varying usually from the size of a marble to that of a large chestnut. It is also often caseous in the middle, and is surrounded by a highly vascular fibrous investment. Gummata are frequently associated with the diffused form of growth, which after a time becomes converted into a tough fibrous tissue; this finally contracts, and thus puckers, deforms, and often seriously affects the functions of the organ in which it grows. Fibroid induration and scarring are not uncommonly discovered in the organs of syphilitic subjects, but fibroid disease is not generally recognised as being unquestionably syphilitic unless gummata be also present.

Besides the changes that have just been described, *lardaceous disease* is frequently caused by syphilis. Indeed this is probably the commonest visceral affection found in the bodies of old syphilitic persons.

MODES OF COMMUNICATION.—Before considering the different ways in which syphilis may be propagated, it is necessary to mention the vehicles of the virus. These are:

1. The discharge of the initial lesion.
2. The secretions of all the secondary eruptive

lesions, especially of the moist papules known as mucous patches or tubercles.

3. The blood, during the continuance of secondary symptoms.

The secretions of the later or tertiary affections have not been proved to be contagious, nor have the physiological secretions of a syphilitic person—for example, the saliva, sweat, tears, semen, milk—unless mixed with the secretions of syphilis or with the blood, even though the disease be in an early stage. Further, the secretions of other diseases from which a syphilitic person may be suffering are not always contagious. This at least is the case with regard to vaccinia; for healthy children have been often vaccinated from syphilitic ones without contracting syphilis.

The sources of contagion being so numerous, it is easy to understand that the modes of communication must be so also. They may be described under three heads:—1. *direct contact*; 2. *mediate communication*; and 3. *hereditary transmission.*

1. *Direct contact.*—In the great majority of cases syphilis is imparted during sexual intercourse, first, because the genital organs are the most frequent seat of the contagious lesions; secondly, because the delicate epithelium of those organs is especially liable to abrasion during coitus. Hence syphilis is usually described as a venereal disease, but it should always be remembered that it is not necessarily so. Wherever the poison comes in contact with a broken surface, it may be absorbed and general infection follow. Instances of syphilis being conveyed quite independently of sexual relations are unfortunately far from rare. Perhaps the most frequent mode of extra-genital contagion is the contamination of a wet nurse by a syphilitic child, or of a child by its nurse. The disease may also be spread by kissing, contagious syphilitic lesions being very common about the lips and in the mouth. Again, medical men and midwives not unfrequently contract syphilis by attending diseased women in labour; and surgeons by examining or operating upon syphilitic persons.

2. *Mediate communication.*—When syphilis is communicated indirectly the medium may be of almost endless variety. Articles which are used in common by different persons, such as spoons, drinking vessels, pipes, &c., are perhaps the commonest media; implements used in various trades—the tubes used in glass-blowing, for example—have also acted in the same way. Again, through the performance of tattooing, cupping, catheterisation of the Eustachian tube, &c., by ignorant persons and quacks, the disease has been communicated, and it has also happened during vaccination; but in this country, where that operation is performed only by duly qualified medical men, such an accident is of extreme rarity. Another mode of mediate communication, where one person conveys syphilis to a third through the medium of a second who escapes contagion, has also been described by various authors.

3. *Hereditary transmission.*—Our knowledge is still imperfect respecting the ways in which syphilis may be transmitted from parent to child; and the questions involved are much too wide for discussion in this article. Consequently, no attempt will be made to do more than state briefly the facts which are most generally accepted, and the most usual course of events when syphilitic persons become parents.

In the first place it must be remembered that the child does not *necessarily* become contaminated, in whatever stage of syphilis the parents may be. As a rule, however, the more recent the infection of the parents the more likely is the child to inherit the disease. The elder children usually suffer most severely; but this is by no means always the case. For instance, treatment has great influence over the transmissive power, and a healthy child may be born while the mother is under the influence of mercury, but a subsequent one may be tainted, if treatment have been discontinued, and the disease have again resumed activity. There are also periods of quiescence in syphilis independent of treatment, during which healthy children are sometimes born. When the infection of both parents is recent the child almost invariably suffers, and this is also the case if the mother alone be diseased. Under such circumstances abortion or premature birth is common. When the father alone is syphilitic, both mother and child may escape. Some believe that a syphilitic father may procreate a diseased child while the mother escapes, but this is by no means proved. Indeed, it appears most probable that the mother of a syphilitic child does not really escape contagion, although she may show no characteristic signs of the disease. The most weighty evidence in support of this view is that known as 'Colles's law'—namely, that the mother of a syphilitic child never becomes infected by it after birth; and further, seems proof against contagion in any other way. In the cases where the mother does not show the ordinary early signs of syphilis, it is believed by many that the fœtus becomes diseased directly by the father, and in turn infects the mother through the placental circulation ('*choc en retour*'). There is much evidence in favour of this view. Lastly, if the mother acquire syphilis during the earlier months of pregnancy the child commonly suffers; but if she be infected after the seventh month the child may escape.

Symptoms.—The symptoms of syphilis are usually divided into three groups—**primary, secondary,** and **tertiary.** And although such division is really artificial, it will be useful to retain these terms for the purpose of description; but it must be borne in mind that the patient during the primary stage is just as much the subject of syphilis as during the stage of general symptoms, and that in certain cases the signs proper to all three periods may be present at the same time.

Primary syphilis.—A patient is said to be suffering from primary syphilis as long as the initial manifestation (hard chancre), and the accompanying glandular enlargement, remain the sole signs of the disease.

When the syphilitic poison, unmixed with any irritating matter, has been inoculated, the abrasion quickly heals, and no further change is observed for three weeks or a month. This interval is called the period of *incubation*, and its average length, judging from cases of experimental inoculation, is about twenty-four days; but it may be as short as ten, or as long as forty-six days. After the lapse then usually of an interval of three or four weeks, a certain change occurs at the site of inoculation, which is called the *initial* manifestation or lesion. This may assume various forms, and is commonly termed a *hard*, or *indurated*, or *infecting chancre*. The initial lesion presents certain differences in appearance, according to its position, and according to whether it be irritated or not. Its chief characteristic is the presence of induration at its base, and the aspect of the sore is much affected also by the degree in which this hardness is developed. Sometimes the lesion appears as a hard desquamating papule; sometimes as a well-marked indurated ulcer, having a hard well-defined base and thickened adherent margins (the so-called '*Hunterian chancre*'); but most commonly as an erosion or shallow ulcer, with an amount of induration which varies much in different cases, and which is not always easily appreciable unless care be taken. Sometimes the induration develops in a thin layer, like a piece of parchment or even paper; hence the term 'parchment sore' often applied to this form of the initial lesion. In rare instances, especially in women, induration appears to be absent altogether. The secretion is thin, scanty, non-purulent, and not inoculable on the bearer. Hence, the syphilitic primary sore is usually *single*, contrasting strongly in this respect with the local chancre, in which multiplicity is the rule. The sore is indolent and often painless, and tends to disappear spontaneously after having lasted several weeks or months.

The *seat* of the initial lesion is most frequently the genital organs, but, as has already been stated, absorption of the poison may occur in any situation where a breach of surface exists. Consequently the initial lesion may be found on any part of the body, as about the lips or mouth in children, on the nipple in nurses, or on the hand or finger in the case of doctors and midwives.

If, as frequently happens, irritating matter of any kind have been inoculated along with the syphilitic poison, the course of events will vary according to circumstances. Thus, if it be mixed with ordinary pus, irritation will begin at once at the site of inoculation. Again, if the pus of the local chancre have also been absorbed (a very common occurrence), the period of incubation will be occupied by the course of the suppurating sore, which may or may not have healed at the time the change peculiar to syphilis occurs. If the sore be still present, induration will develop, and the lesion will for a time assume the characters of both varieties of sore; but if it have healed, the cicatrix will harden and eventually assume more or less closely the appearance of one or other of the varieties of initial lesion which have just been mentioned.

The progress of the initial lesion is usually slow. The duration varies from two or three weeks to several months, according to its size, and the influence of treatment. It sometimes breaks out again after cicatrisation; induration may also reappear without fresh contagion. If the sore, from irritation of any kind, be made to suppurate, the secretion may become inoculable on the bearer. When the chancrous and syphilitic poisons have both been inoculated, the resulting lesion has been termed by Rollet a 'mixed chancre.'

Glandular Enlargement.—On whatever part of the body the initial lesion may be situated, the nearest lymphatic gland or glands become perceptibly enlarged in from seven to fourteen days after its appearance. The whole group is usually affected, but the gland most directly connected with the point of contagion enlarges first, and often attains a greater size than the others. Each gland can be felt as a separate distinct indolent swelling, usually about the size of a marble, the cellular tissue and skin remaining free. At this time the enlargement commonly remains limited to the nearest group, but later is sometimes general. Suppuration of the glands probably never occurs unless there be some source of irritation in addition to the syphilitic poison; or the patient be scrofulous, or over-exert or injure himself, or be in bad health from some other cause. Even when suppuration does occur, the abscess is always of a simple nature, and the matter is not inoculable on the bearer unless the local chancre be present as well, and direct absorption of chancrous pus take place (*see* Bubo). Besides the glands, the *lymphatic vessels* leading to them—those of the penis, for example—are frequently enlarged also, and can be felt as hard cords, freely movable beneath the skin.

Secondary Syphilis.—After the development of the initial manifestation, with its accompanying adenopathy, another interval occurs before further signs appear. This period is sometimes called the 'second incubation,' to distinguish it from that which intervenes between contagion and the appearance of the initial lesion. This second period of quiescence, counting from the appearance of the initial lesion to the appearance of the general eruption, is usually, unless prolonged by treatment, about six weeks. Thus as a general rule it may be stated that the exanthem appears from sixty to seventy days after contagion; from forty to fifty after the initial lesion; and from thirty to forty after enlargement of the proximate lymphatic glands.

During the earlier part of this period the patient commonly does not feel ill, but towards its close, and shortly before the appearance of the exanthem, some patients, especially women, if they be not already under the influence of mercury, develop certain symptoms of constitutional derangement which have received the name of *prodromata*. Thus the patient may become pale and anæmic, and may suffer from shortness of breath and lassitude. In addition, headache, loss of appetite, malaise, pains in the limbs and back, and sometimes rise of temperature, and other symptoms known under the name of 'syphilitic fever' are present. During this period also, as was first pointed out by Ricord and Grassi, whose conclusions have since been confirmed by Wilbouchewitch, Keyes, and others, the proportion of red blood-cells is diminished. The prodromata are usually mild in degree, but occasionally they are intense. Thus, headache may be agonizing, and in rare instances the amount of constitutional disturbance is so great that the onset of one of the acute specific fevers may be suspected.

Cutaneous system.—At the end of this second interval of quiescence then, and having been preceded or not by some of the symptoms just mentioned, the first general eruption appears. This, in the vast majority of cases, takes the form of roseola, consisting of numerous rosy red spots, varying in size from a hemp-seed to a shilling, fading on pressure at first, but afterwards becoming dull red or brownish, and finally disappearing altogether, sometimes with slight desquamation of the cuticle. The spots usually appear first about the flanks, chest, and abdomen. The extent and duration of roseola vary much in different persons. It may be limited to a few faint spots on the anterior surface of the trunk, or the whole body may be covered with the rash, in which case it often greatly resembles that of measles. Roseola may appear suddenly and disappear quickly, or it may last for several weeks and indeed occasionally for months, if untreated. It sometimes relapses, but in that case is never general, being usually limited to a few blotches on the forehead, trunk, or limbs.

As the macular eruption fades, papules not uncommonly appear, so that a maculo-papular eruption is often seen in early syphilis. The papules are raised, bright red at first, but soon changing to the so-called 'coppery' hue, which, however, is much more like that of raw ham. Finally, the cuticle separates in scales, leaving a characteristic silvery border or 'collarette' round the base of the papule. The papules are very liable to relapse, and the oftener they re-appear the more scaly they become. When they fade a brown stain is left, which gradually disappears without leaving any scar. At this time also crusts are frequently present on the scalp among the hair, which itself becomes dry and withered, and at a later period very often falls out either generally or in patches. Besides the scalp the eyebrows, eyelids, axillæ, and indeed all the hairy regions of the body, may suffer. The nails also are liable to be attacked in several ways. *See* Nails, Diseases of.

Though the macular and papular syphilides are by far the most frequent forms of early rash, vesicular, pustular, and ulcerating eruptions sometimes appear during the secondary stage, the two latter being most common in patients of bad constitution.

The earlier eruptions are usually superficial, and widely spread. The colour is at first bright red, but afterwards ham-red. Except in the case of the earliest rash, the papule forms the base of the eruption. Irritation and itching are usually absent. The eruption has certain favourite seats, namely, the trunk, the border of the hairy scalp, and the flexor surface of the limbs, including the palms and soles. Several forms of eruption are often present at the same time; most commonly maculæ and papules, but sometimes papules and vesicles, or pustules. They all tend to disappear spontaneously, and, except the pustular form, without leaving any scar.

Mucous membranes.—Besides the affections of the skin, lesions of the mucous membrane, particularly that of the mouth and throat, are nearly always present during the secondary stage. Erythema, excoriations, or shallow ulcers are very common about the fauces and tonsils, as well as on the buccal surface and tongue, during the early portion of this stage; and the nasal and laryngeal mucous membrane is also liable to be similarly affected. Equally common, though usually somewhat later, are mucous patches or tubercles (condylomata). They are merely the papules of the general eruption altered by moisture, and are most common on the mucous surfaces and in localities where skin and mucous membrane join, for instance, on the genital organs, at the angles of the mouth, and round the anus; but in dirty people they may form between the toes, about the umbilicus, and even behind the ears.

These affections of the skin and mucous surfaces are often accompanied by more or less deterioration of the general health, with pallor, lassitude, and considerable loss of weight. Pains in the muscles, bones, or joints (osteocopic pains) and sometimes periosteal swellings or synovial effusions also occur; as well as more or less general enlargement of remote lymphatic glands, particularly those of the neck and beneath the jaw; but the axillary, epitrochlear, and indeed all the glands within reach, may be enlarged. *Iritis* is also liable to come on about this time, and later, *choroiditis*. Sometimes, but more rarely, affections of the *auditory apparatus* are present.

The number, extent, and severity of the secondary manifestations vary greatly in different persons. In some cases roseola, and slight redness and excoriation of the throat, are the only signs that appear. In other instances roseola is succeeded by papular and scaly syphilides, and by obstinately recurring lesions of the mouth, throat, genital organs, or other parts of the body.

After the lapse of a period which varies usually from six to eighteen months, the secondary stage comes to an end, and in many cases the disease troubles the patient no longer. But supposing this not to be the case, there may be an interval of months or years during which no symptoms appear. Sometimes, however, symptoms continue to develop from time to time, which partake of the characters of both the secondary and tertiary stages, and which gradually merge into the latter without any strict line of demarcation between the two. Examples of these intermediate signs are thickened scaly patches on the skin, which often take a circular form, and sometimes ulcerate; obstinate eruptions of the soles and palms (the so-called plantar and palmar 'psoriasis'); ulcers of the tongue, gradually becoming deeper, and with thickened edges; periosteal swellings; orchitis; and affections of the choroid and retina.

Tertiary Syphilis.—While the secondary stage of syphilis is mainly characterised by the occurrence of superficial lesions, more or less widely spread over the surface, and tending to spontaneous disappearance; the main features of tertiary affections, on the other hand, are that they usually attack only a limited area, that they have a marked tendency to extend deeply and to cause destruction of tissue, with consequent contraction and scarring, and that they do not tend to spontaneous recovery.

The chief lesions usually classed as tertiary are severe forms of eruption, such as rupia, and deep ulcers of the skin and mucous membrane; and diffused infiltration or gummata of the subcutaneous and submucous cellular tissue, muscle, bone and periosteum, testes, brain and spinal cord, blood-vessels and the internal viscera, of which the liver is most frequently attacked. The tertiary period, also, is often attended by severe cachexia, with a peculiar earthy pallor of the skin.

The syphilitic new growth may develop in a diffused or in a circumscribed form; but in either case, unless checked by treatment, degeneration is usually rapid, leading to obstinate ulceration when the superficial structures are attacked, and to the production of tough contractile fibrous tissue when the viscera are the seat of the new formation.

When the gummy growth develops in the skin or mucous membrane in a diffused form, it produces hard, flat plaques of varying extent. The skin after a time becomes purplish-red and adherent, and finally breaks down at several points; and an ulcer is left, which sometimes creeps over the surface (serpiginous ulceration), healing in the middle and extending at the margins, until a considerable amount of tissue is destroyed. When this diffused infiltration occurs in the pharynx, larynx, or rectum, the disease is very obstinate, unless actively treated at an early stage, and the ulceration and subsequent contraction may produce incurable and fatal stricture in any of those situations.

When the circumscribed form develops in the skin itself, it is known as a *syphilitic tubercle*, and when in the cellular tissue as a *gumma*. Gummata vary much in size. At first, they are small hard nodules, freely movable beneath the skin; but after a time they enlarge, soften, and become adherent to the discoloured integument, which finally gives way, exposing a mass of yellowish-white material, which is gradually cast off in the form of *débris*, and thin ill-formed pus. The cavity then heals by granulation, leaving a depressed scar.

The syphilitic affections of the other tissues, and of the various organs of the body, with their symptoms, will be found described along with the other diseases of the several parts. *See* BRAIN, Syphilitic Disease of; BONE, Diseases of; LIVER, Syphilitic Disease of; TESTES, Diseases of, &c.

Malignant Syphilis.—It has already been mentioned that the division of syphilis into a secondary and a tertiary stage is to a great extent artificial, and that it is often impossible to say under which title certain lesions ought to be classed. There are again cases, fortunately not common, to which the term malignant or galloping syphilis has been applied, in which the disease from the first pursues a rapid, destructive, and sometimes uncontrollable course. Skin-eruptions, which partake of the secondary stage in their wide-spread character, and of the tertiary in their tendency to ulcerate, appear early, even while the initial lesion is still present. Deep ulcers form also in the mucous membrane, and the gummy growth may develop in the internal organs, and cause death, or the patient may die worn out by exhaustion.

Inherited Syphilis.—Syphilis is a very frequent cause of *abortion*, which occurs most commonly about the fifth or sixth month. If the child be carried the full term, it may be born dead with or without signs of syphilis; most commonly, however, if the child be born alive it does not show any signs of the disease at birth.

In inherited syphilis the initial manifestation is of course absent, and the disease begins at the secondary stage. With this exception the symptoms of the inherited are in their main features similar to those of the acquired disease, allowance being made for the difference between the actively growing tissues of the child and the fully developed organs of the adult.

Supposing, then, the child to have been born alive, it usually shows no evidence of disease for a period ranging between two and six weeks after birth. It then, as a rule, gradually loses its healthy appearance, begins to snuffle, becomes fretful, and loses flesh rapidly. The skin assumes a dull dirty colour, and though loose, dry, and wrinkled, is very brittle and easily breaks round the mouth and nose into chaps and fissures, the scars of which often form a very characteristic sign in after-life if the child survive. Macular, papular, vesicular, or pustular rashes, resembling those seen in the adult, also appear, and mucous patches are nearly always present about the orifices of the body. Pemphigus is seen only in severe cases; it appears very early, and is frequently fatal. The lesions of inherited syphilis are just as contagious as those of the acquired form of the disease.

A peculiar feature of inherited syphilis consists in the tendency to visceral disease as well as to bone-lesions at an early period, even during intra-uterine life. These changes have been particularly described by Wegner, Parrot, R. W. Taylor, Barlow, Lees, and others of late years. The bones most liable to be attacked are those of the cranial vault, and the long bones of the extremities, particularly the humerus and tibia. *See* BONE, Diseases of.

In later life, inherited syphilis may manifest itself by a number of symptoms which were formerly ascribed to scrofula. The forehead is prominent, and the bridge of the nose sunken. The growth is checked, the individual being stunted, weakly, ill-nourished, and of low vitality. The skin is greasy and earthy-looking, and perhaps scarred by previous ulceration. The permanent teeth, especially the central upper incisors, as was first pointed out by Mr. Hutchinson, are conical or 'pegged' and sometimes notched at the free border (*see* TEETH, Diseases of). The cornea is liable to a low form of inflammation (interstitial keratitis), leading to opacity and more or less impairment of vision; the iris and the deeper structures are also liable to be invaded; and deafness is sometimes present. The bones of the palate and nose may be diseased; and nodes may appear in various situations. The fingers and toes also, and, more rarely, the metacarpal and metatarsal bones may become enlarged (dactylitis). This affection is most common in early life; but it has been observed after puberty, as well as in connection with acquired syphilis. The soft palate and pharynx are often the seat of ulceration. The deeper tissues and the viscera are also liable to be attacked by processes similar to those which occur in the acquired disease, giving rise to a variety of symptoms, and sometimes leading to a fatal issue. Some authors, Mr. Hutchinson for example, believe that early life may be passed without symptoms, and that these later affections may constitute the first signs of inherited taint.

COURSE, DURATION, AND TERMINATIONS.—The course of syphilis varies very much, according to the individual, and according to the treatment adopted. In the majority of cases the disease runs its course in a year and a half or two years; but in certain rare cases it appears to end with the first exanthem; sometimes, perhaps, even earlier than this. When tertiary symptoms ensue, the commonest period for their appearance is probably about five years after contagion; but they may be delayed for ten or twenty years, or even longer. On the other hand, as has been already stated, the secondary may run on into the tertiary stage without any appreciable interval. When tertiary symptoms have once appeared, the duration of the disease is very uncertain, depending greatly on the habits and constitution of the patient, and on the effects of treatment. In some cases the patient continues to suffer throughout his life.

The most usual termination of acquired syphilis is recovery, and this in many cases without treatment, if the patient suffer only from the more superficial forms of disease. In syphilitic disease of the viscera the termination is frequently fatal.

In *inherited syphilis*, if the child be born with signs of syphilis, it usually dies; but when it remains healthy for some weeks after birth, the disease not unfrequently ends in recovery within a year, provided proper treatment be carried out. In later childhood, however, or in adolescence, further symptoms may develop; in which case the duration and termination will depend greatly upon their due recognition and appropriate treatment. When the disease is neglected, death is a frequent termination, especially among the ill-fed children of the poor.

The course and duration of syphilis are also influenced by many other causes, for example, climate, age, idiosyncrasy, pregnancy, and the hygienic surroundings of the patient.

The greater or less severity of the disease, or the stage at which it may have arrived in the person from whom it is contracted, does not appear to have any appreciable influence on the course of acquired syphilis, but the children of syphilitic parents usually suffer more or less severely, according as the infection of the parent is recent or of long standing.

COMPLICATIONS.—*Phagedæna* is an occasional complication of the initial lesion, but more frequently of the later ulcerating syphilides. The *local chancre* is a frequent complication, giving rise to what has been termed the 'mixed chancre.' *Erysipelas* sometimes attacks syphilitic patients, and is said to act beneficially in causing the disappearance of certain obstinate eruptions. This influence, however, is only seen in some chronic cases when the patient is otherwise in fair health. If erysipelas attack a cachectic person, with rapidly spreading lesions, the complication is a serious one and not infrequently proves fatal. In *scrofulous* patients syphilis is often very obstinate and severe, and the skin-affections in such persons are very prone to ulcerate. In *tuberculous* subjects syphilis is apt to rouse the constitutional disease into activity. The *gouty* diathesis also greatly influences the course of syphilis. The skin-eruptions in such cases often assume the scaly form, and resist treatment obstinately. *Bright's disease* is a very serious complication. Patients whose kidneys are diseased are very liable to suffer severely, both as regards the superficial tissues and the internal organs. *Alcoholism* is detrimental in two ways: first by its injurious influence on the system generally; secondly, by preventing the proper action of specific remedies.

DIAGNOSIS.—In the diagnosis of syphilis much will depend on the stage at which the disease has arrived when the patient comes under observation. Before the incubation-period has come to an end the diagnosis will of course be impossible; but when the initial manifestation, with its accompanying glandular enlargement, has appeared, there is usually no difficulty, unless some local complication be present. The initial sore is distinguished by its indurated base, the indolent superficial character of the ulceration, the thin serous discharge which is not inoculable on the patient himself, and the indolent painless enlargement of the nearest group of lymphatic glands. The points of difference between the initial lesion of syphilis and the local chancre are considered elsewhere. *See* VENEREAL SORE.

The diagnosis of the early exanthem does not, as a rule, present much difficulty, if the general characters of the eruption already mentioned be attended to. In some cases, however, where pyrexia and general constitutional disturbance precede the outbreak of the eruption, the symptoms may, for a short time, be mistaken for those of some other disease. Syphilitic roseola has been mistaken for measles, and a vesicular syphilide for small-pox. In doubtful cases, careful attention to the temperature, and the condition of the tongue, throat, and air-passages, together with the presence or absence of other signs of syphilis, will decide the question in a few days.

It is, however, at a later stage—perhaps many years after contagion, and long after the disappearance of outward signs of the disease—that the diagnosis presents most difficulty to the physician. For example, a patient comes with obscure symptoms, pointing to some lesion of the nervous centres, lungs, liver, or other viscus. In such cases the skin and mucous membrane, particularly that of the mouth and throat, should be carefully inspected, and the more superficial bony surfaces examined for irregularity or thickening. The eyes may afford important aid, by the detection of iritic adhesions or changes in the deeper structures. The presence of local paralyses, especially of the ocular muscles, is a valuable diagnostic sign. The absence of signs or characters distinctive of other diseases—cancer or tubercle, for example—is often also of value in doubtful cases.

When no conclusive information can be gained from any of these sources, the history becomes of the greatest importance. A venereal sore with lumps in the groins, and followed by a rash on the skin, sore throat or tongue, loss of hair, pains in the bones worse at night, and bad eyes, are some of the points that should be inquired into, and in women the occurrence of abortion or of still-births.

In investigating the history of a supposed syphilitic person, especially if the patient be a woman, it should be borne in mind that syphilis is not necessarily a venereal disease, and that the early manifestations in women may be so slight as to escape observation. Again, some may have forgotten that they have suffered from earlier signs, and others who do remember obstinately conceal the fact. However this may be, the practitioner frequently fails to elicit any history of earlier manifestations in those who suffer from visceral syphilis. Sometimes also, for various reasons, the history cannot be enquired into. If neither the symptoms present at the time, nor inspection of the patient's body, nor the method of exclusion, nor the history of the case, separately or combined, suffice to render the diagnosis clear, specific remedies should be administered, and their effect awaited before a positive opinion is given.

In the diagnosis of *inherited syphilis* at an early stage, the snuffling and coryza, which are often present, are characteristic. The radiating cracks around the mouth and nostrils are also valuable signs. Mucous patches again are nearly always present about the mouth, anus, or genital organs. Pemphigus of the palms or soles is nearly always syphilitic, but it is comparatively rare. Enlargement of the spleen is also a valuable corroborative sign. The bones of the skull, the humeri, and tibiæ should always be examined for osteophytes or epiphysial enlargement. It must be remembered also that a syphilitic child sometimes retains a healthy appearance throughout.

In later childhood the most valuable diagnostic signs are the low stature and puny development; the peculiar condition of the teeth; the dull, pasty complexion; radiating scars about the mouth; the sunken bridge of the nose; signs of present or past mischief in the cornea, iris, or choroid; nodes on the bones; unhealthy ulceration or its scars, especially of the face or throat. Here, again, if no conclusive signs be present, the history becomes most important, both of the patient himself and of his parents, and here also the diagnosis has occasionally to be postponed until anti-syphilitic remedies have been administered.

PROGNOSIS.—This, in the great majority of cases, is favourable, if the patient be otherwise in good health, of temperate habits, and especially if his disease be properly treated at an early period. The effect of other constitutional diseases has already been indicated among the complications of syphilis. Probably nothing tends more to prolong and aggravate the course of syphilis than habits of drinking. In persons given to alcohol, therefore, the prognosis should always be guarded.

A very interesting question, and one on which further information is much needed, is whether any trustworthy data as regards prognosis can be gained from the character of the early manifestations. Neither the length of incubation, nor the amount of induration or ulceration of the initial lesion, has been shown to afford any reliable evidence as regards prognosis. Early *general* glandular enlargement is often an unfavourable sign. Persons thus affected become anæmic, and consequently more liable to grave affections. As regards the early syphilides, it may be mentioned that the ordinary general macular and papular eruptions appear to be less common precursors of late visceral affections than early rashes that are ill-marked and scanty. Obstinate, frequently recurring, but superficial lesions of the skin and mucous membrane also are rarely associated with visceral disease. In connection with this may be mentioned the frequent failure of the practitioner to elicit any history of early symptoms in those who suffer at a later period from grave visceral affections, especially from syphilis of the nervous system.

In the cases of malignant or galloping syphilis, in which ulcerating and rapidly spreading lesions attack the skin and mucous membranes, and are associated with a tendency to phagedæna and great prostration at an early period after infection, the prognosis is grave; the patient may die worn out by the pain and profuse discharge of the superficial lesions, or of some acute affection. Again, if a patient be once proved to have visceral disease due to syphilis, his future is usually a precarious one, and as a rule the duration of life is greatly curtailed.

Finally, one of the most important points to be considered in prognosis is the way in which the patient has been treated. For, although we do not yet know any certain sign which proves that syphilis has come to an end, it may with much confidence be stated that if mercurial treatment have been begun at an early period of the disease, and continued a sufficient length of time, and if the patient be constitutionally robust and of temperate habits, the chances are greatly in favour of complete subsidence of the disease within two years after contagion.

There remains, however, a class of cases, fortunately rare, in which anti-syphilitic remedies cannot be borne—in which indeed they appear to be harmful. In such persons the prognosis is unfavourable, for unless the disease run a mild course, a fatal result is common within a few years, either directly from syphilis, or indirectly from some intercurrent affection.

Much of what has been said as to the prognosis of acquired syphilis applies also to the inherited form of the disease. A child in whom symptoms do not appear until several weeks after birth, who is well cared for, properly fed, and who receives proper medical treatment, will probably recover; one who is ill-fed and neglected will most probably die. Indeed, among the children of the poor, syphilis is one of the most fatal diseases of infantile life.

TREATMENT.—1. **Preventive Treatment.**—The measures adopted by Government for preventing the spread of venereal diseases are noticed elsewhere. *See* PUBLIC HEALTH.

Among individuals the strict daily observance of cleanliness, too often neglected by both sexes, constitutes the best protection against disease. Certain mechanical contrivances are sometimes effective in preventing contagion, but they are untrustworthy. The free use of soap and water immediately after intercourse is probably as effectual as any other application.

Every person who contracts syphilis should be warned of the danger of communicating it to others. Sexual intercourse should always be prohibited while the disease remains active. This direction should never be omitted, as many patients are unaware that they are liable to communicate the disease after the initial manifestation has healed.

The contagious nature of the lesions of the mouth and throat should also be pointed out, and the consequent risk of contagion by kissing, or by the use of drinking-vessels, towels, or other articles in common with other persons.

The question of *marriage* in relation to syphilis is one of great importance, and it is the obvious duty of the physician to prevent the contamination of a healthy spouse, or the procreation of syphilitic children, whenever it is in his power to do so. No person who shows obvious signs of syphilis should be permitted to marry, however long a time may have elapsed since contagion; for although communication of the disease is rare after several years have gone by, it may take place after ten years, or even longer in neglected cases. It has already been stated that syphilis usually ceases to be active within two years after contagion; but this is not always so. Hence, after the last symptoms have disappeared, there should be an interval of at least a year before marriage takes place. Consequently, the shortest period between contagion and marriage should be three years. If the treatment during the early stages have not been systematic and prolonged, it will be prudent to subject the candidate for marriage to an assiduous course of mercury for at least three months, and after this he should be kept under observation for a year before he is allowed to marry. During this period a course of bathing in warm sulphur springs is sometimes useful; for if the poison be still active, the stimulus of the sulphur may hasten the development of the symptoms. This test, however, is by no means reliable.

The spread of syphilis from children to wet nurses, and *vice versâ*, is not so common in this country as abroad; but the physician should never allow a syphilitic child to be entrusted to a healthy wet nurse, nor a syphilitic nurse to suckle a healthy child.

2. **Therapeutic Treatment.**—The treatment of syphilis may be divided into (*a*) *general*; (*b*) *special*; and (*c*) *local treatment*.

(*a*) *General treatment.* — Syphilis is essentially a debilitating disease, hence it is most important that the general health of the patient should be supported by nourishing diet, good air, warm clothing, extreme moderation as regards alcoholic liquors, cleanliness, cheerful society, and moderate exercise in the open air. In nearly all cases the patient should follow his usual employment, in order that his mind may be diverted from dwelling on the slow progress of his cure. The skin should be stimulated to act freely by the frequent use of soap and water, and an occasional Turkish bath if thought desirable. Flannel should be worn next the skin, and sudden chills avoided as much as possible. Smoking in moderation may be allowed, as long as the mouth and throat remain free; but when syphilitic lesions are present, it should always be discontinued. Regular action of the bowels is also important. Exercise, short of fatigue, should be taken daily, unless the weather is very bad.

(*b*) *Special treatment.*—Besides attention to the general health of the patient on ordinary principles, the administration of certain drugs which are known to have special influence over syphilis should never be omitted, however mild the earlier manifestations of the disease may be. For although syphilis tends in most cases to subside spontaneously, it does not do so in all; and in the present state of our knowledge we have no certain means of distinguishing at the onset the cases which will get well, from those in which tertiary symptoms will follow. There is also much evidence to show that when proper and sufficient treatment has been carried out in the earlier period, the danger of later manifestations is much less than in cases that have been untreated, or treated only by ordinary means. Again, in many of the gravest cases of visceral syphilis there is an absence of any history of early signs, showing that they must have been so slight as to have been overlooked, and consequently untreated.

The two special drugs now almost exclusively used in the treatment of syphilis are *mercury* and *iodine*. Of these the former only can be looked on as a real and permanent remedy. Iodine is of the greatest value in dispersing the later manifestations of syphilis, and is also useful in many cases at an earlier period, but its effects are not lasting, and therefore the iodides cannot be trusted to alone.

Much of the prejudice against the use of *mercury* has arisen from the fact that in former times its administration was carried to a poisonous extent. It is now known that salivation is hardly ever necessary, and that if the drug be properly administered in small doses, it acts as a tonic, syphilitic patients rapidly improving in health and gaining weight under its use.

As soon as induration at the site of contagion, and multiple indolent enlargement of the proximate lymphatic glands, make the diagnosis of syphilis certain, mercury should be given. For all the general symptoms of the secondary stage, also, mercury is appropriate. And in the later stages it should be used in conjunction with iodine, or to complete the cure after the symptoms have been dissipated by iodine, or in cases where the iodides fail to relieve. In fact, there is no stage of the disease at which mercury may not be administered with advantage in many cases. It may be given to almost all persons when its use is indicated, but its effect must be carefully watched if the patient be in very feeble health, or the subject of disease of the kidneys.

Before a mercurial course is begun the mouth should, as far as possible, be put into a healthy condition. Unsound teeth should be stopped or removed, and tartar got rid of. If the gums are spongy, an alum mouth-wash should be used frequently.

Mercury should be given more or less continuously for at least a year after contagion. If symptoms be present at the end of that time, treatment should be continued for at least three months after their disappearance. During this period it will of course be necessary to omit the mercury from time to time, or to vary the form of the drug, according to the peculiar circumstances of each case.

In small doses mercury is a tonic, and the aim should be to limit its action as much as possible to the tonic effect. When taken in syphilis the patient usually improves rapidly in health. If a rash be present it soon begins to fade, and ulcerated surfaces begin to heal. All the useful effects of the drug are usually attained when only the slightest effect is produced on the gums.

Mercury may be introduced into the system in various ways—by the stomach, rectum, vagina, skin, or subcutaneous cellular tissue, but its action is essentially the same by whatever channel it is administered.

In the majority of cases mercury may be most conveniently given internally in pills, or in a mixture; but it is sometimes used in the form of suppository. This, however, frequently gives rise to irritation. In early syphilis blue pill, or grey powder, usually fulfils all the requirements of the case. If no urgent symptoms be present, 1 or $1\frac{1}{2}$ grain of either of these preparations may be given, with a little extract of gentian, three or four times a day, at or immediately after meals. Quinine or reduced iron may be added, if thought desirable. In such small doses mercury rarely disagrees, and opium is unnecessary. If, however, a rapid effect be desired—in iritis, for example—2 or 3 grains of blue pill, with $\frac{1}{4}$ or $\frac{1}{3}$ grain of opium, may be given three or four times a day until the requisite effect is produced, after which the drug may be given less frequently, or be reduced in quantity. If the milder degrees of salivation be inadvertently set up, the mercury should be discontinued for a few days, a purge administered, and the mouth washed out frequently with an alum or chlorate of potash gargle. *See* SALIVATION.

The green iodide of mercury is more liable to decomposition, and to cause irritation than the forms just mentioned. If preferred, it may be given in doses of $\frac{1}{4}$ to 1 grain, with a little opium, twice or thrice a day.

The perchloride is mostly given in the later and more chronic forms of syphilis, when only a mild action is required. It may be prescribed in doses of $\frac{1}{16}$ to $\frac{1}{8}$ grain, either in a pill with sugar of milk, or in a mixture with iodide of potassium or with tincture of iron, according to circumstances.

When other preparations disagree, the bicyanide may be given. The red iodide is also often useful, especially in cases of relapsing scaly syphilides.

A preparation of mercury with sarsaparilla and aromatics, known as *Zittmann's decoction*, is sometimes useful in tertiary syphilis.

Subcutaneous injection of mercury is very effective and speedy in action; but it is painful, and requires daily medical attendance. Hence it is only to be recommended when other means fail, or in urgent cases. The solution known as Ragazzoni's (containing the red iodide) is one of the most useful preparations.

Inunction is also very effective, but it is dirty and troublesome to the patient; hence he often neglects to carry it out properly. It may be employed whenever mercury is indicated, 20 to 60 grains of mercurial ointment being rubbed in every night, or every other night, as required.

The *mercurial vapour bath* is very beneficial in certain cases, especially those of wide-spread rash. From 20 to 40 grains of calomel is the usual quantity for each bath.

The *iodides* are principally used in the treatment of the lesions usually called tertiary. In the later stage of the secondary period, and in cases where the lesions partake of the characters of both stages, the iodides may often be advantageously combined with mercury.

In all cases where the symptoms have been controlled by iodine, mercury should be given to complete the cure.

Iodide of potassium is the salt most frequently used; but the iodides of sodium and of ammonium are also employed, and may be used if the former disagree. The action of all is very similar, but the sodium appears to be less depressing than potassium, while the ammonium salt is stimulating. The dose of the iodides varies from 2 or 3 to 100 grains or even more. It is best to begin with 3 or 4 grains, with a little ammonia, three times a day, and to increase the dose if necessary. In urgent cases of visceral disease, and particularly in syphilitic affections of the nervous system, 20 grains may be given at first, and the dose rapidly increased to an almost unlimited extent until some effect is produced. In such cases, also, it will often be prudent to carry out inunction, or the subcutaneous injection of mercury, at the same time. The iodides should be given in a large quantity of water; and any of the bitter infusions, or tartarated iron, may be added when their use is indicated.

Iodoform is occasionally given internally in the later stages of syphilis; but it frequently causes so much gastric and intestinal irritation that it cannot be borne. The dose is about a grain, in the form of pill.

The *bromides of potassium and ammonium* are serviceable when the patient has become insensible to iodine, and in certain cases of affection of the nervous system. They may be given alone, or with iodide of potassium.

Besides the foregoing remedies many others, especially tonics and sedatives, may be required in the treatment of syphilis. Iron, for example, is frequently beneficial, either in conjunction with specifics or with quinine, or in the form of the iodide. Cod-liver oil also is very valuable in many cases. Sarsaparilla is sometimes beneficial in enabling the patient to bear large doses of iodide. It is also often useful during or after a prolonged course of mercury. Mineral acids and vegetable bitters are often of service during the intervals of specific treatment. Opium is of great value in many of the affections produced

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by syphilis—phagedæna and periostitis, for example.

Certain bathing resorts which possess *sulphur springs*—Aix-la Chapelle, for example—have become noted for the cure of syphilis; and there can be no doubt that great benefit is often derived from the course of treatment pursued at such places. The good results, however, appear to be due more to a combination of specific remedies and diaphoresis, with strict attention to diet and general hygiene, than to any special virtues of the waters themselves.

When syphilis is complicated with scrofula, gout, rheumatism, &c., the appropriate remedies should be given with those proper for syphilis, or temporarily substituted for them according to circumstances.

(*c*) *Local treatment.*—The initial lesion usually requires only cleanliness, and the application of wet lint. If it be indolent, black wash, or a lotion of sulphate of zinc, or other mild astringent, may be applied. If the sore suppurate, either through neglect or from the presence of the virus of the local chancre as well, the surface should be cleaned, dried, and dressed with finely-powdered iodoform. *Phagedæna* must be treated by immersion, caustics, or the actual cautery, while the general health receives attention (*see* VENEREAL SORE). If the lymphatic glands become tender or inflamed, warm fomentations should be applied, and the patient kept lying down. If abscess form, it must be treated according to the directions given in the article on BUBO.

The early *syphilides* rarely require local treatment. *Erosions* or *fissures* may be dressed with an ointment of calomel and vaseline, or with iodoform. Indolent or unhealthy sores, especially in weakly persons, are often benefited by a lotion of tartarated iron. In the scaly affections of the palms and soles, an ointment of ammoniated mercury, oxide of zinc, and vaseline may be well rubbed in at bedtime, and gloves worn during the night. Mercurial plaster also is often a very useful application. *Mucous patches* should be cleansed and dried several times daily, powdered with calomel or oxide of zinc, and covered with dry lint. If they become very large and prominent, solid nitrate of silver or acid nitrate of mercury may be applied. Cracks and ulcers about the *nails* should be dressed with mercurial plaster, or with red oxide of mercury ointment.

Ulcers or fissures, or mucous patches of the lips, tongue, mouth, and throat should be touched every other day with nitrate of silver, or sulphate of copper, and an alum or borax wash used frequently, especially after eating. For the later ulcers soothing applications should be used, but internal treatment is of the greatest importance in such cases.

Ulcers and chinks about the nostrils should be kept moist with red oxide of mercury and vaseline ointment. When *necrosis* of the nasal or palatal bones has occurred, a lotion of permanganate of potash or chlorinated soda should be used with the nasal douche, and the fragments removed as soon as they become loose. The early affections of the *larynx* usually disappear without local treatment. In the later affections tracheotomy may be necessary.

Ulcers of the anus require careful cleansing and the application of calomel or iodoform ointment. For *ulceration within the rectum* iodoform suppositories and astringent injections should be used. In *stricture of the rectum* careful dilatation by means of bougies should be tried. In extreme cases rectotomy, or even colotomy, may have to be performed.

As regards *the bones*, the pain produced by early nodes is relieved by painting with a solution of iodine, and by blisters. Nodes should never be opened. If necrosis take place, the dead bone should be removed as soon as it becomes loose.

In *iritis*, besides the prompt administration of mercury, a solution of sulphate of atropine (4 grains to the ounce) should be dropped into the eye every two hours till the pupil is well dilated. Afterwards a weaker solution may be used to keep up the effect. In *interstitial keratitis* also atropine should be used. Iridectomy is occasionally necessary. In *choroiditis* and *retinitis* repeated leeching is sometimes useful when there is much pain, but constitutional treatment is most important.

In syphilitic *orchitis* a suspensory bandage should be worn, but other local treatment is usually unnecessary, unless the gumma break down and fungous protrusion occur, in which case support should be given by strapping. In *syphilitic affections of the uterus* frequent injections of borax or sulphate of zinc are required, and in case of ulceration, iodoform or caustics are sometimes necessary.

Treatment of Inherited Syphilis.—*Preventive treatment.*—If a syphilitic husband have a relapse before his wife becomes pregnant, he ought at once to desist from sexual intercourse—indeed from contact of every kind, and undergo treatment. The wife also should be watched, that treatment may be begun as early as possible, if she have contracted the disease. If the wife become pregnant while the husband shows signs of syphilis, both parents should be treated with mercury.

Treatment of the child.—Mercurial treatment should always be adopted as soon as symptoms appear. Grey powder may be given in one-grain doses twice a day. But a strip of flannel smeared with diluted mercurial ointment, and worn round the waist, is preferable. The ointment should be renewed every night, and the skin cleansed every third day. Syrup of the iodide of iron and cod-liver oil may also be given. Treatment should always be continued for at least six months; and, if symptoms be then present, until their disappearance, and for several months afterwards.

Iodide of potassium is most valuable in the later forms of disease. The rules for its employment are the same as in acquired syphilis, but the dose must of course be smaller.

The *local treatment* of the syphilitic affections of children is similar to that recommended for adults. When the nostrils are obstructed by inspissated mucus, they must be carefully cleansed with a camel's-hair brush, and the excoriations touched with red oxide of mercury ointment.

The *general management* and *diet* of syphilitic children are most important. Whenever the mother can suckle her child, she should always do so. If this be impossible, a syphilitic wet-nurse is the best substitute. If neither be available, ass's, goat's, or cow's milk must be given. Extreme cleanliness and fresh air are essential. As the child grows older, the method of feeding must be conducted on ordinary principles. Arthur Cooper.

SYRINGOMYELIA (*σύριγξ*, a cavity, and *μυελὸς*, the marrow).—This is a name under which Ollivier grouped numerous cases in which cavities of different kinds were met with within the substance of the spinal cord. For a reference to the nature of these cases, *see* Spinal Cord, Special Diseases of, No. 21, Malformations.

SYSTOLIC.—Of or belonging to the systole or contraction of the heart, and usually associated with the cardiac impulse or sounds, or with murmurs. *See* Physical Examination.

T

TABES (*tabes*, a consumption).—A term formerly employed to denote consumption or wasting of the body.

TABES DORSALIS (*tabes*, a consumption, and *dorsalis*, spinal).—A name formerly applied to a condition of debility caused by excessive sexual indulgence, and characterised especially by failure of nervous power. The term is now used as synonymous with locomotor ataxy. *See* Locomotor Ataxy.

TABES MESENTERICA (*tabes*, a consumption, and *mesenterica*, mesenteric).—A wasting disease caused by tubercular or scrofulous affection of the mesenteric glands. *See* Mesenteric Glands, Diseases of.

TACHE (French).—A spot or patch. The word is most frequently used in connection with morbid conditions of the skin. *Tache cérébrale* has been specially applied by Trousseau to a patch or streak of hyperæmia, produced by irritating the skin in certain cases of cerebral meningitis. *See* Meninges, Cerebral, Diseases of.

TÆNIA.—Synon.: Tape-worm.—A genus of cestode entozoa, characterised by the possession of a head furnished with four sucking disks; also by having reproductive papillæ either uniserially or biserially disposed along the lateral margins of the segments of the body. Strictly speaking, a tapeworm is a colony of incomplete individuals (called *zooids* or *proglottides*) arranged in single file, the uppermost zooid being transformed into an organ of anchorage, which is popularly called the *head* of the parasite. Several species of this genus occur in man, the two most common forms being the beef-tapeworm (*T. mediocanellata*) and the pork-tapeworm (*T. solium*). A third has been indicated by the writer as the mutton-tapeworm (*T. tenella*), but at present it is only imperfectly known. *See* Hydatids; and Tape-worms.

T. S. Cobbold.

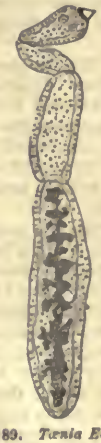

Fig. 89. *Tænia Echinococcus.* Origin

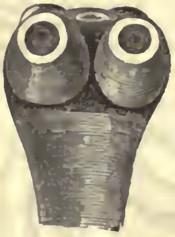

Fig. 90.
Unarmed Head of *Tænia mediocanellata*; × 10 diam. After G. Fritsch.

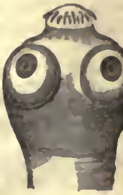

Fig. 91.
Armed Head of *Tænia solium*; × 10 diam. After G. Fritsch.

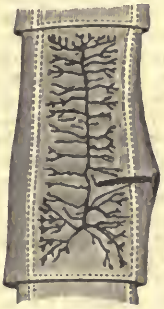

Fig. 92.
Proglottis of *Tænia mediocanellata*; × 1½ diam. After G. Fritsch.

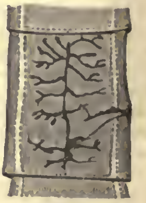

Fig. 93.
Proglottis of *Tænia solium*; × 1½ diam. After G. Fritsch.

TANGIERS. *See* Morocco.

TAPE-WORMS.—Synon.: Fr. *Tænia*; *Tänia*; Ger. *Bandwurm.*—Under the heading *Tænia* the zoological characters of these parasites are given. Besides *Tænia mediocanellata* and *T. solium* the human body may be attacked by several other species, some of which, however, are only imperfectly known (*Tænia lophosoma, T. tenella*

T. elliptica, *T. flavopuncta*, *T. marginata*, *T. nana*, *Bothriocephalus latus*, *B. cordatus*, and *B. cristatus*). Practically, in treating cases it matters little which form we have to deal with, except in so far as the complete expulsion of the worm is rendered difficult or otherwise. This varying result depends in a great measure upon the character of the species. Those tape-worms which are armed with hooks, in addition to powerful suckers, are more difficult to dislodge from the intestines than are those species which are unarmed. The prognosis is therefore always more favourable in cases of the beef-tapeworm and the ordinary pit-headed worm, than in cases of the pork-tapeworm. In so far, however, as the mere selection of drugs is concerned, the remedies that suffice to expel the one kind are equally suitable, as poisons, for the expulsion of the other. Unquestionably, the ability to recognise the various species of tape-worm liable to be encountered in practice is a great help in the general management of cases; and also, more particularly, in forming an opinion as to the correct mode of dealing with any particular case. Such means of diagnosis, however, can only be thoroughly acquired by careful study of museum specimens, aided by the descriptions given in standard works on helminthology. Whilst it is a comparatively easy matter to recognise the *head* of any form of tape-worm, and thus to pronounce upon the nature of the species, the recognition of the true source and character of the entozoon is not so readily made, by inspection of fragments of the so-called body of the parasite. All kinds of mistakes are continually occurring in practice from a want of exact knowledge of this sort. The writer has had brought to him many foreign bodies that were erroneously regarded as links (joints, segments, cucurbitini, or proglottides) of tape-worms; and he has also known instances where true fragments of the worm were mistaken for ascarides. The result of such errors has been that the supposed victims had been undergoing treatment, more or less vigorous and prolonged, when there never had been any tape-worm present. No doubt, partly from the distaste for the subject of parasites generally, partly from the circumstance that the management of cases has long been relegated to quacks and other unqualified and ignorant persons, and partly also because some have taught that the diagnosis and treatment of tape-worm is a very commonplace and simple matter —too simple, in fact, to need special lectures at our medical schools—partly, we say, from these and other minor considerations, the subject has never received that measure of attention which it demands.

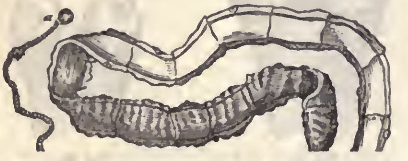

FIG. 94. Head (*a*); and several segments of *Tænia mediocanellata*; reduced from the natural size. After Owen.

SYMPTOMS.—The symptoms occasioned by the presence of tape-worm are extremely variable, both in character and degree. The bearer may be little inconvenienced, or he may suffer severely. He may experience only feelings of weariness and lassitude, which, in some cases, are set down to other causes than tape-worm. In young persons not even these feeble indications may be present. In grown persons, however, sooner or later a general loss of health commences; the processes of digestion are interfered with; and the patient becomes anæmic, irritable, and restless at night. There is headache, accompanied by vertigo. The sight and hearing become affected; noises in the head, local irritation at the nose and anus, dyspepsia, and obscure pains about the limbs and body, present themselves in a greater or less degree. The patient often feels faint, and finds it necessary to obtain artificial support. In the worst cases various sympathetic phenomena make their appearance, but in the female they are not so grave as in the male, commonly developing as hysteria and chorea. Occasionally, however, in both sexes, there may be paralysis, with or without epileptiform seizures. Cases of insanity from tape-worm are reported by Winslow, W. Wood, Ryan, David Ferrus, Féréol, and many others. In one instance mania of eight days' duration was cured by expulsion of the worm. Cases of convulsions, often accompanied by peculiar symptoms, are not infrequent, but they usually do well. Affections of the eye, such as amaurosis and squint, have also yielded to appropriate vermifuges (Burgiss; Streatfeild). In Dr. Davaine's invaluable treatise a variety of singular nervous cases are given. Amongst these we may particularise Leroux's instance of spasmodic phenomena in a girl of nineteen; Legendre's case of strange convulsive phenomena in a man twenty-seven years of age; Quettier's instance of periodic trembling; and especially Billard's case of voracity, accompanied by maniacal symptoms. Happily in all these severe cases the evacuation of the worm was followed by restoration to health. This is the usual result; but in those instances where the worm redevelops itself the symptoms are apt to return. It does not necessarily follow, however, that the identical sympathetic phenomena will again make their appearance.

PROGNOSIS.—On the whole, the prognosis is favourable. In a small percentage of cases tape-worm proves dangerous to the victims. Some infested persons, rather than let another know the fact, will privately endure any amount of inconvenience, such as daily arises from the frequent passage of proglottides. Such morbid sensitiveness is uncalled for and unwise.

TREATMENT.—As regards drugs the resources are ample. We have turpentine, kousso, kamala, panna, pumpkin-seeds, pomegranate root-bark, areca nut, and last, not least, male fern; not to mention some of the older favourite remedies, such as calomel, oxide of silver, tin, scammony, cowage, jalap, and a host of drastic and injurious purgatives. Speaking generally, it may be said that the right administration of any of the comparatively modern remedies is likely to be attended with success, at least as regards the expulsion of the body of the parasite. In the writer's judgment, based upon a lengthened experience, no remedy is equal to male fern, for he has found the ethereal extract of this root effective in cases where the employment of nearly all the other remedies had failed. On the other hand, Dr. Fock speaks of the infallible effects of pomegranate root bark (*De Lintworm en het middel om hem uit te drijven*, Utrecht, 1873). In the country districts of England the favourite remedy is turpentine, but its employment is gradually giving way to that of male fern. Without doubt, the oil of turpentine is an excellent tæniafuge; yet its nauseous character (except in capsules), combined with the well-known fact that it not unfrequently produces strangury, besides other irregular effects, should render practitioners cautious in its employment. To a certain extent the use of the male fern oil or extract is open to objection on the score of its nauseous taste; but this disadvantage is more than counterbalanced by the smallness of the quantity required for a dose. In only one instance has the writer seen this drug *persistently* rejected by the stomach. To obviate this inconvenience a variety of extracts have been prepared by pharmaceutists. The writer has tried several of the vermifuge extracts, such as kousso, kamala, male fern, but finds none equal in power to the oil of male fern. M. Heckel has sought to ascertain the active part of pumpkin-seeds, and he found that it resides in the outer membrane surrounding the embryo (*Lancet*, 1875, vol. ii.). In two cases in which he administered this membrane the tapeworm was expelled entire. M. Heckel believes the active agent to be a resin, and he thinks that castor oil, which in the cases in question was given both before and after the remedy, acts favourably, not merely by its purgative properties, but also in virtue of its power of dissolving the resin.

Success in the result depends, not so much on the choice of the tæniafuge, as upon the mode of administering it, and of observing the results accurately. In nine out of ten cases it is taken for granted that all is right, if the patient has only stated that, after taking the medicine prescribed, he got rid of several yards of the worm. The writer has heard of an instance where the patient alleged that he passed a single tapeworm which measured 100 yards. Of course it is quite conceivable that a person may be the victim of half-a-dozen or more tape-worms at a time. Twelve full-grown tape-worms, each 25 feet in length, would collectively give an admeasurement of 100 yards; but the writer has never yet found proof of the occurrence of more than four perfect tæniæ in one and the same human bearer. Such an instance has been recorded by Mr. Welch in his admirable memoir on the anatomy of *T. mediocanellata* (*Quarterly Journal of Microscopic Science*, 1875). On several occasions the writer has had patients suffering from more than one tape-worm, and in one instance, where there were two, both *heads* were expelled at one and the same time. Küchenmeister refers to numerous alleged instances of the occurrence of several tape-worms in one host, quoting, amongst others, that by Madame Heller, who, it is said, encountered as many as forty in one patient. We take upon ourselves to say, that in most, if not in all, of these so-called multiple tape-worm cases, the various broken fragments of one or two large parasites have been reckoned as representing so many different worms. Not infrequently foreign bodies resembling segments of tape-worm are regarded as so many parasites, and the cases are treated accordingly. In the management of genuine cases it is most important that the *head* should be secured. This minute structure is very frequently detached separately from the body, and it is still more frequently left adhering to the mucous membrane of the small intestine, when the greater part of the body of the worm has been expelled. It rarely happens that either a nurse or a patient has any notion as to what the head of a tape-worm is like, and we fear that many practitioners are in the like case. For this want of knowledge there is really no excuse; nevertheless we have heard it laid to the charge of our clinical teachers that they have never afforded the necessary instructions on this subject. Be that as it may, the writer has for many years past insisted on a more thorough examination of the fæces following upon the administration of vermifuges. Only in exceptional instances does the head of the worm remain attached to the unbroken strobile or tape-worm-colony. In such cases a nurse, or the patient himself, may remove the head and bring it with the body to the practitioner. In the majority of cases the body of the worm breaks off at the base of the neck, but frequently also at the upper and narrower part, about an inch from the head, more or less. Occasionally the rupture takes place at the base of the head, leaving nothing but the expanded cephalic portion with its suckers (and crown of hooks, if it be an armed species) intact. The writer has recorded an instance in which only the suckers themselves were left after the expulsion of the entire body of the worm had been effected (*Tape-worms*, 3rd edition, case iv. p. 55). In regard to the employment of enemata, as recommended by Mosler, the writer is of opinion that the practice is altogether contra-indicated. If it were true that the once detached head were capable of re-anchoring itself in the lower bowel, as Mosler supposes may be the case, then possibly such injections might be employed with advantage. The notion that a tapeworm could re-develop in such a situation is quite at variance with all that we know respecting the growth and economy of human cestoids.

As regards prescribing, all that we deem it necessary here to say is that caution should be exercised as to the quality and quantity of the drugs administered, and also in respect of the length of time during which the worm-poisons may be given. The writer has witnessed serious results from the persistent use of turpentine and male fern, though the doses themselves were not excessive. He has witnessed toxic effects from one-drachm doses of the male fern extract, when given a few times in succession to adults. In young children half-drachm doses sometimes produce wandering and mental confusion. These unpleasant symptoms are of brief duration, provided the tæniafuges be stopped. In treating young persons with powerful anthelmintics the patients should always be carefully watched, and great care be exercised lest the treatment be injudiciously prolonged. So variable are the phenomena and experiences encountered, that it is not easy to lay down any precise rules which shall be applicable to all cases. In every instance the practitioner must be guided by the actual result of each day's successive treatment. If he obtain the head of the worm he need not hesitate to pronounce that his patient is cured, unless there be evidence that he has to deal with more than one parasite. This very essential point is not so easy of determination as might be supposed. If the bodies of two or three distinct parasites be broken up by the worm-poison and expelled, it requires very accurate knowledge of the sexually mature and immature proglottids respectively, in order that, by inspection, the practitioner may determine the point in question. All the portions must be carefully removed from the stool and laid end to end, according to the form in which they would present themselves during life. If this be accurately done, then, and then only, can it be said whether the patient has been the victim of one, two, three, or more tape-worms. In the correct management of such cases there is much trouble and labour to be overcome, to say nothing of the exercise of that scientific knowledge which a careful study of the structure and economy of these singular parasites involves. No two cases are exactly alike. In diagnosis, as well as in treatment, various questions present themselves, the correct solution of any one of which may be of importance to the patient. The writer has witnessed serious results from false diagnoses. In one of these maltreated cases the patient, a lady, had undergone six years of persistent drugging by vermifuges, when all this time she was not infested by tape-worm, neither had she at any time previously entertained the presence of any cestode parasite. *See* Tænia.

T. S. Cobbold.

TAPPING.—A popular synonym for paracentesis. *See* Paracentesis.

TARANTISM (*tarantula*, a ground spider). Synon.: Fr. *Tarentisme*; *Chorée épidémique*; Ger. *Tarantismus*.

Definition.—An epidemic dancing mania, prevalent in Italy in the sixteenth and seventeenth centuries, originating in fear of the bite of the tarantula, as a remedy for which the dance was adopted. A full account of it will be found in Hecker's *Epidemics of the Middle Ages*.

History.—The Italian dancing mania commenced in Apulia, in the latter part of the fifeenth century, contemporaneously with the St. Vitus's dance in Germany. The ground spider had long been held in dread, as causing, by its bite, symptoms of nervous and physical prostration, which might end in death, or lifelong lassitude. At this period the fear of the frequently recurring epidemics of the Black Death, eastern plague, and other diseases, caused widespread depression. The tarantula was dreaded throughout Italy, and a bite from an unknown source was a ready explanation of any symptoms of nervous prostration. The inspiriting influence of music and rhythmical motion was found to dispel, for a time, the depression, and the theory arose that by this means the poison of the spider was distributed over the body, and expelled through the skin. The nervous excitement of the remedy proved, however, a greater evil than the real or supposed disease. The induced emotion outran control. The dancing became frantic, and was continued until the dancers fell senseless from exhaustion, with the result of leaving them for a time free from the depression. The dancing mania spread by moral contagion, and large numbers of persons, young and old, male and female, became affected. The temporary relief gained by the dance led to the adoption of the remedy at intervals, which ultimately became yearly; and every summer the sufferers grew depressed in anticipation of the advent of the annual dance. Strange psychical conditions were induced by the emotional disturbance; other sensory impressions besides music gave pleasure, and certain colours, such as red, or the sight of the sea or even of clear water, exerted a strange fascination. The sexual passion became involved in the tumult of emotion, and the mental excitement occasionally ended in self-destruction. Of longer duration than the dancing epidemics of Northern Europe, tarantism was at its height in the seventeenth century, and gradually died out in the eighteenth, leaving only a designation for a lively dance as its harmless legacy.

W. R. Gowers.

TARASP, in Unterengadin, Switzerland.—Alkaline sulphated waters. *See* Mineral Waters.

TARTAR EMETIC, Poisoning by.—Synon.: Fr. *Empoissonement par l'Antimoine*; Ger. *Antimoniumvergiftung.*—Poisoning by tartar emetic, a soluble double tartrate of antimony and potassium, is not very common. The emetic properties of the salt generally ensure its speedy ejection from the stomach. Poisoning by the salt may be either (1) *acute*, from the ingestion of a large dose; or (2) *chronic*, the patient succumbing under the exhaustion consequent upon its prolonged administration.

1. **Acute poisoning.**—Shortly after taking a large dose of tartar emetic, the patient is seized with intense nausea and faintness, accompanied by depression of the force of the pulse, and increased perspiration. Violent vomiting and retching follow, with a burning pain and sense of constriction in the mouth, throat, and gullet. Vomiting affords no relief to the nausea and pain, and is repeated, the vomited matters becoming bilious, and ultimately perhaps blood-tinged. A metallic taste is felt in the mouth; the abdomen becomes painful and tender; and profuse diarrhœa sets in, the fæces often containing a considerable quantity of blood. The urine is at first increased in quantity; but later it may be scanty, blood-tinged, or suppressed. The circulation is throughout depressed; and the skin cold, clammy, and bathed in profuse perspiration. The muscular system is relaxed; but cramps of the extremities may torture the patient. In rare cases a pustular rash appears, like that produced by the external medicinal application of the drug. In some cases neither vomiting nor purging has occurred, the symptoms being simply those of intense prostration, with embar-

rassed respiration. In fatal cases death occurs within a few hours.

2. **Chronic poisoning.**—The administration of repeated small doses of tartar-emetic causes nausea, vomiting, purging, exhaustion, and debility, which not infrequently prove fatal. These symptoms are accompanied by depressed irregular circulation, profuse perspiration, and disturbances of respiration.

ANATOMICAL CHARACTERS.—These are somewhat variable, but on the whole are those of a metallic irritant poison. In most cases there is inflammation of the stomach and intestinal tract generally, not so patchy nor marked by such bright redness, as in arsenical poisoning. Not infrequently the stomach and small intestines escape, and the inflammation may be confined to the large bowel; even ulceration of the intestines may occur, accompanied by hæmorrhagic extravasations. Hypostatic congestion of the lungs is often prominent.

DIAGNOSIS.—Poisoning by tartar emetic may be diagnosed from other irritants, especially arsenic, by the greater and earlier depression, the profuse perspiration, greater irregularity of pulse, and the more irregular respiration. An analysis of the ejecta or of the urine is always advisable, and often indispensable to complete the diagnosis. In chronic cases an analysis of the urine is the only satisfactory mode of determining the nature of the illness, where tartar emetic is not known to have been administered as a medicine.

PROGNOSIS.—This must always be grave, so long as the ejecta contain considerable quantities of the poison. In acute cases the patient cannot be considered out of danger till not only the vomiting has ceased, but an obvious return of strength has set in for some time.

Fatal Dose.—Two grains have proved fatal to an adult. Much larger doses may, however, as a rule, be taken with impunity. The danger is much increased if the poison be taken in conjunction with some substance, such as opium, which deadens the susceptibilities of the stomach.

TREATMENT.—The stomach-pump is seldom necessary, vomiting being very profuse. The elimination of the poison may be hastened by free administration of diluents, and the stomach protected by mucilaginous drinks. The stomach should, however, be washed out by means of the syphon-tube. The most effective antidote is tannin, which forms an insoluble tannate of antimony. For this purpose tincture of cinchona, decoction of oak-bark, or strong infusions of tea or coffee, may be administered; or the stomach may be washed out with similar fluids, or with a solution of half a drachm of tannin. Not till after this has been done, or the stomach well and repeatedly cleansed by free vomiting, should opium be administered. The after treatment will depend upon the symptoms. The treatment of chronic cases consists in cessation of the administration of the poison; in the exhibition of ammonia, stimulants, and tonics; and in careful support of the strength. Nutrient and opiate enemata are of the greatest service.

THOMAS STEVENSON.

TASMANIA.—A warm, equable, sub-tropical climate. Mean temperature of Hobart Town, the capital, 54° Fah. Prevalent winds, N.E. and S.W. *See* AUSTRALASIA (in APPENDIX); and CLIMATE, Treatment of Disease by.

TASTE, Disorders of.—SYNON.: Fr. *Troubles du Goût*; Ger. *Störungen des Geschmackes.*

Disorders of taste have to be carefully distinguished from disturbance of olfactory impressions, on which all perception of flavour depends. They have also to be distinguished from disturbed appreciation of the sensations of taste—increased or diminished enjoyment of, or disgust at, sensations which are themselves normal.

1. **Increased sensitiveness of the nerves of taste.**—SYNON.: Gustatory hyperæsthesia; *Hypergeusia.*—This condition is evidenced by detection of a substance too minute in quantity to be perceived by normal taste, or by an abnormally intense impression when a given quantity of a substance is tasted. In excitable states of the nervous system, as in general malnutrition, substances in small quantities in the blood are tasted with great readiness; the bitterness of morphia injected beneath the skin may be at once noticed (Wernich), and for long after a bitter substance has been taken, whatever is tasted may seem bitter. Gustatory hyperæsthesia is often met with in hysterical persons, and sometimes in the insane. It is not usually a symptom of sufficient prominence to demand special treatment.

2. **Perverted sense of taste.**—SYNON.: Gustatory paræsthesia; *Parageusia.*—This is not uncommon in neurotic states. Substances excite a different taste from that to which they naturally give rise. A bitter flavour, for instance, is detected in a simple saline. This condition is commonly conjoined with altered appreciation of the taste which is recognised, so that substances commonly considered pleasant are disliked, and those are enjoyed which commonly excite disgust. It is seen in a slight degree in some toxæmic conditions, but more frequently in psychical disturbances. In hysteria it leads to various absurdities in diet.

3. **Subjective sensations of taste.**—These occur sometimes from disorders of the central nervous system, in hysteria, insanity, and occasionally in epileptoid states. The sensation is usually of an unpleasant description, and probably, from its character, is produced in the region supplied by the glosso-pharyngeal nerve.

Subjective sensations of taste occur also, very rarely, from irritation of the gustatory nerves. They have been produced experimentally by galvanising the chorda tympani, when exposed by disease of the internal ear, and have occurred in some cases of disease of the petrosal part of the facial nerve. Irritation of the nerves ending in the tongue by mechanical and electrical stimuli may also cause a sensation of taste. These subjective sensations have to be distinguished from abnormal sensations due to substances in the blood or to secretions of the mouth. The treatment of the symptom is that of its cause.

4. **Loss of the Sense of Taste.**—SYNON.: Gustatory anæsthesia; *Ageusia.*

ÆTIOLOGY.—Diminished sense of taste may

depend (*a*) On thickening or other changes in the mucous membrane of the mouth, rendering the nerve-endings less accessible to sapid solutions. (*b*) On local applications lessening the irritability of the nerve-endings. Hot or cold applications may temporarily destroy the sense of taste. Cool substances cannot be tasted so well as those which are warm. (*c*) On hysterical and other functional nervous disturbances. (*d*) On disease of the nerves which conduct the sensation. There is still much uncertainty as to the nerves concerned in this function. Perception of taste over the posterior, and perhaps also the middle third of the tongue, the soft palate, and the anterior pillars of the fauces, is believed to depend on the glosso-pharyngeal nerve, and to be lost when that nerve is paralysed. It is probable, however, that this is not the case in all persons. The writer has met with an instance of complete unilateral loss of taste on tongue and fauces, in which the fifth nerve was paralysed, and the glosso-pharyngeal was unaffected. Taste in the anterior third of the tongue depends on the gustatory or lingual branch of the fifth, and probably on the fibres it receives from the chorda tympani. Hence destruction of the lingual (section for neuralgia—Inzani), disease of the chorda tympani, and disease of the facial just above the origin of the chorda tympani, have all been followed by loss of taste in the front of the tongue. It is exceedingly common in facial paralysis from rheumatic inflammation of the nerve-trunk, no doubt from the mischief passing up the bony canal as far as the origin of the chorda tympani. Division of the facial nerve outside the skull has also caused loss of taste (Stich; Lotzbeck), and hence it is thought that some fibres from the tongue must reach the facial, by external junction. It is much more probable that migrating neuritis may have passed up the nerve, and have involved the chorda tympani, in these cases. But instances are on record in which no loss of taste has resulted from destruction of the chorda tympani, and hence it is assumed that some gustatory fibres pass from the lingual to the otic ganglion, and thence by the small superficial petrosal nerve, and the nerve of Jacobson, to the glosso-pharyngeal. In these cases it is possible that the fifth nerve may supply the gustatory fibres directly to the front of the tongue. Moreover, the glosso-pharyngeal fibres have been themselves traced by Rudinger to the fore part of the tongue, anastomosing with the twigs of the lingual, and Eulenberg suggests that in some cases they may maintain the function of the latter. As to the path of the gustatory fibres which the chorda tympani conveys to the facial nerve, there is much difference of opinion. Lussana believes that they continue with the facial and, as the 'intermediate part' of that nerve, pass to a nucleus near that of the glosso-pharyngeal. But since disease of the facial nerve within the skull does not, as a rule, cause loss of taste, most authorities consider that the fibres leave the facial nerve in the large superficial petrosal, and thus reach the spheno-palatine ganglion, and, according to Schiff, pass to the brain by the fifth nerve. This view is supported by the case just mentioned and by one recorded by Hirschberg, in which disease of the fifth within the skull caused loss of taste in the front of the tongue. In other cases of disease of the fifth there is no loss of taste (Lussana, Renzi, Althaus); but this is not decisive, since, as just observed, the extensive distribution and connection of the glosso-pharyngeal nerve may permit vicarious action. Moreover the position of the disease in the fifth nerve was, in many of the cases, uncertain. In some the symptoms may have been due to disease of the nucleus of the nerve, from which the gustatory fibres may be separate. Hermann suggests that more fibres may pass from the large and small superficial petrosal nerves, directly to the glosso-pharyngeal, than is commonly assumed; but the glosso-pharyngeal nerve has been paralysed without loss of taste in the anterior part of the tongue. It is highly probable that the difference of opinion regarding the course of the gustatory fibres is due to the circumstance that this path varies in different individuals.

SYMPTOMS.—Loss of taste involves the perception of bitter, sweet, and saline characters, to which should, perhaps, be added the metallic quality. These may be lost in varying degrees. Each part of the tongue possesses the power of recognising every quality, but not in the same degree; bitterness and sweetness are appreciated chiefly by the glosso-pharyngeal at the back, acidity and saltness by the lingual in the fore part of the tongue, chiefly at the tip and edges. The onset of the defect may be sudden, as in hysteria; or gradual, as in most forms of nerve-lesion. In the latter it is usually unilateral; in rare cases both sides are involved. It is associated with other symptoms of loss of function of the affected nerves, as in the case mentioned, in which there was loss of sensibility in the face, and paralysis of the muscles of mastication.

DIAGNOSIS.—Loss of taste has always to be carefully distinguished from loss of smell, since all flavours are recognised by the olfactory nerve, and it is commonly assumed that when these cease to be perceived, taste is lost. The power of tasting must be ascertained by powders or colourless solutions which shall convey no information. Citric acid, quinine, sugar, and salt, in powder or solution, answer well. The tongue must be held out, and the substance or solution placed on the part of the tongue it is desired to test, and after each observation the mouth must be rinsed with water. It must be remembered also that the anterior part of the tongue is almost destitute of the sense of taste, except on the edges and tip. If the loss is unilateral, the powder may be rubbed on the side of the protruded tongue, near the tip, with the finger, and the patient should indicate, by nodding or shaking the head, whether it is tasted, before the tongue is withdrawn into the mouth.

PROGNOSIS.—This is good in hysteria, less favourable in nerve-affections. The loss due to affection of the facial nerve is frequently recovered from, but may prevail even when the function of the latter is recovered. In intracranial disease of nerves the prognosis is very unfavourable.

TREATMENT.—The treatment in nerve-disease is that of the cause of the symptom. Stimula tion of the nerves in the tongue may sometimes aid the recovery of function, and for this faradisation is the most effectual. In hysterical loss of taste this commonly suffices. Where it depends on affection of the mucous membrane of the tongue, local measures alone are necessary.

W. R. Gowers.

TEETH, Diseases of.—Synon.: Fr. *Maladies des Dents*; Ger. *Krankheiten der Zähne.*

Introduction.—The teeth are peculiar organs, both anatomically and physiologically. The three hard tissues of the teeth are comparatively of low organization, while they are in connection internally with a structure, the pulp, mainly composed of plexuses of nerves and blood-vessels, and their roots are covered externally with a highly nervous and vascular periosteum.

The *functions* of the teeth are important. They exercise a large influence in the production of articulate sounds. They have a keen tactile faculty, by which they recognise the texture of food, and detect the presence of foreign bodies. But their most important function is mastication, by which food is comminuted and at the same time insalivated, two essential preliminaries to digestion. The loss of the teeth is with many of the lower animals the limit of life, from the cessation of these processes; and the failure of mastication, through edentulous age, is a frequent cause of intractable dyspepsia in the human subject. This fact cannot be too constantly remembered by the practitioner. The restoration of mastication by means of artificial teeth is often the immediate cure of imperfect digestion, which diet and drugs have failed to influence.

The diseases of the teeth are for the most part of a surgical character, and need operative interference. The pathological conditions of the teeth are, however, of important interest to the medical practitioner, causing and explaining, as they do, many maladies, especially of the nervous system, and having a serious bearing on digestion and nutrition as dependent on efficient mastication.

Again, the forms of the teeth, and the characters of their tissues are, in some instances, indicative of former illness, and in other instances are of critical diagnostic value in establishing the existence of a constitutional taint which may modify or develop disease. The teeth are dermal organs, and, as such, are liable, especially during their development, to be affected by the poison of the eruptive fevers, leading to disastrous consequences to the teeth themselves, and to the immediately contiguous structures.

From the peculiar position and surroundings of the teeth, they are liable to mechanical injuries, and to chemical and physical changes of the most interesting nature in themselves, and in relation to the vital manifestations to which they lead.

In this article the diseases of the teeth will be discussed in the following order:—1. Abscess, and blood-stains; 2. Caries; 3. Enamel, pitted; 4. Eruption of wisdom teeth, difficult; 5. Hæmorrhage after extraction; 6. Loosening; 7. Necrosis, after acute diseases; 8. Nervous affections originating in diseases of the teeth; 9. Odontomes; 10. Syphilitic teeth; and 11. Toothache.

1. **Abscess in dentine, and blood-stains.** Dentine is occasionally liable to abscess within its substance, from suppuration of enclosed fibro-vascular tissue. It is also not infrequently discoloured by the extravasation of hematine. In neither of these conditions do symptoms arise of interest to the practitioner.

2. **Caries.**—Caries of the teeth is by a great deal the most common pathological change to which the human body is liable. It generally affects some of the temporary teeth before they are shed; and there are very few adults, indeed, in whose teeth caries, in some degree, is not to be found. Dental caries is a softening and disintegration of the tooth's surface, gradually penetrating towards its centre. It is essentially a superficial affection, dependent on external influences. These are chiefly chemical, though partly mechanical, and it is not improbable that the action of a vegetable parasite (*Leptothrix buccalis*) has some share in the process. One of the most remarkable circumstances in this pathological change is, that though the dentine of the tooth undergoes, through disease, a radical change in physical characters and chemical composition, it long retains its vitality, and even becomes increasedly sensitive. The idea that death of the tissue antecedes caries is quite erroneous. The most obvious commencement of caries takes place on the surface of the dentine immediately underlying faulty enamel, but in some instances it commences in the enamel itself. When the enamel is attacked, it becomes opaque, whitish, or grey, and then gradually stained of a brownish colour, and this is soon followed by still more obvious changes in the dentine. The latter tissue undergoes more rapid alteration than the enamel; it becomes brown and soft, and the change penetrates in the direction of the tubes towards the pulp, while it spreads laterally beneath the as yet healthy enamel. These changes occur in endless variety, one form passing into another. The extreme varieties have been described as distinct species of decay, without, however, sufficient justification.

At times the disease advances to a certain stage, and then ceases; the intra-tubular material becomes calcified; and the surface perfectly hard and dull-brown or black. This is called 'arrested,' 'stationary,' or 'carbonised' decay. There is a peculiar and characteristic smell in dental caries, like that of gangrene of the lung, or like the scent of the little neuropterous insect *Chrysopa.* The softening of the dentine is brought about by the removal of the phosphate of lime in a soluble acid form, and its replacement by water. Carious dentine has an acid reaction.

The real causes of dental caries are as yet involved in much obscurity, and need not be here discussed. The consequences are of more practical import. Though carious dentine may retain its vitality for a considerable time, it ultimately dies, while part of the same tooth may be living, and a line of demarcation of the live and dead tissue indefinable. The results of caries are many and serious. Tooth-ache, neuralgia, periostitis, suppuration of the pulp, alveolar abscess, and occasionally muscular paralysis, may all arise as a consequence of this condition; and it is particularly important for the practitioner to bear this in mind, as a possible association.

Treatment.—The treatment of caries may be divided into *preventive* and *remedial.* The general conditions of health that lead to caries are not known with sufficient accuracy to allow of such regulation of the functions of nutrition as would prevent the occurrence of decay when it arises from such causes, but the mechanical influences which occasion it are within easy control. Every mechanical action which injures the surface of the teeth should be guarded against, especially the crushing of the enamel by the pressure of contiguous teeth when crowded. Cleanliness, by brushing with a dentifrice—which removes all decomposing matter from contact with the teeth—is of the greatest importance; but tooth-powders should be soft, and free from cutting particles: vegetable charcoal being carefully avoided, as it contains small particles of silicates, which frequently remove the enamel. Remedial treatment cannot be called curative, as there is no restoration of lost tissue; and that which has become decalcified never hardens again. But caries may be arrested, and further decay prevented. The softened tissue should be removed; the hard subjacent structure polished and kept smooth; projecting edges, which might entangle food, levelled and burnished; and above all, cavities should be stopped, and, if possible, with gold.

3. **Enamel, rocky and pitted.**—It is of great importance to distinguish between syphilitic teeth, and other malformed teeth which have no similar signification. When Mr. Hutchinson first described the characters of teeth which are often associated with inherited syphilis, much unnecessary distress was occasioned by confounding teeth having rocky and pitted enamel with those that were truly syphilitic in their origin, and many persons supposed themselves to inherit syphilis, who merely possessed teeth bearing marks upon them which registered a temporary illness, or a condition of depressed nutrition in childhood when the affected teeth were forming. Teeth with rocky and pitted enamel vary indefinitely as to the extent of their defective formation, from a slight horizontal grooving in the enamel, to a condition in which the whole surface is rocky and rugged, and studded with pits like a thimble. In extreme cases the enamel may be almost entirely wanting; but there is no narrowing of the apices of the crowns of the teeth, and no crescentic notch in the superior incisors, as in syphilis. The defects of the enamel are nearly always horizontal in their disposition; and even the pits have such an arrangement in series. This condition is most frequently seen in the permanent teeth, though sometimes in the temporary. It is most manifest in the first molar, the incisors, and the canines. Rarely it affects the bicuspids, near the apices of the cusps; and still more rarely the whole bicuspid crown suffers. But it will be observed that the malformation is symmetrical in the corresponding teeth, and that in the different teeth it has occurred at a point in its development which each tooth had attained at one particular time. The writer believes that the mildest and severest cases are essentially the same in their pathological meaning, and that the difference is only one of degree. It has been supposed by Mr. Hutchinson that this condition of teeth is the result of the constitutional influence of mercury given in childhood. The writer believes it is quite unconnected with such supposed cause. It is extremely rare for mercury to affect the mouth in children. This condition of teeth occurs where mercury has never been given, and equally among peoples not addicted to the use of that drug. It is found, moreover, among extinct races, who lived before mercury was used as a medicine. The microscopical structure of teeth, thus degenerated, shows that the condition is essentially one of imperfect calcification of the enamel and dentine; and the writer believes that any influence or disease of childhood, suspending for a time or depressing the nutrition, may be an efficient cause. As this state of tooth is permanent, it remains a record through life of an illness in childhood. These defects in the tissues of the teeth are concurrent with their lamination. The tissues of the teeth, especially the dentine, exhibit a series of layers due to different degrees of calcification, in which the earthy impregnation has been greater and less alternately. This is a normal condition up to a certain degree; but when the laminæ of lesser calcification are extremely defective in earthy matter, histological defects arise which lead to the appearances in the teeth described.

4. **Eruption of wisdom teeth, difficult.**—Insufficient room in the jaw for the advent of the wisdom teeth is sometimes attended with very painful and even serious symptoms. These are confined to those cases in which the obstruction occurs in the lower jaw. The wisdom tooth has insufficient room to come through, and remains impacted at the base of the ascending ramus of the jaw, growing and pressing against the second molar. This gives rise to inflammation, and pain of a rheumatic character wandering down the neck and arm, the latter being often weakened in muscular power. In acute and neglected cases, abscess forms at the angle of the jaw, and burrows about the cheek. One remarkable symptom is trismus, which is very usual in these cases, and is a characteristic symptom; the masseter muscle becoming contracted and firmly set, so that the jaws can hardly be opened a quarter of an inch. This locking of the jaw sometimes occasions very unnecessary alarm.

Well-authenticated instances of epilepsy, delirium, and insanity have been recorded, having been occasioned by the resisted eruption of the lower wisdom teeth, and cured by removal of the cause of irritation.

Treatment.—The treatment depends much on the degree of obstruction. Lancing the gum is sometimes sufficient. Removal of the wisdom tooth is the proper cure. Where there is trismus it is necessary to wedge open the jaws—slowly but persistently; and then to extract the offending tooth, if possible. If it cannot be reached, the second molar should be extracted, when its posterior fang will sometimes be found absorbed. When once an abscess has formed in association with an obstructed wisdom tooth, the removal of that tooth is unavoidable. Though it may be necessary to remove the second molar first, the third must afterwards follow, or the abscess will remain. The trismus immediately vanishes on the extraction of the tooth.

5. **Hæmorrhage after tooth-extraction.**—This is an occasional manifestation of the hæmorrhagic diathesis, but, considering how many teeth are extracted, it is rare. This form of bleeding usually comes on some hours after the tooth has been taken out, and consists of a more or less rapid welling up of blood in the recently emptied sockets. There is frequently a history of inherited hæmorrhagic diathesis. It is, moreover, occasionally associated with menstruation.

TREATMENT.—The treatment should be local and general. For the former the writer would recommend plugging the alveolar cavities with lint or cotton-wool, previously steeped in tincture of matico, red-gum, or turpentine; for the latter, the internal administration of turpentine, ergot, or tannin. Tourniquets have been devised for applying and sustaining pressure on the bleeding surfaces.

6. **Loosening of Teeth.**—SYNON.: Spongy gums; False scurvy.

DESCRIPTION.—The term 'scurvy of the gums' has long and generally, though very incorrectly, been applied by dentists to this condition of the gums. Instead, however, of being an enlargement of the gums from extravasation of blood within them, it mainly consists of a general dilatation of the smaller vessels of the papillæ and periosteum, and ultimately of those of the alveolar bone. At first the gums are enlarged and protrude; but afterwards, while the edges still remain thickened, they recede from the necks of the teeth, which consequently appear elongated. As the gums retire so do the alveolar processes, which at the same time become large and open, and like the periosteum are soft and spongy. This, as a consequence, loosens the teeth; which, especially in the front upper jaw, have a tendency to protrude. The disease usually occurs about or after middle life. In this condition the gums are very liable to bleed from the slightest friction; tartar forms around the necks of the teeth; considerable ooze from beneath the edge of the gum, often of a purulent character, is discharged; and the breath is generally offensive.

ÆTIOLOGY.—The causes of this condition are neither constant nor always intelligible. Crowding of the teeth, dyspepsia, frequent pregnancies, mercurial action at some previous time of life, and continued use of iodide of potassium, have all appeared to be causes of this spurious scurvy. But very often no apparent reason can be assigned for its occurrence.

TREATMENT.—Restoration of the general health and extreme cleanliness of the mouth are essential. All tartar should be removed, and the bleeding attending this operation often has a salutary effect. A fairly stiff toothbrush should be used unsparingly, and the bleeding of the gums on such occasions is beneficial. This should be followed by an astringent mouth-wash, such as a solution of alum in a decoction of cinchona.

7. **Necrosis of the jaw and teeth after the eruptive fevers.**—These are among the secondary maladies which are apt to occur after small-pox, scarlet fever, and measles in children. The cases are all singularly alike; they usually occur between the third and eighth years, and the severity of the previous attack of fever is immaterial. The local symptoms, which usually appear from three to six weeks after, consist in a peeling off of the gum around one or more of the temporary teeth; and this continues until the bare jaw is exposed to a depth which corresponds, not only to the fangs of the temporary teeth, but the bony capsules of their immature successors. Transverse ulceration then usually follows; and the temporary teeth, their alveoli, the immature permanent teeth, and their bony capsules are shed. Frequently this occurs on both sides of the mouth symmetrically. There is no swelling or formation of supplemental bone. In the lower jaw the writer has never seen the base of the bone involved, and the consequent disfigurement is singularly slight. These exfoliations occur much more frequently after scarlet-fever than after measles, and they are rare after small-pox.

TREATMENT.—The treatment of these cases should consist in as little interference as possible. Little need be done, beyond attention to cleanliness and deodorisation, and the removal of the sequestra when quite loose.

8. **Nervous system, affections of, dependent on diseases of the teeth.**—Affections of the nervous system dependent on the teeth, but not arising from the processes of dentition, have not been sufficiently recognised, and records of them are so few and partial that it is difficult to generalise upon them. These affections are either *reflex*, *direct*, or *complex*. In the first case some portion of the nervous system receives an exaltation of function from the irritation of a tooth-nerve; in the second case some contiguous nerves are involved by the spread of inflammation from diseased teeth, or the pressure of the inflammatory products; and in the third case both would be entailed in a mixed and uncertain proportion.

Reflex affections.—As regards the reflex phenomena of disease dependent on the teeth we may enumerate pain, muscular spasm, muscular paralysis, paralysis of some of the nerves of special sense, and perverted nutrition. These reflex phenomena have been found to be induced by the following diseases:—caries, with or without exposure of the pulp; exostosis—hypertrophy of the crusta petrosa; nodular developments of dentine in the pulp-cavity; periostitis, plastic or suppurative; impaction of permanent teeth in the maxillary bones; and crowding of teeth from insufficient room.

Small excrescences of dentine occurring within the pulp-cavity, or in the form of small nodules in the substance of the pulp, are apt to produce erratic and wide-spread pain among the dental nerves of one side of the face. The same condition not infrequently occurs where the morbid change consists of fine nodular exostoses on the fangs of the teeth. In these cases the pain is reflected from the spot of irritation over a large nervous area; but the tooth containing the offending growth is usually perceptible by tenderness or elongation, or a consciousness on the part of the patient that it is the centre of offence. Where it arises from an exostosis it is apt to be repeated with several teeth one after another. These cases are by no means uncommon, and are often made the subjects of unavailing medical treatment for a long time. Tooth-extraction is the only remedy.

Wry-neck, epilepsy, and tetanus are three forms of muscular spasm which have been distinctly traced to the irritation of disease of the teeth in the adult.

Among the nerves of special sense which have been affected by reflex nervous action from tooth-irritation are the auditory and the optic; cases of deafness and of complete amaurosis having arisen from these causes.

There is a not infrequent form of muscular and sentient paralysis, affecting one or other of the arms, which has often been wrongly diagnosed, and led to much needless suffering and alarm. It consists of weakness, some pain, and occasionally loss of feeling in the arm and hand in question. Pain frequently commences in the side of the neck or at the point of the shoulder, and is of an aching, weary character, much increased by any muscular effort of the limb, which usually hangs in a powerless, listless attitude by the patient's side. The hand is feeble, and the patient has difficulty in grasping and shaking hands with cordial pressure. These symptoms are sometimes only induced by exertion. Such cases have been several times supposed to depend on central nervous disease, and have been so treated. They may depend, however, on some irritation of a tooth of the lower jaw, usually a back molar, which is transmitted through the cervical and brachial plexuses of nerves. A carious or impacted wisdom-tooth is usually the offender. Extraction of the tooth is followed by complete relief within a few hours. There are also on record some curious cases of perverted nutrition, in which the colour of the iris has been altered, and the hair at certain spots has become abruptly white, ulcers have formed and refused to heal, in the neighbourhood of the neck and cheeks, all dependent upon tooth-irritation.

Direct affections.—Direct affections of the nervous system, caused by tooth-disease, are far less common and less varied than those which are reflex, and their mode of production is more obvious and intelligible. The portio dura of the seventh nerve, the nerves which enter the orbit, and, very rarely, the dental nerves in their tracts in the jaw, are those only which suffer in this way—are entangled, that is, in their course by those inflammatory influences and products which tooth-diseases engender.

The consequences of the direct implication of nervous trunks by the inflammatory results of tooth-disease are so very grave, especially when affecting the nerves of the eye in their course to the orbit, and the ultimate results so permanently serious, when relief is not speedily given, that it is impossible to exaggerate the importance of these cases. The writer would lay the more stress upon this subject, because he fears that such cases have been misunderstood, and that injuries have thus become permanent and irremediable, which, if correctly interpreted and properly treated at first, would have been easily removed.

The entanglement of the portio dura leading to facial palsy has arisen from the plastic exudation around an upper back molar, and has been immediately cured by the extraction of the tooth. There have been several examples in which the nerves passing into the orbit, and probably within the orbit, have been surrounded with plastic exudation, leading to the destruction of their functions, and to temporary or permanent loss of sight. The author has seen several such cases; some were, and all might have been, completely cured by the early removal of the offending teeth. It is very rare indeed for the dental nerves in their passage through the jawbones to be pressed upon and functionally disturbed by the inflammatory products of carious teeth. But such cases have occurred, producing loss of sensation of the front teeth, lips, and chin.

Complex affections.—In some instances the nervous symptoms are clearly of a mixed character, partly reflex and partly direct. This is no doubt the case in those remarkable and not infrequent examples of trismus, in which the jaws are firmly closed by the spasmodic action of the masseter muscle, on the side where a carious or impacted lower molar tooth is keeping up irritation, and which is immediately cured by the extraction of the tooth.

The same may be said of those wide-spread and diffused pains, attended with extreme tegumentary sensibility, which so often accompany ordinary toothache.

9. **Odontomes, or tooth-tumours.** — The teeth occasionally develop tumours of their hard tissues of an interesting and remarkable character. They are divisible into two distinct groups —those which are *congenital*; and those which are developed in after-life, the *secondary* or *induced*. The former consist of (*a*) 'warty' growths of the crowns of the teeth; (*b*) 'hernia' of the fangs; and (*c*) nodules of enamel on the roots of the teeth. But with none of these is the practitioner likely to be concerned, as they are not known to produce symptoms other than those which suggest surgical interference.

The secondary or induced odontomes are (*a*) 'exostosis' on the fangs; and (*b*) 'dentine excrescence' within the pulp-cavity of the tooth. These forms of tooth-tumour, though smaller and less obvious than the others, are both liable to occasion symptoms, painful and obscure, which it may be difficult to diagnose and treat.

Exostosis of the fang of a tooth consists of an increased growth of the normal outer layer of the fang—the tooth-bone. This occurs in very varying degrees and forms, and, as a pathological condition is not uncommon. But it is unusual for these hypertrophies to give rise to symptoms of disease. They do so, however, sometimes and with great severity, the one symptom being *pain*, and this is especially the case when the exostosis is small, nodular, and forming on one side of the fang. These exostoses are apt to attack the teeth in succession, and they occur either in early or middle life. Such cases usually commence with pain in some particular tooth, which is apparently sound; the pain is inconstant, of a neuralgic character, and wandering about the side of the face and head. The affected tooth is often elongated, tender, and very susceptible to changes of temperature. The pain is not constant, but intermitting; increasing, however, in frequency and severity; and, though wandering over a considerable area, always emanating from the one affected tooth. The pain at length becomes intolerable, and the apparently sound tooth is extracted, displaying at its fang-end a small lobulated exostosis. The loss of the tooth is followed by complete relief, and this may be permanent; but not infrequently, after an interval of entire ease, another tooth, generally an immediate neighbour, is attacked in the same way, and goes through the same process, till it is extracted. And this may occur till all the teeth are lost. No treatment short of extraction appears to palliate the symptoms.

Dentine excrescences in the pulp-cavity may exist without causing any symptoms; or they may be associated with pain, and a general history scarcely to be distinguished from exostosis. In some of the cases, however—especially where there is a general intrinsic calcification of the pulp, the symptoms have assumed the aspect of the severest tic-douloureux. Extraction is the only remedy.

10. **Syphilitic teeth.**—We are indebted to Mr. Hutchinson for the interesting discovery that children who inherit syphilis are liable to characteristic deformity of certain teeth, and that this is not infrequently associated with specific interstitial inflammation of the cornea. Syphilitic teeth are small, narrow, more or less pointed, and usually of a dirty grey colour. Both the temporary and permanent sets may be affected; but it is the front teeth of the latter that exhibit the characteristic and most marked deformity. The lower incisors are peggy and pointed; those of the upper jaw are narrowed, instead of expanded towards the cutting edge; and the centrals frequently have a crescentic notch. The other irregularities of shape in the teeth may arise or be closely imitated, where there is no specific taint, but the crescentic notch in the contracted cutting edge of the superior permanent central incisor is believed to be absolutely diagnostic of inherited syphilis. As such, it is of great value to the physician in deciding on the nature of doubtful symptoms which may, or may not, have an hereditary syphilitic origin. Mr. Hutchinson considers that these malformations of teeth are occasioned by specific stomatitis. But perverted form and nutrition need not be inflammatory; and the writer doubts if such action arises in these cases. The teeth are dermal organs, and upon the skin syphilis inflicts some of its chief injuries, which need not be inflammatory.

11. **Toothache.**—The term toothache can scarcely be used with critical accuracy, as it is popularly applied to any pain in or immediately round a tooth, without distinction as to its cause or character. Such pain may be produced by many conditions, the commonest of which is *dentinal* caries, with or without exposure of the pulp. But other influences may induce pain, scarcely to be distinguished from that of tooth-decay. Among these causes may be enumerated *impaction of the wisdom-teeth*, especially the lower; *inflammation of the tooth-pulp* and *periosteum; rheumatism; deposit of secondary dentine* in the pulp-chamber; and *exostosis*.

Excepting where pain is very severe, and of such a character as to assert its exact locality, it is not infrequently referred to a position, and often to a particular tooth, other than the one affected. Where this is the case, this pain is, the writer believes, always anterior to the locality of its origin; and it is often only by roughly manipulating or sharply tapping the teeth that the actual offender is discovered.

Toothache dependent upon *dental caries* usually arises when the decay approaches the tooth-pulp, and is the result of its inflammation. The tooth-pulp consists very largely of nerves, and is closely boxed up within unyielding walls, so that its swelling gives rise to great internal pressure; hence the pain is of a very severe and distressing character. Inflammation frequently yields to complete or partial suppuration of the pulp; the escape of the matter being attended with marked relief. This may arise either from the breaking down of the external carious wall of the tooth, or from its finding vent through the orifice at the apex of its fang, and so constituting an alveolar abscess, which ultimately bursts, either as a gumboil within the mouth, or by a fistulous opening upon the cheek.

The *impaction of a wisdom-tooth* produces a form of toothache which is usually of a dull character, and gives a sense of tension and restraint. It arises from a want of room for the coming tooth, whose growth produces pressure on the contiguous structures. The pain often wanders along the whole jaw, and may appear to be especially associated with any other tooth on that side. Occasionally the second molar becomes so eroded, through absorption of its posterior fang by the pressure of the wisdom-tooth, as to cause inflammation of its pulp, in which case there may be acute toothache and loosening of the tooth.

Inflammation of the tooth-pulp may sometimes occur spontaneously, and thus give rise to pain.

Inflammation of the periosteum around any particular tooth, the result of disease or any external violence, may have the same effect. It is said also that the inflammation of the fibrous tissues round the teeth may be of a rheumatic character, but of this the writer has no positive evidence. It may, however, arise from syphilitic periostitis, and from the administration of mercury when pushed to approaching salivation. Iodide of potassium has sometimes a like effect.

Secondary dentine and *exostosis* may also be associated with toothache, which is frequently of a neuralgic and wandering character, so that it is often difficult to fix upon the offending tooth. Whether the pain results from the pressure of the adventitious growth, or whether they are both the result of some sub-inflammatory condition, it is difficult to say.

Treatment.—The treatment of toothache consists in attendance to the general health; in local applications; and in extraction of the offending organ. Tonics, especially quinine, are often useful where the pains are of an inconstant and neuralgic character. Food and stimulants, especially wine, would also give relief in such cases, where the patient is below par. When the toothache arises from caries, great relief is experienced in the early stages by the application of creasote, carbolic acid, and other hydro-carbons. Where pus is pent up within the pulp-cavity it should be evacuated, either by opening the pulp-cavity from above, or by drilling the tooth.

Where the pain arises from impaction of wisdom-teeth, relief from pressure must be given by extraction. If the wisdom-tooth cannot itself be got at, the second molar should be taken out. In all cases where the pain has become excessive and intractable, removal of the tooth is the only remedy. James Salter.

TEETH, Grinding of.—Automatic movements of the mouth are common to many diseases, especially in young subjects. In cerebral disorders in children we often notice a vertical movement of the jaw, as if the patient were chewing. At other times the movement is a lateral one, and the teeth are ground together, so as to give rise to a hard unpleasant grating sound. This symptom is not, however, necessarily dependent upon disease of the brain, nor is it peculiar to early life. Grinding of the teeth may be observed at all ages, and in many different complaints. It is frequently spoken of as a symptom of worms, and is, indeed, often present when the alimentary canal is infested with these parasites; but the symptom is in such cases quite independent of the worms, and is to be ascribed merely to the intestinal derangement which is the essence of the disease, the presence of worms being merely an accidental complication. Disordered bowels are by far the most common cause of grinding of the teeth, and therefore, with the exception of cerebral disease, this symptom is almost confined to such disorders as are accompanied by derangements of the alimentary canal. Thus children with tuberculosis often grate their teeth together with painful persistency; but in this disease an acid condition of the contents of the stomach and bowels is an almost invariable complication. Again, in rheumatism and gout, where there is the same tendency to acid fermentation of food, grinding of the teeth is a common symptom in the adult.

The movement of the jaw occurs, as a rule, independently of the will, and is seldom noticed except during sleep. Sometimes, however, children will grind their teeth voluntarily, and apparently with full consciousness of what they are doing. Such cases are, however, rare.

The *treatment* of teeth-grinding consists in the correction or removal, if possible, of the condition upon which it depends.

Eustace Smith.

TEETHING, Disorders of. *See* Dentition, Disorders of.

TELANGEIECTASIS (τῆλε, far, ἀγγεῖον, a blood-vessel, and ἔκτασις, a dilatation).—Aneurism by anastomosis. *See* Aneurism; and Tumours.

TEMPERAMENT.—Synon.: Fr. *Tempérament*; Ger. *Körperanlage.*—This term denotes the correlation of grouped differences existing among men, in respect of physical structure and conformation, with differences of functional activity, of mental endowment and disposition, and of affection by external circumstances.

The early writers on medicine, recognising the facts that each individual man is different from all other men in physical appearance; that, again, in every man are found qualities proper to himself, inherent and indestructible; that, again, on a review of many men a constant association of certain qualities with certain variations in physical appearance may be observed, proceeded to make generalisations, tending to the doctrine of temperaments. This doctrine, as fully set forth by Galen, established nine kinds of temperament. First, the *balanced* temperament (*εὐκρασία, temperies*) consisting in a mixture of different qualities in such due proportion that none is in excess. Next, four temperaments of simple excess or default—the *hot*, the *cold*, the *moist*, and the *dry*; and then four mixtures of these—the *hot and dry*, the *hot and moist*, the *cold and dry*, the *cold and moist*. Subsequently, under the influence of the humoral pathology, temperaments were classified as *sanguineous*, *bilious*, *phlegmatic*, or *melancholic*, according as the heart, the liver, the head, or the spleen were supposed to be predominant in modifying the humours of the body. More recent writers have again abridged the list, and have given its categories a new interpretation. They mostly acknowledge but three temperaments—the *sanguine*, the *nervous*, and the *lymphatic*. The balanced temperament is not included, because no individual of such perfect structure exists. But it is equally true that the descriptions by which the other terms are defined represent either individuals used as types, and therefore correspond fully only to one or very few of the units of large genera, or are constructive types corresponding to no single existence.

Regarding the method of classification as wholly artificial, yet without denying its usefulness, we propose to preface the generally accepted description of the three temperaments above mentioned by a brief analysis of Galen's picture of the *εὐκρᾶτος*. The thoroughly tempered human being is in his bodily constitution exactly midway between slimness and stoutness, between softness and hardness, between hot and cold. In his mental constitution he exhibits the exact mean between rashness and timidity, between sluggishness and precipitancy, between the sweetness of pity and the bitterness of hatred. Such an one is brave, affectionate at home, and abroad discreet. To these essentials are added, of necessity, temperance in eating and drinking, perfect digestion and assimilation of food, physical and psychical energies without a flaw, the best powers of feeling, the best powers of movement, a clear skin, a good breath. He is neither too much given to sleep nor too wakeful, is midway between baldness and hairiness, between darkness and fairness of complexion. When a child he has reddish rather than black hair, in adult life the reverse. The three modern categories correspond fairly to Galen's mixed temperaments; the sanguine to the hot and moist, the nervous to the hot and dry, the lymphatic to the mixtures of cold with moist or dry.

The Sanguine Temperament.—Persons belonging to this group are described as being ruddy and bright of complexion, as having strong and salient muscles, a relatively large chest, and a relatively small head. The play of their senses, the determinations of their will, the responses of their muscles to impulses, are energetic and well-directed. Arterial blood abounds in them; their veins are small. The functions of their bodies are rapidly and easily performed. The functions of their minds show a similar vivacity. Rapid thought, quick imagination, brilliant courage, are associated with want of depth and persistence, with elastic forgetfulness even of strong impressions. In illness such people inflame quickly, develop diseases in a complete and regular way, and defervesce quickly, often with well-marked crisis. They are especially liable to gout, acute inflammations, and active hæmorrhages. They are men who dominate their fellows.

The Nervous Temperament.—Herein, as authors tell us, the skin is dark, dull, earthy, or sallow, and is hot and pungent to the touch, instead of being warm and moist. The cranium is large in proportion to the face; the muscles spare and not well-defined; the chest narrow; the circulation languid, with preponderance of the venous system. The face has the lineaments of energy and intensity of thought and feeling; the movements are hasty, abrupt, often violent, in alternation with languor. The affections are violent and persistent, the sexual passions usually very strong. Sensations are intense, far in excess of exciting causes. The mental powers are large and capable of persistent exercise. The bodily organization favours venous congestion and hæmorrhage, neuralgia, hepatic and intestinal obstructions, and the mental lunacies. Nevertheless, these people are often found to endure long fatigue, privation, and exposure better than the sanguine. They are the people who teach or lead their fellows.

The Lymphatic Temperament.—A heavy ill-proportioned ungainly form of body, large joints, bulky head, large hands, broad flat feet, light or reddish hair, a sallow or pasty complexion, accompany a general slowness and languor of bodily function. The muscles are often large, but their movements are awkward or inaccurately directed; the chest and heart are inadequate in bulk to the rest of the body. With this, there may often be combined much mental firmness, solidity, and constancy—a good judgment if a poor energy. The power of resistance to acute disease is inferior; the tendency to chronic diseases, particularly of strumous and asthenic kinds, is pronounced.

In the sanguine temperament a predominance of blood-making power and of muscular development is asserted. It may, perhaps, be spoken of as the temperament in which the spinal system and the parts directly subordinate thereto are most developed. In the nervous temperament the predominance of the cerebrum is clearly indicated. In the lymphatic temperament, languor or slowness of both nervous and circulatory systems is connected with slowness or default of the general nutrition.

Practically these types comprehend only a part of mankind. If we admit that they can be extended in their application by the recognition of mixtures of them among themselves in various proportions and degrees, we must admit also that there exist, outside of them altogether, numerous correlations of much importance to the physician. Moreover, many of the constituents of temperaments are capable of being changed by age, external circumstances, and habit. New combinations may be introduced by these agencies, or by bodily changes arising in accident or disease. The building anew of a man's temperament by religious enthusiasm, by suffering, by moral control, or by indulgence, is a spectacle daily to be seen and studied. In that analysis of the *κρᾶσις* of the individual which must furnish the interpretation of much of his behaviour in illness, the accurate estimation of many combined influences, native and accessory, has been called the stumbling-block of practice. It may better be called the touchstone of practical skill. That physician does well who carries with him a mental picture of some such perfect human animal as Galen has imagined; and who marks on the diagram, with his patient before him, the lines of original shortcoming, of development, of warp, of injury, of degeneration, so as to arrive at some clear sight of the outcome or resultant of all in the present organisation and reactions of that patient. WILLIAM M. ORD.

TEMPERATURE.—SYNON.: Fr. *Température*; Ger. *Körperwärme*; *Eigenwärme*.

INTRODUCTION.—The human body, like that of all warm-blooded animals, has a heat of its own, which is, to a great extent, independent of the surrounding temperature. As long as the body is in a state of health, the external circumstances must either very materially change, or a change of them must operate for some length of time, before any but a transitory elevation or depression of the blood-heat will occur. But the temperature becomes much more easily altered when the functions of the body are abnormally performed, in consequence of disease. A change of the blood-heat is often the very first symptom of a disease, and it may occur even before the slightest indisposition is felt by the patient. Hence observations of the temperature may be extremely valuable for diagnosis, and the course of most diseases being accompanied by corresponding alterations of temperature, which in many diseases are quite typical, the great importance of closely watching the course of the temperature becomes evident. Clinical medicine has by the use of thermometry entered on a new phase, having gained the means of a numerical expression for variations of complex states of the system which the practitioner, from the indications of the thermometer, may detect earlier and judge of more correctly than by any other symptom. For an exhaustive account of the changes of temperature which may be observed in health, and especially in disease, the reader may be referred to the classical work of Wunderlich, translated for the New Sydenham Society.

SOURCES AND REGULATION OF THE BODY-HEAT.—The sources of animal heat must be chiefly sought for in chemical processes, especially oxidation, which are constantly going on in the blood and tissues. To a minor degree various processes of a purely physical nature, such as friction, or the transformation into heat of other forms of energy, themselves the outcome of chemical processes, have also a share in its production. But this generation of heat within the body does not explain the fact of the blood-heat being constantly kept at the same level. This fact presupposes that the amount of heat produced is exactly equalled by the sum-total of the losses of heat which are constantly going on—at the surface of the body, by radiation and evaporation, from the lungs by evaporation and by the warming of the colder air taken in at every inspiration, in muscles when mechanical work is done, in the intestinal canal by the warming of ingested cold food or drink, and, lastly, by the dejecta which leave the body. Any disturbance of this equilibrium must be followed either by an increase or by a lowering of the general temperature. But there is another factor, without which the maintenance of this equilibrium, and an equal distribution of the heat throughout the body, would be impossible, namely, the circulation of the blood. By this means a regulation of the loss of heat may be effected whenever required, the blood-supply to the skin varying as the arteries dilate or contract under the influence of the vaso-motor nerves. But not only the losses of heat may be varied, but its production also is capable of being modified, under the influence of the nervous system. Whenever the external temperature would cause too considerable a loss of heat, the peripheral arteries contract, and the circulation becomes slower; heat is thereby retained in the body, but at the same time the heat-producing processes are stimulated to increased action, as shown by the quantity of carbonic acid given off being increased. When, on the contrary, the loss of heat on the surface is prevented, the peripheral arteries dilate; the heart's action becomes accelerated; and a much greater quantity of blood flows through the skin and peripheral parts, the sweat-glands pouring forth an increased quantity of sweat, which, by its evaporation, tends considerably to lower the temperature. At the same time the respiration also is accelerated. Less blood flowing through the internal organs, the chemical changes in them, and therewith the heat-production, become less active, and are further diminished by a direct influence of the nervous system on these processes. Thus a most wonderfully precise reflex-mechanism regulates the heat of the body, by altering the production as well as the loss according to necessity, the maintenance of the proper heat being in this way doubly secured.

Temperature in Health.—The heat of the blood is at every moment of life the result of different forces balancing each other, namely the heat-producing and the heat-destroying processes and influences. So also the temperature of a single part of the body results from the heat-production going on within it, and its exposure to cooling influences, and is chiefly dependent upon its blood-supply. The heat of the body is, therefore, most variable on the surface, and is lowest in its uncovered parts, especially in the most projecting ones; almost uniform, on the contrary, in the interior, where only slight differences, amounting to a few tenths of a degree, exist. In the lower animals Claude Bernard found the temperature highest in the hepatic veins and the right auricle. The heat of an organ increases when its functional activity is heightened, as, for instance, when the brain, a muscle, or a gland is stimulated to increased function.

It is necessary, for practical purposes, to consider chiefly the temperature in the interior, or the blood-heat. The blood-heat is measured, as nearly as possible, by the clinical thermometer. *See* Thermometer, Clinical.

In healthy men the temperature of the body, as measured in the axilla, is about 98·6° Fahr. (37·0° C.) Inside the mouth, underneath the tongue, it is almost the same; whereas in the vagina or rectum it is 0·3° to 0·6° higher. Under special circumstances—for instance, when a considerable cooling of the surface takes place, or when the skin freely perspires—the difference may be somewhat greater, and there may be a difference of 20° between the temperature of exposed parts of the skin and the interior; on the other hand, all parts may be pretty equally warm in the morning in bed, or in a warm room, or when the circulation has been influenced by slight exercise, or by a good meal and a moderate amount of alcohol. Of considerable influence upon the temperature of the surface of the body is the amount of fat in the subcutaneous tissue. In plump children and in very obese adults the surface may be considerably colder than the interior, and in the latter case there generally is yet another and even more effective cause for this difference, namely, weakness of the heart's action.

The temperature of the body is not the same all through the day. Numerous careful observations, of which those of Jürgensen, Liebermeister, and Ogle, may be specially mentioned, have shown that even when kept entirely at rest in bed, the temperature of a healthy person will fluctuate from about 1·8° to 2·3° Fahr. in the course of the twenty-four hours; the mercury standing lowest between 2 A.M. and 6 A.M., and then gradually rising until it reaches the highest point between 5 P.M. and 8 P.M. This rise is mostly not continuous, but becomes somewhat slower, or even interrupted by a slight decrease, in the middle of the day, the afternoon hours showing a more rapid elevation.

This daily fluctuation of the body-heat is a fact of fundamental importance, for it not only takes place in health, but also when, in disease, the whole range of the temperature is either depressed or abnormally elevated. The causes of this daily fluctuation of temperature are not yet fully made out; but this much is certain, that rest and movement, as well as the taking of food, have some share in producing it. Another cause which must not be overlooked, and which was pointed out by Liebermeister, is the force of habit and inheritance.

Race and sex have no influence, to speak of, upon the range of the temperature. Age, on the contrary, has, by different observers, been found to influence the range as well as the daily fluctuation. In the infant, immediately after its birth, the temperature is slightly higher than later on, its temperature in the rectum having even been found higher than that of the vagina of its mother. A higher range is maintained in the first weeks of life, and there has also been found wanting in infants that steady course of the daily fluctuation which is observed in adults. In children, even somewhat more advanced in age, the temperature is still easily influenced by external changes, and the range of the daily fluctuation is greater. In old age again, the range is a little higher than in adult life, and here, also, a greater mobility of the temperature under various external causes is observed. No appreciable influence on the temperature in association with menstruation or pregnancy can be observed in healthy women. Parturition slightly increases the temperature, evidently by the increased muscular action, an increase which is compensated by a corresponding fall after the birth of the child. If no complications occur, the temperature in the puerperal state generally does not deviate from the normal.

Such, in fact, is the constancy of the body-heat in health, that the general conditions of life, occupation, &c., hardly show any influence upon it, and whenever, by muscular exertion, or by the effect of external heat or cold—as, for instance, by baths of various temperatures—a more considerable deviation from the normal range has for a time been caused, there is a strong tendency in the system to compensate the increase or the loss of heat, by a corresponding fall or rise afterwards. This faculty is somewhat altered in disease; and even in those states which are on the borderland of disease, we frequently find a less perfect action of the regulation of the local or general temperature of the body.

Local Changes of Temperature.—Local changes of temperature are brought about by external thermic influences acting locally, or by disease. Local stoppage of the blood-supply or local death lowers the temperature of the part; inflammation, in its first stage, raises it. Considerable local changes of temperature may arise simply from vaso-motor disturbances. Thus in a paralysed limb the temperature may either be lower or higher than in the corresponding limb of the other side; in hemiplegia the temperature of the paralysed side is frequently found ½–1½ of a degree higher than on the normal side. Neuralgia is sometimes accompanied by dilatation of the blood-vessels, and a considerable rise of the local temperature; and, as a purely vaso-motor disturbance, local heat and redness of the skin, due to a passing dilatation of blood-vessels, sometimes occur in hysterical females.

Changes of the General Temperature.—Of much greater practical importance than local disturbances of the body-heat are changes of the general temperature, such as occur in many diseases, whether of the nature of *depression* or *elevation*.

1. Depression.—Depression of the general temperature is observed as a consequence of considerable loss of blood; in starvation from any cause; and in the wasting of some chronic diseases, such as cancer of various organs, or in diseases of the brain and spinal cord. In brain-disease, with the symptoms of melancholia, extreme coldness of the surface and lowering of the general temperature sometimes occur. Vaso-motor paralysis and dilatation of the blood-vessels are sometimes the cause of extreme loss of heat in severe injuries to the upper part of the spine. In a very rapid manner a considerable fall of temperature may take place in the collapse sometimes occurring in the course of typhoid fever, but especially in that of acute peritonitis, and of poisoning by various substances. In the collapse of cholera the lowering of the temperature of the axilla may be considerable—a temperature as low as 89·6° Fahr. (32° C.) in the axilla, and even less under the tongue, having been observed; but the temperature of the interior of the body is generally very high, reaching 104° Fahr. (40° C.), and sometimes much more. In peritonitis a low general temperature may be present for days, even if the peritonitis supervene in the course of typhoid fever. With the collapse caused by alcoholic intoxication great depression of the general temperature occurs, when the patient is exposed to cold and wet; and in a case of carbolic acid poisoning, which came under the observation of the writer, the temperature fell as low as 93·92° Fahr. (34·4° C.). A temperature of 71·6° (22° C.) has been observed in sclerema neonatorum.

In chronic diseases of the respiratory organs, not of an inflammatory or tuberculous nature, as well as in chronic heart-disease, the temperature is generally found somewhat below normal; and the same is the case in chronic nephritis, more especially in those cases accompanied by general dropsy. In cases of the latter kind we even sometimes see a febrile temperature, caused, for instance, by tubercular disease of the lungs, become considerably abated, if not entirely reversed, when chronic kidney-disease supervenes; as also when intestinal ulceration becomes more prominent, or leads to peritonitis.

2. Elevation.—Elevation of the general temperature, as part of the febrile process, is the most prominent symptom in most diseases of an infectious origin, as well as in diseases of an inflammatory nature. In both an increased production of heat, no less than a disturbance of the regulation of the temperature, is the effect of the presence in the blood of some foreign substance, acting injuriously on the nervous system, and causing altered chemical processes. Modern theories give a more and more prominent part in these actions to organised bodies (fungi, bacteria), which, in themselves or, possibly, by products of their own life-changes, or by the changes which they cause in the fluids of the body, are assumed to be the cause of the febrile process, and thus of the increased temperature.

The proper balance of the heat-forming and heat-destroying processes may also be disturbed by other influences acting upon, and by primary diseases of, the nervous system. When the body is subjected to external cold, after it has been fatigued by exercise, and already cooled by perspiration—if, for instance, a cold bath were taken under such circumstances, a rigor, with rapid rising of the temperature may follow; but, no local disease becoming developed, the temperature quickly goes down again amid profuse perspiration, and the whole attack may be over. Or a disturbance of the heat-regulating functions of the nervous system may be caused by the irritation of some nerve-filaments, as by a gall-stone passing the biliary duct, or a stone passing the ureter or the urethra, and a febrile attack will follow. The rigor, leading to a high fever of an evanescent character, which may follow the introduction of a catheter (urethral fever), sometimes belongs to the same group of cases. But generally, in cases of this last kind, the nervous system is already in an abnormal state through the previous disease of the kidneys or bladder. The functions of the nervous system may further be deranged by injury; and a rise of temperature has not only been observed in injuries to the brain, but, in a most excessive degree, sometimes after injury of the cervical part of the spinal cord, when temperatures of 110° to 111° Fahr. (43·3° to 44° C.) have been observed (B. Brodie, H. Weber, Teale, and others). In tetanus a very high temperature may occur, rising still higher a little after death; as much as 112·55° Fahr. (44·75° C.) was reached in a case observed by Wunderlich. An alteration of the heat-regulating functions of the nervous system may be brought about by a considerable external heat acting upon the body, especially when combined with moisture of the air. In cases of sun- or heat-stroke, it is quite common to see the temperature of the body rise to 108° Fahr. (42·2° C.) and more; and it would seem probable that a febrile elevation of temperature, if going on unchecked for a considerable time, by causing exhaustion of the nervous system, may lead to hyperpyrexia. Thus it is not very uncommon to see the temperature rise excessively in infectious diseases, especially scarlatina, towards the close of life (proagonic hyperpyrexia); and the temperature may, in such cases, even rise a little more immediately after death. This is due to the losses of heat being greatly reduced after the stoppage of the circulation, the heat-production going on in the interior for a time; and the gradual failure of the circulation probably also takes a great share among the causes of a proagonic hyperpyrexia.

Hyperpyrexia sometimes comes on in the convalescence from acute rheumatism, even after the fever has entirely subsided, and when the patient is on the point of being discharged from the hospital. An excessive rise has occurred and caused death in severe cases of hysteria; and in hysterical patients hyperpyrexia has occasionally been observed without any of the other symptoms which in other cases usually accompany so grave a phenomenon. Cases of this kind are extremely suspicious, and in some of them it was discovered how this hyperpyrexia was simulated. Thus the patient has driven up the mercury by rubbing the bulb of the thermometer between the folds of her night-dress; whilst in other cases the high elevation of the mercury has been brought about by means of poultices, or by the patient having lowered the top of the instrument, so that the column of mercury began moving by its own weight. This, however, is not possible with a thermometer of the thin bore which English thermometers now generally have. A very high temperature, to which the pulse and respiration and the other symptoms do not correspond, must always arouse a suspicion that the rise of the mercury has been artificially produced, and the verification will be easy if the physician carefully watch the mercury as it rises, or by taking the temperature in the rectum or vagina.

The very important part which the nervous system plays in regulating the blood-heat, is also seen in the great liability of the temperature easily to deviate from the normal range during convalescence from acute disease, when the weakness of the nervous system, brought on by the previous illness, will show itself in this no less than in other alterations of function. This can frequently be observed in convalescence, not only from the specific fevers, but also from pneumonia and other acute febrile diseases, when trifling external influences may cause a considerable rise of the temperature, which, however, is generally of short duration only, but which, in the case of specific fevers may cause apprehension lest a relapse be coming on. In a somewhat different manner, and more lasting, a slight sub-febrile elevation of temperature may be observed in the convalescence from acute rheumatism, where it may persist for weeks without any joint- or heart-symptoms being present.

Significance of Abnormal Temperature for Diagnosis and Prognosis.—The maintenance of the heat of the body at a certain range being so insured, any deviation of the general temperature from the normal standard, however slight in degree, and unless of a very transient nature or brought on by evident external causes, is to be taken as a sign of disease. Such deviation may be of a variable degree, along with symptoms which, in part, are the consequence of the abnormal temperature, such as an abnormal rate of pulse and respiration, and nervous symptoms. The whole range of deviation within which life can well be maintained is comprised between 90° Fahr. (32·3° C.) and 110° Fahr. (43·4° C.). A temperature approaching either end of this range indicates a condition of extreme danger, which is already great with a temperature of 95° Fahr. (35° C.), or beyond 106·5° Fahr. (41·5° C.). With reference to the general condition of a patient who presents an abnormal temperature, a few distinctions may be conveniently tabulated:—

1. *Temperature below the normal*:—

a. Temperature of collapse, below 97° Fahr. (36·2° C.)

b. Subnormal temperature, 97–98° Fahr (36·2–36·7° C.)

2. *Normal temperature*: 98·0–99·5° Fahr. (36·7-37·5° C.).

3. *Temperature above the normal*:—

a. Subfebrile temperature, 99·5–100·5° Fahr. (37·5–38 05° C.).

b. Febrile temperature of moderate degree, 100·5–102° Fahr. (38·05–38·88° C.), morning; 102·2–103° Fahr. (39°–39·44° C.), evening.

c. Febrile temperature of high degree, 102·5° Fahr. (39·2° C.), and more in the morning; 105–106° Fahr. (40·6–41·1° C.) in the evening.

d. Hyperpyrexia, 105·8–107·5° Fahr. (41–42° C.) and more. Extremely dangerous.

Single Observations.—Near the ends of this scale a single observation of the temperature of a patient may at once decide the prognosis. Thus a temperature below 93° Fahr. (33·88° C.), or above 108° Fahr. (42·22° C.) is almost always fatal, although cases have been recovered by active treatment in which the latter point has been exceeded by several degrees. No less valuable may single observations be for diagnosis, chiefly in a general way, in showing that there is disease when, perhaps, no other symptom points to it, but also for the diagnosis of a special disease in some instances. Where there are other symptoms of disease, the discovery of an abnormally high or a febrile temperature may at once give quite a different aspect to a case, as, for instance, when a patient who has been suffering for some time from a troublesome cough, but in whom the most careful examination of the chest could not detect any lung-disease, is found to have pyrexia. The suspicion that there is commencing phthisis may thereby be at once confirmed, or aroused for the first time. Or, again, in a case where the patient simply complains of dyspepsia and lassitude, the thermometer may give a degree of heat which would not have been expected either from the looks of the patient, or from the temperature of his hands or chest, and the attention may thereby at once be directed to the possibility of the case being one of typhoid or some other specific fever. One reservation must be made with regard to single observations in patients who have not been kept at rest for some time before, for example, in patients who have walked to the physician's house, or who had to undergo a journey to the hospital. In such cases the temperature may be somewhat altered by the fatigue; and it is quite common to find the first temperature in a patient, immediately after his admission into the hospital, considerably higher than after a few hours' rest, or, if he have been exposed to cold, much lower than what would otherwise correspond to his condition.

Systematic Series of Observations.—But of much greater value than isolated observations of temperature is the regular and continued watching of the course which the temperature takes in a disease. Many diseases present a deviation from the normal temperature showing a typical course as regards the duration, as well as the daily fluctuations, of the abnormal temperature. The course of its temperature being part of the natural history of a disease, the study of this is of great importance for diagnosis.

TYPES OF PYREXIA.—First, it is *the mode of rising* of the temperature which varies, and by which some diseases may be distinguished. In some diseases a contraction of the peripheral arteries takes place at the onset, which, by diminishing the peripheral circulation and the giving off of heat, leads to a rapid rise of the internal temperature, and is accompanied by a sensation of cold. In pneumonia, therefore, and other diseases commencing with a rigor, the temperature rises rapidly and continuously to a height of 104° Fahr. (40° C.) or more; whereas diseases with a more gradual beginning show simply a slow elevation of the normal range, both morning and evening temperature becoming gradually higher, and the usual daily fluctuation being maintained. Thus, in typhoid fever the temperature rises every day about 2° Fahr.; but the temperature going down again in the morning, the maximum of about 105° Fahr. is only attained on the fifth or sixth day.

At *the height of a disease* the temperature may fluctuate round an average temperature of about 103° Fahr. (39·5° C.) or more, whilst it shows the same daily course as in health, that is, being lowest in the morning and highest in the evening. The range of this daily fluctuation may, however, differ considerably in different diseases; and according to the extent of the daily fluctuation, three types may be distinguished. When the daily fluctuation of an elevated temperature shows only the normal difference, or even a smaller difference, between the morning and evening temperatures, we speak of *continuous*, or, more correctly, *sub-continuous* pyrexia; when the difference is greater than the normal, the remission having a tendency to a low temperature, and the exacerbation, on the contrary, to a considerable rise, the pyrexia is called *remittent*; and, thirdly, when the remissions reach the normal, or recede even below it, we have the *intermittent* type of pyrexia.

A *continuous* elevation of temperature is observed soon after the commencement of a disease, and during its height.

Considerable *remissions*, or even intermissions, of the febrile temperature are principally observed in the decline of some acute diseases, and in chronic inflammatory diseases, especially of a tubercular nature, or in chronic syphilitic affections, the remissions generally becoming more marked as the exhaustion of the patient increases.

The *intermittent* type of pyrexia is most typically shown in malarial diseases, in which the elevation of temperature may follow a quotidian, tertian, or quartan type. The same also sometimes occurs in chronic tubercular disease of the lungs. Pyrexia of a remittent type may present a peculiarity which is worthy of note, as being of some diagnostic value. Whereas in the great majority of cases the daily fluctuation follows the rule of health, the exacerbation taking place in the evening, we sometimes meet with cases where this order is reversed, the rise taking place in the morning, and the remission occurring in the evening. This 'inverse type' as Traube called it, of the daily fluctuation of a febrile temperature has been observed in some rare instances in typhoid fever; more frequently in cases of chronic lung-disease; whilst in doubtful cases of inflammation of the lungs it has some significance as to the disease belonging to the class of phthisis.

Slight deviations in the maximum daily rise of a febrile temperature occur sometimes in this way, that the height is reached in the middle of the day, or that the exacerbation takes place in the night, or that two or more considerable elevations, instead of one only, take place in the twenty-four hours. Such occurrences, which have been observed in typhoid fever and in phthisis, can, of course, only be found out by the observations of the temperature being repeated with sufficient frequency. A more frequent application of the thermometer will also be necessary in some cases of ague, where the attacks are not well-marked, or occur in the night, in order correctly to judge of the case.

The *decline of the elevation of temperature*, at the termination of a disease, may be gradual, the daily fluctuation, however, taking place as usual; or it may be rapid, by a continuous sinking of the temperature to, or somewhat below the normal, in the course of from twelve to thirty-six hours, or even in six to eight hours, as in relapsing fever. The latter mode of termination of a fever is called *crisis*, whereas the former is designated *lysis*. A crisis may sometimes be accompanied by symptoms of collapse, and, in some rare instances, by acute delirium, which, however, generally passes off within a day or two, and is not of bad omen provided the general condition of the patient remain good. Symptoms of this kind, as well as a more considerable elevation of the temperature just previously to its fall, or a great irregularity in the course of the temperature preceding it, may be called *perturbatio critica*. It would appear that diseases caused by the action in the system of some foreign substance—as, for instance, some infective agent, its action being of a limited duration—have a tendency to a critical defervescence. Diseases, on the contrary, in or by which an organ has become materially altered, as by an injury, or in the course of an infectious disease of longer duration, show a slow decline of the pyrexia, with a tendency to a remittent type. The repair of the damaged structures taking some time, the decline of the pyrexia is slow, and the defervescence by lysis. Examples of the former mode of defervescence are furnished by acute pneumonia, erysipelas, typhus, relapsing fever, and measles when not complicated by more serious inflammation; the latter type is shown by typhoid fever, in which the specific process produces deep alterations in the glandular structures of the intestine, which persist for some time after it has terminated. The same is observed whenever an organ is altered by an inflammatory process, be this of a traumatic or of an infectious origin. The ancient physicians believed that a crisis took place with preference on certain days, as, for instance, the seventh day of an illness; but more extended experience, gained by means of the thermometer, has shown that, although a change or a termination of a disease take place at a certain definite period, the latter is not bound to one particular day. *See* CRISIS.

Any *irregularity of the course* of the temperature in a disease in which, as a rule, it runs a very regular and definite course, is indicative of some disturbance or complication, and its early detection is therefore important for diagnosis, no less than for prognosis and treatment.

On *the approach of death* the temperature in many cases gradually sinks; but instances are not of rare occurrence in which, on the contrary, especially in diseases with high fever, a continuous rising takes place towards the fatal termination, reaching sometimes hyperpyrexic degrees.

In *convalescence* the temperature is more easily influenced by external causes, as well as by internal changes, and the approach of a relapse or complication being at once indicated by a rise of temperature, the continuance of regular thermometrical observations in the first period of convalescence is of very great importance; the more so as convalescents are sometimes not sensible to changes, which at first only show themselves in an alteration of the temperature.

TREATMENT.—Abnormal states of temperature ought not, as a rule, to be considered as objects of treatment by themselves, all the concomitant symptoms, in fact the whole state of the patient, having to be taken into consideration, in order properly to treat a case of febrile disease. But there are exceptional cases in which the state of the temperature at once urgently requires a symptomatic treatment. Such are, for instance, cases of hyperpyrexia in sun- or heat-stroke, in which the most energetic means ought at once to be applied to reduce the temperature. As the experience of American physicians has shown, life may in such cases sometimes be saved by continually rubbing the surface of the body with large pieces of ice, using at the same time stimulants by the rectum or subcutaneously. A rapid abstraction of heat by rubbing with ice, or cold bathing with affusions, may also be the only means of saving a patient in whom, in the course of acute rheumatism, hyperpyrexia has set in; and a case published by Dr. Wilson Fox in which the temperature reached 110° in the rectum, is very instructive in showing that external cooling may be successful, when even very large doses of quinine (120 grains had been given in six hours), had been administered without effect. The same plan must be followed in hyperpyrexia occurring in the course of other diseases. Complications, such as pneumonia, do not contraindicate this treatment, the success of which is, however, dependent upon the possibility of rousing the nervous system, and upon the circulation remaining sufficiently active.

An abnormally low temperature requires the external application of heat, which will be materially assisted by warm stimulating drinks or injections, using eventually subcutaneous injections of ether or of tincture of musk, to stimulate the action of the heart.

Apart from such exceptional cases, the treatment of the abnormal states of the temperature must be subordinated to the general treatment of the case. In many cases the abnormal temperature being dependent upon some local cause, the removal of the latter will make the abnormal temperature also disappear, or at least reduce it—an experience with which surgeons are quite familiar.

Rise of temperature being, however, the chief and most important symptom of pyrexia, leading of itself to serious consequences, especially by weakening the heart's action, it becomes necessary in many cases of protracted febrile disease, besides the general or special treatment which the case requires, to treat the febrile temperature symptomatically. It has now been shown by an overwhelming experience that the course of the specific fevers, such as typhus, typhoid, scarlatina, although it cannot be cut short, can yet materially be influenced, by keeping the febrile temperature artificially down, by means of cold baths or wet packing, and by antipyretic medicines. And it is very important not to wait in a case with continuous high temperature until symptoms of failure of the heart's action—a weak pulse, cold extremities, cyanosis, and congestion of the lungs, and muttering delirium—show themselves, but to try to prevent these symptoms by keeping down the temperature. Patients treated early on this principle will be found much less frequently to pass into that state, to sleep more soundly, and to retain their appetite; bedsores and other serious complications being of much rarer occurrence; and it has been established that the mortality in specific fevers has by the antipyretic treatment been considerably diminished, and that convalescence also is quicker than in cases treated on the expectant plan.

In the symptomatic treatment of pyrexia in acute disease, and especially in the continued fevers, it is best to follow the principle laid down by Liebermeister, than whom no one has had more experience in these matters. Starting from the fact that a febrile elevation of temperature, of a remittent type, is much better supported by the patient than a temperature of even a lower degree, but which has a more continuous course, the object he has in view is, by the anti-pyretic treatment, to increase the remissions that normally take place every day, and to prolong them as much as possible. Comparative experiments have shown that external cooling by baths, and other means, as well as antipyretic medicines, are of greatest effect at those times of the day when the temperature spontaneously has a tendency to decline. In order to attain the greatest antipyretic effect with the least frequent repetition of baths, the most suitable time for the latter, according to Liebermeister, is the night; and the antipyretic medicines may be given to assist and prolong the effects of the baths.

As regards external cooling, by far the most effective means are cold baths of 60° to 70° Fahr. (15° to 20° C.), and about ten minutes' duration. More agreeable to the patient are baths of about 95° Fahr. (35° C.), gradually cooled down by the addition of cold water to 70° Fahr. (20 C.), or less, but their duration must be longer to have the same effect as the former (*see* HYDROTHERAPEUTICS). Cold wet-packing is less effectual, but may replace baths in patients of small volume (*see* COLD, Therapeutics of).

Quinine, in order to derive the greatest effect from its use, ought to be given in one large dose, 20 to 40 grains, in the evening, its action being slow and passing off slowly. Salicylic acid, on the contrary, and its soda-salt, which produce a fall of the temperature much more quickly, but also much less durably, are best given in a dose of 60 to 120 grains in the night or towards the morning. Neither these medicines nor cold bathing must, however, be used in a routine way, many things having to be taken into account in their use and in judging of their effect, as the time of the day, the severity of the case, and, not least, the individuality of the patient.

C. G. H. BÄUMLER.

TENDERNESS.—This word, in relation to medical and surgical practice, usually implies that pain, in various degrees and of different kinds, is elicited by pressure, as distinguished from the sensation which is felt spontaneously by the patient. The term might conveniently be made to include all painful sensations elicited by any physical disturbance of a part, as, for instance, the movement of a joint, or the pressure of its structures against each other. The like observation applies to any irritation of the mouth or throat, when these parts are the seat of disease accompanied by tenderness; as well as to other mucous surfaces.

Tenderness is a symptom often of great importance, and it claims the careful attention of the practitioner. It is often present when there is no complaint of pain on the part of the patient; while, on the other hand, it is by no means a necessary accompaniment of spontaneous pain; its very absence is frequently of much consequence in diagnosis. In an investigation for the purpose of eliciting tenderness, care is required, especially in certain cases; and the examination should be made with gentleness and restraint, so as not to give the patient unnecessary pain, or to produce other effects, which might prove serious in some instances. It may be that only a slight touch can be borne, but pressure may be gradually increased, if necessary, until tenderness is produced; it must be noted what degree of pressure is needed to cause the sensation. The observer must thus endeavour to fix upon the structure in which the tenderness is located; as well as to measure the intensity of the feeling. Its limitation in extent must also be determined. The patient can often give useful information as to its exact character. Care, however, is necessary to guard against being misled by malingerers, hysterical persons, or those who have imaginary ailments; and also not to mistake tenderness for mere hyperæsthesia of the skin. For this purpose it is of much help, among other points, to watch the patient's expression of countenance whilst pressure is being made. Hysterical patients may seem to suffer acutely when slight pressure is made; but if this be gradually increased, while their attention is diverted by conversation, it is found that the suffering is not real. It must also be remembered that some persons are much more sensitive than others.

VALUE IN DIAGNOSIS.—Without attempting to treat the subject exhaustively, a few hints may be offered as to the diagnostic relations of tenderness, and as to the more prominent diseases and conditions in which the presence and degree of this symptom are of essential service in indicating their existence.

When pain is complained of, the presence or absence of tenderness, and its degree, may be of signal value in diagnosing the kind of painful sensations to which it belongs. For instance, it may be affirmed, as a general rule, that the pain of inflammation is accompanied with tenderness, and especially so if the condition is superficial, has ended in suppuration, or involves nerves. On the other hand a purely neuralgic pain is on the whole free from tenderness, and is not uncommonly relieved by pressure, although there are certain localised 'tender points' in some forms of this complaint, and these are also of significance. Hence, when pain is evidently seated in a particular nerve or nerves, pressure may determine whether they are actually involved in some inflammatory mischief, or merely functionally disordered. Again, the pain of muscular rheumatism, when not inflammatory, is often relieved by pressure; while spasmodic muscular pains are usually thus greatly alleviated, so that patients of their own accord press upon the affected part. In this way a very obvious and decided distinction is frequently afforded between spasmodic and inflammatory conditions involving the abdominal structures. Further, in connection with tumours and growths, those which are of a malignant nature are often accompanied by pain and tenderness, while those which are benignant may be said to be, as a class, free from such symptoms. Marked tenderness may be an important sign of destructive changes, such as those which occur in some diseases of joints, or as a result of the pressure of an aneurism or other tumour, where there is at the same time spontaneous pain. Very limited and obvious tenderness may indicate the seat of a foreign body, lodged in the soft parts or irritating them, especially if it should be pointed, as, for instance, a needle.

It must be remembered, in the next place, that tenderness may be a valuable diagnostic sign, when there is no complaint of pain on the part of the patient. For example, it may reveal joint-disease, not previously known to exist. The writer has found this symptom of great assistance in recognising the presence and situation of obscure limited disease in the abdomen, such as cancer, ulceration, or suppuration. It may also lead to the discovery of undetected suppuration. In the case of children who are too young to complain, but who, on account of their crying, may be supposed to be suffering, an unusual manifestation of pain during their examination must be carefully looked for and attended to, as useful information may thus be obtained. It may be mentioned that general tenderness is in some instances a striking symptom of commencing rickets in children. In the case of ulcers, in order to determine their condition for purposes of treatment, it is worth while to notice whether they exhibit tenderness, as well as its degree. Some ulcers are indolent, and scarcely at all sensitive; others are extremely irritable, and cannot be touched.

These illustrations will suffice for the general diagnosis of tenderness, and it now remains but to point out some of the complaints in which this symptom is peculiarly prominent. Amongst these may first be mentioned superficial inflammatory affections, such as acute erythema or erysipelas, and also any condition ending in suppuration. Peritonitis is usually attended with remarkable tenderness, either generally distributed over the abdomen, or localized, according to the seat and extent of the disease. Here, however, it is necessary to guard against being misled by certain hysterical cases, in which there is intense hyperæsthesia of the skin covering the abdomen, but the distinctions already pointed out should prevent any mistake in diagnosis. Gout affecting the joints is generally accompanied by exquisite tenderness, much more than in other forms of articular disease, although affections of the joints generally give rise to tenderness. Hysterical patients are again liable to mislead the practitioner in this direction, as they sometimes seem to be intensely tender about a joint, when there is really nothing the matter with it. There is also a peculiar complaint met with in these subjects, called 'spinal irritation,' in which exquisite tenderness is experienced along the spine, or over some of the spinous processes (*see* Spinal Irritation). Amongst other conditions which are attended by peculiar tenderness may be mentioned corns and bunions; neuromata; certain stumps after amputation; boils; whitlows; and many affections involving such sensitive structures as the eye, or the matrix of the nails.

Treatment.—In the first place, of course, the disease with which tenderness is associated must be treated independently of this particular symptom, although it may afford useful indications. For example, it may reveal suppuration, when an incision will give vent to the pus, and relieve the tenderness. For the nervous and hysterical conditions in which tenderness is a prominent symptom, general treatment directed to the particular condition present is essential. When a part is really tender, all pressure must be avoided, or even, in some instances, the mere touch of such articles as clothing or bed-clothes. For instance, in cases of acute inflammation of joints, or in peritonitis, it is of great service in treatment to raise the bed-clothes by means of cradles, so that they do not come into contact with the patient. Hot and cold applications, anodynes, and allied agents may be employed locally with good effect in many conditions for the purpose of diminishing undue sensibility. *See* Hysteria; Pain; and Spinal Irritation.

Frederick T. Roberts.

TENDON-REFLEX.—*See* Spinal Cord, Diseases of; page 1458.

TENDONS, Diseases of.—Synon.: Fr. *Maladies des Tendons*; Ger. *Krankheiten der Sehnen.*

Although simple in their structure, and performing a purely mechanical function of a passive kind, tendons and tendon-sheaths are liable to a considerable variety of diseases. In some instances these diseases are *primary*, and originate in the fibrous and synovial structure of the parts involved; whilst in other instances they are *secondary* to morbid conditions of the muscles, joints, and fasciæ with which the tendons are connected. The primary injuries and diseases alone call for notice here.

Injuries.—Tendons are subject to a variety of injuries as the result of violence, such as partial or complete rupture of the tendon proper; rupture of the sheath; dislocation; incised wounds; and, most common of all, sprain of its fibres.

Inflammation.—Inflammation of a tendon and its sheath may be traumatic in origin, but it frequently makes its appearance without obvious cause, and then constitutes one form of whitlow (*see* Whitlow). Certain effusions into the synovial sheaths may be regarded as of a chronic inflammatory nature.

Rheumatic affections.—Of greater frequency and importance are the affections of tendons and tendon-sheaths, which occur in acute and chronic rheumatism, in rheumatic arthritis, and gonorrhœal rheumatism. These will be found fully described in the several articles on those subjects. In acute rheumatism, and in the early stage of gonorrhœal rheumatism, the involvement of the tendon-sheaths may give rise to nothing more serious than pain and stiffness; but in protracted cases of the gonorrhœal affection, and in rheumatic arthritis, permanent changes may result, including contractions, adhesions, calcification, and even complete destruction.

Gout.—The tendons and their synovial sheaths are by no means an uncommon seat of gouty deposit. This condition is probably best marked in the extensor tendons of the hand, giving rise to a characteristic form of rigidity, or false anchylosis of the finger-joints.

Ganglion.—This affection is usually a local dilatation of a tendon-sheath, or a cystic formation in connection with it. In the opinion of the writer it is especially common in rheumatic subjects. *See* GANGLION.

Deformities.—The most obvious and the most common deformities involving tendons are of the nature of contractions, such as give rise to club-foot and distortions of the fingers. As a rule, these are the result of some of the morbid conditions already referred to, but in other instances they are of more obscure origin. Thus, in the so-called 'Dupuytren's contraction of the palmar fascia,' a highly characteristic deformity of the fingers and palm of the hand results from a kind of stricture of the sheaths of the flexor tendons of the fingers and wrist, due to shortening of the fibres connecting them with the palmar fascia. In several cases of this nature the writer has found marked thickenings of the extensor tendons also, where they are in relation with the inter-phalangeal joints.

New growths.—Various new growths of a fibrous, cartilaginous, osseous, or malignant nature have been found in connection with tendons.

SYMPTOMS.—The symptoms connected with diseases and injuries of tendons are chiefly of an objective and easily recognisable kind. The most obvious of these is impairment of movement of the tendon in its sheath, and of the associated muscles and joints. In its slightest degree, such impairment amounts only to stiffness; but when it is more marked, it may take the form of rigidity, or even complete loss of function. Deformities may then very readily arise in connexion with the joints, such as unnatural flexion or extension, or actual dislocation; whether referable to shortening of the tendon, to constriction of its sheath, to prolonged disuse of the joint, or to wasting of the associated muscles with over-action of their opponent groups. Similar results may follow rupture, wounds, or destructive ulceration of tendons.

Traumatic, rheumatic, and gouty effusions into tendon-sheaths give rise to swellings along their course, which are easily recognised if the anatomical relations of the parts be remembered, but which are probably often mistaken for intra-articular disease. Localised swellings on tendons, such as ganglia, nodules, and new growths, present unmistakeable characters.

The chief subjective symptoms connected with the diseases of tendons are pain and a feeling of stiffness. Both of these symptoms vary greatly in different instances, and neither is perhaps characteristic of affections of these structures, apart from the associated muscles, bones, and ligaments.

TREATMENT.—The treatment of diseases of tendons, where it is not of a strictly surgical nature, is fully described in the several articles in this work, to which reference has been made.

J. MITCHELL BRUCE.

TENESMUS (*τείνω*, I stretch).—SYNON.: Fr. *Ténesme*; Ger. *Stuhlzwang.*—A certain group of morbid sensations referred to the anus and its vicinity have been thus named. There is a feeling of fulness and weight, with frequent or constant inclination to go to stool, and straining during the act of defæcation, little or nothing being passed, and that often of the nature of slimy mucus or blood, while no sense of relief is experienced afterwards. Tenesmus is a common symptom in cases of dysentery. It may also be associated with local diseases about the lower part of the rectum or anus, such as piles, fistula, or malignant disease. Other sensations are often present at the same time.

TREATMENT.—Any local cause of tenesmus must be removed or cured, if practicable. The sensations are best relieved by local applications of heat or cold, or by the use of small enemata containing laudanum, or of suppositories of morphia or extract of belladonna.

FREDERICK T. ROBERTS.

TEPLITZ, in Bohemia.—Simple thermal waters. *See* MINERAL WATERS.

TERMINATIONS OF DISEASE. *See* DISEASE, Terminations of.

TERTIAN (*tertius*, the third).—A term applied to a form of intermittent fever, in which the paroxysms return on the third day, or at an interval of about forty-eight hours. *See* INTERMITTENT FEVER.

TERTIARY (*tertius*, the third).—This word is usually associated with the advanced forms of syphilitic disease. *See* SYPHILIS.

TESTES, Diseases of.—SYNON.: Fr. *Maladies des Testicules*; Ger. *Krankheiten der Hoden.* The diseases of the testes will be discussed in the following order:—1. Abnormalities of development; 2. Hypertrophy; 3. Atrophy; 4. Injuries; 5. Acute Inflammation; 6. Chronic Inflammation; 7. Hernia Testis; 8. Cystic Disease; 9. Fibroma; 10. Chondroma; 11. Malignant Disease; 12. Teratoma; and 13. Neuralgia.

1. **Abnormalities of Development.**—(*a*) *Absence.* There may be complete absence of the testicles. The subjects of this imperfection, if they attain the age of puberty, present the ordinary characteristics of eunuchs. As the complete gland is formed from two distinct parts, the failure or arrest of development may be limited to either part, separately from the other. Thus cases are described where a well-developed vesicula seminalis and vas deferens have been found, without any trace of a testicle; and others,

where a testicle existed with complete or partial absence of the vas deferens.

(*b*) *Excess.*—Supernumerary testicles have been described, and men not unfrequently believe themselves to be so gifted. The mistake has arisen from the presence of encysted hydroceles, or of fatty or fibrous tumours of the cord, or of an old epiplocele. There is no well-authenticated case recorded of the presence of more than two testicles.

(*c*) *Malposition.*—The testicles, which are developed in the abdomen, immediately below the kidneys, are at birth, or shortly after, lodged in the scrotum. This change of position is frequently described as 'descent of the testicle,' an obvious misuse of words, if regard be paid to the usual position of the fœtus in the uterus.

The testicle may be retained in the *abdomen*, or in the *inguinal canal*; or may pass through the inguinal canal into the *perineum*, and be lodged between the bulb of the urethra and the anterior part of the tuber ischii, or over the external pillar of the ring into the subcutaneous tissue of the *upper part of the thigh*; or may pass through the crural canal to the *upper and inner part of the thigh*; or, if it has passed into the scrotum, may be *rotated*, so that the epididymis is in front and the testicle behind. More rarely it has the long axis transverse instead of oblique; or it may be completely inverted, so that the globus major is below, the globus minor above.

Retention in the abdomen or inguinal canal may be the result of adhesions from intra-uterine inflammation, or of disproportion between the gland and the orifices through which it has to pass, or of some constricting band. The passing through the crural canal to the thigh, or through the inguinal canal to the perineum or thigh, must be the result of some unusual attachment of the lower end of the gubernaculum. Malposition in the scrotum must be caused by some abnormality in the development of the cord.

The consequences will vary with the position. If the testicle is retained in the *abdomen*, the corresponding half of the scrotum remains undeveloped, and the gland is always much smaller than normal. Sometimes there is an arrest of development, or it undergoes fatty or fibrous degeneration, or if otherwise normal, does not secrete a fertilising fluid. This seems fairly established by numerous observations, both in men and the lower animals, where the testicle has been abnormally retained in the abdomen. One case, however, has been recorded by Hutchinson, where the observer, to whom the retained testicle was submitted for microscopic examination, stated that he found numerous spermatozoa.

When the testicle lies at the internal inguinal ring, the epididymis is frequently found partly in the badly-developed scrotum, into which also extends the processus vaginalis. As the communication between this and the peritoneal cavity is usually maintained under such conditions, in case of peritonitis with peritoneal effusion there may be distension of this process, so as to greatly simulate a hernia, and render an exploratory examination necessary.

Retention of the testicle in the *inguinal canal* is more liable to complications than retention in the abdomen. It is often accompanied by inguinal hernia; is more exposed to injury; and when enlarged at puberty, or by inflammation, may cause severe pain from constriction by the surrounding parts.

Inflammation of a testicle retained in the inguinal canal has been mistaken for strangulated bubonocele, or for a bubo. Careful examination of the scrotum should, therefore, be made in doubtful cases.

Retraction can usually be distinguished from retention of the testicle by the state of development of the corresponding half of the scrotum.

The *perineal* or *femoral* position of the gland is not of necessity attended with any bad results. A testicle, however, so situated, is usually smaller than normal and is more exposed to injury. This is especially the case in the perineal position.

Treatment.—If retention of the gland in the inguinal canal be attended with any inconvenience, operative interference may succeed in placing it in the scrotum. But if this should fail from shortness of the cord, extirpation would be necessary. When in infants retention of the testicle is complicated by an inguinal hernia, the use of a truss is not to be recommended, as it will prevent the possible descent of the testicle, and the hernia not infrequently spontaneously subsides. If the retention of the gland be permanent and cause inconvenience, it is better to remove it at once. If the gland have passed through the crural canal, nothing can be done to remedy the malposition; but when it has passed through the inguinal canal into the perineum or the thigh, an attempt may be made to place it in the normal position. In an adult, such a proceeding would be hopeless, from the non-development of the scrotum. In infants, the attempt has been twice made at the London Hospital, by Curling and James Adams. Both cases died, and in the second, in which alone a *post-mortem* examination was allowed, acute peritonitis was found, which had extended from the pervious processus vaginalis. With antiseptic precautions, however, better results might be anticipated.

Mr. John Wood has successfully transplanted in an infant a testicle from the perineum to the scrotum subcutaneously. When a band of tissue in the perineum, probably the gubernaculum, had been divided with a tenotomy knife, the gland could be pushed up to the inguinal canal, and from thence into the scrotum, where it was retained by a harelip-pin passed above it as in acupressure. This method, when practicable, would be unattended with danger. But as sometimes the unaided efforts of nature draw the gland from the perineum up to the inguinal ring, where it is comparatively safe from injury, and more favourably situated for any attempt at removal to the scrotum, it is advisable always in infants to allow time for such a possible modification, which might moreover be encouraged by electric stimulation of the cord.

Of malpositions in the scrotum, that where the epididymis is in front, and the testicle proper behind, is alone of any practical importance. In any operation for hydrocele or hæmatocele of the tunica vaginalis, the position of the testicle ought first to be ascertained.

(*d*) *Arrest of Development.*—This sometimes occurs after the testicles have passed into the scrotum, so that these glands remain permanently in their infantile condition. No general cause has been discovered for this abnormality.

2. **Hypertrophy.**—When only one testicle has been retained in the abdomen, the other sometimes attains an unusually large size. Such cases of, as it were, compensating development, are, however, the exception and not the rule.

3. **Atrophy.**—Wasting of the testicle may result from inflammation, or from lesions of the spinal cord caused by injury or disease, or subsequently to injuries of the head. It may also be produced by early and excessive venereal excitement; or by deficient blood-supply, due to aneurism or other causes. It is frequently found associated with varicocele.

4. **Injuries.**—These glands are greatly protected from accidental violence by their mobility, and the laxity of the surrounding structures. Immediate death has resulted from severe contusions of the testicle, probably from reflex inhibition of the action of the heart. Contusion and wounds require appropriate surgical treatment.

5. **Acute Inflammation.**—When acute inflammation attacks the body of the gland solely or chiefly, it is called *orchitis*; when the epididymis, *epididymitis*. For the comparatively rare cases in which the vas deferens, or this duct along with the other structures of the spermatic cord, is affected, without the testicle being implicated, the barbarous hybrids, *deferenitis* and *funiculitis* have been coined.

Ætiology.—Acute inflammation may be caused by direct violence, or by the extension of inflammatory processes from the mucous membrane of the urethra. It may also occur, though rarely, as a sequela in small-pox or in pyæmia. It is not infrequently a concomitant of parotitis or mumps.

Of these varieties, the most frequent is gonorrhœal epididymitis. This was at one time regarded as an instance of 'sympathetic inflammation.' Careful examination will, however, always prove that the vas deferens is also affected, though sometimes in so slight a degree that its participation in the inflammation might easily escape notice. This form is, therefore, due to direct extension of the inflammation of the urethral mucous membrane. Orchitis associated with mumps has been generally regarded as an instance of 'sympathy,' or 'metastasis.' Kocher, however, considers it to be the result of urethritis. According to this experienced observer, the disease commences as stomatitis, by which the parotid, or sometimes the submaxillary and neighbouring lymphatic glands become infected. The morbid material is carried by the blood to the kidneys, and in its course through the urinary passages sets up cystitis or urethritis, and thus the orchitis results. The question cannot, however, be regarded as finally decided. Orchitis and epididymitis sometimes occur in rheumatic or gouty subjects. Occasionally cases are met with in which no exciting cause can be discovered.

Symptoms.—The symptoms of orchitis are local pain and swelling, with, in cases of orchitis sometimes, and in cases of gonorrhœal epididymitis frequently, redness and tension of the corresponding part of the scrotum. Severe lumbar pain is in some cases felt, especially by labouring men, who apply for relief on account of some supposed sprain or injury, being either ignorant of, or attaching no importance to, the affection of the testicle. This is probably due to inflammation of the lumbar lymphatic glands, with which the lymphatics of the testicle freely communicate; but it may possibly be an example of 'referred sensation.'

Prognosis.—The prognosis is good. The inflammation usually subsides speedily, and leaves the gland in a healthy condition. Atrophy sometimes results after inflammation associated with mumps, or caused by severe contusion. Chronic induration of the epididymis may persist; but after some months it usually disappears. Stricture of the epididymis, or of the vas deferens, is very rare. Suppuration does not occur except in pyæmia, or after small-pox, or in strumous and very enfeebled persons.

Treatment.—Rest in the recumbent position, with the scrotum supported by a crutch-pad, and the application of ice locally, are in ordinary cases sufficient. Where rest is impossible, well adjusted strapping of the part affords considerable relief, and promotes absorption of the products of inflammation so rapidly as not infrequently to necessitate the re-application of the strapping within twenty-four hours. Attention to diet and avoidance of all violent exercise will be requisite. In more protracted cases, mercury, taken in small doses internally, or applied locally by inunction, or on strapping, will be found of benefit. The practice, recently recommended by some eminent surgeons, of puncture or incision of the ordinarily inflamed gland, is, according to the writer's experience, never necessary. If suppuration, however, occur, a free incision should be made as early as possible.

6. **Chronic Inflammation.**—Chronic orchitis may sometimes be the result of an acute attack, but is much more frequently induced by *syphilis*, *struma*, or *gout*.

(*a*) *Syphilitic Orchitis.*—Description.—This may occur in young children who are the subjects of inherited syphilis, in the form of hard nodules in the testicle. In adults it belongs to the tertiary stage of the disease, but is very often symmetrical. It is usually painless, the patient being frequently ignorant of its existence. The gland is enlarged, very hard, insensitive to pressure, and often nodular in form.

Treatment.—This form of orchitis is usually very amenable to treatment, but has a tendency to recur. Iodide of potassium combined with mercury in small doses internally, when it can be tolerated, and strapping locally, will in most cases produce rapid disappearance of the disease, for a time at any rate. Atrophy may sometimes result; and in some cases suppuration, with the formation of troublesome sinuses, may occur. In one case under the notice of the writer, which was complicated by an inguinal hernia, the gland had, after very prolonged and unsuccessful treatment, to be removed, as the use of a truss caused great pain, and the non-use of it led to a dangerous descent of the hernia.

(*b*) *Strumous Orchitis.*—In most systematic works on surgery tubercular disease of the testicle is given as a distinct affection, but the descriptions of it are very confused, no two being in perfect agreement. This is partly because at one time the presence of caseous matter was regarded as evidence of tubercle, and partly because in many cases microscopic examination of the gland after its removal can alone determine the nature of the disease. Tizzoni and Gaule have, therefore, proposed to substitute the term 'phthisis' for 'tuberculosis' of the testis, since in this organ, as in the lungs, tubercular and non-tubercular processes, either separately or concurrently, run the same course.

Symptoms.—Tubercular disease of the testis is not rare in young children, and usually commences in the body of the gland. It occurs, however, much more frequently after puberty, and then commences, in the majority of cases, in the epididymis; the body of the gland and the vas deferens becoming subsequently infected in the progress of the disease.

A nodular swelling is found either in the gland or in the epididymis, which is usually only slightly, if at all painful, and runs an indolent course. After a longer or shorter time, this softens down into an unhealthy pus; adhesion and perforation of the superjacent structures ensue; and a fistula is formed. This condition may continue for a long time, but usually the disease extends to the rest of the glandular apparatus. Sometimes the testicle is very much enlarged. The vas deferens, if affected, may either be uniformly thickened, up to the inguinal ring; or present a number of distinct round or spindle-shaped enlargements. The prostatic portion of the duct and the vesicula seminalis are frequently similarly affected. Digital examination of these parts, through the rectum, ought therefore always to be made.

Treatment.—The treatment of strumous orchitis consists in careful attention to diet and hygienic conditions; in the use of cod-liver oil and iodide of iron; and in the protection of the part from accidental injury by a suspensory bandage. Abscesses should be opened as early as possible, and any fistula either laid open by incision or dilated by laminaria, and treated with stimulating lotions, such as nitrate of silver, of the strength of five grains to the ounce. In favourable cases the disease may be arrested, but in many cases removal of the gland becomes necessary. If the epididymis and the vas deferens are much involved, the gland, by obliteration of its duct, is functionally useless; and as there is always considerable risk of infection of the system generally, early removal of the gland is, in such cases, to be recommended. If the prostate and vesicula seminalis have become affected, this would, of course, be useless.

There is another form of caseous orchitis, not of tubercular origin, in which the intertubular lymphatic spaces of the testis become filled with a new growth of lymphoid tissue, by which the seminal tubules are ultimately compressed and destroyed. This may become transformed partly into fibrous tissue, but in the greater part usually undergoes fatty degeneration, forming caseous masses, which subsequently break down into curd-like pus. The symptoms are very similar to those of the tubercular disease, but there is not the same danger of general infection of the system.

(*c*) *Gouty Orchitis.*—Chronic orchitis from gout can be diagnosed by the history of the patient, and yields readily to the ordinary treatment for gout, but is very apt to recur.

7. **Hernia Testis.**—This morbid condition was formerly known as 'benign fungus of the testis.'

Description.—It consists of a fungous protrusion from the scrotum, of a red or yellowish-red colour, and varies from the size of a pea to that of a small egg. There are two varieties, which may be distinguished as *superficial* and *deep*. The superficial form springs from the visceral layer of the tunica vaginalis, and is very comparable to the fungous granulations occasionally met with in cases of suppuration, or in wounds of the synovial sheaths of tendons. In this the tunica albuginea is intact, but probably altered in structure. In the deep form the tunica albuginea has been perforated, and the protruded mass consists largely of seminal tubules. It cannot be regarded as an evidence of any special disease of the gland, as it may occur, but by no means necessarily, after any form of orchitis in which there has been suppuration.

Treatment.—The treatment consists in well-adjusted pressure upon the protrusion; with the occasional application of caustics, such as nitrate of silver or red oxide of mercury. Freeing the margins of the opening from adhesions, and bringing the thus liberated integument over the protrusion by means of sutures, is usually very successful. When the precedent inflammation has been due to some specific cause, the appropriate constitutional treatment must also be employed.

8. **Cystic Disease.**—Cysts are frequently found in the testicle, either separately or associated with other growths.

Description.—In true cystic disease or simple cystoma, the whole or part of the body of the testicle is replaced by a closely aggregated mass of cysts, of very variable size. Some are so minute as only to be visible on microscopic examination, while others may attain to the dimensions of a pigeon's egg. When only part of the gland is so affected, healthy glandular substance is found at the periphery, enveloping the cystic growth. The cysts have no proper wall, and are lined with shallow cylindrical epithelium, which is sometimes ciliated. They are filled with either clear watery, or sometimes very viscid, fluid; or with atheromatous matter, resembling the contents of a sebaceous cyst. Very frequently nodules of cartilage are found interposed between the cysts. The disease usually occurs in adults, but one case has been recorded where the enlargement was first observed at the age of three months. The structure seems to indicate very clearly the origin of the cysts to be from retention within the rete testis.

There is another form of cystic disease, where the cysts are separated by a considerable quantity of gelatinous connective tissue, and often contain polypoid ingrowths, which sometimes completely fill their cavities. The tumour is often as large as a child's head. This form is regarded as cystic adenoma of the gland.

Cysts of the epididymis have been described in the article on Hydrocele.

Symptoms.—Cystic disease of the testicle is usually attended with very little pain. The tumour is of an oval form, either with a smooth surface, or with irregular elevations; and does not attain a very considerable size, being generally about as large as a goose's egg. There is an indistinct sense of fluctuation, unequal at different parts.

Diagnosis.—Cystic disease has sometimes been mistaken for hydrocele or hæmatocele. The form of the tumour, its relatively greater weight, the absence of transparency, and the impossibility of detecting the body of the testicle at any part, distinguish it from hydrocele. The distinction from hæmatocele is in some cases more difficult. If exploratory puncture be considered requisite, a full-sized instrument should be used, as the fluid may be so viscid as not to flow through a small cannula.

Treatment.—Castration is the only remedy for this condition.

9. Fibroma.—Fibrous tissue is found in abnormal quantity in atrophy of the testis, in chronic orchitis, and associated with new growths. By fibroma of the testicle, however, is meant a new formation of fibrous tissue to a considerable extent, without any other important change. In structure it resembles fibrous tumours of the uterus. It so rarely occurs, however, as to practically be devoid of clinical importance.

10. Chondroma.—Cartilage, usually of the hyaline, but sometimes of the fibrous variety, is found in association with many new growths in the testicle. Pure chondroma is comparatively rare.

Description.—This form of tumour of the testis occurs as disseminated nodules, connected by fibrous tissue; or as elongated masses with branching processes. By compression of the seminal tubules, it leads to dilatation of other parts of the tubules; and by invagination of the walls of such dilatations, the growth often seems to be in the interior of a tubule. Careful examination, however, will always prove it to be of extra-tubular origin. It similarly invades the lymphatics, and through them has a great tendency to infect other parts of the system. It is often associated with myxoma; and sometimes, though rarely, it develops into bone. It can only be diagnosed with any certainty when the tumour has attained a large size, and is then characterised by the hardness and slow growth of the mass.

Treatment.—Castration is the only treatment; and in consequence of the tendency of this disease to invade other organs, the rule laid down by Mr. Carling is the best—'to recommend an operation without unnecessary delay, in all cases of large sarcocele which do not give any indication of yielding to treatment.'

11. Carcinoma and Sarcoma.—These are classed together, because, though histologically of very different origin, the distinction between them in any individual case is often impossible, except by microscopic examination of the tumour after removal. Even then the distinction is sometimes impossible, if we may judge from the description of recorded cases of mixed sarcoma and carcinoma.

The latter originates in the epithelial structures of the gland, and is almost invariably of the encephaloid variety. Scirrhus is said by all writers to occur sometimes, and so-called specimens are in many museums. According to Butlin, however, many of these are probably examples of fibrous sarcoma. Encephaloid cancer usually commences in the body of the testis, by the formation of one or more nodules. Sometimes the epididymis is first attacked. Very rarely is there general infiltration of the gland. In an early stage of the disease the gland is hard, from tension of the tunica albuginea, but when this has been destroyed in the progress of the growth, the mass is soft, and there is often distinct fluctuation. This may be unequal at different parts, from the presence of cysts. The growth is usually painless, but in some cases there is acute pain, either locally or in the lumbar region. The chief aids to diagnosis at this period are the rapidity of the growth, the enlargement of the blood-vessels of the cord, and the age of the patient. For while encephaloid cancer has been met with in young children and old people, still the vast majority of recorded cases have occurred between 20 and 40 years of age.

If the tumour attain a very large size, the scrotum may slough, and a bleeding fungus protrude. The disease has a great tendency to invade other parts of the system, and especially at an early period the lumbar lymphatic glands. This may lead to œdema of the lower extremities, from pressure on the abdominal veins. The inguinal glands generally escape infection, except in some cases where the scrotum has been involved in the disease. Secondary growths have been found in the mesenteric glands, liver, spleen, and lungs.

Sarcoma originates in the connective tissue of the testicle, and sometimes develops in both glands simultaneously. With microscopic examination two varieties can be distinguished, the round and the spindle-celled. The latter grows more slowly, and both are often associated with cystic and cartilaginous formations. The symptoms are very similar to those of cancer.

Sarcoma sometimes commences in the tunica vaginalis, and is then usually accompanied with extravasation of blood into the sac. The writer has met with two such cases, where the shape of the tumour, the complete absence of pain, the history of gradual enlargement, and the very distinct fluctuation were suggestive of hæmatocele. Exploratory examination, however, proved them to be cases of sarcoma. Castration was performed, and the testicles were found to be only slightly affected by the disease. Both cases died within a short period after the operations, from secondary affection of other organs, accompanied by similar hæmorrhages.

Melanoma of the testis was formerly regarded as a form of cancer, but is now considered to be sarcomatous. It is extremely rare, and in the few recorded cases of it, similar growths were found in many other organs of the body.

rinity Medical College.

Diagnosis.—As a general rule it may be stated that sarcoma occurs most frequently under ten and after forty years of age; and that the epididymis is more frequently the primary seat of the disease, and, when secondarily involved, is attacked at an earlier period than in cancer. The distinction in any individual case must, however, be very uncertain, and is of little importance.

Prognosis and Treatment.—The prognosis is very unfavourable in both, as recurrence of the growth in other organs after the removal of the tumour is the rule to which there are but few exceptions. Castration is the only possible treatment for both diseases.

12. Teratoma.—The testis, like the ovary, may be the seat of cysts, containing hair, skin, bones, &c. The cysts are sometimes within, sometimes upon the gland. The more complex cases may be best explained as resulting from the inclusion of a second fertilised germ; while the simpler cases may be due possibly to the accidental grafting of the germs of such tissues on the rudimentary testicle. The history of a congenital tumour will suffice to direct attention to any such case. They are very rarely met with, and castration is the only suitable treatment.

13. Neuralgia and Irritability.—The testicle is sometimes the seat of very acute persistent or periodically recurring neuralgia. This must be distinguished from hyperæsthesia or irritability of the gland, which is occasionally associated with varicocele, or may be the result of self-abuse, excessive venery, or even of unsatisfied sexual excitement. Neuralgia may be due to some local cause, to varicocele, or to induration of some part of the glandular apparatus from precedent inflammation. It may also be sympathetic, as in renal colic, or where the digestive system is disordered. Occasionally no cause can be discovered, and we have to assume that it is due to some affection of the central nervous system.

Treatment.—When of local origin, the treatment of neuralgia of the testis must be directed to the removal of the cause; and if all other methods fail, and the pain be severe enough to warrant it, castration may be required. When due to affections of other parts of the body, the treatment must be regulated accordingly.

Hyperæsthesia of the gland usually yields in time to tonics, and attention to ordinary hygienic conditions. Jeremiah McCarthy.

TETANUS.—Synon.: Lock-jaw; Fr. *Tétanos*; Ger. *Starrkrampf.*

Pathology and Ætiology.—Our knowledge regarding the pathology of tetanus is very limited, but the symptoms which characterise this affection are undoubtedly referable to an abnormal influence of the nervous centres which control the action of the voluntary muscles. Dr. C. Allbutt and other observers have described the pathological changes in the spinal cord, after death from tetanus, to consist of intense congestion of the tissues, with structureless exudations, especially in the grey matter; it is difficult to determine, however, whether these changes are the causes, or simply the effects, of the abnormal nerve-action which characterises tetanus. Most of us have formed some conception of the nature of this disease, from the analogy which exists between the effects of poisonous doses of strychnia and the spasms of tetanus; but we have no grounds whatever for supposing that the *modus operandi* of nux vomica on the nervous system is the same as the cause, whatever it may be, which induces tetanus. On the other hand, there is much in the phenomena presented by some instances of traumatic tetanus, to lead us to think that the violent contraction of the muscles in this disease is due to irritation set up in the peripheral distribution of a nerve, and that this hyper-action once established is conveyed along the nerve to the spinal cord, exciting by reflex action the muscles near the injured nerve to a state of spasm. The irritation subsequently extends, and so the whole length of the spinal cord becomes implicated, a slight impression on the skin producing general tetanic convulsions. In support of this theory as to the origin of the disease, a few cases have been recorded in which division of the principal nerve, or in other instances the stretching of a nerve leading from a wound, has completely stopped an attack of tetanus. And in some cases the writer has certainly seen tetanic spasms commence as if by reflex action; for instance, after tying a large bleeding pile, the patient, within thirty-six hours of the operation, complained of spasms of the sphincter ani muscle, and although the ligature was instantly removed, nevertheless the disease ran a very rapid and fatal course.

On the other hand, the circumstances of tetanus, when considered in all their bearings, point to some influence at work which is different in its nature from that of ordinary reflex action. It is the exception rather than the rule for the muscles in the neighbourhood of the wounded part to be first involved in the disease, as they probably would be if it arose from a purely reflex action; it matters not where the seat of the injury may be, in by far the greater number of cases the muscles of the face are affected before those of any other part of the body. In numerous instances of tetanus the writer has noticed, for twenty-four or forty-eight hours before spasms of the muscles have set in, that the patient's face has presented a pinched appearance, which is very characteristic of the disease, depending on rigidity of the muscles of expression. Various groups of muscles are subsequently involved, in the following order—those of mastication, the neck and back, the muscles of respiration, and lastly, those of the extremities. So generally is this the order in which the muscles are implicated, that the writer is disposed to think that, whatever the pathology of the disease may be, the morbid influence which produces it commences in the medulla oblongata, and extends to the spinal cord. Lastly, the writer has met with many severe cases of tetanus among persons in whom it was impossible to discover any wound or abrasion of the skin or mucous membranes of the body,[1] and in instances of this description it is difficult to account for the symptoms of the disease on the theory that it depends on reflex action.

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[1] In the surgical wards of the Mayo Hospital, Calcutta, within a period of five years, 83 cases of tetanus were treated. Of these, 44 cases were traumatic, and 24 died. Of the remaining 39 idiopathic cases, 10 died.

It seems very certain that local circumstances and meteorological conditions greatly influence the occurrence of tetanus. In the tropics, the disease is far more frequently met with than in other parts of the world. It is seldom absent from the Calcutta Hospitals, and in some seasons appears to prevail as an epidemic. It is, in fact, a matter of common observation in Bengal, that after sudden changes of temperature cases of tetanus appear among surgical patients; so that, while admitting that in many instances of tetanus wounds are the immediate cause of the disease, we cannot overlook the fact that a chill is frequently an immediate antecedent. The disease attacks persons of all ages; it occurs occasionally among infants immediately after birth, but more commonly commences a few days after the remains of the umbilical cord have separated from the child's body. Men are more subject to tetanus than women. In the tropics the disease is by no means uncommonly seen among horses, especially after they have undergone the operation of castration.

Symptoms.—Tetanus almost invariably commences, in man or the lower animals, whether it is of traumatic origin or otherwise, in rigidity of the muscles of expression. In the course of a few hours the muscles of mastication and of the head, neck, and back become involved, so that the patient experiences difficulty in opening his mouth, or in moving his head from side to side; and deglutition is impeded by spasmodic contraction of the pharynx. The rigidity of one or more of the groups of muscles above referred to is constant throughout the whole course of the disease; but in addition to this, from time to time these muscles are thrown into the most frightful spasms; in this way the patient's body is sometimes bent like a bow, the whole weight of the trunk being supported on the back of his head and heels. The abdominal and thoracic muscles are also implicated, and hence the patient's belly is tense and hard, and the walls of his chest expand imperfectly in the effort of breathing. The muscles of the arms and legs are often extremely rigid, and convulsed in a most violent manner; they are the seat of terrible pain. The interval between the paroxysms of spasm of the affected muscles is very uncertain; sometimes the cramps last only for a few seconds, at other times for five and even ten minutes. The most dangerous cases of tetanus are evidently those in which the muscles of respiration are principally involved, for death is generally caused in this disease by the interference with the respiratory process, the chest being, as it were, compressed in a vice (Watson). In consequence of the condition of the muscles of the neck and thorax, the sick person is unable to speak, but his intellect generally remains clear up to the last, nor are the other functions of his body materially deranged. The patient suffers much from hunger and thirst, which he is unable to alleviate; and, above all, he longs for sleep, which is frequently denied him in consequence of the recurring spasms. The surface of the skin is bedewed with perspiration; and the pulse rises and falls with the intensity of the spasms, and the duration of the disease.

Course and Duration.—Tetanus is one of those maladies which run a definite course, although its duration is not so precisely defined as that of some other diseases; in some cases it may kill the person affected in the course of a few hours, but in the greater number of instances patients die of tetanus from the seventh to the eleventh day after the commencement of the disease. If they survive the twelfth day, the malady, as a rule, gradually subsides; and the patient may usually be pronounced cured in twenty-five days from the commencement of the attack; but he often suffers for many weeks subsequently from rigidity of the muscles which have been involved in the tetanic spasms.

Prognosis.—The writer has for some time past relied much on the thermometer, not only as a means of forming a prognosis, but as indicating to some extent the treatment to be followed in tetanus. Doubtless in some of the worst instances of this disease the thermometer fails us; for if the muscles of respiration are very much affected, as they are in the most severe cases, the process of combustion within the body is so much interfered with that its temperature is not kept up to the degree it should be, in proportion to the violence of the muscular action. Nevertheless, as a general rule, in instances of tetanus, so long as the thermometer indicates that the temperature of the patient's body is under 101° Fahr., we may remain easy regarding the issue of the case. If the mercury rises in the instrument beyond 101°, there is impending danger; and if it reaches 103°, the case is one to cause us the greatest anxiety. After death from this disease the writer has found the temperature of the body to rise as high as 107°.

Treatment.—One of the most remarkable facts connected with tetanus is the almost incredible amount of Indian hemp and opium which persons suffering from it will swallow, without producing their poisonous effects on the system. The writer has prescribed these drugs in very large doses, but has failed to satisfy himself that they influence for good the progress of the malady. He has also given the Calabar bean a fair trial in tetanus; but unless it be pushed to the extent of rendering the patient collapsed, the temperature of his body falling perhaps to 94° or 95°, and the pulse being hardly perceptible at the wrist, he has found that this medicine hardly affects the spasms of tetanus in severe cases, whilst in the milder forms of the disease there is no necessity for resorting to such a dangerous means of cure. In fact, we know of no system of treatment which will cut short the progress of a case of tetanus, and, therefore, the indication is to employ all our efforts to keep the sick person alive during the illness through which he is passing. As means to this most desirable end, we must feed him, and, if possible, secure him at least some eight hours' sleep during the day. With respect to food, the patient must be made to swallow about four ounces of milk every four hours; one egg, or half an ounce of the juice of raw meat, being mixed with the milk, morning, noon, and evening. If the pulse indicates great exhaustion, beef-tea and brandy may be given as an enema, in addition to the above-mentioned food. In cases of tetanus the teeth are often so firmly locked together that it is necessary to insert one's fingers between the closed jaws and the cheeks, and pour the milk into the cavity thus formed; the liquid will trickle between and behind the patient's teeth, and pass down his throat. Some of it may occasionally run into the trachea, and cause considerable spasm, but the writer has never seen any more serious result follow from this. If the patient can swallow with comparative ease, arrowroot may be mixed with the milk; a man can live very well on a diet of this description for some twenty-five days.

With reference to drugs, the writer knows of no medicine which procures sleep so well as the hydrate of chloral in cases of tetanus. It should be administered in 40-grain doses (to an adult) at bedtime; and in severe cases of the disease (the temperature of the patient's body rising to upwards of 101°) an additional 30 grains of chloral should be given at mid-day. However serious the case may seem to be, we should rigidly adhere to the plan of treatment above described, the urgency of the symptoms not causing us to deviate from our attempts to make the patient swallow a sufficiency of food, and of the hydrate of chloral, to enable him to struggle through the malady from which he is suffering.

C. Macnamara.

TETANY.—Synon.: *Tetanilla*; Idiopathic muscular spasm; Fr. *Tétanos intermittent.*

Tetany is a neurosis originally described by Dance in 1831, and more or less fully described since under many names, especially in France. It is probably much more common in that country than in England, where it is very rarely met with. It is mostly a comparatively trivial and temporary malady.

Ætiology.—The disease is associated with no recognised organic changes in any part of the nervous system, and much uncertainty prevails in regard to its causation. It occurs mostly between the ages of 15 and 30 years, though it may show itself in older people, as well as in young children, and even in infants. It occurs in either sex, but is more common among females. Persons of a neurotic temperament, or those whose constitutions have been disturbed or weakened from many causes, are specially liable. Teething, the establishment of menstruation, chronic diarrhœa, lactation, the state of convalescence from many acute diseases, are all conditions which predispose to this affection; whilst exposure to cold, and emotional disturbance seem to act as the most common exciting causes.

Symptoms.—The morbid manifestations consist, in the main, of tonic spasms, frequently recurring for brief periods in one or other part of the body, painful in character, and unaccompanied by loss of consciousness. The attacks in different individuals vary widely, the spasms being sometimes quite local, and sometimes involving many different regions of the body.

In the *slighter kinds* of attack, a numbness and tingling is felt in the fingers and toes, which speedily become fixed in tonic spasm. As the spasms strengthen, they may extend to higher parts of the limb, and become painful. The fingers are drawn together and slightly flexed, the thumb is bent into the palm, and the wrist slightly flexed. The toes also are drawn together and towards the sole, the big toe being drawn under them. The dorsum of the foot is arched and the heel pulled up, whilst the leg and thigh are more or less rigidly extended. One or more of the limbs may be affected in this way, or if all are implicated, it may be simultaneously or successively. This condition of things lasts for a few minutes, or even for an hour or two, accompanied often by severe pain along the nerve-trunks, and by some diminution of sensibility in the parts affected. When the attack is about to terminate formication sets in, as at the commencement of the spasm. After variable intervals the attacks are renewed, it may be in an hour or two, or only after several days. Such paroxysms may be frequent during several months; and, according to Trousseau, so long as a tendency to recurrence of the spasms exists, they may always be excited anew by simply 'compressing the affected parts, either in the direction of their principal nerve-trunks, or over their blood-vessels, so as to impede the venous or arterial circulation.' On the other hand, the application of cold to the parts affected frequently arrests the spasms for a time.

In the *more severe forms* of tetany, the attacks may begin in the way above indicated in the upper extremities, next in the lower extremities, and then, whilst diminishing in the parts first affected, they may extend more or less generally to the trunk muscles. The contractions are invariably more or less painful. The spasms may even spread to the facial muscles, so that the jaws may be firmly clenched, and speech greatly embarrassed. If the muscles of the larynx are involved, as well as those of the chest and abdomen, extreme dyspnœa may be induced. Still there is no loss of consciousness. These attacks may be of brief duration; or they may be extreme in degree, long-continued, and frequently repeated. In such severe cases there is slight elevation of temperature, with greatly quickened pulse, and a furred tongue. After some weeks or months the paroxysms usually become less severe, less frequent, and finally cease altogether.

Diagnosis.—The diagnosis must be based upon the progressive character of the attacks; upon the fact that they begin in the upper and lower extremities, and after a time completely intermit; upon the absence of all loss of consciousness during the attack; and upon the fact of the possibility of reinducing the paroxysms by pressure upon the nerves or vessels of the parts affected. These characters will suffice to distinguish the affection from tetanus, epilepsy, and hysteria.

Prognosis.—The prognosis is usually favourable, the complaint gradually subsiding after a few months. Still, in very exceptional cases, the patient may die asphyxiated during one of the extremely severe attacks.

Treatment.—The treatment of tetany should in the main be directed to the improvement of the patient's general health, and the diminution of all debilitating conditions or causes of irriation. At the same time, we must endeavour to lessen the general mobility of the nervous system, by seeing that the patient obtains regular and sound sleep, as well as by the administration of the bromides in suitable doses, in combination with valerian, musk, conium, or other antispasmodic remedies.

H. Charlton Bastian.

TETRASTOMA RENALE (*τέτρα*, fourfold; *στόμα*, a mouth; and *ren*, a kidney).—A form of entozoon found on one occasion in the urine of a patient by Lucarelli, and described by Delle Chiaje. See *Entozoa*, by Dr. Cobbold, Lond., 1864.

TETTER.—Tetter is an old Saxon word, equivalent to the French *dartre*. Tetter is defined to be 'a tickling and itching scab,' and may be taken to signify a chronic inflammation of the skin, attended with desquamation and itching. In this sense the term is popularly applied to patches of chronic eczema, and especially to those of psoriasis; but it is altogether too indefinite in its meaning for scientific use.

Erasmus Wilson.

THALAMUS OPTICUS, Lesions of.—Synon.: Fr. *Maladies des Conches optiques*; Ger. *Krankheiten der Sehhügel.*

Introduction.—Diseases of the optic thalamus vary in their symptomatology according as the lesion is strictly limited to the ganglion itself, or implicates also neighbouring structures.

In the former case it is apparently well established, by numerous recorded cases, that lesions, such as apoplectic cysts, or areas of softening, may exist without producing any discoverable symptoms, either in the domain of motility or sensibility, general or special. This is more particularly the case when the lesions occupy the convexity or ventricular aspect of the optic thalamus.

But more frequently diseases affecting the optic thalamus implicate also, directly or indirectly, the corpus striatum, internal capsule, crus cerebri, or corpora quadrigemina. Owing to the community of vascular supply between the corpus striatum and optic thalamus through the opto-striate arteries of Duret, embolism or rupture of these vessels leads to conjoint destruction, more or less extensive, of both ganglia, as well as rupture, or pressure on the fibres of the internal capsule. A hæmorrhage or embolism in this region produces hemiplegia of the opposite side of the body. But that the hemiplegia cannot be due to the lesion of the optic thalamus is clear from the fact that such lesions may exist without any motor paralysis whatever. It is, therefore, more logical to attribute motor paralysis, when it does occur in connection with lesions of the optic thalamus, to implication, direct or indirect, of the corpus striatum or the motor fibres of the internal capsule.

Localizing Phenomena.—It is a question whether, apart from considerations as to causation, there are any symptoms specially characteristic of hæmorrhages in the region of the optic thalamus.

Among other symptoms noted are clonic or tonic spasms of the paralysed limbs in a considerable number of the cases. These, however, though, according to Bastian, occurring in about three-fourths of the cases, cannot be regarded as pathognomonic, for similar spasms may occur from lesions elsewhere, as in the cortex, centrum ovale, and pons.

Nor is it true that lesions of the optic thalamus specially cause paralysis of the upper extremity, as has been contended by Saucerotte and others. The leg may suffer quite as much; and indeed when the motor paralysis is associated with anæsthesia, the affection of the leg is frequently much more pronounced than that of the arm or face.

The occurrence of anæsthesia on the paralysed side is more constant and more enduring when the lesion invades the optic thalamus and its neighbourhood, than when it is confined to the ganglia of the corpus striatum. This is owing to the fact that the posterior fibres of the internal capsule are directly injured, and not merely pressed on, as in the latter case. The anæsthesia may extend to the special senses as well as common sensibility, but more frequently the tactile sensibility only is distinctly impaired. The reflex cutaneous excitability is also greatly diminished, as has been shown by Crichton Browne (*West Riding Asylum Reports*, vol v.). The paralysed limbs are frequently also affected with unsteadiness, tremors, or choreic-like spasms, intensified on volitional efforts. This affection, termed *post-hemiplegic chorea* (Weir-Mitchell, Charcot), is generally if not invariably associated with a greater or less degree of impairment of sensibility in the affected limbs. It is doubtful how much, if anything, can be assigned to the lesion of the optic thalamus itself in the causation of these symptoms. But for regional diagnostic purposes, they may be regarded as significant of lesion of the optic thalamus and its immediate neighbourhood. When the lesion involves only the posterior fibres of the external capsule, lying external to the optic thalamus, the result is hemianæsthesia, general and special, of the opposite side of the body. The power of movement may not be apparently affected. If so the leg is, in general, relatively more affected than the arm. But, though the motility is retained, the muscular sense is lost, so that the patient is unaware of the state of contraction of the muscles or the position of the limb, and requires the aid of vision in guiding its movements.

Cases have been recorded by Hughlings Jackson and others, which render it in the highest degree probable that lesions of the posterior aspect of the optic thalamus, and region of the corpora geniculata, cause hemiopia towards the side opposite the lesion, from paralysis of both retinæ on the corresponding side. A similar result ensues from direct lesion of the optic tract, however, and also from severance of the medullary fibres of the occipito-angular region. Hence hemiopia alone, without other symptoms, cannot be taken as absolutely diagnostic of lesion of the posterior aspect of the optic thalamus. Conjoined with affection of the other forms of sensibility, however, it points to lesion in this region.

Tumours of the optic thalamus, in addition to the general symptoms of intracranial growths, though sometimes these even seem to have been wanting, produce either no special symptoms, or such a variety as to render the regional diagnosis very uncertain or altogether impossible. The symptoms may be those indicative of lesion of the internal capsule, both its motor and sensory strands; or they may be such as have been observed in connection with lesions of the corpora quadrigemina.

It will thus be seen that, in respect to the regional diagnosis of diseases of the optic thalamus, we are obliged to rely on a combination of symptoms, not one of which can be regarded as absolutely depending on the optic thalamus itself, and our localisation is at best only approximate.

Treatment.—The treatment of diseases of the optic thalamus comes under the head of treatment of cerebral disease in general.

D. Ferrier.

THERAPEUTICS (*θεραπεύω*, I attend.—Synon.: Fr. *Thérapeutique*; Ger. *Therapie*.

Definition.—The science and art of healing.

Introduction.—Therapeutics is the most essential part of medicine, for although other parts of medical science are interesting to the practitioner, it is the cure of disease which the patient seeks. Therapeutics may be divided into two classes—the therapeutics of fancy, and the therapeutics of fact. In order to cure disease with certainty, the practitioner must know what the nature of the disease is, and what the action of his remedies will be. When these are positively known, therapeutics becomes a science, but when either is uncertain, it is simply an art. Its principles may hereafter become a science, but its practice must always remain more or less an art, and be dependent for success upon the skill of individuals. For the symptoms which ought to indicate to the practitioner the nature of the disease may be wrongly interpreted by him, or, as it is usually termed, he may form a wrong diagnosis, and thus be led to apply wrong remedies. The idea in the practitioner's mind may correspond more or less exactly with the condition of the patient, or may not have the slightest resemblance to it; and it is only by careful comparison and experiment that their agreement can be ascertained. An absurd fancy of the practitioner will lead to absurd treatment, and the therapeutic results will not be satisfactory.

History.—In all ages of the world's history we have had the therapeutics of fancy and the therapeutics of fact running side by side, and, in proportion as the latter has predominated, has treatment been improved. In primitive times the imagination of physicians was busy with fancies regarding the nature, the causes, and the cure of disease. The nature of the disease was sometimes supposed to consist in the possession of the body by an evil spirit, which caused the morbid symptoms, and the cure consisted of various incantations and exorcisms. At other times the disease was supposed to consist in alterations of the fluids or of the solids of the body, or of the formative principle which pervaded them. It was supposed that in disease the juices left their proper places in the body, or became disproportioned in quantity, or that the atoms and pores of the solids became altered, so as no longer to allow of free atomic motion. At other times, again, morbid conditions were attributed to fermentation, with production of alkalies or acids in the body; and later on, when the contractile power of muscular fibre was recognised, diseases were supposed to be due to spasm or atony. Equally fanciful qualities were attributed to medicines, some being reckoned hot, some cold, some astringent, some opening and some closing the pores, some contracting and some relaxing the muscular fibres, and some being supposed to cure disease because there was some external resemblance between them and the organ of the body affected.

Principles.—The unsatisfactory results of such fanciful therapeutics have led some, in all ages of medicine, to a more or less *experimental* therapeutics. Physicians saw men suffering and dying all around them, and could not wait for exact knowledge. They therefore applied themselves to tentative therapeutics, giving first one thing and then another in the hope of doing good, and collecting the results of these experiments on their patients, for the guidance of themselves and others in subsequent cases. The results thus obtained, showing that a certain drug was useful in a certain disease without the reason of this utility being known, constituted *empirical* therapeutics. In order to obtain a broader basis than that afforded by the observation of any single man, some have collected numbers of cases from various observers, and have analysed and tabulated them. The results of this method constitute *statistical* therapeutics. But it is liable to great fallacies, inasmuch as cases which are very different are tabulated, for convenience' sake, under the same name, and the results are, therefore, rendered untrustworthy.

The problem placed before the practitioner in the treatment of any one case is rendered exceedingly difficult, not only by reason of the complexity of the bodily mechanism itself, but by the manifold alterations to which it is subject in disease, and the variations produced in the action of a drug by alterations in dose, by differences in the original constitution of the patient, and further differences superinduced by the disease. So complex, indeed, is the problem, that it is impossible to unravel it by any number of observations in disease, and it can only be solved by making ourselves acquainted with a few of the conditions at a time. This can only be done by experiment upon animals, for human life is too valuable to allow of the necessary sacrifice. By experimental physiology, the functions of the various parts of the body and their relations to each other are being gradually ascertained; in experimental pathology diseases are induced artificially, in order that we may discover the alterations produced by them in the functions; and in experimental pharmacology, drugs are administered in order to determine the part of the body which they affect, and the nature of the alterations which they produce in its function. The problem being thus simplified, the practitioner may hope to recognise, from the symptoms of the patient, the organ affected by disease, the nature of the disturbance in its function, and to apply with some degree of success a remedy which will counteract such disturbance. This constitutes *rational* therapeutics. Great advances have of late years been made in this direction, but it will be a long time yet before we can hope to attain such exact knowledge as we desire, and at present our therapeutics must be to a certain extent empirical. When directed towards the removal of the cause of the disease it has been called *pathogenetic* therapeutics. When this cannot be recognised, or cannot be removed, the treatment is directed to those parts of the organism on which the cause of disease acts, so as to lessen or remove the symptoms which it would otherwise produce. This is *symptomatic* therapeutics. And when we can neither remove the cause nor relieve the symptoms, but are forced to trust to the *vis medicatrix naturæ*, and try to maintain the patient's strength by food and nursing, we have *expectant* treatment. This might perhaps also be called expectant therapeutics, for although in its narrowest sense we generally understand by this term cure by means of medicines, in its wider acceptation it includes nursing, climate, and measures of treatment, such as regulated exercise, regulated gymnastics, friction, massage, the application of heat, and cold water. T. Lauder Brunton.

THERMOMETER, Clinical (*θέρμη*, heat, and *μέτρον*, a measure).—Synon.: Fr. *Thermomètre*; Ger. *Thermometer*.

Definition.—An instrument for measuring different degrees of heat or cold.

Description.—The thermometer was invented by Galilei, about 1603, but it was Sanctorius (1561–1636) who first had the idea of investigating the temperature of the human body in health and disease. The substances made use of in the construction of thermometers are mercury, first used by Fahrenheit; a coloured fluid—such as alcohol; or air. Any of these substances, enclosed in a fine exhausted glass tube, expanding at one end into a globular or cylindrical bulb, represents a thermometer. On applying heat or cold to the bulb the contents expand and rise, or contract and descend in the tube. The extent of the rise or fall can be expressed in a number of a scale, which is engraved on the stem or on a separate piece of white glass, or on a strip of paper fixed to the stem, and enclosed with it in a wider glass tube.

The thermometers used in this country and in the United States are graduated with *Fahrenheit's* scale, whereas on the Continent of Europe the *Centigrade* or *Celsius* scale is now everywhere used for medical and scientific purposes, the *Réaumur* scale falling more and more out of use. The difference between these three scales is this, that in the centigrade and Réaumur scales the melting-point of ice is marked zero, and the boiling-point of water (or rather the heat of the steam of water boiling at an atmospheric pressure equal to 29·92 inches of mercury) marked 100° and 80°, respectively; whilst *Fahrenheit* marked the former by 32° and the latter by 212°; 180 degrees of the Fahrenheit scale are, therefore, equal to 100° centigrade and 80° Réaumur, and the relation of the three scales to each other is, therefore, as

F.		C.		R.
9	:	5	:	4

One degree of F. = $\frac{5}{9}$ C. or $\frac{4}{9}$ R.; one degree C. = $\frac{9}{5}$ F.

In converting degrees of the Fahrenheit scale into centigrade degrees, it must, however, be borne in mind that zero of the C. scale corresponds to 32 of the F. scale; 32 must, therefore, be deducted in converting a certain degree of the F. scale into the corresponding degree of the C. scale, and 32 must be added when C. degrees are to be expressed by the corresponding degrees of F. The formulæ for these conversions are, therefore:—

$$x \text{ deg. F.} = (x - 32) \times \tfrac{5}{9} \text{ deg. C.}$$
$$x \text{ deg. C.} = (x \times \tfrac{9}{5}) + 32 \text{ deg. F.}$$

For instance:

$$99{\cdot}5 \text{ F.} = (99{\cdot}5 - 32) \times \tfrac{5}{9} = 67{\cdot}5 \times \tfrac{5}{9} = 37{\cdot}5 \text{ C.}$$
$$39 \text{ C.} = (39 \times \tfrac{9}{5}) + 32 = 70{\cdot}2 + 32 = 102{\cdot}2 \text{ F.}$$

It will be convenient, for quick reference, to give the corresponding degrees of the Fahrenheit and centigrade scales in that range with which human physiology and pathology are concerned, side by side:—

Fahr.	Cent.	Fahr.	Cent.
95·0	35·0	104·0	40·0
96·0	35·55	104·9	40·5
96·8	36·0	105·0	40·55
97·0	36·11	105 8	41·0
98·0	36·66	106·0	41·11
98·6	37·0	106·7	41·5
99·0	37·22	107·0	41·66
99·5	37·5	107·6	42·0
100·0	37·77	108·0	42·22
100·4	38·0	108·5	42·5
101·0	38·33	109·0	42·77
101·3	38·5	109·4	43·0
102·0	38·88	110·0	43·33
102·2	39·0	111·2	44·0
103·0	39·44	112·1	44·5
103·1	39·5	113·0	45·0

In thermometers for clinical use the degrees on the scale ought to be divided into fifths. Thermometers ought to be carefully compared from time to time with a standard thermometer, as they are liable, after a certain time, to give abnormally high indications, owing to the bulb gradually contracting a little. In England they may be sent for comparison to the Kew Observatory.

Of great convenience for clinical use has been the introduction of self-registering mercurial maximum thermometers. It is not without interest to notice that a self-registering thermometer by a small piece of iron being introduced into the tube, had been used by Currie, at the end of the last century; but just as Currie and de Haën's work with the thermometer had been entirely forgotten for half a century, so were self-registering thermometers only used again in medicine some time after the ordinary thermometer had been re-introduced into clinical practice by Baerensprung, Traube, and Wunderlich. Casella was the first who constructed a registering clinical thermometer, by introducing a small quantity of air into the tube, and thereby separating a small part of the mercurial column from the rest. Instruments are now made in which the index—that is, the small separated part of the mercurial column—is prevented from falling back into the bulb, or in which an index is only formed each time the mercury rises out of the bulb. In using an instrument of this kind, the index, it need hardly be said, must be shaken down below 95° or 90° before the thermometer is applied to the patient.

Another principle has been followed in the construction of very sensitive instruments for special researches on temperature, namely, that of the thermo-electric apparatus. The electric current, which is produced in a circuit composed of two different metals, when their point of contact assumes a different temperature from that of the other ends, or again the changes which a galvanic current shows when the resistance of a part of the circuit is altered by a change of temperature acting on it, can be measured by a galvanometer inclosed in the circuit. Gavarret, Heidenhain, and other physiologists have used the thermo-electric pile in physiological investigations in animals. J. S. Lombard and Hankel have applied it to observations in man. Quite recently a convenient form of thermo-electric apparatus for clinical purposes has been devised by Rédard. The apparatus constructed, on the last-mentioned principle, by C. W. Siemens, for measuring deep-sea temperatures, might also easily be adapted for clinical purposes.

A self-registering apparatus for continuous observations, on the principle of an air-thermometer, has been constructed by Marey; and it would seem as if the desideratum of a clinical thermograph, automatically registering the changes of temperature on the surface of the body during a certain time, were near being satisfactorily realised in the instrument brought out by Mr. W. D. Bowkett (*Lancet*, July 1881).

For measuring surface-temperatures, mercurial thermometers of special shape, namely, a long cylindrical bulb coiled up in one plane at a right angle to the stem, have also been constructed. A thermo-electrical apparatus, or Bowkett's instrument, is however more sensitive and more convenient for that purpose.

Applications of the Thermometer.—The object we generally have in view with clinical thermometry being to examine as nearly as possible the temperature in the interior of the body, or the blood-heat, which is less variable than that of the surface (*see* TEMPERATURE), the localities most suitable for applying the thermometer would be the natural cavities, or the openings by which a thermometer might be introduced to a certain depth into the interior of the body. In the rectum, vagina, or bladder, the temperature is not subject to the ordinary changes acting from without, and the time required for taking an observation with the thermometer in any of these localities, would be only such as is necessary for raising the temperature of the mercury to that of the surrounding mucous membrane. This time might be materially shortened by previously heating the thermometer to a degree a little below that to be expected in the body. With this precaution an observation of the temperature in the rectum or vagina will not take more than half a minute.

The case is very different if we take the temperature in a cavity of the body which is not always closed, such as the mouth; or in the axilla, which can be formed into a closed cavity only by placing the arm closely against the chest. Here the time required for an observation is much longer, because the temperature of the mucous membrane of the mouth, or of the skin of the axilla, begins itself slowly rising after the closing of these cavities, until it is raised to that of the deeper tissues which are not exposed to the loss of heat from without. Whereas nine to eleven minutes on an average are required for an observation of the temperature in the mouth, ten to twenty-four may be necessary for the mercury to become stationary in the axilla. The time varies also according to the state of the general circulation. It will be found much longer in persons with a weak circulation, for instance, in a case of heart-disease, than in the case of a vigorous patient with a good circulation and with febrile heat. It is evident that, as was first pointed out by Liebermeister, the time for an observation in the mouth or axilla can be materially shortened, not so much by previously heating the thermometer, as by, previously to the introduction of the latter, keeping the mouth or axilla closed for ten to fifteen minutes. These cavities will then have assumed a steady temperature, and the time required for the observation will only be that necessary for raising the temperature of the mercury and the glass to the temperature of the surrounding parts. It is, therefore, a good plan if the patient had been lying on one side to turn him over to the other, or to make him lie on one side for a time before the thermometer is introduced, and then to put it into that axilla which had been closed by the position of the patient. If the skin of the axilla be very wet with perspiration, it ought to be wiped dry before applying the thermometer.

For practical purposes the rule generally recommended in observations being taken in the axilla, to leave the thermometer until the mercury has remained stationary for five minutes—a rule which naturally applies to self-registering no less than to ordinary thermometers—secures sufficient accuracy, and this rule should be given to nurses and attendants to whom the observations are left. Especially in obscure cases, in which much depends upon the discovery of even a trifling elevation of the temperature above the normal standard, which may be of great importance for diagnosis, this precaution ought never to be omitted; and for observations requiring scientific accuracy, as, for instance, when the effect of some drug on the temperature of the body is being studied, the observations ought to be made by the physician himself.

For various reasons the axilla is the locality most suitable, and, therefore, generally used for thermometrical observations. In very young or restless children, however, as well as in very emaciated adults, axillary observations would become untrustworthy. In such cases, or where patients are in an insensible state, or under special circumstances—for instance, when a great divergence exists between the axillary and the internal temperature, or when doubts arise as to the correctness of an axillary observation—the rectum, or eventually the vagina, may be used for applying the thermometer, and with a self-registering thermometer this can be done without unnecessarily uncovering the patient. In using the rectum, great care must be taken not to let a small instrument slip into it, and in restless children to prevent the instrument from being broken. This is best prevented by placing the patient on his side, and while the thermometer is kept *in situ* with one hand, letting the other one rest on the hip of the patient, in order to be able at once to arrest any turning movement which he might happen to make. The thermometer ought to be introduced about two inches deep into the rectum; and may, before being taken out, be gently pushed forward a little more, in order to bring the mercury in contact with a fresh part of the mucous membrane, which has not been cooled by the bulb of the thermometer. When large masses of fæces fill the rectum, the thermometer passing into them may indicate a somewhat lower temperature than when in contact with the mucous membrane.

Other places of application, such as the inguinal fold, or the fold of skin between the thumb and the second metacarpus, may be used for special, but are quite unsuitable for general, clinical purposes. For observations made with the thermometer *see* TEMPERATURE.

Thermometrical Records.—It is extremely useful to register the thermometrical observations in a case of disease on a chart, and to connect the marks by lines; the curves which are thus formed being quite typical in many diseases. On the same chart may be entered, also by marks and lines, or otherwise, the numbers of the pulse and respirations, as well as remarks concerning other symptoms, or the treatment.

The use of the thermometer for estimating the temperature of rooms, and especially of wards, is fully described in other appropriate articles. *See* NURSING; and PERSONAL HEALTH.

C. G. H. BÄUMLER.

THIRD NERVE, Diseases of.—The third nerve is purely motor in function and supplies the levator palpebræ superioris, the superior inferior and internal recti, the inferior oblique, the ciliary muscle, and the sphincter of the iris. It arises from the surface of the crus cerebri by a series of fasciculi, which pass to a nucleus of grey matter lying on the posterior portion of the floor of the third ventricle and beneath the aqueduct of Sylvius. The anterior part of the nucleus in the floor of the third ventricle innervates the ciliary muscle; the middle part, beneath the anterior extremity of the aqueduct of Sylvius, supplies the sphincter of the iris; and the posterior part of the nucleus innervates the extrinsic muscles of the eyeball (Hensen and Vœlckers).

Morbid states of the third nerve show themselves as spasm or paralysis in the muscles supplied by it, that is, of the eyeball, the upper eyelid, the iris, and in the ciliary muscle.

1. **Spasm.**—Spasm is never met with at the same time in all the muscles supplied by the third nerve. It occurs in isolated ocular muscles, especially in the internal rectus, in conditions of irritation of the trunk and nucleus of the nerve, as in meningitis, in hysteria, also in hypermetropia, and in paralysis of the antagonist muscle. When extreme the eyeball is turned inwards, and cannot be moved out. Clonic spasm of the muscles occurs in 'nystagmus.' The elevator of the upper eyelid is occasionally spasmodically contracted, so that the eye cannot be shut, but remains widely or partly open (lagophthalmos). Slight contraction of this muscle occurs in cases of long-continued paralysis of the orbicularis palpebrarum. Spasm of the muscle is chiefly due to reflex causes, especially to neuralgia of the fifth nerve.

Spasm of the sphincter of the iris produces contraction of the pupil, sometimes to very small dimensions (myosis). It may be a congenital condition, but also results from irritation of the trunk of the third nerve; from stimulation, central or reflex, of the nucleus; or it is secondary to paralysis of the dilator fibres supplied by the sympathetic. It may result from excessive (associated) efforts at accommodation. It is, however, most frequently met with in locomotor ataxy, and is associated with loss of reflex action. The condition is described more fully in the next section. Spasm of the ciliary muscle may result from the other causes of irritation of the nerve-trunk, or from excessive efforts at accommodation in hypermetropia. Its effect is to produce a fixed accommodation for near objects.

TREATMENT.—The treatment of the central causes of overaction of the third nerve commonly resolves itself into that of the primary condition. Where no cause is obvious, rest is most important, and efforts at accommodation should cease; tonics and counter-irritation, and sometimes injections of morphia, may be employed. Atropia will overcome spasm of the sphincter pupillæ or of the ciliary muscle. The cold douche to the eyeball is useful in spasmodic lagophthalmos.

2. **Paralysis.**—ÆTIOLOGY.—The commonest cause of paralysis of the third nerve is some affection of its trunk in its passage through the membranes at the base of the brain, the orbital fissure, or within the orbit; due either to rheumatic inflammation of the nerve-sheath, or to syphilitic inflammation of the nerve or membranes. Less frequent causes are diseases of, or adjacent to, the inner part of the crus cerebri through which the fibres pass and from which they emerge (hæmorrhage or softening of the crus, aneurism or growth in the interpeduncular space), basilar meningitis, and aneurism of the termination of the internal carotid. It is also met with as a result of diphtheria, and in association with disease of the spinal cord, especially locomotor ataxy.

Occasionally all the muscles supplied by the third nerve become paralysed, together with the other orbital muscles—the ophthalmoplegia externa of Hutchinson. In such a case the writer has found a degeneration of the nerve-cells of the nuclei of these nerves.

SYMPTOMS.—Paralysis may affect some or all the fibres of the third nerve. When complete the upper eyelid is dropped and cannot be raised, and can be moved only outwards, and a little outwards and downwards; after a short time it is always turned outwards. The pupil is in a mid-state between contraction and dilatation, and cannot be made to contract by light; power of accommodation in the eye is lost by paralysis of the ciliary muscle. Each part supplied by the nerve may be paralysed separately, by affection of the special branch of the nerve after it leaves the main trunk. When the levator palpebræ superioris is affected, *ptosis* or dropping of the eyelid alone results. An attempt is made to raise the eyelid by excessive contraction of the corresponding half of the occipito-frontalis. Double ptosis is often seen in elderly persons, without other evidence of nerve-weakness.

In paralysis of one of the three straight muscles supplied by the third nerve, there is strabismus, with defective movement in the direction of action of the affected muscle, and double vision, the distance between the two images increasing as the object is moved in the direction of action of the affected muscle. When the internal rectus is paralysed, slight power of movement inwards still remains from the superior and inferior recti. There is divergent strabismus and crossed diplopia; when looking upwards and inwards the images approach at the top, when looking downwards and inwards they approach at the bottom. The patient carries his head turned towards the side of the affected muscle, to avoid the double vision. When the superior rectus alone is paralysed, the movement upwards of the affected eye is diminished, and the eye deviates a little outwards; there is crossed diplopia in the upper half of the visual field, the image formed by the affected eye being higher than the other, the two diverging above, the difference in height being greater in looking outwards and upwards, while the difference in obliquity is greater on looking inwards and upwards. When the inferior rectus only is affected there is defective movement, with crossed diplopia, on looking downwards. The second image is below that of the healthy eye, the distance between them being greatest on looking downwards and a little inwards. The images are not parallel, but diverge at the bottom, and the difference in obliquity increases on looking inwards and downwards. The inferior oblique is very rarely affected alone.

In paralysis of the sphincter pupillæ the elasticity of the structure maintains the pupil at middle size, and it can be further dilated by atropin, but all power of contraction beyond the middle size is lost. When the ciliary muscle is paralysed, the power of accommodation is lost, the far point of vision remains the same, but the near point is rendered much more distant.

The remarkable loss of reflex action of the iris which occurs in association with locomotor ataxy is usually accompanied by myosis. Not only does the pupil not contract on exposure to light, but, if small, it does not dilate on stimulation of the skin (Erb). The associated contraction on accommodation is usually preserved (Argyll-Robertson). Sometimes this is lost, and the ciliary muscle is also paralysed—the ophthalmoplegia interna of Hutchinson. These symptoms may also occur in cases of old syphilis, apart from spinal disease. They probably depend on localised degeneration in the nuclei of the third nerve.

DIAGNOSIS.—Paralysis of the third nerve is generally obvious: it is only the slighter paralyses of separate branches supplying the ocular muscles which are sometimes not easy to recognise; and, for this purpose, a careful examination of the double images is often necessary. The diagnosis of the cause is less easy. Rheumatic paralysis succeeds exposure to cold, and is often attended by much pain; in syphilis other cranial nerves are often affected independently; in meningeal and spinal disease there are the respective distinctive symptoms; in disease of the crus there is hemiplegia of the opposite side, coincident in onset with the affection of the third nerve; in interpeduncular disease the affection of the third nerve may precede the hemiplegia, and both third nerves commonly suffer. After diphtheria the ciliary muscle is usually alone affected.

PROGNOSIS.—When due to cold or to recent syphilitic mischief, or after diphtheria, the prognosis is good if proper treatment can be secured. In cases of organic cerebral disease it is less favourable, and is subordinated to that of its cause. In association with spinal disease the ultimate prognosis is unfavourable, for, although the early attacks are usually recovered from, the affection commonly recurs.

TREATMENT.—In rheumatic paralysis from cold, hot fomentations, counter-irritation by blisters to the temple, small doses of iodide of potassium, and tonics are the most useful. When of syphilitic origin large doses of iodide of potassium usually suffice to effect a cure. If associated with spinal mischief, strychnia, iron, and arsenic are occasionally of some service. In intracranial disease—tumour, aneurism, or meningitis—the treatment is that of its cause. After diphtheria tonics are alone necessary. In paralysis of the sphincter pupillæ and ciliary muscle, occasional instillation of a small quantity of Calabar bean, by stimulating locally the paralysed fibres, does good, and has been said to be beneficial in affections of other branches of the nerve. In the paralysis of the ocular muscles electricity is sometimes of use, applied through the eyelid to the affected muscle, small electrodes being used, and the eye so turned as to bring the muscle as much as possible within reach. One electrode may be placed on the muscle, the other on some indifferent part or on the temple, or both electrodes may be placed over the muscle. The voltaic current slowly interrupted is the more useful; the negative pole should be placed on the muscle, the positive on the temple. Faradisation is of less service; the feeble strength which alone can be used is, so to speak, absorbed by the orbicularis. The application of the continuous current in the neighbourhood of the orbit sometimes produces slight temporary improvement.

W. R. GOWERS.

THIRST.—SYNON.: Fr. *Soif*; Ger. *Durst.*—Thirst is a sensation indicating a necessity on the part of the system for an increased supply of water, as appetite shows there is a need for the introduction of food. Although the sensation is referred to the back of the throat, it is not a purely local feeling, as is proved by the fact, well-known to physiologists, that it cannot be allayed by the swallowing of water, unless the fluid reach the stomach and be absorbed. It is always present in febrile disorders, an increased supply of liquid being required both to reduce the heat, by promoting the evaporation of moisture from the skin and lungs, and also to wash away the products of the increased tissue-changes that accompany these complaints. In like manner it is always present when much fluid has been abstracted from the system; thus, it shows itself after all surgical operations attended by hæmorrhage. It is a prominent symptom in cholera and diarrhœa, in which diseases large quantities of serum are rapidly removed from the gastro-intestinal circulation, and it is equally so in diabetes, where fluid is largely excreted along with sugar by the urinary organs. A craving for cold and acid drinks presents itself in acute gastritis, the intensity of the thirst being perhaps due to the incessant vomiting, which prevents fluids remaining long enough in the stomach to be absorbed. In chronic gastritis thirst is usually present, and is chiefly complained of towards evening. It forms a useful diagnostic sign where there is a difficulty in distinguishing between this disease and more atonic dyspepsia.

Treatment.—Thirst is relieved by the agents usually recognised as refrigerants, such as water, barley-water, toast and water, and similar drinks; sucking small pieces of ice; effervescing drinks; freely diluted acid drinks, especially those made with vegetable acids or phosphoric acid, alone or combined with a little aromatic bitter; the juices of fruits, or these made into drinks. Care has often to be exercised in the employment of these apparently harmless agents, and their consumption has to be checked, otherwise patients will take them to excess, and may thus do themselves considerable injury.

Samuel Fenwick.

THORACENTESIS (*θώραξ*, the chest, and *κεντέω*, I prick).—A synonym for paracentesis thoracis, or tapping of the chest. *See* Paracentesis; and Pleura, Diseases of.

THORACIC ANEURISM.—Under this head are included aneurisms of (A) the **intra-thoracic aorta**; (B) the **arteria innominata**; (C) the **pulmonary artery**; (D) the **coronary arteries**; and (E) the **heart**. The last two forms have been fully treated of under their respective articles, and will not be further referred to here. *See* Coronary Arteries, Diseases of; and Heart, Aneurism of.

A. **Aneurism of the Intra-Thoracic Aorta.** This may be most conveniently discussed in its clinical aspects under two heads, namely, (1) *aneurism of the arch*, and (2) *aneurism of the descending thoracic aorta*; whilst the former may be subdivided into aneurism of (*a*) the *ascending*, (*b*) the *transverse*, and (*c*) the *descending* portion.

Relative frequency.—Of seventy-six cases analysed by the writer, including fourteen treated by himself, the seat of aneurism, single or multiple, stated in the order of relative frequency, was as follows:—*Single*: ascending portion of arch, thirty; transverse portion, seventeen; descending thoracic aorta, ten; ascending and transverse portions of arch, nine; transverse and descending portions, two; entire arch, two; descending portion, one; thoracico-abdominal aorta, one. *Multiple*: ascending portion of arch and descending thoracic aorta, two; ascending portion of arch and abdominal aorta, two.

(1) **Aneurism of the Arch.**—The different parts of the arch of the aorta must be considered separately.

(*a*) *Ascending portion.*—Aneurisms arising from one of the sinuses of Valsalva, within the range of the valves, rarely attain a size larger than that of a billiard-ball. They are saccular and not unfrequently pedunculated, communicating with the aorta by a small orifice. They further exhibit a remarkable tendency to *descend* in the progress of growth, involving in their course the heart or the root of the pulmonary artery. By their position they are sheltered from direct influx from the ventricle, whilst they are exposed to the maximum force of reflux from the aorta. When, however, the orifice is partially or entirely above the level of the valves, the main pressure sustained by the sac is that of efflux from the ventricle; hence the direction of growth is upwards. Aneurism of the portion of the vessel immediately above the level of the valves is especially prone to advance towards the right side, forming a tumour visibly projecting, or detectable by palpation and percussion, in the vicinity of the right nipple. It may be fusiform or saccular, true or false; it usually attains a large size; and, when fusiform, not unfrequently extends over a great portion, or even the whole of the arch. The direction of growth may, however, be backwards or to either side; the aneurism in its progress implicating the œsophagus, the pulmonary artery or one of its branches, the superior vena cava, or either auricle: it is in such cases usually saccular, and of comparatively small size. Aneurisms of the extra-pericardial portion of the ascending aorta usually tend forwards and upwards in the line of main blood-pressure, projecting at the right margin of the sternum above the fourth costal cartilage, and occasionally likewise into the root of the neck, involving the arteria innominata. They may, however, grow backwards and to the right, implicating the right bronchus or lung, or the superior cava; directly backwards, pressing upon the œsophagus or the bifurcation of the trachea; or, projecting mainly towards the left side, they may involve the left branch of the pulmonary artery, and the left bronchus or lung.

Symptoms and Signs. — Aneurism of the sinuses is rarely attended with very definite symptoms; indeed only when it presents at the anterior wall of the chest.

Owing to its position within the pericardium, and its close proximity to the heart, the symptoms produced by aneurism in this situation may be readily confounded with structural or valvular disease of the heart itself. The acoustic signs are, for the purposes of diagnosis, no less indefinite;

because, from the position of the aneurism close to the orifice of the aorta, a murmur produced by it, whether of influx or of efflux, may be easily mistaken for one of the same rhythm caused by obstruction or inadequacy of the valves. The difficulty of diagnosis is further increased by the usual co-existence of atheroma with dilatation of the first portion of the aorta, relative incompetency of the valves, and dilated hypertrophy of the left ventricle. The ordinary symptoms are those of palpitation and derangement of the rhythm of the heart, from affection of the cardiac plexus. But the diseases just mentioned may, in the absence of aneurism, give rise to similar phenomena. The existence of venous stasis and congestion of the upper half of the body, viewed in conjunction with tumultuous and irregular action of the heart, and in the absence of discoverable cause of venous obstruction at a higher point in the chest, would, however, warrant the *presumptive* diagnosis of aneurism at the root of the aorta, implicating the right auricle or the termination of the superior cava; and if with these symptoms were associated systolic murmur at the base, not transmitted in the course of the aorta, or a double murmur, a positive diagnosis to the above effect might be made. Were the diastolic murmur preceded by a distinct second sound, valvular inadequacy from dilatation of the aorta, without valvular disease, would be thereby indicated, and the diagnosis of aneurism *pro tanto* sustained. Symptoms of obstruction of both cavæ, namely, general venous congestion, and engorgement of the liver, would in the foregoing connection justify the special diagnosis of pressure upon the sinus of the right auricle. The symptoms of pressure upon the other chambers of the heart are those only of deranged rhythm and circulation, such as may be due to various causes inherent in the heart. Systolic murmur in the pulmonary artery may result from the pressure of an aneurism on the root of that vessel. Communication of an aneurism with one of the chambers of the heart is usually effected by an aperture not more than two to three lines in diameter. It is the result of progressive absorption, and the symptoms are scarcely to be distinguished from those of antecedent pressure. The physical signs are more characteristic; they consist in a loud murmur, systolic or diastolic, of a 'booming' or 'splashing' character, accompanied by thrill, traceable from the root of the aorta in the direction of abnormal influx, and not transmitted in any of the ordinary lines of valvular murmur. If two murmurs exist, they are fused or converted into a continuous rumble. Sudden transfer of the seat of greatest intensity of such a murmur, from the aortic area to some other point of the precordia, would be conclusive, not only as to the irruption of an aneurism into one of the chambers of the heart, but likewise as to the date of its occurrence.

Aneurism of the ascending aorta, external to the pericardium, is occasionally latent, but ordinarily it is characterised by very definite symptoms and signs. A large fusiform aneurism of this portion of the vessel, or engaging the entire arch, equally expanded, not in contact with the anterior thoracic wall or pressing inconveniently upon any of the adjacent organs, may be virtually latent; exhibiting no symptom of aneurism except vague neuralgic pains darting over the chest, shoulders, arms, and back, and no sign but exaggerated double sound. Pointing externally, or in persistent contact with the chest-wall, an aneurism may be readily identified by the circumstance that it presents a second centre of pulsation and sound. The ordinary pulsation is systolic, expansile, and diffused (though not always equally) over the entire surface; but a second and minor impulse of diastolic rhythm may likewise exist. The former is in many cases accompanied by tactile thrill. The acoustic signs consist either in two sharp accentuated sounds, nearly alike in character, and corresponding in rhythm to those of the heart; or in a single or double murmur of blowing or 'booming' quality. There is likewise absolute dulness, with suppression of respiratory sounds and of vocal fremitus, to the extent of the tumour.

Pressure upon the superior cava is characterised by venous congestion, limited to the upper half of the body: whilst actual communication with that vessel is evinced by cyanosis to the same extent; extreme engorgement with pulsation of the jugular veins; a buzzing systolic murmur, with intense thrill, at the seat of communication and transmitted into the veins of the neck. According to Dr. Mahomed, in cases of arterio-venous aneurism *inspiration* alters the markings of the sphygmograph, by diminishing the volume of blood in the artery. Pressure upon the main bronchus is indicated by diminished or suppressed respiration, with normal percussion-sound, in the corresponding lung; and occasionally by 'whiffing' or 'jerking' inspiratory sound. Diminished respiration throughout either lung, with inequality as between its upper and lower portions, would indicate pressure, but unequal in degree, upon the primary bronchus and its superior secondary branch; whilst partial or complete suppression confined to the upper lobe would show that the superior lobular branch was alone implicated. Passive pneumonia, from occlusion of the pulmonary vessels, is a frequent result of the pressure of an aneurism upon the bronchi. It is worthy of notice that consolidation of lung-substance so produced is especially characterised by the *absence* of vocal fremitus. Bronchitis may likewise arise from mechanical irritation; and where present may, in greater or less degree, mask the physical signs of aneurism. The sudden irruption of an aneurism into one of the bronchi is indicated by copious discharge of florid blood from the mouth and nostrils, and is instantly fatal by syncope or asphyxia. An opening established into the pulmonary substance is followed by 'leakage' of blood, or repeated but limited hæmoptysis. Pressure upon the pulmonary artery is necessarily attended with engorgement of the right chambers of the heart, and general venous congestion; and the establishment of an opening into that vessel, with sudden and urgent dyspnœa without spasm or stridor, extreme congestion of the lung, and hæmoptysis. Death is rapid in such cases; but should an opportunity for physical exploration be afforded, a 'buzzing' systolic hum might be detected in the second and third left intercostal spaces, close to the sternum.

Pressure upon the œsophagus is indicated by dysphagia, referred by the patient to a corresponding point of the chest. Dysphagia due to the pressure of an aneurism is remittent, and varies in some degree with posture—traits by which it is distinguished from that produced by cancer. Dysphagia from volvulus of the œsophagus may, however, exhibit similar variations.

(*b*) *Transverse portion.*—Aneurisms of this portion of the aorta are usually fusiform: they involve mainly its anterior and superior wall, pushing forward the upper end of the sternum, projecting into the neck, compressing the left innominate vein, and modifying, in many cases, the circulation in the primary arteries and their branches. They likewise frequently press backwards upon the œsophagus and trachea, the pneumogastric or sympathetic of either side, or the left recurrent nerve. Owing to the backward course of the left extremity of the arch, aneurisms arising from this portion of the vessel rarely appear in front. They project above the left clavicle, involving the innominate vein, the pneumogastric, sympathetic, or recurrent nerve of the left side, and occasionally all three; or posteriorly in the left scapular region.

Symptoms and Signs.—Pressure upon the left innominate vein is accompanied by visible engorgement of the thyroid, left jugular, subclavian, brachial, and superficial thoracic veins and their tributaries, with œdema of the left arm. The circulation in the carotid or subclavian artery of one side is often diminished or suppressed by the lateral pressure of an aneurism, or by clot-formation in the sac. Pressure upon the trachea is indicated by clanging or metallic cough, and stridor 'from below,' that is, loudest at the upper part of the sternum, and distinctly audible over the lower cervical and upper dorsal vertebræ. The symptoms of aneurismal pressure upon the sympathetic, pneumogastric, and recurrent nerves are most frequently exhibited on the left side only. Those due to implication of the sympathetic or its cilio-motor roots are manifested in the pupil on the affected side. They consist in dilatation or contraction of the pupil according to the degree of pressure; the former from irritation, and the latter, which is the more usual phenomenon, from paresis of the nerve. Laryngeal stridor, huskiness or loss of voice, and harsh metallic cough, in the absence of local disease of the larynx, are eminently diagnostic of pressure upon either recurrent nerve. By means of the laryngoscope the vocal cord on the side of disease, and in rare cases the cords on both sides, are seen to be fixed during breathing and vocalisation, from unilateral or bilateral paralysis of the abductor muscles of the larynx. Dr. George Johnson holds that unilateral paralysis is distinguished by slight huskiness of voice, with stridor on full inspiration; and bilateral paralysis, by permanent dyspnœa and stridor. Paroxysmal dyspnœa or fatal asphyxia may result from collapse of the arytænoid cartilages in such cases. Pressure upon either pneumogastric is especially characterised by paroxysms of remittent spasm of the glottis, which may be suddenly fatal; but, where the recurrent nerve is not likewise implicated, persistent stridulous breathing, aphonia, and metallic cough are not exhibited. The writer has occasionally witnessed urgent laryngeal and bronchial spasm from the pressure of an aneurism, engaging the root of the lung, upon the pulmonic plexus exclusively.

The physical signs are identical with those already described in connection with aneurism of the ascending portion of the vessel.

(*c*) *Descending portion.*—Aneurism of the left curvature and descending portion of the arch involves the left recurrent nerve in nearly every instance. In the progress of growth it passes into the root of the neck; backwards towards the left scapula; or backwards and outwards into the substance of the lung.

Symptoms and Signs.—These include symptoms of pressure upon the recurrent or pneumogastric nerve, as well as the subclavian or internal jugular vein; a pulsating tumour in the left interscapular space, which may attain very large proportions; and signs of congestion and consolidation of the upper and back part of the left lung. In the last case the aneurism, being involved in the pulmonary structure, may afford no specific evidence of its existence.

The physical signs differ in no respect from those which characterise aneurism of the other portions of the arch.

(2) **Descending Aorta.**—Aneurisms of the upper portion of this division of the vessel rarely attain a large size. They may pass upwards and to the right side, implicating the trachea and œsophagus; or directly to the right, stretching the œsophagus or thoracic duct, and ultimately opening into one of them, or into the right pleura. In a case which came under the writer's notice, the trachea and the œsophagus were simultaneously perforated, and death occurred by hæmorrhage into both. The aneurism may advance to the left, and ultimately prove fatal by rupture into the left pleural cavity; it may erode the vertebræ and ribs, and point in the left infrascapular region; or it may advance towards the anterior wall of the chest, displacing the heart, and involving itself in the substance of the left lung. Aneurism of the lower part of the vessel usually extends into the abdomen, constituting the thoracico-abdominal form of the disease. It may displace the heart forwards, and the liver downwards; it may likewise extend backwards, eroding the vertebræ, and pointing in the lower dorsal or the lumbar region on the left side. Finally, an aneurism in this situation may prove fatal by simultaneous hæmorrhage into the left pleural cavity and left retro-peritoneal space, or into the vertebral canal.

Symptoms and Signs.—To what has been already stated on this subject it is only necessary to add, that progressive absorption of the vertebræ is indicated by fixed and boring pain referred to a particular point of the vertebral column, which is tender to pressure, and whence not unfrequently radiating or 'nipping' pains extend round the chest. Forward displacement of the heart by an aneurism would be characterized by violent impulse, simulating that of cardiac hypertrophy (the distinction would rest upon the presence of the special symptoms and signs of aneurism); a remarkable derangement of cardiac impulse, constituting the 'double jog' of Hope; with absence of the positive signs of hypertrophy. Pressure upon the thoracic duct is very rare; it would be indicated by the symptoms of mal-assimilation, wasting, and inanition,—symptoms which are foreign to aneurism under its ordinary forms.

The physical signs of aneurism of the descending thoracic aorta are ordinarily limited to a sharp sound, single or double, audible over the dorsal vertebræ and somewhat to the left; and, more rarely, perceptible impulse. The existence of murmur is exceptional; when present, murmur is all but invariably single and post-systolic, and is inaudible in the erect posture.

Duration and Terminations.—The duration of aneurism of the intra-thoracic aorta may vary from a few days to several years. Death is most frequently caused by rupture of the sac into various parts; or by gradual exhaustion from insomnia and inanition. Of seventy-one cases of aneurism in this situation tabulated by the writer, including twelve observed by himself, twenty-six were fatal by rupture of the sac; namely, into the pericardium ten—all being aneurisms of the ascending aorta; into the left lung or pleura five—four being of the transverse, and one of the descending thoracic aorta; into the trachea four—three of the transverse, and one of the ascending aorta; into the right lung or pleura three—two of the ascending, and one of the descending thoracic aorta; into the left bronchus or œsophagus three—two of the descending thoracic, and one of the transverse aorta (in one of these an opening existed both into the left bronchus and the œsophagus); externally one—the aneurism having arisen from the transverse aorta. Death may also result from asphyxia, intercurrent inflammation of the lungs or pleura, or from coma.

B. Aneurism of the Arteria Innominata. Aneurism involving the innominate artery may be mistaken for aneurism of the aorta, at or near the first curve of the arch.

Symptoms and Signs.—Those which are most distinctive of innominate aneurism are the early appearance of pulsating tumour above the right clavicle, accompanied by arterial obstruction on the right side; displacement of the trachea and larynx to the left; and pulsation with sound, localized at the right sternoclavicular joint and immediately above. Diminished circulation in the right carotid and subclavian arteries at an early period of the disease, and the reduction or arrest of pulsation in the sac by digital pressure upon these vessels, afford the most constant and least equivocal evidence of innominate aneurism. The early occurrence of neuralgic pains in the right side of the neck, the right shoulder and ear, followed by œdema and partial paralysis of the right arm, are likewise suggestive of innominate, as distinguished from aortic aneurism. The symptoms of nerve-pressure on the right side, as exhibited in the larynx and pupil, are usually well-pronounced in this disease. The physical signs are in no respect different from those of aneurism of the arch. Concurrent implication of the aorta is ordinarily determined with the greatest difficulty, and occasionally a positive diagnosis in this respect cannot be made. If pulsation and sound of maximum intensity exist at the level of the second costal cartilage, or an inch and a-half below the sternal end of the clavicle, whilst the pulse-tracing of the right radial artery exhibits imperfect aneurismal characters, the aorta may be considered as involved in the disease.

C. Aneurism of the Pulmonary Artery. Aneurism of the main trunk or primary branches of the pulmonary artery is unknown; but aneurism and ectasia of the secondary and subsequent branches have been repeatedly found in connection with cavities in the lungs, and are recognised as the ordinary source of fatal hæmoptysis in the third stage of phthisis. Cavities confined to one lung with walls condensed by fibroid growth, and either stationary or in process of secondary ulceration, are those which are most favourable to the formation of pulmonary aneurism or ectasia. In the walls or trabeculæ of such cavities the branches of the pulmonary artery remain pervious; their coats, already thickened by chronic inflammation, and weakened by degenerative changes, expand under vascular pressure, where least supported, and form an aneurism, globular, fusiform, or semi-fusiform, according to the extent and degree of their structural change and denudation, or a simple ectasia. These ultimately give way by rupture or erosion, and severe hæmorrhage into the cavity and connected bronchia is the immediate result. Active ulceration of an existing cavity is usually attended with partial thrombosis of adjacent vessels. Hence, in such cases hæmoptysis is seldom copious, and death results from exhaustion produced by repeated small hæmorrhages. In the process of primary and active excavation of lung-tissue the vessels are completely blocked, and hæmoptysis, even to a small amount, is exceptional. *See* Hæmoptysis.

Symptoms and Signs.—Of a special kind there are absolutely none. Copious hæmoptysis in connection with cavity would be eminently suggestive of pulmonary aneurism. Of twelve cases of fatal hæmoptysis in the third stage of phthisis, tabulated by Dr. Douglas Powell, a ruptured aneurism or ectasia of a pulmonary branch was found to be the source of hæmorrhage in eleven instances.

Treatment.—The treatment of aneurism will be found described in the articles Abdominal Aneurism; and Aorta, Diseases of. The *curative* treatment of aortic or innominate aneurism should be directed to the single object of effecting consolidation of the contents of the sac. With this object in view three methods have been pursued, either separately or conjointly, namely, the *postural* and *dietetic*; the *medicinal*; and the *surgical*. As complemental of the first plan of treatment of thoracic aneurism, an occasional blood-letting by venesection, to the amount of eight to ten ounces, for the purpose of reducing arterial tension or venous engorgement, may be demanded. With a view to causing or promoting deposition of fibrin in the sac several agents have been used, namely, acetate of lead, in doses of four to eight grains; iodide of potassium, ten to thirty grains; and aconite, five minims of the tincture thrice daily. Ergotin has been used hypodermically by Langenbeck. Each of these agents has been credited with success in the treatment of aneurism. But, as spontaneous cure has been occasionally witnessed under favourable circumstances as to diet and rest, where no medicine had been given, a more than promotive influence, by retarding the circulation and reducing vascular pressure, can scarcely be assigned to the medicine used, where rest and restricted diet have been observed. Galvanopuncture of the sac has been practised with success. Deligation of the common carotid artery, or of that vessel and the subclavian, may be followed by the most favourable result, in cases where pressure upon these vessels has been found to control pulsation in the sac. For details of the surgical treatment see ANEURISM.

The *palliative* treatment of thoracic aneurism is discussed in the article AORTA, Diseases of. A few leeches applied from time to time in the vicinity of the sac, or a hypodermic injection of morphia, will relieve the pain and repress the inflammation caused by excentric pressure.

THOMAS HAYDEN.

THORACIC DUCT, Diseases of.—SYNON. Fr. *Maladies du Canal thoracique*; Ger. *Krankheiten des Ductus thoracicus.*—The thoracic duct is the main trunk belonging to the absorbent system, by means of which the chyle from the lacteals, and the lymph from the lymphatics (except that from the right side of the chest, neck, and head, and the right arm), are conveyed into the circulatory system, so that these fluids may be mixed with the blood. It starts from the receptaculum chyli, deep in the upper part of the abdominal cavity; passes through the aortic opening of the diaphragm, on the right of the aorta; accompanies this vessel along the thoracic cavity; passes beneath its arch and the left subclavian artery; then along the left side of the œsophagus; and, finally, comes forward in the neck from behind the left carotid artery, arching over the subclavian artery, and crossing the phrenic nerve and anterior scalenus muscle, to open usually into the left subclavian vein, near its junction with the internal jugular. It is requisite to remember these facts respecting the course and anatomical relations of the thoracic duct, in order to understand how its chief morbid conditions are produced.

The diseases of the thoracic duct resemble those of the absorbent vessels generally (*see* LYMPHATIC SYSTEM, Diseases of); and it will suffice to indicate here the following practical points:—1. The passage of fluid along the duct, and its escape into the subclavian vein may be impeded by any condition which interferes seriously with the venous circulation, and distends the veins considerably, such as certain cardiac diseases. 2. Local obstruction of the thoracic duct may arise at any point, from direct pressure upon it, especially by an aortic aneurism, and it may become thus permanently occluded; or from intrinsic tubercular disease, which is of special importance (*see* memoir by Stilling, Virchow's *Archiv*, and *Lancet*, vol. i., 1882). 3. As a result of obstruction, dilatation of the portion of the tube behind this point will probably supervene in various degrees, and it may become considerably enlarged and thickened. The other portion tends to become contracted and atrophied. 4. Perforation of the thoracic duct occurs in exceptional instances, owing to the destructive effect of an aneurism or other morbid condition, or as the result of injury.

It is, as a rule, quite impossible to determine during life that the thoracic duct is diseased. This might be suspected if, along with some known cause which might lead to obstruction of the tube, the patient became extremely emaciated, anæmic, and weak, without other obvious reason to account for these symptoms. No treatment directed immediately to the thoracic duct can be practicable under any circumstances.

FREDERICK T. ROBERTS.

THORACIC TUMOUR.—A tumour within the chest. *See* BRONCHIAL GLANDS, Diseases of; LUNGS, Malignant Disease of; MEDIASTINUM, Diseases of; and THORACIC ANEURISM.

THORAX, Diseases of. *See* CHEST, Diseases of; CHEST WALLS, Diseases of; and DEFORMITIES OF CHEST.

THORAX, Examination of. *See* PHYSICAL EXAMINATION.

THREAD-WORM.—SYNON.: *Oxyuris*; Fr. *Oxyure*; Ger. *Spitzschwanzwurm; Fadenwurm.*

As stated under the article OXYURIS, thread-worms represent a genus of nematoid worms. They are commonly spoken of as *Ascarides*, but this is a misnomer. The oxyurides, or thread-worms, are also sometimes termed *seat-worms*. By whatever name called, they have acquired much clinical importance, since they prove injurious not only to young persons, but also to people advanced in life. It may be said, indeed, that they are more annoying to adults than to children; the prognosis in cases of the former being more unfavourable than in the latter. It is usually stated in manuals that these parasites reside in the rectum of the human bearer; but this is an error, since their presence in the lower bowel is rather an accident than otherwise. No doubt they are frequently present, both in the rectum and sigmoid flexure of the colon, but their true habitat is higher up, namely, in the cæcum. Probably the tendency to migrate is the chief cause of their frequent presence in the lower bowel; at all events, their passage by the anus at night-time is a constant source of distress to young persons. Their wanderings thence into the vagina, and about the neighbouring parts, proves an additional source of serious irritation and discomfort, often leading to the involuntary practice of objectionable habits. It is of the utmost importance to get rid of them, especially at the age of puberty. Before we speak, however, of the symptoms and treatment, it may be as well to say a few words respecting their modes of introduction into the human body. Until lately nothing had been done to clear up the mystery of their origin. It was generally supposed—and this view is still held by some unscientific persons—that these entozoa were generated only in individuals affected by a peculiar cachexia. The enfeebled condition produced by their presence was pronounced to be the cause instead of the effect. Many practitioners cannot shake off their old notion, and some few are impatient of correction in this respect. A healthy person is just as

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liable to be attacked by nematoid worms as a diseased one. The real question is, How do the germs gain access to the human body? Various experiments, in which the writer has himself taken part, have been conducted with the view of determining this important point.

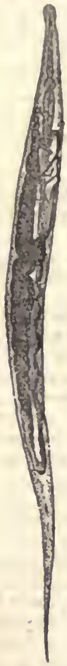

Fig. 95. *Oxyuris vermicularis*, female. Highly magnified. After Leuckart.

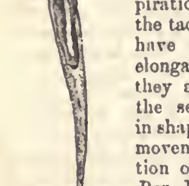

Fig. 96. Eggs of *Oxyuris vermicularis*, inclosing tadpole-shaped embryos; × 450 diam. (original).

Everyone is familiar with the size and appearance of the common thread-worm (*Oxyuris vermicularis*), at least of the females, which are more numerous than the males. If one of the former, measuring nearly half an inch in length, be submitted to a magnifying power of twenty diameters, the uterine ducts will be seen to contain a multitude of eggs. Those ova whose contents are in the most advanced stage of development already show a more or less perfectly formed and tadpole-shaped embryo. These embryos, after extrusion of the eggs from the maternal body, soon acquire the ordinary vermiform character. As Vix and Leuckart have shown, 'one needs only to expose the eggs to the action of the sun's rays in a moistened paper envelope, when, at the expiration of some five or six hours, the tadpole-shaped embryos will have already become slender elongated worms. At this stage they are not altogether unlike the sexually mature oxyurides in shape, exhibiting rather lively movements under the application of warmth' (*Die Mensch. Par.*, Bd. II. s. 130). Professor Heller has remarked to the writer, that for the artificial rearing of the vermiform embryos no plan is better than that of simply placing the eggs in a glass tube filled with saliva. This tube may be conveniently carried in the arm-pit, when in a very short space of time the embryonal transformations may be followed. In this connection it is a matter of practical importance to know whether or not these and all other embryonal changes which are necessary to the sexual maturity of the parasite, can be accomplished within the human bowel. On this point Leuckart affirms (*loc. cit.* s. 329) that 'elongated embryos are to be found not only in the fæces but also in the mucus of the rectum above and around the anus.' And it appears that Vix, who was the first to discover the filiform stage, has detected vermiform embryos, along with eggs of oxyurides, in the large intestine. These statements, taken by themselves, would seem to show that, notwithstanding all that has been said to the contrary, the old view as to the propagation of thread-worms in the human bearer is correct. All the more recent evidence, however, leads to a contrary conclusion. Thus Leuckart distinctly states that *ordinarily* the escape of the embryos 'takes place under the action of the gastric juice, and *primarily* also under that condition when by some means or other they have gained access to a new bearer' (*loc. cit.* s. 329). Speaking also of the subsequent development of oxyuris-embryos, he says: 'The development of these embryos continues not merely in the free state (when the favourable conditions are thus afforded) but also—at least in the human species—in the intestine of the bearer, presupposing of course that the eggs remain there the necessary time.' What Leuckart conjectured to occur really does take place. According to Heller, who has made experimental observations on this subject, the embryos, after being liberated in the human stomach, escape into the duodenum and upper bowel. In this situation the vermiform embryos undergo a series of moultings, accompanied by organic changes, and growing with great rapidity, soon reach the cæcum, where they finally arrive at sexual maturity. As the question at present stands, therefore, we conclude that our patients ordinarily contract thread-worms by swallowing the eggs of oxyurides. This they may do by ingesting them with uncleaned fruit, and other kinds of food, to which the eggs have become adherent; but, undoubtedly, the most common way in which the disease is prolonged, if not at first contracted, is by swallowing fresh germs conveyed directly to the mouth by the hands of the patient. The writer has had a gentleman under his occasional care, who confessed that, in his rage with these disgusting parasites, he had taken them alive between his teeth and bitten them. In this exceptional way he must, of course, have liberated thousands of ova at a time, a fact which accounts for the myriads of adult oxyurides by which he is infested. Patients frequently handle these parasites, and still more frequently carry the ova under the nails. Children and also grown persons become infected by biting their nails after scratching the anus. The writer lately met with an instance where, from only the vestige of a nail left upon a boy's thumb, he obtained some ova of oxyurides. Thus, it is obvious that without great cleanliness, persons already harbouring thread-worms are liable to increase the number of their parasitic guests.

Personal cleanliness is thus essential, but it is, we think, going too far to say, with Dr. Ransom, that 'probably any infected person who adopted the requisite precautions against reinfection from himself or others would get well in a few weeks without treatment by drugs.'

Symptoms.—The symptoms produced by thread-worms are very variable. Unpleasant sensations show themselves generally in the evening and at night, consisting ordinarily of heat and irritation around the anus. These phenomena often become excessively distressing, especially when they are accompanied by itching within and about the genito-urinary passages. By the wandering of the worms local inflammatory action is set up. Presently, various sympathetic phenomena are superinduced, such as simple restlessness, general nervousness and irritability, itchings at the nose, involuntary spasms, chorea, convulsions, and epileptiform seizures. At early puberty the local irritation sometimes induces the sufferer to seek relief by practices which show a perverted condition of the sexual functions, and in young females these phenomena are occasionally accompanied by leucorrheal discharges, with more or less hysteria. Cases exhibiting varied and anomalous symptoms in connexion with the presence of these and other worms are recorded by different writers, but not many presenting the severer phenomena from thread-worms have appeared in our English journals. In one case, where multitudes of oxyurides were present, a patient of the writer's suffered from anæmia, deafness, and extreme prostration, the feebleness being so marked that the young lady could not even bear the exhibition of ordinary vermifuges (*Worms*, 1872, case liii. p. 94).

Prognosis.—Speaking generally, the prognosis in cases of thread-worm is favourable or otherwise, according to the age of the sufferer.

Treatment.—In young persons small doses of steel, followed by brisk saline purgatives, sometimes suffice to expel most, if not all, of the parasites. If the worms return, a repetition of the remedies may be advised, increasing the doses. As a rule, the threadworms will return, and if very numerous they are apt to prove obstinate. In adults the results of treatment are far less satisfactory. The worms are expelled with more difficulty by cathartics, and even copious enemata fail to reach those worms that are lodged high up in the colon and cæcum. Many patients object to injections altogether; but if, containing turpentine, they can be employed two or three times weekly, whilst active salines are given by the mouth, there is probably no better mode of obtaining good results. A great variety of drugs have been recommended, such as calomel, scammony, jalap, salt, santonin, iron, aloes, and assafœtida; one or other of these being administered separately or together, followed by medicated enemata containing either lime, tincture of steel, sulphuric ether, tansy, or quassia. It may be said that all of these remedies prove more or less useful, but the writer has of late years relied more upon moderate doses of aloes and assafœtida, followed by copious draughts of active mineral waters, such as those of Friedrichshall, Pullna, and Hunyadi-Jânos. Many persons who object to drastic cathartics as ordinarily prescribed will not refuse to take the Friedrichshall waters by themselves, or the Hungarian waters in combination with steel or other tonics, to any reasonable amount. In the writer's experience these waters are of great value in the treatment of certain forms of entozoal disease, especially of threadworms. Whatever drugs are given, it is especially necessary that attention be paid both to diet and regimen. All green vegetables should be avoided, whether cooked or uncooked. The utmost cleanliness must be enjoined. Daily local washings are, above all things, to be insisted on, especially after the act of defæcation, or nightly at bed-time, whether or not enemata be employed. Simple cold water or olive oil injections are almost as beneficial as those that are medicated. The nails must be kept short and clean, and the practice of biting them should be denounced. Under any circumstances, and in view of a permanent cure, not only is great perseverance in the employment of the remedies necessary, but also in the matter of general cleanliness. *See* Ascarides; Oxyurides; and Seat-worms.

T. S. Cobbold.

THROAT, Diseases of.—Synon.: Fr. *Maladies de la Gorge*; Ger. *Rachenkrankheiten.*

The throat is a comprehensive term, its diseases including those of the pharynx, tonsils, palate, and uvula, and in popular language even those of the larynx and trachea. The principal affections of these different structures, with the exception of the palate, are described in their appropriate articles, to which the reader is referred, and here it will only be necessary to offer a few general remarks on throat-diseases, and to refer briefly to the affections of the palate. In many instances all the parts are more or less involved in the morbid conditions present, but in other cases one structure is mainly or exclusively involved. Moreover, the throat may be interfered with by neighbouring diseases, such as retro-pharyngeal abscess, and some affections of the neck.

Summary of Diseases.—The affections of the throat may be thus grouped in a general way:—1. There may be no actual disease, but the patient merely complains of various sensations referred to the throat, these being of a nervous character. 2. The throat is liable to injury by substances swallowed. 3. This part is obviously affected in certain general diseases, especially some of the acute specifics. Thus it is particularly involved in scarlatina and diphtheria, and to a less degree in measles, rötheln, influenza, and general catarrh. Syphilis also implicates the throat in its various stages. This region is sometimes attacked by erysipelas, small-pox, herpes, or thrush. 4. Acute congestion, and various forms of acute inflammation, affecting different structures of the throat, are of common occurrence, resulting from causes acting either locally or generally. The cases present much diversity in their severity, depending upon the extent, seat, and terminations of the inflammation. 5. Chronic congestion and inflammation are also not uncommon, of various degrees, and producing different effects in different cases. 6. Ulcerations of the throat are of frequent occurrence, being usually dependent on some general condition, such as syphilitic, scarlatinal, or diphtheritic ulcers, but sometimes local in their origin. They may become sloughing and gangrenous, causing much destruction of the tissues, or even opening up vessels, and thus proving fatal by hæmorrhage. The after-effects of ulceration may be evident in the way of cicatrices, contraction, adhesions, and permanent loss of parts. 7. Certain structures in the throat are very liable to become relaxed, and thus to produce symptoms, especially the uvula. 8. The throat may be occupied by some enlargement or morbid growth. Here may be mentioned chronic enlargement or so-called hypertrophy of the tonsils, which, however, is usually the result of chronic inflammation, congestion, or albuminoid disease. Cancer and polypi are the forms of morbid growth usually met with, and cancer may proceed to ulceration. 9. Malformations are not uncommonly of importance in connection with the throat. The size of the pharyngeal cavity varies much in different persons, but its unusual smallness may be of more or less consequence. Deformities of the palate are of much importance, being either congenital or the result of disease. 10. Sensory or motor paralysis involving the throat is sometimes a serious affection. The condition is especially met with after diphtheria, or in cases of labio-glosso-laryngeal paralysis.

Clinical Signs.—The symptoms in throat-affections are very variable, as regards their severity, exact nature, and combinations, but they are more or less of the following nature:—1. Painful or other abnormal sensations are usually complained of. Pain may range from mere 'sore-throat' to marked suffering, and in some instances it is attended with throbbing, or shoots towards the ear. Tenderness is also very common, when anything passes over the surface, or even when the parts are moved in the act of swallowing, and the painful feeling may be only experienced at this time. Talking or coughing is sometimes painful. Tenderness may also be felt when pressure is made over the tonsils from without. Amongst other sensations often complained of are a sense of dryness, irritation, fulness or tightness, heat or burning, and obstruction. 2. Not only may the act of deglutition be painful, but in throat-disease it is often attended with difficulty in various ways, and may be quite impracticable (*see* Deglutition, Disorders of). 3. Articulation is affected in certain conditions, the voice being characteristically altered, and becoming of a thick, guttural, or nasal quality. In other cases it is slightly rough or husky, and, of course, is particularly liable to be affected if the larynx is involved in any way. 4. In some forms of throat-disease the breathing is obstructed, owing to structures filling up more or less the passage of the pharynx. This is especially felt in the recumbent posture; and patients suffering in this way often breathe with the mouth wide open, and snore loudly. The breath may have an unpleasant or even fœtid smell, as the result of morbid states of the throat. 5. Throat-affections frequently excite the acts of hawking or coughing, and various materials are thus expelled in many cases. It may also be mentioned here that some irritation in the pharynx not uncommonly causes reflex vomiting. 6. Morbid conditions in this part may give rise to hæmorrhage, and this occasionally proves of a serious or even fatal character, as the result of certain destructive lesions. 7. Physical examination of the throat is of essential importance in revealing its morbid conditions. Inspection is usually sufficient, with the aid of a good light, and it is in most cases necessary to depress the tongue by means of the finger, the handle of a spoon, or a tongue-depressor. In some instances it is requisite to feel the parts in the throat with the finger. External examination should also be made beneath the angles of the lower jaw. The objective conditions determined by physical examination will depend on the nature of the disease.

Palate, Diseases of.—The palate consists of two parts—namely, the hard, and the soft palate with its arches. This structure takes an important share in the performance of deglutition, as well as in articulation. It is liable to be affected by any of the morbid conditions which are met with in the throat, and assists in the production of the symptoms resulting therefrom. When the palate is inflamed or ulcerated, marked soreness or pain is likely to be felt when anything passes over its surface in the act of swallowing. As a rule it can be very readily inspected. The points that demand special notice with reference to the palate are, that it is not uncommonly the seat of more or less extensive congenital deficiencies, as in the different forms of cleft palate; and that it may be destroyed in various degrees during the progress of ulceration, in some instances a perforation remaining, in others the whole soft palate being removed, or even the hard palate involved. Consequently the two functions above referred to are often seriously impaired. During the act of deglutition, substances tend to pass back into the nasal cavities through the posterior nares, especially liquids; while speech is nasal or guttural and indistinct, or in some cases almost unintelligible, it being impossible for the patient to articulate the words properly. During the act in some cases the features are more or less distorted.

Treatment.—For the treatment of the different throat-affections the reader must refer to the articles in which they are respectively discussed. The writer only mentions the subject in order to draw attention to two points, namely: first, the great importance of *general* treatment in a large proportion of cases of affections of the throat; secondly, the necessity of using *local* measures *efficiently*, when these are required; while at the same time it is often most desirable that the parts affected should be kept as much at rest as possible. Should the palate be congenitally deficient, or destroyed by disease, surgical operations are often of the greatest service; or plates of different kinds may have to be worn. Frederick T. Roberts.

THROMBOSIS (θρόμβος, a clot).—Synon.: Fr. *Thrombose*; Ger. *Thrombose.*

Definition.—The coagulation of fibrin in the heart, blood-vessels, or lymphatics during life.

Description.—Thrombosis may take place in the heart, the arteries, the capillaries, the veins, and also in the lymphatics. The coagulum consists of fibrin, entangling in its meshes a larger or smaller number of blood-globules, which, in rapidly formed thrombi, consist of both red and white varieties, and hence the thrombus is at first dark-coloured. In slowly-formed thrombi, and in those due to projections from the coats of the vessels, the red cells may be absent, and the thrombus is colourless or yellowish-white. In most thrombi the white cells are present in a much larger proportion than in normal blood.

When a thrombus occupies the place where coagulation began, it is called a *primitive* thrombus; when it gradually extends from this point along the vessel, an *extension* or *produced* thrombus. This extension usually proceeds along the vessel to its junction with a large branch, into which the thrombus may often be seen to project with a rounded extremity, and this, by obstructing the blood-current, may again form the starting point for a fresh extension.

Structurally, thrombi may be distinguished as *laminated*, and *non-laminated* or *uniform*. The former result from a process of continuous, the latter from one of intermitting coagulation. In laminated thrombi there is often a layer of white blood-cells between the laminæ, due to the tendency which these bodies have to wander out of the clot.

Thrombi may further be distinguished into *parietal*, or those which adhere to some part of the wall of the vessel; and *obliterating*, or those which completely fill the vessel. Parietal thrombi are generally nearly colourless, and are due to some roughness or other change in the lining membrane. Obliterating thrombi, which are at first coloured, are produced by the sudden coagulation of the blood; the thrombus thus formed shrinks, and leaves a space which again fills with blood; this again coagulates, and so complete obstruction of the vessel is effected. A *post-mortem* coagulum never completely fills the vessel, as after the shrinking process has taken place, there is no further supply of blood to coagulate. Other points of distinction between *post-mortem* coagula and thrombi are these—the former are never laminated; they are looser in texture, and moister; they do not adhere so closely to the wall of the vessel; and though they may be either coloured or colourless, they never present the appearances due to the subsequent changes which take place in thrombi.

Changes in Thrombi.—The first change observed after the thrombus has shrunken and become denser is *decolorisation*. The colouring matter dissolves out of the blood-globules, becomes diffused, and is transformed. The thrombus accordingly changes from dark red to tawny, and finally to a yellowish-white; and at the same time it loses its soft elastic texture, and becomes tougher, denser, or even somewhat friable.

The subsequent changes vary. First, a process of *shrinking* and drying up may occur, by which the thrombus gets converted into a tough leathery substance, which may even become calcified, and in this way are formed the concretions in veins known as *phleboliths*.

Secondly, *softening* may take place; this may either be due to a process of molecular disintegration, or more rarely to suppuration. In the former case the thrombus liquefies into a milky fluid, consisting of an oily and granular detritus, the process beginning in the centre. In the heart this change often occurs in the layers of fibrin entangled among the trabeculæ, or in the globular masses which sometimes project from them into the cavities, thus giving rise to the formation of cysts.

Suppuration is occasionally seen in the thrombi of veins surrounded by, or leading from, inflamed parts; a multiplication of leucocytes takes place in the thrombus, either by proliferation or immigration, and the whole softens down into a purulent fluid. In these cases the wall of the vein itself is always inflamed. These softened and broken-down thrombi are a common cause of embolisms.

Lastly, the thrombus may become *organised*. Organisation has been chiefly studied in wounds and ligatures of arteries and veins, and the appearances have been very differently interpreted by different observers. According to one opinion the thrombus itself becomes organised; the white blood-cells contained in it, or immigrant leucocytes from the vasa vasorum, as proved by including a portion of vein between two ligatures and impregnating the blood with vermilion (Bubnoff), become converted into stellate connective-tissue corpuscles, with interlacing processes; new vessels permeate the clot along the line of the stellate processes from the unobstructed portion of the artery or vein, and form anastomoses with offshoots from the vasa vasorum perforating the tunica intima, which disappears; and thus a vascular reticulated connective tissue is formed, in the meshes of which lie the remains of the red blood-globules and fibrin of the clot. The progressive dilatation of the newly formed vessels gradually renders the thrombus cavernous; and finally, by their coalescence, it entirely disappears, and the vessel again becomes pervious. Cornil and Ranvier dispute the correctness of these observations, and assert that the appearances are really due to the outgrowth, from the tunica intima, of vascular granulations penetrating the thrombus, which gradually disappears without taking any part in the formation of the reticulated connective tissue which is found occupying its place.

Pathology.—According to the views of coagulation now entertained, the formation of fibrin is due to the interaction of two substances present in the liquor sanguinis: fibrinogen, and fibrinoplastin or paraglobulin, under the influence of a third substance which acts analogously to a ferment. The fibrinoplastin and the ferment are contained in the white blood-cells, and are, in all probability, derived from these bodies, for in all spontaneously coagulable fluids white blood-cells are present, and where they are absent coagulation does not take place. Even in the blood, when coagulation is retarded, as by keeping horse's blood in a tube formed of the excised jugular vein, it is found that the upper layers, from which the white cells have subsided, coagulate very imperfectly, while a firm clot forms in the lower layers, where the corpuscles are numerous. The white blood-cells also are often seen to form the starting point from which the threads of fibrin form.

The nature of the process of coagulation is still very obscure. It does not appear to resemble a chemical precipitate, and it is very doubtful whether the fibrinoplastin actually enters into the formation of the clot; for in artificial coagulation, effected by adding fibrinoplastin to fibrinogen, the weight of the clot is always less than that of the fibrinoplastin used.

As all the three factors of coagulation, fibrinogen, fibrinoplastin, and the ferment, are present in the liquor sanguinis, it is evident that there must be some restraining influence which prevents coagulation; and the cause of thrombosis must be looked for in the removal or weakening of this influence. According to Brücke, contact with the healthy lining membrane of the vessels prevents the blood from coagulating; consequently any structural change in this membrane is liable to cause thrombosis. The presence of a foreign body produces the same effect, and a thrombus itself acts as a foreign body. Retardation or arrest of the blood-current is also a common cause of thrombosis. Loss of motion in itself tends to retard coagulation, but free circulation is necessary for the maintenance of the nutrition and integrity both of the vessels and the white blood-cells; hence stagnation tends to cause thrombosis by removing the restraining influence of the healthy vascular wall, and also by setting free fibrinoplastin from the white corpuscles; moreover, the motion of the blood maintains the contact between each particle and the lining membrane of the vessels, and so prevents coagulation.

The principal causes, therefore, of thrombosis are alterations in the lining membrane of the vessels, and retardation or arrest of the circulation; to these may be added the presence of foreign bodies, and probably also the microzymes of septic processes.

Hyperinosis, or increase in the constituents of the fibrin, and diminished fluidity, as in cholera, can only be regarded as predisposing causes requiring retardation of the circulation to take effect.

Retardation of the circulation being one of the most important causes of thrombosis, we find, as might be expected, that its most frequent seat is the veins, where the circulation is naturally feeble.

Varieties.—1. *Venous.*—The principal causes of venous thrombosis are two. The first of these is wounds and injuries of veins, where the formation of thrombi is the natural way of arresting hæmorrhage. The thrombus may extend along the vein from its primitive seat, and thus cause blocking of venous trunks at a distance from the site of the injury. This is often seen after parturition, when thrombosis of the uterine sinuses may extend to the iliac and femoral veins. Secondly, inflammation of the coats of the vein, by altering the condition of the lining membrane, may cause thrombosis; but in many cases of phlebitis the thrombosis is the primary change, and the inflammation of the coats is set up by it. Other causes of venous thrombosis are pressure on the veins, dilatation, and arrest of the circulation in the capillary territory of the vein, as from embolism or inflammatory stasis. Hence we occasionally find the veins leading from inflamed organs thrombosed. Lastly, thrombosis of the veins is not unfrequently due to retardation of the circulation, owing to failure of the propelling power of the heart, in cases of marasmus and exhausting diseases. These thrombi are most frequently met with in the veins of the lower extremities and pelvis, next in the sinuses of the dura mater.

2. *Arterial.*—Apart from wounds and injuries, thrombosis of the arteries is most frequently caused by degeneration of the lining membrane, giving rise to rough surfaces to which the coagula attach themselves, and to aneurisms in which the coagulation is due to stagnation; aneurysmal thrombi are commonly laminated. Arrest of the circulation from any cause, as embolism, will also cause thrombosis.

Thrombosis of the larger arteries, without alteration of the lining membrane, is most probably always the result of embolism, the embolus being usually derived in the systemic arteries from thrombi of the heart, the result of asystole. Of this nature are the cases of thrombosis and gangrene of the extremities which sometimes occur in fevers and wasting diseases. Thrombosis of the pulmonary artery may be produced in a similar manner, or the embolus may be derived from a thrombus in the veins.

3. *Cardiac.*—Thrombosis of the heart may be caused by endocarditis, the thrombi then usually forming caps to the inflammatory outgrowths or vegetations. Large thrombi are most commonly caused by imperfect emptying of the cavities and consequent stagnation, due either to stenosis of the orifices, or to want of tone in the muscular walls. Thrombi may also extend into the right auricle from the venæ cavæ.

4. *Capillary.*—Capillary thrombosis may be due to extension from the veins and arteries, or it may be primary. In the latter case the conditions which cause it are imperfectly known; aggregations of white blood-globules will often block the capillaries and small vessels in the manner of thrombi, but this condition is usually transient, and not attended by true coagulation. The inhibitory influence of the lining membrane of the blood-vessels is so powerful in the capillaries that, as long as their structure remains intact, coagulation rarely takes place. Thus inflammatory stasis, or obstruction of the afferent artery by embolism, may exist for a considerable time without the blood in the capillaries coagulating.

5. *Lymphatic.*—Thrombosis of the lymphatics has been chiefly observed in the puerperal condition, in the lymphatics of the uterus and their continuations to the lumbar glands, and in rare instances in the thoracic duct. It is probably due to alteration in the constitution of the lymph, normal lymph having very slightly coagulable properties.

Symptoms.—The symptoms of thrombosis are those of arrest of the circulation, and they differ according to the vessel affected. In the veins, if a main trunk be obstructed, so that a sufficient collateral circulation cannot be rapidly established, the effects produced are passive hyperæmia, venous dilatation, transudation of serum, and sometimes hæmorrhage in the territory of the blocked vein, with enlargement of the collateral channels. In extreme cases moist gangrene may result. Thus, according to the vein affected, we may have anasarca of an extremity, ascites, or hydrothorax; hæmorrhage from the stomach, intestine, or kidney; œdema and cyanosis of the face and neck; and so on. The symptoms of arterial thrombosis are in the main those which have already been described as occurring when the artery is blocked by embolism (*see* Embolism). Coagulation of blood in the arteries of the heart is described in a separate article. *See* Heart, Thrombosis of.

Treatment.—The treatment of thrombosis varies according to the seat of the process. *See* Aorta, Diseases of; Brain, Vessels of, Diseases of; Heart, Thrombosis of; and Veins, Diseases of.

W. Cayley.

THRUSH.—Synon.: Fr. *Aphthe*; Ger. *Mundschwamm*.

Definition.—The popular name given to aphthæ in the mouth, and to morbid states resembling them. It is convenient to confine the term *aphthæ* to cases in which the *oïdium albicans* is present; but the term thrush must be allowed a wider signification, and must be taken to include also many cases of simple stomatitis. *See* Aphthæ; and Stomatitis.

Description.—Thrush is characterised by small white flakes scattered over the tongue and the mucosa of the mouth and lips. Occasionally the disease spreads down the œsophagus. It is frequently met with in infancy, and in adults it occurs in the last stages of wasting complaints. The white flakes are composed chiefly of exudation from a small spot of subjacent mucosa, which is acutely inflamed. Thus it is that they are surrounded by a red areola, and that, if they are picked off, they are speedily reproduced. In the cases which are, strictly speaking, aphthous, the white flakes may readily be transferred from the infant's mouth to the mother's nipple. The minute spots of inflammation have a tendency to occur in clusters, and in successive crops, some fading as others appear. They are attended by local heat and tenderness, so that in a severe case the infant can hardly take the breast; and with this there may be feverishness, drowsiness, and perhaps diarrhœa. The white flakes are sometimes so abundant as to coalesce, and form large patches of fur. When these flakes are shed, or are removed, small ulcers are left behind, which are flat and circular or oval, with inflamed bases, and a thin yellowish or greyish slough. Their margins are well-defined, but without thickening or elevation. They are always attended by increased heat and congestion of the mucosa, together with active gastric or intestinal disturbance; and there is fever of a more or less atonic kind.

Treatment.—Thrush in infancy is usually due either to improper or insufficient food, giving rise to an acid state of the secretions of the mouth; and the attention of the medical man should, therefore, be directed particularly to this subject. If the infant is being nursed by its mother, inquiry should be made as to her health, for the disease may perhaps arise, or be kept up, by a morbid condition of the milk. If there be no reason to suspect this, the child should be confined entirely to the breast, and this should be given only at stated intervals. If the infant is being brought up by hand, the most careful attention should be paid, not merely to the milk or artificial food with which it is supplied, but also to the cleanliness of the vessels in which it is kept, and of the bottles or spoons in which it is given. If, notwithstanding every precaution, artificial feeding does not agree with the child, a wet-nurse must be procured. Attention to these primary rules of health sometimes has an almost magical influence in removing the complaint. At the same time the child's bowels should be regulated by a slight aperient; while a little of the glycerinum boracis, or a powder composed of borax and sugar, should be laid upon the tongue every hour or two. If ulcers have formed, they should be dusted with powdered alum, or touched with a strong solution of nitrate of silver or of sulphate of copper, or with the solid caustics. In cases arising from weakness caused by insufficient nourishment, two or three drops of brandy given in the food, four or five times a day, has often a marked effect in checking the disease. When the child begins to amend, a change of air will probably hasten its recovery.

When thrush occurs in old people, or as an accompaniment of some wasting disease, it is less easy to destroy the microscopic fungus, and to prevent its reproduction. Still much may be done to regulate the *primæ viæ*, to support the powers of nature, and to arrest the spread of the aphthous patches. For this purpose, Sir William Jenner recommends a lotion of sulphite of soda (ʒj to the ℥j of water). It should be applied frequently with a camel's-hair brush, or the mouth should be rinsed with it. A weak solution of carbolic acid may be used in the same way; or a solution of sulphurous acid, in the proportion of one part of the acid to six of water.

W. Fairlie Clarke.

THYMUS GLAND, Diseases of.—Synon.: Fr. *Maladies du Thymus*; Ger. *Krankheiten der Thymusdrüse*.

In consequence of the atrophy of this organ in early life, little notice has been taken of it, either in its healthy state or when affected by disease.

According to the researches of Mr. Simon, the thymus gland reaches maturity in the child at the age of two years; it remains more or less perfect up to eight to twelve years; then it rapidly decreases in size, the glandular substance becoming converted into fat; and at the age of twenty years there is no trace of the organ left. At birth its weight is in proportion to the weight of the child. Taking 22 grs. to the lb. to be the usual proportion, 100 to 200 grains will be the weight of the gland at birth. From investigations made on young and hybernating animals, it appears that the greater the ratio of respiratory and muscular activity, the speedier is the decline of the gland. Consequently Mr. Simon thinks 'the thymus fulfils its use as a sinking fund of movement in the service of respiration.'

Summary of Diseases.—Instances both of excessive growth, and of prolonged existence of the thymus have been reported. A list of such cases was published by the late Mr. Alexander Bruce. In a healthy boy, aged fourteen, killed by an accident, the gland was found to weigh 620 grains; in a lunatic, aged twenty-one years, 300 grains; in a woman, aged twenty-nine years, 57 grains; in another woman, aged forty years, 30 grains. Krause mentions three cases, aged twenty-five, twenty-five, and twenty years, wherein the glands weighed respectively 292, 380, and 356 grains.

The actual diseases of the thymus gland which have been recorded are:—(1) Inflammation, followed by suppuration. In one such instance the abscess burst into the trachea. Syphilis has been stated to be a cause of embryonic inflammation of the gland. (2) Fatty degeneration of the gland. (3) Tubercular deposit in the gland. (4) Malignant disease. (5) Enlargement of the gland in leucocythæmia, and in (6) lymphadenoma. (7)

Calculi have been found imbedded in the gland-substance.

Cases have been reported of children dying from suffocation, with no other cause assigned for their death than pressure on the trachea from an enlarged thymus gland. Considering the position of the gland, between the sternum and the windpipe, and the small power of resistance possessed by the rings of the trachea during infantile life, an enlarged thymus may be a possible cause of suffocation.

In connection with an enlargement of the gland, a respiratory affection called 'thymic asthma' has been recognised. It is also named after two physicians, 'Kopp's,' or 'Millar's asthma'; but the majority of writers on diseases of children deny the existence of such a malady.

Pugin Thornton.

THYROID GLAND, Diseases of.

Synon.: Fr. *Maladies de la Glande thyréoïde*; Ger. *Krankheiten der Schilddrüse.*

Goître is the most common affection of the thyroid; and associated with it, but as a less prevalent disease, is exophthalmic goître. *See* Goître; and Exophthalmic Goître

The diseases of the thyroid gland other than goître are rare. They comprise:—1. **Acute Inflammation** or thyroiditis. 2. **Hydatid cysts.** 3. **Calcareous deposit** in the gland. 4. **Cancer.** 5. **Sarcoma.** Fatty degeneration of the thyroid is of doubtful occurrence. Enlargement of the gland occasionally occurs in leucocythæmia, and in lymphadenoma. The gland is sometimes absent, or an accessory lobe may be present. It may degenerate in old people. The following affections alone require brief notice.

1. **Acute Inflammation.**—Synon.: Thyroiditis.—This disease occurs in three forms:—(*a*) *idiopathic*; (*b*) *metastatic*; and (*c*) *traumatic.*

(*a*) *Idiopathic* thyroiditis is the rarest of these forms of inflammation. It chiefly attacks young people, and is generally due to sudden changes of temperature.

(*b*) *Metastatic* thyroiditis is rarely observed as a complication of acute infectious diseases, especially typhus, puerperal fever, and pyæmia. It has also been met with in pneumonia and bronchitis; and in connection with orchitis.

(*c*) *Traumatic* thyroiditis usually results in suppuration. Sphacelus of the gland is a possible result of active suppuration—a result not necessarily followed by any further mischief.

Symptoms.—All three forms of thyroiditis commonly produce, amongst other symptoms, dyspnœa and dysphagia.

Treatment.—The treatment of inflammation of the thyroid gland consists in applying leeches and ice, and in using other antiphlogistic remedies. Deep-seated suppuration should be relieved by an early incision, otherwise the pus may find its way into the trachea or beneath the fascia. The best plan for opening the abscess is by means of the trochar and cannula.

2. **Hydatid cysts.**—Echinococci have, in a few cases, produced an enlargement of the thyroid gland. These hydatid cysts are difficult to diagnose from goitrous cysts until the fluid contents have been examined microscopically.

3. **Calculi.**—These bodies have been found imbedded in the substance of the thyroid. The writer has met with a specimen in which the calculus was the size of a walnut, and almost entirely took the place of the gland-substance of one lobe.

4. **Cancer.**—Primary cancer of the gland is a rare disease. It is met with in two forms—encephaloid and scirrhus. Cancer is not, it would appear, so commonly developed in a healthy gland as in one already affected by goitrous degeneration. Secondary cancer of the thyroid may also occur.

Symptoms and Diagnosis.—The special symptoms caused by malignant disease of the thyroid are dyspnœa and dysphagia. The trachea and œsophagus may be involved in the disease. Very commonly one or both recurrent laryngeal nerves are included in an extension of the growth, and sometimes also the large vessels and nerves of the neck. Cancerous disease of the thyroid is probably present when there is a rapid enlargement of the gland, followed in an early stage by duskiness of the skin over the most prominent parts of the swelling. Superficial ulceration at a later date, often accompanied by hæmorrhage, and the general condition of the patient, will render the diagnosis clearer.

Treatment.—The only available treatment is entire removal of the gland, and this, to be of service, must be carried out at an early stage of the disease.

5. **Sarcoma.**—Sarcoma may be developed in the substance of a healthy thyroid gland, or in one already affected by goitrous disease. Thyroid sarcoma is, according to Lücke of Strasburg, rapid in its growth, not exceeding a year in duration.

An exceedingly interesting class of cases has been recognised within the last few years, in which tumours, growing simultaneously in various bones, such as the skull, vertebræ, and femur, and in the lungs and glands, have appeared, on examination, to be secondary to a simple adenomatous enlargement of the thyroid gland, and have presented microscopic characters precisely similar to that disease.

Pugin Thornton.

TIC-DOULOUREUX (Fr.).

—Synon.: Facial neuralgia; Prosopalgia.

Definition.—Neuralgia of the trigeminal, trifacial, or fifth nerve.

One alone, more often two, but rarely all three divisions of the fifth nerve of one side may be coincidently the seat of neuralgia. It is less common for the third division to suffer than for the first and second. Tic has often been preceded or followed by neuralgia in other districts, especially in the occipital nerve.

Ætiology.—Trigeminal neuralgia is rare in young children, but may occasionally occur in them, associated with decayed or irregular protrusion of the permanent teeth. In these circumstances, it is sometimes accompanied by epileptic convulsions. In its migraine shape, it almost always attacks the sufferer at some time during the period of bodily development. According to the late Dr. Anstie, the middle period of life is not fruitful in *first attacks* of trigeminal neuralgia, but, given a declared neuralgic tendency, the wear and tear of this stage tends much to recall it. In women utero-gestation, the exhaustion from hæmorrhage at parturition, menorrhagia, or over-suckling, as well as the sexual changes in middle life, are especially prone to reproduce facial neuralgia. It is, however, in the period of degeneration that the worst and most intractable examples occur.

The term 'brow ague' is still frequently applied to a neuralgia of the first division of the trigeminal, which cannot be referred to a malarious origin. Formerly, when malarious fevers were rife in this country, such an affection was, doubtless, of common occurrence; but at the present day, owing to drainage and cultivation, it is rare for this cause to be in operation. Cases do, however, occur, and these may usually be recognised by regular periodicity in the attacks of pain, a semi-algide condition of the system, and the rapid and effectual influence of quinine. Cold wind, especially with a moist atmosphere, has an undoubted influence in starting neuralgia of the fifth nerve, the unprotected condition of the face explaining probably its peculiar liability to be so attacked. There appears reason to think, however, that when damp with cold excites an attack of neuralgia, there must be at the same time a peculiar condition of the system, or neuralgia of the fifth would be much more common in this climate than it is. Such a condition is probably of a rheumatic or gouty nature, and the cold seems to start a subacute neuritis in the sheath of the nerve. As regards general conditions predisposing to the affection, they are those common to neuralgia. *See* NEURALGIA.

Injury of the nerve; foreign bodies, irritating either this or some other nerve; morbid growths of bone, especially such as cause contraction of bony canals traversed by branches of the nerve; and syphilitic periostitis, may act as exciting causes of tic-douloureux. Or the immediate cause may be in the floor of the cranium, in the form of tumours or disease of bone or of membranes, aneurism, or abscess.

SYMPTOMS.—Some obscure feeling of discomfort may precede the outburst of actual pain, or this may occur suddenly and without warning in some part of the district supplied by the fifth nerve. There will be one or more foci from which the pain will seem to emanate in swift flashes, a dull aching remaining between whiles, of a very wearying character. Generally short-lived at first, the paroxysms of darting, burning, boring pain gradually increase in severity and duration. The patient sometimes cringes under the violence of the agony. When fairly pronounced there is a great tendency to the excitement of a paroxysm by the influence of such slight irritants as a current of air, a sudden noise, or the muscular movements concerned in speaking, laughing, chewing, blowing the nose, or coughing. The attack of tic may vary to any extent in degree and duration, from a short-lived paroxysm which never returns, to a disease of the most obstinate character, embittering, with more or less constantly repeated attacks, the whole of a long life. In such cases it has a tendency to remit during the course of severe intercurrent diseases.

When the *ophthalmic division* of the nerve is affected, it sometimes happens that the first notice of the attack is an exceeding soreness of some spot on the scalp, recognised only on brushing the hair, and this is followed some hours afterwards by pains in the branch of nerve distributed to this point. The pains are most marked, and tenderness on pressure can generally be noted in one or more of the following places—the supra-orbital notch, at a point a little above the parietal eminence, in the upper eyelid, at the junction of the nasal bone with its cartilage, within the eyeball, or at the inner angle of the orbit. There is often lachrymation, with redness of the conjunctiva, and sometimes intolerance of light. There is sometimes so much tenderness that the patient cannot wear a hat, or even wash his forehead. Or he may be unable to blow his nose. If one or two hairs be drawn over this hyperæsthetic surface, it will be found that the tactile discrimination is diminished, as compared with the corresponding region of the opposite side. The pain is sometimes described as shooting in the upper eyelid, or going between the eyeball and the cavity of the orbit, extending thence over the brow, as though the forehead were being slit open. Pressure upon the parietal point will send a sort of heavy dull shock into the eye. To neuralgia of this division, in consequence of the pain being limited to one-half of the anterior aspect of the head, the term *hemicrania* has been applied, whence the *migraine* of the French, and the vernacular 'megrim.' The neuralgic affection constitutes, however, only a portion of the complex group of phenomena to which the term migraine is properly applicable, and which includes, besides, subjective sensations of dazzling lights or colours, often of a zig-zag shape, transient hemiopia, vertigo, unilateral numbness and tingling of extremities, impairment of speech, nausea, and vomiting. *See* MIGRAINE.

When the *superior maxillary division* is in fault, violent pain is experienced in the cheek-bone or jaw, or in both, points of tenderness being found at the site of emergence of the infra-orbital nerve, over the malar bone, or on the gum of the upper jaw. The attacks of pain are sometimes accompanied by profuse watery secretion from the nasal and buccal mucous membranes. There may be swelling and acute sensitiveness of the lip and nostril, the slightest contact with which causes pain to shoot widely in various directions, sometimes appearing to affect distant parts of the body. Acute pain may also occur in the parotid gland, accompanied by a great flow of saliva, and also in the teeth.

When the *third division* is attacked, points of intensity may be found on the temple, a little in front of the ear, at the place of exit of the inferior dental nerve, at the side of the tip of the tongue, or more rarely in the lower lip. The writer has under his care two ladies past middle life, who are afflicted with neuralgia of this division. In one the pains attack both sides of the lower jaw and the under surface of both borders of the tongue. They occur in plunges of agony, which cause her to utter a kind of shrieking groan, and the head is jerked convulsively. They are brought on by chewing, swallowing, and even by speaking. Taste is not affected. In the other case the pain is entirely localised in the left side of the tongue-tip, but here at times it is so intense that the patient rolls on the floor in agony. There is slight tenderness on pressure, but no painful dartings occur at the point of emergence of the inferior dental nerve. To cases of this kind marked by lightning-like seizures of exquisite character, and accompanied by spasmodic movements of the facial muscles, the term *epileptiform neuralgia* is sometimes applied. Hereditary tendency to insanity often accompanies this form. The lingual branch of the fifth is happily not so often affected as the other portions, for there is probably no form of neuralgia involving more exquisite suffering. When the auriculo-temporal division is affected, pain is located in the outer auditory meatus and temple. Many cases of so-called ear-ache are doubtless examples of neuralgia affecting this nerve.

There is a variety of trigeminal neuralgia which is known as *clavus hystericus*, and which occurs chiefly, but by no means solely, in females, and affects the period of bodily development. It is characterised by intense pain, limited to one or two small points (the parietal, or supra-orbital), and resembling the driving of a nail into the skull. It occurs most often in the anæmic, and has frequently been mistaken, with unfortunate results, for some inflammatory affection demanding depletory measures.

In severe tic-douloureux the facial muscles, those of the tongue, and even sometimes those rotating the head, may be spasmodically contracted by reflex action (*see* TRIFACIAL NERVE, Diseases of). With supra-orbital neuralgia there may be blepharo-spasm or strabismus. The writer has lately seen a patient liable to neuralgia of the supra-orbital division for twenty years past, in whom, one year ago, the attack began to be attended with complete ptosis and external strabismus, from paralysis of the third nerve. A certain amount of weakness has continued between the attacks, but it is as an immediate sequel of the pain that the loss of power is most strongly marked. Two days after the cessation of the pain the eyelid can be raised fairly well and the eyeball moved, though never quite freely. Some degree of vaso-motor paralysis is shown by the reddening and heightened temperature of the face and swelling of the veins, which occur unilaterally during the paroxysms of pain, as well as by the soreness of skin, indicating probably a temporary congestion which remains behind. To the same cause must be referred the extreme redness of the conjunctivæ and mucous membrane of the nostrils, with increased lachrymation and flow of nasal and buccal secretion, often observed in this form of neuralgia. The hair is very liable to be changed in colour about the seat of pain. There may be a permanent blanching, as of the greater part of an eyebrow or a small tuft upon the head, or the change may be a fluctuating one, the colour returning during the intermissions of the disease. Individual hairs in the district of the affected nerve may be hypertrophied, or the converse may happen; and during the persistence of attacks the hair may become brittle and fall out, to return, however, when the neuralgia subsides. Anstie describes a state of thickening, the result of subacute inflammation, in the periosteum of bone and in fibrous fasciæ in the neighbourhood of the painful points of neuralgic nerves. Pressure on these swellings may not merely excite pains in the affected branches, but send a powerful reflex influence through the cord to distant organs, causing vomiting, or affecting the action of the heart. The skin is apt to grow coarse, and patches of pigment to occur in the painful situations. In neuralgia of the second and third divisions the corresponding half of the tongue is sometimes seen to be covered with fur from overgrowth of epithelium, and this even when the process of mastication has taken place equally on each side; or there may be salivation severe enough to cause a suspicion of mercurial action, but which may be distinguished by its being unilateral. Acute inflammation of the skin, in the form of herpes or of erysipelas, not unfrequently attends neuralgia of the fifth, especially its first division; and the eyeball itself may become in similar circumstances the seat of serious inflammatory action in one or other of its tissues. There may be a profuse and extensive eruption of herpes, leaving cicatrices which suggest confluent small-pox. In such a case neuralgic pains may cease during the eruption, to recur with great violence whilst this is scabbing. Acute glaucoma is attended by symptoms which appear to refer it to trophic changes consequent on neuralgia of the ophthalmic division of the fifth. There appears reason to think that recurrent iritis may sometimes be due to neuralgia or some kindred affection of the same division. Common sensation is frequently blunted during and after paroxysms of tic, but occasionally there will be so much and such persistent hyperæsthesia of the skin, that the patient cannot bear the face to be washed. In epileptiform tic the sufferer will often be observed to rub violently with a handkerchief the part of the face affected; but, on the other hand, there are cases in which not even the touch of a light bonnet can be borne, so exquisitely sensitive is a portion of the scalp. A touch with the finger upon this locality will sometimes cause the patient to fall to the ground.

DIAGNOSIS.—The paroxysmal character of the pains, coupled with the tenderness on pressing various points, sufficiently indicate tic-douloureux. The only condition with which it is at all easily confounded is the painful anæsthesia which is apt to be an early symptom of the encroachment of a tumour upon, or some other destructive lesion of, the trunk of the nerve within the cranium (*see* TRIFACIAL NERVE, Diseases of). The presence of pain will distinguish the spasmodic contractions of the facial muscles secondary to the neuralgia from mimetic spasm proper. There is no doubt that neuralgia about the forehead is often mistaken for some inflammatory intracranial mischief, and this is peculiarly liable to happen where either ptosis or strabismus forms part of the symptoms. Careful examination, bearing in mind the points of diagnosis described, ought to obviate error. Still more important is it to avoid the error of ascribing to this form of neuralgia the pain occasioned by the growth of intracranial tumour (*see* BRAIN, Tumours of). It must be remembered, too, that pus in the antrum may occasion neuralgic symptoms. A most fruitful source of trigeminal neuralgia is caries of the teeth. The first care in a case should be to have the state of the teeth accurately investigated, and faulty teeth removed or otherwise treated. It may happen that a tooth betraying no outward signs of decay is carious internally, and may thus easily escape recognition.

PROGNOSIS AND DURATION.—Tic-douloureux occurring in youth and apparently as an accident of exposure, or as a result of faulty teeth, may never recur. It is perhaps more common, however, for repetitions of the attack to take place, alternating, it may be, with neuralgia in other quarters. Tic is not unfrequently liable to recur, especially under circumstances of depression, through a whole lifetime, but it may never have the character of extreme severity. In certain few cases, however, it is not only obstinate, but of terrible violence, the patient being incapacitated through many years by the constantly recurring affection. The pain has been in some cases violent enough to destroy life. As a rule, however, the disease, however severe the agony entailed by it, does not seem of itself to shorten the duration of the life which it fills with suffering.

TREATMENT.—As in neuralgia generally, the treatment is partly constitutional and partly local and palliative of suffering (*see* NEURALGIA). The hypodermic injection of morphia holds the first place as a means of relief. It is well to begin with a small dose, say $\frac{1}{10}$th grain, and repeat it in the course of twelve hours if necessary. If the doses employed can be kept at a moderate amount, there will not be much fear of opium-hunger being created, and they can be discontinued without difficulty as the disorder subsides. The injection is quite as efficacious when made in the arm as in the face. Blisters are often of great service. A small one should be applied over the branches of the cervico-occipital nerve at the nape of the neck, and repeated if necessary. The constant voltaic current is sometimes useful. A sufficient number of cells (from four to eight or ten) should be employed to give such a current as causes the negative pole to impart a very distinct burning sensation. The circulation should never be abruptly opened by the removal of the rheophore, but on applying and when leaving off a gradual heightening or lowering of the strength should take place, in order to avoid a shock. The rheophores should be fitted with sponges well moistened with salt and water, or with carbons plunged for a minute or two in hot water. The application may be continued for five or ten minutes at a time, and be repeated several times daily. In some cases of tic a combination of 20 or 30 grains of chloride of ammonium with five drops of nepenthe, taken two or three times a day, is singularly efficacious.

Croton chloral—2 to 4 grains in a pill taken every two hours for a few times—may be sometimes employed with advantage. So, also, the tincture of gelsemium sempervirens, given in doses of 15 to 20 minims every two hours, till relief is obtained. The hydrate of chloral in a dose of 20 grains will sometimes be of great service, if the pain is not very severe, in procuring a natural kind of sleep from which the patient wakes relieved. If, however, the pain be severe, chloral is useless. It is important not to confound the epithelial overgrowth of the tongue, which so commonly occurs in tic, with the ordinary furring from digestive difficulties which is supposed to indicate a necessity for purgatives. It will be observed that it only affects a lateral half.

In two cases of epileptiform tic of from seven to ten years' duration, which had resisted all treatment, and incapacitated the sufferers from earning their livelihood, the writer had two out of the three divisions of the trigeminal stretched, with most satisfactory results. In one case five months, in the other about twelve months have elapsed since the operation, without return of pain. It appears to be essential that not only the central end of the nerve should be pulled upon with considerable force, but also the peripheral portion. A considerable amount of cutaneous anæsthesia ought to follow the operation, though it usually does not last more than a few days. *See* NERVES, Diseases of.

T. BUZZARD.

TIN, Poisoning by.—SYNON.: Fr. *Empoisonnement par l'Étain*; Ger. *Zinnvergiftung.*

The importance of tin as a toxic agent has only recently been recognised; for although attention was drawn nearly a century ago to the possible danger attending the use of tinned vessels for culinary purposes, the danger was supposed to be due simply to the contamination of the metal with arsenic. Subsequently alarm was excited in consequence of the employment of alloys of tin for the storage of tinned preserved articles of food, such as meat, vegetables, and fruits; but here again the danger has been assigned to the lead with which the tin is alloyed, a lead-tin alloy being used for the construction of the capsules employed. Very recently, however, attention has been directed to the tin with which tinned foods are almost invariably contaminated, as itself presenting a source of danger to the consumer. It is known that the soluble salts of tin, met with in commerce as *Dyer's salt*, *pink salt*, &c., are poisonous; and experiments on animals show that even the insoluble hydrated oxides of tin are fatally poisonous, the oxides being no doubt dissolved in the alimentary fluids, tin having been detected after death in such cases in the liver and other solid viscera. Certain kinds of sugar recently brought into commerce are prepared by a process which introduces tin to the extent of from one-fourth to one-third of a grain per lb. of sugar into the manufactured article; and it is at present a moot point whether these sugars are innocuous or deleterious.

ANATOMICAL CHARACTERS.—The *post-mortem* appearances in fatal poisoning by tin are those of the mineral irritants. The cases observed have been too rare to be spoken of otherwise than generally. *See* POISONING.

SYMPTOMS.—Of these but little is known. Concentrated solutions of stannous chloride and of stannic chloride—the lower and higher chlorides respectively of the metal—are known to act as irritant poisons. Neurotic symptoms are also manifested, so that tin-salts do not appear to act simply as irritants. In large doses the chlorides produce fatal results. Probably the toxic results are heightened by the free hydrochloric acid invariably present in the commercial solutions of stannous and stannic chlorides.

Treatment.—The treatment to be employed is that for mineral acids. *See* Poisoning.

Thomas Stevenson.

TINEA (*tinea*, a moth-worm).—Synon.: Fr. *Teigne*; Ger. *Flechte*; *Tinea.*

Definition.—A class of diseases of the skin, due to the presence of vegetable parasites in the integumentary structures. The term is also employed as a generic name for the organisms themselves.

Varieties.—The varieties of tinea generally distinguished are *Tinea tonsurans*; *Tinea kerion; Tinea circinata; Tinea sycosis; Tinea ungium; Tinea versicolor*; and *Tinea favosa.* The first five are varieties caused by the same fungus, and are included under the term *Tinea trichophytina.* Tinea favosa is described in the article Favus; tinea versicolor in the article Phytosis Versicolor; and tinea sycosis is also referred to under the heading Sycosis.

1. **Tinea tonsurans.**—Synon.: Ringworm of the hairy scalp; *porrigo scutulata* and *herpes tondens* of old writers.

Description.—This is a chronic disease of the scalp, resulting from an attack on the epithelial tissues of a fungus called *trichophyton tonsurans.* The characteristic lesion is a textural alteration of the hairs, due to the growth of the fungus, which causes them to become lustreless, opaque, dry, swollen, and brittle, and to break off close to the scalp, as though nibbled away, at the same time that they are surrounded and invaded by fungus-elements. This change takes place over more or less circular areas, which are of varying size, from a threepenny-piece to that of the palm of the hand, and are the seat of fine, white, meal-like desquamation. The fungus, once implanted upon the surface, leads to the changes detailed in the article Epiphytic Skin-Diseases. There may be many spots of disease, or only one. Clinically it is important to be aware that the disease may vary in appearance from the typical characters above described. The patch of tinea tonsurans may not be circular but irregular, which may be due to the coalescence of two or more patches. In strumous subjects a certain amount of pus may be produced at the seat of mischief; and this, together with the hairs, may be matted together into a semi-crust, in which the diseased hairs of ringworm are not very recognisable at first. Lastly, in chronic cases of tinea tonsurans, there may be only a diseased hair here and there amongst the healthy ones, and these are very liable to be overlooked. To be made aware of these variations in appearance is, however, to greatly facilitate the diagnosis. Whenever the growth of hairs seems to be interfered with in a patchy form, and there is desquamation, a careful examination should always be made for the parasite in the hairs. Tinea tonsurans (of the scalp) often co-exists with T. circinata (of the general surface), and the latter may extend to the scalp and there become T. tonsurans. Thus these two varieties are essentially the same in nature, the only difference being, that in the one case the fungus attacks a hairy part, and causes a peculiar change in the hairs; and in the other it grows on parts where any implication of hairs is a secondary feature.

In examining a hair, it should be soaked for some time in diluted liquor potassæ, placed on the slide, and covered by thin glass in the usual way; and then a little pressure should be made, so as to flatten the piece of hair to separate its component fibres, by getting as it were a thinner section, to bring the fungus more readily into view. The fungus, the *trichophyton tonsurans*, as usually seen, consists almost entirely of *conidia*, or those reproductive bodies commonly called spores. They are round, ·003 to ·007 mm. long, by ·003 to ·004 mm. broad (equivalent to from $\frac{1}{8000}$ to $\frac{1}{3000}$ in.) very uniform in size, however, in any particular case; nucleated; sometimes constricted; and very abundant about the roots of the hair. The *mycelial* filaments, when seen, are few, jointed, somewhat undulated, and with interior granules. The fungus attacks both the hairs and other epithelial structures.

Diagnosis.—The diagnosis of tinea tonsurans is at once made by the presence of the short, texturally altered, and broken-off hairs; and attention should be given to this point, and not, as is too often done, to the mere 'eruptive' phase of the complaint.

Treatment.—The treatment is most disappointing, and it is difficult to enforce with any great degree of success, except in cases under the immediate eye of the medical attendant. It is needless to enter here into detail at length, and the following is a summary of the treatment of ringworm, as applicable to the majority of cases. There are three indications. *First*, we must improve the general nutritive tone of those attacked, for thereby the fungus finds a less favourable soil for growth. *Secondly*, we have to get rid of the fungus; and this is effected in two ways, partly by removing as far as possible all diseased hairs by epilation, and partly by bringing parasiticides in contact with the diseased structures. And, *thirdly*, it is necessary to secure an entirely new growth of hair, since, practically, hairs once attacked by the fungus never return to a healthy condition; and the occurrence of this latter desideratum is favoured in proportion as epilation is complete, and is accelerated by stimulation after the removal of the diseased hairs.

The *first* indication above stated is effected by the administration of good food; by placing the patient under the influence of good hygienic conditions; by prescribing cod-liver oil, iron, quinine, or arsenic, according as the constitutional state is one of a strumous or lymphatic nature, or is attended by anæmia, debility, or the like. Fatty substances of all kinds, when they can be digested, are, as a rule, to be taken by children suffering from severe ringworm.

As regards the *second* indication, before epilation or parasiticides are used, the hair should be cleared away from off and around the diseased surfaces. It there are many places about the scalp, it is well to cut all the hair off. It is best removed by the scissors; if the scalp be shaven, it is mostly excoriated and made tender, so that strong remedies cannot be so well applied. The preferable plan is to cut the hair as close as possible to the scalp with scissors, and to repeat the operation every few days. When the hair has been removed, the diseased surfaces appear as more or less well-defined circular areas or patches, which are darker than the healthy scalp, covered by scales, and studded by hairs, which are swollen, thickened, lustreless, and brittle. Epilation is now to be proceeded with. The nurse, mother, or medical man, whoever it may be, should take a pair of ciliary forceps, and clear away the hairs as far as practicable, over an area of an inch or more in diameter at a sitting; many hairs break off, but some come away whole, and if they do break away, more decided access is given to the follicles for parasiticides. All patches should be epilated, the operation being repeated over the same areas from time to time, as the diseased hairs grow up. After epilation, two or three courses may be adopted. The part may be blistered, or parasiticides of a non-vesicating character—and their name is legion—may be applied, or a plan combining the use of both means may be adopted. Repeated blistering with acetic acid, or acetum cantharides, may be resorted to, but perhaps the mixed course is the best. It is a good plan to blister occasionally or once a week, going over the same parts two or three or more times after each blistering, allowing time to get the scab off, then rubbing in freely a parasiticide for several days, and then re-applying the blister. The best parasiticides are the iodine liniment, sulphur compounds, mercurials, tar, creasote, and carbolic acid, which may be variously combined in strength according to the age of the child. The ointment form is preferable, and it should be thoroughly inuncted night and morning. Very small inveterate patches may be treated by croton oil liniment, to excite the formation of pustules round each hair, or better still artificial kerion. The hair is thus loosened and got rid of. The number of remedies for ringworm is legion; but the particular remedy used is not so important, as that it be used vigorously, with epilation, till every vestige of a diseased hair has disappeared. In fact, the entire absence of any short, thick, brittle stubs, which may be broken off quite in the follicles, and the springing up of fine, downy, silky hairs, are the only real proof that a scalp ringworm is cured. During this treatment the head should be well washed every day, and light linen or silk caps must be worn. The individual affected is to be regarded as capable of spreading the disease from person to person, or of conveying ringworm of the surface, tinea circinata, to adults. Change of air is always desirable.

The *third* indication, namely, the promotion of the re-growth of the hair, is secured by the use of some stimulating wash. The following is a good one:—Tincture of lytta 6 drachms; distilled vinegar, 2 ounces; spirit of rosemary, 2 ounces; glycerine, 2 drachms; and 6 ounces of rose-water; to be well sponged into the roots of the hair night and morning.

2. Tinea kerion.—Description.—This is not a common disease. It is a modification of tinea tonsurans, in which each separate hair-follicle is swollen and prominent, and exudes a puriform fluid like mistletoe juice. The joint result of the swelling of the many hair-follicles together is the production of a raised boggy circular swelling, studded over with minute orifices, discharging muciform fluid. In some cases, it would seem as if subcutaneous formation of pus were about to take place. The hairs lie loose in the follicles, having been detached from the follicular linings by the exudation; and they are readily pulled away, and indeed often fall out spontaneously. If they remain in the follicle for any time, they are apt to get very brittle. This disease is idiopathic; or it may be set up by the use of irritant remedies to the scalp, by which the follicles are inflamed.

Treatment.—This disease cures itself, so to speak. The hairs, being loose in the follicles, are readily removed therefrom, and with them the fungus; or so little of it is left behind that the mildest parasiticides alone are required. Epilation, in fact, is both easy and immediately successful. The writer was the first to demonstrate the parasitic nature of the disease, and his experience teaches him that, as a rule, all that is needed is the removal of the hairs, and the use of soothing remedies, such as liquor plumbi ointment.

3. Tinea circinata.—Synon.: Ringworm of the surface.—Description.—As stated above, this disease is produced by the same fungus that is present in tinea tonsurans, but it is an affection of non-hairy parts. It generally begins by a small scurfy spot, or rarely a minute red patch with a vesicular edge. In either case the fully developed disease consists of one or more well-defined circular patches, the bounding edge being red, raised, and vesicular; whilst the central area is much paler, and is the seat of branny desquamation. If an examination be made of scrapings from the surface of the patch, the fungus will be detected, and in its mycelial form chiefly. Tinea circinata is common about the forehead, cheek, chin, and back of the neck, but also occurs on other parts of the body. It often co-exists with tinea tonsurans; and it can give rise to the latter by transmission to the scalp of its fungus-elements, or by its extension from the face or neck to hairy parts of the scalp.

In some cases, especially in persons who perspire, and in hot weather—that is to say, under the combined influence of heat and moisture, and consequently in hot climates—ringworm of the surface may be very severe and extensive. The circular patches are very large, with well-defined edges, spreading over various regions of the body. The common seat is the fork of the thigh, to which it may be localised, festooning downwards some little way. This is the *eczema marginatum* of Hebra, an eruption often seen in England. In other cases there may be rings or patches, still with papular or vesicular edges and desquamating centres, scattered over the buttocks, the thighs, about the front of the chest, the axillæ, or the neck and face; two, three, or more places being affected at a time. This condition is common in China, India, and other hot climates and to it the terms 'Dhobie's' and 'washerwoman's itch,' 'Indian ringworm,' and 'Chinese ringworm,' are applied. But these locally-named varieties are all modifieations of common tinea circinata; and the writer has seen equally severe cases in England in very hot seasons.

Diagnosis.—The diagnosis is made certain by microscopic examination, and the detection thereby of the fungus. All circular well-defined patches of skin-disease, with papular or vesicular edges and paler desquamating centres, should be examined for a parasitic cause.

Treatment.—Tinea circinata is usually easily cured by the innunction of any of the parasiticides already mentioned; but such treatment may be preceded by the application of some mild vesicant, as acetic acid or blistering fluid, to remove the epidermic layers in which the fungus mostly flourishes. In some cases the disease is very obstinate, but most will yield to the free application of a hyposulphite of soda lotion, ℥ss to ℥ij of water; or to repeated applications of gunpowder or goa powder made into a paste with vinegar.

4. **Tinea sycosis.**—Tinea sycosis is also produced by the attack of the trichophyton tonsurans upon the hairy parts of the face, namely, the whiskers, or more commonly the beard. It is fully described under its own heading. *See* Sycosis.

5. **Tinea versicolor.**—This disease is characterised by the presence of fawn-coloured, more or less circular, patches, slightly raised, itchy, and the seat of branny desquamation. The fungus is the *Microsporon furfur*, composed of conidia of a round shape, ·0008 to ·002 mm. in diameter, collected together into characteristic heaps, connected by a network of thick wavy and branched threads. In examining for the fungus a very small piece and a very thin layer of scale must be taken, and it must be rendered very transparent by potash, and gently pressed out between the glasses. For a description of the disease *see* Phytosis Versicolor.

Onychomykosis. — Definition. — Parasitic disease of the nails.

Description.—Occasionally the trichophyton, and very rarely, the achorion, will attack the nail, sending mycelial threads through the nail-substance, and rendering the nail opaque, thickened, and brittle. Other causes produce thickened, opaque, brittle nails, such as psoriasis, syphilis, general debility, general eczema, lichen ruber; but in parasitic disease only a single, or perhaps two or three nails are affected, the nails of the feet escaping almost invariably. Hence, in all cases where only one or two nails are opaque, brittle, and thickened, a careful examination of the nail-substance should be made for fungus-elements. Onychomykosis may occur with tinea circinata, the latter, in fact, investing the nail, or it may be derived by contact with tinea tonsurans, as in the case of those who attend to ringworm cases.

Treatment.—The treatment consists in scraping away the nail-substance and soaking the parts continuously in hyposulphite of soda, sulphurous acid lotion, or some approved parasiticide.

Tilbury Fox.[1]

TINKLING, METALLIC.—A sound of a peculiar quality, which the name sufficiently defines, occasionally heard on auscultation in connection with cavities in the chest. *See* Physical Examination.

TINNITUS (Lat.).—Synon.: Fr. *Bourdonnement d'Oreilles*; Ger. *Summen*; *Klingen*.—This term, which is commonly used when speaking of noises in the ears, is a frequent symptom in many diseases of the external, middle, and inner ear. It is usually present in all those conditions where there is undue pressure on the labyrinth; for instance, when there is pressure on the tympanic membrane from cerumen, imperfect entrance of air into the tympanum, due to obstruction of the Eustachian tube, or effusion within the tympanic cavity. It accompanies most inflammatory diseases of the external or middle ear; follows injuries to the tympanic membrane, and blows on the head or ear; may occur in aneurism at the base of the skull; and is a prominent symptom in all nervous affections of the auditory apparatus, as well as in many states of disordered hearing where the ear is healthy. So infinite are the degrees and variations in this symptom that there is probably no known sound to which it has not been compared by patients. When tinnitus is due to some curable local cause, the symptom rapidly disappears with its removal. When, however, it accompanies deafness in nervous affections, it is often the more troublesome symptom of the two, and the less amenable to treatment. Strychnia is the most useful tonic in ear-affections, and quinine the least suitable, as this drug exercises a distinctly injurious effect, if taken in large doses. *See* Ear, Diseases of; Hearing, Disorders of; and Vertigo.

W. B. Dalby.

TITUBATION (*titubo*, I stagger).—A term for staggering or stumbling gait. *See* Cerebellum, Diseases of; and Vertigo.

TOBACCO, Poisoning by.—Synon.: Fr. *Empoissonement par le Tabac*; Ger. *Tabakvergiftung*.—The minor effects of tobacco-poisoning—nausea, depression, vomiting, vertigo—are well known to the incipient smoker. Fatal poisoning by tobacco rarely occurs, except through its ignorant administration by mouth or rectum. Cases of nicotine-poisoning are still more rare, this, the volatile active alkaloid of tobacco, not being readily procurable.

Anatomical Characters.—After death from tobacco-poisoning the organs and tissues have a tobacco-like odour, and the odour of nicotine becomes more pronounced on treating them with liquor potassæ. Turgescence of the brain has been described; but, beyond the odour, there is nothing diagnostic in the appearances.

Symptoms.—When a strong decoction of tobacco or snuff is administered, either by mouth or rectum, very speedily—usually in about five minutes—the patient is seized with vertigo, acute abdominal pain, nausea, and vomiting. The skin is pallid and bathed in perspiration. Stupor supervenes, with partial or general convulsions, and stertorous respiration; and death may result in fifteen or twenty minutes, preceded by dilatation and insensibility of the pupils. When the alkaloid, nicotine, is swallowed, insensibility supervenes almost immediately; the pupils are widely dilated; respiration is speedily suspended; and the patient dies in three or four minutes.

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[1] Revised by Dr. T. Colcott Fox.

DIAGNOSIS.—The *odour*, coupled with the above-described symptoms, would leave no doubt as to the nature of the case. Usually there is a history of administration.

PROGNOSIS.—The prognosis is in all cases unfavourable. *Fatal Dose.*—Thirty grains of tobacco are said to have proved fatal. A drop or two of nicotine would doubtless prove fatal.

TREATMENT.—The treatment of poisoning by tobacco consists in the exhibition of emetics, followed by tannin freely in any form to render the alkaloid insoluble. Strong tea, coffee, and stimulants should also be administered. Iodine, dissolved with iodide of potassium, has been recommended; but is probably of little efficacy, and is undoubtedly irritating to the stomach. Twenty to thirty minims of tincture of nux vomica may be given, and repeated at intervals; or, better, a hypodermic injection of $\frac{1}{25}$-grain of the nitrate or other soluble salt of strychnia may be administered.

THOMAS STEVENSON.

TONE, Want of.—This expression, although commonly employed in a somewhat loose and unscientific manner, is sufficiently understood in the main. To appreciate its meaning, it is first necessary to enquire what tone is. In the widest sense of the term, a person may be described as being *in tone* when his several organs individually discharge their functions in a perfect manner, and act harmoniously as a whole, just as a violin is said to be *in tune* when melody can be educed by striking its individual strings. More correctly, tone is applied to a condition of the muscular system, as signifying that state of tension in which voluntary muscular efforts can be produced and continued with a healthy and pleasurable feeling; and also to muscular organs, to indicate a certain degree or power of contraction of their walls.

ÆTIOLOGY AND PATHOLOGY.—Various factors combine to produce and maintain muscular tone. First, this state is dependent on a proper supply of *nervous energy*; secondly, *nourishment and oxygen* must be furnished in abundance; thirdly, the *products of waste* must be thoroughly *removed* from the system; and fourthly the *work* required of the muscular tissue must *not be excessive*, that is, a certain amount of rest must be afforded to it.

Want of muscular tone results, then, from failure of any of these circumstances.

1. *Nervous failure.*—Whatever view may be taken of the nature of nervous and muscular force, modern research has shown that they are intimately connected with each other. If the nerve-supply be cut off, muscles waste; and *vice versâ*, if the muscles remain unemployed, their nerve-centres suffer. The effect of nervous disease or disorder in producing loss of muscular tone is illustrated by such neuroses as hysteria and epilepsy, by some forms of mental disease, and by the large but indefinite class of cases known as 'nervous debility,' of which mental strain, anxiety, sexual excess, and alcoholism are frequently the exciting causes. It is in these cases that we derive special benefit from what are called 'nervine tonics,' such as strychnia, the phosphates, and cod-liver oil.

2. *Failure of nutrition.*—Deficiency of the blood-supply immediately lowers muscular activity, in consequence of interference both with the nutrient and the oxygenating processes. It is on this account that want of tone is found in anæmia, in convalescence from acute diseases, and to a certain extent even in chronic dyspepsia. Want of oxygen and impurity of the atmosphere lead as distinctly to lassitude; and, if long continued, to lowering of muscular energy and loss of tone, as amongst the inhabitants of large towns, and in persons employed in close, ill-ventilated rooms.

3. *Retention of waste products.*—When muscles are called into action certain compounds are formed within them, which must be eliminated by being passed back into the circulation and excreted. The lungs, skin, kidneys, liver, and bowels must, therefore, discharge their functions properly to keep the muscular system in tone. We have here the explanation of a very common class of cases of want of tone. Many persons, either from choice or from necessity, habitually take an insufficient amount of active bodily exercise for the removal of the waste products from the muscular and other systems. In the former case this is the result of indulgence in abundant rich food, combined with lazy habits, confinement to warm 'relaxing' rooms, and the avoidance of 'bracing' exercise. In the latter case, the metabolic inactivity is referable to enforced confinement in sedentary employments, often of an exhausting kind, carried on perhaps in an impure atmosphere, or throwing a continuous strain upon one set of muscles, such as those involved in standing or sitting. Both these classes of cases also are met with chiefly in large towns, and they constitute a considerable proportion of the persons who 'require tonics.'

4. *Muscular exhaustion.*—Excessive muscular exercise leads to loss of tone; first, by interfering with nutrition, which is most active during rest; secondly, by wear and tear; and thirdly, in the case of hollow muscular organs, such as the intestines (the muscular walls of which have to resist internal pressure), by gradual exhaustion of muscular irritability from continuous excitement, or possibly even by over-stretching and dislocation of the fibres. The first two forms of muscular atony are well illustrated by certain instances of cardiac exhaustion; the third form is met with not only in the alimentary canal, but in the bladder, in the blood-vessels, and indeed in all muscular tubes and ducts, when over-distended by solid, fluid, or gaseous contents.

5. *Combined causes.*—In many cases two or more of the causes mentioned under the preceding heads are combined, and give rise to want of tone or atony. Thus in that large class of cases of debility with which practitioners in large towns are familiar, and which especially includes young female subjects engaged in business, over-work, impure air, insufficient light, badly cooked or otherwise improper food, the constant strain of the muscles of the legs and

back without sufficient movement, and frequently many circumstances relating to the nervous system, are all combined. Again, the subjects of chronic nervous affections, such as epilepsy and hysteria, are too frequently over-fed, nursed in warm rooms, and spared every form of healthy exertion, with the result of producing a flabby, atonic state of system.

Symptoms.—Want of tone in the muscular system generally is characterised by a number of symptoms, which are all more or less ill-defined and difficult to describe, being chiefly of a negative and subjective kind. The chief of these are a peculiar feeling of want of muscular vigour; weakness, heaviness, and even aching of the limbs; languor, inability and unwillingness to undertake or to continue any kind of physical or mental exertion, and a desire to remain passive and undisturbed. This reacts upon the mind, causing depression of spirits, melancholy, and other subjective symptoms.

The symptoms of want of tone or atony of muscular organs vary greatly with the part affected. Thus atony of the stomach is characterised by a familiar form of dyspepsia, which is called 'atonic;' atony of the bowels is chiefly attended by constipation and flatulence; atony of the bladder is associated with retention of urine. Ulcers are said to 'want tone' when the healing process flags.

Treatment.—It will be gathered from the preceding remarks that want of tone, whether general or local, is a condition which calls for very different kinds of treatment, according to its cause. One of the principal reasons of the want of success which frequently attends attempts to restore tone to the system is failure on the part of the practitioner to appreciate this truth, and to discover and remove the cause or causes of the morbid state. Tonic drugs suggest themselves only too readily as the proper means to be employed; and so great is the number of remedies which go by this name, and so complex are the combinations in which they are now presented by the pharmacist, that recourse is often had to them before an accurate estimate has been made of the direction in which the system or the affected organ is really at fault, and hence injury, not benefit, results. These remarks apply both to loss of tone generally, and to atony of special organs. Thus it happens that the best tonic measure in one case may be rest, in another case exercise; in a third case food and stimulants may be urgently called for, in a fourth case lowering measures are essential at the commencement of treatment. Time is an equally important factor in the process of restoration to tone. This is especially true in the instances where rest is necessary; but even in the very opposite class of cases, where exercise is demanded, this must be carried on for a long time, being commenced with caution and slowly increased.

The details of tonic treatment are indicated in a special article (*see* Tonics). Here it need only be added that when the nervous elements are distinctly deficient in activity, strychnia, cinchona, phosphorus, and cod-liver oil appear to be specially indicated, whilst galvanism and massage may be useful. Alcoholic stimulants and iron are best adapted to cases in which nourishment and oxygenation have fallen below par. Dr. Weir Mitchell has lately shown how much may be done by systematic feeding in conjunction with the other means just indicated. When the activity of the organs is diminished from accumulation of waste products, we must have recourse to moderate cholagogue purgation, to such diuretics as digitalis, to diaphoretics, and especially to change of occupation and exercise of such a kind in an open healthy atmosphere as shall bring all the voluntary muscles into action, and stimulate if possible every bodily function. In the converse class of cases, where exhaustion is the result of over-exertion, we have, after removing the cause, to exhibit antispasmodic or even sedative drugs, such as belladonna and opium, which are especially useful in the first stage of atony of the stomach and alimentary canal, as well as in atony of the bladder.

William Bruce.

TONGUE, The.—Synon.: Fr. *La Langue*; Ger. *Die Zunge.*—Apart from its own particular diseases, which are described in a separate article (*see* Tongue, Diseases of), the tongue, as is familiarly recognised, gives important clinical indications regarding the morbid conditions of the general system, and of various local diseases, which it will be the object of this article to endeavour to point out in a systematic manner. To 'look at the tongue' is one of the first acts of 'physical examination' which every tyro in the medical profession performs; but there is much that is indefinite and uncertain in the ideas as to what this examination is intended for, and what information it affords.

Mode and Objects of Investigation.—In general terms it may be stated that we examine the tongue, for clinical purposes, with reference, first, to its *subjective sensations*; secondly, to its *movements*; and, thirdly, to the *objective characters* which it presents.

1. Its *subjective sensations* chiefly include ordinary tactile sensation and the sense of taste. In most cases we rely for information on these points upon the statements of patients: but under certain circumstances common sensibility may be tested experimentally by a suitable instrument; and taste, by applying different articles to the tongue with a brush, or in other ways (*see* Taste, Disorders of). Dr. Quain has called the attention of the writer to a peculiar sense of heat or burning, sometimes felt in the tongue, which seems to be associated with the gouty diathesis.

2. The *movements* of the tongue are studied by watching them directly, and by noticing any abnormal affection of speech or deglutition, arising from defect or disorder of these movements. A peculiar thickness of speech, or an inability to swallow properly, may result from this cause, and finally articulation and deglutition may become impossible. To examine the tongue directly as a motor organ, it should first be looked at while in the mouth, both at rest and when the patient moves it from side to side, or in other directions; then he should be directed to put it out, and to perform similar movements when the tongue is protruded. This mode of

investigation gives, in certain cases, important information.

3. The *objective examination* of the tongue in itself is of far more frequent application than the methods just considered, being indeed called for and ordinarily practised in every case, although it may not necessarily afford any positive information. No patient thinks his case properly investigated unless he is told to put out his tongue. The examination is usually carried out by inspection; but it may also be requisite, and very advantageous, to feel the tongue with the fingers. In looking at the organ, an endeavour should be made to inspect its entire upper surface, and for this purpose the patient should be directed to open the mouth, and protrude the tongue as far as possible, a good light being also needed for observing it. In some instances, as in infants and rebellious children, as the result of congenital malformations or wearing false teeth, in many low febrile cases, and in certain nervous diseases, the tongue must be examined while in the mouth, as the patient either cannot or will not put it out properly; for this purpose it is sometimes necessary to open the mouth rather forcibly, but with due care, and it may be desirable to employ some artificial light. For more minute information in certain cases it is requisite to scrape the surface of the organ, and to examine microscopically what is thus removed. The points to be noticed in the objective examination of the tongue are:—*a.* Its size and shape as a whole, as well as its point and margins. *b.* Its condition as to firmness or flabbiness. *c.* The colour of the mucous membrane. *d.* Whether the surface is normal, unusually smooth and glazed, furrowed, fissured, or otherwise altered. *e.* The condition of the papillæ, especially the fungiform papillæ. *f.* Whether the tongue is moist, sticky, or dry. *g.* The absence or presence of any fur on the dorsum of the organ; and, if present, its arrangement, thickness, colour, and other general characters, as well as in some cases its microscopic characters. It may be remarked that in connection with this examination of the tongue, it is often advantageous to notice the condition of the mouth generally, but especially of the gums and teeth, and of the lips. Further, the patient may afford information with regard to the objective conditions of the tongue, not coming immediately under the notice of the practitioner, such as whether it is much furred on waking in the morning, or if it is inclined to dryness.

It is requisite to offer a few remarks respecting *fur* on the tongue. This varies much in its extent, thickness, and appearances. It may cover the whole surface of the organ; or only its posterior or anterior part, one lateral half, or even a limited patch when due to local causes. The fur may be a mere film, or of considerable thickness. Its chief colours are white, whitish-yellow, yellow, yellowish-brown, brown, brownish-black, and black. It is either moist and easily separated; sticky and viscid; or dry, being then often cracked and peeling off. Under certain circumstances fur appears and disappears with great rapidity. Microscopically it is found to consist chiefly of epithelium-particles, either formed in excess, or accumulated upon the surface of the tongue from various causes. The particles are held together by saliva and mucus; and mixed with them are often the remains of food, or bacteroid growths, especially bacilli and micrococci. Yellow fur is supposed to be due to fatty degeneration of the epithelium, and then fatty particles are present. Blood or altered blood, and pigments are found in the brown and black furs. The increased production of epithelium, causing a fur, is due to hyperæmia of the tongue, dependent either upon the general condition of the patient, or upon direct or reflex irritation. There are serious conditions, however, in which the development of epithelium on the tongue is prevented, and so it is not furred, but becomes red and raw.

CLINICAL INDICATIONS.—In the following remarks it is intended to give a summary of the principal conditions and diseases in which the tongue affords useful information, and to indicate the main characters which it presents. Allowance must always be made for individual peculiarities in the shape or size, and in the appearances presented by this organ; for the effects of certain habits, such as excessive smoking, or chewing tobacco and other materials; for changes in colour due to taking iron or other medicines; and for any local irritation. Moreover, most people, but especially those who sleep with the mouth open, have a more or less furred tongue in the morning, which is of no special importance, or it may tend to dryness; while in some individuals its surface presents constantly a thick fur, without evident disturbance of any organ, appetite being excellent, and the digestive functions performed in a most satisfactory manner. On the other hand, a perfectly clean and healthy-looking tongue may be associated with severe dyspeptic symptoms, or even with serious organic disease of the alimentary canal or its related organs. Many persons have the surface of the tongue much furrowed.

1. **Nervous diseases.**—In this class of diseases the tongue often affords information of much value, and it is here that its sensations and movements are mainly disordered. In many cases of cerebral lesion one half of the tongue is paralysed in its muscles, so that the organ is unsymmetrical in the shape of its two sides; and deviates, when in the mouth to the healthy side, but when protruded towards the paralysed side. In exceptional cases the entire organ is affected, so that it cannot be protruded or even moved. The way in which a patient attempts to put out the tongue when asked to do so, may be made use of to indicate the state of consciousness in various conditions affecting the brain. In many cases of cerebral disease the tongue shows a marked and speedy tendency to become thickly furred, and very foul. This is well seen in cases of apoplexy due to hæmorrhage.

The tongue is specially affected in certain peculiar nervous diseases, especially labio-glosso-laryngeal paralysis, many cases of diphtheritic paralysis, general paralysis of the insane, and extreme cases of wasting palsy. Beginning with slight indications of loss of power, as tremulousness, thickness of speech, and difficulty in swallowing, the affection is liable to end in complete paralysis of the organ, which may also involve its sensibility. These results depend on disease involving the roots of the nerves supplying the tongue. The organ may also be thus affected in various degrees, owing to some morbid condition implicating its nerves in their course or at their origin. When completely paralysed, the tongue in time may come to present the appearance of a sodden mass lying in the mouth. In cases of severe neuralgia of one side of the face, the tongue occasionally presents peculiar appearances, such as unilateral furring, thickening of the mucous membrane, or enlargement of the papillæ. The tremulous and foul tongue of acute or chronic alcoholism may also be mentioned under this head. Signs of the organ having been bitten may be useful in the diagnosis of obscure cases of epilepsy. The jerking and irregular movements of the tongue are very striking in many cases of chorea. During attacks of migraine its surface usually becomes much furred.

2. **General conditions and diseases.**—The tongue is usually markedly altered in the febrile state, whether associated with specific fevers, or with inflammatory diseases. It becomes covered with more or less fur, often of considerable thickness, and usually either white or yellowish-white. In particular fevers the organ commonly presents peculiar characters. Thus, in most cases of typhoid fever it is small and irritable, with enlarged papillæ, and a thin, whitish or yellowish fur; or sometimes it is red, smooth, and glazed or shining. In this disease it may be peculiarly tremulous, and this has been regarded as a bad sign, as indicating deep ulceration of the intestine. In scarlatina the papillæ tend to become much enlarged and prominent, so that they project through the fur, and the tongue in many cases presents the so-called 'strawberry' appearance. In diphtheria it may exhibit a diphtheritic deposit upon its surface. There is generally a very thick, creamy fur in acute rheumatism, as well as preceding and during attacks of gout, and in the latter especially it often becomes brownish. In acute pneumonia also the tongue is usually thickly coated. In the 'typhoid state,' whatever this condition may be associated with, the tongue is dry, and usually covered with a brown or even blackish crust, appearing as if it were baked. It is often very red and irritable in itself, and occasionally the typhoid tongue has little or nothing on its surface, but is very dry, deeply red, like raw beef, and fissured. This is due to the fact that the long-continued pyrexia, especially if high, prevents the formation of epithelium. The organ may be in such a condition that it can scarcely be moved at all. At the same time sordes are present on the teeth and gums. In malarial fevers the margins of the tongue are said to present sometimes a faint bluish tinge.

It may be remarked here that the tongue not uncommonly affords evidence of constitutional syphilis, owing to the past effects of this disease upon the organ. It also indicates the general tone of the system, being usually large and flabby when this is below par. In some instances of diseases attended with marked general wasting, the tongue comes to present an irritable appearance.

3. **Conditions affecting the blood and circulation.** — The tongue often exhibits abnormal characters, due to the state of the blood or circulation. Thus, in anæmia it is more or less pale; generally large, flat, broad, and flabby; and frequently marked at the sides by the teeth. In the plethoric condition it is also large, but tends to be of a deeper colour than normal, and may present a venous tint. The anæmic tongue is frequently quite clean, though this will depend much on its cause; but the tongue of plethora is generally furred, on account of the condition of the alimentary canal. A temporarily congested condition of the digestive organs and liver is supposed to produce a corresponding plethoric state of the tongue. Any cause of general obstruction to the venous circulation, or of interference with the due aëration of the blood, whether seated in the heart or lungs, is likely to give rise to enlargement of the tongue, and to make it assume a congested, or even a cyanotic appearance in marked cases, such as those of congenital malformation of the heart. It occasionally happens that some local obstruction, affecting the large veins in the thorax, as from the pressure of an aneurism, produces a similar condition of the tongue.

4. **Affections of the alimentary canal and its related organs.**—The tongue is of peculiar importance in relation to these organs, in most cases affording very definite and valuable information as to their condition. Indeed, some of the deviations from the normal state already considered depend directly upon disorder affecting the digestive apparatus. Without attempting to give a complete or detailed account of the varieties of abnormal tongue associated with diseases of these parts, the general indications which it affords may be thus pointed out.

a. The tongue is peculiarly liable to be altered in local affections of the mouth and throat. In catarrh of these parts it is more or less furred. In tonsillitis there is usually a very thick fur; and it may be most marked on the side of the inflamed tonsil. Even a local irritation, such as that caused by decayed teeth, may originate a fur, and it is under such circumstances that it is liable to be localized.

b. In any acute disorder of the alimentary canal the tongue speedily becomes furred, usually either white or yellowish-white, but it may be more or less brown. This is seen in so-called acute dyspepsia, catarrh of the alimentary canal, and hepatic disorders. The fur often disappears very speedily. In severe acute gastritis the organ often presents a strikingly red and irritable appearance, especially at the tip and edges, with enlarged papillæ, and a tendency to dryness.

c. In chronic forms of dyspepsia and gastric catarrh, the tongue presents different appearances according to circumstances. In the atonic variety it is usually large, flat, soft, and flabby; frequently marked with the teeth; and more or less furred, though it may be quite clean. In the irritative form it tends to be small, elongated, and pointed; contracted and firm; red and irritable; with enlarged papillæ; and generally only having a thin white fur, through which these papillæ project, but it may appear unusually clean and raw-looking. The organ may present characters more or less similar to those just described, in those cases where the food passes rapidly out of the stomach into the duodenum in an undigested state. In the more grave diseases of the stomach, namely, cancer and ulceration, the tongue has no special characters, and indeed is often very healthy-looking; its characters will depend on the state of the gastric mucous membrane generally.

d. The relation of the tongue to affections of the intestines is not so evident as in the case of the stomach. When they are implicated together in the same disorder, the organ presents the characters already indicated. The bowels, however, are often much deranged or diseased without any abnormal appearances being exhibited by the tongue, provided the stomach is unaffected. It may be said, however, that constipation, especially if habitual, tends to make the tongue large and furred, particularly if associated with portal congestion and deficiency of bile. In some cases of chronic intestinal catarrh, with diarrhœa, the organ presents an irritable appearance. In chronic dysentery it often becomes red, glazed, or fissured.

e. As regards the organs connected with the alimentary canal, it is only the liver which can be stated definitely to affect the tongue. As has been already mentioned, any interference with the portal circulation is liable to cause a plethoric condition of the organ; and, owing to the effects produced on the alimentary canal, it becomes more or less furred. Any deficiency of bile in the intestines also leads to furring of the organ; and if this is very marked, or if the bile is entirely absent, the tongue tends to become very foul. It is much affected in acute biliary disorders; and may become coloured yellow in jaundice.

5. **Special diseases.** — In diabetes the tongue is often peculiarly irritable, red, clean, cracked, and dry. In acute peritonitis it is usually remarkably small and contracted, also red and irritable, with but little fur, and tending to dryness. In advanced cases of phthisis, especially with a high temperature, it frequently becomes red and raw, and exhibits enlarged papillæ; the occurrence of thrush upon its surface may also be a sign of approaching dissolution in this disease. These illustrations will suffice to point out the special information which the tongue may afford as regards particular diseases.

CONCLUSION.—By a consideration of the characters of the tongue, it will be seen from the foregoing remarks that important and valuable indications are often afforded, not only as regards diagnosis, but also for prognosis and treatment. Therefore it is essential that its characters should be properly studied in every case, bearing in mind the three clinical aspects which it presents to the practitioner, namely, its sensibility, movements, and objective characters.

FREDERICK T. ROBERTS.

TONGUE, Diseases of.—SYNON.: Fr. *Maladies de la Langue*; Ger. *Krankheiten der Zunge.*

The principal morbid conditions affecting the tongue may be thus enumerated in alphabetical order:—1. Adhesions; 2. Atrophy; 3. Cancer; 4. Hypertrophy; 5. Inflammation; 6. Parasitic affections; 7. Syphilis; 8. Tongue-tie; 9. Tumours; 10. Tylosis; and 11. Ulceration. Aphthæ and thrush are discussed under their respective headings (*see* APHTHÆ; and THRUSH). The simpler disturbances of the surface of the tongue, of which the practitioner avails himself as an aid to diagnosis, are separately discussed. *See* TONGUE.

1. **Adhesions.**—Occasionally the tongue is attached more or less extensively at its sides and under surface to the corresponding surfaces of the mouth. These adhesions may be congenital, but more frequently they are the result of ulceration or sloughing.

TREATMENT.—In congenital cases the membranous bands may either be divided with blunt-pointed scissors or with a scalpel; or, if they are too thick and extensive to be treated in this way, a ligature may be passed round them, and drawn tight, so as to bring about their division. Adhesions which have been caused by ulceration or sloughing may be dealt with in a similar manner, but the result is much less hopeful.

2. **Atrophy.**—Some degree of atrophy of the muscular substance of the tongue usually accompanies those forms of paralysis which affect its nerves. If the paralysis be considerable, the muscular fibres become wasted, but the bulk of the organ is often kept up by the interstitial deposit of fat. Besides this, there are two groups of cases in which there is well-marked wasting. These are (*a*) cases in which there is disease of the medulla oblongata, involving the hypoglossal nucleus; and (*b*) cases in which the ninth nerve is diseased or injured between the cerebrum and the muscles to which it is distributed. The cases which fall under the first head may depend upon softening, hæmorrhage, syphilitic disease, or other causes. This class includes the labio-glosso-laryngeal paralysis of Duchenne. Those which come under the second head are due to morbid growths of different kinds, or to accidents or injuries. The atrophy may affect both sides equally, or only one. *See* HYPOGLOSSAL NERVE, Diseases of.

TREATMENT.—Treatment must be directed to the cause of the complaint.

3. **Cancer.**—ÆTIOLOGY.—Cancer of the tongue is most frequently seen between the ages of forty and seventy; and it is more than twice as common in men as in women.

DESCRIPTION.—Cancer of the tongue commences either as a small excrescence, blister, or crack; or as a hard lump in the substance of the organ. Its origin may often be traced to some local irritation, or to some previous lesion. In whatever way it begins, the same symptoms are common to all varieties. There is occasional darting pain, radiating towards the ear, temple, and vertex. The diseased portion is tender; eating is rendered difficult; speech is thick and indistinct; the base of the tongue becomes infiltrated; and the organ cannot be freely moved or protruded from the mouth. The sublingual and submaxillary glands, as well as those which are connected with the lymphatic system, become enlarged and painful. There is an increased flow of saliva. The circu lation through the brain may be disturbed, and the patient then complains of giddiness and headache. Rapid wasting and loss of strength manifest themselves.

The local disease gradually involves more and more of the mouth. Sometimes large sloughs form, and profuse bleeding takes place. The difficulty of swallowing and even of breathing is great, on account of the obstruction which the disease causes at the pharynx; and this obstruction is increased by œdema, the result of retardation of the venous current. Gradually the growth invades the neighbouring parts; and frequently, before death takes place, bronchitis or pneumonia sets in. The most common seat of cancer of the tongue is on the side of the organ, at its middle or back part. It is almost always of the epithelial variety; very rarely it is scirrhous or encephaloid. Its average duration is fifty-seven weeks; but if the cases which are submitted to operation are taken by themselves, its average duration is eighty-six weeks.

Diagnosis.—The earlier stages of cancer of the tongue are sometimes difficult to distinguish from the simple affections of that organ, and still more frequently are they confounded with its syphilitic diseases. Indeed, the diagnosis between cancer and syphilis is a matter which often requires very nice discrimination.

Treatment.—Nothing effective can be done by medicines to induce the cure of a cancer, or to arrest its growth. It is hardly necessary to say that everything should be done to rectify the patient's general health, and that all sources of local irritation should be removed. But our main reliance must be placed in operative treatment. Operations are either complete, when the whole disease can be removed; or palliative, when they are undertaken merely for the relief of symptoms. They may be performed either with the knife, scissors, the galvano-cautery, the écraseur, or the ligature. Which of these means is used must depend upon the circumstances of the case. The knife is the most expeditious, but then there is sharp bleeding, and for this reason the patient cannot take an anæsthetic. But when the écraseur or the galvano-cautery is used, there is little or no hæmorrhage, and anæsthetics can be given. The ligature is seldom used, because it involves the presence in the mouth for some days of a disagreeable slough. When the case admits only of palliative treatment, portions of the diseased tissues may be removed; or the gustatory nerve may be divided to relieve pain and excessive salivation; or the lingual arteries may be tied to arrest hæmorrhage. Supposing, however, that the case admits of no operation, pain may be blunted by conium, and sleep procured by opium and its allies; whilst in some instances the subcutaneous injection of morphia is of the utmost value. Sometimes the backward pressure is so great that the patient is unable to swallow, and then it may be necessary to feed him by means of the stomach-pump or by enemata.

4. **Hypertrophy.**— Synon.: *Macroglossia; Prolapsus linguæ.*—Hypertrophy consists in an over-development of the tongue, and is usually associated with prolapse. Generally it is congenital; sometimes it follows an attack of inflammation. In the congenital cases it is often complicated with imperfections in other organs, or with idiocy. At first the enlarged tongue has a normal appearance. Gradually, from exposure to the air and constant stimulation, the mucous membrane becomes dry, thickened, and callous, or covered with a slimy secretion; while the papillæ become larger and more prominent than natural. After a time the pressure of the teeth acts as a line of constriction, and the protruding portion of the organ rapidly enlarges from mechanical congestion. The surface of the tongue becomes bluish or brown; the mucosa roughened and cracked; there is a tendency to ulceration and hæmorrhage; the muscles become palsied, and are unable to retract the organ. As time goes on, the lower jaw is pressed down by the superincumbent weight, and occasionally this goes so far as to produce dislocation. The teeth project forwards, the lips are everted, and there is a constant flow of saliva from the mouth. Altogether, the patient's appearance is most unsightly, and his condition very distressing; for with such a tongue mastication and deglutition are difficult, and speech is thick and indistinct.

Treatment.—Bandaging, with astringent lotions, and strapping, should first be tried. If this fails, an operation for the removal of the redundant part must be undertaken.

5. **Inflammation.**—Synon.: Glossitis.—Occasionally the surface of the tongue is covered by a crop of vesicles—a kind of herpetic eruption—and this without affecting the deeper structures. At other times the whole substance of the organ becomes acutely inflamed.

Ætiology.—Fifty years ago by far the most common cause of inflammation of the tongue was the excessive use of mercury; but happily mercurial glossitis is now seldom seen. In some cases acute glossitis arises from a chill; the inflammation, for some reason which it is not easy to explain, attacking the tongue, just as in other cases the same exciting cause gives rise to coryza or quinsy. Sometimes it is due to the contact of septic substances, or to the eating of particular articles of food, or to taking corrosive or acrid substances into the mouth; or it may arise in the course of fevers or eruptive diseases, or sometimes without any assignable cause.

Symptoms.—The earliest symptom of glossitis is a red line along the gums, at their junction with the teeth. The gums are tender, spongy, and apt to bleed. At the same time the breath acquires a peculiar and offensive fœtor, known as mercurial, and the patient has a disagreeable metallic taste in his mouth. As the case advances, the gums, the tongue, and the inside of the lips and cheeks become much swollen. The tongue is sometimes so large as to protrude constantly from the mouth. At its edges it becomes deeply marked by the teeth, and it is very prone to ulceration. The flow of saliva is incessant. The salivary glands are enlarged and painful; and the teeth ache and become loose, though it seldom happens that they drop out. The pulse and respiration are hurried. There is great thirst, but the patient has difficulty in swallowing; and he is wholly unable to speak. As a rule this state of things subsides under proper treatment but occasionally matter forms in the substance of the tongue, or it may become ulcerated or even gangrenous.

Treatment.—In acute inflammation of the substance of the tongue, scarification—in the form either of one or two long incisions, or of a number of punctures with the point of a lancet—or the application of leeches beneath the jaw may be needed, if the symptoms are urgent, and the patient plethoric. But generally milder measures will suffice, for instance, a saline purgative, or a drop or two of croton oil, followed, if need be, by enemata from day to day, together with a mustard plaster to the throat, and a suitable mouth-wash. As a wash, while the inflammation is at its height, there is nothing better than warm water or poppy decoction. Subsequently dry powdered alum may be dusted on the tongue; or a lotion of alum, chlorate of potash, or borax may be employed. As a change, a wash containing dilute nitric, hydrochloric, or acetic acid may be prescribed; but these must not be continued too long. At the same time ammonia, iron, quinine, or bark should be given. If an abscess form far back in the tongue, and if it can be localised with sufficient accuracy, an incision should be made with a view to its evacuation. If pus is set free, the patient will experience immediate relief, and the disease will soon be cured.

6. **Parasitic Affections.**—The most important parasite connected with the tongue is the *Oïdium albicans*, which is present in thrush (*see* Aphthæ; and Thrush), with which the minute beaded strings of *Leptothrix buccalis* are often associated. *Hydatid cysts* are occasionally met with; and so is the *Cysticercus cellulosæ*. Among the nœmatodes the *Guinea worm* (*Dracunculus* or *Filaria medinensis*) and the *Trichina spiralis* have been found. The dracunculus may give rise to an abscess, which will require to be opened; and hydatid cysts will have to be excised.

7. **Syphilitic Affections.**—These form five-ninths of all the lesions of the tongue which come under our notice. Primary sores are occasionally seen in this situation, but their occurrence is so rare that we need only mention them. For the sake of clearness it is well to arrange these syphilitic affections into four classes:—(*A*) *superficial ulcerations;* (*B*) *mucous tubercles and vegetations;* (*C*) *gummy tumours and deep ulcerations*; and (*D*) *chronic morbid states* of the mucous membrane.

A. Superficial Ulcerations.—Slight superficial ulcerations of the tongue are very common in what is called the secondary stage of syphilis. They are usually situated on the sides, tip, and under surface of the free portion of the organ; and are often associated with similar ulcerations upon the inside of the cheeks, the lips, and the angles of the mouth. They begin in small inflamed spots, and spread into linear cracks and fissures (rhagades). These are exquisitely sensitive, and, as it is very difficult to keep the tongue at rest, are a source of constant suffering. When these ulcerations heal, whitish scars and cicatrices are left, which are very persistent. When these scars are extensive, so as to form patches, their appearance somewhat resembles tylosis, though they are essentially different from that disease.

B. Mucous Tubercles and Vegetations.—Mucous tubercles, when they occur on the tongue, are generally met with about the sides and under surface of the organ, or on the fold of mucosa that is reflected to the floor of the mouth; and they have been noticed to coexist with mucous tubercles about the anus, the labia, and other parts.

C. Gummy Tumours and Deep Ulcerations.—Gummata are common in the tongue. Sometimes, when they first come under notice, they are not larger than a pea; at other times they are as large as a marble. Histologically they consist of granulation-tissue, which becomes very imperfectly organized into a fibrous structure, and rapidly undergoes degenerative changes, so that the growth comes to be made up of atrophied and broken-down cell-products, imbedded in an incompletely fibrillated matrix. When they degenerate they form a soft, semi-fluid material, which may either be absorbed, or make its way slowly towards the surface. When they take the latter course, they break, discharge, and, under appropriate treatment, ultimately heal up. Sometimes, however, they form the starting point for deep and intractable ulceration.

D. Chronic Syphilitic Disease.—Various morbid conditions of the mucosa of the tongue are often seen in association with the later stages of syphilis. Sometimes circumscribed patches of the epithelium become dead-white, and drop off, leaving a red, raw surface beneath. The epithelium is speedily restored, but another patch becomes affected in a similar manner, and so the disease continues—one patch healing and another desquamating. This is the proper *psoriasis linguæ.* Again, there is a much more extensive disease, to which the name *chronic superficial glossitis* has been given. At the commencement some portions of the membrane present their natural appearance, while others are of a deep red colour and raw-looking. These patches are often oval or oblong. Their surface is smooth and glossy. They are either entirely denuded of epithelium, or this is reduced to an extremely thin layer, and the papillæ are obliterated by distension. These patches are slightly elevated and hard to the touch, in consequence of interstitial thickening. The tongue is swollen. At its edges it takes the impression of the teeth, and the lines thus produced are prone to ulcerate. Sometimes the whole organ has a bluish, congested hue, as if its circulation were retarded in consequence of the matted and thickened state of the tissues. The mucous secretion all over the affected part is viscid and glairy, giving the organ a peculiar, smooth, glazed appearance; and sometimes the patient's breath is so fœtid that he is offensive to himself and to all about him. He complains of thirst; his mouth is parched, especially at night; and when he wakes in the morning, his tongue feels dry and chipped. The disease is, in fact, a chronic glossitis, limited to the mucous membrane. Supposing the more active mischief to be checked, the swelling subsides, and the tongue resumes its normal size—indeed it may become smaller than natural, and rather misshapen from the irregular contraction of the diseased parts.

But the membrane never resumes its healthy character. The patches that have been affected remain smooth and shining. The papillary structure has been impaired, and what is left is in fact cicatricial tissue, a tissue which is exquisitely sensitive to the contact of hot, acid, or pungent substances, and which is apt to become inflamed from very slight causes. At a later date portions of this cicatricial membrane become more completely fibrous, presenting a whitish appearance, and being callous to the touch.

This condition is most frequently seen in persons who have long been affected with syphilis; and the question will sometimes arise whether it is due to the disease, or to the prolonged use of the drugs by which this has been combated. Syphilis is so prone to manifest itself in the tongue, that no doubt in some cases the appearances described are entirely produced by it—possibly by syphilis in association with dyspepsia. But in other cases, particularly in those which are attended by fœtor and an alteration in the mucous secretion, it seems certain that they have been aggravated, if not caused, by excessive medication. In some instances this excessive medication may be the result of iodide of potassium, in others of mercury; for both these drugs, as is well known, but especially the latter, are apt to determine to the mucous membrane of the mouth. But in other cases the chronic superficial glossitis seems to be due to severe and prolonged dyspepsia, or perhaps to other non-specific causes, such as gout, which impoverish the blood, irritate the stomach, and impair the nutrition of the mucosa of the tongue.

Treatment.—In the treatment of these syphilitic affections, it is of importance that the tongue should have rest, and the practitioner should satisfy himself that the patient is living tolerably well, and is warmly clad. Unless he has a certain amount of *vis vitæ*, it is impossible for him to overcome the intensity of the syphilitic poison.

If the so-called specific drugs have already been given to excess, we must confine ourselves to local treatment, and to the administration of stomachics and tonics. But if the patient have not already been overdosed with mercury or iodide of potassium, we naturally turn to them as our most powerful remedies. In the case of the superficial ulcerations about the sides and tip of the tongue, the best plan is to touch the fissures with a fine pencil of nitrate of silver, and to prescribe iodide of potassium, or perhaps a mild course of grey powder. In the case of gummy tumours, if they are seen early, their absorption may be promoted by iodide of potassium or the perchloride of mercury, or by a course of mercurial inunction or fumigation. If they have softened and broken, they should be allowed to discharge, like an abscess; care being taken to keep up the patient's general health, so that they may heal kindly. If they show any tendency to ulcerate, they should be freely touched with nitrate of silver. The deeper and more obstinate ulcerations may require the application of nitric acid, or of the acid nitrate of mercury; and along with such treatment a mild course of mercury should be combined.

Mucous tubercles on the tongue generally yield speedily to the local application of nitrate of silver; and a course of iodide of potassium, grey powder, or iodide of mercury.

The treatment of chronic superficial glossitis is far from satisfactory. The first object should be to improve the digestion, and to regulate the general health. With this view the vegetable bitters and the mineral acids should be given; or bismuth and hydrocyanic acid; or effervescing mixtures containing an excess of alkali. These and other remedies will suggest themselves according to the particular variety of gastric irritation from which the patient is suffering. If there be reason to think that the disease is of syphilitic origin, and that specific drugs have not already been given to excess, iodide of potassium or mercury may be prescribed in moderate doses, either separately or in combination. With either of these lines of treatment it is well to order opium, especially Dover's powder, hyoscyamus, conium, chloral, or bromide of potassium, in sufficient doses to quiet the system and procure sound sleep.

When there is much superficial soreness, a mouth-wash of borax and glycerine, bismuth and glycerine, or chlorate of potash, should be ordered.

8. **Tongue-tie.**—The tongue is said to be 'tied' when the frænum is either too short or comes further forward than it should, and thus restrains the movements of the anterior part of the organ. The infant cannot put out its tongue, or use it in sucking; and if the defect is allowed to remain, it interferes with speech.

Treatment.—The remedy is to snip the frænum with a blunt-pointed pair of scissors, the points being directed downwards so as to avoid the ranine arteries and veins. Mothers often suppose that their children are tongue-tied when, in truth, they are only backward; so the surgeon should be on his guard, and not operate unless he sees good cause.

9. **Tumours.**—The tongue may be affected by tumours which are neither parasitic, cancerous, nor syphilitic. Thus, the mucous membrane is occasionally the seat of a nævus, of simple warts, or of polypi. Cysts are also met with, not merely beneath the tongue, but also in its substance; and fatty, fibrous, and fibro-cellular growths have from time to time been removed from this situation.

Treatment.—Warts should be touched with lunar caustic or with nitric acid, or even excised, Polypi should be ligatured, or snipped off with scissors. The other tumours mentioned will all require operation.

10. **Tylosis.**—Synon.: *Ichthyosis linguæ.*—This is a peculiar disease, which affects the tongue, and, to a slight extent, the adjacent mucous membrane.

Ætiology.—The irritation which gives rise to tylosis may be due to excessive smoking or drinking, superficial syphilitic ulceration, or to other causes, such as gout. It is almost entirely confined to men, and is never seen before the age of puberty.

Description.—Tylosis consists in an overgrowth of the papillary and epithelial elements of the mucosa, which become white and sodden from continued immersion in the fluids of the mouth. It is the filiform papillæ which are chiefly affected, and the disease never spreads further back than the line of the circumvallate papillæ. Sometimes the papillæ, though enormously enlarged, and overloaded with epithelium, retain their separate form; at other times they are welded together into smooth, hard, masses. The tylotic coating presents a silvery or snow-white appearance, quite different from any ordinary fur. When the disease has once shown itself, it is very persistent. Its essential nature appears to be that of a chronic inflammation. Sometimes the patches are irregular in form and in situation; at other times they have a remarkably symmetrical arrangement. The disease appears to have a strong tendency to become cancerous, though it may last for twenty or thirty years before it passes into that stage.

Treatment.—If the patch be small, it should be excised; and when the disease has reached the epitheliomatous stage, it must be dealt with as a cancer. But between the early and the late stage the less it is meddled with the better. If any local treatment be used, it should be of a mild and soothing kind. The use of strong caustics, as well as all parings and scrapings, should be forbidden. Mercury, arsenic, or iodide of potassium may be tried, but little dependence can be placed on them. They may produce some amendment, but they cannot effect a cure. Our best hope is to guard the tongue against all sources of irritation, and to regulate and improve the general health.

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II. **Ulceration.**—Ulcers of the tongue, as already said, may be syphilitic or cancerous, but they may also be of simple origin. Simple ulceration is usually associated with dyspepsia. Dyspeptic ulcers are apt to occur in ill-fed children, and also in adults who habitually eat and drink freely. Such ulcers are generally situated upon the sides or upper surface near the tip; but not unfrequently they are on the frænum. They are encircled by an inflamed margin; shallow; their bases being flat and covered with a greyish slough. They are very sensitive to the touch, and painful when the organ is moved. Sometimes there is offensive discharge, with a good deal of swelling of the sublingual and submaxillary glands.

Simple ulceration is often excited by external causes, acting upon the tongue at a time when its nutrition is impaired by faulty digestion. Thus it may be bitten, or scalded, or wounded with knives or forks, or irritated by the sharp point of a tooth, or by a rough accumulation of tartar.

Treatment.—Attention should at once be directed to the digestive organs; and, after a cholagogue purgative has been given, a course of alterative medicine should be ordered, to be followed by stomachics and tonics. Arsenic sometimes acts like a charm. Whatever dyspeptic symptoms are present must be met by their appropriate remedies, for example, dilute hydrocyanic acid, bismuth, chlorate of potash, or bromide of potassium. As a local application, there is nothing better than nitrate of silver. In the case of ulceration following injury, the sore should be touched with caustic, and the patient's general health regulated and supported.

W. Fairlie Clarke.

TONIC (*τονος*, tension).—A distinctive term used in reference to the nature of spasms, which are usually divided into two classes, namely, *tonic spasms* and *clonic spasms*; the former being those in which the muscles concerned remain in a state of continuous rather than in one of intermittent contraction. *See* Spasm.

TONICS (*τόνος*, tension, tone).—Synon.: Fr. *Toniques*; Ger. *Tonische Mittel.*

Definition.—Therapeutic agents which impart permanent strength to the body or its parts.

Enumeration.—Amongst the most typical medicinal tonics, which impart a feeling of strength, are iron, nux vomica, quinine, and vegetable bitters. As the strength of the body generally depends on the proper action of its various parts, tonics have been subdivided into those which have an especial action on the blood, circulation, digestion, and nervous system.

1. **Blood Tonics.**—Cod-liver oil and other fats, and iron and its salts, are the most important of this group of tonic remedies. Perhaps also phosphate of lime, and salts of potash and soda should be included. Light, fresh air, good food, bathing, and exercise are valuable adjuncts.

2. **Vascular Tonics.**—The principal vascular tonics are nux vomica and strychnia, digitalis, hellebore, erythrophleum, and squill. The local application of warmth and cold, friction, and massage increase the effect of these medicines.

3. **Gastric Tonics.**—Small doses of sulphuric, nitric, and hydrochloric acids, small doses of arsenic, small doses of alum, aloes, small doses of bismuth, bitter beer, chamomile, cinchona, cusparia, cascarilla, small doses of copper, calumba, hops, gentian, orange and lemon peel, quassia, rhubarb, small doses of silver, strychnia, generally vegetable bitters, and small doses of zinc—all impart vigour to the gastric function. Valuable adjuncts are pepsin and hydrochloric acid.

4. **Intestinal Tonics.**—These are chiefly nux vomica, belladonna, rhubarb, the mineral acids and metallic salts just mentioned, and astringents.

5. **Nervine Tonics.**—Nux vomica and strychnia, cinchona and its alkaloids, coca, phosphorus, arsenic and its compounds, salts of iron, zinc, copper, and silver, are all included under this head. The tonics which act especially on other parts of the system increase also the power of the nervous system, and act indirectly as nervous tonics.

Action.—The derivation of the word 'tonics' indicates the nature of their action. When a person feels limp and weak, and unfit for exertion, like a relaxed bow-string, tonics restore the energy and strength, and render him again fit for work, like, as it were, a re-tightened bow. The exact mode in which tonics act is not yet perfectly ascertained, but in all probability they increase the functions of the different parts of the body by aiding tissue-change, either by increased nutrition, increased tissue-metabolism, more rapid removal of waste, or possibly by all three taken together.

Uses.—Tonics are employed in conditions of debility, either of the body generally or of its different parts, the selection of each depending upon the part of the body affected.

In cases where the malnutrition of the body appears to be dependent on the want of the proper constituents of the blood, as in anæmia, struma, or general debility, without any affection of a particular organ, *blood tonics*, including iron, cod-liver oil, and phosphates are employed; and these are also useful where impoverishment of the blood is due to a definite constitutional disease, such as phthisis, or Bright's disease. Where enfeeblement of the stomach appears to be present, as shown by loss of appetite and such signs of imperfect digestion as flatulence, weight, and pain after eating, *gastric tonics* are used. Should its muscular coat be feeble or inactive, as shown by tendency to dilatation, and splashing of the contents on movement, strychnia is especially indicated, and galvanism or systematic kneading may be also employed. Where the stomach is too debilitated to respond sufficiently to this form of treatment, as after long-continued gastric catarrh, or in old age, its work must be partly done for it, and then such substances as hydrochloric acid and pepsin are useful. When the muscular movements of the intestine are sluggish, as indicated by constipation, and by a tendency to the distension of the bowel with gas, nux vomica and belladonna may be given; and when its mucous membrane appears to be relaxed and flabby, and secreting too profusely, the mineral acids, astringents, and metallic salts may be of much service. When the pulse is soft and feeble, and there is a tendency to vascular dilatation, either general or local, as shown by local congestion and œdema of dependent parts, or by drowsiness in the upright position and sleeplessness in the recumbent posture, *vascular tonics* are serviceable. *Nervine tonics* are used where the nervous functions are imperfectly performed, as shown by dulness, loss of memory, incapacity for work, languor, or tendency to spasm, as in chorea, and also in paralysis. As the functions of this system depend very greatly upon the quality of the blood with which the nervous system is supplied, and on the rapidity of the circulation, the other tonics frequently require to be given in addition to nervous tonics.

In administering tonics, care should always be taken to ascertain that the case is suitable, for in very many cases of apparent debility the imperfect functional activity of the body or of its parts does not depend upon insufficient nutrition, but upon imperfect removal of the products of waste. The proper treatment in these cases is not to give tonics, but to remove the waste products by cholagogues, purgatives, and diuretics.

T. Lauder Brunton.

TONSILS, Diseases of.—Synon.: Fr. *Maladies des Amygdales*; Ger. *Krankheiten der Mandeln.*

These two glands, situated between the anterior and posterior pillars of the fauces, are unusually liable to participate in all affections of the throat, both from their peculiar structure and from their position. An evident example of the truth of this statement is to be found in that every-day affection, a common cold, in which the tonsils usually exhibit symptoms of the general catarrh. They are also involved in diphtheria, scarlatina, and syphilis; they may be the seat of ulcers, or even gangrene; and they may be involved in malignant disease. The following affections demand special notice, namely, (1) **acute inflammation**; (2) **follicular catarrh**; (3) **hypertrophy**; and (4) **tonsillar calculus.**

1. **Acute Inflammation.**—Synon.: Tonsillitis; *Cynanche Tonsillaris*; *Amygdalitis*; Quinsy.

Ætiology.—This affection is most commonly met with in young persons, in the damp weather of spring and autumn, and one attack seems to predispose to another. Exposure to damp, cold, and wet is generally regarded as sufficient to excite this disorder.

Symptoms.—These usually set in with indications of fever. The patient becomes restless, irritable, and hot (the temperature in very acute cases rising to 104° or 105°); complains of headache and general weariness; and may be delirious at night, especially if young. The tongue is covered with a thick, heavy, yellowish coating; the other symptoms of oral catarrh are present; the breath is unpleasant; and salivation is complained of. The patient loses the power of opening the mouth to any extent; and swallowing is attended with much pain and great difficulty, the food not unfrequently returning through the nose. The tone of the voice is altered, becoming thick, guttural, and nasal. The breathing is not, as a rule, impeded, but the patient snores during sleep; and when he is awake, respiration may be noisy. Occasionally he becomes deaf. The first indication of uneasiness in the throat is a complaint of pricking and dryness in the region of the tonsil, soon passing on to actual soreness, and pain of a dull character, which shoots up towards the ear on the affected side. Externally, behind the angle of the lower jaw, considerable swelling is observed, firm, and exceedingly painful to touch. On examination of the parts internally, one tonsil, rarely both, will be found to be greatly swollen, of a bright red colour, perhaps with patches of yellowish secretion adherent to its surface. The soft palate is also greatly swollen, red, œdematous, and falling inwards to the middle of the mouth. The uvula likewise partakes of the general infiltration, and is usually found pushed to the healthy side, and not unfrequently adherent to the tonsil. This state of matters continues for four or five days, increasing in severity, and then it may gradually begin to subside, the inflammation passing off; and in ten days to a fortnight the patient is able to resume his usual employment. Quite as frequent a termination as resolution is suppuration and formation of abscess in the tonsil. In such a case the symptoms are generally aggravated before the formation of the pus, and more decided pain and throbbing are complained of, extending upwards to the ear. The abscess may burst spontaneously and unexpectedly. After the evacuation of the pus, which is often fetid, convalescence is speedy.

Treatment.—If a case of quinsy is seen at the very outset, an attempt may be made to abort the disease. This, though seldom successful, may be tried by giving an emetic, or by administering tincture of aconite every hour in drop doses;

or alum or nitrate of silver may be applied to the inflamed throat. If not seen for two days, or if these abortive measures fail, the patient should be confined to bed; hot poultices kept constantly round the throat; steam inhaled as often as practicable; and gargles of warm milk and water made use of every hour. A brisk saline purgative should be given. Ice, if found grateful, may be allowed at discretion. Such diet as the patient can be persuaded to swallow should be ordered, of course in liquid or rather semi-solid form. Stimulants, if called for, must be administered. Tonics, such as chlorate of potash and iron, or quinine and iron, will be needed when convalescence sets in. If an abscess should form, it must be evacuated by means of a well-protected bistoury; and astringent gargles should be made use of for some time after convalescence is established.

2. **Follicular Catarrh.**—The office of the tonsils is to secrete a lubricating fluid to the bolus of food as it passes into the pharynx, as well as to moisten the fauces. Occasionally we meet with cases where this secretion is altered in character or in quantity. And this may be the result either of a simple catarrh of the tonsils; or of thickening of the interstitial tissue of the gland, compressing the follicles, and thus interfering with the free outflow of the secretion. The appearance of the tonsil in such a condition is at times mistaken for a diphtheritic state, in consequence of the whitish patches of secretion deposited upon them. In this catarrhal affection it will be observed that there is no tendency to the formation of a true membrane as in diphtheria, the deposit assuming a pultaceous form, being readily removed, its borders being well-defined, and it is seen to proceed from the follicles of the tonsil. As to the treatment of this condition, all that is wanted is a stimulant gargle, probably some general tonic, and the constant use of chlorate of potash—a convenient form of administering which is found in Wyeth's lozenges of the compressed salt.

3. **Hypertrophy**—This condition of the tonsils is met with both in the young and in the adult. In the case of the former, there seems to be a hereditary tendency in some families, the tonsils becoming immensely large even as early as the second year. In such there is usually some scrofulous habit of body. In the adult this condition is more frequently the result of repeated angina, which induces a permanent thickening of the structures of the tonsils, whereby the secretion, no longer finding free exit, distends the follicles, thus setting up a low form of inflammation, which results in hypertrophy of the gland. This condition is free from pain. When the interstitial tissue becomes much thickened and indurated, there occurs what is sometimes described as 'scirrhus' of the tonsil. The symptoms indicative of hypertrophy are snoring during sleep; obstruction to the breathing, in consequence of which the mouth is always open night and day; slight impediment to swallowing, with a sense of something permanently needing to be swallowed; some degree of deafness; and thickness of voice or snuffling. These are all greatly aggravated when catarrh is superadded; and persons having enlarged tonsils are specially liable to attacks of angina, and to severe throat-symptoms when any disorder overtakes them, in which the throat is more than ordinarily the point in which the disease centres itself, for example, scarlatina.

Treatment.—The treatment in cases of scrofulous children consists in the administration of plentiful nourishment, cod-liver oil, iodide of iron, and other drugs of which iodine forms the chief constituent. The bromides of ammonium and potassium also enjoy the reputation of reducing enlarged tonsils. Locally, they should be treated with iodine dissolved in glycerine, or with the simple tincture, every other day. They should not be removed in children under the age of puberty, as frequently after that period they decrease spontaneously. In adults, if they cause much inconvenience, they should be excised, but not otherwise.

4. **Tonsillary Calculus.**—When two or three neighbouring follicles of a tonsil, as well as the interstitial tissue, are destroyed, the cavity thereby created pours out a greatly altered secretion, the product varying in consistence from a creamy pulp up to a calcareous deposit, of a white or yellow colour. This, on examination, has been found to consist of albumen, phosphate, carbonate, and oxalate of lime, with some animal matter. Some authors regard these calculi as the 'resolution of tuberculous deposits in the tonsils, which subsequently give rise to inflammation, suppuration, and ejection.'

Claud Muirhead.

TOOTHACHE.—Synon.: Fr. *Odontalgie; Mal de Dents*; Ger. *Zahnweh.*—Pain in connection with the teeth. *See* Teeth, Diseases of.

TOOTH-RASH. *See* Dentition, Disorders of.

TOPHUS (*tophus*, sand).—A term for the concretions which are met with in gout, in connection with the joints and other structures. It is also sometimes applied to gravel, and to the collection of tartar on the teeth. *See* Gout.

TOPICAL (*τόπος*, a place). *See* Local.

TORMINA (Lat. *griping*).—This word is applied to severe griping or colicky pains in the abdomen, due to flatus and other causes. *See* Colic; and Intestines, Diseases of.

TORPOR (Lat. numbness).—Synon.: Fr. *Torpeur*; Ger. *Torpidität.*—A condition of inactivity, bodily and mental, which may be met with in certain brain-diseases or febrile states, more especially in aged persons. The cerebral condition associated with torpor is an unnatural state of consciousness, closely allied to that known as stupor.

TORQUAY, in South Devon.—A mild, rather relaxing, and sedative marine climate. Sheltered from W., N., and E. winds. Mean winter temperature 44° Fahr. *See* Climate, Treatment of Disease by.

TORSION (*torqueo*, I twist).—This word signifies a twisting, and is used in the following associations:—

1. In relation to certain hollow organs, it indicates a form of displacement in which an organ

is twisted on itself, a condition especially noticed in connection with the intestines. It gives rise to more or less narrowing of the canal, and may close it completely, so as to cause absolute obstruction. Torsion also interferes with the circulation, thus leading to congestion, inflammation, or ultimately even to gangrene. *See* Intestinal Obstruction.

2. As a method of treatment, torsion is employed in checking arterial hæmorrhage, the ends of the bleeding artery being seized by the aid of suitable forceps, and twisted. It is chiefly used in bleeding from small arteries, but may prove efficient even when arteries of some size are the source of the hæmorrhage.

Frederick T. Roberts.

TORTICOLLIS (*tortum*, twisted, and *collum*, the neck).—A synonym for wryneck. *See* Wryneck.

TORULA.—Description.—Torula is a form of microscopic fungus, belonging to the order *Saccharomycetes*, of the class *Protophyta*, which is the lowest division of *Thallophyta* (Sachs). It consists of round or ovoid cells, of an average diameter of about $\frac{1}{3000}$ inch, without nuclei, but composed of masses of vacuolated protoplasm, confined within a definite cell-wall. Occasionally they are free, but they are frequently associated into branching chains. *See* Microscope in Medicine.

Sources.—Vinous, acetous, and other fermentations are due to the presence of low organisms, of which the 'yeast plant,' *Mycoderma* or *Torula cerivisiæ*, is the best known. Certain varieties of torula are of constant occurrence in the alimentary canal, and would seem to be normally associated with intestinal digestion. In those cases of vomiting where the ejected matters ferment, torulæ are always to be found, together with sarcinæ. These bodies are also of frequent occurrence in diabetic urine, if left standing; but they have also been found in non-saccharine urine. The pathological significance of torula, if any, is not known. W. H. Allchin.

TOUCH, Disorders of.—Synon.: Fr. *Troubles du Tact*; Ger. *Stöhrungen des Tastsinnes.*—The sense of touch may be considered as a compound of four distinct senses, namely, those of contact, pain, temperature, and muscular activity; and it is not necessary that all of these should be affected simultaneously or in an equal degree. Sometimes but one is the seat of disorder, and occasionally only one escapes. The lesion producing tactile disorder may be in any part of the sensory apparatus—in the peripheral end-organ in the skin which receives impressions, in the trunk of the nerve which conveys them, or in the central ganglion, the reaction in which is represented in consciousness as feeling. For the most part disorders of touch must consist either in a defective or in an unnaturally heightened reaction to impressions—conditions which are termed respectively *anæsthesia* and *hyperæsthesia.* But there are besides certain abnormalities of sensation which cannot be referred to either of these categories, as, for example, when a touch causes a sensation of burning, or the electric current is felt as something cold, and in these circumstances the term *paræsthesia* is used.

1. **Increased sensibility.**—Description.—It is doubtful whether the sense of touch proper, the power of tactile discrimination, is ever morbidly *increased*, except possibly in certain cases of hysteria and mental disorder. The term *hyperæsthesia* would be properly applied to such a condition instead of, as it is more commonly used, to excess of sensibility to painful impressions, which is perhaps better called *hyperalgesia.* In cutaneous *hyperalgesia* even a light touch upon the skin produces more or less exquisite pain. The patient often cannot even wash the skin, which is described as feeling raw or sore to the touch. The symptom frequently occurs in connection with neuralgia (especially of the trigeminal nerve), and in hysteria, as well as in the various forms of local inflammation. It may precede by some days the characteristic pains of neuralgia; is often associated with excess of sensibility to heat and cold; and usually with diminution of sensibility of the tactile sense proper. It is seen in its severest form in connection with gunshot injuries of nerves.

There may be heightened sensibility to *temperature*, either as regards heat or cold singly, or in respect to both at the same time. This symptom is observed in connection both with peripheral and central disease, as an accompaniment of neuritis, as well as of degenerative changes in the cord or cerebral ganglia. It is often, but not always, associated with *hyperalgesia.*

Heightening of the sense of *contact* is rarely observed, and is of but little practical importance. Perhaps the condition known as 'fidgets' is best explained as depending upon a heightened sense of *muscular activity.*

Treatment.—So far as is practicable, the lesion which is the cause of hyperalgesia, whether peripheral or central, must be discovered and become the subject of treatment. But the symptom itself may be mitigated by appropriate means. Such are the local application of moist heat by fomentation or poultice; of cold, by means of ice; or of anodynes, such as veratria ointment somewhat diluted, or atropia ointment; or the hypodermic injection of morphia (gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$). Spongiopiline may be sprinkled with a liniment composed of chloroform one part and belladonna liniment three parts; or equal parts of ether, sal volatile, laudanum, and eau de Cologne may be applied. A piece of lint soaked in chloroform may be laid upon the painful portion of skin and covered with oiled-silk, or the part may be rubbed with camphor-chloral and vaseline, equal parts; or painted with amyl-colloid. The application of one pole of the continuous current to the hyperalgesic spots, whilst the other is placed on an indifferent part, will often be of service, the power of bearing a gradually increased strength showing the improvement produced. Hysterical hyperalgesia can sometimes be successfully treated by the application of a strong induced current, by means of the wire brush, the patient, if necessary, being placed under the influence of ether.

2. **Defective sensibility.**—Description.—Cutaneous anæsthesia may result from local ab-

straction of heat, as from exposure to a very low temperature. In such a case anæmia is produced, from spastic contraction of blood-vessels, followed by hyperæmia from their secondary relaxation. In the anæmic stage, whilst the other tactile sensations are lowered, that of temperature is heightened. Deficient sensibility may be caused by irritating applications, such as soda used by laundresses, and various chemicals employed in the arts. In such cases there is numbness in the hands and forearms, with a sensation of 'going to sleep' in the fingers. It may occur in connection with *herpes zoster*, the skin between the groups of vesicles being often partially anæsthetic. In *lepra anæsthetica*, in which there are enlargements of the cutaneous nerves, the senses of temperature and pain are often abolished, and severe burns may take place without being recognised. Anæsthesia may be produced by pressure upon sensory or mixed nerves, by syphilitic and other growths in adjacent tissues. Narcotics, as chloroform and ether, may quell the sense of pain, that of contact being, to a certain extent, retained. Wounds and lacerations of the sensory or mixed nerves, followed by inflammatory processes, may, by irritating, cause pain to precede the anæsthesia, arising from the interruption of conductivity in the nerve-fibres. Simple mechanical pressure upon a nerve, if long continued, will often, especially if its nutrition be impaired by constitutional causes, excite a low inflammatory condition. In traumatic cases, as also in lepra anæsthetica and in cases of new growths pressing on the nerve, motor and nutritive disturbances are apt to accompany the anæsthesia, the nerve-trunks conveying not only sensory, but also motor, vaso-motor, and trophic fibres. Severe trophic disorder is usually associated with the anæsthesia occasioned by lesion of the fifth nerve; and to a less extent with that accompanying trigeminal neuralgia. *See* TRIFACIAL NERVE, Diseases of.

Preceding attacks of neuralgia, the skin of the part about to be affected is often found to be anæsthetic, and during attacks of sciatica and cervico-brachial neuralgia there is often much diminution of tactile sensibility, severally in the foot and lower part of the leg, and in the fingers; whilst the skin around the eye may be greatly deficient in tactile sensibility during severe supra-orbital neuralgia. It is important to discriminate anæsthesia of the skin caused by disease of the nervous centres, from that which is of peripheral origin.

Cutaneous anæsthesia is occasionally an important symptom of an approaching cerebral hæmorrhage. A sudden and increasing numbness is experienced in one half of the face, or in the limbs on one side of the body, which may be followed shortly by coma and hemiplegia. An apoplectic seizure usually causes unilateral cutaneous anæsthesia, which is at first widely diffused, owing probably to the disturbance of circulation in, and consequent disarrangement of the nervous molecules, which extends at first far beyond the site of the effusion. A few hours or days usually suffice for the clearing off of this anæsthesia, leaving, however, a subjective feeling of numbness, which may endure for a longer or shorter period.

The extent of anæsthesia bears no necessary relation to the amount of motor paralysis. It usually affects the paralysed side of the body, but in certain cases of hæmorrhage into or other lesion of the medulla oblongata and pons varolii, it may occupy the opposite side. Complete hemi-anæsthesia of central origin may persist long after the paralysis of motion has disappeared, and in such a case a lesion is likely to be found in the outside of the optic thalamus, involving the internal capsule. Occasionally, too, hemi-anæsthesia may from the first be unaccompanied by motor paralysis. Much more frequently, however, cutaneous anæsthesia (except for the first few hours) is of comparatively slight and transitory character, even in cases where there has been extensive disorganisation of the brain from hæmorrhage or softening, and where the resulting paralysis of the muscles is complete and permanent. It may be absent altogether from the first, but this is not common, except in cases of cortical lesion of the brain. Recovery is gradual, and proceeds from the nervous centre downwards, the fingers sometimes retaining slight anæsthesia long after the rest of the arm has entirely recovered. Cerebral tumours may give rise to cutaneous anæsthesia by pressure upon the Gasserian ganglion, or upon the trunk or branches of the fifth nerve as they traverse the floor of the skull. Like the motor paresis or paralysis which may be occasioned at the same time, the loss of sensibility is usually, but not always gradual, tending to increase rather than to diminish as time goes on. It is not usually a prominent symptom in cerebral abscess.

Lesion of the spinal cord or its membranes may give rise to cutaneous anæsthesia, which is frequently, in the lower extremities, extensive and complete; but it may be absent when—as, for example, in very advanced sclerosis of the antero-lateral columns—there is complete paraplegia. A varying amount of cutaneous anæsthesia, especially affecting the soles of the feet, is apt to occur in progressive locomotor ataxy. Anæsthesia of spinal origin is usually bilateral; but it affects that lower extremity alone which is opposite to the one paralysed in its motility, when the causative lesion is limited to one half of the cord. Intercurrent complications from disturbances of circulation, the temperature of the limb, the extension or subsidence of inflammation, and the effusion of inflammatory products about the posterior roots, as well as the spread of sclerotic changes, may cause the extent and completeness of cutaneous anæsthesia to vary considerably in cases dependent upon spinal cord disease. Where the lesion lies tolerably high up, tickling the soles of the feet, although quite unfelt by the patient, is able to excite the motor nerves, and produce reflex muscular contractions, which the loss of muscular sense prevents him from recognising. It is extremely important to remember that cutaneous anæsthesia of spinal origin is liable to be associated with bed-sores. In certain cases, where probably trophic and vaso-motor nerves have been included in the lesion, this liability is excessive, and may defy all precautions.

Loss of the *sense of muscular activity* may occur in an isolated form, the other modes of tactile sensibility being unaffected; or it may be associated with impairment of some or all of them. The symptom is especially notable in progressive locomotor ataxy (*see* LOCOMOTOR ATAXY). It may also occur in connection with paresis resulting from coarse disease of the occipital lobe of the cerebrum. Loss of muscular sense may accompany hemiplegia, attended with strongly marked and prolonged anæsthesia, from disease of the optic thalamus. It occurs sometimes in hysteria. There is a form of anæsthesia occasionally met with in hysteria which it is important to recognise, so as not to confound it with a somewhat similar condition resulting from disease of the neighbourhood of the optic thalamus. In this the patient may lose the power of perceiving impressions of contact, temperature, and pain throughout the whole of one lateral half of the body, sharply divided from the sound side by a line passing downwards from the vertex to the os pubis. Accompanying this *hemianæsthesia*, as it is called, there is often amblyopia and colour-blindness of the corresponding eye, loss of taste and smell, together with tenderness on deep pressure over the region of the ovary on the same side. In some cases, too, the skin is unnaturally pale and cold, and pricks with a pin are said to be not followed by bleeding, which readily takes place in corresponding circumstances on the opposite side of the body.

DIAGNOSIS.—As regards both hyperæsthesia and anæsthesia the most important consideration, after establishing the existence of either, is as to whether the cause be central or peripheral. It is impossible to do more than indicate the general principles upon which this inquiry is to be conducted. The patient's history, the condition of viscera and circulation, the existence or not of accompanying paralysis or of modifications of the organs of special sense, will lend important aid. As a rule, the anæsthesia of central origin is much more widely diffused, though less complete, than that dependent upon lesion of nerve-trunks, when it is also often accompanied with localised atrophy of muscles or other trophic disturbance. It is very rare that hemianæsthesia of central origin is so complete as the hysterical, and it is not accompanied, like the latter, with tenderness on deep pressure over the ovarian region. There is no doubt that hyperæsthesia has often been mistaken for localised inflammation, and treated accordingly. The absence of febrile movement, and the fact that it is mainly upon light surface-touching that the exquisite tenderness occurs, which fails to be felt when deeper pressure is made, coupled with the history, and a study of the concomitant condition, ought to suffice to prevent all mistakes.

TREATMENT.—Anæsthesia is a symptom of a lesion either in the central nervous system or in a peripheral nerve, and its treatment is bound up with that of the disorder which gives rise to it. But there are many cases in which, apparently as a result of disease, the sensory nerves fail to convey impressions for a considerable time after the lesion which interfered with their function has been healed. In such circumstances very much good can often be done by electrical treatment. The skin, carefully dried, should be brushed over for a few minutes every day with the wire brush, connected with an induction machine; or the well-wetted rheophore connected with the negative pole of a constant current battery may be slid about over the affected surface, well moistened with hot water. In hysterical anæsthesia the application of various metals (gold, silver, copper, tin, lead, iron—one or other of these), has been found very successful in the hands of Drs. Burq and Charcot, of Paris, and a trial of them in appropriate cases should not be omitted. The metal should be closely applied to the affected skin for ten minutes at a time.

Static electricity is a valuable means of combating anæsthesia of this kind. The patient, seated on an insulating chair, is connected by a conducting chain with a frictional electrical machine, and sparks are drawn from the affected surface.

3. Paræsthesia.—DESCRIPTION.—The varieties in disorder of the different kinds of tactile sensibility—touch, pain, temperature, muscular activity—are very numerous. Pinches or pricks with a needle may be felt as touch only, whilst a very light touch with the finger is appreciated as touch. Strong faradaic currents (intolerable to the healthy) may be felt as cold. Heat may be felt as cold, but kept still longer applied may be recognised as heat or warmth. A limb plunged into hot or cold water may get the feeling, not of heat or cold, but of pain. To such modifications, as well as to feelings of burning or cold, tingling, creeping of ants, or actual numbness, the term *paræsthesia* is often applied. A seamstress may be able to pick up and thread her needle, evincing thereby considerable delicacy of sense of contact, and yet be scarcely able to feel a prick of a needle in the finger-tip. Or the sense of contact may be in abeyance, as well as that of pain and temperature, and the movements may be then guided by the sense of muscular activity, aided by sight.

T. BUZZARD.

TOXÆMIA (*τοξικὸν*, a poison, and *αἷμα*, blood).—This word literally signifies poisoning of the blood. It is not employed with any very strict or definite meaning, but most commonly implies blood-poisoning due to some pathological condition within the body itself, in contradistinction to that which results from the introduction of the ordinary poisons from without. As illustrations of toxæmic states may be mentioned pyæmia and septicæmia; uræmia; and acetonæmia, upon which, according to some authorities, the comatose condition which precedes the fatal issue in some cases of diabetes depends. The accumulation of bile in the blood, in cases of jaundice, is also a form of toxæmia. The morbific agents which are supposed to produce the several infectious and malarial fevers are likewise regarded by many as originating toxæmic conditions; as are also those which originate such affections as gout and rheumatism. These subjects will be found discussed under their several headings. FREDERICK T. ROBERTS

TRACHEA, Diseases of.—SYNON.: Fr. *Maladies de la Trachée*; Ger. *Krankheiten der*

Luftröhre.—The trachea is but little prone to disease, except in association with affections of the larynx, bronchi, and neighbouring parts. The diagnosis and treatment of these several diseases is greatly facilitated by the laryngoscope. With this instrument a skilful manipulator can in many cases examine the trachea in its whole length, and an accurate diagnosis being thus attained, remedies may be applied, and instruments may be introduced for the removal or destruction of growths, or for other purposes, either through the larynx, or by an artificial opening made in the trachea. The principal morbid affections of the trachea will be discussed in the following order:—1. Malformations; 2. Inflammation; 3. Ulceration and Perforation; 4. Syphilis; 5. Tuberculosis; 6. Tumours; 7. Stenosis; and 8. Foreign bodies.

1. **Malformations.**—Defects in the development of the trachea occur as rare causes of the death of newly-born infants. The tube may be short and imperforate; or communication may exist with the œsophagus. These conditions are necessarily fatal. A fistulous opening through the skin occasionally occurs, giving rise to no serious symptoms. *Tracheocele*, a hernia of the mucous lining of the trachea, is a rare malformation, easily recognised, which may arise from a congenital defect, but is more frequently acquired.

2. **Inflammation.**—Tracheitis, simple, specific, or diphtheritic, may result from the extension of inflammation, either from the larynx above, or from the bronchial tubes below; it is rare except in this connection. Some degree of congestion is a usual condition of ordinary catarrh; and chronic tracheitis is a frequent cause of the cough of old people. *See* BRONCHI, Diseases of; DIPHTHERIA; and LARYNX, Diseases of.

3. **Ulceration and Perforation.**—Ulceration and perforation of the walls of the trachea may result from the pressure of an aneurism, which ends by bursting into the air-passages, where it meets with least resistance; or from an abscess which has taken a similar course.

4. **Syphilis.**—Syphilis, in its secondary and tertiary stages, may affect the trachea. In the tertiary stage it gives rise to ulcers, which contract in healing, and cause a formidable condition of stricture, to be presently considered. Tracheal syphilis, being in its advanced form so grave a matter, calls for active constitutional treatment before this irremediable stage is reached.

5. **Tuberculosis.**—Tubercle occurs in connection with laryngeal and pulmonary phthisis. When the disease has proceeded to ulceration, it may cause the rare complication of general emphysema, the air being forced into the cellular tissue by cough and other expiratory efforts, made when the larynx is closed.[1]

6. **Tumours.**—(*a*) *Cancer.*—Cancer of the trachea as a primary disease is almost unknown, but the organ is frequently affected by the extension of the disease from neighbouring organs. The growth first causes the symptoms of stenosis; and then, as ulceration proceeds, it gives rise to expectoration and other symptoms. The diagnosis will not be difficult. The only treatment available for prolonging life is tracheotomy, if the seat of the disease is high enough to admit of it. (*b*) *Non-malignant growths.*—Polypi are very rare. The symptoms are those of obstructed breathing, modified by the size and seat of the growth. A certain diagnosis can be attained only by tracheoscopy. Without treatment, a polypus is almost certain to cause death by suffocation, its rate of growth depending on its pathological nature. Small growths situated high up may be treated by the galvano-cautery or by other applications through the larynx; larger tumours can only be removed through a free opening made into the trachea. A tumour may be so situated that tracheotomy, without extirpation, may ensure the safety of the patient.

7. **Stenosis.**—The calibre of the trachea may be lessened (*a*) by *stricture*, or by *tumours growing within it*; or (*b*) by *pressure from without.*

(*a*) *Stenosis from true stricture, or internal tumour.*—Stricture is almost always a result of syphilis; it may be annular and limited, but it usually involves the tube for some length. Tracheal narrowing, is indicated by obstructed breathing, with hissing inspiratory dyspnœa, unaccompanied by the up-and-down movement of the larynx, and the affection of the voice characteristic of laryngeal dyspnœa, and also without the stethoscopic signs of pressure on, or plugging of, a bronchial tube. Under these circumstances, and in the absence of any tumour in the neck or thorax pressing on the trachea, the stenosis must depend on a stricture, or on a tumour within the tube. A syphilitic history would lead us to diagnose the former; and a tracheoscopic examination, if practicable, would make the diagnosis certain.

PROGNOSIS.—Stricture being usually cicatricial, the prognosis is most unfavourable.

TREATMENT.—Treatment other than operative is seldom available. If the stricture be high up, tracheotomy must be performed below it; or, an opening being made above the contraction, a long flexible tube may be introduced and passed through it. Stricture of the trachea is less amenable than laryngeal stenosis to treatment by mechanical dilatation with hollow bougies, but this method must be borne in mind for exceptional cases.

(*b*) *Stenosis from compression.*—The source of stenosis caused by pressure from without is usually patent, thoracic tumours being diagnosed by their physical signs and concomitant symptoms. The paroxysmal dyspnœa frequently caused by these tumours is usually laryngeal, depending on pressure on the recurrent nerve; but in some cases it is a peculiar result of pressure on the trachea. It is not relieved by tracheotomy, and is akin apparently to the paroxysmal dyspnœa occasionally seen as a result of pressure by the tampon-tube used after tracheotomy, for plugging the trachea in certain operations.

8. **Foreign bodies.**—A foreign body entering the air-passages from the pharynx, may lodge in the larynx, either becoming impacted or lying loose. But, unless prevented by its form or bulk, it usually falls or is drawn through the open glottis into the trachea. Here it may

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[1] The writer recently examined *post mortem* the body of a child (the patient of Dr. W. M. Craig) which had died of acute tuberculosis, and in which this rare phenomenon had resulted from an ulcer of the right bronchus, situated immediately beyond the bronchial spur.

lodge; but it more frequently passes on into one of the bronchial tubes—most frequently into the right bronchus, the orifice of which is slightly larger than that of the left, and occupies more of the floor of the trachea.

Symptoms.—Occlusion of the larynx by a foreign body, which from its bulk obstructs the passage, may cause instant death; and the same may be said of the trachea, as when a person vomiting, in a state of unconsciousness from intoxication, or from the action of an anæsthetic, draws in a quantity of food sufficient to choke up the air-passages. If the body be smaller, it causes dyspnœa, with severe exacerbations from spasm. A very small body, such as a sharp piece of bone or a pin, may be impacted in a position in which it causes only pain and dysphagia without dyspnœa. Speaking generally, it may be said that when the substance has passed into the trachea, the symptoms to which it gives rise depend on its bulk and weight. Rarely, it lies in the air-passages, giving rise to no symptoms; more frequently, varying its position with the rush of air in coughing, &c., it gives rise to paroxysmal dyspnœa, light bodies being forced up to the glottis and exciting spasm. If the substance pass into the bronchus, it may become impacted there, and will give rise to characteristic physical signs, usually exciting a chronic circumscribed inflammation, with symptoms akin to pneumonic phthisis.

Treatment.—From the larynx a foreign body may be removed by the finger or a suitable forceps, its presence having been determined from the symptoms, aided by digital or laryngoscopic examination. Although different forms of long forceps are made for passing through the larynx into the trachea, it is seldom practicable to remove *per vias naturales* a foreign body which has once passed through the rima. A free opening must be made in the trachea, and its edges held well asunder, to give a chance of the body being expelled by cough. If this fail, a forceps must be introduced through the opening, and the body, if possible, extracted. Inversion of the patient, so as to allow a heavy substance to fall back through the glottis into the pharynx, is sometimes successful, but not as a rule without previous tracheotomy. T. J. Walker.

TRANCE (*transitus*, a going beyond—of the soul from the body).—Synon.: Lethargy; Fr. *Léthargie; Maladie du Sommeil*; Ger. *Schlafsucht.*

Definition.—A sleep-like state, which comes on spontaneously, apart from any gross lesion of the brain or toxic cause, and from which the sleeper cannot be roused.

The term 'trance,' in its derivative meaning, aptly expresses the apparent reduction to a vegetative life, but the popular use of the word refers rather to the separate activity of the mind than to the inactivity of the body. Hence many writers prefer the term 'lethargy,' which also, although etymologically exact, is currently employed in a modified sense. The condition is sometimes included under the generic term 'catalepsy,' according to its etymological meaning, 'a seizing'; but this term is usually restricted to those forms which present a peculiar rigidity. It may be noted that the terms trance and catalepsy are both due to the theories of a mythical pathology.

The ordinary forms of trance will be first described, and afterwards the peculiar variety of 'sleeping-sickness' which is met with on the West Coast of Africa.

Ætiology.—The influence of heredity in relation to trance is to be traced only in the production of a 'neuropathic disposition.' It occurs chiefly in the female sex, between the ages of twelve and thirty; very rarely in young men or children. The subjects are seldom in perfect health; they usually present other manifestations of hysteria, and are often anæmic. The condition is rare, however, even in hysteria. Of a large number of hysterical patients which have come under the writer's notice, only two presented spontaneous trance. The condition has been in some cases apparently due to exhausting diseases, as typhoid fever, excessive brain-work, insolation, or mechanical obstruction to the supply of blood to the head. The immediate exciting cause is usually emotional disturbance. In rare cases, in which trance has followed traumatic influences, the mechanism has probably also been psychical. In several cases, trance has succeeded an hysterical convulsion. Rarely no exciting cause may be discoverable. In still more rare instances the state has been voluntarily induced, as in the well-known case of Colonel Townsend, who could throw himself into a condition of apparent death, lasting several hours. Such voluntary induction is occasionally seen in the East. Lastly, minor degrees of trance may, without difficulty, be artificially produced in most hysterical persons, and less readily, in many others, by the methods described in the article on Hypnotism. The state now designated hypnotism is really induced trance, and trance has been accurately termed 'spontaneous hypnotism.'

Symptoms.—The onset of the state of trance is usually sudden. For instance, in a case which came under the writer's notice, a girl went into a room by herself, and was found, shortly afterwards, in a state of trance-sleep, which lasted for thirty-eight hours. In another case (Madden) a young lady went into a room to change her dress, and was presently found on the bed in a state of trance which lasted for a fortnight. As already stated, it may succeed an hysteroid convulsion, and in some other cases the onset has been attended with an aura, resembling the globus hystericus or the sensation which precedes hysteroid and epileptic fits, as of a ball rising from the abdomen to the throat. In the cases which succeeded typhoid fever (Madden) the delirium of the fever passed gradually into comatose sleep, which continued for several weeks.

During the state of trance, the countenance is usually extremely pale. The limbs are relaxed, although brief initial rigidity, and sometimes occasional recurrent cataleptic rigidity, or transient convulsive spasms, tonic or clonic, have been noted. In a few instances distinct hysteroid fits have occurred from time to time during the course of the trance. The eyelids are usually closed, and may resist and quiver on attempts to open them. The eyeballs are directed upwards in most cases; they often deviate from the middle line, and sometimes diverge slightly. The pupils are usually moderately dilated; rarely they are moderately contracted. The state of reflex action varies according to the depth of the trance. That from the limbs is sometimes excessive, so that cutaneous stimulation produces tetanic rigidity. Much more frequently reflex action is lost; snuff blown into the nostrils causes no sneezing, ovarian compression has no effect, and pressure on hysterogenic points, which may have existed before, no longer causes the usual phenomena. Reflex action from the conjunctiva, and even from the cornea, is commonly absent. The pupil may contract to light, but in lessened degree, and sometimes no distinct action can be observed.

The mental functions seem, in most cases, to be in complete abeyance. No manifestation of consciousness can be observed, or elicited by the most powerful cutaneous stimulation, and on recovery no recollection of the state is preserved. But in some cases volition only is lost, and the patient is aware of all that passes, although unable to give the slightest evidence of consciousness. The senses may be even preternaturally acute, as in the analogous phase of induced hypnotism; or there may be spontaneous mental action, irrelevant to external impressions, and analogous to, probably identical with, the state of ordinary dreaming; it is manifested by exclamations, and even by movements. Rarely the 'obedient automatism' seen in induced hypnotism may be present; hallucinations occur, and actions are performed, according to suggestions made to the patient. The usual condition, however, is that of an entire absence of all evidence of mental activity.

The pallor of face is the result of a profound depression of the vascular system. The pulse may be less frequent or more frequent than normal, but it is invariably weaker, and it may be imperceptible. The cardiac impulse may disappear, although the heart-sounds are still to be heard, sometimes much weakened. Very rarely they have been inaudible. In a case observed by Weir-Mitchell, vascular disturbance preceded the other symptoms. The breathing during trance may be tranquil, slightly quickened, or slower, or may be so feeble and deliberate that no movement of the thoracic walls can be observed, no respiratory murmur can be heard in the lungs, and a mirror held over the mouth is undimmed by moisture. Rarely respiration presents rhythmical variations. Temperature, when observed, has been normal in the central parts, lowered at the periphery. The secretions go on; the urine may be retained in the bladder, or passed into the bed. The catamenia are usually absent, but menstruation has been known to occur without modifying the course of the trance-sleep. In the cases in which the depression of the vital functions reaches an extreme degree, the patient appears dead to casual and sometimes to careful observation. This condition has been termed 'death-trance' (*Scheintod*), and has furnished the theme for many sensational stories, but the most ghastly incidents of fiction have been paralleled by well-authenticated facts.

Duration and Course.—The duration of trance has varied from a few hours or days, to several weeks, months, or even a year. When of short duration, the trance-sleep may be unbroken, but when it lasts for more than a few days, there are usually remissions of a greater or less degree, in which, for instance, the patient will half-wake, take food in an automatic manner, and then relapse into stupor. A long trance-sleep may be more profound at first than later. Recovery may be sudden or gradual. Occasionally it is attended by some vaso-motor disturbance; in a well-authenticated case of death-trance the intense mental excitement produced by the preparations for fastening the coffin-lid occasioned a sweat to break out over the body. In other cases hæmorrhages have occurred at the time of recovery, and such extravasations in the skin have been regarded as legendary 'stigmata.' After the trance is over, nervous prostration, with defective articulation, or mental dulness, may remain for a time. In many cases repeated attacks of trance occur, at intervals of days, months, or years. Most cases of trance-sleep end favourably. The depression of the vital functions enables life to continue with a very small amount of nourishment. Occasionally death occurs, as in the case of a deserter from the German army, and in one of the cases after typhoid fever described by Madden.

Pathology.—The very few *post-mortem* examinations which have been made after death in trance, throw no light on its nature. The theoretical pathology of the subject is involved in the obscurity which envelopes all the psychical processes in health and disease, the nature of volition, and ordinary sleep. The lowered action of the brain in sleep, and its lessened blood-supply, have suggested the existence of cerebral anæmia, which the meagre results of anatomical investigation have been supposed to confirm. It is certain that the condition is sometimes associated with defective cerebral nutrition; but that much more than cerebral anæmia is needed to explain the state of trance, is evident from the facts that, on the one hand, it may occur when there is no preceding sign of defective blood-supply to the brain, while, on the other hand, the occurrence of cerebral anæmia without trance-sleep is a matter of daily observation. The phenomena of hypnotism also afford little support to the theory of the dependence of trance-sleep on cerebral anæmia, but, beyond this, they throw no light on its pathology. The subject affords abundant scope for theories, which have been freely supplied, but are, for the most part, mere re-statements of the observed phenomena, in the language of psychology.

Diagnosis.—The diagnosis of trance rests on the impossibility of rousing the sleeper, combined with the absence of any evidence of a local cerebral lesion or a toxic cause. Other diagnostic symptoms are the pallor and vascular depression, the occurrence of convulsive phenomena of hysteroid type, and the history of other manifestations of hysteria. These symptoms sufficiently distinguish trance-sleep from apoplexy, for which, at the onset, it is sometimes mistaken. The distinction from catalepsy rests on the absence of the *flexibilitas cerea*, but catalepsy is merely a variety of trance. The peculiar tendency to brief sleep termed *narcolepsy* is distinguished from trance by the shortness of the periods of unconsciousness. Thus a man had from youth fallen asleep for a few minutes under various influences, and always did so when a probe was passed down a nasal fistula. It is to be remarked, however, that the term *narcolepsy* has been also applied in America to cases of true epilepsy, in which the attacks of *petit mal* are characterised by sudden somnolence.

In cases of 'death-trance,' in which no sign of vitality can be recognised, the presence of life may be ascertained (1) by the absence of any sign of decomposition; (2) by the normal appearance of the fundus oculi as seen with the ophthalmoscope; (3) by the persistence of the excitability of the muscles by electricity. This excitability disappears in three hours after actual death. In a case observed by Rosenthal, thirty hours after supposed death the muscles were still excitable, and in forty-four hours the patient awoke. *See* DEATH, Signs of.

PROGNOSIS.—In cases of hysterical lethargy the prognosis is fairly good. The attack usually passes off. In very rare cases death has occurred. The slighter the degree of the trance, the shorter is likely to be its duration. The prognosis is grave only when the lethargy has been preceded by a state of great physical depression, and is the most serious when the condition succeeds an acute disease.

TREATMENT.—The treatment has to be directed to two ends: the maintenance of life, and the arrest of the trance. Advantage must be taken of any intervals of semi-consciousness to give nourishment in a concentrated form. If swallowing is continuously impossible, food must be given by the nasal tube, or by enemata. Warmth should be applied to the extremities, and care taken to prevent bed-sores. In severe cases, every attempt at arrest is often fruitless. Errhines, as snuff, have usually no influence, and it is only in slight cases that this, or stimulation of the skin, as by sinapisms, is effective. The most powerful cutaneous excitant is strong faradisation. In a case under the writer's notice, which had lasted for thirty-six hours, strong faradisation to the arm quickly roused the patient. In another case, which lasted for several months, this treatment had, for a long time, no influence; afterwards the patient could be partially roused for a short time by faradisation, and by repeating the application at the same hour every day, a tendency to periodical waking was established, the remissions became longer and more complete, and the attack was ultimately brought to an end. Nervine stimulants, such as ether and valerian, may be given by the bowel, or sulphuric ether may be injected subcutaneously. Alcohol must be given with caution and in small quantities; enemata of strong coffee are often more useful. A remedy which, from its effect on the vascular system, would certainly deserve trial in trance, is the inhalation of nitrite of amyl. Transfusion of blood has been proposed, and would be justified in cases following exhausting disease. The recurrence of attacks must be prevented by the improvement of health, physical and moral.

African Lethargy.—The 'sleeping sickness of the West Coast of Africa is met with chiefly in the Congo and Sierra Leone regions, and affects exclusively negroes. It occurs in both sexes and at all ages, but is most frequent in males between twelve and twenty. Except that depressing emotions seem to predispose to it, the proximate causes are entirely unknown. Europeans, living in the same localities, are exempt. Swelling of the cervical glands sometimes occurs at the onset, and they are excised by the native doctors as a remedial measure; but the condition is not invariable, and its influence is doubtful. The general health may be perfect. The symptoms differ considerably from those of hysterical trance. There is a gradually increasing tendency to somnolence. The patient will fall asleep at his work or over his meals. At first he can be roused, and if treated by cutaneous stimulation and purging, the symptoms may be removed for a little time; but they soon recur, and increase in spite of treatment, until at last the patient is always asleep, and refuses food. He gradually emaciates, and dies at the end of three or six months from the onset of the symptoms. Just before death the disposition to sleep often ceases. The disease is extremely fatal. Guèrin met with 148 cases, all of which died. The observations of Gore and others place the mortality somewhat lower—at about 80 per cent. *Post-mortem* examination has revealed only hyperæmia of the arachnoid, slight signs of chronic meningitis, but no considerable excess of fluid within the ventricles or outside the brain. The cerebral substance is usually pale. No treatment appears to influence the symptoms. Only one observer (McCarthy) has seen good from excision of the cervical glands. This mysterious affection clearly needs more systematic investigation than it has yet received.

W. R. GOWERS.

TRANSFUSION OF BLOOD.—SYNON.: Fr. *Transfusion du Sang*; Ger. *Transfusion des Blutes.*

DEFINITION.—The injection of blood from the human subject or from one of the lower animals, in a pure or defibrinated condition, into the veins of a patient.

DESCRIPTION.—This operation was invented in the middle of the 17th century, and is now fully established as a proceeding of great value; but authorities are still divided as to the best mode of performing it. Transfusion is most frequently undertaken as a means of saving life after a great loss of blood, and most commonly after *post-partum* hæmorrhage. It has also been employed in cases of profound anæmia from other causes, as in leucocythæmia, phthisis, and 'pernicious anæmia,' and its use has been suggested in the so-called blood-diseases, as fevers or pyæmia, but the benefit derived from it in these cases is at most only temporary, and it is probable that the operation will ultimately be limited to cases of anæmia from hæmorrhage. Transfusion benefits the patient, first, by increasing the quantity of fluid entering the ventricles, and so encouraging their action; secondly, by increasing the number of blood-corpuscles which, as the carriers of oxygen, are essential to life;

thirdly, by supplying albumen, and so giving nourishment at a time when it is probably impossible to do so by any other means. For none of these purposes is the fibrin of the blood essential, and consequently many operators prefer to defibrinate the blood, by which much trouble in the operation is saved. Experiments on the lower animals, and observations of operations performed on the human subject, seem at present to indicate that defibrinated blood is in every way as efficient as pure blood. Yet when all the necessary appliances are at hand, pure blood is undoubtedly the most natural fluid to inject. When human blood has not been available, the blood of a calf, a sheep, or a lamb has been used instead, apparently with equally beneficial results. The difference between the size of the corpuscles in these animals and in man is of no consequence, as those of man are the larger. The corpuscles from these animals probably break up very soon, as hæmatin has been found in the urine the day after transfusion with lamb's blood; but they no doubt serve as carriers of oxygen for a short time, during which the patient may rally. The dangers of transfusion are not very great, but as cases have occurred in which the donor of blood has died in consequence of the operation, it should not be undertaken without a clear prospect of benefiting the recipient. Care must be taken that air is not injected with the blood. The experiments of Oré (*Études historiques et physiologiques sur la Transfusion du Sang*, Paris, 1868) have, however, shown that this danger has been much exaggerated. A bubble of air does no harm; the quantity to cause death must be considerable. Too great care cannot, however, be taken to exclude air, as fatal cases have occurred from this cause. The injection of clots giving rise to embolism, and perhaps to pyæmia, is always considered one of the dangers of the operation; but evidence is wanting to show that it has been a frequent cause of death, or that in all the cases in which pyæmia or septicæmia followed the operation it was due to this cause. One case is recorded by Jürgensen (*Vier Fälle von Transfusion des Blutes*, Berlin, 1871) in which red maculæ formed on the skin after the operation, which subsequently suppurated. These were supposed to be due to minute fragments of fibrin injected with the defibrinated blood. Dr. Madge (*Brit. Med. Jour.* vol. ii. 1874; and *Obst. Jour. of Gt. Brit.*, 1874) has shown, however, that with care no such fragments need be left after whipping and straining. The wounds left after transfusion present nothing special, and are to be treated as ordinary venesection wounds. The difficulties with which the operator has to contend are not great when defibrinated blood is used. When pure blood is used by any but the immediate method of transfusion from artery to artery, or vein to vein, there is some necessary hurry, as the operation must be finished before coagulation sets in. To avoid this, Dr. Braxton Hicks recommends the addition of a solution of phosphate of soda (℥j to Oj), in the proportion of one of the solution to three of blood; and Dr. Richardson a solution of liquor ammoniæ (♏xx and distilled water ℥j), to be added to a pint of blood. Both these solutions have the power of arresting coagulation. There is often some difficulty in finding the collapsed and empty vein of the patient. An ordinary venesection incision is useless; the vein must be cut down upon, picked up with forceps, and then opened.

Transfusion is either *mediate* or *immediate*. In the *mediate* operation the blood may be either defibrinated or pure. When pure blood is used, the vein of the patient must first be exposed and opened, and a silver cannula introduced. It is better to use an assistant's fingers rather than a ligature to retain the cannula in its place. It is well to allow a drop or two of the patient's blood to escape from the cannula, if possible, to make sure it contains no air, or it may be filled with warm water or a solution of phosphate of soda. While this is being done the donor is bled into a clean vessel. No precautions need be taken to keep the blood warm. Cold delays coagulation. As soon as sufficient blood has been obtained, it is transferred to a syringe which is provided with an india-rubber tube. Care being taken that the tube and syringe contain no air, they are now connected with the cannula, and the blood slowly injected. Innumerable instruments have been invented for this operation, with the object of saving time, and ensuring against the entrance of air. It is impossible to describe them here. The best known are Hewitt's (*Brit. Med. Jour.* 1863, vol. ii.), Hicks's (*Guy's Hosp. Reports*, 1869), Higginson's (*Liverpool Med. Chir. Jour.*, 1857), and Mathieu's (*Bull. Acad. de Med.* Paris, 1867). In this last the blood is received directly from the donor into a funnel at the top of the syringe, and great rapidity of operation is consequently attained. An ingenious instrument, which it is impossible to describe without a drawing, was introduced into London in 1877 by Dr. J. Roussel. When all its parts are in good order it doubtless works extremely well, but it is somewhat complicated and uncertain in its action (Dr. J. Roussel on *Transfusion of Human Blood*, with a preface by Sir James Paget. London, 1877). When defibrinated blood is used, complicated instruments are unnecessary. The blood must be received into a clean vessel, and whipped with a clean stick or a twisted glass rod, till fibrin ceases to separate. The whipping must be done gently, so as not to injure the blood-corpuscles, or to break off minute fragments of fibrin. After whipping, the blood must be carefully strained two or three times through some clean linen. It may then be injected as above described. The operation of *immediate* transfusion has been reintroduced by Dr. Aveling (*Obst. Jour. of Gt. Brit.*, 1873). In this operation two cannulæ are required, one for the vein of the donor, and one for that of the patient. They are connected with each other by an india-rubber tube, with a small ball in the middle and a stop-cock at each end. The cannulæ having been inserted are allowed to fill with blood so as to expel the air; or that in the patient's vein, if no blood will flow into it, is filled with warm water. The india-rubber tube having been previously filled with warm water, is now applied to the cannulæ, and the stop-cocks turned on. The small ball is then squeezed, while the tube is pinched on the side of the donor by an assistant. This drives the fluid in the tube into the vein of the patient.

The tube is next pinched on the side of the patient, and the ball allowed to expand and then emptied as before. Each squeeze of the ball drives in three drachms of blood. Immediate transfusion from artery to vein has only been performed when an animal has been the donor. In this operation the carotid artery of a lamb or calf is connected directly with the vein of the patient by means of a simple india-rubber tube, with a cannula at each end. The force of the animal's circulation is quite sufficient to carry the blood into the patient's vein. As the result, however, of a series of experiments carried out at the request of the Obstetrical Society of London, Professor Schäfer has recommended immediate transfusion from artery to artery as the most efficacious method of performing the operation (*Trans. Obst. Soc. Lond.* 1879, vol. xxi.). The quantity injected in any of the foregoing methods of operating varies with the effect produced. Sometimes as much as a pint has been introduced. Half that quantity is usually sufficient to produce a marked effect.

Marcus Beck.

TRANSFUSION OF MILK.—This operation, or, as it is more correctly termed, *Infusion or Intravenous Injection of Milk*, has been recommended in America by Thomas (*N. Y. Med. Journ.* May, 1878), Howe (*N. Y. Med. Rec.* 1878, p. 443), and others, as a substitute for transfusion of blood. In this country it has been practised and recommended chiefly by Dr. Austin Meldon, of Dublin (*Med. Press and Circular*, Oct. 22, 1879; and *Lancet*, 1880, vol. i. p. 527). The subject has been experimentally studied in France by Béchamp and Baltus, Laborde, Culcer, and others, with the result of showing that a small amount of milk may be injected without any evil consequences; but if the quantity be too large and too rapidly injected, the animal dies asphyxiated after severe dyspnœa. The *post-mortem* examinations showed minute hæmorrhages and embolisms, caused by the milk-globules sticking in the capillaries of the lungs, kidneys, brain, and other viscera. The numerous cases in which the operation has been performed on the human subject show that it can be safely undertaken, provided that, in addition to the usual precautions observed in intravenous injections, the following points are attended to. The milk must be freshly drawn from a cow or goat. A goat may be brought to the bedside of the patient. The milk must be alkaline; and this is best secured by the addition of a small quantity of carbonate of ammonia. It must be raised to a temperature somewhere near that of the body. Under no circumstances must more than 4½ ounces be injected (Meldon). If any dyspnœa is observed the operation must be at once arrested. The injection is usually followed by a considerable rise of temperature, and there may be some disturbance of respiration, which passes off in a short time. The operation is reported to have been successfully performed in cases of cholera, pernicious anæmia, phthisis, and loss of blood; and it may perhaps be recommended as a last resource in some of these conditions if no blood can be obtained for transfusion. Injection of milk can only effect two of the purposes of transfusion. It can increase the amount of circulating fluid; and it can, in an imperfect way, supply food at a time when it could not otherwise be taken; but it can do nothing to increase the oxygen-carrying power of the blood. Its inferiority to immediate transfusion is self-evident; and it is more dangerous and less efficacious than the transfusion of freshly-defibrinated blood, either of man or animals.

Marcus Beck.

TRANSPOSITION OF VISCERA. *See* Organs, Displacement of.

TRAUMATIC (τραῦμα, a *wound*).—That which is associated or connected with a wound or injury, for example, *traumatic fever*, *traumatic gangrene*, and *traumatic aneurism*.

TREATMENT. *See* Disease, Treatment of; and Therapeutics.

TREMENS, DELIRIUM. *See* Delirium Tremens; and Alcoholism.

TREMOR (Lat. trembling).—The most delicate form of clonic spasm, consisting of successive movements of very small amplitude. Tremors are seen principally in the hands, the head, the tongue, or the facial muscles, as a result of disease or of old age. They are commonly spoken of as 'coarse' or 'fine,' according to the amount of movement which they involve. For some account of the mode in which tremors are related to other disorders of movement *see* Motility, Disorders of.

TRICHIASIS (θρίξ, the hair).—A morbid condition in which the eyelashes are inverted towards the eye. *See* Eye and its Appendages, Diseases of.

TRICHINA (τρίχινος, made of hair).—Synon.: Fr. *Trichine*; Ger. *Trichina*.—A genus of nematoid worms, originally established by Professor Owen for the reception of the minute spiral flesh-worm (*T. spiralis*). This entozoon was first discovered in human muscle by Sir James Paget, when a student at St. Bartholomew's Hospital. The history of this and other discoveries in connection with trichina, so much misunderstood abroad, is exhaustively discussed in the writer's work on *Entozoa* (Supplement, 1869, p. 1 *et seq.*); but it must, in justice to continental observers, be here at least permitted us to remark that whilst Herbst was the first to rear capsuled *trichinæ* by experiment, and whilst Virchow was the first to rear and recognise sexually mature intestinal trichinæ in a dog, it yet remained for Zenker to open up a new epoch in the record of trichinal discovery, by a complete diagnosis of the terrible disease which these parasites are capable of producing in the human frame. With Leuckart rests the honour of communicating the fullest and most complete details in reference to the structure of the worm, whilst at the same time he solved most of the difficult problems relating to the source and genetic relations of the parasite. In this connection the separate labours of Pagenstecher, Davaine, and Heller are also especially noteworthy; the writer's own experimental results at the same time corresponding very closely with those obtained abroad (*Linn. Soc. Proceed.*, 1865).

Description.—The *Trichina spiralis* may be described as a minute helminth, the sexually mature male measuring the $\frac{1}{18}$ of an inch, and the female $\frac{1}{8}$ of an inch in length. The tail of the male is distinguished by the presence of a bilobed prominence, between the divisions of which the anal opening is placed, and from which latter a single spiculum can be protruded. The female is stouter, and supplied with a bluntly rounded caudal extremity, the reproductive outlet being situated towards the anterior part of the body. The eggs measure only the $\frac{1}{1270}$ of an inch in their long diameter, their contained embryos being produced viviparously. As explained by Professor Leuckart, the entire course of development from the period of impregnation up to the time of sexual maturity may, under favourable circumstances, occupy considerably less than three weeks. The ingestion of trichinous pork is followed by the maturation of the muscle-larvæ in two days, by the birth of embryos in six days, and by the arrival of the migrating progeny within the muscles of the human or animal bearer in fourteen days. The formation of the lemon-shaped protective capsules around the muscle-worms is a subsequent process, requiring several weeks for its accomplishment. In the perfectly formed larvæ males and females are already recognisable as such.

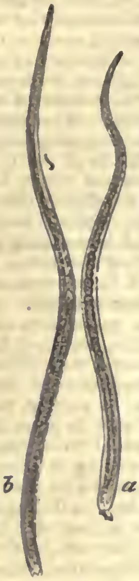

Fig. 97.
Trichina spiralis magnified; male (*a*), and female (*b*). After Leuckart.

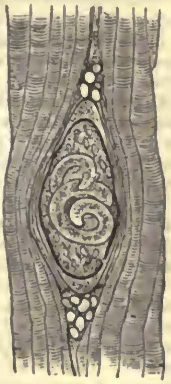

Fig. 98.
Portion of human muscle, enclosing a single capsuled *Trichina*. Highly magnified. After Lenckart.

The disorder produced by trichinæ is almost entirely due to the injury inflicted on the host by the act of wandering performed by the embryos. The grave symptoms and results thus superinduced are described in the article Trichinosis.

T. S. Cobbold.

TRICHINOSIS or TRICHINIASIS.—

Synon.: Fr. *Trichinose*; Ger. *Trichinenkrankheit*.

Definition.—The name applied to the verminous disorder called 'flesh-worm disease,' or to that form of helminthiasis which results from the wanderings performed by the larvæ of *Trichina spiralis*. The discovery of this disease in the living human subject is due to Zenker. *See* Trichina.

History.—Whilst the literature of this affection is of great extent, the exigencies of clinical instruction can be sufficiently met by a brief record of the principal phenonema of the disease as ordinarily presented by trichinised patients. Whilst the discovery of the worm itself, as a nematoid, rests with Sir James Paget, the earliest recognition of the calcified and lemon-shaped capsules ('gritty particles') was made by Mr. Hilton of Guy's Hospital. Not only so; Mr. Hilton suggested the parasitic nature of the 'specks' observed in human muscle, which were, however, regarded by him as 'depending upon the formation of very small cysticerci.' The advocates of the prior claims of Tiedemann in this connection, though, in the estimation of a few persons, apparently well-established, do not pretend to credit that anatomist with the possession of the faintest conception of the parasitic origin of the specks, or 'stony concretions,' as he termed them in Froriep's *Notizen* for 1822. In 1828, Mr. Peacock observed similar little bodies. In looking at the subject from a pathological standpoint, we see how large a share our countrymen had in first recognising the trichina capsules in their calcified state. This degenerated condition may be regarded as an invariable sequela of the disease, whenever the latter has run its natural course without proving fatal to the bearer. Mr. Richard Davy discovered a number of lenticular or oval bodies, averaging the fourth of an inch in length, in the muscles of a dissecting-room subject at the Westminster Hospital. To the naked eye they resembled the early condition of degenerating cysticerci; being also firm in texture, white, and of almost uniform size. The writer examined one on the 1st of March, 1876. It consisted of a dense fibrous capsule, containing caseous matter which effervesced on the application of strong acid. Probably they would have become concretions, similar to those described by Tiedemann.

Symptoms.—The symptoms of trichinosis, though by no means uniform, are tolerably characteristic. Under ordinary circumstances, the ingestion of badly trichinised meat, insufficiently cooked, is followed after a few hours by symptoms of indigestion, such as nausea and vertigo, which may be succeeded by actual sickness and marked febrile disturbance. In milder cases the premonitory indications are usually insufficient to excite attention; failure of the appetite, or aversion to food, with more or less *malaise*, being all that is noticeable. If only a very small quantity of diseased meat has been taken, the attack may pass off without particular observation; but in bad cases diarrhœa sets in, and may continue for several days in succession, the fever becoming more and more marked. The patient is now prostrate. The extremities become stiff and painful; and thus the first stage of the disorder, usually lasting for about a week, is completed. The second stage of the affection is coincident with, and dependent upon, the active migration of the progeny resulting from the maturation and propagation of the capsuled trichinæ originally ingested by the patient. The fever increases; there is œdema of the face, which, however, in some cases is limited to the eyelids. Movements of the eyes are accompanied with pain, and there is intolerance of light. Later on, the muscles of the limbs are swollen and rendered extremely painful to the touch, the slightest attempt at movement causing excruciating distress. The tongue is red and slightly coated. The pulse is very rapid, rising to 110, 120, or more, per minute; the respiratory movements and temperature likewise generally increase in rapidity and height. There is usually abundant perspiration, whilst the thirst is by no means excessive. In all cases the pain is apt to render the patient very irritable, his inability to sleep being one of the most distressing symptoms. In grave cases delirium frequently sets in; the limbs become flexed and paralysed; and there is also, generally speaking, excessive and continuous diarrhœa, which rapidly exhausts the patient, and places him in great danger. He lies on his back in a state of utter helplessness, and frequently can neither move a limb, sneeze, yawn, nor perform the ordinary acts of mastication and swallowing, in consequence of the paralysis of the various muscles concerned in these different functions.

Course and Terminations.—In about a month or five weeks from the commencement of the attack the second stage of the disorder is completed; but the lines of demarcation between these various stages of the malady are necessarily somewhat arbitrary. If death take place, it usually happens before the completion of the second stage, in the third or fourth week; but when the patient's strength can support the complete immigration of all the progeny resulting from the original infection, then the marked cessation of the febrile symptoms indicates the commencement of the third stage or common period of recovery. This third stage, however, is not one of invariable convalescence. As a rule, the diminished frequency of the pulse, the improved state of the respiration, and the diminution of the temperature go on more or less uniformly, until the patient's strength gradually returns with his recommencing and, at first, very slowly increasing appetite. In bad cases, however, the diarrhœa continues, and there is a general collapse of all the vital powers, resulting from all sorts of sequelæ that had set in during the progress of the affection. Amongst these, affections of the chest usually play a conspicuous part, such as hæmoptysis, pneumonia, and hydrothorax. During the period of returning convalescence, the appetite sometimes becomes voracious, the body rapidly gains flesh, and there is always more or less desquamation of the cuticle. The periods both of recovery and death, as the case may be, are exceedingly variable; in some instances the health not being re-established until two or even three months have elapsed.

Diagnosis.—The diagnosis of this disease must be founded on a consideration of the symptoms described, taken in connexion with the discovery of the parasite itself, first, in the suspected articles of food; secondly, as adult trichinæ, in the alvine evacuations during the first six or eight weeks of the disease; and, thirdly, as specimens obtained from the muscles of the living subject by an instrument called the harpoon, or by simple incision, the part being anæsthetised.

Treatment.—The indications as to treatment are obviously few and simple. To support the strength is essential. In our judgment no good can possibly result from the administration of the picronitrate of potash, benzoin, arsenic, or any other drug which is given with the view of destroying the young and migratory trichinæ. When once the young parasites have started on their journey, all hope of arresting their progress is at an end; when they have become encapsuled, even a strong solution of chloride of zinc (injected into the body of the deceased victim for anatomical purposes) will have no effect on them. Far otherwise, however, are the results of treatment if the disorder be attacked immediately on the appearance of the premonitory symptoms. If the trichinous food has not left the stomach, an emetic may prevent all further mischief. If the stomachal contents have passed into the upper bowel, a brisk purgative, repeated for several days in succession, may expel the trichinæ before they have arrived at sexual maturity. For this purpose, nothing seems to answer the end so well as calomel, which may be given in five-grain or larger doses, combined with jalap, scammony, or colocynth. According to Rupprecht (who enjoyed large opportunities for testing the value of different drugs during the Hettstädt outbreak), one-scruple doses of calomel can be borne, not only with impunity, but with positive advantage. Castor oil and turpentine, either separately or combined, may be given with benefit; but the employment of the ordinary vermifuges, such as male fern and santonin, is clearly contra-indicated. A good, active cathartic, such as the compound senna mixture, or the simple scammony draught of the British Pharmacopœia, will probably be fully as efficient as any of the drugs usually administered as vermifuges. The measure of success is clearly dependent in the main upon prompt catharsis. In cases where the second stage of the disorder has fairly set in, less active purgatives may be given at first, the great object being to lessen the fever, and to support the system by judicious dieting. The disinclination of the patient to take food of any kind must be overcome at all hazards, and soda-water, with meat extract very slightly diluted, must be administered. When the yolk of an egg, or milk, or broth can be given in the ordinary way, as a meal, it should be preferred. As remarked before, the strength must be supported, if necessary, by small quantities of wine or brandy. In this way the patient's life may be upheld during the most critical period, after which, when convalescence is being re-established, the employment of the ordinary vegetable tonics and steel may be advantageously resorted to. Natural chalybeate waters are also likely to prove serviceable.

Prevention.—In regard to the prevention of trichinosis, all that need be remarked in this place has reference to the temperature to which all cooked meat should be raised in order to kill the parasites. According to most authorities, trichinæ succumb to a moist heat of 170° Fahr., whilst some assert that 20 degrees less than this, if prolonged, is sufficient for the purpose. According to some interesting experiments by Dr. Lewis, the centre of a leg of mutton attains a temperature of 107° Fahr. in about five minutes after the surface of the joint has been exposed to boiling heat (212°). Clearly, with the most ordinary precautions it is easy to avoid infection. Recent experiments show that salting is not fatal to the capsuled trichina. England is singularly free from trichinosis; but rather from the circumstance that our swine rarely contain trichinæ, than that we are unaccustomed to eat underdone meat. Only one small outbreak of trichiniasis has been observed within our borders, the original account of which, by Dr. W. Lindow Dickenson, appeared in the *British Medical Journal* for the year 1871. Some outbreaks supposed to be those of true trichinosis have turned out to be spurious. The epidemic on board H.M. training ship 'Cornwall' was of this character. An autopsy of one of the boys revealed the existence of a new species of free nematoid, which the writer called *Rhabditis Cornwalli*, and which Dr. Bastian named afterwards *Pelodera setigera*. A large number of parasites have been wrongly described as trichinæ, thus causing much error of interpretation (*see* PELODERA). In Germany true trichina epidemics have been notoriously frequent, and thus for our knowledge of the phenomena of the disorder we have been mainly dependent upon the writings of Rupprecht, Zenker, Virchow, Leuckart, Pagenstecker, Heller, and others. The disease is not infrequent in the United States, where, however, it is for the most part confined to the German inhabitants, who have retained the habit of eating 'smoked sausages,' so common in the Fatherland. (For details, see Dr. Sutton's excellent *Report on Trichinosis*, as observed in Dearborn co., Indiana, in 1874: *Transactions of the Indiana State Medical Society* for 1875; and also, especially, Dr. W. C. W. Glazier's *Report on Trichinæ and Trichinosis*, published by order of Congress, Washington, 1881.) For further particulars on this subject the reader is referred to the writer's book on *Parasites*; to Dr. Althaus's *Essay on Trichinosis*; and to the still more elaborate and exhaustive memoir by Dr. Thudichum, published in the reports of the Privy Council for the year 1864. *See* TRICHINA.

T. S. COBBOLD.

TRICHOCEPHALUS (θρὶξ, a hair, and κεφαλή, a head).—SYNON.: Fr. *Trichocéphale*; Ger. *Haarkopfwurm.*—A genus of nematode worms, comprising forms in which the anterior two-thirds of the body is filiform, terminating in a mere point. They are sometimes called whipworms; the thickened body answering to the handle of the whip. The human species (*T. dispar*) varies from an inch and a half to two inches in length, according to sex, and it resides principally in the cæcum. The male is smaller than the female, and is readily recognised by its spirally contorted tail. This parasite probably enjoys a wide distribution; but little attention has been paid to it out of Europe. In England it is rare as compared with France, where, according to the testimony of Davaine and Duval, it is extremely abundant, the former authority having calculated that one-half of the Parisians were infested by it. Leidy says it is frequent in the United States. Clinically, its importance by no means corresponds with its prevalence; nevertheless, in rare instances it has been known to occasion severe symptoms. A most interesting case of this kind has been placed on record by Mr. D. Gibson, in which 'paralysis, with loss of speech' resulted from the intestinal irritation occasioned by the presence of large numbers (*Lancet*, August 9, 1862, p. 139). In like manner, Davaine quotes a case by M. Felix-Pascal, where a little girl, four years of age, died with cerebral symptoms, the *post-mortem* revealing the presence of a 'prodigious quantity' of whipworms in the cæcum and colon. The writer has occasionally expelled this parasite when employing vermifuges for other parasites. It is worthy of remark that in animals the presence of a closely allied species (*T. affinis*) has been known to produce severe intestinal irritation. *See* WHIP-WORM. T. S. COBBOLD.

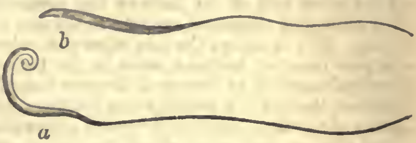

FIG. 99. *Trichocephalus*; male (*a*), and female (*b*). Enlarged one-fourth.

TRICHOMONAS VAGINALIS (θρὶξ, a hair, and μονὰς, a monad; and *vaginalis*, connected with the vagina).—A ciliated infusorial animalcule, discovered by Donné in the vaginal mucus, and somewhat resembling a spermatozoon. *See* RAPE.

TRICHOPHYTON (θρὶξ, a hair, and φυτὸν, a plant).—A genus of parasitic fungi, to the presence of which tinea is due. *See* TINEA.

TRICUSPID VALVES and ORIFICE, Diseases of. *See* HEART, Valves of, Diseases of.

TRIFACIAL NERVE, Diseases of.—The fifth or trifacial nerve (*nervus trigeminus*), the largest of the cranial nerves, consists of a motor and sensory portion, the sensory fibres passing through the Gasserian ganglion and being distributed to the face and a portion of the head. The motor portion, much the smaller, is physiologically independent of the ganglion, and supplies the pterygoid, masseter, buccinator, and temporal muscles. The two first divisions—the ophthalmic and superior maxillary—are entirely sensory, and proceed from the ganglion. The third, or inferior maxillary division, proceeds also from the ganglion, but receives besides the whole of the motor root. Lesions of this nerve cause disorders of sensation, motion, nutrition, or secretion according to the anatomical position and extent of the injury.

The affections of the fifth nerve may be considered in the following order:—

1. **Trifacial Neuralgia.**—Neuralgia may affect one or all of the three divisions of the nerve.

It is fully described under the head of tic-douloureux. *See* TIC DOULOUREUX.

2. **Trifacial Anæsthesia.**—Anæsthesia of the trigeminus, usually unilateral, may be dependent either upon (*a*) *central lesion*; or upon (*b*) *peripheral lesion*.

(*a*) *Central lesion.*—Hemiplegia from apoplexy, tumour, or other coarse disease of the central nervous organs is usually accompanied by some anæsthesia in the district supplied by the trigeminus, arising from interference with the integrity of the fibres of origin of the nerve in their central course. The anæsthesia usually occurs on the same side of the body as the paralysis of motion, and therefore opposite to the seat of lesion. This is always the case when the lesion occupies its most frequent seats in the higher ganglionic centres. In disease of the pons Varolii, however, the loss of sensibility may involve both halves of the face, although it usually affects the same side as that upon which the limbs are paralysed, and opposite that upon which the portio dura and sixth nerves (when either or both of them are involved) are affected. In cases of apoplexy, the anæsthesia is usually very imperfect, and not sharply defined. It is short-lived, lasting from a few hours to days; but in certain cases it may continue, and even outlive the motor paralysis with which it is conjoined.

Intracranial tumours may produce more persistent anæsthesia, either by immediate destruction of sensory fibres, or, indirectly, by the cerebral enlargement, due to their growth, causing compression of the fifth nerve as it traverses the floor of the skull.

(*b*) *Peripheral lesion.*—Anæsthesia dependent upon lesion of the trigeminus in its peripheral course is a symptom of serious moment, which it is important to distinguish from that of central origin, and this may be accomplished by noting the following points:—The degree of peripheral anæsthesia far exceeds that which obtains in cases owing their origin to a central cause. It is much more complete, and involves, which the latter does not, trophic and vaso-motor complications. Its extent varies according as the trunk of the nerve, including the Gasserian ganglion, is involved; or only one or two of its branches. Should the main trunk be affected, there is more or less complete anæsthesia of one side of the face and part of the ear, conjunctiva, cornea, nostril, mouth, half the tongue, the gums on the same side, and a part of the palate. If the conjunctiva be touched with the finger, there is no reflex contraction of the eyelids. A glass from which the patient drinks seems to him as though it were broken, for he feels the material on the sound side and not on the affected side. The skin of the face is cool, and may be somewhat œdematous, and purplish in tint. After a few days, if the cause persists, the eye on that side looks dry, glazed, and congested; the cornea becomes cloudy, and in time sloughs and perforates, the contents of the eyeball escaping to a varying extent, so that the organ is destroyed. There is dryness of the nostril on the affected side, and irritant substances applied to it fail to produce sneezing. Taste is lost on that side of the tongue, except at the base, which is supplied by the glosso-pharyngeal nerve. The salivary secretion is diminished. In time there may be bleeding from the gums, and ulceration of the mucous membrane. Should the lesion exist upon one of the three divisions of the trigeminus, the anæsthesia will be found sharply limited to the district supplied by that division. The nature of the lesion must be determined by the examination of concomitant conditions. Whatever be the active cause by which the nerve is damaged, the effects will be the same; pressure upon, and disorganisation of the nerve-fibres will result in the disorders described—sensory, motor, trophic, and vaso-motor. In such circumstances, one or more of the other cranial nerves are usually affected coincidently. In tubercular meningitis, the fifth nerve is shown to be paralysed (along with others traversing the floor of the skull) by the conjunctivitis and corneitis so often present in advanced stages of the disease. Should the condition accompany bulbar paralysis, the lesion must be referred to the nuclei of origin of the nerve in the medulla oblongata.

TREATMENT.—Syphilitic gummata on the floor of the skull, developed either in the membranes of the brain or in the nerve itself, are so frequently the cause of the disorganisation of the fifth nerve which gives rise to anæsthesia, that in all cases it is right—unless some other cause is evident beyond all doubt—to bear in mind the possibility of such a cause, and to prescribe accordingly without delay. Ten-grain doses of iodide of potassium should be administered every four hours. Should there be a gumma pressing upon the trunk of the nerve, this treatment will have the effect of bringing about a rapid amelioration, and, in many cases, supposing it has been applied early enough, a complete cure. It is evident that, as regards other causes, there is no particular indication for treatment, which must be adapted to the special circumstances of the case.

3. **Trifacial Hyperalgesia.**—Hyperalgesia may accompany or precede neuralgia of the fifth nerve. It may also precede facial anæsthesia when this is due to neuritis. There are varieties in the degree of this hyperalgesia. It is sometimes so severe that the slightest touch occasions pain. The face cannot then be washed in the ordinary way, but the patient has to take a piece of sponge or wetted rag and cautiously dab the skin with it. Sometimes it is described as a feeling of soreness only when the hand is passed over the face. In either case the condition is accompanied by diminution of the tactile discrimination in the part. In *mimetic spasm* of the portio dura, there is often hyperalgesia in the region of one or more divisions of the fifth, and the lesion is then doubtless connected with the deep origin of the nerve. In blepharospasm it will often be found, if the face be carefully examined, that pressure with the finger at some point will check the spasm.

Subcutaneous division of a twig of the fifth (or afferent nerve) at this point, will often bring about a cure of the affection. The supra-orbital or subcutaneous malar, are the nerves most commonly in fault.

Photophobia is referable to hyperalgesia of the branches distributed to the conjunctiva.

4. Motor Disorders.—Affections of the motor root of the fifth nerve are either (*a*) of a *spasmodic*; or (*b*) of a *paralytic* character.

(*a*) *Spasm.*—Spasm of the muscles supplied by the trigeminal nerve may be tonic or clonic. In trismus, or 'locked jaw,' the teeth are clenched together by the tonic contraction of the masticatory muscles, which can be felt tense to the touch. According as the muscles are generally involved, or only partially, the lower jaw will be fixed in a symmetrical position, or be pulled over to one side, or advanced or receded. Clonic spasm of the same muscles is observed in various convulsive disorders; and slower movements of a horizontal character constitute the grinding of teeth sometimes indicative of cerebral disease.

Trismus may either be one symptom of tetanus, or it may occur by itself, and then it either arises from cold, or is of reflex origin, from irritation of the sensory portion of the nerve by decayed teeth, dentition, or disease of the jawbone. It may be due to the presence of a foreign body, possibly of very small size, lodged in the cicatrix of a wound upon the face, or even in some distant part of the body. Irritation from worms is a possible cause. It is still more commonly hysterical.

Treatment.—When arising from cold, the constant current should be applied to the contracted muscles. Any source of irritation must be sought for, and, if possible, removed or remedied.

The removal of a foreign body will sometimes bring about an immediate cure. This failing, the hypodermic injection of morphia, in doses of gr. ⅙, may be employed, and bromide of potassium given internally in doses of 20 grains. When the presence of worms is suspected, appropriate treatment must be employed. If the affection be hysterical, somewhat powerful faradaic currents, directed to the muscles of the jaw, will scarcely ever fail to open the mouth and cure the ailment. Hysterical trismus will not be mistaken for dislocation of the jaw, if it be remembered that in the latter accident the jaw is fixed with the mouth partly open.

(*b*) *Paralysis.*—Paralysis of the masticatory muscles is not very common, but may be observed sometimes in cases of bulbar paralysis, or it may accompany anæsthesia of the face, and depend upon tumour, abscess, aneurism, or some such coarse disease encroaching upon the trunk of the nerve within the cranium. To test the state of the muscles, the patient should be asked to move his jaw to and fro laterally, as well as in opening and shutting the mouth. Any irregularity of movement will be evident to the eye, and defective strength or absence of contraction in the affected muscles may be felt by placing a hand on each cheek, whilst the patient performs movements of mastication. When the jaw is found to fail in being carried to one side in a munching movement, the fault of course lies with the pterygoid muscles of the *opposite* side. The affection is more often unilateral than bilateral. Its importance is bound up with that of the lesion which gives rise to it.

As in peripheral affections of the sensory portion of the nerve, especial attention should be paid to the causation, and if this probably depends upon a tumour, the possibility of its syphilitic character should be borne in mind, and iodide of potassium administered.

T. Buzzard.

TRISMUS (τρίζω, I gnash.)—Lock-jaw, or tetanic closure of the jaws; a prominent symptom in tetanus. *See* Tetanus.

TRISMUS NASCENTIUM (Lat.).—A form of tetanus occurring in newly-born children. *See* Tetanus.

TROPHIC LESIONS.—Description.—This name is given to various departures from healthy nutrition, which are caused (*a*) by the cutting off, from certain tissues or parts, of some customary nervous influence, as in the production of 'secondary degenerations' in the nervous system (*see* Spinal Cord, Diseases of, § 6), or in the production of rapid muscular atrophy, consequent upon the severance of or severe damage to motor nerves or their related ganglion-cells in the anterior cornua of the cord; and also to lesions or morbid changes which are caused (*b*) by some irritative or perverted influences passing outwards along nerves to certain tissues or parts, so as to weaken or otherwise disturb their nutrition. In this latter way, the nutrition of the skin and its appendages may be variously affected, leading to eruptions of different kinds, to atrophy, to ulceration, or undue proneness to inflammation, as well as to altered pigmentation of the skin or blanching of the hair. Or the nutrition of the joints may be affected, as in some forms of hemiplegia, and of locomotor ataxy more especially. In these various cases there may be disease, secondary or primary, of the grey matter of the spinal cord, or some irritative lesions of the sensory nerve-roots or trunks.

Pathology.—Much dispute has taken place during recent years as to the modes in which such nutritive changes are brought about. Some have endeavoured to establish the existence of special 'trophic nerves,' and have taught that the various trophic lesions referred to above, are to be explained by a cutting off or a perversion of the influences usually operating upon the tissues through such nerves. Others believe that these nutritive changes can be accounted for by altered states of excitation of the vaso-motor nerves, leading to spasms or dilatations of the vessels supplying the parts affected, and, as consequences, to the nutritive changes themselves (*see* Sympathetic System, Disorders of). Much evidence, however, could be cited against both these modes of explanation, and it seems, on the whole, more probable that trophic lesions are due either (*a*) to the cutting off of certain accustomed influences (*viâ* motor channels), or (*b*) to the action upon the tissues of perverted or unnatural influences (in a peripheral direction *viâ* sensory channels).

On the subject of these trophic lesions *see* also Spinal Cord, Diseases of, § 7; Glossy Skin; and Unilateral Facial Atrophy.

H. Charlton Bastian.

TROPICAL DISEASES.—Diseases incident to hot climates. *See* Climate; Disease, Causes of; and the special diseases, such as

Cholera; Chyluria; Dysentery; Fungous Foot of India; Intermittent Fever; Liver, Diseases of; Remittent Fever; and Sunstroke.

TUBERCLE (*tuberculum*, a little swelling). Synon.: Fr. *Tubercule*; Ger. *Tuberkel*.—We have not yet attained to anything like unity of opinion in respect of tubercle. We are not yet agreed concerning what shall take the name of tubercle, and this alone implies the utmost discord in other matters. It is a chapter of pathology wherein few assertions can be made which will stand the test of a dogma; that is to say, a belief held always, everywhere, by all. But although dogma has no place here, it would be wrong to fly to the other extreme of denial. A method of simple inquiry will be our safest guide through so perplexed a topic. We will note the diverse opinions in order as they arose, being convinced that most of these opinions are true in some particular, that they commonly err by exclusiveness, and that the next best thing to the absolute truth will be found in a comprehension of all opinions.

There have been four stages in the history of tubercle, namely, the first, or etymological stage; the second, or stage of morbid anatomy studied by the naked eye; the third, or stage of morbid anatomy studied by the help of the microscope; and the fourth, or stage of experimental pathology.

Stage I.—This stage begins with the earliest writings on medicine. The word tubercle has not yet been wrested from its original meaning: tuberculum, a little lump of any kind. And this primitive etymological meaning survives even in the present day. We still speak of tubercles of the ribs and other bones; acne is a tubercular disease of the skin, and so on. But down to the beginning of the nineteenth century, tubercle meant a little lump, and nothing else.

Stage II.—At the beginning of the present century tubercle lost its simple etymological meaning, and acquired a pathological meaning. Tubercle is no longer a matter of special shape, for now it signifies a special structure. This great change concurred with the rise of morbid anatomy. And thus it came to pass. Many of the dead bodies examined were necessarily cases of pulmonary consumption, and in this form of disease it was that little morbid lumps or tubercles were discovered with especial frequency. Hence the tubercles found in phthisical lungs early showed a strong tendency to become emphatically the tubercles of pathology. We may remark this tendency in Morton (A.D. 1689), and in Baillie (1795). But it was Bayle (1803) who first broke with the ancient meaning altogether, and introduced the second stage of opinion. Debates concerning tubercles are henceforth debates concerning morbid structures.

Bayle thus defines tubercle: A homogeneous substance; always opaque; in colour, white or dirty white, sometimes yellowish, sometimes greyish; in size, from a millet seed to a chestnut. He makes the criterion of tubercle to consist in its opacity. Now this opacity is most marked in the cheesy products of degeneration. Therefore, in other words, the criterion of tubercle consists in the cheesy state. Cheesy matter, wherever found, in the shape of a little lump or not, is the tubercle of Bayle. He called that tubercle which Baillie had called scrofulous matter.

Bayle did not, and could not, overlook the fact that the lungs sometimes contain little nodules which are translucent. He would not call them tubercles because they lacked his note of tubercle, opacity; he called them granulations. Granulations are never opaque. And so, between tubercles and granulations he drew an excessively strong distinction.

It was not long before Laennec (1819) reunited what Bayle had put asunder, by showing that granulations at length became opaque. And, therefore, he enlarged the definition of tubercle, so as to make it include, not only actual, but also potential cheesy matter. Thus Laennec's tubercle acquired a most inclusive pathological meaning. Moreover, he remarked that tubercle sometimes involves large, irregular tracts of tissue, a condition which he distinguished by the name of tuberculous infiltration. Each of these forms, the nodular and the infiltrated, he subdivided into three—the transparent, the semi-transparent, and the opaque or cheesy. Hence six forms of tubercle in all—three nodular, namely, the transparent, or Bayle's granulations, the semi-transparent or miliary, and the opaque or crude yellow tubercle; three diffused, namely, the transparent or gelatiniform infiltration, the grey or semi-transparent infiltration, and the yellow or opaque. Laennec's descriptions relate especially to the lungs of adults. But the structure of the lungs makes the study of tubercle singularly difficult in them, and it is easy to note that our debates concerning tubercle in general show an unconscious leaning towards pulmonary tubercle in particular. The writer does not say that this is wrong; we feel that if we could master tubercle in the lungs the rest would soon follow.

Laennec's unit began to be broken up when men set themselves to discover the seat of tubercle. Carswell (1838) proved, what Broussais had guessed, that crude tubercle was often formed within the cavity of the pulmonary air-sacs. Thomas Addison (1845) went much further. He began by examining genuine pneumonia, which he found to have its original and essential seat in the air-cells of the lungs, and the ordinary pneumonic deposits are poured into these cells. And when he, like Carswell, found this to be the chief seat of Laennec's crude yellow tubercle and grey and yellow tubercular infiltrations, he declared that, if called upon to give an expressive name to these lesions, he would venture to designate them scrofulous pneumonia. The case was altered with respect to the granulations; these he found to be seated in the delicate filamentous tissue which forms the slight filmy parietes of the air-cells. Let it be understood that Addison's criterion of tubercle lay in its formation in the septa of the air-sacs; he denied the criterion to be cheesiness, and thus, in matter of fact, his use of the word tubercle was almost the exact contradictory of Bayle's. Addison revived in some degree Baillie's scrofula. The other forms of Laennec's tubercle, Addison conceived to be inflammatory exudation, mingled or not with his own true tubercle. It seems as if the naked eye could not carry us much farther.

Stage III.—About this time the microscope began to be used for examining healthy and diseased tissues. Cheesy matter being commonly deemed the most characteristic form of tubercle, men naturally supposed that the microscopical characters of tubercle would be found in cheesy matter. Tubercle being thought, moreover, to possess perfectly distinct naked-eye characters, it was expected that its minute structure must likewise be peculiar and distinct. And thus it came to pass that Lebert (1844) found certain bodies in cheesy matter which he believed to be characteristic of tubercle, and which he called tubercle-corpuscles. These corpuscles, not being found in the transparent granulation, some persons went so far as to deny its tubercular nature, and so revived Bayle's doctrine, in all its severity, upon a microscopical platform. But William Addison (1849) came to a very different conclusion respecting the characters of pulmonary tubercle. He repeatedly examined with the microscope the material deposited in the air-cells of the lungs in pneumonia, and compared its characters and appearance with that forming a tubercle, without being able to detect any more essential or specific difference between them than exists between purulent matter recently excreted and that of an old chronic abscess. This was a microscopical confirmation of Thomas Addison's doctrines. Virchow (1850) arrived at the same opinion, namely, that there was nothing characteristic of tubercle in cheesy degeneration. For instance, nowhere is the cheesy degeneration better seen than in the enlarged glands of scrofula; yet, examine these glands before they become cheesy, and nothing more (so Virchow said) than a simple hyperplasia will be found, and no new formation. On the other hand, examine tubercle before it becomes cheesy, examine the transparent granulations, and it will be found to possess a distinct lymphatic character. But granulations are formed in the connective tissue; hence they are heteroplastic. So that Virchow's tubercle signifies a heteroplastic lymphoma. The characteristic tubercle is not opaque, but transparent; in this respect Virchow's doctrine was the exact opposite of that taught by the French school. The criterion of tubercle with him is not cheesiness but heteroplasia. Of late years both parts of Virchow's definition have been assailed: first, the connective tissues which are infested by tubercle have been shown to possess in many places a true lymphatic character, so that tubercle, if a lymphatic growth, may be simply hyperplastic as well as heteroplastic; next, the lymphatic character of tubercle has been put in question by the investigations of Langhans and others. Thus Virchow's distinction between tubercle and scrofula becomes untenable; but we will postpone further discussion of these matters for the present.

Stage IV.—The results of experiment upon living animals, or what is commonly called the inoculation of tubercle, will be narrated at the end of this article. Enough to say in this place that most important changes in the doctrines of both tubercle and scrofula have been largely due to the experimental pathology of the last fifteen years.

Here ends the preliminary historical sketch. Now we will inquire into the present state of opinion concerning the characters of tubercle.

I. Concerning the structure of single tubercles.—The formation of tubercle begins at distinct foci. The primitive tubercle is a microscopic body. W. Addison (1849) taught that it consists, in greater part, of corpuscles, like blood-leucocytes, or like the corpuscles of lymph and of pus. Rokitansky (1855) showed that giant or myeloid cells are sometimes found in tubercle. Virchow (1863) taught that tubercle has a more histioid or tissue-like structure, which, on the whole, resembles most the tissue of a lymphatic follicle; so that, in the case of the spleen, tubercle is not always easily distinguished from a Malpighian body. In a tubercle there are corpuscles imbedded in a reticulum. The corpuscles are round; and most of them are like lymphatic corpuscles, smaller than blood-leucocytes; some, however, are larger, it may be twice or thrice. The corpuscle is colourless, translucent, slightly granular, and easily broken up. In the fully developed cell there is a single nucleus, small, tolerably homogeneous, often shining. The larger cells contain two, three, or even as many as twelve nuclei. The reticulum consists of a fine network of connective-tissue fibres. When vessels are present in the tubercle, they are not new-formations, but only remnants of the tissue in which the tubercle has been formed. According as the cellular or the fibrous element of the tubercle predominates, it may be called cellular or fibrous tubercle, the former being more common. The fibrous element sometimes predominates so much that the tubercle can be distinguished from a small fibroma only by a concurrence of the more common cellular form, or by a tendency to undergo the further changes of tubercle, especially the cheesy change. In the fibrous tubercle there are often found large, roundish, epithelioid cells, with large oval or round, sharply-defined nuclei. From this description it will be seen that Virchow recognised lymphoid, epithelioid, and myeloid or giant-cells, among the elements of tubercle. Langhans (1868) was the first to lay much greater stress upon the giant-cells; he found them to be an almost constant element of tubercle in any part. He believed that the tubercular giant-cell had characters proper to itself, namely, a finely

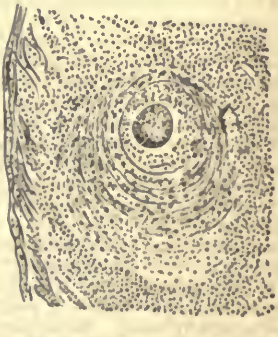

FIG. 100. A tubercle in a lymphatic gland: in the upper third, a large giant-cell (with peripheral nuclei); margin of normal follicular tissue round the tubercle; on the left, the capsule of the gland and cortical lymph-sinus. × 60. (*After Creighton.*)

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granular protoplasma, and nuclei of equal size, peripheral, and arranged in radiate fashion. In cellular tubercle, the epithelioid cells are arranged around the giant-cell. In fibrous tubercle a giant-cell is always present at the very centre. Wagner (1871) described tubercle under the name of tubercular (*tuberkelähnlich*) lymphadenoma, the structure being the same as that of a lymphatic follicle (namely, lymphoid corpuscles, and many nuclei almost destitute of surrounding protoplasma, imbedded in a fibrous reticulum) and in the middle of each tubercle, a giant-cell. Schüppel (1871), who devoted himself chiefly to tubercle of the lymphatic glands, considered the gigantic cell to be an essential (though not peculiar) element of tubercle. A primitive tubercle consists of a central giant-corpuscle, that is to say, a mass of protoplasma of very varied form, spherical, flat, or elongated; the edges even, or provided with more or fewer processes; more or less granular; and containing a large number of nuclei, to be reckoned by the score, even as many as two or three hundred. Around this giant-cell lies a zone of epithelioid cells, which make up the greater part of the tubercle. They are very delicate, easily broken down, and the fact that tubercle has been supposed to consist chiefly of lymphoid corpuscles is due to the setting free of the epithelioid nuclei, which have been mistaken for leucocytes. Lastly, true lymphoid corpuscles are scattered through the tubercle, filling up the interstices between the other cells as it were. In fibrous tubercle there are no epithelioid cells, a fact which Schüppel believes to indicate an arrest in the growth of the tubercle at an early stage. Supporting all these cells, there is a reticulum like that of lymphadenoid tissue. These primitive tubercles contain neither blood-vessels nor lymphatics. Friedländer (1874), with especial reference to these giant-cells, very truly insists that they are by no means peculiar to tubercle; on the contrary, they are found in a number of other structures, both healthy and morbid. Moreover he maintains that there are no distinguishing characters in the giant-cells of tubercle. What has been considered the reticulum of a tubercle, Friedländer asserts to be the result of the hardening processes employed in the preparation of the microscopical specimen; in the fresh state there is nothing but a small quantity of amorphous intercellular matter.

II. **Concerning the origin of tubercle.**—William Addison believed that the lymphoid corpuscles of tubercle were the result of exudation from the blood, through the walls of the vessels. Virchow taught that tubercle proceeds from a proliferation of the fixed corpuscles of sundry tissues, especially the connective-tissue and its allies, namely, marrow, fat, and bone. Hence tubercle is essentially heteroplastic, that is to say, lymphatic tissue is formed in parts where it does not naturally exist. But is there, then, no such thing as tubercle of the lymphatic structures? This is a troublesome question for Virchow. However, he does not deny that tubercle may be found in lymphatic glands; he supposes that it is formed, not in the follicles themselves, but in the connective-tissue trabeculæ which support them; also, that sometimes an adventitious connective-tissue springs up in the gland in consequence of chronic inflammation, and that the tubercle grows in this new tissue. Yet Virchow was not without misgivings respecting his doctrine of the heterology of tubercle, because he saw the close relationship which exists between connective and lymphatic tissues. He pointed out (1856) the frequency with which tubercle is seated in the outer coat of the small blood-vessels, and especially those of the cerebral meninges. Now Robin (1855) and His (1865) showed that this outer coat, or adventitia, is a lymphatic tissue. Neumann (1868) showed that marrow is a lymphatic tissue. In this way, fresh difficulties arose with Virchow's heteroplastic doctrine. In fact, the opposite opinion gained ground, that tubercle is commonly hyper- or homœoplastic. Wilson Fox (1868) and Sanderson (1868) held that it is very often nothing but a hyperplasia or overgrowth of pre-existing lymphadenoid tissue. Lymphadenoid tissue has been found to be much more extensively present in the healthy body than Virchow thought; for instance, in the submucous tissue of the whole alimentary canal; in the conjunctiva; around the smaller bronchia; around capillary tufts beneath the epithelium of the pleura and peritoneum; around the smaller arteries in many parts, such as the pia mater, liver, spleen (constituting the Malpighian bodies), and choroid; besides the marrow, spoken of before. And all these are favourite seats of tubercle. So much for the lymphadenoid tissue as a seat of tubercle. Klebs (1868) maintained that tubercle of the serous membranes arises within the lymphatic vessels, by a multiplication of their epithelium. And Rindfleisch (1871) describes, under the name of lymphangitis tuberculosa, a kind of fibrous tubercle often present around phthisical cavities. Each tubercle consists of a dense fibrous capsule, within which lie concentric layers of spindle-shaped, anastomosing cells. The tubercles are, in fact, developed from lymphatic vessels, by a metamorphosis of the endothelium and outer tunic; the remnant of the lumen of the vessel may often be found in the middle of the tubercle. Last of all, a fibrous sclerosis of the whole takes place. Aufrecht (1869) supposed that tubercle was formed around the lymphatics, and was therefore a perilymphangitis. But Sanderson declares that Klebs and Aufrecht mistook veins for lymphatics, and that the perilymphangitis of the latter is a hyperplasia of the lymphatic sheath of blood-vessels. Wagner (1871) leaned to the belief that tubercle (his lymphadenoma) is always heteroplastic, even when it occurs in parts which naturally possess a certain quantity of lymphadenoid tissue. And Rindfleisch (1871) teaches that the lymphoid cells of tubercle do not come directly from the blood, but from proliferation of the fixed cells of connective-tissue; the endothelium of blood and lymphatic vessels, the epithelium of serous membranes, lungs and kidneys, and even the muscle-cells of the smaller bronchia and vessels, undergoing a tubercular metamorphosis. Schüppel (1872) reduces the question to the origin of what he deemed to be the most important part of tubercle, namely, the giant-cell. It arises, he thinks, within a blood-vessel. Masses of molecular matter, very tenacious and adherent, grow up in small blood-vessels (capillaries or small veins), and become bigger and bigger, until the vessel is quite choked, or even distended at the spot. At first there are no nuclei in the protoplastic mass, but afterwards they begin to appear; and their number is proportionate to the age of the corpuscle. Where the nuclei come from is uncertain. The epithelioid cells next appear around the giant-cell, and are most likely derived from processes of the giant-cell. The lymphoid cells come from the cells of the tissue in which the tubercle is formed. The reticulum, in chief part, is a neoplasm; it grows with the multiplication of the cells, and is always connected with the gigantic corpuscle. So soon as the giant-cell becomes surrounded by other cells, the wall of the blood-vessel disappears. Other authorities differ from Schüppel with regard to the origin of the giant-cell: some supposing it to be formed from the endothelium, some from blood-leucocytes, and some from free protoplasm. And here the question rests at present.

III. Concerning the growth of tubercles. The primitive tubercle increases in size until it becomes visible to the naked eye. The enlargement is brought about by the formation of fresh tubercular foci around the original focus; so that when six or more of the primitive tubercles become agglomerated into one body, it becomes visible as a small nodule (tuberculum). Sometimes the agglomeration does not assume the nodular form, but is diffused and of irregular shape; this is called an infiltration. The difference between nodular and infiltrated tubercle is merely a naked-eye difference; whether the confluent tubercles retain the nodular shape or not, the primitive tubercle is always a tuberculum. 1. *Nodular tubercle* corresponds to most of Bayle's granulations, and Laennec's miliary tubercles, which were spoken of before. The epithet miliary is much older than Laennec, and has lost its original etymological meaning. Miliary tubercle may or may not be of the size of a millet-seed. Tubercle the size of millet-seed may or may not be miliary. All that is now meant by miliary tubercle is a small nodule, roundish, seldom larger than a hemp-seed, almost colourless or greyish, consistence almost equal to that of cartilage, and either quite transparent or opalescent. Lastly, miliary nodules may or may not be tubercular. Miliary tubercle must be distinguished from other small nodular neoplasms; minute disseminated carcinoma and sarcoma, lymphosarcoma, leukæmic nodules, small fibromata. The diagnosis depends upon the discovery of more definite lesions in the same body, and upon the microscopical structure. In the lungs, miliary semi-transparent nodules are sometimes wholly pneumonic in character. The peribronchitis of Virchow possesses, according to Wagner, a lymphadenoid structure, and may therefore be considered a tubercular lesion. 2. *Infiltrated tubercle*, when present in the lungs, corresponds with much of Laennec's gelatiniform and grey infiltration. The gelatiniform infiltration may often be seen surrounding nodular tubercles, in cases of acute pulmonary tuberculosis. In the liver, tubercular infiltration runs along the capsule of Glisson between the lobuli. In the cortex of the kidney, it appears as streaks between the bundles of tubuli, or as ill-defined roundish patches. Tubercle, not nodular, often may be seen alongside the small arteries in the cerebral meninges. Wagner describes a diffuse lymphadenoma (tubercle) of the pleura, which is indistinguishable by the naked eye from chronic pleurisy; and even the microscope shows all stages of transition between lymphadenoid and granulation tissue, in these cases. A similar diffuse lesion occurs in the mucous membranes.

IV. Concerning the lesions which surround tubercle.—First, there is the mechanical effect of pressure. Next, the lymphatics and juice-canals around are widened and filled with chylous stuff containing a few corpuscles. Tubercle is also commonly associated with surrounding hyperæmia, and with inflammatory exudations in the neighbourhood. These secondary lesions are well seen in the serous and mucous membranes. Pleurisy, peritonitis, pericarditis, local or general, are sure to follow upon tuberculosis of the respective membranes. In the mucous membranes, hyperæmia and catarrh are the necessary results. But in the tissues which are themselves undergoing transformation into tubercle an obliteration of the blood-vessels proceeds very quickly. Tubercle, wherever formed, is non-vascular; the only approach to vascularity is when tubercle surrounds arteries or veins without closing them.

V. Concerning the metamorphosis of tubercle.—Sooner or later, the tubercles, which have now been described, undergo sundry changes. These changes sometimes take place very quickly, certainly within two or three weeks from the formation of the tubercle. On the other hand, tubercle may remain unchanged for a long time, even for two or three years, as Schüppel's observations upon one case seem to prove. There are two kinds of metamorphosis—the fibrous and the caseous, and they correspond to the two kinds of tubercle which Virchow describes, the fibrous and the cellular. 1st. *The fibrous metamorphosis* is by far the less common. The reticulum of the tubercle becomes greatly hypertrophied, so as to constitute a dense intercellular substance, interspersed with a few small spindle-shaped nuclei. The cells of the tubercle undergo the caseous change. The result is either a small fibroma with a cheesy centre (which may afterwards calcify), or a simple fibroma, the cheesy matter being wholly absorbed. In the writer's opinion, there is reason to believe that much larger tracts of tubercular infiltration may undergo the fibrous metamorphosis—may cicatrise, in fact. Be this as it may, the fibrous condition, when once attained, is permanent and final. Friedländer (1873) denies the fibrous metamorphosis altogether, and declares that it proceeds from the tissue around the tubercle, and not from the tubercle itself, which must caseate. 2nd. *The cheesy metamorphosis* is very much more common. All parts of the tubercle, first the cells and afterwards the reticulum, become infiltrated with oily molecules. This change begins in the very centre of the primitive tubercle. To the naked eye minute white specks appear; they become larger and more numerous, and at last coalesce. The oily change is incomplete: many of the cells simply lose water, dry up, and shrivel; and in this state they constitute the tubercle-corpuscles of Lebert. It is this addition of partial desiccation which makes cheesy degeneration differ from simple fatty degeneration. But why tubercle should take on the cheesy metamorphosis cannot be explained: the deficient supply of nutritious juices will not alone meet the case. The cheesy change usually begins before the tubercle has reached the size of a millet-seed. But sometimes much more minute granulations degenerate, and to this, the very smallest cheesy tubercle, Rilliet and Barthez have given the name of tubercular dust. The change begins much more quickly in generalised than in local tubercle. Large nodules, formed by the aggregation of smaller cheesy nodules, may reach the size of a peeled horse-chestnut. This caseous tubercle is the crude yellow tubercle of Laennec, and *the* tubercle of Bayle. Before Bayle it was called scrofulous matter, and looked upon as wholly a deposition from the blood. Unlike the fibrous metamorphosis, the cheesy change is not permanent: five further changes may occur. 1. Softening: the whole caseous mass breaks down into a molecular detritus of oily and albuminous particles. When the supply of blood allows of it, these molecules float in a serous fluid, which to the naked eye looks purulent: curdy pus, or a tubercular abscess. The abscess, when superficial, bursts, and leaves a tubercular ulcer. When all the caseous matter has been cast off the ulcer may heal, and so the local disease come to an end. But usually the ulcer steadily enlarges, by the perpetual production and destruction of tubercles around it: this is phthisis, in the anatomical sense of the word. The cicatrix-tissue of tubercle has a tendency to contract strongly. 2. Capsulation: sometimes a capsule of dense fibrous tissue will form around the cheesy matter, whether softened or not. This is the encysted tubercle of Bayle. 3. Calcification: the oily particles become gradually replaced by carbonate and phosphate of lime. The different degrees of calcification are denoted by such words as mortary, chalky, stony. In itself, it is a permanent change; but ulceration may occur around, and thus the petrified tubercle be discharged. 4. Absorption no doubt occurs to some degree. Virchow believes that cheesy glands may wholly disappear in this way. If there be truth in the current doctrine respecting the infectiousness of tubercle, absorption is, of all the terminations, the least to be wished. 5. Sloughing in mass may occur. The cheesy nodule becomes a sequestrum, which is gradually loosened by surrounding suppuration, until it separates, and lies loose in a cavity. The cheesy metamorphosis cannot be by any means looked upon as being peculiar to tubercle, although no doubt most common in tubercle. Simple inflammatory exudations, cancer, syphilitic gummata, lymphosarcoma, all sometimes undergo the same change.

VI. **Concerning the tubercular diathesis and dyscrasia.**—It was not possible that careful examinations of dead bodies should be made, without two prominent characters of tubercle being noted; namely, the fact that certain tissues, organs, or persons are liable to tubercle, and certain others not so; also the frequency with which tubercles are disseminated over a number of organs in the same subject. Hence arose the doctrine of tubercular diathesis and dyscrasia.

1. *Tubercular diathesis* is a phrase first used by Bayle (1803), and means a particular disposition to the generation of tubercles. The contradictory word to diathesis is immunity, or privation of diathesis. The tubercular diathesis relates to tissues, organs, or persons. (*a*) Tissues: it has been already shown that the connective tissues (and especially the variety lymphadenoid tissue) are particularly predisposed to tubercle. The other tissues—namely, the epithelial, and the higher, muscular and nervous tissues, may be said to possess complete immunity. Some would deny this last assertion, but their opinions have been narrated before, and need not be repeated here. Of late years tubercles have been found in sundry morbid tissues. Köster (1869), in cases of scrofulous disease of joints, found innumerable tubercles imbedded in the granulations; not only in those which spring from the synovial membrane and bone, but also in those which line abscesses or sinuses. Friedländer (1873) declares that, under these conditions, tubercles are never absent. They are visible, even to the naked eye, as whitish or greyish specks, surrounded by a ring of enlarged capillaries. He finds tubercles in scrofulous ulcers of the skin, and in the walls of scrofulous abscesses, cutaneous or connected with caries of bone. Köster has seen tubercles in chancrous and cancerous ulcers; Friedländer in the stroma of a cancer recurrent after operation. This local tuberculosis (if it be tuberculosis) has very little disposition to become disseminated; the health of the patients remains good; the tubercles often remain for a long time without becoming caseous. The microscopical structure of these tubercles is identical with that which Schüppel has assigned to tubercle of the lymphatic glands, and which has been already described. (*b*) Organs: the serous membranes (pleura, peritoneum, pericardium) are a very frequent seat of tubercle. Endocardium, very uncommon. Dura mater, not very common. Pia mater, very common. Ependyma, uncommon. The mucous membranes (alimentary, respiratory, genito-urinary), very common. Lymphatic glands, most common. Lungs, liver, spleen, kidneys, common. Suprarenals, not very common. Testes, not uncommon. Prostate, not common. Heart, not very common. Brain and spinal cord, tolerably common. Salivary glands and pancreas, uncommon. Ovaries, voluntary muscle, and thyroid, very uncommon. With regard to the skin, tubercles have been found around scrofulous ulcers; and Friedländer (1872–4) has assigned to lupus a microscopical character identical with that of tubercle. The diathesis of organs can be partly explained by the diathesis of tissues. Lymphatic organs are predisposed; and hence we can understand why the spleen is prone to tubercle whilst the thyroid is not; also why the intestines should be more liable than the stomach, because they are much richer in lymphatic structures. But it is not easy to say why the connective tissue of the ovaries, the mammary glands, and the salivary glands, should be indisposed to tubercle. Partly,

perhaps, it is an error of observation; partly, perhaps, it is explicable by the supply of blood and juices. (c) Persons: the tubercular diathesis, with respect to persons, is met with only in the scrofulous. No age is exempt from the possibility of tubercles; they are especially common in early life, and have been found even in the fœtus.

2. *Tubercular dyscrasia.* The word dys-crasia signifies a mis-composition, or a qualitative lesion. Strictly speaking, there may be a dyscrasia of any tissue, but the word has come to be applied to qualitative lesions of the blood only. The dyscrasia, which is believed to exist in tuberculosis, and to be peculiar to it, is called tubercular. Bayle was the first to note the frequency with which tubercle implicates a number of organs in the same subject and at the same time. Laennec remarked that the tubercles often seem to have been developed in distinct crops: the age of the tubercles being judged of by the degree of their degeneration. So that he came to speak of primary and secondary eruptions of tubercle. He noted that a secondary eruption often seemed to follow the softening of the primary tubercle. And this he deemed to indicate an actual and peculiar change in the juices of the part, a local dyscrasia: as if the primary tubercle were the source of an infection. It is then the multiple eruption of tubercle which suggests the notion of a dyscrasia. For the matter stands thus. The multiple eruption is either protopathic or deuteropathic. Either many organs simultaneously and spontaneously generate tubercle, or they are simultaneously subjected to a common tuberculising influence. Of the two hypotheses, the latter is certainly the more probable. And if so, it is not asking much to suppose that the common cause exists in the common bond of all organs and tissues—that is to say, the blood. And granting this, the further question arises: how does the blood acquire this tuberculising property? Is it protopathic or deuteropathic? Is it a spontaneous generation of the blood, or is it derived from some other source? Now, the prevailing theory of dyscrasiæ asserts that every dyscrasia is due to the constant afflux of morbid material derived from foci external to the circulating blood itself: in other words, dyscrasiæ are always secondary to a local lesion. The justification of this doctrine is believed to be found in certain dyscrasiæ which seem to be less obscure than the tubercular; for instance, pyæmia and melanæmia. Admitting that, in the case of the tubercular dyscrasia also, there is a necessary local antecedent lesion, we have next to inquire what this lesion is, both in itself and in its relation to the blood.

First, concerning the *nature of the lesion* which infects the blood. Dittrich (1853) taught that detritus, derived from the breaking-up of tissues of any kind, and entering the blood, would produce the tubercular dyscrasia. But to this doctrine it is justly objected that detritus, the result of degenerations, is often absorbed and is not followed by tubercle. There must be something peculiar to the detritus which sets up tubercle; what we may call a tubercular virus. Buhl (1857) held that this virus proceeded from the sundry forms of Laennec's tubercle alone: that is to say, from undegenerated tubercle, and from any kind of cheesy matter. He remarked, what is very true, that it is exceedingly uncommon to find disseminated miliary tubercle, without also finding cheesy matter somewhere, especially in the bronchial and mesenteric glands, and in the lungs. And no one would deny that the formation of the cheesy matter must have preceded, in point of time, the formation of the miliary tubercle. Against Buhl's theory there lie three objections, but they cannot be said to overthrow the theory by any means. Cheesy matter often occurs without the tubercular dyscrasia; but this proves nothing more than that cheesy matter sets up the dyscrasia under certain conditions only, or that all cheesy matter will not set up the dyscrasia. In very rare cases of general tubercle no cheesy matter has been found; but it is not denied that recent undegenerated tubercle may infect. The last objection is this: the tubercular dyscrasia implies the tubercular diathesis; and it is not surprising that the signs of former tubercular disease, in the form of cheesy matter, should be found in persons who have died from a more general tuberculosis; but this objection will lose much of its force when we have discussed our second topic, which we will now proceed to do.

The *relation between the local lesion and the blood*, or the mode in which the tubercular dyscrasia is developed. There are three possible ways by which the blood may become contaminated. First, by a lesion of some part of the sanguiferous system: but this, so far as the writer knows, has never been supposed the source of tubercle. Secondly, by an absorption of the virus by the blood-vessels: nothing can be said for this supposition or against it. Thirdly, by means of the lymphatic system: a source of infection which is highly probable. Experience seems to justify the following theory. The local tuberculising lesion first of all infects its immediate neighbourhood, through the juice canals. In serous membranes, mucous membranes, the lungs, and the brain, it is very common to see what may be called the mother tubercle surrounded by a number of daughter tubercles. The lymphatic glands are next infected; and when they have become tubercular, they pour tubercular virus into the blood. The blood conveys the virus to all parts of the body, and thus disseminates the tubercle. This theory is satisfactory on the whole, but it takes the primitive local lesion for granted. When we ask for the cause of the specific local lesion we are thrown back upon the tubercular diathesis, which we know only in its effects, not at all in itself, and not much more in its antecedents.

VII. Concerning the experimental pathology of tubercle.—Passing over the earlier experiments of Cruveilhier, Lombard, Erdt, and others, we will come at once to Villemin (1865), who was the first to draw general attention to the present topic. He inoculated rabbits with fresh tubercle, both transparent and opaque; that is to say, he inserted small pieces of tubercle into an incision made through the skin of the animals. When the rabbits were killed, about a month afterwards, an abundant crop of tubercles was found in many of the viscera. On the other hand, Villemin proved that rabbits are not subject to spontaneous formation of tubercle. He concluded that tubercle contains a peculiar virus, which can be reproduced in the body. Since Villemin's time many pathologists have worked at the artificial production of tubercle. The results of their work may be conveniently arranged under six heads.

1. Animals used in the experiments. In rabbits, guinea-pigs, oxen, sheep, goats, and monkeys, artificial tubercle is easily generated; in cats and dogs, not easily. Villemin failed in his attempts to inoculate a cock and a dove.

2. Material inoculated. Villemin used fresh tubercle. But soon afterwards (1867) Andrew Clark and Waldenburg succeeded in rendering rabbits tubercular, by inoculating them with materials other than tubercle. It was next found that not only animal tissues, but even the vegetable, such as a cotton seton or a piece of cork, could set up tuberculosis. And, lastly, the fact was discovered that a simple wound, into which nothing was inserted, would suffice to generate tubercle in rabbits, guinea-pigs, and certain other animals. However, Sanderson (1868) showed that, of all the means for producing artificial tubercle by inoculation, none is more certain or more active than the material taken hot from the diseased glands of a living animal already infected. The dose required is almost infinitesimal. If a diseased gland is squeezed into a little distilled water in a capsule, and the slightly turbid liquid injected, results are certain. Both Sanderson and Wilson Fox (1868) discovered that when non-tubercular matters are inoculated, they become encapsuled by cheesy matter formed beneath the skin; so that the difficulty of explaining the subsequent tuberculosis is not so great as it seems at first. The tubercles follow, not the material inoculated, but the inflammatory products which surround it. Cohnheim inferred that the infectious matter was always caseous pus. But the inflammatory products around the wound of inoculation are not always cheesy, although they are usually so. Wherefore we must conclude that the infectious virus, which excites the general tuberculosis, is not introduced from without, but is generated by the animal itself; that the animal must possess a tubercular diathesis; and that, given the diathesis, any kind of inflammation, set up in any way, may call forth tuberculosis.

3. Manner of introducing the exciting substance. Villemin inoculated the tubercle. He also succeeded by injecting a watery suspension of tubercle into the air-tubes. Feltz (1867) injected cheesy detritus into the right side of the heart, and produced, in the lungs, embolic nodules which underwent caseous degeneration. Injections into the left side of the heart caused similar changes in other viscera, especially the brain. Lebert and Wyss obtained the same results from injections into the veins. Sanderson injected the serous cavities. Chauveau (1868) found that infectious matters may be introduced into the body through the alimentary canal: he rendered calves tubercular by feeding them with small quantities of tubercle, or with muscle, milk, or sputa of a tubercular animal. Lastly, some have suspected that infective particles may be inhaled into the lungs.

4. Lesions produced. The results of inoculation beneath the skin of guinea-pigs have been well described by Wilson Fox. (*a*) The material inserted becomes surrounded by dry cheesy stuff, which is shown by the microscope to consist of dried-up detritus, rather than true puriform cells. (*b*) Around the cheesy mass are a number of small round granulations, some transparent and some opaque, in size from that of a poppy-seed to that of a hemp-seed. These granulations consist of many nuclei, imbedded in a homogeneous substance, together with some large epithelioid cells. (*c*) Indurated cords reach, beneath the skin, from the seat of injury towards—or to—the nearest lymphatic glands. These cords are sometimes cheesy in the centre. Microscopically they consist of strings or rows of cells and nuclei, like those of the granulations, contained in a limitary membrane. These cords are probably altered lymphatics. (*d*) The next change is found in the associated lymphatic glands. They are enlarged to twice or thrice their natural size, and are also apparently much increased in number—that is to say, very small glands become visible. On section, they look semi-transparent and confused in structure: scattered through them are spots and streaks of cheesy degeneration. The microscope shows a great increase in the number of the natural lymphoid corpuscles, and some larger epithelioid cells. (*e*) The lungs are next most frequently affected. They contain scattered granulations of different sizes, from the minutest speck to the size of a hemp-seed, or even larger; semi-transparent and firm, with a cheesy centre, sometimes softened. A distinct connection with the air-tubes and vessels can often be made out, the granulations being seated in the peribronchial or perivascular sheath; but sometimes they have no particular relation to either. From these granulations proceeds an infiltration of the septa of the air-sacs: and concurrently with this change, the capillaries collapse and cease to be permeable by blood. The bronchial glands also are affected, in the same manner as described above. (*f*) The next most important changes are in the liver. It is much increased both in size and weight, in consequence of a diffuse infiltration of the capsule of Glisson and the tissue between the acini, with small corpuscles (such as before described) imbedded in a fibrous network. The new tissue looks semi-transparent and glistering: scattered through it are spots of cheesy change. Here and there the lesion tends to assume the nodular form. The proper liver-cells degenerate and disappear. (*g*) The spleen is enlarged. Nodules, transparent or cheesy, and transparent diffuse infiltrations, are scattered through it. (*h*) In the agminated and solitary follicles of the intestines are sometimes found white or caseous nodules, or even ulcers. The stomach is unaffected. The lymphatic glands in the mesentery and in the hilum of the liver are usually affected. (*i*) Ascites is common, and probably due to the state of the liver. (*j*) In the omentum numerous granulations are often found, both around the small vessels, and also in the tissue where there are no vessels.

Sanderson found that when the serous cavities are injected with tubercle the membranes become studded, in two or three weeks, with granulations, small, but visible to the naked eye; and, for the most part, mere overgrowths of lymphadenoid tissue previously existing beneath the epithelium. The lungs undergo the change described by Wilson Fox, and also a pneumonic change, consisting in a filling of the air-sac with roundish cells, like those which are always found there in small numbers.

5. Nature of these lesions. The great majority of pathologists are of opinion that these lesions, thus artificially produced in the lower animals, are the same as those which we call tubercular in man. On the other hand, Friedländer holds that these artificially-produced nodules do not possess the structure of true tubercles, to which he holds a giant-cell to be essential. In his opinion, the nodules are nothing but disseminated chronic inflammatory nodules, with a disposition to caseate. He declares that in the lungs the lesion consists in nothing but miliary pneumonia, an assertion which is directly contrary to the experience of Wilson Fox and Sanderson. Friedländer refers to Sanderson's views upon the infective product of inflammation. But Sanderson does not draw so excessively sharp a distinction between tubercles and chronic inflammatory nodules as Friedländer does. Sanderson's doctrines deserve the closest attention. They may be summed up as follows: An inflammation which is more or less exactly limited in duration and extent by the original limits of the injury which has caused it, may, with scientific precision, be designated a simple or normal inflammation. An inflammation which spreads and endures beyond the direct and primary operation of its cause, which induces similar inflammations in other parts, and disorders the functions of the whole body, has in it something beyond the effects of the injury, and may properly be called infecting. In the latter case, material must have been discharged from the original focus, either by the absorbents or the veins, into the circulation. The remote effects of this infecting inflammation consist, partly in the springing up of new foci of inflammation along the course of the infected channels (the anatomical distribution of which secondary foci always distinctly indicates the source from which they have originated), partly in the occurrence of changes in the physical and organoleptic characters of the blood itself, of such a nature as to show that it is impregnated with the infective poison. When, in the lower animals, local infective inflammations are produced, either in the skin or peritoneum by the introduction of irritant substances, two distinct sets of consequences manifest themselves, namely, (1) a chronic disease, exhibiting in all respects the anatomical characters of tuberculosis, and consisting essentially in the overgrowth of certain tissues called lymphatic or adenoid, and in close relation with the lymphatic system; and (2) pyæmia, an acute disease, in which abscesses form. The difference between the rapidly-growing and suppurating nodule of pyæmia, and the slowly-formed caseating granulation of tuberculosis, is one not of origin, or even of structure, but of duration and development. Opinions such as these are held by other eminent pathologists—for instance, Chauveau and Rindfleisch. For a further development of the subject, in respect of human pathology, the reader may refer to the article on SCROFULA.

6. Characters of the virus. Whether these nodules be modified inflammations or not, there can be no doubt of the dyscrasia. But little is yet known concerning the virus. Villemin supposed it to be liquid. Klebs declares that it is soluble in water, but not in alcohol. Waldenburg, Sanderson, Chauveau, and most other pathologists deem it to take the form of minute solid particles.

Klebs, Aufrecht, and Baumgarten describe the virus as being of the nature of a bacillus; Schüller and Toussaint describe it as being a micrococcus. More recently Koch has announced the discovery by him of a specific tubercular organism in tuberculous structures and in the sputa of phthisis. This organism is a slender, rod-shaped, motionless bacillus, which equals in length from one quarter to the whole of the breadth of a red blood-corpuscle. This tubercle bacillus differs from all known bacilli in remaining unaffected by the staining reagent vesuvin. *See* ZYME. S. J. GEE.

TUBERCULAR ERUPTIONS.—This term is applied to eruptions consisting of small prominences of the skin. The use of the expression is somewhat arbitrary, inasmuch as a small tubercle would fall under the denomination of 'pimple,' and a large tubercle under that of 'tumour.' Willan defines tubercle to be 'a small, hard, superficial tumour, circumscribed and permanent, or suppurating partially.' In this definition prominence and bulk alone are regarded; and, as a consequence, in his group of tubercular eruptions of the skin, Willan brings together an incongruous assemblage of superficial growths, wholly discordant in their nature, some being grave and some only trivial, and of which the greater part can only be dealt with under their separate heads. For example, he enumerates as members of this group:—'phyma, verruca, molluscum, vitiligo, acne, sycosis, lupus, elephantiasis, frambæsia;' and omits altogether that very important group of tubercular eruptions which are due to syphilis.

ERASMUS WILSON.

TUBERCULAR MENINGITIS. — A form of meningitis dependent on the presence of tubercle. *See* MENINGES, CEREBRAL, Diseases of.

TUBERCULAR PHTHISIS.—A synonym for one or more of the forms of pulmonary consumption associated with tubercle. *See* PHTHISIS; TUBERCLE; and TUBERCULOSIS.

TUBERCULOSIS.—SYNON.: Fr. *Tuberculisation; Tuberculose*; Ger. *Tuberculose; Tuberkelbildung.*—By tuberculosis is meant the production of tubercle. The anatomical and ætiological aspects of tuberculosis are discussed in the articles on SCROFULA and TUBERCLE. The present article is devoted to the semeiotic aspect of tuberculosis, that is to say, to the signs whereby we discover the tubercular process in the living man.

We lay down two prime distinctions at the outset. First, although tubercle tend to be disseminated more or less widely, yet it commonly affects some one organ more than the rest, so that during life this organ alone seems to suffer. Wherefore tuberculosis is distinguished according to the organ most affected, a rule to which there is but one exception—namely, the form of tuberculosis which does not predominate in any part, which is a disease of the whole substance, which resembles typhus or enteric fever, and which will be described hereafter. Secondly, tuberculosis is acute or chronic; words which we take in their common meaning, without further definition.

In the article on tubercle will be found a list of the organs prone to tubercle. The signs of the corresponding local forms of tuberculosis are described in the appropriate articles. We speak of tubercular pleurisy, peritonitis, pericarditis, meningitis; tubercular disease of the fauces, of the intestines, of the larynx; pulmonary tuberculosis and phthisis; tubercle of the kidneys, of the genito-urinary passages; of the lymphatic glands, of the suprarenals, of the testicles, of the brain, of the skin, of the choroid, and of other parts.

Tuberculosis tends to be chronic. But some of its forms are acute, specially tubercular meningitis, tubercular pericarditis, acute pulmonary tuberculosis, and the typhoid form of the disease.

Acute typhoid tuberculosis.—The signs of this disease may be summed up thus: Fever, and the usual attendants thereof; without signs of local inflammation, or of typhus or enteric fever. Marked by the thermometer, the fever is not high, seldom rising above 103°. The face devoid of expression, pale or dusky. The patient heavy, loth to be disturbed, but answering to the point. Sleep disturbed; much dreaming. Progressive emaciation. Skin dry and harsh, no eruption. Tongue dry, sordes on teeth, thirst. Belly not distended: spleen large. Nausea, vomiting; bowels costive and stools pale, or temporary looseness with yellow stools. Frequent short cough; no expectoration; no physical signs of disease in chest, except, perhaps, of slight catarrh. Pulse frequent and weak. Urine high-coloured. In a case such as this, probability would become certainty if tubercles were discovered in the choroid during life—a lesion which the writer has found after death. Trousseau says that headache more or less severe, and delirium more or less violent, may be present.

The onset is somewhat sudden; the duration, from three to six weeks; and the termination, death. We may suppose that slight forms of the disease end in recovery; but proof is difficult or well-nigh impossible.

Treatment.—The treatment of acute tuberculosis is the same as that of any severe fever; for instance, typhus. S. J. Gee.

TUBULAR.—A peculiar quality of sound, as indicated by its name, either elicited by percussion, or heard on auscultation, in certain conditions. *See* Physical Examination.

TUMOURS.—Synon.: Fr. *Tumeurs*; Ger. *Geschwülste*.

Definition.—In the broadest sense of the word, a tumour signifies *a swelling*, and must therefore include conditions so far apart as a phantom-tumour, a hypertrophied muscle, an abscess, a hernia, or a cancer; but in its more restricted sense its application is confined to *a swelling caused by some form of new growth.*

Classification. — The separation of new growths into benign and malignant, though very useful as an approximate clinical distinction, is not admissible in a scientific discussion. Nor again is one that is founded upon the seat or shape of the tumour sufficiently accurate for the purpose. This arrangement would involve such antiquated terms as parenchymatous or superficial, nodules, infiltrations, fungus-growths, &c. The true classification must depend upon the actual structure, that is, the microscopical character of the growth. Such a classification is the following:—

A. **Tumours composed of normal tissue of the adult human body, or of such a tissue very slightly modified.**—1. Fibroma, hard and soft, including cheloid; 2. Lipoma; 3. Chondroma; 4. Osteoma; 5. Papilloma (warts and corns); 6. Adenoma and glandular hypertrophies; 7. Lymphoma; 8. True Myoma, including myo-fibroma; 9. True Neuroma; 10. Angioma; and 11. Lymphangioma.

B. **Tumours consisting of some modification of embryonic connective tissue,** that is, the *Sarcomas*. 1. Round-celled sarcoma, including glioma; 2. Oval-celled sarcoma; 3. Spindle-celled sarcoma, large and small; 4. Alveolar sarcoma; 5. Mixed sarcoma; 6. Myeloid sarcoma; 7. Myxoma; 8. Osteo-sarcoma; 9. Chondro-sarcoma; 10. Melanotic sarcoma; and 11. Psammoma.

C. **Tumours consisting of a modification of epidermic, epithelial, and secreting-gland structures.**—1. Cancers; and 2. Rodent ulcer. These forms of new-growth are described in special articles. *See* Cancer; and Rodent Ulcer.

D. **Tumours consisting of an inflammatory growth.** — 1. *Simple.* — Granulation-tumours, exostoses, &c. 2. *Specific.*—Depending on syphilis, tubercle, struma, leprosy, glanders, and other conditions.

The inflammatory tumours included under this class do not come strictly within the scope of the present discussion; its various sub-divisions must be sought under the description of the diseases which give rise to them, in the several articles bearing their respective names.

E. **Cysts.**—This division is also dealt with in a separate article. *See* Cysts.

A. **Tumours composed of a normal tissue of the adult human body.**

In this class are included representatives of each of the primary tissues of the adult body. The members of it, therefore, differ widely in structure and appearance, but they are distinguished from those of the second and third classes by one important feature, namely, that though often multiple, they show little or no tendency to return after complete removal—that is, they are essentially *benignant*. To this may be added another less characteristic distinction, namely, that they have, consequently, but little tendency to ulcerate; and that, as a result, if they interfere with life at all, it is by pressure on important organs, or in such an accidental way as by the bleeding which may result from a uterine fibroid, rather than by the production of direct constitutional disturbance.

1. **Fibromata.**—Definition.—Tumours consisting simply of fibrous tissue or some modification of it.

Varieties, Clinical Characters, and Microscopical Appearances.—Fibromata may be divided into *hard* and *soft fibromata.*

a. Soft fibrous tumours.—The soft fibromata are simple masses of connective tissue, occurring in the submucous or subcutaneous tissues, and generally, but not always, more or less pedunculated. In many cases there are overgrown papillæ on the surface; and overgrown and distorted glands of the skin or mucous membrane are often entangled amongst the meshes of the tumour. The *subcutaneous* variety occurs in all parts of the body, but is perhaps most common in the labia majora and the lower limbs; and to it the name of *molluscum fibrosum* has been applied. These tumours often contain a considerable amount of fat, and thus approach the lipomata. They often appear œdematous; and may undergo calcareous or other forms of degeneration. The *submucous* variety includes the simple polypi of the nose and ear. In these the fibrous tissue is somewhat modified; the ordinary connective-tissue cells, oval, oat-shaped, or branched, being imbedded in a more or less copious gelatinous (? mucous) matrix. Such tumours are nearly related, on the one hand, to the myxomata, and are covered by a mucous membrane corresponding to the region in which they occur—ciliated, for example, in the nose (fig. 102), and columnar in the intestine. On the other hand, they often contain in their interior the characteristic glands of the part they affect, and thus approximate to the adenomata. To the naked eye they have a gelatinous appearance. The reader will observe that the varieties of *elephantiasis*, a disease which presents a complex structure, are not included under this heading.

b. Hard fibrous tumours.—These tumours are made up of pure fibrous tissue, but it is very difficult to draw the line between them and some forms of sarcoma. They are firm, and always encapsuled, and often pedunculated. To the naked eye a section is white or pinkish, and presents an appearance as if its component parts were arranged concentrically round a number of points. This appearance is more marked on microscopic examination, which, while it shows this concentric arrangement in bundles that have been cut across, exhibits others which have been divided longitudinally (*see* fig. 101). Hard fibromata occur in many situations: in the subcutaneous tissue, including amongst others the fibrous tumours of the pinna, which are not uncommon in idiots, and some, at least, of that peculiar class of tumours called 'the painful subcutaneous tubercle'; in submucous tissues, including many of the naso-pharyngeal polypi, and some of the fibrous tumours and polypi of the uterus; in connection with the periosteum, including some of the forms of epulis, the so-called fibrous tumours of bone, and according to some authorities, though this is doubtful, some kinds of subungual exostosis; in nerves, including the common neuromata, and bulbous nerves in a stump; and in the intermuscular planes. They are liable to various forms of degeneration; they often calcify; and those in connection with the periosteum may undergo ossification. Some fibrous tumours cause serious danger to life from the position they occupy; it will be enough to cite the cases of naso-pharyngeal polypi, and polypi of the uterus.

Treatment.—Fibromata can only be treated, if interference of any kind be necessary, by complete removal, the nature of the operation depending upon the position of the growth. If completely removed they have no tendency to recurrence.

2. **Lipoma.**—Definition.—A tumour composed of normal adipose tissue.

Varieties and Clinical Characters.—Occasionally more or less local hypertrophies of the subcutaneous fatty layer occur, and merit almost the designation of a tumour; but the true lipoma is a pretty well-defined tumour, made up of a larger or smaller number of overgrown fat-lobules. These are sometimes of enormous size, so that only two or three are found in a tumour of considerable dimensions. The skin presents a very characteristic dimpling, when moved to and fro over such a subcutaneous fatty tumour. The superficial parts of the mass may generally be easily separated from the surrounding structures during an operation for its removal; but the deeper parts, often consisting of smaller lobules, and generally containing a vessel of some magnitude, require more careful enucleation. Fatty tumours are met with in all parts of the body in which adipose tissue is normally developed. The writer once met with a fatty tumour inside the spinal column. They may occur congenitally, but are more common in middle and advanced life. They are often multiple, and are apparently in some cases developed as the result of pressure; and sometimes they are remarkably symmetrical. They involve no danger to life, but are often very painful, as the result of pressure upon cutaneous nerves. Microscopically, the structure is that of ordinary adipose tissue.

Treatment.—Though fatty tumours are said to shift their position, and sometimes to diminish in size spontaneously, they are not to be dispersed by internal remedies or external applications. If necessary, they must be removed by the knife, an operation which, as was mentioned above, is usually easy. It is a remarkable fact that, unless they be completely removed, recurrence is not uncommon.

3. **Chondromata.**—Definition. — Tumours made up altogether, or in great measure, of cartilage.

Varieties, Course, and Clinical Characters.—Cartilage-tumours may be divided into those which grow in connection with a *bone*; and those which are developed in the *soft parts.*

Cartilaginous tumours growing in connection with bone.—These may be again subdivided into those which grow from the surface of the bone—*ecchondromata*; and those which grow from the interior—*enchondromata.* The latter are the simplest form of cartilage-tumours; they com mence usually during the period of adolescence, and affect by preference the fingers and toes, but are occasionally found elsewhere; they are almost always multiple, but never show a malignant tendency; they may reach a very considerable size; and they are generally coated with a thin layer of bony tissue. The *ecchondromata* are developed, as a rule, during a later period of life; are found in connection with any of the bones of the body; and often attain an enormous size. Some of these tumours, to which Virchow has given the name of *osteoid-chondroma*, such as are occasionally found forming elongated swellings in the shaft of a long bone, present a high degree of malignancy, recurring as such in distant parts of the body.

Cartilaginous tumours of the soft parts.—These tumours occur principally in connection with certain glands, and especially in the neighbourhood of the parotid, and in the testicle. It has been suggested that they may originate from some remains of fœtal structures. Rarer situations for such tumours are the submaxillary gland, the breast, the ovary, the lachrymal gland, the kidney, and, it is said, the lung. These tumours are comparatively seldom pure, but are usually mixed with myxomatous, adenoid, or sarcomatous structure; the degree of such admixture determining in great part the benignness or malignancy of the growth.

An account of the so-called *ossifying chondromata* is given under the heading **Osteomata**.

Naked-Eye Appearances.—Cartilaginous tumours vary very much in density; the hardest contain fibrous tissue, and are, in fact, fibrocartilaginous growths; the softest are very soft, and are very closely related to the myxomata; indeed, it may be held that many myxomata are merely varieties of chondroma. Some chondromata soften, either in many parts or in the centre, giving rise to one or more cysts in the interior; the bursting of such may lead to a permanent sinus. Other forms of degeneration are not uncommon, and especially calcification. True ossification is not rare.

Microscopical Characters.—Microscopically the structure often differs widely in different specimens of chondroma, and in different parts of the same tumour; the matrix may be hyaline or fibrous; and the cells round, irregular, stellate, or much-branched (figs. 105 and 106). It will easily be understood that with a soft hyaline matrix and much-branched cells, the appearance of myxoma is very closely simulated.

Treatment.—Bearing in mind the great variety of these tumours, it will be seen that it is impossible to sum up the treatment of them in a few words. The simple enchondromata of the fingers should only be removed to cure deformity or similar inconvenience. As a rule, other forms should be removed as early as possible; but many chondromata spring from regions which are altogether beyond the reach of the surgeon's knife.

4. **Osteomata.**—Definition.—Tumours composed of bone.

Varieties.—If the inflammatory exostoses be excluded, such as those which are found round a joint affected with chronic rheumatic arthritis, or those which depend upon the ossification of a node, we may divide this class of tumours as follows:—

a. Osteomata developed as such on the exterior of a bone, including the ivory exostosis—*periosteal exostoses.*

b. Osteomata developed as such in the interior of a bone—*enostoses.*

c. Pedunculated exostoses.

d. Osseous tumours of *the soft parts.*

e. Osseous tumours produced by the *ossification of other kinds of new growths.*

f. And lastly (though not strictly coming under the same category) the *odontomata.*

a. Periosteal exostoses.—These are irregular bony tumours, appearing usually in adult life; they are directly continuous with the bone from which they spring; and are composed sometimes of cancellous structure, with a thin coating of compact tissue, but much more frequently of denser material. They most often affect the bones of the face, where they produce horrible and distressing deformities: but are also found on the skull, in the meatus of the ear, or, more rarely, on the long bones. From the importance of the neighbouring structures it is, in most cases, impossible to remove them. Some of these tumours are of extreme density, and have hence been called *ivory exostoses*; these, when they affect the upper jaw, their commonest seat, must be distinguished from the *odontomata*, to be presently described.

b. Enostoses.—Enostoses need only be mentioned in order to point out their extreme rarity; but it may be remarked that many of the last-described series of tumours probably spring from the diploë of the cranial bones, and should thus, perhaps, more properly be included under this heading.

c. Pedunculated exostoses.—The pedunculated exostosis, or ossifying chondroma, is a subperiosteal chondroma, with a tendency to ossification, developed in young people, near the junction of an epiphysis with a diaphysis.

Pedunculated exostoses approach the spherical shape, but are sometimes irregular or flattish, and often tuberculated. The peduncle varies in its relative size, the growth being often nearly sessile. On section the tumour shows a layer of periosteum superficially; beneath this is a layer of cartilage, sometimes thick, sometimes almost imperceptible. The deeper part of the cartilaginous layer is calcified, and looks like imperfectly formed bone. The centre of the tumour consists of true bone, with Haversian systems complete, and is directly continuous with the tissue of the bone itself.

The microscopical appearance answers exactly to the structure which is apparent to the naked eye (fig. 104).

Symptoms and Treatment.—These tumours occur most often near the ends of the long bones, but may be found elsewhere; in the scapula, for example. They are often multiple and symmetrical, and if multiple are often hereditary. In certain situations, as, for instance, on the inner side of the knees, they may cause much inconvenience, and for this reason, or from their size, they may require removal. This may be done freely if antiseptic precautions be adopted; otherwise the opening of the cancellous structure of

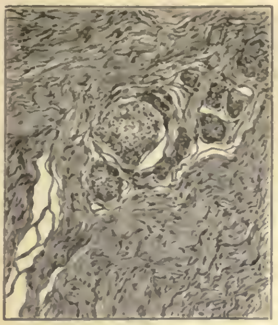
FIG. 101. Fibroma (Neuroma).

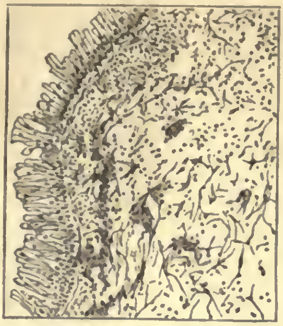
FIG. 102. Polypus of Nose.

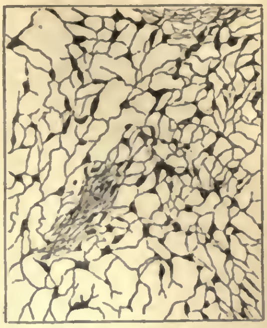
FIG. 103. Myxoma.

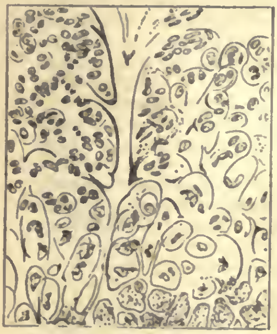
FIG. 104. Ossifying Chondroma.

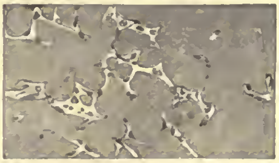
FIG. 105. Enchondroma (of Jaw).

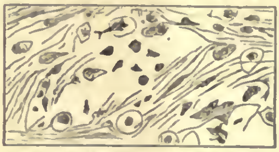
FIG 106. Enchondroma (of Orbit).

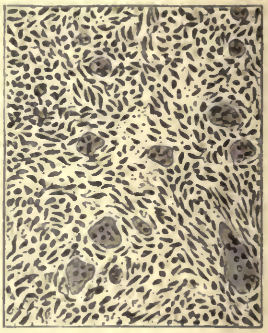
FIG. 107. Myeloid of Jaw.

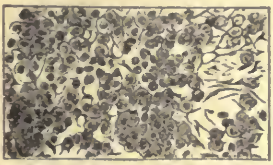
FIG. 108. Large Round-celled Sarcoma.

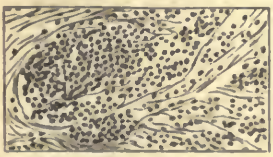
FIG. 109. Small Round-celled Sarcoma.

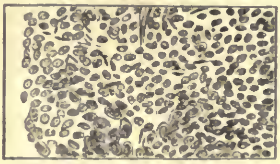
FIG. 110. Oval-celled Sarcoma.

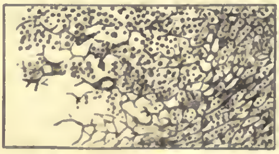
FIG. 111. Lymphoma.

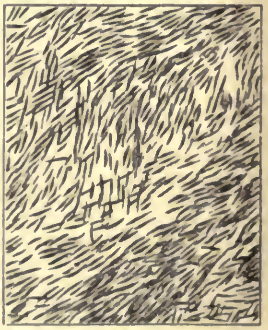
FIG. 112. Small Spindle-celled Sarcoma.

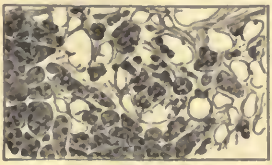
FIG. 113. Alveolar Sarcoma.

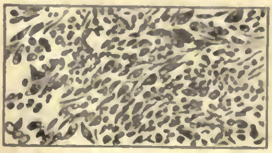
FIG. 114. Mixed Sarcoma.

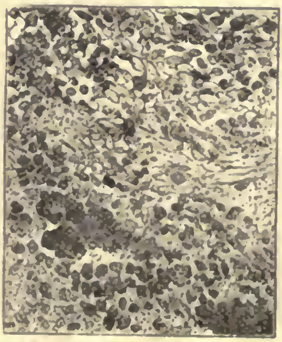
FIG. 115. Melanotic Sarcoma.

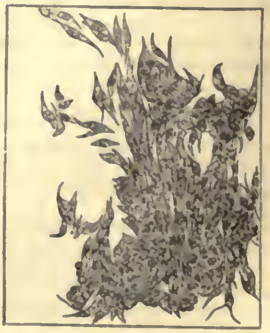
FIG. 116. Large Spindle-celled Sarcoma.

Drawings Illustrating a Series of Tumours of the Connective-tissue Type. All drawn to the same scale (× 87 *diameters*).

the bone, and the danger of wounding the contiguous joint, may perhaps involve greater risk than the amount of inconvenience entailed by the tumour would justify. They have sometimes been either purposely or accidentally separated from their attachment by a blow, without inflicting a wound on the soft parts at all. Unless the whole cartilage-layer be removed, recurrence will probably occur, as growth of the tumour takes place by increase of this layer only, the process of calcification and subsequent ossification being secondary and, so to speak, accidental.

d. Osseous tumours of the soft parts.—These osteomata are also uncommon. They include such conditions as the following:—tumours springing from the periosteum, but not actually united to the bone; ossifying chondromata not connected with the bone; detached exostoses; ossification taking place in muscles or tendons, such as that which is occasionally met with in the adductor longus; and perhaps some other varieties of greater rarity.

e. Osseous tumours produced by the ossification of other kinds of new growths.—These are only secondarily, and often only partially, worthy of the name of osteomata; they are the result of a process of ossification taking place in tumours of a different nature originally, such as fibromas or sarcomas. It must be remembered that, while calcification of new growths is a common form of degeneration, the occurrence of true ossification is very rare.

f. Odontomata. — Odontomata are tumours composed of one or more of the constituents of the teeth. The simplest variety consists of a sort of exostosis from the fang. These are usually of small size, and may extend from one tooth to another. Such tumours are composed altogether of cement. The other kind is more or less covered with enamel, and contains dentine and cement in varying proportions; these, the true odontomata, may sometimes attain a very considerable size.

5. **Papillomata.**—DEFINITION.—Papillary and villous over-growths, whether occurring on the mucous membrane, skin, or serous membrane, which do not present malignant characters.

VARIETIES AND SYMPTOMS.—Mucous papillomata are found on the lips, tongue, and soft palate, and in the larynx; in the intestines, especially at the lower part; round the anus (condylomata); in the bladder (the simple villous tumour); on the conjunctiva; and at the orifice of the female meatus urinarius. Epidermic papillomata include the warts and corns, and may occur on any part of the skin; those about the external genitals may reach an enormous size, and are frequently the result of gonorrhœa. The serous and synovial papillomata are more rare; under this class must be named the Pacchionian bodies, and the enlarged synovial fringes which are often the commencements of loose bodies in joints. Many papillomata are of syphilitic origin; others may be caused by local irritation, as, for instance, the dissecting-room wart, in which the papillary growth is accompanied by inflammation and suppuration beneath the skin.

NAKED-EYE APPEARANCES. — The naked-eye appearances vary very much with the locality in which the growth is developed; but they present this character in common, that they are obviously composed of the papillæ or villi of the part from which they grow, though these are of much more than the natural size. Those springing from mucous and serous membranes are soft, and usually moist on the surface; while epidermic papillomata are dry and hard.

MICROSCOPICAL CHARACTERS.—Microscopically papillomata are made up of connective tissue, containing numerous vessels, covered by the characteristic epithelium or epidermis of the part (fig. 117, p. 204). The arrangement of the connective tissue and epithelial elements is a close imitation of that of the normal tissues from which they grow. The microscopical structure of the benign polypus of the intestine (fig. 120, p. 204) is hardly to be distinguished from that of many malignant growths in this situation. *See* CANCER—*Glandular epithelioma.*

TREATMENT.—If affecting the larynx or bladder papillomata may give rise to distressing and dangerous symptoms, and may necessitate severe operations for their extirpation. Those which occur on accessible parts are generally removed without any risk, except such as arises from their great vascularity; and show, as a rule, but little tendency to recur after complete removal. The common wart, however, often gives great trouble; various caustics may be used, such as the acid nitrate of mercury, fuming nitric acid, caustic potash, acetic acid, or nitrate of silver, but while these remedies are sometimes efficacious, the warts will often recur with the greatest possible inveteracy. At the same time it must be remembered that they frequently show a most capricious tendency to spontaneous cure; the surgeon will sometimes be mortified at finding that while his energies have been devoted with but partial success to the cure of one or two out of an extensive crop of these growths, the remainder have, in the meantime, spontaneously disappeared. The cadaveric or dissecting-room wart is best treated in the early stages by soothing applications, and may perhaps be cured by the external use of belladonna: should this, however, prove unsuccessful, the employment of a caustic must be resorted to (*see* POST-MORTEM WOUNDS). The best local treatment for condylomata and gonorrhœal warts is the application of some desiccating powder, such as dried alum. It is well to remember that warts which remain a long time uncured are apt to take on an epitheliomatous action; and not only so, but that any chronic irritation, whether from the application of insufficient methods of cure or other causes, is likely to lead to the same result.

6. **Adenomata.**—DEFINITION.—An ill-defined group of tumours, a typical member of which is essentially non-malignant, and is made up of tissue exactly resembling that of the gland from which it springs; but the departures from the ordinary type are so many and so varied, and, at times, so indefinite, that it becomes impossible to draw a clear line between the adenomata and the carcinomata.

(*a*) *Adenoma of the Sweat-glands.*—This class is said to include some non-ulcerating cutaneous tumours (the tubular epitheliomata of some authors); and some ulcerating ones—the cancroids or rodent ulcers. *See* RODENT ULCER.

(*b*) *Adenoma of the Sebaceous Glands.*—This is a rare tumour, growing on different parts of the skin; the most usual seat being the nose, when it receives the popular name of 'grog-blossom.' This forms a nodular purplish tumour, growing from the end of the nose, and often reaching an enormous size. When cut into it bleeds freely, and exudes from innumerable cavities in its interior an inspissated sebaceous secretion. *Microscopically* it is seen that the connective tissue and the vessels are hypertrophied, as well as the sebaceous glands. The *treatment* consists in removal by the knife; and cicatrisation generally occurs with wonderful rapidity. Recurrence is not uncommon.

(*c*) *Adenoma of the Mucous Glands.*—Under this heading might be included some of the simple polypi of the nose (*see* **Fibromata**). The best representation, however, is the simple polypus of the rectum; this is a sessile or pedunculated roundish tumour, occurring mostly in children and young subjects. It bleeds freely from the surface, and is often the cause of painful and somewhat troublesome symptoms, amongst which prolapsus ani is the most common. *Microscopically* it consists of tissue closely resembling that of the mucous membrane of the rectum, but the hypertrophied follicles are often imbedded in a tissue very similar to that which forms the basis of the mucous polypus of nose (fig. 120, p. 204). The *treatment* is by removal either with the knife or ligature, or some form of snare or écraseur. Recurrence does not, as a rule, take place.

As is stated in the article CANCER, and as is shown in figs. 120 and 121, p. 204, it is often almost impossible to distinguish, by their microscopical appearances, the simple adenomata of the large intestine from the malignant growths affecting the same structures. The same observation applies to many tumours of the jaws, such as that in fig. 128, p. 204, which, though classed amongst the adenoids, often exhibit a high degree of malignancy.

(*d*) *Adenoma of the Breast.*—The most typical adenoma of the breast is a rounded tumour of moderate size, occurring often at the margin of the gland and frequently near the axillary border, completely encapsuled, and consisting of tissue which hardly differs from ordinary mammary structure (fig. 130, p. 204.) It occurs usually in young women, often during the child-bearing period. It shows no tendency to recur after removal. A large number of adenoids of the breast do not, however, agree with this description, either as regards position or structure. In structure departure may take place from the normal type in two directions; by an excessive or abnormal development either of the epithelial or of the connective-tissue elements. In the former case the tumour, in proportion to its abnormality, approaches the cancers; in the latter it assumes more and more closely the characters of the sarcomas. Thus we find some of the softer adenomata, as shown in fig. 131, p. 204, exhibiting a tendency to recur after removal, in the same way as a carcinoma, and with an almost equal degree of malignancy; while others, presenting characters like those of fig. 132, p. 204, may follow the same course as a sarcoma, both as regards the manner of involving surrounding tissues, and the way in which they recur in the viscera. These latter are called *adenosarcomata*, and often attain an enormous size. If the stroma of one of these tumours be in large amount, and fibrous or myxomatous, the names of *fibro-adenoma* and *myxo-adenoma* may be applied. Adenomata often contain cysts, and these cysts not unfrequently intracystic growths. They must be treated by removal of the growth.

The reader must be content with the foregoing approximate description of this important class of tumours, the varieties in the nomenclature of which are equal to the number of the authors who have written on the subject. The writer believes that much unnecessary confusion has been caused by this multiplication of names, for a detailed account of which special works must be consulted, as their discussion would lead far beyond the limits of the present article.

(*e*) *Other forms of adenoma.*—Amongst other rarer forms of adenoma, bearing a more or less close relationship to the glands from which they spring, may be enumerated the following: adenomata of the testicle or ovary, of the salivary and lachrymal glands, of the liver, and some tumours of the thyroid. Tumours of the thyroid, however, are in most cases simply hypertrophies of the gland itself, and should therefore be classed with simple hypertrophy of the breast and ordinary enlarged prostate, rather than with the tumours now under discussion. It should be noted that many of the less typical adenomata, especially those of the salivary glands and the testicle, frequently are found in combination with other heteroplastic growths, such as chondroma, myxoma, or some form of sarcoma.

7. **Lymphoma.**—Under certain circumstances, for an account of which the reader is referred to the article LYMPHADENOMA, the lymphatic glands throughout the body become enlarged, forming tumours, often of enormous size. Occasionally these growths assume a more malignant character, involving the parts in the neighbourhood of the glands from which they spring, and being followed by the appearance of secondary growths in other parts of the body. To such a condition as this the term *lymphoma* has been applied. The glands are soft, and in the early stages easily moveable amongst, or removable from, the surrounding tissues; in colour they are a yellowish-white, as also are the secondary growths. *Microscopically* they show the structure of an ordinary lymphatic gland, which, it will be observed (fig. 111), differs from that of a small round-celled sarcoma only in the fact that the stroma is much more definite and characteristic.

8. **Myoma.**—DEFINITION.—A tumour composed of muscular tissue.

With certain very rare exceptions, the only form of muscle-tissue occurring as an integral part of a tumour, is the *unstriped* variety; and almost the only position in which this is found is in the so-called 'fibroma' of the uterus. This growth consists of a mixture of fibrous tissue, with plain muscular fibres in varying amount, usually exhibiting the concentric arrangement of its elements, which was described as characteristic of fibromas generally. Fibromata of the uterus may form pedunculated tumours on the external or internal surface of the uterus, or they may not extend beyond the uterine wall. They give rise to a variety of special symptoms, and require special methods of treatment, which it is beyond the scope of this article to discuss. *See* WOMB, Diseases of.

Striped muscular fibre has been found in a few cases of congenital tumour of the kidneys, and the writer has also seen it in a fatty tumour growing inside the spinal canal.

9. **Neuromata.**—DEFINITION.—Tumours composed essentially of any form of nerve-tissue.

The majority of neuromas are really fibromas, that is, fibrous tumours developed amongst and around the fibres of the nerve from which they spring. The idiopathic forms are sometimes single, but generally multiple, of small size, very hard, and affecting usually the branches of a particular cutaneous nerve. The amount of pain and tenderness caused by these growths varies very much, but is sometimes excessive. A clinical feature of some use in diagnosis is the fact that they usually move readily in the lateral, but very imperfectly in the vertical direction. What may be called traumatic neuromata, are fibromas developed at the end of a divided nerve in a stump. These often cause excessive pain, and peculiar reflex phenomena, and show a remarkable tendency to recur after removal.

It must not be forgotten that less simple tumours not unfrequently affect nerves, such as the various forms of sarcoma, or myxoma. No special description of these growths in this situation is, however, required.

10. **Angioma.**—SYNON.: Teleangiectasis.

DEFINITION.—A tumour composed of blood-vessels.

Angiomata divide themselves naturally into those in which the *capillary* element predominates; and those which are chiefly made up of vessels of *larger* size.

a. Capillary angiomata.—DESCRIPTION.—These are the *nævi*, which, while they sometimes form tumours of some magnitude, often, as in the case of so-called 'claret-cheek,' involve no increase in the size of the affected part. Nævi are nearly always congenital, hence the term 'mother's mark.' They may be subdivided into *cutaneous* and *subcutaneous* nævi. The former are of a more or less bright red colour, and affect only the cutaneous structures; the latter, as seen through the skin, in cases where this remains unaffected, have a purplish tint, and may involve any of the deeper structures of the body. Very commonly, however, the subcutaneous nævus involves the skin as well. Nævi often grow with extreme rapidity, and though they involve no danger to life, may cause serious inconvenience and great disfigurement. Sometimes, however, they exhibit a tendency to spontaneous disappearance, and often they remain permanently stationary. They are liable to various forms of degeneration, notably the cystic, and the ulcerative or suppurative.

Microscopically a nævus is composed of large capillaries, amongst which are seen arterial and venous trunks of larger size. Between the vessels are found connective tissue or fat, and sometimes the special constituents of the skin, such as sweat or sebaceous glands. It must be remembered that the nævus-element enters rather largely into the composition of some other tumours, and notably of congenital moles (*benignant melanoses*).

TREATMENT.—Inflammation of a nævus generally leads to spontaneous cure; nature thus suggesting one of the best methods of treatment at the disposal of the surgeon, namely, the injection of the tumour with some suitable irritant, such as carbolic acid. In adopting this line of treatment, it must be remembered that a danger exists of the irritating fluid entering a larger vessel, and by passing to the heart and setting up coagulation there causing instant death; this may be guarded against by the application of a temporary ligature. Other recognised and useful plans of treatment are the following:—the ligature, pressure, the application of caustics—and especially fuming nitric acid, galvano-puncture, puncture with the actual cautery, and complete excision of the mass.

b. Cavernous angiomata.—DESCRIPTION.—Those angiomata which are made up of larger vessels, and which are hence called the cavernous angiomata, from their resemblance in structure to erectile tissue, consist of cavernous spaces, communicating by smaller or larger vessels, and separated by trabeculæ of greater or less thickness and substance. These are the *pulsating nævi*, and perhaps some of the so-called *aneurisms by anastomosis*. They are of a more dusky colour than simple nævi, and often present a distinct thrill or bruit, which is perceptible both to the patient and to the surgeon. They are sometimes encapsuled, sometimes diffused; and in the latter case show an almost malignant tendency to involve neighbouring structures. The pulsation is often a most distressing symptom to the patient, if the tumour be found occupying such positions as the pinna of the ear or the fat of the orbit, both of which situations are not at all uncommon for the occurrence of the disease. *Microscopically* a cavernous angioma presents fibrous trabeculæ, lined with the characteristic vascular endothelium, and in parts perhaps separated by layers of areolar or any other tissue which the tumour may be involving.

TREATMENT.—The treatment must be pursued on the same lines as that for the simple forms of nævus.

11. **Lymphangioma.**—DEFINITION.—A rare kind of tumour, which may briefly be described as a cavernous angioma made up of lymphatic vessels.

To this class belong, in all probability, the *cystic hygromas* occasionally met with congenitally, forming large masses in the neck, beneath the tongue, on the upper extremities, or, rarely, in other parts of the body. Our knowledge of the pathology and treatment of these tumours is at present very imperfect, and the literature on the subject is extremely meagre. The reader is referred, for an account of all forms of angiomata, to the fourth volume of Virchow's *Krankhaften Geschwülste*.

B. **Sarcomata.**—DEFINITION.—It is to be regretted that the term Sarcoma has not been allowed to slip out of pathological terminology. From the days of Galen almost to our own time it has served, in the hands of different authors, to designate different classes of tumours, sometimes of the simplest, sometimes of the most malignant character. Virchow, however, has given a meaning to the word, which is now generally recognised by pathologists. He includes under *sarcomas* those new growths which, while they do not actually consist of any of the tissues of the adult body, are evidently built on the connective-tissue type, and consist of a modification of the connective tissue of the embryo. They are thus very closely related to some of the simple tumours, and indeed often include portions of some normal tissue, such as bone, cartilage, or fibrous tissue—a fact which necessitates the employment of complicated and confusing names, including *Osteo-sarcoma*, *Chondro-sarcoma*, *Fibro-sarcoma*, and such-like.

Microscopical Characters.—Histologically, then, a sarcoma is made up simply of cells of the connective-tissue type, which may assume very various shapes and sizes in different tumours, and which are surrounded by a varying amount of intercellular substance.

Clinical Characters.—Theoretically sarcomata should always be developed in one of the connective-tissue structures, and practically they are not very often seen to originate in a secreting gland. But a glandular origin is not by any means very uncommon, as indeed might have been expected when it is remembered that every gland contains a considerable amount of connective tissue. Sarcomas present all degrees of malignancy; but, as a rough rule, it may be stated that the higher the degree of development of the tumour the less likely is recurrence to take place after removal. In connection with this point it is interesting to note that each recurrence of a sarcoma often shows a more rudimentary structure, but at the same time a greater degree of malignancy.

Recurrence does not follow the same rule that has been observed in the case of cancer. The lymphatic glands often escape altogether, or are but slightly affected; while fresh tumours spring up in abundance in distant parts of the body.

Sarcomas increase in size in the same way as cancers, but in the less malignant forms are often surrounded by a more or less distinct capsule.

Naked-Eye Appearances.—The naked-eye appearances of sarcomata are subject to very wide variations. It may, however, be observed that they never present the hollowed surface on section which is characteristic of some cancers; and they do not, except in the case of the softest tumours, exude a milky juice on scraping. Sarcomata are well supplied with vessels.

Varieties.—1. *Round-celled Sarcomata.*—These are the most rudimentary, and, as a rule, the most malignant of this class. They are usually soft—sometimes very soft, seldom encapsuled, and generally of a whitish colour. Formerly they were classed amongst the medullary cancers. They are made up of round cells, as the name implies, and have a tendency to group themselves into two classes, in one of which the cells are *small* and uniform in size (fig. 109), closely resembling those of granulation-tissue; and in the other large, and sometimes very large, and often somewhat irregular (fig. 108). The intercellular substance may be copious and homogeneous, in which case the tumour approaches the myxomata; or smaller in amount and fibrous, when, if the cells are small, it may be difficult to separate such a sarcoma from the lymphomata.

Under this head must be placed the *Gliomata*—soft medullary tumours connected usually with nerves, frequently with the retina, and occurring commonly in children. They show microscopically a delicate stroma.

2. *Oval-celled Sarcomata.*—This variety of sarcoma represents the next stage in advance from the simplest towards a more complex structure. They differ, in fact, but slightly from the round-celled growth, either in clinical or in microscopical characters (fig. 110), but may be looked upon as intermediate between these and the spindle-celled sarcomas.

3. *Spindle-celled Sarcomata.*—This class must be sub-divided into the *small spindle-celled* and the *large spindle-celled* varieties.

The *small spindle-celled sarcomata* are firm, whitish, well-defined tumours, which approach the fibromata, sometimes very closely, and which after complete removal show a comparatively slight tendency to recur. These were the *recurrent fibroids* of older writers, and are the *fibro-sarcomata* of the present day. *Microscopically* (fig. 112) they consist of broad interlacing bands of elongated cells, with but little intercellular material—a structure which does not differ widely from imperfectly-formed fibrous tissue.

The *large spindle-celled sarcomata* (fig. 116) is a softer growth, frequently supplied with a very imperfect capsule, generally pinkish on section, or stained in parts dark red from extravasated blood, and often showing cysts. It may occur in any fibrous structure, but is rather common in connection with the periosteum. The malignancy of these growths is much greater than that of the small-celled class. *Microscopically* they consist of very large nucleated cells, with long tapering tails, and but little intercellular substance. These are the *fibro-plastic* tumours.

4. *Alveolar Sarcomata.*—*Microscopically* this rare form of tumour (fig. 113) bears a superficial resemblance to that of a cancer. There is, that is to say, a coarse stroma forming alveolar spaces, each of which contains a variable number of large, round, nucleated cells; each space is, however, again sub-divided by a very delicate secondary intercellular stroma. This is only demonstrable on pencilling out the cells, which, unlike a similar process applied to a cancer, is a work of considerable difficulty. Alveolar sarcomas affect most commonly subcutaneous tissues primarily; they are apt to recur in other parts of the body, and ultimately in internal organs, but often run a very chronic course.

5. *Mixed Sarcomata.*—Tumours are often met with which present a mixture of the different structures just described. Such are conveniently called mixed sarcomata; and the term may with advantage be made to include those growths which contain, besides sarcoma-tissue, bone, cartilage, gland-tissue, and what not. The latter growths will necessitate the employment of such names as osteo-sarcoma, chondro-sarcoma, adeno-sarcoma, &c.

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6. **Myeloid.**—Synon.: Giant-celled Sarcomata.—These tumours are best classed amongst the sarcomata. *Microscopically* (fig. 107) they present the following elements, one or other of which may greatly predominate: fibro-plastic or spindle-cells, oval or round-cells, and very large nucleated cells, the so-called 'myeloid' or 'giant' cells. These last are irregular or rounded collections of granular protoplasm, in which occur numerous clear oval nuclei, containing a well-marked nucleolus. The amount of intercellular substance is small. In a fresh scraping, the clear oval nuclei are set free by the breaking up of the giant-cells. To the naked eye a section of a myeloid tumour is pink or yellowish, but almost always mottled with darker spots, the result of extravasations of blood. Very frequently they present points of ossification or calcification, and not unfrequently cysts. They are very soft, and usually yield a thick juice on scraping. They generally originate in, or, more rarely, close to, the end of one of the long bones; probably most often in the medullary cavity or the cancellous structure. Another frequent seat is the alveolar border of the jaws, where they form the myeloid epulis. They occur most often in young people, and if the bone involved be removed completely or in great part, have no tendency to recur; but in rare cases they may exhibit a high degree of malignancy, recurring not only in other bones, but in internal organs.

7. **Myxoma.**—It is not easy to say whether myxomata should be classed amongst the sarcomata or amongst the simple tumours. On the one hand, the tissue of which a myxoma is composed finds no representative in the adult; but, on the other, they approach very closely some of the soft fibromata, and are nearly related to fatty tumours. At the same time a large number of myxomas appear to be actual chondromata.

Microscopically (fig. 103) a myxoma presents elongated or roundish much-branched cells, the prolongations of which intercommunicate freely. These cells are imbedded in a copious, homogeneous, transparent matrix. The structure thus resembles that of fœtal fat.

Clinically these tumours are very soft and elastic, strictly encapsuled, gelatinous, semitransparent on section, and exuding a peculiar mucous juice. Myxomata are not malignant; and as a rule, if completely removed, do not recur locally. They may be found in many parts of the body, but perhaps most frequently in the subcutaneous tissue, in connection with some gland, particularly the parotid. Here, however, they are often mixed with adenoid and cartilaginous material. Not unfrequently myxomatissue is combined with that of an undoubted sarcoma, which necessitates the term *myxo-sarcoma*. These tumours may occasionally be mistaken for colloid cancers. Histologically some of the soft enchondromata resemble them very closely.

8 and 9. *Osteo-Sarcoma*; and *Chondro-Sarcoma.*—These forms of sarcoma have just been referred to under the head of *Mixed Sarcoma.*

10. *Melanotic Sarcomata.*—These tumours are, in the experience of the writer, usually of the mixed, round, and spindle-celled variety. Some, but not all, of the cells contain a brown pigment, but in very varying amount (fig. 116). This gives the tumour a brown or blackish appearance. These tumours, though often completely encapsuled, show a high degree of malignancy; but are often succeeded by a mixture of white and black tumours, or sometimes by white tumours alone. They are not uncommon in connection with the choroid of the eye, and as affecting the papillæ of the skin (malignant mole), but have often been met with primarily in other parts of the body. The secondary growths are often found disseminated through every tissue of the body, forming tumours in such situations as the intestine, of peculiar and characteristic appearance. It has been observed that in some cases of melanosis the presence of black pigment, accompanied with other morbid appearances, has been found in the blood and also in the urine.

11. **Psammoma.**—It is only necessary to mention this very rare tumour, which is found only in connection with the membranes of the brain. It is composed of flattened cells, and is characterised by the peculiarity of containing brain-sand in its interior. It seldom or never gives rise to symptoms.

12. **Teratoma.**—Mention must be made, in conclusion, of a form of growth, which does not come within the classification here selected. This is a congenital tumour not unfrequently met with in the region of the sacrum (*congenital sacral tumour*), but occasionally seen elsewhere; often reaching a size almost equal to that of the infant itself. In structure these tumours consist of various imperfectly developed fœtal or mature elements of the body mixed together in apparently great confusion. Various theories as to their causation have been propounded; such, *e.g.*, as that they consist of an imperfect attached fœtus, or that they originate from Luschka's gland; but we have not sufficient data at present to express an opinion on this point. Attempts at their cure by removal are attended with great danger. R. J. Godlee.

TUNBRIDGE WELLS, in Kent.—Iron waters. *See* Mineral Waters.

TUNNEL WORM.—A synonym for the Sclerostoma duodenale. *See* Sclerostoma.

TURGESCENCE (*turgesco*, I swell).—A term applied to a swollen condition of a part, generally associated with fulness of the blood-vessels, as in the mucous membrane of the conjuctiva, the fauces, or the rectum. *See* Swelling.

TUSSIS (Latin).—A synonym for cough. *See* Cough.

TUSSIVE.—This word is applied to certain physical signs which are elicited by the act of coughing, such as *tussive fremitus* and *tussive resonance*. *See* Physical Examination.

TYLOSIS (τυλόω, I make hard or callous.) Synon.: Callosity.

Definition.—Thickenings of the epidermis, occurring on parts of the body that are habitually subjected to pressure or friction. Tylosis is found, for example, on the feet, from the wearing of shoes; on the hands, from rowing or the constant use of some implement or tool; and on other parts of the body unduly submitted to pressure. A corn begins by being a callus or laminated corn, and only rightfully acquires the title of corn when it has forced itself at a given point against the derma, and has depressed the latter to a greater or less extent, thereby producing pain and suffering. Callosities are inconvenient rather than painful; but occasionally the inconvenience is so great as to make the resort to treatment necessary.

Treatment.—The best remedy under the above circumstances, is the removal or avoidance of the cause. Next to this, the hardened cuticle may be softened by soaking in hot water, or by means of a water-dressing, and afterwards scraped. Or it may be painted over with the liniment of iodine daily, until the excess of cuticle exfoliates in laminæ and flakes. In either case, the skin must be subsequently protected, in order to prevent it from retrograding into its former state.

Erasmus Wilson.

TYMPANITES (*tympanum*, a drum).—Synon.: Fr. *Tympanite*; Ger. *Windsucht.*—This word is associated with the distension of the abdomen that results from excessive accumulation of gas within its cavity. As a rule, the gas collects in the interior of the alimentary canal, especially the intestines; but in exceptional cases it occupies the peritoneal cavity.

Ætiology.—Tympanites is chiefly met with under the following circumstances:—1. In connection with certain diseases which, from their local effects, tend to paralyse the intestines, especially acute peritonitis, typhoid fever, and dysentery. 2. In cases of intestinal obstruction from any cause, but particularly when this condition is acute. 3. In certain low febrile diseases, accompanied with the 'typhoid state,' and tending towards a fatal issue, such as typhus fever, small-pox, erysipelas, and typhoid pneumonia. 4. As the result of perforation of the alimentary canal. 5. In certain cases of chronic disease of the spinal cord, of which the writer has seen a marked example. 6. In connection with hysteria, sometimes. In all these conditions, except where the gas escapes into the peritoneal cavity, the immediate cause of the tympanites is a paralysed state of the walls of the intestines; but there is often, at the same time, an excessive formation of gas.

Symptoms.—The symptoms of tympanites are due to the mechanical effects of the accumulation of air. The patient is usually conscious of the distension of the abdomen, and the sensation may amount to extreme discomfort or actual suffering and great distress, there being a feeling as if the abdomen must burst if the condition is not relieved. The mental state of the patient may, however, be such that he is unconscious of, or indifferent to, any unusual sensations. Breathing is often interfered with in various degrees, and the act may be very hurried, with a feeling of urgent dyspnœa. The heart is also liable to be affected, and its action more or less disturbed. The secretion of urine may be impeded, even almost to actual suppression.

Physical Signs.—These are usually very characteristic. 1. The abdomen is uniformly enlarged, often to an extreme degree; being of a rounded shape; equal and symmetrical in every part, unless there happen to be a portion of bowel unduly distended, and without any tendency to projection in dependent parts. The skin is stretched more or less, but there is no protrusion of the umbilicus. 2. The sensations on palpation are those of perfect smoothness and regularity, with tension or a drum-like feel. 3. Percussion gives a general tympanitic sound over the abdomen, and also brings out the drum-like sensation. If ths distension is extreme, however, the sound becomes more or less muffled and dull. Frequently the dulness of the solid organs in the abdomen is partially or entirely obscured, or is displaced upwards. 4. Change of posture produces no alteration in the physical signs. 5. There may be signs of displacement of the thoracic organs. It must be mentioned that tympanites may be associated with some fluid in the peritoneal cavity, or with other conditions, and the physical signs will be modified accordingly.

Treatment.—In the first instance, any direct cause of tympanites must be removed, if practicable, such as intestinal obstruction. If the symptom calls for direct treatment, relief may be afforded in some cases by applying heat over the abdomen; and administering internally such remedies as brandy, aromatic spirits of ammonia, the various ethers, camphor, musk, sumbul, galbanum, assafœtida or other gum-resins. Should these fail, enemata containing assafœtida or turpentine may sometimes be used with advantage. The passage of a long tube through the anus into the bowel, reaching as high up as possible, such as an œsophagus-tube, is often very serviceable. In extreme cases it is allowable to puncture the large bowel in several points by means of a very small trochar, and thus afford an exit for the contained gas.

Frederick T. Roberts.

TYMPANITIC (*tympanum*, a drum).—A peculiar drum-like quality of sound elicited by percussion (*see* Physical Examination). The term is also applied to the abdomen, when it is distended with gas. *See* Tympanites.

TYMPANUM, Diseases of. *See* Ear, Diseases of.

TYPES OF DISEASE. *See* Disease, Types and Varieties of.

TYPHLITIS (τυφλὸν, the cæcum).—Inflammation of the cæcum. *See* Cæcum, Diseases of.

TYPHOID FEVER (τῦφος, stupor)—Synon.: Enteric Fever; Pythogenic Fever; Gastric Fever; Infantile Remittent Fever; Fr. *Fièvre typhoïde*; *Fièvre gastrique*; *Dothiénentérie*; Ger. *Typhus Abdominalis.*

Definition.—A continued fever of long duration, usually attended with diarrhœa, and characterised by peculiar intestinal lesions, an eruption of small rose spots, and enlargement of the spleen.

Ætiology.—In common with other continued fevers, typhoid fever is due to the introduction from without of a specific poison into a system more or less predisposed to the disease. The nature and origin of the poison, and the modes in which it is propagated, are questions of extreme interest and importance, and they will be the first to be considered.

With regard to the origin of the poison two distinct views have been entertained: one that it is specific in its nature, and derived only from some pre-existing case of the disease; the other that, while usually produced in a person suffering from fever, it may also be generated anew by the decomposition of sewage, and perhaps of other forms of animal filth. The former of these views is associated with the name of the late Dr. Budd of Bristol; the latter, or pythogenic, hypothesis had its chief supporter in the late Dr. Murchison. Fortunately, the practical issue of both theories is the same, namely, that the great preventive measure is the prompt removal of fæcal matters, so that neither air nor water may be contaminated by them.

Klebs claims to have identified a specific typhoid bacillus, which he has found not only in the lymphatics and blood, but in the tissues; and it is probable that this discovery will be confirmed.

It is accepted on all hands that the typhoid poison is reproduced in the system during the fever, and that its chief, if not exclusive, outlet is in the intestinal discharges. There is no evidence that it is conveyed at all by the breath or perspiration, or by the urinary secretion. While, however, the contagium is present in the fæces, it has not apparently at the moment of their passage its full virulence, but requires for its complete development a certain period of time, and this is forwarded by some conditions, retarded or prevented by others. Warmth, stagnation, seclusion from open air, accumulation and concentration of the infected discharges intensify the poison, and it would seem that a small amount of typhoid evacuations may give rise to a large development of the contagium in excretory matters with which they become mingled, and even in milk to which they may obtain access This increase by a sort of fermentation explains the autumnal prevalence of typhoid fever observed in large towns, and the association pointed out by Dr Murchison between a hot and dry summer and a high fever-rate in London: the drains not being flushed by abundant rainfall, sewage accumulates and stagnates in them, and typhoid stools never being wanting, the specific fermentation goes on rapidly under the influence of the high temperature, and produces the poison in quantity and intensity. It is possible, however, to put another interpretation on facts of this kind, and to attribute the generation of contagium to fermentation of fæcal matters, independently of any specific germ introduced in typhoid evacuations. Such is, indeed, the basis of the pythogenic theory of origin of typhoid fever. It is impossible to reproduce here the discussion of the question as to the specific or non-specific character and source of the contagium. There is overwhelming evidence that as a rule the poison is derived from some previous case, and the only facts which seem to require the supposition of its independent origin are occasional outbreaks of fever in villages or isolated buildings which cannot be traced to any known source. On similar grounds, however, we should have to admit the origin *de novo* of small-pox and all other contagious affections, and it should be added that with increasing experience in investigations of this kind unexplained outbreaks become more and more rare. There are again many instances known in which water largely contaminated by sewage has been consumed for years without giving rise to fever, until the sewage has itself been contaminated by typhoid excreta, when an epidemic has at once broken out. So with regard to milk, impure water has been habitually employed in its adulteration without traceable bad effects; but when to this water typhoid poison has gained access, the disease has immediately begun to be distributed with the milk.

The modes in which typhoid fever is disseminated are various. It is rarely, if ever, transmitted directly from person to person. Medical men, clergymen, and others visiting those who are suffering are not attacked, nurses very rarely when proper precautions are observed. If, however, bed-clothes or carpets soiled by the evacuations are not removed, and still more where gross neglect of cleanliness and of decency is permitted, attendants will contract the disease.

The most common vehicle of the poison is drinking water, which may be contaminated in various ways, mostly through sewage. The water-supply of a town may be thus poisoned at its source, such as a river into which drains empty themselves, or a reservoir or well accidentally contaminated; or the pipes of distribution, when the supply is intermittent, may while empty become charged with sewer gases, or may even receive sewage; or excessive rainfall may, in villages and small towns, wash the contents of cesspools into wells. This same rainfall flushing the sewers of well-drained towns, and in them preventing the disease, has often thus a a contrary effect in town and country. In some places the subsoil water, permeating a bed of gravel, is at the same time the well water of a village, and a reservoir of its sewage. An imported case of fever will under these conditions poison almost the entire community. With these examples of wholesale dissemination of typhoid fever must be mentioned the so-called 'milk epidemics' already alluded to. A case of fever occurs at a farm, or among the employés of a dairy; from defective sanitary arrangements the water used at the farm or dairy becomes contaminated by the excreta; this is added to the milk as an adulteration, or, as is usually said, is used in washing out the cans, and in this way the poison obtains access to the milk, where apparently it must increase very rapidly. Hundreds of cases have been traced to a single dairy.

More commonly, perhaps, the occurrence of typhoid fever is traceable to the absence of proper sanitary arrangements in individual houses. Not to speak of cesspools and leaking drain-pipes allowing the basement to be sodden with sewage, sinks or water-closets may be imperfectly trapped, and sewer gas diffuses through the apartments or is drawn into the living-rooms by fires, or is forced into the house by pressure in the main drains, when the poison probably enters the system through the lungs. Or the waste-pipe of the cistern is in direct communication with the drains, and sewer gases conveyed by it are confined in the space under the cistern-lid, and absorbed by the water used for drinking purposes, which conveys the poison. In connexion with these modes of dissemination it should be borne in mind that well-made and closefitting doors and windows may aid in compelling foul air to enter from the drains or subsoil, and that houses in elevated situations, and thus apparently well placed for drainage, are in greater danger from pressure of gases in the main drains.

It is again possible that emanations from a newly-opened drain, or cesspool, or foul privy, may communicate the disease by atmospheric contagion—though this is comparatively rare, it being understood always that typhoid excreta form part of the contents. But a drain open to the air throughout its course, however offensive, is not so likely to give the disease as closed and unventilated sewers; and sewage-farms, if at all well managed, are quite harmless.

It should be added that while, in this country and in Europe generally, all the evidence tends increasingly to confirm the dependence of typhoid fever on pre-existing cases, and the dissemination by drinking water as its chief mode of propagation, observations and investigations in India appear to show either that typhoid fever can there arise independently, or at least differently, or that there is a disease not yet distinguished from typhoid fever which has a different method of rise and spread.

It is unnecessary here to discuss Pettenkofer's hypothesis that the varying prevalence of typhoid fever is connected with the varying level of the subsoil water, which as it rises displaces gases which have become saturated with poison from the soil into the atmosphere. It certainly does not apply to the facts as observed in this country.

One word must be said with regard to individual susceptibility to the disease, and with regard to predisposing causes acting on the individual. It is a matter of almost daily observation that some persons never contract typhoid fever, however much they may be exposed to the poison, while others take it readily; and it is almost equally obvious that certain families are extremely susceptible, and liable to have the disease in a severe form. It is always a reason to apprehend a formidable attack if a parent have died of the fever. Typhoid fever may occur at any age, but it is very rare in advanced life. It is probably more common in infancy than is generally supposed, as it is easily overlooked or confounded with common infantile ailments. The period of life at which the disease is most common is during adolescence and the first decade of adult age. Among the predisposing causes are mental depression or shock, over-work, debility, however induced. It is natural to suppose that unfavourable hygienic conditions would generate a predisposition, but doubt is thrown on this by the fact that typhoid fever does not by any means predominantly affect the poor. The influence of habitual consumption of impure water again is not very clear. In some instances it has appeared to make an epidemic severe, but, on the other hand, it would almost seem that the inhabitants of some towns, the water of which is constantly contaminated, acquire an immunity from the disease.

Anatomical Characters and Pathology.—Special interest attaches to the structural lesions which take place in typhoid fever, as they are closely associated with the symptoms, and are accountable for many of the complications which occur. The primary change is in the blood, but in this there is nothing characteristic. In fatal cases local congestions and inflammations are met with in the lungs and other organs, but the special and characteristic lesions are those taking place in the intestines and mesenteric glands. The intestinal mucous membrane of the ileum generally presents the appearances of acute catarrh; but the chief seat of the morbid changes is Peyer's patches, and the changes consist in a gradual infiltration of the glands here crowded together, followed by ulceration. The process is divisible into three stages—of *infiltration*, *ulceration*, and *separation* or *resolution*, each of which may be said, speaking roughly, to occupy a week. In the first, that of infiltration, the glands of Peyer's patches are swollen and distended by a corpuscular exudation. The entire patch is thickened and raised above the level of the surrounding mucous membrane; has a reddish, or fawn, or grey colour, according to the intensity and stage of the inflammation; and an irregular surface; is firm to the touch; opaque when the intestine is held up to the light, often showing through the peritoneal covering.

The patches are attacked successively from below upwards, and as they are largest and most numerous at the lower end of the ileum near the ileo-cæcal valve, it is here that the lesions are most extensive and most advanced.

In about a week the follicles begin to ulcerate, or, as it is sometimes said, burst. This marks the beginning of the second stage; as it progresses, the minute ulcerations extend and coalesce, the patch having first a worm-eaten appearance, and later becoming one large ulcer, which may be superficial or deep; in very severe cases the patches slough and fall off as a whole, a deep line of demarcation forming round them. At this period they are stained with bile, or when gangrenous are almost black.

During the third week in mild cases a sort of resolution may occur, the infiltrated material being broken down and absorbed; and this change probably takes place in patches high up in the ileum when in those lower down there is ulcerative destruction. For the most part this stage is occupied by the separation by ulceration or sloughing of the affected patches, and an ulcer is left of corresponding size and shape. Of course, as the patches run longitudinally along the aspect of the bowel, away from the mesenteric attachment, the ulcers also have their long diameter in the same sense. The superficial layer only of the mucous membrane may be ulcerated, or its entire thickness may be destroyed, and where there has been necrosis of a patch as a whole, the muscular coat may be implicated, and even in some cases the peritoneal covering. When the muscular fibres are laid bare, and especially when they are partially destroyed, the base of the ulcer will have a shreddy appearance. Large vessels may be opened, giving rise to hæmorrhage; or perforation of the intestine may take place from necrosis of the serous coat, near the centre of the ulcer, and a perforation formed in this way will usually be large.

At the end of the third week the separation of the diseased patches will be completed, and the ulcerations left begin to granulate. There is for some time a liability to hæmorrhage from erosion of vessels, and perforation may still occur, the apertures now, however, being as a rule minute. Unless perforation has been preceded by adhesion to some neighbouring coil of intestine, which may possibly be the case at this period, the escape of gas and extravasation of liquid fæcal matter will set up general peritonitis, which is almost always fatal. The time required for complete healing of the ulcers varies.

Besides the large ulcers formed in the patches of Peyer, it is not uncommon to find small circular ulcerations scattered over the mucous membrane, and at times minute disseminated ulcers constitute the predominant lesion, Peyer's patches being absent, or if present, little affected. The large intestine is usually healthy or nearly so, the ileo-cæcal valve forming a sharp demarcation between healthy and diseased mucous membrane, but in some cases there are numerous small ulcerations in the cæcum and colon.

The changes in the mesenteric glands are secondary to those in the intestinal mucous membrane. The glands are enlarged, firm, pink or fawn-coloured, and present on section a corpuscular infiltration like that affecting the agminated glands. Later, they become paler and softer, and may gradually return to a normal condition, or may undergo caseation.

The spleen is almost always much enlarged, dark in colour, and soft.

Granular degeneration of the gland-cells of the liver and kidneys, of the muscular fibres of the heart, and of the voluntary muscles generally, is a constant morbid change. It is due to the prolonged high fever, and proportionate to its severity and duration; when it reaches an advanced stage, it may be the cause of fatal syncope from failure of the heart.

SYMPTOMS.—The period of incubation of typhoid fever is not definitely known. There is great difficulty in fixing it, as the date of exposure to the poison can rarely be exactly ascertained, and the onset of the attack is usually insidious. It is certain, however, that the incubation-period is long, probably in most cases about twenty-one days. Instances are on record in which the disease appears to have come on immediately after exposure to powerful emanations from sewers which have burst, or have been opened on account of obstruction, but they are quite exceptional. The incubation is not attended by any marked symptoms; sometimes the appetite falls off, the tongue becomes furred, and there is headache or depression, but, as a rule, the patient is not debarred from his avocation, and there may be no complaint of any kind.

Invasion.—The invasion is almost always insidious; occasionally severe headache sets in suddenly, with depression, muscular weakness, general pains, and chilliness almost amounting to rigor; but, as a rule, the patient at first feels simply out of sorts, loses appetite, is indisposed for his usual work or for exertion of any kind. Epistaxis is not uncommon. The headache increases; the prostration becomes greater; sensations of cold down the back, alternating with heat and slight flushing, come on at intervals. At this point medical advice is usually sought, when the patient giving the above history will be found to present the usual indications of the febrile state—the pulse will be increased in frequency, the temperature raised and the tongue will have a whitish or yellow coat, thick or thin in different cases. The bowels may be confined or relaxed; the urine high coloured and diminished in quantity, or so far apparently normal.

In endeavouring at this early period to decide whether the case is one of enteric fever, the first thing to be done is to exclude local inflammation as a cause of the pyrexia. Among the positive indications the appearance of the patient is often a guide; he may look more heavy and oppressed than is accounted for by the temperature or the duration of the illness, and may be more prostrate. The tongue, as a rule, is not thickly coated, and the fur does not extend quite to the margins or tip, which even now may be unduly red. The abdomen may be tumid, and there may be some tenderness over the right iliac fossa, but the absence of these symptoms does not exclude enteric fever. The recurrence two or three times of slight epistaxis during the first few days of a severer attack would increase the presumption of the disease being typhoid. The temperature, however, if it is watched from the first, affords the most conclusive early evidence of the disease; it rises with remarkable regularity from day to day, and is from one to two degrees higher in the evening than in the morning; the appearance of the temperature-chart recording morning and evening observations is highly characteristic, and may, indeed, almost be called diagnostic. The opportunity of watching this gradual rise, however, is often wanting; but if, on the third or fourth day of an illness, without obvious local cause we find a temperature of 103° or 104° Fah., and especially if the evening rise and morning fall are marked, the probabilities are that the case is one of enteric fever,

As has been stated, the fever is of long duration, lasting from twenty-one to thirty days on an average, and probably the clearest idea of the course and progress of the disease will be conveyed by a brief description of the condition of the patient week by week, during an average attack.

At the end of the first week the temperature will have reached the level, whatever that may be, which will be maintained in the absence of complications, throughout the dominant stage of the disease—103°, 104°, or 105° Fah. in the evening, 1° or $1\frac{1}{2}$° Fah. lower in the morning; in mild cases it may not be more than 102° Fah. when highest. The fever is now well-established, and all its characteristic features will be more or less pronounced. The initial headache will in most cases have disappeared; the patient lies on the back or on either side; the face is flushed, often presenting a bright patch on the cheeks, rarely dusky; the expression is good; the eyes are bright and observant; the skin is more or less hot, usually dry, but often moist at some period of the day. The pulse is frequent, 80, 100, or 120—short, large, and very often dicrotous. A short cough is common; and a scattered sibilus, heard on auscultating the lungs, is so frequent as to constitute a feature of the disease. The tongue will be moist, with a white or yellowish fur thinning off towards the edges and tip, where the mucous membrane is red, and the fungiform papillæ often conspicuous. The abdomen will be more or less tumid; and on pressure tenderness may be elicited in the right iliac fossa, and gurgling of liquid and gas may be felt in the intestine. It is to be understood that the gurgling is an incident attendant on diarrhœa, and is absent in cases where there is constipation. The spleen may sometimes be felt below the ribs, and when not reached from the left hypochondrium may give an enlarged area of dulness on percussion, but it will not yet have reached its full size. The characteristic spots may occasionally be found, but though they have been seen as early as the fourth or fifth day, they do not usually come out till after a week or more of fever. The bowels will mostly act loosely, and sometimes frequently, so that there is diarrhœa. The urine will be high-coloured and generally turbid. The motions will have a powerful and offensive peculiar odour; they will be copious, liquid, rather pale, yellowish or drab in colour, with flocculi. A familiar descriptive comparison is to 'pea-soup.'

A week later, that is on the 14th or 15th day, he disease will have told obviously upon the patient. He will lie mostly on his back, and little on his side. The face, still flushed, and presenting often the red patches on the cheeks, will begin to look worn and thin; the eyes, still bright, will be less observant. The hand may be unsteady when held out, and there may be slight twitchings of the lips. There may be restlessness or even sleeplessness, and very often delirium. It has been stated that delirium mostly sets in about the twelfth day, but the time varies greatly. At first the patient is confused on waking from sleep, does not quite know where he is, and appears to have been dreaming, but soon collects himself; later he fails to shake off the confusion of thought, and he may talk incoherently, may ramble, in fact, as it is said. At this period the delirium does not go beyond slight rambling, and it is rarely violent at any stage.

The pulse will be more frequent, less full, weaker; dicrotism is rarely well marked. The lungs will not have undergone much change; the sibilant sounds may be more numerous.

The tongue will be more characteristic; the fur will be represented by a thin yellow or brownish streak down the centre, while the tip and edges will be red and angry. There will be a tendency to dryness, and generally the entire tongue looks shrunken and pointed.

The abdomen will be larger and more tense, and the tenderness and gurgling in the right iliac fossa more marked; the spleen will be larger. Now the eruption may be expected to present itself, if at all, but it must be remembered that it is absent in a considerable proportion of cases—a proportion estimated by some observers at 30 per cent. The eruption consists of small pink spots, about the size of a pin's head, slightly raised and pointed, well-defined, and disappearing on pressure, or when the skin is stretched, to re-appear when the pressure is withdrawn. They are usually few in number, and are distributed irregularly over the abdomen and chest; but sometimes they are very profuse, the number having no relation whatever to the severity or character of the attack. The spots do not all come out at once, but in successive crops, till the end of the fever; the duration of individual spots, as observed by surrounding them with a ring of ink and dating them, being about four days. It has been recommended that the back should be searched for spots, but conclusions from eruption found here only would be unreliable, as the back is seldom free from spots, and there is nothing very peculiar in the spots of typhoid fever to distinguish them from others.

If the case is characterised by diarrhœa, it is usually at this period that it begins to be most troublesome; the stools have the appearances already described.

The temperature will be maintained at about the same height as at the end of the first week, but not uncommonly there is about this time a deceptive remission of fever, and it is perhaps worthy of remark that the active ulceration is now coming to an end. The fever which persists after this period has indeed been attributed to septic absorption from the intestinal ulcers—with doubtful justice, however.

It is from the later part of the second week onward that complications, both local, such as hæmorrhage or perforation from ulceration and separation of sloughs, and general, such as pneumonia, are to be apprehended.

The end of the third week finds the sufferer at his worst. If he is now able to turn in bed and to lie on either side, and if other symptoms correspond with this indication of power, the case is favourable. In a severe attack he will lie on his back, and probably tend to slip down in bed. The face may be either pale or dusky; its look will be that of prostration. The patient is mostly very deaf, often dull of apprehension, so that he is with difficulty made to put out his tongue; he may be half unconscious, or in the condition of coma-vigil, a stuporous sleep with the eyes half open; or he may be restless, with muttering delirium, picking at imaginary objects in the air, or at the bedclothes. Sometimes the slightest pressure on any part of the body appears to give pain, or the patient may start in great alarm when spoken to. The body will be emaciated; the skin thin, pale, dry, and harsh; the muscles wasted; the tendons starting up, from sudden irregular muscular contractions (*subsultus tendinum*) when the limbs are at rest, while attempted movements are attended with jactitations and tremors; the lips tremble and the tongue twitches when the patient speaks or puts out the tongue. A tap with the end of the finger on the pectoral muscle will cause a small swelling to rise on the spot—the so-called 'myoidema,' due to contraction of the degenerated fibres; it lasts for twenty or thirty seconds. The tongue is shrivelled, dry, brown, or even black, destitute of true epithelium, dry and shiny, or coated with sticky slime or with black sordes. Sometimes it cannot be protruded at all. The roof of the mouth will be similarly coated; and there will be sordes on the teeth, and perhaps on the lips.

The pulse will be small, soft, extremely weak, often very frequent—130 or upwards per minute in bad cases; the beats run into each other, and are not distinct, giving the undulatory sphygmographic trace. The heart is extremely weak: the impulse absent, or a mere tap; the first sound short and feeble, or altogether extinguished. The lungs exhibit evidence of hypostatic congestion, impairment of resonance, and imperfect entry of air all over the posterior aspect of one or both sides of the chest.

The abdomen will usually be distended; spots may be present and continue to come out. There may or may not be diarrhœa. The stools may be passed unconsciously; and there may be retention, or more frequently incontinence, of urine. Bedsores often form rapidly, unless the nursing is both careful and skilful.

A tendency to recovery is usually indicated by improvement in the temperature, pulse, tongue, and abdomen. The temperature gradually falls, but at first this is shown chiefly by the increasing morning remissions, giving a greater difference between the morning and evening temperatures, and showing on the chart greater zigzags; the evening temperature then begins to fall day by day. The pulse becomes less frequent, and more full and distinct; the tongue gradually cleans, beginning at the margins; the abdomen subsides, the diarrhœa ceases; and strength returns little by little. In fatal cases the mode of death, when not due to some complication, may be by asthenia, or more frequently by coma and asthenia combined; hyperpyrexia is not uncommon as a phenomenon of the moribund condition; and as the heart fails, hypostatic congestion of the lungs is usually very marked.

Relapses.—Relapse is very common in enteric fever. It usually occurs about ten days after the subsidence of the temperature in the primary attack, and is sometimes attributed to premature administration of solid food, but more commonly has no such cause. A true relapse is not merely a recurrence of pyrexia, but a return of all the phenomena of the fever. Fresh Peyer's patches are attacked, and there is frequently a fresh outbreak of the spots at about the same period after the initial symptoms, or often earlier. The relapse, however, is rarely as long as the original fever; very commonly, indeed, the third stage, that of so-called infective or pyæmic fever, is wanting, and when this is so, it is probable that there is no ulceration of the intestinal glands. Fortunately, also, it is not so often fatal as might be expected, seeing that the patient is reduced by the first attack. A second or a third relapse may take place; the writer has even indeed seen a fourth, the patient recovering, and surviving five distinct attacks of fever, each of which was severe. No satisfactory explanation of the relapse of typhoid fever has been given. It has been said that there is a re-infection of the subject by poison lodged in the mesenteric glands, but it is not easy to understand why he should be susceptible to the influence of the poison from this source, when for the most part the susceptibility to the disease is exhausted by an attack.

Special Symptoms and Complications.—These are so numerous and varied that it has been thought better to describe them separately, rather than to interrupt the account of the fever.

Hæmorrhage.—This occurs in about 6 or 8 per cent. of the cases. It may come on as early as the tenth day, but more commonly it is between the fourteenth and the twenty-fourth days, and in the later rather than the earlier part of this period; bleeding may be provoked by imprudence in diet, or by exertion later still. The hæmorrhage is due to the erosion of some vessel during the ulceration of Peyer's patches, without protective plugging by fibrin, or to vessels being laid open by the detachment of a slough. The quantity of blood lost, and the rate at which it is poured out, vary greatly. Sometimes the fact of hæmorrhage having taken place is only known by the stools being black, sticky, and offensive. At other times the blood is discharged in large clots, or it may be extravasated so rapidly that it is liquid and red, not having had time to become blackened and coagulated by the intestinal contents or secretions. When the hæmorrhage is considerable, the patient is rendered pale and pulseless. The temperature always falls, and not unfrequently the loss of blood can be recognised before it appears in the stools by this fall of temperature, and by the pulse and general appearance of the patient. It is said that severe and persistent headache early in the attack is often followed by hæmorrhage in a later stage.

This complication is always attended with anxiety, and often exhausts the strength of the sufferer; but it is not by any means necessarily fatal. In many cases, indeed, the occurrence of considerable hæmorrhage marks the setting in of improvement; the temperature which falls on account of the loss of blood does not rise again; the patient becomes clearer and less heavy and oppressed; the tongue cleans; and all unfavourable symptoms gradually subside.

Perforation.—This, like hæmorrhage, may occur early or later; when early it is due to the entire thickness of the intestinal wall being implicated in the necrosis of the Peyer's patch, and the perforation may then be large. Later, at the end of the third week or afterwards, the perforation results from ulceration, and is often very minute. Unless adhesive inflammation at once glues the affected point to a neighbouring coil of intestine or to the abdominal wall, there is extravasation of intestinal gases and liquid into the peritoneal cavity, producing general and fatal peritonitis.

It might be expected that this occurrence would give rise to severe pain, but very often there is neither pain nor tenderness. The abdomen, however, rapidly becomes distended, often to an extreme degree; its walls are absolutely motionless in respiration; and on the application of the hand and making pressure, there is not only tension but resistance of a peculiar kind, which is highly characteristic. With the local symptoms there are evidences of shock; great anxiety of countenance, which may be flushed and beaded with perspiration, or pallid and livid; extreme frequency of pulse, often 140, 160, or 200, which is small and weak; and very great frequency of respiration. The respiratory distress is so marked that, in some instances which the writer has been called to see, the perforation had been overlooked, and the condition attributed to some lung-complication.

Peritonitis.—Peritonitis, without antecedent perforation, is an occasional complication of typhoid fever. It differs from the peritonitis caused by perforation in the more gradual onset, and in the less urgent character both of local signs and general symptoms—of the latter especially.

Tympanites.—Great distension of the abdomen by flatus is not uncommon in the course of typhoid fever, coming on independently of peritonitis or perforation. Most frequently it gradually appears late in the disease, together with other symptoms of prostration of the nervous system, but it may set in abruptly within the first week, and it is then prognostic of an early fatal issue. Simple tympanites is distinguished from peritonitic distension by the difference in the feel to the hand; but chiefly by the fact that the respiratory movements of the abdomen are not suppressed, though, of course, impeded. Absence of pain is so common in the peritonitis of typhoid fever, that it is no criterion by which to distinguish inflammation from tympanitic distension.

Diarrhœa.—As has been stated, the bowels are usually loose in typhoid fever. Not unfrequently this looseness becomes excessive, and is thus a cause of exhaustion and a source of danger. Unless there is blood in them, the stools are more liquid, frequent, and copious, but not otherwise different from the usual typhoid motions.

Albuminuria.—Albuminuria is not uncommon as a complication of typhoid, and it may be accompanied with convulsions, though it is by no means so dangerous as in typhus. The albuminuria may be the effect of the poison or of the fever-processes on the blood, or it may indicate nephritis. In the former case, which is much more common, the urine does not differ in appearance from this secretion as usually seen at the stage of the disease at which it is present, and the albumen is only detected by examination; in the latter, the urine will be scanty and dark-coloured, as in desquamative nephritis, when it is not a complication of typhoid fever.

Pneumonia.—Inflammation of the lung may come on early or late in the course of typhoid fever. When early it is usually a lobar croupous pneumonia, not differing greatly from ordinary pneumonia; in the later stages it is often a combination of lobular catarrh with hypostatic consolidation. The symptoms are not marked. The temperature rises or is more sustained; there is increased frequency of the pulse and respiration, and perhaps obvious respiratory distress; the face may be flushed or anxious. As a rule, there is little or no cough or expectoration. Examination, when practicable, reveals the ordinary physical signs.

Pulmonary gangrene.—Gangrene of the lung may occur from obstruction of branches of the pulmonary artery by fibrinous coagula carried from the heart.

Pleurisy.—Pleurisy is occasionally met with as a complication of typhoid fever. It does not give rise to much pain, and may easily be overlooked, the condition of the patient precluding careful examination.

Thrombosis.—Thrombosis may be either a complication or a sequel of typhoid fever. It arises from the languid state of the circulation, and from the condition of the blood, which is liable to coagulate. The femoral vein and its branches are the vessels most commonly obstructed; there may be deep-seated pain and tenderness in the calf or in the gluteal region for a day or two before the large vein is affected. Thrombosis gives rise to pain and swelling of the limb, with some œdema, and the vein can usually be felt as a solid cord; there is a new access of pyrexia, especially if convalescence have already set in.

Embolism.—Embolism by plugs of fibrin deposited in the heart, and subsequently launched into the arteries, may occur in any part of the body. Hemiplegia may occur from this cause in the course of typhoid fever; or occasionally, but very rarely, gangrene of part of a limb.

Parotitis.—Parotid abscess is less common in typhoid than in typhus fever; but it may occur in very severe cases, and is then an additional source of danger.

Sequelæ.—Enteric fever always leaves the patient weak, and the debility lasts long. This is due not merely to the waste of tissue by the protracted fever, but to the fact that the intestinal and mesenteric lesions interfere with absorption of nutrient material. In some cases the patient never recovers strength, but gradually becomes emaciated, and dies from asthenia or from some intercurrent attack. Occasionally the ulcerations do not heal, and they may prove fatal after the lapse of a considerable time. Phthisis again may be started by an attack of typhoid fever, usually, but not invariably, in an individual predisposed to the disease. Insanity is another occasional sequel; the most common form of mental derangement is melancholia, but there may be acute mania. It may come on almost immediately, the patient never appearing quite to recover his faculties after the stupor of a severe attack; or it may develop itself at an early or late stage of convalescence, or not till a still later period.

VARIETIES.—To complete the account of typhoid fever, some of the principal deviations from the ordinary course and type of the disease must be enumerated, and in the first place it must be understood that, both in individual cases and in entire epidemics, typhoid fever may run its course without rise of temperature, the characteristic lesions being found after death. Again, there is sometimes so little general depression of strength that the sufferer may walk about, and carry on his usual avocations up to a late period of the attack. The term *typhus ambulans*, or *ambulatorius*, has been applied to such cases. The writer has known several instances in which patients have *walked* into the London Fever Hospital with perforation.

Infantile Remittent Fever.—Infantile remittent fever is so called from the remissions often observed in typhoid fever affecting young children. No special description is necessary, the disease pursuing much the same course in children as in adults, only with greater fluctuations. Spots are less frequently seen.

Typhoid Fever with Constipation.—This really constitutes a distinct variety, the constipation persisting throughout, and not merely lasting for a few days and then giving place to diarrhœa.

Bilious Fever (*Fièvre bilieuse*).—This is recognised as a special form of typhoid fever by French observers, and deservedly so. The characteristic feature is frequent, sometimes almost incessant, vomiting of liquid containing bile, both after food and when no food has been taken. Severe headache often persists throughout the attack. The temperature does not, as a rule, rise high, and it fluctuates much; the face is pale and anxious; the pulse is frequent and very weak; the tongue is usually coated, and may be white or yellow. It is a very dangerous form of the disease, and may end fatally early by simple asthenia, without delirium or comatose symptoms.

Typhoid Fever with Meningitis.—True meningitis sometimes, though rarely, occurs at an early period of typhoid fever, and is attended with excitement, which may be maniacal in character, or violent delirium, and perhaps pain in the head.

Abortive Typhoid.—This is sometimes described as 'fourteen-day fever.' After well-marked symptoms of the attack, the temperature is not maintained, but gradually subsides. Such cases are mostly set down as common continued fever, or febricula.

Diagnosis.—A well-marked case of enteric fever at the height of the disease is easily recognised by the aspect of the patient, and by the symptoms already described: the red tip and edges of the tongue, the tumid abdomen, the enlarged spleen, the rose spots, and the character of the stools. In the early stage, however, it is often necessary to suspend the judgment for a day or two, and there may be difficulty in forming a definite opinion for a much longer period. The diseases which have most frequently been taken for typhoid fever are tubercular meningitis, acute pulmonary tuberculosis, and gastro-intestinal catarrh; typhlitis, catarrhal pneumonia and other acute affections of the lungs, glanders, pyæmia, and ulcerative endocarditis, have also from time to time been confounded with it. On the other hand, typhoid fever may possibly be taken for one of these affections, or may more easily be masked by some complication, such as pneumonia or peritonitis. What is most liable to happen is, that it may be entirely overlooked.

The insidious onset of typhoid fever is very characteristic, and, as has been said before, the thermometric chart of the first four days showing a rise day by day with the morning remissions, might of itself suggest the diagnosis. But occasionally the invasion is abrupt, or there is some pulmonary complication at the outset, which raises the initial temperature, so that it would be unsafe to rely too implicitly on the temperature. The first thing to be done in establishing a diagnosis of enteric fever, is to exclude local inflammation as a cause of the febrile condition, which will be effected by physical examination and other means. It must not be forgotten during this investigation that in pneumonia the consolidation may not occur for three or four days. When there is doubt, epistaxis will be evidence in favour of, herpes labialis against such a diagnosis, though herpes may break out when there has been a rigor. The presumption of typhoid fever arrived at by excluding local inflammation and other acute diseases, will soon be strengthened by the appearance of corroborative indications which we need not again specify, or be overthrown by their continued absence.

As regards the particular diseases enumerated as those with which it is specially liable to be confounded—in tubercular meningitis the temperature is not usually so high as in typhoid fever, the pulse is at first not very frequent, and is often hesitating, while it almost always presents the condition of tension, thus contrasting with the soft short pulse of fever. There are usually, but not constantly, headache and vomiting early in the attack, the bowels are mostly confined, and the abdominal wall is retracted. Squint, inequality of the pupils, or double optic neuritis, would be unmistakable indications of meningitis. In acute pulmonary tuberculosis there is more cough; and although at first there may be only scattered sibilant sounds, such as are heard in typhoid fever, these soon become more abundant, and other physical signs of the infiltration of the lungs are added, such as impairment of the resonance, and imperfect entry of air. The temperature also is usually more sustained. Gastro-intestinal catarrh in children is sometimes attended with so much febrile disturbance as to give rise to a suspicion, or even a diagnosis, of typhoid fever, especially as the abdomen is tumid, and there may be diarrhœa; over-feeding with milk may keep up the appearance of fever for some time. There are, however, intermissions and variations which, when carefully noted, are found to be inconsistent with continued fever; the tongue is more thickly and coarsely coated; and the stools, though they may be pale from undigested milk, have not the typhoid character. In typhlitis there is more local pain and tenderness, and a lower temperature; and the symptoms set in more abruptly, vomiting being common. It is unnecessary to enter upon the distinction between typhoid fever and the other diseases mentioned; for the most part a few days will clear up any uncertainty or confusion.

As a matter of fact, errors rarely arise, when it is deliberately considered whether a given case is or is not one of fever. The danger is that the idea of fever may not be entertained at all, its symptoms being attributed to some slight local ailment. Or there is pneumonia or peritonitis as a complication, when the patient first comes under observation, which is not very uncommon among the poor or in hospital practice. The possibility, therefore, that typhoid fever may underlie an acute local affection, should always be borne in mind, and when the desired crisis does not come on in pneumonia, or if in peritonitis the general symptoms are not altogether those of inflammation of the peritoneum, indications of enteric fever should be carefully looked for. When, again, a patient complaining only of some functional derangement, or of weakness and loss of appetite, has a look of illness and prostration which is disproportionate to the assigned cause, enteric fever should be suspected.

There is often great difficulty in distinguishing *infantile* remittent fever from tubercular meningitis on the one hand, and from gastric catarrh on the other. In gastric catarrh the tongue is more loaded; the temperature is less sustained and more irregular; constipation is more common than diarrhœa; and the evacuations, whether solid or liquid, have not the specific characters, but consist more of undigested food. In meningitis there will usually be purposeless vomiting, but not always; the temperature is not so high; the pulse is often slow or irregular, and the respiration shallow and sighing; the abdomen is not distended, and may be retracted; the bowels are confined. A squint would at once confirm suspicions of meningitis.

Prognosis.—It is never safe to speak confidently of the recovery of a case of typhoid fever, in view of the complications which may arise; but the prognosis is favourable or unfavourable, according to the antecedent condition of the patient, and to the severity of the attack, as estimated chiefly by the temperature. The mortality varies from 15 to 25 per cent., but there may be epidemics in which it may be throughout lower or higher than the average here stated.

Children seldom die of typhoid fever, and in the young the attack is less likely to be severe, and there is a better chance of recovery even when it is. In debilitated subjects, and especially in persons addicted to alcohol, typhoid fever is always attended with danger; even in a mild attack there may be failure of the heart, and pulmonary complications or thrombosis, which may prove fatal. Pregnancy also renders an attack dangerous. Apart from causes of anxiety in the general condition of the patient, and exception being made of cases in which the fever assumes the bilious type, attended with frequent vomiting of bile, headache, and prostration, and of the rare instances of meningitis as an early complication, the prognosis turns mainly on the temperature. If this is not more than 102½° Fah. in the evening, at the end of the first week, there is very little danger; on the other hand, if the evening temperature reaches 105° Fah., nearly half the cases prove fatal. When the temperature ranges high, it is of great importance to ascertain whether it is so for many consecutive hours, or only for a short period; a heat of 104° Fah. sustained for a great part of the day, is a more serious matter than a brief rise to 105° Fah. On this account, and also because the maximum may be attained at different periods of the day, it is desirable that the temperature should be taken in serious cases every two or three hours, or even more frequently. In typhoid fever as in other acute diseases, a contrast between the surface temperature and the temperature of the blood, as revealed by the thermometer, is of unfavourable significance. If with high temperature there are indications of failure, either in the nervous system or in the heart, the prognosis becomes serious; a tendency to stupor, or retention of urine early in the disease, is a bad sign; and acute tympanites at this period, indicating, as it does, paralysis of the muscular walls of the intestine, and presumably of the sympathetic nervous system, almost invariably points to a speedily fatal termination; the later gradual distension of the abdomen, ranks with the unfavourable signs, but is often met with in cases which recover.

Unusual frequency of the pulse, marked dicrotism early, and extreme weakness of the beat, and compressibility of the vessel later, intimate danger, as does also an increasing frequency day by day at the end of the third week. When the beats run into each other, and the pulse is a mere flutter, the danger is immediate and extreme. The sounds of the heart should be noted throughout the disease; the first sound, as heard at the apex, tends to become, first, short and sharp, then weak, and it may altogether cease to be audible; a good or bad first sound is of good or bad augury respectively. A systolic apex-murmur is not uncommon, and occasionally a distinct presystolic murmur is heard; these murmurs have no great significance, and usually disappear as the patient recovers.

Treatment.—The principles on which the treatment of typhoid fever should be conducted are generally accepted and well understood. Success depends greatly on their intelligent application to individual cases, and on careful attention to details at every stage of the disease.

The patient should, if possible, be placed in a large, airy, and well-ventilated room, the windows and door of which should be more or less continually open, according to the season and weather. The bed should not be too wide, and it should be approachable on both sides, so that the patient can be easily reached from either hand; it should be firm, but comfortable. A feather or flock bed is very objectionable, on account of the hollow into which the patient sinks in it. When practicable, it is a great comfort to have two beds, one for day, the other for night. The covering should be light, but sufficient to protect the patient from changes in the external temperature; eider-down quilting, or any material impervious to the insensible perspiration, should be forbidden; the under surface of such coverings will often be found quite damp, and exhaling an offensive odour. Conscientious, skilful, and efficient nursing is of the utmost consequence; and that nothing may be overlooked, a record should be kept of the condition of the patient, of the food, stimulants, and medicines administered, and of the evacuations passed.

The patient should be sponged night and morning with tepid water, to which a little vinegar or permanganate of potash may or may not be added. The temperature of the water may vary, the feelings of the patient being consulted, and the effects in producing sleep and quiet noted. The hands and face may be washed or bathed

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frequently, and the general sponging may be repeated at any time when it seems to be required by heat and restlessness.

It is useful to habituate the patient to the use of the bed-pan from the first. It is true that very often the chair or utensil is used throughout; but in severe cases, or on the occurrence of hæmorrhage, the sitting posture is dangerous, and indeed impossible, and it may be most distressing to have to pass the excretions into the bed-pan for the first time under circumstances of extreme prostration; this may, indeed, destroy the patient's chance of recovery. A disinfectant solution should be placed in the pan or other vessel into which the stools are received, and more should be added before they are thrown away.

Perhaps the most important element in the treatment of typhoid fever is the regulation of the diet. This should be exclusively liquid, and the staple constituents will be milk, and beef-tea or broths of one kind or another. It should be borne in mind that these liquids are food, and not mere drinks, and they should be given with strict regularity. Two or three pints of milk, and a pint or pint and a-half of beef-tea or some equivalent, will be about the quantity required for twenty-four hours' consumption in the first instance; and it should be so divided that milk and beef-tea are given alternately about every three hours, judgment being exercised in waking up the patient if he is sleeping when food is due, or allowing him to sleep beyond the hour. The great tendency now, on the part of the public, is to over-feed cases of fever. When the patient asks for drink, milk is offered, and if it is iced or diluted with soda or seltzer water it is sufficiently grateful in quenching thirst, to be accepted in quantity altogether beyond the digestive powers; it then coagulates in masses, escapes solution by the gastric and pancreatic juices, and passes down the intestine in heavy curds, which irritate the ulcerated surfaces, besides producing other disturbances. It is in this way that milk has been discredited as an article of diet. The writer's experience is in accord with that of the late Dr. Parkes, who looked upon milk as the typical diet for enteric fever. In later stages of the disease it may be necessary to give nourishment more frequently, but the attention of the medical attendant will in most cases be required rather to moderate the amount of food given, than to urge its administration; it may, however, be found necessary to take precautions against neglect in this respect during the night. In emergencies concentrated meat-extracts may have to be given in teaspoonfuls every few minutes. The patient should, of course, be allowed to drink freely of cold water, toast-water, or any simple drink. The key to the regulation of the diet—it may almost be said to the management of the patient—is to be found in the careful inspection of the stools; the medical attendant ought to see every evacuation, or, at any rate, one motion every day, supplementing his own information by the report of a trustworthy nurse. When curds appear in the dejections, either too much milk is taken, or too much at a time, or its digestion is interfered with. If the passage of undigested milk is not remedied, there will certainly be flatulence, discomfort, and restlessness, elevation of the temperature, and in most cases diarrhœa. When without error in the administration of the milk, curds appear in the stools, dilution with soda or seltzer water, or the addition of lime-water or carbonate of soda, may prevent premature and unduly firm coagulation; or the admixture of arrowroot or of gelatine may cause the curds to be subdivided, and thus ensure their digestion. In some cases, on the other hand, beef-tea excites diarrhœa, and given in excess, it will almost always have this effect.

As the fever subsides, eggs beaten up, or lightly boiled or poached, may be added to the dietary. In all cases the return to ordinary diet must be made with great caution, bearing in mind the fact that there may be intestinal ulcerations unhealed, and it should be a rule that no really solid food be given till the temperature has been normal for a week; even at the end of this time it is not uncommon for the temperature to rise one or two degrees, after a moderate amount of fish or meat with bread has been taken.

It is an unfortunate aggravation of the sufferings in typhoid fever that fruit, which is so grateful when the mouth is dry and parched, cannot be given freely, on account of its liability to excite diarrhœa, but a few grapes may be permitted, care being taken that the skins and seeds are not swallowed, and the effects being carefully watched.

The question of stimulants is an important one. Here again the prepossession in the public mind is in the direction of almost indiscriminate administration of alcohol, and the importunities of friends may have to be resisted. The amount of brandy or wine given must therefore be carefully checked and controlled. In a large proportion of cases no alcohol is necessary from first to last; it is scarcely ever required in the early stages of the disease, except perhaps in drunkards; and at no period should it be given as a matter of routine, or merely because the case is one of fever, but only to meet certain definite indications. These are mainly evidences of weakness of the heart—frequent, weak, and fluttering pulse, and weakness or absence of the first sound of the heart. When, as is usually the case, the tongue is also dry, and the teeth and lips are covered and the mouth lined with sordes, the indications for the use of stimulants are unmistakable. The effects should be watched; when alcohol does good the pulse becomes less frequent, and of better strength and volume, and the temperature is usually lowered; an important indication also is that the odour of spirit is not detected in the breath. When very high temperature and other unfavourable prognostic symptoms set in very early, stimulants may be given without waiting for the conditions above-mentioned. Alcohol is again often required as an adjunct to the treatment of fever by the cold bath. The safest form of stimulant is brandy or whiskey; the quantity needed will vary greatly in different cases; in some 2 or 3 ounces in the twenty-four hours will be sufficient, in others 10 or 12 ounces may be required. It should be given in divided doses in, or immediately after, the milk or beef-tea.

It will be convenient to say here a word on the use of opium. Its employment in certain complications—tympanites, peritonitis with or without perforation, hæmorrhage, and excessive diarrhœa—will be described later; the question now is whether it is well to give it for the relief of sleeplessness and restlessness. In the writer's opinion, when the restlessness is not so far allayed by cold or tepid sponging as to permit of sleep, it is of great advantage to the patient to give 10 or 15 minims of laudanum at night, or its equivalent in some other form. The writer has not found it to interfere with the digestion.

It is now almost universally recognised that it is not in the power of medicinal agencies to cut short an attack of fever, or indeed effectually to modify its course; no specific treatment, therefore, has to be described. It is true that the hypothesis of the bacteroid origin of typhoid fever has led to the employment of carbolic acid, of sulpho-carbolates, and of salicylic acid, and good results are said to have been obtained, but satisfactory evidence is still required. Every new line of treatment is pronounced to be successful for a time. In a large proportion of cases no medicine need be given from first to last, but effervescing salines are usually grateful; the mineral acids, at one time very largely employed, often seem in small doses to do good; and one or two grains of quinine may frequently be given with advantage. It should be understood that medicines are of less importance than food, and that they are not to be allowed to interfere with its regular administration. A gentle aperient at the outset is often useful, but it may be blamed for subsequent diarrhœa. At one time grey powder (3 or 4 grains) was given two or three times a day during the early part of the attack, and in watching cases so treated the writer's impression has been that the fever has been moderated. A single dose at the outset has seemed to him to do good. In Germany the treatment is often begun by administering 6 or 8 grains of calomel in two doses. The main use of pharmaceutical remedies in typhoid fever is in the treatment of certain emergencies, and of the various complications, and this will be for the most part described at the same time with the complications. An important drug, however, has not been mentioned, namely, digitalis. This has been employed in considerable doses for the purpose of forcing down the temperature, sometimes alone, but more commonly as an adjunct to quinine, and it has been said that it is not to be given for the purpose of strengthening the failing heart, or of reducing the frequency of the pulse. In the writer's experience it is of great value for these last-named purposes, given with ammonia or other stimulant, or with tonics.

There still remains to be discussed the employment of the cold or graduated bath. The great source of danger in typhoid fever is the prolonged high temperature, and it is to this, rather than to the fever poison or process, that are due the prostration of the nervous system, and the weakness of the heart which are the most frequent causes of death; to keep down, therefore, the febrile heat of the body is to diminish very greatly the danger attending this disease, and such is the object of the treatment by bathing. The cold-water treatment of fever was, as is well known, originated by Dr. James Currie, and practised with marked success by him and many other distinguished and trustworthy physicians. Notwithstanding results obviously good, it fell into disuse, till revived by Dr. Brand, of Stettin. Dr. Brand's method is to place the patient in water at a temperature of 65° or 70° Fah. whenever the temperature of the body, as taken in the rectum, reaches 102·2°, and to keep him there for ten, fifteen, or twenty-five minutes, until the heat is reduced 2°, or at any rate until he has been shivering for some minutes. Liebermeister takes 103° as the temperature which requires the bath, and this he does not make quite so cold, that is, 75° Fah., while he recommends ten minutes only as the period of immersion. The bath has to be repeated three, six, or eight times a day, as often indeed as the heat of the body rises to the point named; and it must be persevered with for two or three weeks or more, as may be required. A little brandy is given before or during the bath; and when the patient is taken out of the water, he is placed in bed, dried, covered up, but not too warmly, and kept at rest (*see* HYDROTHERAPEUTICS). In order that the full benefit may be obtained from this treatment, it must be begun early, in which case the temperature need never be allowed to reach an injurious height, and it is claimed that the intestinal lesions are also held in check. When thus carried out, it must be taken as established that the mortality of enteric fever is very greatly reduced by the bathing; Jürgensen's statistics show a reduction from 15·4 per cent. to 3·1; Liebermeister's from 27·3 to 8·2 (this observer, however, employing quinine largely); others show a still larger fall; and it may be safely estimated that in France and Germany the deaths have been diminished by at least one-half. No such results unfortunately are as yet forthcoming in England, but Dr. Cayley has shown that they are to be expected, and the writer's own experience is corroborative of his conclusions. Against the advantages of cold bathing are to be set off the difficulty of carrying it out, and the labour it involves; the prejudices of the public, and the dislike and dread of some patients; the facts that some cases may be protracted (which, by the way, might otherwise end fatally); and that relapse is certainly more frequent. These are good reasons for trying whether the same end may not be attained by other means; but unless we are successful in this, the duty of the medical attendant is to insist on the uncompromising employment of the cold bath. The graduated bath, in which the initial temperature of the water is 90° Fah., or, as the writer has found to answer the purpose equally well, 80°, is often more acceptable to patients, the water being cooled down rapidly to 70° or 65°. If the fever be high, and the nervous prostration great, conditions in which the shock of sudden cold is of great service, the cold water added to bring down the temperature may be poured over the patient's head. The cold wet pack and Thornton's ice-cap have been tried as alternatives to the bath, but without effects adequate to the requirements of the case. It has been hoped again to prolong the effects of the bath, and so render frequent repetition unnecessary, by the administration of large doses of quinine or salicylic acid. Quinine, to keep down the temperature for any considerable time, must be given in large doses, 30 or 40 grains; and even this amount will, as a rule, produce no decided impression unless the way has been cleared by a bath. It is to be given, then, shortly after a bath in two or three equal portions within the space of about half-an-hour, and a little laudanum may be given with, or just before the quinine, to prevent vomiting. Very frequently the temperature remains depressed for twenty-four hours afterwards, sometimes even for a longer period. The patient often suffers from severe symptoms of cinchonism, but in view of the advantage obtained this need not be seriously regarded. Sometimes, however, violent and protracted vomiting is set up, which is an absolute bar to the further employment of quinine, except hypodermically. The neutral sulphate is the most convenient form for this purpose, and it is sufficiently soluble to be given in adequate doses, that is, of 5 or 6 grains. The writer's own experience tends to the conclusion that the frequent bathing has advantages over the combination of quinine with the bath, both as regards the safety and the comfort of the patient; though he has also seen cases in which the bath alone seemed inadequate, while with the aid of quinine the fever was kept down. He has twice seen severe tetanus produced by the bath and quinine, both cases, however, recovering. Salicylic acid and the salicylates have appeared to him to have a dangerously depressing effect. Of digitalis employed in large doses as an antipyretic, he has had no experience.

Without going so far as to say that Brand's rule should be obeyed absolutely, and in all cases, the writer is of opinion that many lives would be saved were cold-bathing at once put in practice, whenever a temperature of 103·5° or 104° Fahr. in the first few days shows that the attack is of more than average severity; and it is of the greatest importance that this should be done early, so that the pyrexia may never get the upper hand, and that the intestinal lesions may, if such a thing is possible, be modified. And no patient should be deprived of the chance which is afforded by the bath when, at any stage of the disease, life is threatened by hyperpyrexia or by consequences of high temperature, such as violent excitement, sleeplessness, restlessness, or nervous prostration. The only complications which render the bath inadmissible are hæmorrhage, peritonitis, and the advanced cardiac weakness and degeneration sometimes found late in the disease. Albuminuria or pulmonary affections do not constitute a bar to cold bathing. The writer has known albumen to disappear from the urine at once, and pulmonary congestion to clear up after a single bath.

Treatment of Complications.—We will now consider the treatment of the chief symptoms and complications. The most careful watch should be kept for complications at all stages of the fever, but especially after the end of the second week. A rise of temperature must always be taken to have some definite significance requiring explanation. With increased frequency of respiration, it may be the sole indication of the accession of pneumonia or pleurisy. A fall of temperature may give warning of hæmorrhage. Retention of urine, though uncommon in typhoid as compared with typhus fever, should always be borne in mind; and unusual restlessness should at once suggest an examination of the hypogastrium. The passage of a catheter has often put an end to sleeplessness and excitement. Bed-sores ought never to occur, and it will conduce to their prevention for the medical attendant to inspect the sacral region and other parts where they are liable to be produced.

Hæmorrhage.—In the treatment of hæmorrhage the first thing to be done is to arrest the peristaltic action of the bowels by a full dose of opium; and as an immediate effect is required, one of the liquid preparations should be given—the tincture or liquor, and the dose may be from 20 minims to a drachm. The bleeding vessel has to be closed by a clot, and peristaltic movements will tend to disturb this, while it must be remembered that the blood poured out is a continued provocative of movements on the part of the intestine. Direct astringents which depend on local action are useless; before they could travel the whole length of the small intestine, and reach the bleeding point, they would be neutralised by combining with the intestinal contents. Physiological hæmostatics may be of more service. Alternate doses every hour or every two hours, of liquor ergotæ, ʒss to ʒj, and of turpentine ♏x–xv have seemed to the writer to have most effect. Acetate of lead and opium or morphia, sulphuric acid and decoction of logwood, tannic acid, and all the known styptics have been recommended. An important adjunct—probably more effectual than any internal remedy except opium, is an ice-bag over the region of the cæcum; this at the same time quiets peristalsis, and contracts the vessels.

Stimulants must be given if the patient is in danger of dying from syncope, but it must be borne in mind that fainting gives time for the vessels to close, and until the bleeding has stopped, this condition must not be too diligently averted. We must, in fact, sail as close to the wind as is consistent with safety. The same considerations apply to the administration of food; very little, if any, should be given by the mouth for twenty-four hours, nourishment being supplied by small nutrient enemata.

Perforation.—The only treatment likely to be of any service is the administration of large doses (ʒj or more) of laudanum or liquor opii or an equivalent of morphia, either hypodermically or by the mouth. This has saved life in a few cases of undoubted perforation, but in the immense majority of cases a fatal termination speedily ensues.

Peritonitis.—Here, again, opium in repeated moderate doses is the most useful remedy; with poultices applied over the abdomen.

Tympanites.—Once more the remedy is opium, which should be given in pill three or four times a day when the distension is late and gradual; in very large doses of some liquid preparation when it is sudden. Charcoal has been recommended, but in the writer's experience it has rarely been other than hurtful.

Diarrhœa.—As long as the stools do not exceed three a day, or while they do not appear to distress or exhaust the patient, nothing special need be done to check the diarrhœa. It must always be borne in mind that beef-tea or other strong flesh-juices may excite diarrhœa; undigested curds of milk may have the same effect. As soon as undue frequency in the action of the bowels is observed, any possible cause in the diet should be eliminated; this failing, the best remedy is an opiate enema, 20 or 30 drops of laudanum in 2 ounces of thin starch. In most cases two or three enemata will arrest the diarrhœa; should this not happen astringents must be given by the mouth—acetate of lead and opium or morphia, sulphuric acid, laudanum, logwood, or tannic acid.

Constipation.—This, whether intercurrent when there has been diarrhœa, or present throughout the fever, is a perplexing symptom. It is best relieved by enemata given every other day, but sometimes these are insufficient: a teaspoonful of castor oil may then be given, care being taken that any accumulation in the rectum which might give rise to difficulty is previously removed by enema.

Albuminuria.—Nephritis must be treated by poultices and dry cupping over the kidneys. Albuminuria due to alteration of the blood requires no special treatment, and it is not a bar to cold bathing, but on the contrary may be among the symptoms calling for it. The disappearance of albumen from the urine, which is sometimes observed when the temperature has been reduced by bathing, seems to show that the blood-change is due to the pyrexia, and not to the poison.

Pneumonia.—When pneumonia sets in, stimulants are generally required, and the patient will derive benefit from bark or quinine, which may be given in the form of the ammoniated tincture. Turpentine in small doses, or the stimulant balsams, will often be found useful. Turpentine stupes are generally better than poultices.

Thrombosis.—Elevation of the leg on soft cushions, warmth, and gentle support by means of a flannel bandage, will be the treatment required.

W. H. Broadbent.

TYPHOID STATE (*τῦφος*, stupor).—Synon.: Fr. *État typhoïde; État adynamique*; Ger. *Typhose Erscheinungen.*

Definition.—A condition which may arise in the course of any febrile disorder, when the approach of death is gradual, and the rise of temperature either excessive or long-continued. The typhoid state is, however, most frequent in typhus, enteric, yellow fever, and pernicious malarial fevers; and in such cases the tendency is often evident from the very beginning of the attack.

Ætiology.—It is unwise to attempt to attribute all these different symptoms to one single cause. The chief primary cause may be the injurious influence of a high internal temperature upon the central nervous organs, but this same temperature acts directly also upon the parenchyma of glandular organs, and upon the muscular fibre, both of the heart (Stokes), and of the voluntary muscles (Zenker); and the disorder of the nervous centres must be greatly increased by, if not sometimes directly due to, the changes in the composition of the blood, and in the forces of the circulation.

Description.—The symptoms of the typhoid state relate chiefly to the nervous system, and indicate depression, not excitement. There is low muttering delirium, passing into stupor, with little or no true sleep (*coma-vigil*); with derangement of the senses, and hallucinations of sight and hearing. The urine and fæces are passed unconsciously, or there may be retention of urine. The sensibility of the skin is greatly impaired: flies may creep unnoticed even over the eyelids. General muscular weakness is marked, the patient lying on his back, sunk down in the bed. The lips and gums are covered with sordes, and the tongue is dry and black. *Subsultus tendinum* is present. The pulse is frequently running, so that it is difficult to distinguish and count the beats; small and weak; sometimes irregular and easily affected by slight causes, for instance, failing distinctly during inspiration. The heart's impulse is greatly weakened; the first sound almost or quite lost at the apex. The skin is dry, if, as is often the case, the temperature is high, 104–5° Fahr. or upwards; or it is bathed in clammy sweats, which rarely prevail at one time over the entire surface. There is lividity of, or even ecchymoses on, the under aspect of the trunk and limbs; and in the exanthematous fevers the eruption becomes petechial. The breathing is hurried, shallow, and towards the close frequently assumes the type known as Cheyne-Stokes respiration.

Prognosis.—The prognosis of the typhoid state is always grave, but in fevers which run a definite course recovery may take place, even when the condition is fully developed, if it be so only at or near the crisis.

Treatment.—The treatment consists in the free use of stimulants. Of these brandy is the best, and may be given in doses of half an ounce every half-hour or hour; but the quantity must be determined, not by measure, but by the effects upon the patient. If no improvement follows its exhibition by the mouth, frequently repeated rectal injections of brandy with egg or strong beef-tea ought to be tried. Musk, in doses of one to three grains, has been recommended, but the writer does not attach any value to this drug in these cases. The subcutaneous injection of five to fifteen minims of ether is often so successful in increasing the vigour of the heart's action, that it well deserves a trial here, too, if other means prove ineffectual. If the temperature is excessive, the cold or tepid bath, or the cold pack, should be used; but immediately before or during the application of external cold, half an ounce of brandy at least should always be given. The salutary effects of cold are maintained and increased by full doses of quinine, such as five or ten grains of the sulphate every hour, until twenty or thirty grains have been taken. The writer cannot advise the use of salicylic acid or its salts in the typhoid state. External stimulating applications are not without value, for example, vesication by blistering fluid, or by strong liquor ammoniæ to the shaven scalp, when nervous symptoms predominate, or a flying blister to the præcordia when the heart's action is seriously impaired. Throughout the typhoid state the patient's strength must be husbanded as carefully as possible; and the great object of the nursing should be to save him from the necessity of any mental or muscular effort whatever.

JAMES ANDREW.

TYPHUS FEVER (τῦφος, stupor).—Synon.: Fr. *Typhus*; Ger. *Typhus*; *Flecktyphus*.

Definition.—A contagious febrile disease, marked by a peculiar dark rash, with considerable cerebral depression, and lasting about three weeks.

Ætiology and Pathology.—Typhus is a disease of temperate and cold climates, and appears from time to time as an epidemic in our towns and larger villages. Purely rural parts of the country seem to be in a great measure exempt from it. Sometimes it spreads as an epidemic over a large part of the country, either affecting many towns simultaneously, or breaking out in them in rapid succession; but often it attacks only a single town, or a few towns at considerable distances from each other, leaving others between them untouched. When a serious epidemic of typhus occurs in a town, it usually lasts for a considerable period, often for the better part of three years; not, however, of the same severity throughout, but increasing or diminishing with the fall or rise of the temperature. Thus the greatest number of cases occur during winter, and the smallest number during summer; and changes of temperature are followed (not closely, but in a sort of rough way) by changes in the numbers attacked; whilst the ratio of mortality remains substantially the same from the beginning to the end of the outbreak. The larger number of cases is usually made up of females and young persons, and this is particularly noticeable at the commencement of an epidemic; but the heaviest rate of mortality is among the adult males.

Like the other exanthems, typhus usually attacks an individual but once; although it must be admitted that this is not invariable, for some persons seem liable to catch the disease as often as they are exposed to contagion. Such cases, however, must be considered as exceptional; while many cases of so-called second attacks are not real, and may be otherwise accounted for. When typhus enters a household, and sweeps over the members of a family, it often happens that one or two of them, instead of presenting the regular symptoms of the disease, are affected merely by a slight febrile attack, lasting for a short time. Such cases are usually spoken of as having had 'the fever' along with the rest of the family; and if they are at some future period affected with typhus, are set down as having undergone a second attack. This is obviously a mistake; but, even separating these cases, there remain a certain number—not very large, it is true—where a second or even a third attack has occurred in the same individual.

Although not so extremely contagious as scarlatina or small-pox, yet typhus is undoubtedly propagated by contagion.[1] The area of contagion is, however, limited to a comparatively small space around the patient. As the breath has a peculiar, heavy smell—noticeable, however, only within a short distance (a foot or two) of the patient's face, it is not unlikely that the contagion is contained in the exhalations from the lungs. Whether this be the case or no, the contagion is certainly propagated through the air; it is not capable of being carried by the clothes or by the excreta; and its free dilution with abundance of fresh air destroys entirely its noxious influence. Hence, if the patient can be isolated in a large, well-ventilated apartment, there need be no difficulty in preventing the spread of the disease to others of a family; and the facility of thus limiting typhus is in marked contrast with the great difficulty of doing so in such diseases as scarlatina or small-pox. Unfortunately, it is only among the wealthier classes of society that this mode of checking the spread of typhus can effectually be adopted, and hence the rapidity with which it sweeps over the poorer and working classes, when once an epidemic has fairly broken out.

If we examine carefully the details of any epidemic, we find that it is in the most crowded parts of a town that it always begins, and that in a given street it is in the most crowded houses that it appears; that if at the outset the population be quickly thinned by the removal of several of the inmates from a house or group of houses, the disease is often checked; but that it readily breaks out again if the crowding be renewed. Hence the primary cause of typhus is, in all probability, to be ascribed to the exhalations from a closely crowded population, pent up in small rooms, and prevented from free access of fresh air by the obstacle of houses closely packed together. This view of its origin readily explains its greater prevalence in winter, and its attacking females and young persons in greater numbers than adult males in a working population; for it is in winter that houses are, for the sake of warmth, most crowded and most badly ventilated; and the females and younger members of a family are those most continuously exposed to any injurious influences which the home may possess. This also explains the comparative immunity from the disease of purely rural districts, and the small extent to which the upper classes, and those inhabiting the open sparsely-built suburbs of our towns, are affected by it. It may be objected that, were this the cause, the disease ought to be an endemic constantly present in all our towns; but if it rarely attacks an individual more than once, it must evidently die out after a short time from lack of materials, and would not reappear for some years, or until another generation has grown up liable to its attacks. According to this view the bulk of typhus cases should be comparatively young; and this is found really to hold good, the great majority of those attacked being between the ages of ten and thirty.

It would seem as if in some epidemics typhus were connected with an under-fed or half-starved condition of the working classes; but this is by no means an essential condition. When famine exists, it will, for obvious reasons, carry with it the condition of overcrowding; and it will have a material effect on the results of an epidemic, inasmuch as it will render individuals less able to resist the disease, and so will not only facilitate its spread, but will increase the ratio of mortality. But even when the working classes are in full employment and well-fed, typhus from time to time breaks out among them, and the only condition uniformly observable is that of overcrowding.

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[1] Examination of cases where accurate data were attainable shows the period of incubation to be about a week. This may be shortened, or somewhat lengthened; but statements extending it over several weeks are to be received with much hesitation.

Anatomical Characters.—Of the pathology of typhus little is known. *Post-mortem* examination shows that the blood is dark-coloured, usually fluid, or presenting soft and very loose coagula in the cavities of the heart and the larger vessels. This appearance, however, depending apparently on a deficiency in the fibrin of the blood, is not peculiar to typhus, but is common to it with most zymotic diseases. No intestinal affection is seen, such as is present in enteric fever. The vessels of the brain are usually loaded, but there is no effusion, and no trace of any deposit, or of anything approaching to inflammatory change. The only decided lesion to be seen is in the cervical sympathetic, the ganglia of which are somewhat enlarged by a granular amorphous deposit. This, which extends more or less to all the cervical ganglia, is best seen in cases dying during the second week; when death occurs later, it is much less noticeable, or may be wanting altogether. From this it may be assumed that the condition passes away with the fading of the characteristic symptoms of the disease. Sometimes the deposit is limited to the ganglia of one side, and in this case it may be connected with a symptom occasionally observable—a difference between the temperature of the two axillæ. If this lesion be regarded as an essential feature of the disease, it would certainly afford an explanation of the localisation of the symptoms, of the disturbed function of the brain, and of the weak action of the heart; but even admitting this, there is still wanting an explanation of the nature of the infection, and of the reason why its force should be spent on these organs alone. It has been stated that there occurs a definite structural change in the heart itself, to which may be due the alteration in the heart's sounds; but this the writer has been unable to verify, although he has had the opportunity of looking for it in a large number of *post-mortem* examinations. The texture of the heart certainly is soft and flabby, with but little cadaveric rigidity; but the same is observed in the whole muscular system.

Symptoms.—Typhus frequently begins in a well-marked way with a rigor, or with headache and sickness—more commonly the former; but very often nothing definite marks the exact time of commencement, and then the symptoms come on slowly, and gradually increase in intensity. The symptoms may be shortly summarised as follows:—Heaviness and listlessness, with a certain amount of confusion of ideas, and a difficulty or impossibility of fixing the mind steadily or continuously on any subject; dulness of all the senses, with a heavy stupid look in the face; dark-coloured rash, in small dusky-brownish spots, especially noticeable over the abdomen, and not fading till convalescence begins; heat of skin, and rise of temperature; quick, weak, frequent pulse; white or brown dry furred tongue; thirst; constipation; and considerable muscular prostration.

The disease runs its course in three weeks, which may be divided into a week of onset, a week of danger, and a week of convalescence. During the first two or three days of the attack the symptoms may not be very urgent; the patient may be going about, and even at his usual avocations, although he feels that these are performed with difficulty, especially if they involve any mental exertion. Towards the end of the first week the symptoms become all well-marked; the characteristic rash makes its appearance; and the patient is now confined to bed. During the second week the symptoms increase rapidly in intensity, especially the muscular prostration, the rapidity of the pulse, and the confusion of ideas; and these steadily progress until the fourteenth day, when the disease appears to have attained its height. With the third week the tongue begins to clean, and the pulse and temperature to fall; the rash quickly disappears; the expression of the face changes; the mind becomes clear; and the symptoms gradually disappear. By the end of the third week the attack may be said to have terminated, but there is often much weakness left, and it may be some time before the strength is completely re-established. Usually a week or ten days will suffice for this; but after a severe attack, or in a patient previously debilitated, several weeks may be required.

The more important symptoms may now be described somewhat in detail:—

Nervous System.—The best-marked of the local symptoms are those referring to the brain. From the very commencement there is a feeling of dulness and heaviness, with an indisposition to any mental exertion; a dull heavy look about the face; a vacant expression in the eyes; a slowness in answering questions, and a partial confusion of ideas; the patient lying as if in a half dreamy condition, and paying little attention to anything around him. As the disease progresses, these symptoms become more and more marked. Even in comparatively mild cases there is often a little muttering, or a few incoherent words are uttered from time to time; but the patient is aware that he is talking nonsense, and readily admits it though unable to control it. In severer cases, again, the delirium is very decided; the patient lies perfectly indifferent, muttering incoherently from time to time; and replies scarcely, or not at all, to questions, although he is not absolutely unconscious, as he will protrude the tongue if sharply told to do so. Not unfrequently patients afterwards ask whether in this delirium they have not spoken of things they would wish concealed, but on this point they may be safely reassured; nothing like a continuous or connected train of thought passes through the mind—all is disjointed and fragmentary; and accordingly the words uttered, even if pieced together, are entirely meaningless. Along with this confusion of ideas goes a dulness of all the senses; taste and smell are entirely lost; and although, from the great thirst, there is a craving for drinks, yet all are accepted alike, and the feeling of relief which they give is unconnected with their taste, which is not really perceived. Hearing is considerably dulled, a certain amount of deafness being a very common symptom; so that it is necessary to speak to the patient in a distinct tone of voice, and tolerably close, otherwise he will fail to catch what is said to him. Vision is seemingly also a little impaired, although not to so marked an extent as the other senses. Even ordinary tactile sensation is dull, and the impressions derived from it are often confused.

Muscular System.—Muscular prostration is, even from the first, a prominent symptom. At the very onset, and while the patient may still be going about, he complains of a feeling of weakness; the gait is often somewhat unsteady; and after he is confined to bed this weakness becomes more marked. In serious cases he lies supine, turning himself rarely, or in bad cases not at all. If turned on the side he soon slides round again upon the back; the limbs are allowed to lie slack in almost any position; when the hand is raised it is tremulous; so also is the tongue when protruded—the very protrusion is accomplished with difficulty, and the point is pushed scarcely, if at all, beyond the lips. In bad cases, subsultus is occasionally present. This muscular prostration, in conjunction with the dulness of sensation, is doubtless the cause of the constipation so usually present; and the occasional occurrence of retention of urine is to be explained in the same way, by inattention to the sensation, and by disinclination to make even the slight exertion requisite for emptying the bladder.

Circulatory System.—The pulse is always weak, and commonly frequent. In mild cases it does not usually rise over 100; in more serious ones it rises to 120; and in bad cases to 140, or even more. The character is, however, of more importance than its frequency; for while a very frequent pulse always indicates danger, a comparatively infrequent pulse, if it be weak and jerking in character, may be equally serious, and hence it occasionally happens that cases prove fatal where the pulse has not risen above 100. In some cases the pulse is markedly dicrotic during the second week, and this especially happens if there be any pre-existing lesion of the heart.

A good deal of stress has been laid by some observers upon the action of the heart as indicated by the stethoscope. In all serious cases, the heart's sounds are much fainter than usual, and one or other, more commonly the first sound, may become so faint as to be inaudible. This condition is generally most readily made out by placing the stethoscope over the apex of the heart, when the altered character or absence of the first sound is at once noticeable. Sometimes the second sound, as heard over the base of the heart, is lost; but this is unusual. The alteration or absence of the first sound has no necessary connection with the rapidity of the heart's action, being as often present when the number of beats is under 100, as it is when the number is over that figure; but the symptom marks the weakness of the heart's action, and is always associated with a weak pulse, and a considerable amount of cerebral disturbance.

Digestive System.—With great thirst, there is a dry tongue, which is first white and finally brown. The brown colour is at first in the form of two broad bands, one on each side, the centre and edges remaining white. In bad cases the whole tongue becomes brown, often cracked and bloody; and the same dry, cracked, and bloody appearance may extend to the lips, the gums and teeth becoming crusted with sordes. When the week of convalescence begins, the tongue at once commences to clean at the edges; then becomes moist; and finally the fur clears slowly off. It generally requires the whole week of convalescence to accomplish this.

Eruption.—The rash in typhus fever is very characteristic, and is almost invariably present, although the amount varies much. In an epidemic stray cases from time to time occur where the rash is wanting, and the symptoms are otherwise mild; but it may be doubted whether these are cases of genuine typhus; at any rate it is amongst cases of this kind that second attacks are chiefly found. The rash appears in the form of small, roundish, dusky, or brown-red spots; not raised at all above the surface; generally very distinct, but sometimes indistinct, as if dimly seen through a hazy medium. It is always most marked about the upper, or middle and upper parts of the abdomen; and it may be limited to a few spots there. If more extensive, it is scattered over all the fore part of the abdomen, and over the lower and central parts of the chest. It sometimes extends to the limbs, and is then found over the fore part of the thighs and arms; but this is by no means very common.

The rash shows itself during the latter half of the first week, most commonly about the fourth or fifth day; but sometimes its appearance is delayed till the early part of the second week. The spots, if few, appear nearly simultaneously; but if numerous may come out in successive crops, extending over two or three days. Once out they undergo no further change, except a gradual deepening or darkening in colour. They remain out till the commencement of the week of convalescence, and then they rapidly disappear. In bad cases petechiæ may also be present, and passive hæmorrhage in any situation.

COMPLICATIONS.— The only complication of common occurrence in typhus is a low form of pneumonia. This seems to begin chiefly by hypostatic congestion; it occurs first at the back of the lungs, usually affecting both more or less; and seems to be due mainly to position. The patient, in severe cases, lies nearly continuously on the back, and this posture, along with the weak and languid state of the circulation, permits a gorging of the posterior part of the lungs. Probably in all severe cases this gorging is present to a certain extent—at least, it is a very common *post-mortem* appearance; but in some cases the condition goes a step farther, and drifts into pneumonia. The disease thus produced rarely runs the course, or presents the symptoms, of acute pneumonia; it scarcely goes beyond the first stage, presenting on *post-mortem* examination a very dark appearance, as if of great venous congestion, with a certain amount of œdema and solidification: but usually nothing of red or grey hepatisation. When it does appear, it is commonly towards the end of the second week—the period when the causes above-mentioned are in operation to the greatest extent, and if it involve much of the lung, it proves fatal in a few days. Most of the cases that are fatal during the third week are cut off by this complication. Occasionally, though rarely, the attack of pneumonia continues longer, and causes death in the fourth week, that is, after the attack of typhus is over; but in such cases the symptoms and *post-mortem* appearances approach more to those of ordinary pneumonia. The signs of this complication are cough, with little or no sputa; more or less oppression of the breathing; and small crepitation, most noticeable always at the back of the chest. This last is to be accepted as the reliable indication, for the patient, as a rule, makes little or no complaint; and, therefore, if cough, even to a small extent, be present, the stethoscope should be used to determine the state of the lung. It sometimes shows itself after the week of convalescence has begun; and if at that time the tongue becomes again dry after it has begun to clean, or if the pulse begins again to rise, the chest should be examined, even though no cough be spoken of, for the arrest of convalescence is often due to the commencement of this affection of the lung.

DIAGNOSIS.—Typhus as above defined is readily recognised. It is distinguished from typhoid or enteric fever, by the character of the eruption, which in typhus is in dusky brown-red *spots*, remaining out till convalescence, whilst in enteric it is in bright rose-red *points* coming out and fading in successive crops; by the presence of the head-symptoms; and by the absence of sickness, vomiting, diarrhœa, and abdominal tenderness. From meningitis, or any acute cerebral affection, it is distinguished by the absence of excitement or of acute pain; by the character of the delirium; by the dry-coated, usually brown, tongue; by the weak pulse; by the eruption; and by the muscular prostration. From any chronic cerebral affection it is distinguished by the presence of fever, in addition to the above characters.

MORTALITY AND PROGNOSIS.—The ratio of mortality from typhus varies somewhat in different places and in different epidemics; but the average may be stated as from 10 or 12 to 18 or 20 per cent. This, however, applies only to the total mortality extending over a large number of cases. If this mortality be analysed, it is found that it varies directly with the age. In the young the mortality is small, in the middle-aged it is considerably increased, and after middle life it is very high. This may be expressed in figures thus:—under 25 years of age, mortality about 5 per cent.; from 25 to 50 years of age, mortality about 25 per cent.; over 50 years of age, mortality about 50 per cent.

In adults the rate of mortality is usually higher in males than in females,[1] a difference, however, which does not hold good in the case of young persons or children. This is probably due to the circumstance that when females or young persons are attacked, they are at once put under treatment, or at least allowed to rest; whilst adult males, especially heads of families, struggle on for some time after the disease has begun, being unwilling, for the sake of those dependent on them, to give up work until the advance of the disease compels them to do so; and by this means the strength is exhausted early in the disease, and the chance of recovery materially impaired. In the better classes of society, the ratio of mortality is often higher than among the working classes.

The bulk of the deaths occur in the second week, and most commonly in the latter half of it—from the tenth to the twelfth day inclusive being the most fatal period. Death very rarely occurs during the first week, although in bad cases it may occur early in the second week. It sometimes happens that death occurs in the third week in uncomplicated cases, as if there had not been sufficient strength left to rally after the brunt of the attack was over; but this is unusual. When death occurs in the third week, it is commonly due to pneumonia.

The prognosis in typhus depends on the severity of the symptoms, especially of the brain-symptoms, and of the muscular prostration. If there be much delirium or muttering incoherence, the prognosis is bad, especially if, as is commonly the case, this be associated with a quick pulse (130 or over), such cases being usually fatal. On the other hand, if the pulse be not over 100, if there be little confusion of ideas, and if plenty of nourishment be taken, the case is a mild one, and will readily recover. The indications from the rapidity of the pulse, and from the cerebral symptoms, do not, however, invariably coincide; and in that case the latter are the more to be regarded. Thus, if there be much incoherence, with indifference and prostration, and but little nourishment be taken, even though the pulse may not be over 100, the prognosis is bad; whilst, if there be little confusion, and plenty of nourishment be taken, even though the pulse be 120, the prognosis, though guarded, is not unfavourable. The character of the pulse, as to weakness or otherwise, is of more value than the mere rapidity. If the pulse rise much early in the attack, it is indicative of danger. The amount of the rash seems to be of little moment, and is no guide to the severity of the attack. If the tongue, after beginning to clear, become again furred, or if the pulse rise again after having fallen, it is significant of danger, and points to the occurrence of some complication, most commonly pneumonia.

The stethoscopic character of the cardiac sounds (impairment or absence of the first sound) may be associated with weak pulse and cerebral disturbance, as a measure of the amount of danger. It implies great weakness of the heart's action, corresponding so far to the muscular prostration elsewhere noticeable, only to a greater extent; and, as occurring in so important an organ, indicating always the presence of danger.

TREATMENT.—*Preventive.*—When typhus breaks out in a family, the first step to be taken is to endeavour to prevent its spread. For this purpose the patient should be isolated, and placed in a large well-aired room, with a single attendant as nurse; and as little communication as possible must be allowed with the rest of the inmates of the house. Amongst the better classes of society, this is easily effected; but amongst the working classes an arrangement of this kind is usually impracticable, and then the best course is the removal of the patient to a suitable hospital. This removal should be effected at once, not only because the risk of the disease spreading is lessened by thus removing a source of infection; but also because removal late in the disease is always injurious to the patient, and often dangerous. In this removal the patient should always be carried, and not allowed to walk, even should he fancy himself able to do so.

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[1] In pregnant females abortion often occurs, and such cases are usually fatal.

Curative.—Many attempts have been made, by very various means, to cut short the disease; but of these it may be said that all have failed. The principle of treatment is therefore to keep up and economise the strength by every means, until the fortnight shall have passed, when convalescence will occur of itself. For this purpose constant and careful nursing is essential. The patient should be kept absolutely in bed, and not allowed to rise, even in the early days of the attack, when he may fancy himself able to do so; he should be fed at short intervals with liquid nourishment, especially milk and strong beef-tea, or strong soups, and these should be given to as great an extent as the patient can be induced to take them. The thirst should be relieved by diluents of any kind, such as plain water, barley water, effervescing drinks, or diluted lemon-juice. Taste being nearly gone, the patient will take them indiscriminately; but it should be remembered that in serious cases he will not trouble to ask for them; they should, therefore, be offered very frequently, and the nourishment should also be pressed upon him. The tendency to constipation is easily obviated by an occasional dose of castor oil. Care should be taken that the bladder is regularly emptied; not that there is any real retention, for the patient can readily empty it if he makes the effort. Usually all that is required is to tell him to do so; but sometimes, though rarely, it may be requisite to pass the catheter. Absolute quiet should be secured; the patient should not be spoken to more than is absolutely necessary; no conversation should be permitted; if he talks in a rambling way, as is often the case, he should not be answered. For sleeplessness or delirium, the best remedies, besides quiet, are darkening the room, and applying cold wet cloths steadily to the head. Cold applications frequently soothe the delirium and procure sleep. Opium and sedatives are ill-borne, and should never be had recourse to. The use of stimulants has been much debated; but there can be little doubt that their judicious use in moderate quantity is often very advantageous. They ought not, however, to be used indiscriminately, nor should they be employed early in the disease, but should be kept, as it were, in reserve, to push through an emergency. The best guides to their employment are the rapidity, and especially the strength, of the pulse; the extent of the muscular prostration; and the quantity of nourishment taken. If the latter be taken in fair quantity, and the weakness be not very great, the case will recover without the use of stimulants, and then they are better omitted. Recourse should not be had to them sooner than is absolutely necessary—certainly not during the first week if it can at all be avoided; and their use need not be prolonged far into the third week, for as soon as the appetite begins to return, reliance should be placed upon feeding, and stimulants should be laid aside. The quantity administered need not be large; four to six or eight ounces of wine, in small quantities at a time, in the twenty-four hours—a little more, with perhaps a small quantity of brandy added, in bad cases—will procure all the advantage obtainable; large doses tend to increase the head-symptoms, and do harm. The best indication of their doing good is the falling of the pulse. Attention should be given to the position of the patient, especially in view of the possible occurrence of pneumonia, or occasionally, in spare or emaciated individuals, of bed-sores. To avoid this, the supine position, which the patient always assumes in serious cases, should from time to time be altered, and he should be occasionally turned on one or other side. He will not lie long thus, but will gradually slip round again on to the back; but the change of position, even for a short time, is useful. If pneumonia occur, ipecacuanha or similar remedies in small doses should be had recourse to, along with stimulants. Cold sponging, especially of the face and hands, when the skin feels hot, is extremely agreeable and soothing to the patient.

R. Beveridge.

TYROSIN.—Tyrosin ($C^{18} H^{11} NO^{6}$) is always found in conjunction with leucin. It is never found in healthy livers (Kühne), but is perhaps present in small quantities in the spleen and pancreas. It is found in the liver and urine of acute yellow atrophy, and said to be present in the urine of typhoid fever and variola. The significance of tyrosin in the urine is uncertain. Under the microscope tyrosin is seen as fine colourless needles, but this appearance must never be trusted without chemical tests. Its mode of preparation is the same as that of leucin; but the residue of this, insoluble in boiling alcohol, must be dissolved in boiling water, and set aside to cool and crystallise. If to a solution of tyrosin a few drops of nitrate of mercury be added, and the whole boiled, the fluid becomes a rosy red, and throws down a red precipitate (Hoffmann's test). *See* Leucin; Jaundice; and Liver, Atrophy of, Acute Yellow.

J. Wickham Legg.

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ULCER and ULCERATION (*ἕλκος*, *Ulcus*, a sore).—Synon.: Sore; Fr. *Ulcère*; Ger. *Geschwür*.

Definition.—A solution of continuity on an epithelial or endothelial surface, secreting pus.

Ætiology.—A breach of surface may arise from external causes, such as a cut or laceration, pressure, destruction produced by an escharotic, a burn, or a bruise; or, on the other hand, it may result from changes commencing within the tissues themselves. These might be acute inflammation, giving rise to pus; chronic inflammation, giving rise to thickening of the fibrous tissue, with strangulation of the blood-vessels passing through it to the surface; or defective nutrition of the skin and subcutaneous tissues, as seen in senile subjects.

Anatomical Characters.—The parts of a healing ulcer are—the *surface*; the thin blue epidermic *pellicle*; the *edges*; the *surroundings*; the *discharge*. When an ulcer departs from the healing type, every possible variety of appearance occurs in the surface, edges, surroundings, discharge, and in the character and intensity of the accompanying pain.

When a section of an ulcer is examined microscopically, the following parts are made out:—a layer of pus on the surface; projecting up into the pus, fine points consisting of loops of blood-vessels, coated over with living white corpuscles, constituting granulations; beneath this, a zone of thickened inflammatory tissue, consisting mainly of fine fibrous tissues; and underneath this again, a zone of hyperæmia, where the blood-capillaries are very numerous, and the white blood-corpuscles are in excess. Beyond this zone healthy tissues are met with.

Should the whole of the affected part be seen on a perpendicular section, it would appear depressed in the centre, and each zone, from the surface downwards, would appear as an arc of a greater circle than the previous. Should the ulcer be other than healthy, the same parts would be met with, but each part would be modified according to the cause and character of the ulcer.

The history of the commencement of an ulcer will evidently vary, according as it originates (1) from *external*, or (2) from *internal* causes.

1. When *a wound* does not heal by primary union, by scabbing, or by first intention, it begins in twenty-four hours to show signs of active hyperæmia. The surface exudes first serum, then white blood-corpuscles, fibrin, and albuminous matters; the surroundings become congested and swollen; granulations appear in the bottom of the wound; and an ulcer is thus established.

2. When the changes commence *within* the tissues, they depend upon some local irritation, causing a determination of blood to the part. The irritation may be a varicose vein, a foreign body, a gumma, a strumous gland, or a scirrhus tumour. The blood-vessels at first exude serum, which infiltrates the neighbouring tissues, causing them to swell. White blood-corpuscles and fibrin after a time escape from the blood through the capillary walls, and the irritated spot becomes permeated by an embryonic connective tissue. The tissue thus formed passes, as the result of chronic irritation, to a higher state of development, becoming fine fibrous tissue, and having a tendency to shrink or contract upon the structures passing through it. The consequences of such a change as this in any part are, first, an increased activity of its normal functions; and, secondly, a cessation of its functions, and destruction of the tissue from the cutting off of its nutrition.

A section of the part in this condition would show the irritating spot in the centre, then a zone of indurated fibrous tissue, and around all a zone of hyperæmia. When the skin becomes involved it changes colour, the epidermis is shed rapidly, serum oozes out through cracks and fissures, and finally may collect on the surface to form a scab. When the scab falls off, a raw surface, consisting of the papillary layer of the skin, is seen, and from this a discharge flows away, becoming thicker and more purulent. The surface is now an open sore, secreting matter, and exists as an ulcer.

Pathology.—**Ulceration.**—The ulcerative process is so intimately associated with inflammation, suppuration, gangrene, phagedæna, granulation, and cicatrisation, that it is impossible to detach it from any one of these, and call it a separate definite process. Few writers agree in their descriptions of the extent of the process, some looking upon the ulcerative process as implying destruction of the tissues only; others, as signifying both destruction and repair. In its widest sense, the ulcerative process is the process whereby ulcers are formed, spread, arrested, maintained, and healed. The actual formation of an ulcer has been discussed; and when the ulcer is once established, the ulcerative process is seen to be a liquefaction and dissolution of the edges, and the formation of granulations and discharge. This process goes on from the beginning to the end of the history of an ulcer, so that it is impossible to say that it ends before healing takes place.

In the immediate neighbourhood of any ulcer, vascular changes take place, which have to be followed closely before the ulcerative process can be understood aright. In the first place, the capillaries in the neighbourhood of the irritated spot are in a state of tension, from increased blood-pressure, and they tend to relieve themselves by the transudation, first, of serum, and then of white blood-corpuscles and fibrin. These products behave differently, according as they escape into the *surrounding tissues*, or reach the *surface*.

(*a*) When the cells and fibrin escape into the *surrounding tissues*, they infiltrate the immediate neighbourhood of the ulcer, and produce swelling and blocking up of the tissues, and beyond that an area of increased nutrition, caused by the determination of blood. The pressure on the blood-vessels leads to interference with the circulation, and as a consequence, to a deficiency of the nutrition of the surrounding tissues. The cellular elements of these tissues swell, undergo degeneration, liquefy and are absorbed, or remain in the tissues. According to the intensity of the irritation, and the condition of the patient, so the area of infiltration and of liquefaction extends, and the degenerative process continues; or, on the other hand, along with the infiltration, induration occurs, and stays the processes of destruction. The arrest of the extension of infiltration, by the formation of a barrier of firm, fibrous, indurated tissue, is necessary before repair sufficient to heal the ulcer is induced.

(*b*) The portion of the transudation that reaches the *surface* consists of two parts. The part for which sufficient nutrition cannot be obtained flows away as pus, whilst the part that is retained in close proximity to the blood-vessels becomes formed into a layer of embryonic connective tissue. This layer, as the irritation declines in intensity, increases in thickness, becomes vascularised, and rises into small protuberances constituting granulations. The vascularisation of the embryonic connective tissue keeps pace with the continued addition of new cells on the surface, and so the reparative action is kept going. The deeper layer of first-formed cells now become spindle-shaped, with their long axis parallel to the blood-vessels. Along with the blood-vessels, lymphatics and sympathetic nerves find their way into the granulations. The spindle-shaped cells now form a denser tissue and shrink, and, as a consequence, the granulations diminish in size; the purulent secretion grows more scanty; and by-and-by the whole surface is involved in cicatricial tissue, and glossed over by an epithelial pellicle (*see* CICATRIZATION). The details of this process will vary according as the destructive or the reparative process predominates; the predominance of the former will cause ulcers to spread, forming inflamed and phagedænic ulcers; whilst the predominance of the latter will cause ulcers to heal, or when in excess to form 'proud flesh' or weak ulcers.

That an ulcer heals by the building up of new tissue is much to be doubted. The ulcer comes to the same level as the surroundings, not so much, if at all, by the growth of its granulations, as by the subsidence of the swelling and induration in the edges and surroundings themselves. Before it can heal these must be restored to a normal state, and it is only when this takes place, and the same level is reached, that the epidermis advances and glosses over the fibrous tissues of the cicatrix.

VARIETIES.—No better classification of the varieties of ulcers than Syme's can be given. All writers on surgery, since his time, follow the spirit if not the letter, of his classification, and it is proposed to adopt this system here, noticing in order the following varieties of ulcers:—1. the *healing* or *healthy*; 2. *those which do not heal, from defect of action*; 3. *those which do not heal from excess of action*; and 4. *those which do not heal, from peculiarity of action.*

1. The healing or healthy ulcer.

The surface is covered by granulations, which are small, sensitive, and bleed when smartly touched. There is a thin, blue, epidermic pellicle, consisting of the epidermis advancing from the edges and over the surface. The edges are on a level with the surface, of a pink tint, and free from induration. The surroundings are free from induration, and normal in appearance. The discharge consists of healthy, laudable pus. The pain is inconsiderable.

TREATMENT.—The treatment consists in helping the healing process by local and constitutional means. The local means consist, first, in rest, by position, or by splints or bandages: and, secondly, in the application of a piece of lint dipped in water or slightly stimulating lotion, to absorb discharge and protect the surface; over this a piece of oiled silk slightly larger than the piece of lint, to prevent evaporation; and then a bandage or piece of strapping over all, to fix the dressing and support the part. Should the healing of the ulcer flag, stimulating lotions are required to restore the tone. If the ulcer has involved a large amount of skin, the process of skin-grafting hastens the cure, and is an efficient means of helping the cicatrization. The patient's general health must be attended to, and the character of any retrograde change in the part will serve as a guide to such treatment.

2. Ulcers that do not heal, from defect of action.

(*a*) *Weak ulcer.*—The cause of this form is generally the prolonged use of emollient applications. The characters are:—The granulations look flabby, watery, gelatinous masses, and rise above the level of the surroundings, constituting 'proud flesh.' The edges are normal, but overlapped by the granulations. The surroundings are normal. The discharge is thin and watery. There is little or no pain.

TREATMENT.—It is necessary to get rid of the exuberant granulations by caustics, such as nitrate of silver or sulphate of copper in substance. Afterwards we must employ firm bandaging with astringent lotions, or powdered substances, such as oxide of zinc, oxide of zinc and starch, tannin, or sub-nitrate of lead. When at the same time the patient's health is lowered in tone, tonics and bitter astringents must be given freely.

(*b*) *Indolent, callous, or chronic ulcer.*—This sub-variety occurs when, from chronic irritation, the fibrous tissue induration is excessive, the blood-vessels reach the surface of the ulcer in too minute quantities to build up healthy granulations, and so the ulcer is perpetuated.

The surface is sunk below the level of its surroundings, is destitute of granulations, and looks glazed. The edges are raised, hard, and irregular. The surroundings are indurated, raised, and the veins in them are frequently made varicose. The discharge is thin, serous, and small in quantity. The pain at times is very great, especially at night.

TREATMENT.—The induration is got rid of by strapping tightly and evenly with soap or resin, or a mixture of soap and resin plaster; holes must be made in the plaster to allow the discharge to escape, and the strapping should be reapplied every forty-eight hours. At each removal, the surface may be touched with caustics, or washed with a strongly stimulating lotion, as of carbolic acid, 1 to 20, or chloride of zinc 20 grains to the ounce. When the induration is gone and granulations appear, the ordinary treatment for a healthy ulcer is all that is required. Another method is to blister the surface of the ulcer with emplastrum lyttæ, or solution of cantharides, to apply a poultice over all, and to let this remain for six hours; and on removal of this, to wash the part with carbolic acid lotion, 1 to 20, and apply antiseptic dressings (*see* ANTISEPTIC TREATMENT). Still another method of treatment is by the elastic bandage; this is used for the lower extremity only. We first wash the part with carbolic acid 1 to 20, and then bandage the limb firmly and evenly with Martin's elastic bandage, from the toes upwards, covering over the ulcer. No dressing is placed over the ulcer. The bandage by continued pressure causes softening, liquefaction, and absorption of the hard surroundings; and the surface of the ulcer is bathed in the natural secretion of the part. The bandage is removed nightly, washed with carbolic acid, hung up to dry at a distance from the fire, and reapplied in the morning.

3. Ulcers that do not heal, from excess of action.

(*a*) *Irritable ulcers.*—These are met with on the legs of nervous and anæmic women. The surface is uneven, covered often with a grey slough. The edges are irregular. The surroundings are red and glazed, but not thickened. The discharge is a thin sanious pus. The pain is excessive, of an aching kind.

TREATMENT.—In the treatment of irritable ulcer it is necessary, first of all, to relieve pain by giving opium hypodermically or internally, and opiate or lead lotions externally. We must then remove the cause by restoring the patient's health and tone. When the pain has ceased we treat the ulcer by any of the above methods.

(*b*) *Inflamed ulcers.*—Any form of ulcer may become inflamed. This sub-variety usually arises during the course of an indolent ulcer, from derangement of the patient's health and local irritation.

The surface is covered with a greenish-grey slough. The edges are swollen, everted, red, and angry. The surroundings are red, swollen, and hot. The discharge is ichorous, offensive, often bloody, and causing irritation wherever it touches. The pain is of a throbbing kind.

TREATMENT.—The inflamed ulcer should be treated by rest, with bread-poultices properly applied; by three or four leeches, applied around the sore; or by scarification of the edges, which will allay the inflammation. After this the ordinary treatment recommended above is to be followed.

4. Ulcers that do not heal, from peculiarity of action.

(*a*) *Phagedænic and Sloughing ulcers.*—When an inflamed ulcer commences to spread, the edges liquefy and rapidly break down. This may take place with extraordinary rapidity, as in chancre, when it is called phagedæna, or as in hospital gangrene, when it spreads chiefly by sloughing. The patient in either case is usually in a cachectic state; the ulcerated part is dusky red, angry-looking, hot, and painful. The surface is covered by a grey or black slough, and the edges are sharply cut and undermined. *See* BUBO; GANGRENE; and VENEREAL SORE.

TREATMENT.—Rest, opiates internally and externally in the form of lotions, and careful dieting are necessary, to subdue the spread of the inflammatory action. Should this not control the action, the application of strong nitric acid will often succeed. Fresh air and disinfectants are abundantly required.

(*b*) *Varicose ulcers.*—The points to be observed about a varicose ulcer are that it follows the chronic irritation of a varicose vein; that when formed it may become indolent, inflamed, irritable, &c.; and that it frequently bleeds, from the ulcerative action extending towards and thinning the wall of a vein. *See* VEINS, Diseases of.

TREATMENT.—Varicose ulcer itself is to be treated by the ordinary methods, but the varicose vein must be supported by an elastic stocking, or, what is better when the ulcer is in a healthy state, Martin's elastic bandage.

(*c*) *Hæmorrhagic ulcers.*—Hæmorrhagic ulcers occur in persons suffering from amenorrhœa, scurvy, chronic jaundice, or hæmophilia. They possess the characters of irritable ulcers, but in addition have a special tendency to ooze blood from the surface. The blood is of a capillary-venous character, and flows freely at times.

TREATMENT.—In the hæmorrhagic sub-variety we have to attend to the diathesis with which this special form of ulceration is associated, and treat the ulcer by any one of the usual methods.

(*d*) *Syphilitic*, *lupoid*, *rodent*, *scorbutic*, *endothelial*, and *mucous* ulcerations.—These are described in separate articles.

One form of ulcer possesses so much interest to the practitioner that it calls for special consideration.

Bed-sore. — SYNON: Fr. *Décubitus*; Ger. *Decubitus*; *Wundliegen*.

DEFINITION.—A form of ulcer caused by continued pressure, consequent on the recumbent position.

ÆTIOLOGY.—Bed-sores are dependent either on a low condition of the nutrition of the tissues of the patient, on bad nursing, or on a combination of the two. In patients suffering from fractured spine, especially if the spinal cord be torn; in those paralysed from other causes; in cases of fractures of the lower extremity; in angular curvature of the spine; in patients suffering from hip-joint diseases; in the acute specific fevers; and in the aged—in fact, in any disease necessitating long confinement to bed, and rest in one position—bed-sores may be developed. When in addition to the illness, the nursing is badly conducted, as shown by urine, pus, blood, or any discharge whatever being allowed to remain on the part where the patient lies, a strong determining cause is set up, which will in all probability end in a bed-sore. Other strongly predisposing causes are the use of a feather bed, and the presence of a blanket between the mattress and the under sheet, into which the perspiration from the patient's body soaks, causing the blanket to act like a poultice. Hence it will be seen that paralysis and an enfeebled state of the circulation, combined with pressure and inattention to strict rules of cleanliness, are the main elements present in the production of a bed-sore.

The various sites on which bed-sores form are arranged here in the order of frequency with which they are met:—the heel, the sacrum, the buttocks, over the trochanters, between the shoulders, on the middle of the back from the shoulders to the sacrum, on the malleoli, on the elbows, and on the calf of the leg. On the heel the usual cause is the pressure of a splint; on the elbow bed-sores frequently supervene in such cases as hip-joint disease, owing to the tendency patients have to support themselves on one or both elbows.

Anatomical Characters.—This disease is only one of the many forms of the evil results of pressure. The passage of blood through a part where pressure is great becomes mechanically difficult. Exudation from the blood-vessels takes place, causing the cuticle to be first raised, then to peel off, and finally a moist catarrhal surface results. By-and-by stagnation of the blood in the blood-vessels occurs, and as a consequence the part becomes practically dead. In the surrounding parts the blood-vessels become engorged; and the presence of the slough acting as a foreign body, the irritation causes inflammation, and an exudation of inflammatory products occurs between the living and dead parts. This takes place all around and beneath the slough, but is first apparent as a furrow on the skin. This furrow gets gradually deeper and deeper, and the process of separation extending beneath the slough, it becomes detached and finally thrown off. An ulcerating surface now results, the further history of which will vary with the patient's health, and according as the illness, which rendered confinement to bed necessary, is of a curable or an incurable nature.

Symptoms.—The premonitory symptoms of bed-sore may be either subjective or objective. Subjectively the patient complains that the bed feels hard, that there is a crease in the sheet, that there are crumbs of bread or salt in the bed; along with these generally imaginary troubles, a pricking numbing sensation is felt at the point of pressure; but on examination of the part complained of, no change may be apparent. Or, again, the complaints may be *nil*, as in the paralysed, and yet the effects of pressure may be far advanced. The objective symptoms, that is, the changes apparent in the part, may be, as in the paralysed, the first indication of the effects of pressure. These are—alteration in the colour of the skin, a roughening of the cuticle, and a variable amount of pain on pressure with the finger. Any of these is sufficient indication that preventive measures must be immediately undertaken, otherwise a bed-sore will develop. As the symptoms advance, the discoloration becomes deeper, passing from red to livid red, from purple to black. The pain, except in the paralysed, becomes for a time severe, and then finally disappears, as all nervous connexions are severed. The circulation through the part being completely stayed, a dark slough is formed, and a line of demarcation between the living and dead tissue is set up. A foul discharge runs from the part; the tissues around become red and congested; the edges are undermined; and a feeble attempt is made to throw off the central slough. Should the slough be thrown off, the muscles, fasciæ, and even the bone of the damaged part may be exposed. The general symptoms associated with bed-sores are chiefly those of the disease in the course of which this complication has supervened. In some instances a form of pyrexia may, however, be induced by the discharging ulcer itself—a condition which constitutes one form of 'bed-fever.'

Diagnosis.—The appearances described in the skin, at the point or points of pressure, are unmistakeable evidence either of the likelihood of a bed-sore developing, or of its actual presence.

Progress and Prognosis.—Should the patient recover from the illness for which confinement to bed had become necessary, the bed-sore will in all probability heal. Bed-sores, however, can scarcely be healed in those patients whose maladies do not improve, or in whom recovery does not take place. At times pyæmia supervenes; or the exhaustion, consequent on a long-continued and profuse discharge from the sore, proves too great a drain on the patient. The prognosis in regard to bed-sores developing in any individual case, will depend on the disease, the age of the patient, and the care taken in nursing. The patients in whom a bad prognosis might be given, in regard to the appearance of a bed-sore, would be the old, and the partially paralysed, especially when bad nursing is superadded.

Treatment.—It is necessary to consider this subject under the heads of (1) the *preventive* measures; (2) the treatment *when abrasions have taken place*; and (3) the treatment or cure of the *sore when formed.*

(1) The *preventive measures* have, in paralysed patients, and in patients suffering from incontinence of urine, to be commenced at the beginning of the illness, and signs of changes in the skin are not to be waited for. The part must be thoroughly cleaned, the circulation stimulated, the skin hardened, and pressure removed from the parts where it is greatest. The best means by which to gain these ends are as follows. First, we must wash the part with soap and water; and then dry it thoroughly. Secondly, a piece of cotton wool dipped in spirits of wine, eau-de-Cologne, or brandy, must be applied to the part with gentle rubbing, until the part has become thoroughly dry; and this process must be repeated three or four times at each dressing. Thirdly, a draw-sheet must be placed beneath the patient, and oxide of zinc powder sprinkled on the part on which the patient is to lie; the sheet must be changed the moment it becomes wet, whether from urine, blood, pus, or sweat. Next, we must keep the skin supple. To manage this, a very small quantity of oxide of zinc ointment or simple ointment must be rubbed into the part, until all greasy feel has disappeared. This is to follow the application of spirit. Pressure must be removed by frequent changes of position, and by suitable pads, air-cushions, water-

pillows, or water-beds. The part where the edges of the cushion press is to be treated by the same preventive measures, and to be dressed two or three times a day. Lastly, we must avoid a feather bed, and a blanket beneath the under sheet. In many cases bed-sores are caused by careless nursing, but in others the best nursing possible cannot prevent badly nourished tissues from falling into decay.

(2) When *abrasion* or roughening of the cuticle occurs, the same precautions in regard to pressure, moisture, and the use of the draw-sheet have to be observed; and, in addition, some specific applications are used. Sometimes the part is greased over with zinc or simple ointment; this is useful in certain cases, preventing urine or other irritating fluid from touching the tender parts. Over an abraded portion, soap plaster spread on amadou or linen is applied; at other times collodion or flexible collodion may be used. The best fluid applications are rectified spirit, or camphorated spirit, with one-third water; it is necessary to add water owing to the pain caused by pure spirit. The surface may also be touched with a solution of 2 grains of mercuric chloride in one ounce of spirit; or with one consisting of 5 grains of nitrate of silver to an ounce of water.

(3) The treatment of the *bed-sore itself* consists in keeping the part sweet; in aiding the removal of the slough; in applying some one of the many stimulant and disinfectant lotions in use; and in preventing the neighbouring tissues from breaking down. To clean the parts, and hasten the removal of the slough, we must apply a bread-and-water poultice. When the discharge is foul, the part should be washed with Condy's fluid between each application of the poultice; and, to overcome the odour and sweeten the part, a poultice of half linseed-meal and half charcoal should then be applied, and changed every three hours. Poulticing should not be continued longer than is necessary to clean the surface, as the heat and moisture tend to soften and weaken the parts, and permit of their rapidly breaking down.

Stimulating and disinfectant dressings are employed in one or other of the following methods. Cut a piece of lint the exact size of the sore; soak it in some stimulant and disinfectant lotion, such as carbolic acid, 1 in 40, or the red lotion, or the compound tincture of benzoin, the balsam of Peru, or the tincture of myrrh or of catechu; and apply it exactly within the edge of the sore. Over this piece of lint place a piece of oiled silk or guttapercha tissue, a fraction larger than the lint used; and over this again three or four large folds of lint or amadou, with a hole cut in the centre corresponding to the sore.

In place of the folds of lint and amadou, pads or water-cushions might be used to take the pressure off. When the slough is large, lotions and poultices should not be applied to it, as the moisture only favours putrefaction. To prevent this, we may place a piece of oiled silk or guttapercha tissue exactly over the slough; and the lint, dipped in one of the above-mentioned lotions, when applied over it, can only touch the sore at the ulcerating furrow between the living and dead tissue. All dressings should be fixed by diachylom plaster, and not by a bandage, owing to the heat and moisture engendered by use of the latter.

The neighbouring tissues must be treated with the preventive measures mentioned above.

When the slough has separated, an attempt is to be made to heal the part by improving the patient's general health, provided the existing malady permits. The usual precautions have to be taken with the surrounding parts; and the ulcer treated by one of the methods recommended under the head of ulcers that do not heal from defect of nutrition.

James Cantlie.

UMBILICAL REGION.—This is the central region of the abdomen, corresponding to the umbilicus and its vicinity. The principal structures which normally lie underneath it are the great omentum, and part of the transverse colon and small intestines, with the deep structures situated in front of the spine. The stomach often reaches the umbilical region when distended after a meal.

Clinical Investigation.—There is nothing special to say on this point, the ordinary methods of abdominal examination being applicable in the investigation of the umbilical region. The following points may be noticed with regard to the abnormal conditions met with in this region.

1. When the stomach is diseased, it is often so distended as to reach the umbilical region. The liver also, either when enlarged or displaced downwards, frequently extends to this region. More exceptionally the spleen or kidney may attain such a size as to encroach upon it. Enlarged organs or tumours may also ascend thus far from below, as in the case of the uterus and ovaries; and even a distended bladder may rise to this height.

2. In general enlargement of the abdomen the umbilicus and its vicinity often give useful information in determining its cause. Thus, when the enlargement is due to fluid in the peritoneum, the umbilicus tends to become stretched, everted, obliterated, or pouched out, which is not the case in other forms. In some instances of portal obstruction it not only projects, but has a peculiar feel, due to the presence of enlarged and thickened veins. Moreover, the percussion sound in this region remains tympanitic, and sometimes even excessively so, when the rest of the abdomen is universally dull. On the other hand, when the enlargement is due to an organ or tumour, this is not observed, and the umbilical region is often dull when the flanks are resonant. An important element in the diagnosis of ovarian tumour is often thus afforded.

3. Should a very small quantity of fluid be present in the abdominal cavity, this may be detected by placing the patient on his hands and knees, when the fluid gravitates towards the umbilical region, and can be discovered there by percussion.

4. The umbilicus itself may be the seat of disease, such as inflammation, eczema, or gangrene. These conditions are most important in infants, and soon after birth peritonitis may be set up by the extension of irritation from the umbilicus inwards.

5. The umbilical portion of the abdominal

wall is liable to be involved in malignant disease affecting the underlying great omentum, to which it then becomes fixed, so that it cannot be moved.

6. Umbilical hernia is an important form of hernia, of which the writer has seen several examples. It may attain a very large size. Moreover, in connection with this condition, much thickening and induration may be met with about the umbilicus, as the result of a chronic inflammation. The writer has met with one case presenting these changes in a marked degree. FREDERICK T. ROBERTS.

UNCONSCIOUSNESS.—Loss of consciousness or mental perception. *See* CONSCIOUSNESS, Disorders of.

UNDERCLIFF, on the South Coast of the Isle of Wight.—Extends from Bonchurch to Niton. A mild, tonic climate. *See* VENTNOR; and CLIMATE, Treatment of Disease by.

UNILATERAL FACIAL ATROPHY.—SYNON.: Progressive Facial Hemiatrophy; Neurotic Facial Atrophy; Fr. *Aplasie lamineuse progressive*; Ger. *Prosopodysmorphia.*

In this affection the whole of one side of the face becomes notably smaller than its fellow, owing to an atrophic condition of the subcutaneous tissues and of the skin, together with atrophy of the muscles, and sometimes even of the bones on the affected side of the face. The pathology of this rare progressive atrophy of one side of the face is involved in considerable doubt. It has been regarded by some as an essential atrophy; by others, as a result of disease in certain hypothetical 'trophic nerves'; by others as a result of irritation acting upon the fifth nerve, and on the portio dura of the seventh cranial nerve; and, finally, as an effect of persistent irritation acting upon the cervical sympathetic, especially in its upper and middle ganglia. These ganglia have been found distinctly tender on pressure being made over them; and the latter view as to the pathology of the affection would seem to be still further borne out by the fact, that marked amelioration has been produced in some cases by the long-continued application of a continuous current, of weak tension, to the cervical sympathetic ganglia.

H. CHARLTON BASTIAN.

UNILATERAL HYPERIDROSIS.—SYNON.: *Hyperidrosis*, or *Ephidrosis unilateralis.*—Excessive perspiration on one half of the body, occurs more or less habitually, or only after exercise. It may be limited to one side of the face and head, or the neck may be included; or it may implicate the whole of one half of the body. It has sometimes, and especially when limited to the face and neck, appeared as one of the symptoms due to paralysis of the cervical sympathetic nerve. In other cases no such relation has been ascertained to exist. *See* SYMPATHETIC SYSTEM, Disorders of.

TREATMENT.—In the absence of definite information as to the pathology of this affection it is not possible to indicate any rational principles of treatment. Empirically some of the remedies used for checking perspiration, such as zinc, belladonna, and quinine, may be tried. *See* PERSPIRATION, Disorders of.

H. CHARLTON BASTIAN.

URÆMIA (*οὖρον*, urine, and *αἷμα*, the blood).—SYNON.: Fr. *Urémie*; Ger. *Urämie.*

DEFINITION.—This term is applied to a group of nervous symptoms, which occasionally occur in the course of acute or chronic Bright's disease, as well as in other maladies which prevent the secretion or the discharge of the urine.

ÆTIOLOGY AND PATHOLOGY. — The circumstances in which uræmia arises are pretty well ascertained, but the connection between these circumstances and the symptoms is still obscure. It occurs when there is interference with the secretion or the discharge of urine. It is thus met with in all the forms of Bright's disease; in cystic, tubercular, and cancerous disease of the kidney; in suppurative nephritis; and in cases of anuria, either of obstructive or of non-obstructive origin. But some of these conditions frequently exist for long periods without uræmia being developed, and it is sometimes developed unexpectedly without apparent alteration of the patient's state. The attack is, however, precipitated frequently by pregnancy and parturition; by indulgence in alcohol; sometimes by the recurrence of the menstrual period; and probably by intercurrent disease. But the occurrence of these conditions does not in all cases suffice to induce it, for many women suffering from Bright's disease pass through pregnancy and labour without manifesting uræmic symptoms, and so with other inducing causes.

Of the exact nature of the uræmic process we are unable to speak at present with certainty. Two sets of explanations have been suggested—namely, the *mechanical* and the *chemical*. Dr. Owen Rees, in this country, and Prof. Traube, in Germany, have been among the chief exponents of the mechanical explanations. The former dwelt upon the wateriness of the brain in many cases of uræmia; the latter suggested processes by which that œdema might arise. Sudden increase of blood-pressure, and sudden increase of the proportion of water in the blood, might, he thought, suffice to account for the condition. Rosenstein and others have lent the weight of their authority to these views. Mönck has sought to demonstrate by experiment that cerebral œdema from increased pressure may produce the result; but even if these experiments had been correct, which is doubted by many, it cannot be denied that there are many well-marked cases of uræmia in which there is no encephalic œdema. The observation of Popoff, which refers the changes to accumulation of altered corpuscles within the cerebral capillaries, may prove important, if it should be confirmed by other authorities.

Among the chemical theories one of the earliest was that which referred the process to retention of urea, but many difficulties arise in connection with this. The very ingenious theory of Frerichs, which referred the process to decomposition of retained urea by the action of a ferment, must now be held to be disproved, in consequence of evidences discovered, both of a negative and of a positive kind. The evidence at present before as seems to point to the probability of the process being due to retention of some excrementitious material or materials.

Symptoms.—All the functions of the nervous system are occasionally involved in uræmia. Among the disorders of the sensory function the most common are pain, especially in the head, sometimes very intense and persistent; dimness of sight, or actual blindness of one or both eyes, sometimes attended by no change in the retinæ, at others by retinitis albuminurica; ringing in the ears; and sometimes deafness. Among the motor changes the most striking are the general convulsions or twitching of muscles; the tendency to vomiting; and sometimes extreme dyspnœa. Among cerebral and mental derangements, drowsiness, torpor, coma, and delirium are the chief.

The forms of uræmia generally recognised are the *chronic* and the *acute*.

1. **Chronic Uræmia.**—This comes on gradually, and may at first scarcely attract attention; the habitual listlessness and indifference of manner observable in cases of Bright's disease becomes increased. Movements are slow, and speech is somewhat indistinct. There is often dimness of sight, ringing in the ears, uneasiness in the head, or violent and persistent headache. The condition of the patient varies; the symptoms occasionally pass away, but they constantly recur and become by degrees more intense. The drowsiness passes into torpor. If the patient is roused to speak, his articulation is thick and indistinct. It soon becomes impossible to elicit any answer; lethargy deepens into coma; the breathing becomes stertorous, or rather hissing in character, the air being driven against the teeth or hard palate; and death supervenes. Sometimes, instead of silence, a rather noisy delirium comes on, in which wild prolonged howls alternate with muttering, and occasionally with paroxysms of excitement. Sometimes, again, there is a low prolonged muttering, with a repetition of the same expression time after time. Subsultus tendinum and twitching of the facial muscles are commonly seen throughout. Convulsions, vomiting, and diarrhœa are frequent symptoms; epistaxis also occurs, but more rarely. This form of uræmia is a common mode of fatal termination in cases of chronic Bright's disease. It sometimes occurs—but much more rarely—in the early stage of the inflammatory form.

2. **Acute Uræmia.**—This includes all the varieties in which the symptoms are suddenly developed. There are three common forms—the comatose, convulsive, and mixed; and several less common, namely, the delirious, dyspnœtic, ocular, and articular. In the acute *comatose* form, after headache, giddiness, affection of sight, vomiting, or delirious excitement, coma is rapidly developed; or it may supervene without such premonitory symptoms. The face is usually pale; the pupils are dilated or unaltered, and react slowly to light; or, on the other hand, there may be a red spot on the cheek, injected conjunctivæ, and contracted pupils. There is a peculiar stertor, not the deep snoring of hæmorrhagic apoplexy, but a sharper, more hissing sound, produced by the rush of expired air on the hard palate or teeth. The coma may rapidly deepen, and death ensue within a few hours; or, on the other hand, the patient may rally and continue free from the symptoms permanently; or sooner or later uræmia recurs in one or other of its forms; and issues in death. Acute uræmic coma occurs in all of the forms of Bright's disease, but is most frequent in the inflammatory and cirrhotic varieties.

The second acute type is the *convulsive*, which may almost exactly simulate epilepsy; or be unattended by loss of consciousness; or may affect certain groups of muscles, and simulate tetanus. The attack comes on suddenly, with or without warning. The attacks may be single and solitary; or they may occur in rapid succession, five or six, or even more, in the course of twelve hours. They may be recovered from; or they may prove rapidly fatal, either during the paroxysm, or in the coma which succeeds it. They occur in all the forms of Bright's disease, but most frequently in the cirrhotic and in the inflammatory form. The existence of cirrhosis of the kidney is not unfrequently first revealed by the occurrence of convulsions.

The other types of uræmia, namely, the *mixed*, in which sudden coma occurs with convulsions, the *delirious*, in which the ordinary symptoms are replaced by restless delirium; the *dyspnœtic*, in which there are sudden attacks of breathlessness, without corresponding change in the physical signs of the lungs or heart; and the *articular*, which Jaccoud has described as presenting many features in common with acute rheumatism, are so rare that they need not be described here.

Diagnosis.—There is little difficulty in distinguishing the chronic form of uræmia when fairly established. The most important evidence is, of course, afforded by examination of the urine. Uræmia sometimes resembles fever or meningitis; but the history of the illness, the state of the urine, the temperature, and the mode of breathing, suffice to distinguish it from these conditions.

The acute form of coma may closely resemble hemiplegia with loss of consciousness, but differs in the absence of paralysis of one side, and also in the character of the breathing, while the condition of the urine also affords important indications.

The convulsive type may resemble epilepsy, but it has rarely the initial cry, the corpse-like pallor, the predominance of convulsions on one side, the turning in of the thumbs on the palms, and the loss of reflex irritability. The chief reliance is to be placed on the analysis of the urine, because, although after true epilepsy albumen may be present, and urea may perhaps be diminished for a time, the secretion soon returns to its natural condition, while in uræmia it is always distinctly albuminous. From opium-poisoning it is distinguished by the condition of the pupils, and the examination of the secretion. From belladonna-poisoning it is to be distinguished by the same considerations.

Prognosis.—The occurrence of uræmia in a case of Bright's disease is always grave; the chronic form is hopeless, and when it occurs the duration of life cannot be long. The acute forms are often recovered from; they sometimes subside spontaneously, but when they are due to

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chronic renal disease, death cannot, as a rule, be regarded as far off. When they result from acute disease, they are not so hopeless, because the conditions on which they depend are frequently removed by treatment. Puerperal cases, although involving great immediate danger, are very frequently recovered from, probably because they owe their origin to a combination of circumstances which do not long persist.

Treatment.— The first indication is to seek to re-establish the suppressed secretion of the kidneys. For this purpose, dry cupping, wet cupping, leeching, or poulticing over the loins, and the administration of digitalis and other non-irritating diuretics, are indicated. Frequently the blood must be relieved more rapidly than the action of the diuretics can accomplish. Venesection, to the amount of eight, ten, or more ounces, may be of use, especially in the puerperal forms, and the acute inflammatory cases. Purging with hydragogue cathartics, such as elaterium, or compound powder of jalap, or jalap and scammony; diaphoretics, such as pilocarpine subcutaneously or by the mouth; and the hot pack—any of these methods may often relieve the system until there is time for the diuretics to act. When the convulsions are severe, sedatives, such as bromide of potassium and hydrate of chloral, are useful; and although some writers oppose its use, on the ground that it meets merely a symptomatic indication, chloroform is of great value. It quiets the nervous system, and checks the convulsions more rapidly than anything else, but the tendency to coma in the individual case must be carefully kept in view while chloroform is being administered. Tonic remedies, and articles of diet such as milk (which is at once nourishing and powerfully diuretic) should be given, to ward off a return of the symptoms in cases in which the uræmia has disappeared. In puerperal cases an obvious and important indication is to complete the labour with as little delay as possible.

Grainger Stewart.

URETERS, Diseases of.—Synon.: Fr. *Maladies des Uretères*; Ger. *Krankheiten der Harngänge.*

Morbid conditions of the ureters are so generally parts of, or associated with, diseases of the bladder or kidney, and so naturally come to be described in the articles treating of these several diseases, that a separate account or distinct classification of them is perhaps scarcely called for; and a brief description of the most important will be sufficient for all practical purposes.

1. Congenital Malformations.—A double ureter is the most frequent malformation, the division sometimes reaching as far as the bladder. In very rare cases a triple ureter has been found. Congenital malformations, leading to more or less complete obstruction of the ureter, are found most often near the pelvis of the kidney. If the obstruction is complete, it gives rise to hydronephrosis (*see* Hydronephrosis). If incomplete, a slighter degree of the same condition results, the pelvis and calyces becoming dilated, and the kidney-substance atrophied and indurated. The chief congenital obstructions are—1st. Total obliteration of the ureter as it leaves the pelvis. 2nd. Valvular opening from the pelvis into the ureter. This becomes gradually more complete as the dilatation of the pelvis increases. 3rd. A spiral arrangement of the ureter. 4th. An abnormal renal artery pressing on the ureter as it leaves the pelvis. The incomplete obstructions frequently give way at intervals, when there will be a copious flow of urine, usually of low specific gravity and pale colour. One instance has been recorded, in which alternate contraction and dilatation existed.

2. Acquired Obstruction. — *Complete* obstructions which are not congenital may arise:—First, from impaction of a renal calculus; this may take place at any point, the most frequent being at the vesical orifice. Secondly, from pressure of tumours or other conditions, such as uterine cancer, pelvic tumours, fibrous bands, enlarged glands, or fæcal accumulations, in which case the condition would at first be incomplete. *Incomplete* obstruction arises most frequently from impediments to the discharge of urine, existing in the prostate or urethra. In the former case, the bladder being in a state of constant over-distension, the valved opening of the ureter is closed with unnatural force. In the latter the hypertrophy of the bladder increases the length of the portion of ureter lying in the bladder-walls, and the bundles of muscular fibres more or less constrict the orifice. Any cause giving rise to hypertrophy of the bladder will therefore tend to obstruct the orifice of the ureter, as is seen in chronic cystitis, stone in the bladder, and other conditions. The opening is still further narrowed, in many cases, by swelling of the mucous membrane, the result of sub-acute or chronic inflammation. Occasionally the orifice may be partially obliterated by a villous growth in the bladder. *Stricture* of the ureter is found in rare cases, apparently the result of previous inflammation and ulceration. Slight obstruction may occur during pregnancy, from the pressure of the gravid uterus.

3. Dilatation.—The part of the ureter above any obstruction is always found more or less dilated, according to the degree and the duration of the impediment. If the condition be acute and complete, little or no hypertrophy of the coats of the ureter will be found; but if chronic and incomplete, its walls will be thickened, both by fibroid change, and by hypertrophy of the muscular coat. The dilated ureter is always tortuous, being increased in length as well as in diameter, and may even resemble a portion of small gut. The mucous membrane is always opaque and somewhat thickened, occasionally red and injected, and frequently pigmented from previous attacks of inflammation. A largely dilated ureter may sometimes be felt through the abdominal wall. There will probably be some degree of pain or uneasiness in the course of the canal, or in the loin; and a tendency to sickness.

4. Inflammation.—*Simple* inflammation of the ureter is frequently found, as an extension either from the bladder or from the pelvis of the kidney. *Septic* inflammation accompanies septic pyelitis, due to extension of decomposition from the bladder to the pelvis of the kidney, *Scrofulous* or *tubercular* inflammation almost invariably accompanies a similar condition of the bladder or pelvis.

5. **Malignant Disease.**—Cancer may extend from neighbouring organs into the ureter, but there is no reason to believe it ever primarily takes origin there.

Neither the diagnosis nor the treatment of an affection of the ureter can be separated from that of the disease to which it is secondary.

MARCUS BECK.

URETHRA, Diseases of.—SYNON.: Fr. *Maladies de l'Urèthre*; Ger. *Krankheiten der Harnröhre*.—The affections of this canal comprise urethritis, with its various consequences, such as gleet, warts, peri-urethral abscess, inflamed follicles, neuralgia, and stricture; also syphilis and soft chancre. For descriptions of most of these affections the reader is referred to the articles GONORRHŒA; GLEET; SYPHILIS; and VENEREAL SORE. Some forms of urethritis, neuralgia, and stricture remain for consideration here; whilst certain other pathological relations involving the urethra will be briefly referred to.

1. **Urethritis.**—The origin of urethritis is not exclusively due to contagion; inflammation of the tract, which differs mainly by less accentuation of its features from contagious urethritis, is produced by injury, by gout, or even by tubercular disease. A very mild form of urethritis is an occasional concomitant of early syphilis. It subsides spontaneously, and is always very limited in amount. The distinction of these forms from gonorrhœal urethritis is not always marked. In traumatic inflammation the signs of irritation follow immediately on the passage of the foreign body, such as a stone or a catheter; soreness or scalding attends the first subsequent micturition; and swelling and discharge follow, at most twenty-four hours later. In gouty urethritis the inflammation may be as severe as in well-marked gonorrhœa, and attended by the complications of the testes, bladder, eye, or joints which are met with in cases of gonorrhœa. The leading distinctions of gouty urethritis are the milkiness of the discharge; the absence or small amount of swelling of the fore part of the urethra; though the scalding in the perinæum and irritability of the bladder are severe.

Asparagus and arsenic are said to have the power of producing urethritis in some persons. Tubercular urethritis is always a very indolent affection, being due to the slow degeneration and ulceration of tubercular deposits in the deeper portion of the canal. In such cases the irritability and inflammation of the bladder are always more urgent than the urethritis; while the evidence of tubercular disease in other parts of the body is usually sufficient for diagnosis.

2. **Urethral Fever—Sympathetic Irritation.**—Besides inflammation and its complications, the urethra is the source of the conditions termed *urethral fever*, and *sympathetic irritation* of the nervous system, excited by certain states of the urethra. Also, on the other hand, the urethra is occasionally the seat of certain symptoms which are caused by disease of different organs. For example, the passage of a calculus along the ureter will determine pain in the urethra. Injury of the other parts of the body, such as fracture of the femur, may excite spasm of the deeper muscles of the urethra, and thus produce retention of urine.

3. **Neuralgia.**—The causes of pain felt in the urethra, but not necessarily due to disease of that part, are numerous. Gouty irritation is frequent; and a nervous condition produced by prolonged debauchery of various kinds is also not uncommon. The gouty state is relieved by treatment of the diathesis; the nervous irritation by suitable general treatment, to which may often be added local applications which have the effect of dulling the sensibility of the urethra, such as the passage of sounds, and the use of astringent or (in obstinate cases) of caustic injections to the deeper portions of the urethra.

4. **Stricture.**—The average distensile capacity of the urethra has a diameter of ten, or a circumference of thirty, millimètres. This measure varies in different portions, being widest at the portion behind the transverse ligament (anterior layer of the deep perinæal fascia), slightly less in the bulbous portion, and least at the meatus. This outlet is indeed frequently considerably narrower, varying between a mere pinhole and a diameter of fourteen or fifteen millimètres, the most common size being twenty-five millimètres. The urethra in different persons ranges between twenty and forty millimètres in its general distensile capacity.

Strictures are abrupt abnormal contractions of the urethra at any given point of its course, and may be subdivided into (*a*) *spasmodic*, or those due to temporary contraction of the muscular fibres surrounding the canal; (*b*) *inflammatory*, or those caused by swelling and congestion of a limited area, this condition being usually associated with more or less muscular spasm; and (*c*), *organic*, where unyielding fibrous tissue replaces the normal dilatable structure of the urethral walls. In the cases of fibrous thickening, the narrowing is often much increased by muscular contraction.

(*a*) *Spasmodic*; (*b*) *Inflammatory Stricture.*—The *spasmodic* stricture, which is always a temporary affection, is caused by muscular contraction from reflex irritation, the existence of inflammatory swelling being one of the most frequent, but the passage of a calculus or a catheter may also excite it. Again, the presence of a fibrous stricture near the meatus will frequently excite reflex spasm of the deep perinæal muscles. The *inflammatory* stricture is due to swelling of the deeper part of the urethra during inflammation. It is a not unfrequent complication of acute gonorrhœa. The spasmodic and inflammatory strictures, being temporary ailments, involve no permanent lesions. Their treatment is mainly general, consisting in the removal of irritation and congestion by salines, purgatives, and warm baths; and in the relief of retention of urine, if present, by passing a flexible catheter (No. 5 or 6 of the English scale).

(*c*) *Organic Stricture.*—Organic stricture is produced sometimes by the contraction of scars, following injury; but in the larger number of instances it is the result of long-continued inflammation of the sub-mucous tissue following gonorrhœa.

Organic strictures may be situated at any part of the urethra except the prostatic, being numerically most common in the first inch from the meatus. But the thickest and toughest strictures are generally found near the juncture of the bulbous and membranous portions of the urethra, that is, about five inches from the meatus. The membranous portion is only affected when large development of cicatricial tissue reaches backwards from the bulb. This new tissue is developed in various forms, namely, (*a*) as a membranous fold (*bridle stricture*) of which the fibres cross, and occasionally encircle, the axis of the tube. Bridles may be either single or several. (*b*) As warts and superficial scars left by ulcers, which form patches of tough tissue. (*c*) As indurated areas or fibrous nodules of the submucous layers, which stand forward on the surface of the urethra, causing irregular projections, as well as unyielding contractions. Thus they twist the course of the canal, and impede the passage of bougies. Or, instead of being in limited patches, the induration may form evenly along the canal, making it smooth and gristly for a large part of its length, with a narrow passage through the centre. The depth of the fibrous contraction may form only a single layer of fibres beneath the mucous membrane, or may infiltrate the whole thickness of the corpus spongiosum, or it may even spread through the perinæum till it converts that region into a dense gristly mass.

Strictures vary in behaviour: some yield easily to dilatation, and slowly contract; others are rigid, and can be dilated only to a small extent. Lastly, some expand quickly, but as quickly shrink back to their previous narrowness.

The mucous surface of a strictured urethra varies much. It is smooth and almost healthy where the stricture is of no great duration; but in diseases of long standing the lining membrane between the meatus and the narrowest contraction is often puckered with fresh induration, or excoriated, or ulcerated; and sometimes just in front of the main stricture artificial perforations are found, the results of inexpert instrumentation, leading backwards outside the stricture, and ending either as blind-alleys, or opening into the urethra or rectum behind the stricture, constituting 'false passages.' At the stricture itself the surface is dull and roughened, while behind it the urethra is often dilated, pouched, and ulcerated, its surface being beset with shreds of thickened muco-pus. Occasionally the pouches have given way into the cellular tissue, and form abscesses around the urethra; or, if they have pushed their way to the surface of the body, they end as fistulæ of the perinæum or scrotum. The remainder of the urinary apparatus is often affected; the bladder has thickened walls, and is the seat of chronic inflammation; the ureters are dilated and similarly inflamed. The condition of the kidneys varies; sometimes but slightly affected, in cases of long standing they may be greatly diseased. If so, the pelves and calyces are widely expanded; the pyramids are flattened, and partly destroyed by fibrous interstitial degeneration; the cortical substance is wasted, and displays other consequences of prolonged chronic irritation.

Symptoms.—The symptoms of urethral stricture are the more evident the narrower it is, and the longer it has existed. Few symptoms attract observation before the stricture is well advanced. The most common and earliest is a scanty mucopurulent discharge. This sign is indeed very often the indication of the chronic inflammation of limited areas of the tract which end in stricture. Those signs which appear when the stricture has developed are—small size of the stream; straining; frequent call to pass urine; and pain in passing it. Any or all of these may be absent, even when the canal has lost as much as two-thirds of its distensibility. Usually to these troubles are added occasional attacks of complete retention of urine.

Treatment.—The treatment of stricture consists, first, in removing from the habits and diet of the patient all causes of functional disorder. Temperance in alcoholic drinks, in stimulating or highly nutritious foods, in sexual indulgence, and in some forms of exercise, such as horse- and bicycle-riding, must be enforced. Due attention to the condition of the skin and bowels, and sufficient bodily exercise, are requisite. By these means the temporary and dangerous aggravation of the sufferings caused by stricture will be avoided. Next comes the local treatment. The passage must be restored to, and maintained at, such width as, on the one hand, will enable the bladder to empty itself completely by each act of micturition; and, on the other, will allow a sufficient margin to prevent stoppage of the flow of urine during occasions of temporary swelling or spasm of the urethra. Such an expansibility would seem for most persons to be about one inch or three-quarters of an inch in circumference, that is about No. 10 (English scale), though in practice it is advisable to dilate somewhat further than this to allow sufficient margin for neglect. In all organic strictures there is a tendency to contract; hence when sufficient expansibility has been established, it must be maintained by the frequent passage of a bougie. In most cases the patient should learn to do this for himself.

The methods employed for widening the urethra at its unyielding parts are—(*a*) *gradual interrupted dilatation*; (*b*) *gradual continuous dilatation*; (*c*) *cutting or splitting from within*; and (*d*) *cutting from without*. Other methods, such as the use of caustics or the cautery, have dropped into desuetude.

(*a*) *Gradual interrupted dilatation.*—This is procured by passing sounds or flexible bougies (preferably the latter) through the stricture, beginning with that size which will just pass through, and in subsequent sittings increasing the size of the instrument without wounding the urethra, until the requisite size (No. 12 or 13 English) is reached.

(*b*) *Gradual continuous dilatation.*—This method consists in passing through the stricture a flexible catheter, small enough to slip easily through the contraction, and tying the instrument in the passage. As the urethra widens, the catheter must be replaced from time to time by a larger one. lest, being loose, the instrument escape from the passage. A week or ten days usually suffices to bring the stricture to the requisite dimension. The nature of the process appears similar to that of a seton in ordinary sinuses or cellular tissue; the fibrous tissue becomes loose and succulent, its fibres permeated by leucocytes, and partial disintegration into pus takes place.

(*c*) *Splitting or cutting from within.*—In splitting the stricture from within (forcible dilatation, divulsion, 'immediate treatment') the unexpanding fibres are rent asunder by an expanding instrument previously introduced in a contracted condition.

In cutting, by means of a sound or guide passed through the stricture, a sharp edge is applied to the narrowed parts until they are divided sufficiently to give the urethra ordinary dimensions at that point.

(*d*) *Cutting from without.*—When attacked from without, the urethra is reached from the perinæum either with a guide-staff passed to the bladder, indicating the course of the urethra, or, if that be impracticable, by a sound passed along the urethra to the seat of stricture, which is then exposed by incision. The orifice of the stricture being then visible, a fine director is passed along it to the bladder, and its fibres divided from before backwards.

Various instruments have been devised, and are employed for carrying out these several principles—some more suited than others to particular cases.

Gradual interrupted dilatation least interferes with the patient's avocations, is least attended by evil consequences, and is most effectual in strictures of recent formation, situate near the bulb. It is applicable in a larger number of cases than any other form of treatment. Objections to this method are the rapidity with which recontraction takes place; and the impossibility in some patients of dilating the stricture beyond a certain calibre without exciting shivering, pain, and pyrexia, or even local inflammation and abscess.

Gradual continuous dilatation is easy and rapid, but it is liable to be followed by speedy recontraction; it excites in some patients constitutional fever and local irritation sufficient to require its abandonment. Hence gradual continuous dilatation is useful to obtain a speedy enlargement of a very narrow stricture in cases of advanced vesical or renal disease, where it is requisite to give the bladder rest without delay, yet the condition of the kidneys is most unfavourable to any operation. Forcible dilatation and divulsion have the disadvantage of putting the patient to the suffering of a painful operation, while not protecting him from rapid shrinkage of his stricture.

Internal urethrotomy is applicable with best results to young persons, in whom renal changes have seldom advanced much. It is also preferable for those patients in whom gradual dilatation, either by interrupted passage of bougies, or the tying in of catheters, cannot be borne. The locality of stricture has much to do with deciding upon the adoption of internal division. Serious disturbance rarely follows incisions made in strictures between the meatus and the bulb. Again, the shallow constrictions, the so-called 'bridle' strictures, and the elastic, rapidly-yielding, and as rapidly-shrinking strictures, are always situate in this portion. They are specially amenable to incision, while very little affected by the passage of bougies. The great thickness of certain strictures of the bulb renders their division the only mode of securing even moderate duration of their dilatability.

The re-contraction after treatment has established sufficient distensibility would seem to follow less speedily after division than after gradual dilatation.

External urethrotomy is needed in comparatively few cases. It is advisable when the perinæum is hardened and beset with fistulæ; or in those still more rare cases where no instrument can be introduced into the bladder. Under such circumstances it is requisite to attack the stricture from the surface. BERKELEY HILL.

URIAGE, in France.—Muriated sulphur waters. *See* MINERAL WATERS.

URIC ACID DIATHESIS: URIC ACID CALCULUS.—SYNON.: Lithuria; Lithiasis; Nephrolithiasis; Fr. *Diathèse urique*; *Calcul urique*.

ÆTIOLOGY AND PATHOLOGY.—Uric acid is undoubtedly the outcome of the proteid tissues of the body, and it is also derived from the nitrogenous elements of the food; but where and by what agency this metabolism is effected is unsettled. By some physiologists it is considered that the liver is the chief source of uric acid, and this theory is grounded on these facts—that urea is produced in the liver; that urea and uric acid are nearly allied, and often replace each other; and that in so-called liver-disorders, there is frequently a deposit of uric acid in the urine. On the other hand, the liver contains but the merest trace of uric acid; the blood in the hepatic vein contains no more than that in the portal vein; uric acid is found in decided amount, and always, in the spleen; and as all the blood from it passes through the liver, so that which escapes from the liver may have come to this organ from the spleen with the blood-stream. In what relation does the kidney stand to the formation of uric acid? On this point also authorities differ. Many hold that the kidney merely filters it from the blood. But there is much evidence to support the belief that the function of the kidney, as regards both urea and uric acid, is more important than mere excretion; that it has the power to form and produce, as well as simply to eliminate, these nitrogenous constituents out of some antecedents in the blood; and that as the hepatic cell has the power to form bile, so the epithelial cell of the renal tubules, by the metabolic activity of its protoplasm, has the power to produce some of, if not all, the urea and uric acid found in the urine. It is most probable that the water and saline constituents of the urine are simply eliminated from the blood by osmosis through the blood-vessels of the glomeruli, and are, therefore, influenced as to excess or deficiency, by greater or less blood-pressure, whilst the uric acid, urea, pigments, and other constituents are, in part at least, the result of a true secreting power of the renal cells in the tubules.

The quantity of uric acid excreted does not appear to vary much whether vegetable or animal food be exclusively taken. Lehmann found this to be the case in his own person, and it is certain that excess and deposit of uric acid is very common amongst the poor, who consume but little animal food. The amount of uric acid secreted is sometimes very considerable; it may be roughly estimated by adding hydrochloric acid to a definite quantity of urine, and washing and weighing that which is precipitated. Dr. Pavy has suggested a more ready and accurate method, namely, by its reducing action on the oxide of copper (*Med.-Chir. Trans.* vol. lxiii. p. 217).

Characters.—Uric acid exists in the urine in combination with alkaline bases. When these bases are deficient, or when the uric acid is in excess, precipitation occurs, and the well-known red particles are visible. Under the microscope they appear in various forms: rhombic crystals, stars, bundles, tablets, and prisms. Pure uric acid is colourless, but, clinically, it is always tinged brown or orange red. It is so slightly soluble in water as to require 12,000 to 15,000 parts; consequently a very slight excess of uric acid or diminution of the water of the urine leads to deposit. It is insoluble in dilute acids, but readily dissolves in alkalies and their carbonates. When combined with potash, ammonia, and soda, it forms the thick brick-dust sediment so commonly seen in most febrile diseases. These 'mixed urates' are amorphous; soluble by heat; form frequently an opaque film on the surface of the urine; and such is their affinity for the urinary pigments, that they generally, but not always, leave a reddish stain on the utensil.

Calculi or concretions composed of pure uric acid vary in size, from the well-known red granules or gravel up to masses of many ounces in weight. They are generally of a reddish-brown colour; very dense and hard; indistinctly stratified; of a flattened oval shape; of a rough tuberous exterior when single, and smooth and facetted when multiple. To this, however, some exception should be made, for it is not uncommon, when only two or three co-exist in the bladder, to find them rough and mammillated, as if there had been no contact or rubbing between them. When uric acid is combined with ammonia and potash in a concretion, the colour is paler, the lamination more distinct, and its texture more friable. Pure uric acid calculi, when broken by the lithotrite, form sharp angular fragments; the urate concretions, on the other hand, break more readily and assume the form of flaky laminæ.

Symptoms.—The occasional deposit of uric acid and urates, even in large quantity, is sometimes observed without the least disturbance of health; frequently, however, it is accompanied by local irritation of the kidneys and bladder, as shown by frequent micturition, with heat and even pain during the act; and by flatulence, heartburn, and other signs of indigestion. There is, however, no habit of body, no recognised symptoms of so definite a kind, which are plainly due to, or accompanied by, an excess of uric acid, as to warrant the continued use of the term 'uric acid diathesis.' Heartburn, flatulence, and other signs of indigestion and liver-disorder may, and often do, exist without any deposit of uric acid or urates, and when they co-exist there is nothing to show that the one depends on the other; the utmost that can be said is that the presence of uric acid points a way to successful treatment. Uric acid and its salts are found *in excess* in many organic diseases; in maladies of the heart and lungs in which oxidation of the blood is so frequently deficient; in organic diseases of the liver; in almost all febrile diseases; and sometimes associated with diabetes, chorea, and certain skin-diseases. They are *deficient or absent* in advanced diseases of the kidney; in some cases of lead-poisoning; in general anæmia; and in some exhausting non-febrile diseases. The relation of uric acid to gout is interesting and important. In the acute stage the daily secretion of uric acid is diminished, notwithstanding that there is frequently a copious deposit of pink urates; but the normal quantity is restored or exceeded as the attack passes off. In chronic gout uric acid is markedly deficient or wholly absent, while the amount of urea continues steady and almost up to the average in health. *See* Gout.

Treatment.—It will be apparent that the treatment of uric acid in excess must be comprised in that of the various diseases in connection with which it occurs. For that condition of indigestion and urinary irritation in which the chief feature is the copious deposit of uric acid and urates, alkaline remedies, such as the bicarbonate of soda, or the carbonate, citrate, and acetate of potash, in scruple or half-drachm doses dissolved in three or four ounces of water, given three or four times a day, afford the best and quickest relief; they produce an alkaline condition of the urine, and a complete solution of the deposit for the time. Salts of lithia are of much value. Lime-water and solution of carbonate of lime have the same effect, but in part this appears to be due to the diuretic effect of the salts of lime. Where hepatic congestion and general sluggishness of all the secretions are present, saline as well as alkaline remedies are indicated, and particularly those mineral waters, such as Vichy, Carlsbad, Wiesbaden, &c., which seem to have the power of exciting all the alimentary secretory glands to healthy and increased action. Diaphoretics, especially the warm water or the hot bath, by increasing the elimination of the acid secretion, are useful adjuncts. Caution, however, is required in the frequent repetition of alkaline remedies, lest the condition of the blood itself be modified and deteriorated. A well-chosen, simple diet is above all things important, and especially the avoidance of too much animal food, of rich, sweet, or highly seasoned dishes, and of alcoholic drinks. For the treatment of lithic calculus in the bladder reference should be made to surgical works. *See* Gout; Gravel; and Renal Calculus.

William Cadge.

URINARY CALCULUS. A calculus connected with any part of the urinary tract. *See* Calculus; and Renal Calculus.

URINARY ORGANS, Diseases of.—Synon.: Fr. *Maladies des Voies Urinaires*; Ger. *Krankheiten des Harnapparats.*

In accordance with the plan adopted in other corresponding articles, it is intended here merely to discuss briefly the diseases of the urinary organs from a general point of view. These organs include:—1. The kidneys, with the infundibula and pelves. 2. The ureters. 3. The bladder. 4. The urethra. The particular diseases of each part of the urinary apparatus will be found treated of under these several headings, and in certain special articles, to which the reader is referred.

Summary of Diseases.—The primary division of diseases into *functional* and *organic* must be recognised in connection with the urinary organs.

I. **Functional.**—The following disorders may be included under this group:—1. The excretory function of the kidneys is influenced and often disturbed by various conditions, physiological or pathological, quite independent of any obvious local morbid change. Hence the urine is modified in different ways and degrees, as regards its quantity or quality. This may depend, for instance, upon some general condition, such as fever or gout; upon causes originating in the nervous system; upon digestive disorders; or upon special diseases, such as diabetes. 2. The muscular structures in certain parts of the urinary apparatus are liable to be affected, and this applies practically to the bladder and urethra. The bladder is subject to undue irritability, spasm, or paralysis, the last being especially important in connection with disease of the spinal cord. The urethra is not uncommonly the seat of spasm, giving rise to more or less spasmodic stricture, and consequent retention of urine. 3. It is believed by some authorities that the kidneys or bladder may be affected with neuralgic pains, without any local mischief to account for them.

II. **Organic.**—The numerous affections of the urinary apparatus belonging to this division may be thus classified:—

1. *Injuries* of different kinds, under which would be included, not only those of traumatic origin, but also ruptures or perforations due to disease.

2. Conditions affecting the *circulation*, namely: *a.* Acute or chronic congestion. *b.* Embolism. *c.* Hæmorrhage. The first two are only met with in the kidneys, but hæmorrhage may occur from any part of the urinary organs.

3. *Acute Inflammatory Diseases.*—These are of different kinds, and comprise the following subdivisions:—*a.* Acute Bright's disease, involving the kidney-substance. *b.* Suppurative inflammation of the kidney, ending in renal abscess. *c.* Inflammation of the mucous membrane. The urinary mucous tract may be involved throughout, but usually only a limited portion is affected, and thus we have the different complaints known as *pyelitis*, or inflammation of the pelvis of the kidney; inflammation of the ureter, rarely existing alone; *cystitis*, or inflammation of the bladder; and *urethritis*, or inflammation of the urethra, the common form of which is gonorrhœa. This mucous inflammation often leads to a purulent discharge, and may terminate in ulceration or gangrene. *d.* Inflammation around the kidney—*perinephritis*; or around the bladder—*pericystitis.*

4. *Chronic Inflammatory Diseases.*—These may remain after the acute forms, or they are chronic from the outset. Practically they include generally certain forms only of Bright's disease, and mucous inflammations.

5. *Malpositions and Malformations.*—These abnormal conditions may be of considerable importance in connection with the urinary organs, being either congenital or acquired, and varying in their nature.

6. *Hypertrophy and Atrophy.*—The morbid changes of this kind belong to two main classes, according as they affect the kidney-substance, or the walls of the duct or bladder. Atrophy of the kidney is either acute or chronic, the latter being in almost all cases a form of chronic Bright's disease, but it may be congenital or due to compression.

7. *Obstruction, Dilatation, and Accumulations.* Obstruction may be due to different causes, and localised at either of the orifices, or at any point in the course of the ureter or urethra. As a consequence of such obstruction, and occasionally from other causes, dilatation occurs, affecting either the pelvis and infundibula of the kidney, the ureter, the bladder, or the urethra, according to its seat; the entire tract may be thus implicated. Accumulations also follow, either of urine, pus, or other materials, and these may become very serious. Hydronephrosis and pyonephrosis are forms of disease in which urine or pus thus accumulates in the pelvis of the kidney. Retention of urine in the bladder is of common occurrence, arising from various causes. Cystic disease of the kidney may be mentioned under this head, as in some instances, at any rate, it probably arises from limited dilatations of the renal tubules.

8. *New Growths and Degenerations.*—Cancer may involve any or every part of the urinary apparatus. Non-malignant growths are met with in exceptional cases. Tubercular disease is an important and serious malady in connection with the urinary organs. The kidneys are liable to albuminoid disease, and to fatty degeneration. Syphilitic growths may also be found in them.

9. *Gravel, Calculi, and Foreign Bodies.*—The formation of calculi of different kinds, and the morbid conditions resulting therefrom, are of peculiar importance in relation to the urinary organs, and a large proportion of cases in actual practice belong to this group. It may also be mentioned here that foreign bodies are sometimes found in the bladder and urethra.

10. *Parasites.*—Certain parasites are particularly associated with the urinary organs, and especially the Strongylus gigas and the Bilharzia hæmatobia. Hydatid disease is met with in rare instances.

Ætiology and Pathology.—It would be quite out of place here to discuss the ætiology and pathology of some of the morbid conditions that have been mentioned, such as urinary calculus, or cystic disease of the kidney, which are fully considered in special articles. All that can be done is to point out in a general way the principal morbific causes which act upon the urinary organs, and the modes of origin of its disease. 1. These organs are much more liable to injury than most others. This may not only come directly from without, but may also be inflicted by articles introduced into the urethra or bladder, by surgical operations, or by calculi. 2. Certain morbid conditions are congenital, being the result of imperfect development, or of intra-uterine disease. 3. Exposure to cold or wet undoubtedly originates serious renal disease in some cases, such, for instance, as Bright's disease; and it is also supposed to give rise in other instances to less serious complaints in connection with the urinary organs, such as congestion, or some form of mucous inflammation. This cause probably acts by interfering with the cutaneous excretion, and inducing internal congestion. It may also be remarked that want of cleanliness of the skin is capable of assisting in developing renal disease. 4. Affections of the urinary organs are of frequent occurrence in connection with certain acute febrile diseases, either as essential parts of these diseases, or as complications or sequelæ. Scarlatina and pyæmia demand special mention in this connection. 5. Abnormal conditions of the urine when first excreted, or the presence of certain materials in the kidney which this organ cannot properly excrete, are prolific causes of urinary affections. These abnormal conditions and materials may originate in a variety of remote causes, and they are well exemplified by the effects of certain medicines, alcohol, excessive acidity of the urine, diabetic urine, and gout. Such causes may induce congestion, inflammation, chronic renal changes, or calculi. 6. The urinary organs may be implicated as part of some general or constitutional disease, as in cancer, tuberculosis, or albuminoid disease. 7. Certain parasites specially lodge in these organs, as has been already mentioned. 8. The urinary organs may be affected, owing to some neighbouring disease. For instance, a tumour may compress the ureter or bladder, or obstruct the renal vein; or the structures may be involved by extension. 9. Cardiac diseases which impede the venous circulation, not only cause venous congestion of the renal organs, but in time give rise to serious organic changes. 10. The cause of urinary disease may be in the nervous system. Thus may arise a form of acute congestion of the kidneys; and the paralysis of the bladder, which spinal disease so often produces, is liable to be followed by cystitis and its consequences. 11. One specific disease is associated with the urethra, namely, gonorrhœa; and its effects often extend to the bladder, or even higher up along the urinary tract. 12. It is important to notice that the different parts of the urinary apparatus have an intimate relation to each other from an ætiological point of view. For instance, it is believed that one kidney may become hypertrophied, if the other should be destroyed by disease. Or a morbid condition may extend directly from one part of the urinary organs to another. Again, urine which undergoes certain changes after its formation, is liable to cause mischief. There are other relations which probably exist between the different portions of the urinary apparatus, which are discussed elsewhere. *See* SURGICAL KIDNEY.

CLINICAL INVESTIGATION AND SIGNS.—Without entering into details, the symptoms and signs which may be associated with urinary diseases can be summarised in the following way, and this summary will indicate the course to be adopted in their investigation. 1. Painful sensations, with or without tenderness, may be referred to the region of the kidneys, perhaps to the ureter, to the bladder, or to the urethra, when these are respectively the seat of mischief. Moreover, disease in one part may be accompanied with sympathetic sensations in some other part; or in certain conditions there may be pain along the spermatic cord to the testis, with retraction of this organ. Other sensations are complained of in many instances, such as itching or tickling at the end of the penis, heat or burning along the urethra, heaviness and weight in the lumbar region, or fulness of the bladder. These feelings are often modified by various causes. 2. The sensations connected with micturition are of special significance, such as a frequent inclination to pass water, a sudden and urgent desire, or strangury. 3. The act of micturition itself is often affected. It may be too frequent or infrequent; difficult, even to complete retention—*dysuria*; or performed involuntarily—*incontinence*. The stream of urine is altered in size or shape in some conditions (*see* MICTURITION, Disorders of). 4. The urine itself affords signs of great importance in relation to diseases of the urinary apparatus, in regard to its quantity, physical characters, chemical composition, and microscopic appearances. Indeed, it very often happens that the urine alone affords any evidence of urinary disease. At the same time it must, of course, be borne in mind that this excretion is modified by many other conditions, the urinary organs being quite healthy. This subject is fully treated of elsewhere (*see* URINE, Morbid Conditions of). 5. Urinary diseases often produce important effects upon the blood or general system, as well as upon other organs. Hence arise renal dropsy; the phenomena of uræmia, septicæmia, or the typhoid condition in some forms of disease; collapse sometimes; and morbid conditions affecting the heart and vessels, or certain structures in the eye. These morbid changes may be evidenced by more or less marked symptoms. Moreover, enlargement of the kidney may affect neighbouring structures. 6. Physical examination is of essential value in the investigation of many urinary affections, and in carrying this out the aid of a skilful surgeon is often of the first consequence. The local examination is directed to the determination and investigation of enlargements or tumours of the kidneys; conditions of the bladder, especially retention of urine, and the presence of calculi and growths; and morbid states affecting the urethra, such as enlarged prostate, stricture, or the lodgment of a calculus. Physical examination also reveals the changes in other structures already alluded to.

These are the main points which can be usefully discussed from a general point of view with reference to urinary diseases. For their diagnosis, prognosis, and treatment, as well as for more complete details on the various matters alluded to, reference must be made to the different appropriate articles, especially to those which deal with the affections of the several parts of the urinary apparatus. *See* BLADDER, Diseases of; BRIGHT'S DISEASE; KIDNEYS, Diseases of; RENAL CALCULUS; SURGICAL KIDNEY; URETER, Diseases of, &c.

FREDERICK T. ROBERTS.

URINE, Incontinence of.—The involuntary discharge of urine from the bladder, the patient being either unable to retain it, or unaware of its escape. *See* MICTURITION, Disorders of.

URINE, Morbid Conditions of.—SYNON.: Fr. *Maladies de l'Urine*; Ger. *Harnkrankheiten*.

INTRODUCTION.—The urine is the excretion by which the products of nitrogenous waste are eliminated from the body. Alterations in its characters give valuable information regarding tissue-change in the body, and may indicate the presence of disease which would otherwise remain undetected. They therefore require detailed attention. Before entering, however, upon the discussion of the morbid conditions of the urine, it will be well to describe briefly its characters and mode of secretion in health.

In reptiles and birds the waste nitrogenous products of the body are excreted as urates; and the urine is solid. In amphibia and mammals they are chiefly excreted as urea, and the urine is liquid.

Human urine is a clear liquid, of a yellow colour, acid reaction, peculiar odour, and saline taste. It consists essentially of a watery solution of urea, extractive and colouring matters, and salts. Its average specific gravity is about 1,020, but this varies according to the proportion of solids it contains.

Secretion of Urine. — Until lately, the theory of Ludwig regarding the secretion of urine was the prevalent one. He believed it to be a process of filtration of water and salts from the vessels in the glomeruli, and that these were partly reabsorbed in the tubules by the cells lining them. But it has been shown by Heidenhain that the cells of the tubules also play an active part in excreting, inasmuch as sulphate of indigo injected into the blood does not colour the glomeruli, but colours the cells of the tubules. The process of secretion of urine may therefore be looked upon as consisting of two parts—first, the filtration of water, and probably of a small quantity of salts, which takes place under pressure from the vessels of the glomeruli; and secondly, the excretion of urea and other solid constituents by the epithelial lining of the tubules. The water which exudes from the glomeruli dissolves and removes the substances excreted by the tubules, and is very possibly also to some extent reabsorbed in its passage. The higher the tension of the blood in the glomerular vessels, the more rapid is the secretion of urine; or, to put it more exactly, the greater the difference is between the tension of the blood in the blood-vessels and the fluid in the tubules, the more rapid is the secretion of urine. The secretion may therefore be increased either by raising the pressure in the vessels, or by diminishing that in the tubules; and, *vice versâ*, it may be diminished by lessening the blood-pressure in the glomeruli, or by raising the pressure of the urine in the tubules. The blood-pressure may be raised either generally throughout the body, or locally by dilatation of the renal arteries. These arteries have considerable power of contraction, so much so that they can lessen the pressure in the glomeruli even when it is raised throughout the body generally. The blood-pressure may be raised in the body generally by the contraction of the arterioles from exposure to cold, by mental excitement, by the influence of food, or by the action of certain drugs, such as digitalis. It may be lowered by shock, by exposure to external warmth, or by rise of the bodily temperature, as in fever. It seems probable, from experiments made by the writer and Mr. Power, that the arterial tension in the glomeruli may be locally diminished even when the general blood-pressure is increased, by the action of digitalis, which, while causing contraction of the vessels generally, affects those of the kidney more especially, and thus, by their contraction, lessens the blood-supply to these organs. The vessels of the kidney are controlled by the medulla oblongata; and when this is stimulated, either directly by a galvanic current or by asphyxial blood, or reflexly by irritation of a sensory nerve, the renal vessels contract. Dr. Roy has shown that they are also very sensitive to slight changes in the chemical constitution of the blood, water or urea causing slight contraction, followed by greater and longer dilatation. Digitalis does so also; but the contraction is much longer. Common salt, nitrate of soda, and acetate of potash cause dilatation without previous contraction. They act upon the vessels even when the nerves are cut, and therefore they must affect them either directly, or through some local vasomotor nervous apparatus.

By experiments on the kidneys of amphibia, which have a separate vascular supply to the glomeruli and tubules, Nussbaum has found that sugar, peptones, and albumen are excreted through the glomeruli; but that urea is passed out through the epithelium of the tubules, and in passing out causes increased secretion of water from them.

CHARACTERS OF URINE.—1. **Transparency.** Healthy urine is clear when passed, but after standing some time a light flocculent precipitate falls. This consists of mucus and epithelial cells from the urinary passages. A hummocky, white, and sharply defined upper surface indicates the presence of crystals of oxalate of lime in the cloud. Small white flocculi of this size and shape, looking somewhat like small worms, may occur suspended in the freshly-passed urine of persons who have suffered from gonorrhœa or prostatitis some time previously. On microscopic examination they are found to consist of aggregations of leucocytes. The writer has found the presence of these flocculi useful in diagnosing gonorrhœal rheumatism where no history of gonorrhœa was given by the patient.

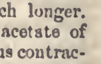
FIG. 133.

Urine which is clear when passed may afterwards deposit sediments of urates or phosphates. These are distinguished from each other by warming the urine. The urates dissolve and the urine becomes clear; but the phosphates are not dissolved, and the urine is rendered more turbid by the heat. On the addition of a few drops of acid the phosphates dissolve readily, and the urine becomes clear. When the urine is concentrated and contains much urates, it may become turbid almost immediately from their deposition, if it is passed into a cold vessel.

Turbidity of the urine as it is passed is generally, however, due to earthy phosphates, mucus, pus, or blood. The whitish or light colour of the turbidity due to the first three causes distinguishes it from turbidity due to blood. The addition of a few drops of acetic acid causes the turbidity due to phosphates to disappear, while it does not remove that due to mucus or pus. Turbidity due to pus is distinguished from that due to mucus by the presence of albumin. The albumin may be recognised by adding a drop or two of a clear solution of ferrocyanide of potassium to the urine previously acidulated by acetic acid. If the turbidity is not increased it is due to mucus. If it is increased it may be due to pus, or to mucus in albuminous urine. In this case let the urine stand until the sediment has deposited, pour off the supernatant liquid, add a small piece of caustic potash to the sediment, and stir it for some minutes with a glass rod. If it is due to pus it will become more transparent and tough, forming a thick mucilaginous fluid, which flows with difficulty when the quantity of pus is small. When there is much pus it will form a thick, glassy coherent lump. If due to mucus it will not become thick and coherent. If due to blood the addition of a drop of tincture of guaiacum and twenty drops or more of ozonic æther will give a blue colour.

2. **Colour.**—The colour of urine varies from an almost imperceptible yellow to a dark brown or almost a black. Four degrees are usually distinguished—*pale*, *normal*, *high-coloured*, and *dark*. It is usually understood that the description applies to urine seen in a white chamber-pot, from one-third to one-half filled, or more exactly, as suggested by Vogel, in a cylindrical glass about three and a half or four inches in diameter. *Pale* urines are those which under such circumstances vary from an almost complete absence of colour, so that they are indistinguishable from water, except when seen in thick layers, up to a straw-yellow colour. *Normal* urines are those which have a golden yellow up to an orange-yellow colour. *High-coloured* have a reddish-yellow to a red colour; and *dark* urines have a deep red-brown or blackish colour.

These variations in the colour of urine are to a great extent due to the proportion of water in which the urinary pigments are dissolved. Watery urine is pale, and concentrated urine is high-coloured. It is probable that they also depend on variations in the nature of the pigments chiefly present. Sometimes they are due to an admixture of foreign colouring matter, such as bile or blood.

Clinical Import.—Pale urine occurs when secretion is rapid, and the urine is consequently dilute, as after copious draughts of liquid or exposure to cold. It is found also in cases of granular kidney, anæmia, chlorosis, diabetes mellitus and insipidus, and after hysterical fits, asthma, or other forms of nervous excitement.

High-coloured urine occurs when the secretion is diminished by profuse perspiration; and also in disorders of the liver, and febrile conditions. The colour of the urine is generally deeper after food, and the urine may be high-coloured after a large meal in healthy persons.

Dark urine generally owes its colour to bile, hæmoglobin, or blood. Bile gives it various tints of brown or green; hæmoglobin or blood imparts a smoky, blood-red, or coffee colour. When blood is mixed with much pus in a strongly alkaline urine, the colour may be greenish-brown. Carbolic acid or creasote extensively used, either externally or internally, renders the urine blackish or black. In cases of melanotic cancer the urine, although of a normal colour when voided, may become black after standing; and this darkening is much accelerated by the addition of nitric acid or other oxidising agents.

3. **Quantity.**—The quantity of urine passed in twenty-four hours varies very greatly. The average may be roughly stated to be about fifty ounces, and the ordinary variation is about one-fifth of the quantity above or below the normal. The quantity is usually increased by anything which raises, and lessened by anything which diminishes, the arterial tension. Thus, cold and nervous excitement will increase it, while warmth and quiet usually diminish it. The quantity passed during the waking hours is much greater than during the hours of sleep; and the fact that the person has to rise during the night one or more times to pass water awakens suspicion of renal disease, or of excessive secretion.

Although temporary conditions may cause the amount of urine passed in one day to differ much from that of another, yet in healthy people it usually equalizes itself in two or three days, unless there be constant disturbing influences, such as persistent cold.

Clinical Import.—(*a*) A persistent *increase* in the quantity of urine may indicate diabetes mellitus, polyuria, waxy kidney, or granular kidney. These are diagnosed by the presence of sugar in diabetes; by the entire absence of both sugar and albumin in polyuria; by the presence of considerable albumin in waxy kidney; and by the presence of albumin—though only in small quantity, and of high arterial tension, in granular kidney. The conditions in which temporary increase in the quantity of urine occurs are exposure to cold, nervous excitement, hysterical fits, copious drinking, the use of diuretic medicines or articles of food containing tartrates or citrates, and the consumption of certain forms of wine and alcohol, as hock and gin.

(*b*) A quantity of urine *below the average* may be due to habit, leading the individual to drink little fluid; or to habitual exposure to heat, leading to excessive perspiration. A diminution in quantity also occurs in acute inflammation of the renal glomeruli or tubules; in subacute exacerbations of chronic inflammatory conditions; and in certain disordered states of the nervous system. It also occurs in cases of granular kidney approaching a fatal termination, and is then a sign of grave import.

4. **Specific Gravity.**—This is most easily ascertained by the form of areometer which

is called a *urinometer*. In using this instrument care should be taken that it is clean and dry before it is put into the urine, and that it does not touch the sides of the vessel. The surface of the fluid forms a meniscus, and the graduation on the stem of the instrument should be read off at the lower edge of the meniscus with the eye on a level with it. When there is not sufficient urine to take the specific gravity, it should be diluted with one, two, or as many times as may be necessary, volumes of water, and the specific gravity taken. The decimal figures of the specific gravity thus found are then multiplied by the number of times the urine has been diluted, in order to get the true specific gravity. Thus if the urine has been diluted by adding four times its own volume of water to it, its bulk is increased to five times that of the original urine. If the specific gravity of the diluted urine is 1002, the specific gravity of the original urine is $1{\cdot}000 + ({\cdot}002 \times 5) = 1{\cdot}010$. The urinometers give the specific gravity at 60° Fahr.; and at any temperatures above this they indicate a lower specific gravity, and at temperatures below a higher specific gravity, than the true one.

The specific gravity of the urine depends on the proportion of solid matters which it holds in solution. The amount of water in the urine fluctuates much more than the solids, and therefore the specific gravity varies also. It is less when the urine is watery, and greater when it is concentrated. The average specific gravity is about 1020, but it may vary in health between 1010 and 1025, or even beyond these limits. It varies in the same person at different times of the day, and in different portions of urine passed at the same time. As the urine is secreted and accumulates gradually in the bladder, it becomes arranged in layers according to its specific gravity, the heaviest layers being lowest. If the person remains quiet, so as not to mix the layers, and passes the urine in successive portions into different glasses, their specific gravity may be found to differ.

The specific gravity is diminished during fasting, but is increased after meals, on account of the greater excretion of solids which then occurs. It is diminished when the secretion is quickened, or rendered more abundant and watery by drinking copiously of fluids, by exposure to cold, by mental excitement, or by the use of diuretics. It is increased when the urine is concentrated by abstinence from fluids; by profuse perspiration, which carries off much water by the skin; and by long retention in the bladder, which allows some of the water to be re-absorbed. The variations in specific gravity due to the causes just mentioned are transitory, and are generally succeeded by variations in an opposite direction; so that the specific gravity of the entire urine passed during twenty-four hours may be little altered.

Clinical Import.—A persistently high specific gravity generally indicates diabetes mellitus, or azoturia. It also occurs at the beginning of acute febrile diseases; and in acute nephritis with hæmaturia.

The specific gravity is increased by the presence of albumin alone, as well as by blood. It is sometimes thought that the mere presence of albumin diminishes the specific gravity of the urine, but this is an error. It is quite true that in certain cases of albuminuria the specific gravity is diminished, but this is due to the absence of other ingredients, and not to the presence of albumin. The writer has found experimentally that the addition of serum-albumin to the urine increases its specific gravity.

An abnormally low specific gravity may indicate contracted or amyloid kidney, diabetes insipidus, or hysteria.

5. **Reaction.**—Fresh normal urine is generally acid, but when passed after a meal it may be neutral or even alkaline, and sometimes, though rarely, the mixed urine of twenty-four hours may present a similar reaction. Sometimes the reaction is amphoteric or amphogenous, that is, red litmus paper is rendered blue, and blue litmus paper is turned red. The acidity of the urine is chiefly due to acid phosphates, and in part also to free organic acids, such as lactic and hippuric. The amphoteric reaction is probably due to the presence of basic and acid phosphates together. The acidity is less when acid is being secreted by the stomach or skin during digestion or profuse perspiration. It is diminished by vegetable diet, and by alkalies or their salts with vegetable acids. It is diminished in anæmia and chlorosis; and in melancholia or paralysis the reaction may be neutral or alkaline from potassium or sodium carbonates. It is increased by a flesh or a milk diet, by muscular exercise, by drinking, and by acids; and also in fever and diabetes.

When urine is passed with proper precautions into a vessel which has been previously heated, so as to destroy all germs, it may be kept unchanged for years.

Usually it becomes altered quickly, its reaction becoming, first, more strongly acid, then less acid, and finally alkaline. These changes are due to fermentation, which leads first to the formation of acid phosphates, and of lactic and acetic acids, from the extractive matters of the urine, with deposition of uric acid. This increase of acidity is not constant, and deposition of uric acid may occur simply from chemical reaction between urates and acid phosphates. After a varying period the urea becomes decomposed, and carbonate of ammonia is formed, which gives to the urine an ammoniacal odour and alkaline reaction, and causes the precipitation of urate of ammonia, ammonio-magnesian phosphate, calcium phosphate, and calcium carbonate.

The acid fermentation, when present, is probably due to an organism similar to yeast. The alkaline fermentation is probably caused in great measure by bacteria, but it may be induced also by a non-organised ferment, which has been isolated from ammoniacal urine. This ferment appears to be generally produced by bacteria, but it may be produced also, under certain circumstances, by the mucus-corpuscles and epithelial cells in the bladder. Fresh urine inoculated with bacteria from decomposing urine undergoes very rapid change, and the same is the case with the urine inside the bladder when it is inoculated by means of dirty catheters. But similar changes may occur in the bladder in cases of cystitis, even when no instruments have been introduced, and the ferment in these cases appears to be formed by the mucus or epithelium. In order to distinguish whether the alkalinity of the urine depends on ammonia or on fixed alkalies, the red litmus paper must be dried after being dipped in it. If the alkalinity is due to ammonia the blueness of the paper which it produced will disappear, and the paper return to its original red colour; but the blue will remain if the alkalinity is due to fixed alkalies.

SOLID CONSTITUENTS.—The solid constituents of the urine are the ashes of the body, and their quantity varies with the amount of food consumed, and the amount of waste in the tissues of the body itself. Their quality depends on the nature of the nutritive processes and of the tissue-change going on in the body: and it thus forms a useful indication of the healthy or diseased nature of the tissue-change and nutritive processes. Some solids are constantly present, although in varying quantities, in healthy urine; others are only occasionally present; and others again never occur in health, so that their presence is a sign of disease. Those present in health are (1) *nitrogenous substances*—urea, uric acid, allantoin, oxaluric acid, xanthin, kreatinin, sulphocyanic acid, Baumstark's body, and perhaps guanin; (2) *ferments*—pepsin, nephrozymose or ptyalin; (3) *salts*—chiefly chlorides, sulphates, and phosphates of sodium, potassium, ammonium, calcium, and magnesium, sodium chloride being the most abundant; (4) *acids*—oxalic, lactic, and glycero-phosphoric acids, possibly present in combination, or partly free; sulphuric acid in two forms, simply combined with bases as sulphates, or united with other substances so as to form ether-sulphuric acids of phenol, kresol, brenzcatechin, indoxyl, scatoxyl, &c.; and (5) *pigments*, and pigment-yielding bodies or chromogens.

Abnormal constituents include albumins, blood, hæmoglobin, methæmoglobin, bile-pigments, bile-acids, grape and milk sugar, leucin and tyrosin, lecithin, cystin, fat, &c.

The *quantity* of solid constituents is determined exactly by weighing the dried residue of a given quantity of urine. It may also be ascertained approximately by multiplying the last two figures of the specific gravity by 2·33. This gives the amount per thousand, and from this the total quantity is reckoned. Thus, if a man passes 1,560 cub. cent. of urine daily, which when mixed has a specific gravity of 1,022, then $22 \times 2·33 = 51·26$ and $1000 : 1560 :: 51·26 : 79·96$ grammes of solids per diem.

The most important constituents must now be described.

1. **Urea** (CON_2H_4).—This is by far the largest and most important of the organic constituents of urine, as 70 or 80 per cent. of the entire nitrogen excreted appears as urea. The quantity of urea passed *per diem* by a healthy man is on an average 33·18 grammes or 512·4 grains. Urea may be regarded as the ash of the nitrogenous substances, whether food or tissues, which have undergone combustion in the body, and therefore its quantity fluctuates greatly according to the amount of nitrogenous food consumed, and also according to the rapidity of tissue-change. The variations due to the food are so great, however, that unless the amount of nitrogen in the food consumed be kept rigidly the same from day to day, or food be altogether withheld, they mask the variations due to tissue-change. Hence most of the earlier experiments on the influence of drugs, exercise, &c., on tissue-change, as determined from the excretion of urea, are untrustworthy.

The quantity of urea varies with age, sex, country, and other circumstances; but most of these variations are easily accounted for by the proportion of nitrogenous food taken by children and adults, men and women, English, French, or Germans respectively. Muscular exercise up to a certain point does not increase it, but when excessive it appears to do so; the explanation probably being that in ordinary exercise no destruction of the nitrogenous constituents of the muscle occurs, the energy being supplied by their non-nitrogenous elements, but that when the exercise is too severe and prolonged, the albuminous constituents of the muscles themselves become partially destroyed.

Nitrogenous food, such as meat of all sorts, eggs, and gelatin or substances which yield it, increase the excretion of urea in proportion to the quantity of this sort of food taken. There seems to be a limit, however, beyond which the excretory powers of the kidney will not go, and when this limit is reached, nature saves the organism by diarrhœa, which carries off the excess of nitrogenous food. The addition of fat alone to an abundant diet of meat rather increases the excretion of urea; but when farinaceous food is added to such a diet, the urea is rather diminished. Farinaceous food and fats given to an animal deprived altogether of nitrogenous food, cause it to excrete less urea than if it were totally deprived of food. The addition of farinaceous food and fat therefore appears to lessen the destruction of the nitrogenous tissues themselves.

When much water is drunk, the absolute amount of urea excreted in twenty-four hours is considerably increased, although, the urine being so much more abundant, the percentage of urea is lessened. The increase in urea is said to be greater when the water is drunk during the meal, than when it is drunk after digestion has taken place.

Table and other salts increase the quantity of urea, even when no more water is drunk, and also increase the quantity of water, probably by causing part of the water to be eliminated through the kidneys, which would otherwise have passed off through the lungs or skin.

Moderate warmth appears to diminish the excretion of urea, probably by increasing the secretion of sweat; but when an animal is kept for a length of time at a high temperature, a condition of fever appears, and the excretion of urea is greatly increased.

Quantitative Estimation.—Formerly urea was usually estimated by Liebig's method of titration with nitrate of mercury; but the mode now usually adopted, as being at once accurate and easy, is the hypobromite process. This method is due to Davy, who used hypochlorite of soda, and this was afterwards modified by Hüfner, who introduced the hypobromite in place of hypochlorite. This method depends on the fact that urea, in contact with alkaline hypobromites or hypochlorites, is decomposed, and gives off nitrogen, from the amount of which the quantity of urea decomposed can be readily estimated. Various modifications in the method of applying the process have been introduced, the one in most common use perhaps being that of Russell and West.

The apparatus consists of a tube in which the urine is allowed to mix with a hypobromite solution, and a pneumatic trough, with a measuring tube, in which to collect the evolved gas. The measuring tube is graduated to give the percentage of urea. Another apparatus is that of Dupré, in which the urine and hypobromite solution are mixed in a bottle connected with the measuring tube by an india-rubber tube. Both of these are well adapted for clinical use. In each of them 5 cc. of urine is mixed with four or five times its bulk of the hypobromite solution. This solution is prepared by dissolving 100 parts of caustic soda in 250 of water, and adding, when cold, 25 parts of bromine. The solution does not keep, and is best made by having the soda solution of a proper strength, and adding the required quantity of bromine at each analysis.

The readiness with which crystals of nitrate of urea form on the addition of nitric acid to a solution containing it, affords a means of estimating roughly the quantity of urea present in urine. These crystals do not form in normal urine on the simple addition of nitric acid, but do so in urine containing great excess of urea. Thus, if equal parts of strong nitric acid and such urine—say, half a drachm of each—be mixed in a test-tube, and this be placed in cold water, the crystals will soon make their appearance. Another form of test is easily applied on an object-glass. One end of a small piece of thread is put into a drop of urine on the glass; the drop, and the half of the thread are then protected by a thin covering-glass; and the other end of the thread is moistened with nitric acid. The whole is then put under the microscope, and hexagonal plates of nitrate of urea are seen forming at each side of the thread when there is great excess of urea. If the urine contains the normal, or less than the normal, amount of urea, it must be more or less evaporated by gently heating over a spirit-lamp before the crystals form; and from the extent to which this is necessary a rough estimate of the deficiency of urea may be formed.

Clinical Import.—When the percentage of urea is much above 2 per cent. it generally indicates that the patient is either feverish, or has been perspiring profusely, or that the quantity of water he drinks is too small to ensure the ready elimination of the products of nitrogenous waste. In such cases, if the thermometer does not indicate the presence of fever, or if the patient has not been perspiring profusely, he should be advised to drink more water, in order to prevent the possible occurrence of rheumatic or gouty affections. A small percentage of urea is of much graver significance. It may be due to copious drinking, exposure to cold, or to mental excitement; but when it occurs independently of these causes in elderly persons, it very commonly indicates the presence of contracting kidney.

The name *azoturia* has been given to a condition in which the excretion of urea is excessive, in proportion to the weight of the body. In some persons excessive excretion of urea is associated with increased secretion of water, so that the proportion of urea remains normal. In others the water is not increased, and therefore the urea excreted is not only increased in absolute quantity *per diem*, but its proportion in the urine is greater than normal, so that such urine at once gives crystals of nitrate of urea on the addition of nitric acid. Excessive excretion of urea, both absolute and relative to the amount of urine, may occur for a time in perfectly healthy persons, without any abnormal symptom whatever. In others, however, such an excess of urea is associated with gastro-intestinal derangement and nervous symptoms, the patient complaining of acidity and flatulence, but not of thirst or excessive appetite. There is languor, fatigue after slight exertion, bodily or mental, nervousness, restlessness at night, dull pain in the back, and sometimes irritation at the neck of the bladder, with constant desire to pass water. It is probable that in some individuals the nitrogenous tissue-change goes on more rapidly than in others, and that they consequently require a larger proportion of nitrogenous constituents in their food, to enable them to do the same amount of work; and that when indigestion occurs in such persons, the nitrogenous products of imperfect digestion or tissue-waste, acting as nervous and muscular poisons, lead to the symptoms of which they complain. In diabetes there is increased excretion of urea, from the greater amount of food taken by the patients; and it has been supposed by Prout that cases of azoturia might pass into diabetes.

The *treatment* consists in ordering nutritious diet, with a large proportion of farinaceous constituents; moderate exercise; avoidance of fatigue, mental or bodily; purgatives; alteratives; and opium.

2. **Uric Acid.**—($C_5H_4N_4O_3$).—When pure, uric acid forms white crystals, very sparingly soluble in water. It does not exist free in the healthy urine, but is combined with potash, soda, and ammonia. From these it may be separated by the addition of an acid, or by acid fermentation in the urine after it has been passed, as already described.

As deposited from the urine, uric acid is nearly always coloured. It may be deposited in scattered brown specks, or as a dense deposit of red sand, resembling red pepper in appearance; or it may form a thin film on the surface of the urine. The crystalline character of the deposit can generally, though not always, be recognised by the naked eye. On microscopic examination the crystals usually present a somewhat lozenge-shaped form. This form is modified by rounding and by aggregation. When the angles are rounded off, spindle-shaped, ovoid, and barrel-shaped forms are produced. Sometimes they are elongated, so as to produce a rod; and the aggregation of the lozenge, ovoid, and rod-like forms produces stars and spikes, varying considerably in appearance. Sometimes, also, they appear like dumb-bells (*see* MICROSCOPE IN MEDICINE). The crystals of uric acid are distinguished by their reddish or brown colour, as well as by their peculiar appearance. They dissolve readily in caustic soda or potash, and separate again on the addition of hydrochloric acid. The chemical test for uric acid is generally known by the name of the murexide-test. It distinguishes uric acid and urates from other urinary sediments, but it will not distinguish free uric acid from uric acid in combination. The mode of applying it is to warm the sediment in a porcelain capsule, with a few drops of nitric acid and a little water, and to evaporate it carefully, almost to dryness. It is then moistened by a glass rod with diluted ammonia, when a fine purple red colour appears, which, on the addition of a drop of caustic potash, passes into a purplish blue.

Quantitative Estimation.—Uric acid is estimated quantitatively by mixing the urine with $\frac{1}{20}$th of its bulk of hydrochloric acid, and setting it aside in a cool place for twenty-four hours. The deposit of uric acid is then collected on a filter, washed with the least possible quantity of water, dried, and weighed; the weight of the filter alone having been previously ascertained. As the weighing is troublesome and difficult, the quantity of uric acid may be ascertained by carefully washing it off the filter, and boiling it with peroxide of lead in a little water, so as to convert it into carbonic and oxalic acids, allantoin, and urea. The amount of nitrogen in this solution is then estimated by the hypobromite method already described. Uric acid contains one-third of its weight of nitrogen, so that by multiplying the weight of nitrogen evolved by 3, one obtains the quantity of uric acid. Besides this ·0015 gramme is to be added for each 100 cc. of the urine employed.

Another method (Cook's) is to add 3 or 4 drops of caustic soda to 300 or 400 c.c. of urine, and, after the phosphates have subsided, to add to 100 c.c. of the clear liquid about 4 c.c. of a solution (1 in 3) of zinc sulphate, sufficient to make the urine faintly acid. This precipitates the uric acid in the form of insoluble zinc urate. The precipitate is washed on a filter with a saturated solution of zinc urate, and then placed with the filter in the urea apparatus, and the nitrogen estimated by the hypobromite method, as already described. When boiled with liquor potassæ and cupric sulphate, uric acid reduces the latter to cuprous oxide. The writer has seen a case in which the reduction was so great as to lead the patient, who was a medical man, to think that he was suffering from diabetes, and to put himself on an animal diet, by which his condition was of course made worse.

2*a*. **Urates.**—Uric acid occurs in combination with soda, ammonia, and lime; the urate of soda being the most common. The urates, being readily soluble at the temperature of the body, are only deposited on cooling, so that the urine, which was clear when passed, becomes muddy, and a sediment forms, which is commonly coloured like brick-dust, varying in shade, being sometimes almost white and sometimes red. Pale white urates are readily distinguished from phosphates by quickly clearing up when the urine is warmed, while the phosphates do not. Microscopically, the urates of soda and lime are usually amorphous; but sometimes the urate of soda forms globules with projecting spikes, which have caused them to be compared to hedgehogs. The urate of ammonia forms opaque globules, or slender dumb-bells, which are either single or aggregated, so as to form a cross or rosette.

Clinical Import.—Deposit of urates occurs readily after any violent exertion or perspiration, or after errors in eating or drinking. People are often frightened by such deposits, but they are of no importance unless they should persist for a length of time. Persistent deposits occur in febrile conditions or deep-seated organic disease. In cirrhosis the urine is sometimes heavily loaded. *See* URIC ACID DIATHESIS.

3. **Oxalate of Lime.**—Oxalate of lime is recognised by the white, hummocky appearance of the top of the mucous cloud in the urine. On microscopical examination, octahedral crystals are seen, presenting the appearance of a folded envelope. It also occurs in colourless dumb-bells. It is distinguished from uric acid by being colourless, and insoluble in alkalies; and from phosphates by being insoluble in acetic acid.

Clinical Import.—The occasional occurrence of oxalates is of slight importance, and is usually connected with diet. In hospital practice the writer has noticed that when the patients ate cabbage for dinner, a large proportion of them had oxalates in the urine next morning. Persistent presence of oxalates in the urine has been supposed to be connected with a peculiar diathesis (the oxalic acid diathesis), the symptoms of which are languor, depression, and melancholia. It is most probable that both this and the presence of oxalates in the urine are simply due to imperfect digestion, more especially as they often disappear readily on treatment by nitrohydrochloric acid. *See* OXALIC ACID DIATHESIS.

4. **Phosphates.**—Two kinds of phosphates are found in the urine—phosphate of lime, and ammonio-magnesian or triple phosphate. They are always deposited when the urine becomes alkaline through fermentation; and when feebly acid urine is heated, so that the carbonic acid is driven off, phosphates are precipitated in the form of a cloud, which might be mistaken for albumin, but clears up at once on the addition of a drop of acid. Under the microscope, phosphate of lime is amorphous. The ammonio-magnesian phosphate occurs in rhombic prisms, which are distinguished from oxalate of lime by dissolving readily in acetic acid.

Quantitative Estimation.—A rough quantitative estimation of phosphates is made by rendering some urine alkaline with ammonia, and adding an ammonio-magnesian solution to it. A precipitate of ammonio-magnesian phosphate at once occurs if the amount in the urine be normal, but is delayed when the quantity is below normal.

Clinical Import.—In persons having little exercise and a good deal of brain-work, the urine may be turbid when passed, from phosphates present in it. This usually passes away when they get more exercise. It may continue for months, and is of importance only in so far as it renders the patient liable to phosphatic calculus. Such deposits do not indicate increased quantity of phosphates in the urine, but are simply due to diminished acidity. The writer has found the actual quantity of phosphates present in such turbid urines less than in specimens of clear urine from the same individual. The occurrence of stellar crystals of phosphate of lime in quantity in the urine is, according to Roberts, of grave import, indicating serious disease of some kind or other, although a few such crystals may occur in normal urine. The triple phosphate almost invariably occurs in ammoniacal urine, and generally appears after urine, alkaline from any cause, has stood for some time. *See* PHOSPHATIC DIATHESIS.

The quantity of phosphates is increased in febrile disorders, and in diseases of the nerve-centres and bones; it is diminished in Bright's disease, and sometimes in dyspepsia, as well as after the disappearance of febrile conditions.

5. **Sulphates.**—Sulphur appears in the urine, first, as sulphuric acid, free or in conjunction with organic radicals; secondly, as oxidisable sulphur compounds, for example, taurine; and thirdly, as sulphur compounds oxidisable with difficulty. The presence of sulphuric acid in simple combination with bases, or in conjunction with radicals, is tested by adding barium chloride and hydrochloric acid to the urine, when a white precipitate takes place.

Quantitative Estimation.—Sulphuric acid is estimated quantitatively by means of strontium, but for the details of the process the reader is referred to text-books. The oxidisable sulphur is estimated by boiling with nitric acid and chlorate of potash, and then determining the quantity of sulphuric acid present, and deducting from the amount thus found the quantity obtained by the first method. The sulphur oxidisable with difficulty is determined by evaporating a measured quantity of urine to dryness, calcining with nitrate of potash, estimating the sulphuric acid, and deducting from these the quantity found by the second method.

Clinical Import.—The excretion of sulphur in the urine may be used as a means of diagnosing the condition of the secretion of bile. The more sulphur is excreted in the bile, the less appears in the urine, and *vice versâ.* In biliary colic, due to impediment to the flow of bile through the ducts, the easily oxidisable sulphur has been found by Lepine to be diminished, but the difficultly oxidisable to be increased.

6. **Chlorides.**—Chlorine is present in the urine in combination with ammonia, fixed alkalies, or alkaline earths. The quantity depends chiefly on the amount of salt taken in the food. When this is constant the excretion is also tolerably constant; but if a larger quantity of salt be then regularly taken, the excess may not begin to be excreted until after about three days, when it will again remain constant; and the excretion will be in excess for about three days after the quantity taken has been diminished. The body has, therefore, the power of retaining a quantity of chlorine. In acute inflammatory diseases the chlorides are retained completely, so as to disappear from the urine. The usual test for chloride is the curdy white precipitate given on the addition of nitrate of silver to urine acidulated with nitric acid.

7. **Pigments.**—These have not yet been fully examined, but they appear to exist in the urine both in the state of pigments and pigment-yielding substances or chromogens. The pigment of normal urine is urobilin, which, according to McMunn, is an amorphous yellow-brown pigment. It gives in solution a spectroscopic band at F, disappearing with excess of ammonia or potash, and being again brought into view by acid. When febro-urobilin is present, caustic soda or potash causes the band at F to disappear, and to be replaced by a band nearer the red end of the spectrum.

Normal urobilin appears to be identical with choletelin, the body produced by oxidising acid hæmatin. Normal urine also appears to contain two chromogens, namely, the chromogen of febro-urobilin, and indican. By the addition of oxidising agents to the urine, or by long standing, febro-urobilin may be produced from the chromogen.

The quantity of indican present in normal urine is small. It is tested by mixing the urine with its own bulk of hydrochloric acid, and adding a drop or two of saturated solution of chloride of lime. The indican is thus split up, yielding indigo, which colours the urine blue, and may be removed by shaking with chloroform and allowing it to settle. The supernatant liquid remains of a reddish or purplish colour, from the presence, probably, of indigo-red. There appears to be some difference in the indigo-yielding substance, because occasionally the addition of nitric acid to the urine has no effect, although indican be present, as shown by the test thus given, while on other occasions the writer has found the mere addition of nitric acid render the urine a dark greenish-blue, or almost black, from the immediate separation of indigo, which could be removed by the treatment with chloroform just described.

Clinical Import.—Indican appears to be derived from indol, formed by pancreatic digestion. Indol administered subcutaneously increases the indigo in the urine. The indigo is much increased by partial or complete obstruction of the small intestines. It is less affected by affections of the large intestines. It has also been found increased in tabes mesenterica, phthisis, cancer of the stomach, lymphatic growths, cancer of the liver, Addison's disease, and cholera. It is present in large quantity in the urine of persons resident in the tropics. It appears to be increased by turpentine, oil of bitter almonds, and nux vomica.

A chromogen, yielding a purple colour on the addition of nitric acid, is often met with in cases of anæmia where the urine itself is of a very pale colour, but on the addition of nitric acid becomes almost cherry-red.

8. **Albumin.**—The ordinary form of albumin is serum-albumin. Besides this we have paraglobulin, fibrinogen, propeptone, and peptone. For the tests of these substances *see* ALBUMIN, and ALBUMINURIA; and for their clinical import *see* BRIGHT'S DISEASE; and KIDNEYS, Diseases of.

Albuminuria is, however, much more common than is usually supposed, and has been found to occur in eleven per cent. of apparently healthy persons presenting themselves for assurance. Its significance in such persons has not been completely ascertained, but it has been found that in many such cases, when they are kept under observation, the health goes on deteriorating. Intermittent albuminuria is not infrequent in persons who have been exposed to malaria; and Dr. Quain has observed that intermittent albuminuria in youth is frequently associated with masturbation. In contracting kidney the albumin is usually small in quantity, and may also be completely intermittent, traces of it appearing only in the urine passed after meals, and being entirely absent from urine passed in the morning. This, as the writer has seen, may occur even when the patient is in a very precarious condition, and is already suffering from nephritic asthma. Dr. Mahomed believes that albuminuria may be quite absent in granular disease. Egg-albumin and pro-peptones readily pass through the kidneys (*see* ALBUMINURIA). It has, however, been recently found by Stokvis that if egg-albumin is made to pass through the kidneys for a length of time, the kidneys themselves undergo structural change, glomerular nephritis being induced. These observations confirm the idea, founded on clinical observation by Dr. G. Johnson, that albuminuria with structural kidney-change may be secondary to continued indigestion.

9. **Sugar.**—For the tests and indications of sugar in the urine *see* DIABETES.

10. **Inosite, or Muscle-sugar.**—This occasionally occurs in urine alternately with dextrose. It has no action on polarised light; it does not ferment with yeast; and it does not reduce cupric hydrate, although it causes it to dissolve. It is detected by precipitating the urine first with neutral lead acetate, then with basic acetate, collecting the second precipitate on a filter, suspending it in a little water, and decomposing by hydric sulphide, filtering, and evaporating to a small bulk. A drop is then mixed with nitric acid, and evaporated almost to dryness on platinum foil. A drop of ammonia and one of calcium chloride are next added, and the whole gently evaporated to dryness. A rose-red tinge indicates the presence of inosite.

11. **Blood, Hæmoglobin, Methæmoglobin.** For the tests and indications of these *see* HÆMATURIA; HÆMATINURIA; and HÆMOGLOBIN.

12. **Bile-acids.** *See* JAUNDICE.

13. **Leucin, Tyrosin.** *See* LEUCIN; LIVER, Atrophy of; PHOSPHORUS, Poisoning by; and TYROSIN.

14. **Cystin.** *See* CALCULI.

15. **Abnormal Pigments.**—The chief of these are uroerythrin, giving a red colour to febrile urine, febro-urobilin, and urohæmatin. The nature and relation both of the normal and abnormal urinary pigments and chromogens is not yet fully understood. For bile-pigments *see* JAUNDICE.

Melanin.—This black pigment has been found in the fresh urine of patients with melanotic cancer. It appears in the fresh urine as a chromogen, the urine, when freshly passed, being normal in colour; but after standing, or after the addition of oxidising substances, such as nitric acid, the black pigment melanin is formed. This must not be confounded with the black colour from carbolic acid, or with the black colour due to great excess of indigo already described.

Accidental Pigments.—Chrysophanic acid may occur, from taking rhubarb or senna. The urine containing it becomes red when it is rendered alkaline by caustic alkali. The colour disappears on the addition of acid.

Santonin colours acid urine yellow or greenish. It is distinguished from biliary pigments by becoming cherry-red and purple on the addition of caustic alkali, this colour disappearing on the addition of acid.

The pigments of bilberries, logwood, beetroot, indigo, and gamboge also pass to a certain extent into the urine, and the Cytisus alpinus gives it a grass-green colour. After the use, either external and internal, of carbolic acid, creasote, or phenol, the urine may be greenish-brown or almost black. This is due to products of the oxidation of these substances, chiefly hydrochinon. Sometimes the presence of iodide or bromide of potassium in the urine may render it very dark after the addition of nitric acid, on account of the liberation of free iodine or bromine. These are distinguished by their penetrating odours, and may be separated by treating the urine with chloroform and then gently evaporating.

T. LAUDER BRUNTON.

URINE, Retention of.—A morbid condition in which there is difficulty or inability to expel the urine from the bladder. *See* MICTURITION, Disorders of.

URINE, Suppression of.—SYNON.: Fr. *Suppression de la Urine*; Ger. *Harnverhaltung*. Suppression of the secretion of urine arises under two conditions: first, where there is obstruction in the line of outflow; secondly, where there is some fault in the action of the kidney itself.

1. **Obstructive Suppression.**—This is most commonly a result of impaction of a calculus in the ureter of a patient who has already, from some cause, had one kidney permanently destroyed; or of the presence of a tumour, as of the bladder or uterus, implicating both ureters. A little urine is commonly passed during the progress of such cases. It is generally pale, and of low specific gravity. When suppression is absolute, seven or eight days may elapse before the patient appears to suffer materially, but then occur muscular twitchings, contraction of pupils, weakness of muscles, drowsiness, and in rare cases convulsions. There is neither dropsy nor urinous odour of the breath. The duration of life appears to vary from nine to eleven days.

2. **Non-obstructive Suppression.**—Sometimes in the course of acute inflammatory Bright's disease, complete suppression of urine takes place. It may also occur in the later stages particularly of the inflammatory and cirrhotic forms of Bright's disease; as a consequence of injuries and diseases of the urethra; and in the cold stage of cholera. Doubtless in some of these conditions suppression is due to the nervous system, but the way in which it is brought about is not at present understood.

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Treatment.—Next to removal, if possible, of the condition upon which the suppression depends, hot baths or fomentations, and the patient avoidance of active interference with powerful medicines, are among the most important indications. In cases of obstructive suppression, careful kneading of the abdomen may be tried; and this should be persevered with in the most advanced conditions, as cases are on record in which relief has been obtained when the prospect has been utterly unfavourable. In the female, the introduction of a sound into the ureter may be successfully practised. If relief be not obtained, and death be imminent, surgical interference may perhaps be tried.

T. Grainger Stewart.

URTICARIA (*urtica*, a nettle).—**Synon.**: Nettle-rash; Fr. *Urticaire*; Ger. *Nesselausschlag.*

Definition.—A form of erythema, accompanied by a sense of burning and itching, and by a nodulated condition of the skin ascribable to spasm of the muscular structure of the derma.

Ætiology and Pathology.—Like other morbid states of the system urticaria is sometimes excited through the medium of the nervous system, and by irritant substances taken into the stomach (*U. ab ingestis*), such as shellfish and different articles of diet; in the latter case it is influenced by idiosyncrasy. Some drugs, for instance, copaiba, cubebs, and turpentine, produce eruptions, scarcely distinguishable from urticaria. The complex phenomena known as dyspepsia are a frequent source of the eruption; whilst in some instances an irritable or excitable condition of the nervous system itself may be taken as the cause. In fact, the functions of the nerves are so intimately intermingled with the symptoms of urticaria, that it has been adopted by some authors as a neurotic disorder. And this view of the nature of the affection is corroborated by the occasional concurrence of spasmodic cough and asthma with the development of the rash at the base of the neck. Uterine irritation from pregnancy or other conditions is another common source of urticaria; the nervous sensibility of the integument is so acute that wheals may be produced by the slightest touch, and written characters may be developed at will by the mere act of tracing their outlines on the skin with the point of a pencil. Amongst the local or external causes of urticaria must be mentioned, first, scratching, or some such mechanical irrition, in a few individuals. This has been called *factitious urticaria.* More often this nervous sensibility exists as a temporary condition, accompanying itching affections, such as scabies or eczema, or the presence of pediculi, and thus it comes about that the existence of wheals (urticaria) produced by scratching is often the most prominent symptom in scabies. Other local causes of urticaria are the stings and bites of insects and the stinging hairs of plants. *See* Sting: Stinging Plants and Animals.

Symptoms and Varieties.—Urticaria varies in the quantity and intensity of its several symptoms. Thus, it may be *general* or *partial*; or it may be distinguished by excess of hyperæmia, of itching, or of prominence and definition of its nodulated protuberances. Its most conspicuous character is the suddenness of its attack, and the equal suddenness of its dispersion, vanishing in a few hours or less without leaving a trace of its previous existence on the skin. But whilst it thus disappears completely on one part, it is apt to show itself on another, and in this manner to keep up the disease for a considerable time; returning, for example, nightly, and interfering with the sleep of the patient for weeks and even months. Moreover its characteristic tubercles, which are pale or white, and show out conspicuously on a bright red ground, may be isolated and dotted over the skin, or accumulated in clusters; they may be superficial, or they may be more or less deep-seated. These several diversities of symptoms have suggested a variety of descriptive appellations for the affection, for example: *U. evanida* or evanescent; *U. perstans* or persistent; *U. conferta*, congregated or confluent; *U. subcutanea* or deep-seated; and *U. tuberosa*, in tuberous masses; all of which varieties may be simply expressed by the terms 'more or less severe,' or 'more or less transient or chronic.

Urticaria has no constitutional symptoms of its own, but, being itself a symptom, may accidentally be associated with general derangement of the system, of greater or less severity. This fact is indicated by the term *U. febrilis*, which ought rather to be named *urticaria cum febre*; whilst another designation relating to its cause is met with in the term *U. ab ingestis.* Some of its features are found likewise in association with other forms of disorder of the skin; such as its tendency to swell in erythema papulosum, tuberosum, and tumescens; and its pruritic proclivity in lichen urticatus and prurigo.

Diagnosis.—The pathognomonic characters of urticaria are, first, white prominences of the skin, sometimes taking the form of round tubercles, at other times occurring in stripes or wheals of varying length and figure, which are shown up on a scarlet or bright crimson ground, and are accompanied by a sense of burning and prickling, suggestive of the painful sensation caused by the sting of a nettle; and, secondly, the sudden and complete evanescence of the local signs, as well as of the associated pruritus, without organic lesion of the skin.

Prognosis.—Urticaria may be very troublesome, but is rarely serious. As a symptom of some other form of derangement, the discovery of the latter must guide our opinion as to the cause and issue of the skin-affection.

Treatment.—The evanescent nature of the local affection points to the consideration of a constitutional treatment by which we may strengthen digestion, assist the functions of the liver, and maintain a healthy operation of the alimentary canal. A tonic-aperient medicine, combining sulphate of magnesia with quinine and a bitter infusion, will afford immediate relief where the digestive organs are concerned. Bilious and gouty subjects may be assisted by a preliminary blue-pill. The tone of the stomach may be kept up by nitro-hydrochloric acid combined with a bitter; in other instances, alkalies will be found serviceable. In neurotic constitutions, on the other hand, we must have recourse to quinine in moderate doses, to the bromides, and occasionally to sedatives, to procure rest at night and induce sleep. In very chronic cases the liquor arsenicalis, in doses of three minims three times a day, is of decided advantage.

To relieve local suffering the best remedy is a lotion of lime-water inspissated with oxide of zinc, one part of the latter to eight of the former. In more severe cases the hot bath may be found serviceable; or heat applied by means of flannel or a sponge wrung out of hot water.

ERASMUS WILSON.

UTERUS, Diseases of. *See* WOMB, Diseases of.

UVULA, Diseases of.—SYNON.: Fr. *Maladies de la Luette*; Ger. *Krankheiten des Zäpfchens.*—Suspended from the middle of the lower and free border of the soft palate, is that small conical-shaped prolongation termed the uvula. In structure it is exactly the same as—indeed it is a portion of—the soft palate, which consists of a fold of mucous membrane, inclosing muscles, aponeuroses, vessels, nerves, and glands, the latter being very numerous.

From its intimate relation with the soft palate, the fauces, the tonsils, and the pharynx, the uvula is likely to become involved when any of these parts is overtaken by disease. This is most evident in cases of catarrhal angina. It is extremely rare for the uvula to be primarily and exclusively attacked with **inflammation**, and yet instances of such an affection are on record. On the other hand, it is by no means uncommon to observe the uvula swollen, œdematous, and elongated, as a consequence of prolonged irritation, **relaxation**, or often repeated catarrh of the fauces. That form of acute catarrh, of which the uvula partakes when the throat is the subject of this affection, disappears along with the other symptoms. But the condition known as **elongated uvula** often proves very intractable to treatment for a long time, and all the more so that not very infrequently this condition is entirely overlooked by the practitioner. It ought to be laid down as a rule, that, in all affections of the throat, the parts should be inspected. In this case, inspection will reveal that the uvula is greatly lengthened, but not of necessity always thickened or œdematous; so that when the patient reclines, this pendulous body falls backwards, sometimes even dropping so low as to reach the glottis. The consequence is, that the mucous membrane of the pharynx and larynx is kept in a continual state of irritation and general uneasiness. A peculiarly annoying cough is set up by the constant tickling of the parts, so that this condition of the uvula may even at times be recognised by the quickly repeated, resultless, brassy cough. It may be described as a quick, ineffectual hack. An inclination to vomit is also induced. An irresistible desire to swallow is observed, owing to the sensation which the patient perceives in the throat, as if something were lodging there, and which ought to be got rid of by swallowing. If there be much thickening as well as elongation of the uvula, then some slight difficulty may be experienced when deglutition takes place. When the elongation is very pronounced, and the uvula finds its way into the larynx, the patient may experience a sense of suffocation, particularly if he happen to be asleep, when he suddenly wakes up in a state of great alarm and breathlessness. A more temporary condition of elongated uvula is observed in that form of relaxed fauces which public speakers and singers are subject to, and which comes on suddenly, or quickly, after continuous use of the voice for an hour or more.

TREATMENT.—The condition associated with elongated uvula must be treated on general principles (*see* PHARYNX, Diseases of). Locally, the elongated uvula is best treated by astringent gargles. One of the best of these, which is perhaps as soothing as astringent, is the bromide of ammonium gargle, 20 grains to the ounce of water. Glycerine of tannin, tincture of iodine, and other agents which are quite sufficient for the cure of the simply relaxed uvula, may prove insufficient to restore the elongated uvula, and then a portion of it must be removed, even to the extent of two-thirds.

Bifid Uvula is a deformity usually congenital, the treatment of which, if necessary, by the actual or galvano-caustic cautery, or other means, falls within the domain of surgery.

Paralysis of the Uvula is met with as a sequela of diphtheria, when other parts of the throat are similarly affected. *See* PALATE, Diseases of; and PARALYSIS, Diphtheritic.

CLAUD MUIRHEAD.

V

VACCINATION (*vacca*, a cow).[1]—SYNON.: Fr. *Vaccination*; Ger. *Kuhpockenimpfung.*

DEFINITION.—Inoculation with the material of vaccinia or the cow-pox. Its purpose, as applied to the human subject, in which relation alone we have here to consider it, is the protection of the person vaccinated from an attack, and especially from a severe or fatal attack, of small-pox.

The cow-pox, which is a natural, though not common, disease in the cow and horse, never occurs spontaneously in man. Nor is it communicable to him by effluvia, or in any other way than by the direct inoculation of its own specific virus. Such inoculation before the time of Jenner was never more than a matter of mere accident, and occurred with comparative rarity.

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[1] This article, which was written by the late Dr. Seaton, has been revised by Dr. Collie. The passages inserted by the latter are marked [ ].

It was matter of popular tradition, but was left for Jenner to demonstrate, that persons who had thus been accidentally vaccinated enjoyed immunity subsequently from small-pox; and it was by his great discovery that the cow-pox, once implanted in the human subject, may be continued by inoculation from individual to individual indefinitely, that the practice of vaccination became possible.

PHENOMENA OF VACCINATION.—The phenomena which follow inoculation with the material of cow-pox vary according as the person, in whom the vaccine lymph is inserted, may or may not have been the subject of a previous successful vaccination [a previous inoculation, or a previous small-pox]. The description may be divided into (1) the course of **primary** vaccination; and (2) the course of **secondary** vaccination, or re-vaccination.

1. Course of primary vaccination.—This may be *regular*, *irregular*, or *complicated*.

(*a*) *Regular course.*—When lymph, taken from a vaccine vesicle at that period of its course when the vesicle is fit for the purpose, is inserted into the skin by puncture, or is applied to a small abraded surface of the skin of an unprotected person, no particular effect is noticeable till about the end of the second day, or early on the third day. By this time, if the vaccination be about to succeed, a slight papular elevation becomes perceptible. This, by the fifth or sixth day, has become a distinct vesicle of a bluish-white colour, with raised edge and central cup-like depression. By the eighth day (the day-week from that on which the lymph was inserted) it has attained its perfect growth; it is then plump, round, more decidedly pearl-coloured, and distended with clear lymph; its margin is firm, and central depression very marked. On this day, or sometimes even by the end of the seventh day, a ring of inflammation, called the areola, begins to form about its base; and the vesicle and areola together continue to spread for the next two days. The areola is circular, and when fully developed has a diameter of from one to three inches, being then often attended with considerable hardness and swelling of the subjacent connective tissue. After the tenth day the areola begins to fade; and in two or three days more it has usually disappeared, with whatever of hardness or swelling may have existed. With the decline of the areola the vesicle begins to dry in the centre; the lymph remaining in it becomes opaque and gradually concretes; and by the fourteenth or fifteenth day a hard brown scab is formed, which gradually contracts, dries, and blackens, and from the twentieth to the twenty-fifth day, but usually about the twenty-first day, falls off. There is then left a cicatrix, which is circular, somewhat depressed, foveated, sometimes radiated, and, with rare exceptions, permanent in after-life.

If the lymph have been inserted by two, three, or more punctures set near together about one spot, or by abrasion over a sufficient surface, two or more vesicles may arise at the spot; and in the course of their growth, either form a large vesicle of a compound character, with but one central depression, or a crop of vesicles, generally coalescing, but each retaining its own central depression. These compound vesicles and crops are round, oval, or of irregular outline, according to the manner in which the cutis has been penetrated or exposed; and the shape of the resulting cicatrices varies accordingly. Vaccination which has gone through the course above described is held to be protective against small pox.

The constitutional symptoms attending these local phenomena are a rise of temperature, sometimes detectable by thermometer as early as the fourth day, more marked, but still often very slight from the fifth to the seventh day; more obvious feverishness, with restlessness, and frequently derangement of the stomach and bowels, from the eighth to the tenth day, that is, during the stage of areola, subsiding as that subsides. The general symptoms are in most cases quite moderate, and often exceedingly slight. Occasionally, when the areola is at its height, swelling of the axillary glands may be intense; and occasionally also at that period in young children of full habit, especially in hot weather, an eruption of roseola (*vaccine roseola*) may occur, chiefly on the extremities; or a papular eruption (*vaccine lichen*); or a vesicular one—the vesicles, however, [differing from] vaccine vesicles, in being entirely free from central depression. The duration of any of these forms of eruption, when they do occur, is very transitory, usually not extending beyond a week, and very seldom indeed beyond the falling of the scab.

(*b*) *Irregular course.*—The exactitude with which vaccination in the immense majority of cases runs the course above described is very remarkable; but in some cases an irregular course is seen. The irregularity may be merely in point of *time*; the development of the vesicle being retarded one or two or several days, or being slightly accelerated, so as to present, for example, by the eighth day, the appearances usually seen on the ninth. If the phenomena are in all other respects regular, these mere variations in time do not [as far as known] affect the protective power of the vaccination. On the other hand, there may be irregularity of the *character* and *course* of the vesicle, constituting *spurious vaccination*, on which no reliance can be placed for protecting from small-pox. Thus, papules or even vesicles may arise, which, instead of undergoing their proper development, begin by the fifth or sixth day to die away, leaving a mere scale or slight scab by the eighth day. More frequently, there are vesicles beginning early after the insertion of the lymph, with itching and irritation—symptoms almost invariably absent in a normal primary vaccination, assuming as they rise an acuminated or conoidal form, instead of the characteristic flat form with central depression; containing straw-coloured or opaque fluid, instead of clear lymph; and developing an early and irregularly-shaped areola, which is at its height by the fifth or sixth day, and far on the decline by the day-week. In other cases the vesicles, rising apparently more regularly at first, are found by the eighth day to have burst; and present either an irregular scabby appearance, or are in the state of open sores. The chief causes of these irregularities will be discussed further on.

(*c*) *Complicated course.*—In spurious vaccinations, especially in the kind last described, and even in the course of a regular vaccination, if the vesicles have been rubbed or otherwise injured, ulcerated sores may succeed, requiring, in children who are of scrofulous or otherwise unhealthy constitution, some time to heal. Occasionally, also, in children of such habit of body, the swelling of the axillary glands, which has been mentioned as sometimes attendant on the areola, may result in abscess. But the only complication which can be regarded as at all formidable is erysipelas. This disease may of course supervene on vaccination, as it may on any other surgical operation, when the conditions which ordinarily give rise to it exist, and especially where there has been exposure to its contagium. [The lesson which this teaches us is not that we should not vaccinate, but that we should guard the place of operation against the entry of dirt or decomposing matter; alike at the time and during the course of vaccination. If erysipelas be from any cause set up during vaccination, it will occasionally be serious and even fatal, just as if it followed on another kind of wound.] But there have been cases, happily rare, in which it has manifestly arisen from the use of improper lymph, that is, from lymph taken from spurious vesicles, or from regular vesicles at an advanced period of their course, or which has been spoilt in keeping.

2. **Course of re-vaccination.**—In some persons the *regular* phenomena of vaccination can only be produced once in the lifetime. But this is not always the case, and vesicles may be produced by a second vaccination, not distinguishable in their appearance from primary vesicles, though usually having a smaller and more transitory areola, and having a small and poor cicatrix. Much the most frequently the result of that process is the production of a spurious papule or acuminated vesicle, with hard, irregular areola, reaching its height by the fifth or sixth day, and having by the eight day an imperfect scab, which soon falls. There is often much itching and more serious local irritation; and the constitutional symptoms are out of all proportion more frequent after re-vaccination than after primary vaccination. In some persons no specific local effect is producible by re-vaccination.

Performance of Vaccination.—(1) **Age.**—Small-pox being a disease to which persons are liable from the moment of birth, and which is peculiarly fatal in infancy, it is of great importance that vaccination should be performed in very early life. In large towns, where a weekly supply of lymph from arm to arm can always be maintained, the vaccination of children who are plump and healthy should be effected within four or six weeks from birth. If the child be less robust, it may properly be deferred for three or four weeks more. In small towns and rural districts the age at which vaccination can be performed must depend to some extent on the arrangements for lymph-supply in the district; but these are always such as admit of a child being vaccinated within a very few months from birth. It is under ordinary circumstances a preliminary condition of the performance of vaccination, that the child to be vaccinated should be healthy; and a careful examination to ascertain this is the first duty of the vaccinator. The child should not only be free from any acute febrile disease, but also from diarrhœa and from cutaneous diseases, especially those of the vesicular type. The states of constitution associated with herpes and eczema singularly interfere with the proper course of vaccination, and seem to be the most frequent causes of those spurious results of vaccination just described. They may both—especially intertrigo—without care, be overlooked; hence examination of the scalp, and of the folds of skin behind the ears, in the neck, and in the groins, is indispensable. Vaccination should also be postponed if erysipelas be prevailing in the neighbourhood in which the child is living, or if it have been recently exposed to the infection of measles or scarlatina. There is, however, a state of things under which these conditions must be disregarded, namely, when there may be *immediate* exposure to the infection of small-pox, as when an unvaccinated child is in a house in which the infection exists, or has come into direct contact with an infected person. Under such circumstances, it cannot be too strongly impressed that no age is too early for vaccination, and no state of health, except the presence of acute disease of a serious character, can be held to contraindicate it. Life then may depend on the promptitude with which the vaccination is done.

(2) **Selection of lymph.**—The second point to attend to is the selection of the lymph to be used in vaccinating. [This may be of two kinds, bovine or human. The advantages claimed for the former are immunity from human disease and greater protection from small-pox. As the risk of conveying human disease is infinitesimal, if the vaccination be done with due care, much weight need not be attached to this; and, moreover, if the argument be sound, it applies *à priori* to the bovine lymph as well as to the human, so that by the adoption of bovine matter we merely substitute one possible risk for another. It is true that the bovine lymph is recommended on the ground that no disease other than cow-pox is capable of being communicated to man by inoculation with it; but this statement must for the present be open to question. In the selection of lymph, whether bovine or human, the important point is to select healthy subjects; and it is probably as easy to select a healthy infant as a healthy calf. Of the greater protection from small-pox, this is not yet established on a sufficiently wide induction, and years must yet elapse before it can be. If the bovine lymph be preferred for general use, it will still be well to choose humanised lymph in the case of delicate children, because of the severity of the local effects when bovine lymph is used. The present writer in the existing state of knowledge prefers humanised lymph, which, as employed by his colleagues and himself, he has never found ineffectual; but, whilst of this opinion, he thinks the propriety of more frequent recourse to the calf, for the purpose of renewing our stock,

deserves consideration.] Human lymph should be taken from primary cases only, from perfectly healthy subjects, and from thoroughly characteristic vesicles. Babies selected for the purpose should not only be in good health themselves, but, as far as can be ascertained, of healthy parentage. Those of dark complexion, not too florid, with a thick smooth, clear skin, generally yield the best and most effective lymph. Vesicles from which the lymph may be taken must be well characterised, uninjured, and free from areola. Lymph may, with perfect propriety, be taken so soon as any can be obtained from a vesicle, as at the fifth or sixth day of its course; but it is then procurable in very small quantity, and it is usually and most conveniently taken on the day-week from the vaccination, when the vesicle is perfectly formed, but before the stage of areola has set in. Any vesicle, which at that date manifests areola, must be discarded. This was Jenner's 'golden rule,' and one which ought to be scrupulously observed. Good vaccine lymph is always perfectly limpid, and has besides a certain degree of viscidity. A thin, serous, too-readily flowing lymph should never be used.

(3) **Method of collecting lymph: Arm-to-arm vaccination.**—The collection of lymph from the human subject for vaccinating is effected by opening the vesicle by numerous minute punctures on its surface, the utmost care being used not to draw blood. Should any accidentally be drawn, the vesicle must be discarded altogether. No lymph must be used which does not exude spontaneously; there must be no pressure or squeezing of the vesicle. The lymph which stands on the surface of the opened vesicle, is taken on the point of a lancet or other instrument employed, and inserted in the arm of the child to be vaccinated. This may be done in various ways, as by puncture, by scratching, by scarifications or abrasions, by tatooing, &c. It would not be possible, within the limits of this article, to give any description of these various modes of operating. Nor would it be of much use. They should be learnt practically under a good instructor. All of these methods may, in careful and skilled hands, be made equally successful. That, however, which in the hands of practitioners generally the writer has found the most successful, has been the plan by scarification or tattooing ·.·.·.·, over surfaces of the extent here depicted. Insertions to this extent should be made on at least four, and preferably five, separate surfaces. If the vaccination be done on both arms, the writer recommends three insertions of this kind in each arm; if it be done on one arm only, then there should be five on that arm. [While an ample primary vaccination affords better protection against small-pox than a scanty primary vaccination (*see* p. 1723), it has to be admitted that no number and no quality of marks give absolute protection for all time, nor even, in all cases, for many years. In well-vaccinated children under ten, for instance, re-vaccination produces large vesicles with well-marked areolæ. Some of such children are certainly liable to contract small-pox, the certainty being proved by the fact that they have contracted it. For this reason and seeing that susceptibility to re-vaccination may (for all that is known to the contrary) be an indication of susceptibility to small-pox, there is something to be said for a repetition of the operation, in well-vaccinated persons, whether children or adults, when small-pox is epidemic. It is certain that the best vaccination will not always protect up to that very vague period called puberty, a period reached at different ages by different persons. Under what circumstances, and how often, vaccination should be repeated is a subject for enquiry; but the experience of small-pox in London during the last ten years proves that in some cases re-vaccination cannot be delayed until puberty, and that a single re-vaccination, when then successfully performed, is not an absolute protection for all time against attack, or even death from small-pox.] In vaccination by other modes of procedure, care should be taken that local results to the full extent are obtained. An ordinary ungrooved lancet is, in the writer's opinion, the best of all instruments for the performance of vaccination. It is not only readily cleaned, but it is one concerning which we can always be sure that it *is* clean. Lancets used for vaccination should be kept bright, and should never be used for any other purpose. If used for more than one vaccination at a time, they should be most carefully cleansed after each case.

(4) **Storage of lymph: indirect vaccination.**—Vaccination should in all cases in which it is practicable, be done direct from arm to arm. The degree of success attending the use of conveyed or stored lymph, in whatever way the conveyance or storage be effected, does not approach that of lymph thus directly transferred. Where vaccination from the arm is impracticable, lymph intended for immediate use may be conveyed from case to case, in the liquid form, by means of the vaccine bottle and other contrivances for the purpose; but it must be a quite indispensable condition of this proceeding that the lymph be used within a few hours—six to eight at the outside—of its being taken. For longer keeping it must be stored either in hermetically-sealed tubes, or on points thickly coated with it, then carefully dried, and kept afterwards constantly protected from damp and heat. When stored in the latter way, the lymph needs revival before use by dipping the point for an instant in water, and laying it on the edge of a book, so that the lymph may become soft. In the use of stored lymph the process of vaccination by scarification or abrasion is always to be preferred.

(5) **After-treatment.**—When the vaccination has been done, the parent should be cautioned against allowing the vesicle to get rubbed or mechanically injured. The case should be seen again by the day-week at least, when, if the vesicle be perfectly formed, and pursuing a regular course, the success of the vaccination may fairly be pronounced. But if the case be then retarded, it should be seen again two or three days afterwards; or if there be anything abnormal in the appearance of the vesicle, the case should be watched unfailingly throughout its course.

VACCINATION AS A PROTECTION AGAINST SMALL-

POX.—The protection which vaccination affords against small-pox is manifested in two ways: first, by the immunity from that disease which, as a rule, it confers; secondly, by the modification which, when immunity is not complete, it induces in the course and severity of the disease in the majority of cases. The most precise of the numerous facts which exist in proof of this are those derived from the Small-pox Hospital in London, where it has been found that while small-pox in the unvaccinated patients runs an unmodified course in all but 2·6 per cent., its course in vaccinated patients is modified in 73 per cent.; and that while the death-rate of natural small-pox is 35·55 per cent., that of post-vaccinal small-pox is but 6·56 per cent. [This latter figure, obtained from cases admitted into the Highgate Small-pox Hospital in the years 1836–55 is lower than would be given from the experience of the Asylums Board Small-pox Hospitals, during later years. The difference is due, in part, to the circumstance that Mr. Marson excluded what he called 'antecedent or superadded disease'; in part probably to the greater fatality of small-pox during more recent years, a circumstance which has also shown itself among the unvaccinated; and in part perhaps to the cases admitted to the latter hospitals belonging to a more destitute class of the community. In the Asylum Board Small-pox Hospitals, where all deaths are included, the post-vaccinal mortality has amounted to 8 per cent.] The difference between 35 and 6, however, gives but a feeble idea of the protection which vaccination really affords, provided it be thoroughly done; for in nearly all the fatal cases the vaccination was found to have been of an imperfect character, and had not been done in accordance with the rules laid down above. The following table published some years ago, based on an examination of 5,000 cases, gives the results of Mr. Marson's observations, extending over twenty years:—

Classification of Patients affected with Small-pox	Number of deaths per cent. in each class respectively
1. Unvaccinated	35
2. Stated to have been vaccinated but having no cicatrix	23·57
3. Vaccinated:—	
a. Having one vaccine cicatrix .	7·73
b. Having two vaccine cicatrices .	4·70
c. Having three vaccine cicatrices .	1·95
d. Having four or more vaccine cicatrices	0·55
α. Having well-marked cicatrices .	2·52
β. Having badly-marked cicatrices	8·82
4. Having previously had small-pox .	19

[These facts are confirmed by the experience of the Small-pox Hospitals of the Asylums Board, as the following table, prepared by Dr. MacCombie of the Deptford Small-pox Hospital, will show:

Statistics of 11,724 cases of Small-pox treated in the Hospitals of the Metropolitan Asylums Board during the years 1871–78:—

Homerton Fever . . .	. 1876–77.
Homerton Small-pox . .	. 1871–78.
Stockwell	. 1874–78.
Hampstead	. 1876–78.
Deptford	. 1878–79.
Fulham	. 1877–78.

		Cases	Deaths	Mort. p.c	Marson's mort. p.c. corrected to include antecedent and superadded disease
One Mark	Good	1095	70	6·4	5·2
	Indifferent	2004	341	16·7	13·8
Two Marks	Good	1461	54	3·7	3·6
	Indifferent	2476	279	11·2	9·9
Three Marks	Good	1096	41	3·7	2·2
	Indifferent	1778	133	7·4	4·1
Four Marks	Good	826	23	2·7	0·55
	Indifferent	949	46	4·3	1·6
Total . . .		11724	987	8·1	6·6 1836–55

Good marks:—4477 cases, 188 deaths. Mort. p.c. 4·1. Indifferent marks, 7247 cases, 799 deaths. Mort. p.c. 11·0

[It deserves to be noted that, if Mr. Marson's experience in 1836–55 were expressed in the same terms as the foregoing we should obtain: Good marks, 2570 cases, 95 deaths. Mort. p.c. 3·6. Indifferent marks, 1956 cases, 206 deaths. Mort. p.c. 10·5.]

The apparent selection of years between 1871 and 1879 is due partly to the fact that the hospitals were not continuously open for small-pox, and partly to the fact that the statistics were not all compiled on the same plan during the period.]

To produce then at least four perfect vesicles, leaving four characteristic cicatrices, should be the aim of every vaccinator.

RE-VACCINATION.—The necessity for re-vaccination—a term the use of which should always be restricted to cases in which vaccination had already been performed *with effect*—has always been recognised in certain cases; but it is only of late years that its importance *as a practice*, after a certain period of life, has begun to be understood. (1) The cases in which later vaccination is most obviously required are those in which the effect of the first 'vaccination' has been of the irregular or spurious kind already described, from which no protection against small-pox can be assured. Circumstances must determine in the case of any particular child how soon a completer vaccination should be performed; but especial care should be taken, before proceeding to vaccinate again, to scrutinise the health of the child, and to correct anything in it which may be found amiss. The re-vaccination should be done with every precaution against failure, and therefore, always, if possible in cases of this kind, direct from the arm. If it totally fail, it will need, of course, to be repeated at intervals till some result is obtained. This result may be a complete success, but more frequently it will be only a modified success, with which, however, the practitioner will have to be content for the present. He will not fail, however, to impress the necessity for a further re-vaccination at puberty, or earlier if there be any immediate danger of small-pox. (2) When primary vaccination has been successful to a certain extent, but not to the extent desired, for example, when there have been one or two vesicles only instead of four or more, but these vesicles quite genuine, re-vaccination at puberty is of great importance, but need not, except under circumstances of immediate exposure to small-pox, be recommended earlier. [Considering that the best primary vaccination does not confer complete protection up to the varying time of puberty, I should be disposed, for my own part, to advise re-vaccination before that period even in the case of persons well vaccinated; and probably the age of ten years would be the most generally suitable. A. C.]. (3) Following the foregoing rules, a practitioner, who has to decide the question of re-vaccination in cases in which he did not himself perform or see the original vaccination, and who must therefore determine by the marks, would recommend re-vaccination as soon as practicable in cases in which the cicatrices wanted the true vaccine character, but would advise waiting when they were genuine in character and wanting only in number. (4) The systematic performance of re-vaccination at puberty is a practice, the importance of which must now be regarded as demonstrated. It is of course infinitely more important to those whose vaccination has been incomplete, than to those whose vaccination has been thorough, but even the best vaccinated derive additional security from it. [When small-pox is of epidemic intensity, even the best vaccinated adults incur appreciable danger of attack; but with them the disease, if it do occur, is in the majority of cases mild and rarely fatal. Amongst re-vaccinated adults attack is rarer still and death is almost unknown.] The reason why the period of puberty, or thereabouts, is fixed on as the time for the systematic performance of re-vaccination, is simply that it is only after that period that serious attacks of post-vaccinal small-pox are, as a rule, met with. The post-vaccinal small-pox, which may occur in childhood, is [as a rule, to which there are exceptions], unless when the vaccination has been very imperfect, of little danger.

Alleged Dangers of Vaccination.—The tendency of parents to refer to vaccination every disease, especially every cutaneous disease, which the child may afterwards manifest, is well known. Most of such allegations are without proof or probability—mere illustrations of *post hoc propter hoc*. It is quite possible, indeed, that in some cases vaccination may, like teething or other irritative cause, hasten the evolution of a constitutional eruption which the child was incubating; but even this is not a common occurrence, nor is it at all within the meaning of the allegation. The only real danger which need be considered here (the danger of erysipelas having been already indicated) is that of the introduction of syphilitic infection along with the vaccine. It is by means of the blood that syphilis has been introduced. Such an accident, though rare, is of the most serious consequence when it does occur, not only on account of the injury inflicted on individuals, but from the damage done by it to the reputation of vaccination; and every practitioner is bound to the most scrupulous observance of the precautions whereby these evils may be avoided. The precautions are (*a*) extreme care in the choice of vaccinifer; (*b*) brightness and cleanliness of lancet, with careful cleansing after each separate vaccination; (*c*) scrupulous care in opening the vesicles of the vaccinifer not to draw any blood, and not to use the lymph of any vesicle from which blood may accidentally have been drawn; and (*d*) care also not to take from lymph-vesicles in which there is an areola, and in which therefore the normal contents of the vesicle will have become mingled with the products of common inflammation. E. C. Seaton.

VAGINA, Diseases of.—Synon.: Fr. *Maladies du Vagin*; Ger. *Krankheiten der Scheide.*

The vagina frequently participates in the morbid processes which affect the uterus and other neighbouring organs. The vaginal affection is then a matter of minor importance, and may not call for special recognition. But this organ is often enough the seat of independent diseases, the more important of which will now be considered.

1. **Atresia.**—Imperforate vagina is met with as a congenital or acquired malformation. *Congenital atresia* may occur alone: or it may be complicated with absence, imperfect development, or closure of the orifice of the uterus. Occasionally the vagina is bifid, and the atresia affects only one side, in which the menstrual fluid of the corresponding horn of the uterus may accumulate, producing the condition described as *hæmatokolpos lateralis.* The occlusion may first affect the organ in its entire length; or, secondly, for a half or third of its length, most frequently towards the lower extremity; or, thirdly, it may be simply membranous, as from a too complete hymen. The congenital atresia is usually complete, so that the passage to and from the uterus is perfectly occluded. *Acquired* or *accidental atresia,* on the other hand, may present any degree of constriction, from a slight and partial narrowing of the canal up to its total obliteration. We find it resulting, first, from sloughing after labour, when it is frequently complicated with vesical or rectal fistulæ; secondly, from sloughing after fever; thirdly, from chronic inflammations and ulcerations; fourthly, from applications of caustics.

Symptoms and Diagnosis.—There are three stages at which atresia may betray itself by symptoms. First, after puberty has set in, the patient has the usual indications that ovulation is taking place, but she suffers from *amenorrhœa.* The uterine hæmorrhage is taking place; but the extravasated blood is detained above the seat of occlusion, and does not appear externally. Secondly, in some women *dyspareunia* (impossibility of copulation) after marriage leads to the examination which discovers the obstruction. Thirdly, in the acquired variety the difficulty is often only discovered in consequence of the *dystocia* that results from the resistance offered to the advance of the fœtal head by the constriction of the canal. The physical examination may discover, first, on abdominal palpation, a swelling in the hypogastric or inguinal region, due to the accumulation of menstrual fluid in the upper parts of the sexual canals. Secondly, on vaginal exploration being attempted, either the finger is soon arrested within the labia, or a bulging fluctuating pouch is felt. Thirdly, we then examine *per rectum* or *per vesicam* with sound or finger, or through these cavities simultaneously, combining the exploration by means of the fingers of one hand through the available openings in the pelvic floor, with pressure and palpation with the other hand above the pelvic brim. The exact seat and extent of the occlusion can thus be detected, and at the same time an estimate can be formed of the amount of accumulation that may have taken place above it.

PROGNOSIS.—(1) Where the obstructing membrane is thin, it may give way at a menstrual period, or under a gangrenous process. (2) The sac formed by the dilated uterine or Fallopian cavities may burst, and pour its contents into the peritoneal cavity. (3) In a considerable proportion of cases early menopause comes on, and lessens the risk. (4) Patients who suffer from atresia vaginæ, even when they have been relieved by operative measures, show a tendency to die of consumption.

TREATMENT.—In view of the dangers associated with the accumulation of menstrual fluid in the genital canals, the indication usually becomes very clear for their evacuation by perforating the obstructing tissues. But this operation has often been followed by disastrous results. Not to speak of the risks of wounding the bladder or rectum, or of setting up pelvic cellulitis, in cases where there is total absence of the vagina, and a canal needs to be tunnelled to the uterus, emptying of a hæmatometra and hæmatokolpos has been followed by death, sometimes from septicæmia, sometimes from bursting of the sac above when pressure is made on it; or dangerous inflammation has been set up in the pelvic organs. Care must be taken never to empty the sac by pressure from above, but by washing it out with a warm antiseptic fluid through an opening, which may be made under antiseptic precautions. Where the atresia has been extensive, there is a strong tendency to its repeated closure. This must be averted by making the patient wear a glass or vulcanite tube, filled with cotton wadding soaked in carbolised oil, through which the uterine cavity can be occasionally washed out until it has collapsed. This must be worn for some months, until the vaginal canal has fully cicatrized around it.

2. **Displacements.**—When the perinæum has become relaxed or lacerated, hernia of the pelvic contents is apt to occur to a greater or less extent. The descent of the uterus in such cases has commonly been regarded as their most important feature, and they have generally been described as *prolapsus uteri*. When the protrusion or herniation, however, is complete, the walls of the hernial sac are formed chiefly by the walls of the vagina, and we get the most extensive displacement, or *inversion*, of the vagina. The symptoms and treatment of this inversion belong to the history of uterine displacements. But we may have displacement of one or other of the vaginal walls as an independent mischief, or as the most prominent disturbance, in a case where the retentive power of the pelvic floor is impaired. If the anterior wall of the vagina descend, it carries with it the back wall of the bladder—*cystocele*. If the posterior vaginal wall descend, it brings with it the anterior wall of the rectum—*rectocele*.

The treatment of these conditions is either palliative or radical. The palliative treatment is effected by the use of astringent injections, and the application of vaginal pessaries—such as the Hodge pessary with cross bars towards its lower end. The radical treatment implies a plastic operation for repair of the relaxed or ruptured perinæum, or for producing a contraction in the displaced vaginal wall.

3. **Foreign Bodies.**—The vaginal canal is sometimes found occupied by foreign bodies. Every gynæcologist has met with cases where pessaries have been left in for years, until by their presence and pressure they began to set up ulcerative processes in the vaginal walls. Introduced at first with a useful object, and producing for a time a beneficial effect, their presence has sometimes been forgotten, until the discharges they excited has recalled attention to them. But bodies of quite another kind are sometimes met with, usually introduced by patients with onanistic propensities. Corks, pieces of wood, pomade-pots, fir-tops, dram-glasses, etc., have been met with in such cases. Portions of glass specula and of glass syringes have sometimes broken off in the hands of practitioners or patients. Ascarides and other parasites seem occasionally to make their way from the anus into the vagina.

Some of these foreign bodies are very easy of removal. Others are a source of great difficulty—those more especially which have become imbedded to some extent in the vaginal walls. Thus it may become necessary to anæsthetize the patient, to lay hold of the foreign body with a polypus forceps or vulsellum, and to detach it with the fingers or with a knife from the tissues that have granulated round it, before it can be withdrawn.

4. **Inflammation.**—SYNON.: *Colpitis; Vaginitis.*—Apart from gonorrhœal inflammation of the vagina we may have colpitis of a non-specific character, either as a primary disease, originating in itself, or spreading to it from the neighbouring structures. The causes of inflammation commencing in the vagina are found in chills (puerperal or menstrual); injuries (as from rude use of obstetric and gynæcological instruments); prolonged presence of pessaries; excessive coition; irritants (as in cases where nitrate of silver applied to the cervix has acted on the vaginal mucosa); neoplasms; and some of the fevers. In elderly women we meet with a *colpitis senilis* or *vetularum* (Ruge), the cause of which is not easily traceable, in which the mucous membrane, especially of the upper part of the vaginal tube, sheds its epithelial covering in patches, becomes studded here and there with papillary granulations, and shows a tendency to cicatricial contractions. In other women the colpitis in its acute forms is found as a catarrh of the mucosa, attended with swelling, rapid desquamation of epithelial cells, and exudation of a serous fluid, which mixed with the granular cells produces a milky discharge. In the chronic forms the discharge becomes more creamy or purulent, as the exudation is less copious, and there is more exfoliation of degenerated and often unripe epithelial cells; and then the surface is often thickly strewn with red papillæ, over which the epithelium is almost destroyed. The symptoms are local discomfort, and leucorrhœal discharges of various kinds; and the diagnosis is made by examination

of the discharge, and exposure of the affected surface by means of the speculum.

The treatment in the acute stage is directed to keeping the part at rest, and using sedative injections. In the chronic forms the use of the injection or douche must be steadily persevered in. The canal must be washed out with a stream of hot water, in the last pint of which alum or some other astringent has been dissolved. Where an acute process is likely to become chronic, or in the chronic forms attended with granulations on the surface, it is well to apply with a mop or brush a solution of nitrate of silver containing half a drachm to the ounce. Frequently the use of pessaries of oxide of zinc, bismuth, or iodide of lead, proves useful in cases where patients have difficulty in using the syringe or douche. In the *colpitis senilis* the distress which the patient feels from the irritating discharge is best relieved, and the unhealthy surface is most speedily brought to heal, by the application of bismuth powder, through a speculum or other tube, to the mucous membrane, after washing or wiping away the secretion.

5. **Injuries.**—It is principally in connexion with labour that the vaginal walls are liable to be injured. Not only in operative cases where the walls may get bruised and torn, or in tedious cases where the walls are so long compressed that they may afterwards slough and become the seat of fistulæ, but even in ordinary cases the vaginal mucous membrane is almost always fissured, or torn more or less deeply, at its lower extremity. These lacerations are mainly important because of their liability to become the channels through which septic matters are absorbed in the puerperal patient. In every case where there is a chance of infection, the canal should be syringed with a solution of carbolic acid; and it is a further safe precaution to keep the raw surface dusted with a powder of several grains of starch combined with one grain of salicylic acid, or with iodoform.

6. **Neoplasms.**—*Fibromata* affect most frequently the anterior wall of the vagina. They may be either sessile or pedunculated. They do not give rise to much distress, except from their pressure on the bladder, or from their protruding through the vulva. Extirpation affords the only cure, and in carrying out the operation care has to be taken to avoid injuring the bladder or urethra when they are seated anteriorly, and the rectum when they spring from the posterior wall. *Sarcomata*, round-celled or spindle-celled, have been in some few cases found springing from the vaginal walls. They have sometimes been described as growing from the submucous tissue. In the only case which the writer has met with, the growths arose from the mucous membrane. Early extirpation is indicated. These growths tend to recur. *Carcinoma*, more markedly even than the other neoplasms, is oftener a secondary than a primary affection in the vaginal walls. It may, however, originate in the vagina itself, running a course at least as rapid as in the uterus, and usually leading early to infiltration of the inguinal glands. It only admits of palliative treatment. *Cystomata*, like the simple solid tumours, are most frequent on the anterior wall. The contents are usually pale, and where they have attained the size of a walnut, watery. In the smaller cysts the contents are more viscid. Some seem to result from cavities into which blood has been extravasated, and then the contents are brownish. They must be freely evacuated, and iodine or nitrate of silver applied to their lining membrane; otherwise they are apt to be re-filled.

7. **Vaginismus.**—Under this designation has been described an affection of the vaginal orifice, which is not infrequent among recently married women, and which utterly unfits the subjects of it for enduring coition. In some of them the hymen is unruptured, and there are excoriations at its base, towards the navicular fossa. More frequently the hymen has been infringed, but the lacerations resulting from the immissio penis have not healed, or fissures have formed at the roots of the hymeneal flaps, and a chronic inflammation is set up in the tissues, which renders them exquisitely sensitive. In such a condition any touch, even of the finger, causes intense pain, and when an attempt is made to pass through the orifice, the constrictor vaginæ and the lower fibres of the levator ani are thrown into a tenesmic state, which prolongs the suffering. The leading symptom is the distressing dyspareunia; and the diagnosis is made by the touch of the finger, supplemented by inspection. An examination can often be effected only when the patient is placed under anæsthetics.

TREATMENT.—Treatment of a palliative kind may be attempted, making the patient use sitz-baths and apply emollients and sedatives. But it is far more satisfactory to have recourse to radical measures. The patient being under the influence of chloroform, the fragments of the hymen should be pared or clipped off. An incision should be made on each side of the vaginal opening towards its posterior aspect, running in a direction outwards and backwards, and passing through the whole thickness of the mucous membrane, and some portion of the thickness of the constrictor muscle. The points of four fingers of the hand gathered together and well greased, should then be passed through the dilated opening, so as fully to distend it, and produce complete relaxation of the sphincter. With due care the bleeding is trifling; the wound heals kindly; and undue contraction is prevented by making the patient wear, for half an hour or longer twice a day, a thick vaginal bougie. For a time the introduction of the bougie is resented, but the pain passes off when it is kept in position; and after a few days its passage ceases to be painful. This operation can be carried out with a very confident expectation that the dyspareunia will disappear; and if no other complication be present, the probability is that conception will ensue. ALEXANDER RUSSELL SIMPSON.

VALENCIA, on the east coast of Spain. A dry, variable, mild, winter climate. Mean winter temperature, 49·7° Fah. Prevailing winds E. (moist), W. and S.W. (rough). *See* CLIMATE, Treatment of Disease by.

VALS, in France.—Alkaline waters. *See* MINERAL WATERS.

VALVES, Diseases of. *See* HEART, VALVES OF, Diseases of; and PYLORUS, Diseases of.

VARICELLA (dim. of *Variola*).—A synonym for chicken-pox. *See* CHICKEN-POX.

VARICOCELE (*varix*, a dilated vein, and κήλη, a tumour).—SYNON.: Fr. *Varicocèle*; Ger. *Krampfaderbruch*.

DEFINITION.—A dilated, elongated, and tortuous condition of the veins of the spermatic cord, due either to increased pressure within the vessels, or to diminished resistance in the walls of the vessels and the surrounding structures.

PATHOLOGY.—The testicle, probably like other glands, receives supplies of blood varying with its activity; and the veins are numerous and tortuous, freely anastomose, are liable to intermittent compression in their passage through the inguinal canal from muscular contraction, and terminate on each side in a single vein, which, like the companion artery, is remarkable for its great length and small size. These conditions are favourable to the production of dilatation and varicosity. Diminished resistance in the walls of the vessels and surrounding structures, is, however, probably the chief cause. Varicocele is so much more frequent in the left than in the right spermatic cord, and when present in both is so much larger in the left, that the inferior muscular development of the left side of the body from predominant use of the right is very possibly a predisposing cause. The termination of the left spermatic vein at right angles in the renal vein, as compared with the termination of the right vein at an acute angle in the inferior vena cava, and the relation of the left vein to the sigmoid flexure, have been suggested as possible exciting causes; but their influence, if any, must be slight.

SYMPTOMS.—Varicocele is generally painless, but is sometimes associated with neuralgia or hyperæsthesia of the testicle. The subjects of it sometimes complain of a feeling of weight or uneasiness in the part, after standing or prolonged exercise; and in extreme cases, when the scrotum is very much relaxed, labouring men have found it a mechanical hindrance in their work. The testicle is usually normal, but is sometimes soft and even atrophied, but these conditions of the testicle are probably the result of other causes, and not of the varicocele. In such cases the patient is generally very hypochondriacal.

DIAGNOSIS.—The diagnosis is easy. The veins can be readily felt, and have been aptly compared to a bag filled with worms.

TREATMENT.—In slight cases of varicocele no treatment is required. The use of a light truss, with pressure sufficient to take off the weight of the superincumbent column of blood from the spermatic veins, without interfering with the current of blood through the spermatic artery, has been recommended with advantage. A well-fitting suspensory bandage, cold bathing, avoidance of constipation, and tonics, will suffice for most cases; and if operative interference be requisite, the writer has found excision of the veins, with antiseptic precautions, most satisfactory. Subcutaneous ligature and division of the veins have been recommended; but the result is always uncertain, and sometimes unsuccessful.

J. MCCARTHY.

VARICOSE VEINS. *See* VEINS, Diseases of; and VARICOCELE.

VARIETIES OF DISEASE. *See* DISEASE, Types and Varieties of.

VARIOLA (*varius*, spotted).—A synonym for small-pox. *See* SMALL-POX.

VARIOLOID (*variola*, small-pox, and εἶδος, form).—This term has been applied to a disease which has the characters of variola in a mild form, but which is really small-pox modified by previous vaccination or inoculation. *See* SMALL-POX.

VEGETABLE PARASITES. *See* PARASITES.

VEGETABLE POISONS. *See* POISONOUS FOOD; and POISONS.

VEGETATIONS (*vegeo*, I grow).—In modern pathology this term is usually applied to growths and deposits connected with the valves of the heart (*see* HEART, Inflammation of). The name is also given to excessive granulations on wounds, and to warty growths.

VEINS, Diseases of.—SYNON.: Fr. *Maladies des Veines*; Ger. *Krankheiten der Adern*.

The diseases of veins will be described in the following order:—1. Inflammation; 2. Varix; 3. Hypertrophy; 4. Atrophy; 5. Degenerations; 6. Phleboliths; 7. Wounds; 8. Parasites; and 9. New Growths. Neither thrombosis nor pyæmia, except in so far as they affect the vessel-walls, will be discussed here. Until late years, the term phlebitis included these diseases and many others, but they have been gradually separated now (*see* PYÆMIA; and THROMBOSIS). The subject of the entrance of air into veins is also separately considered. *See* VEINS, Entrance of Air into.

1. Inflammation.—SYNON.: Phlebitis; Fr. *Phlébite*; Ger. *Venenentzündung*.

DEFINITION.—Inflammation of the coats of a vein, associated with changes in the blood passing through the inflamed spot.

VARIETIES.—Numerous varieties of phlebitis exist, but no satisfactory classification of them has yet been made. Indeed, three methods of classification are suggested, namely, 1, according to the *intensity* of the inflammation—acute, subacute, or chronic; 2, according to the *condition of the thrombus* formed—whether adhesive or suppurative; and 3, according as the inflammation affects the different *parts of the walls*—endo-, meso-, exo-, and peri-phlebitis. The latter commends itself as the best, as it is chiefly with the walls of the vessels we have to do. Practically, however, we may discuss the subject under two heads, namely *endophlebitis* and *periphlebitis*.

ÆTIOLOGY.—The chief cause of *endophlebitis* is the formation of a thrombus, and whatever leads to the one will cause the other. It is especially common in the last stages of exhausting diseases, such as phthisis, and as a complication or sequela of the acute specific fevers. *See* THROMBOSIS.

Periphlebitis, being allied to phlegmonous erysipelas, is set up by like causes. When open wounds exist, whether old-standing ulcers, recent wounds, amputation flaps, or direct wounds of veins, and when they are associated with bad hygiene, there is a tendency to this form of inflammation. Overcrowding is a fruitful source of this and allied diseases; and the same must be said of chronic visceral trouble, such as kidney-disease.

ANATOMICAL CHARACTERS AND PATHOLOGY.—The pathology of phlebitis taken in the limited sense referred to, as it affects the vessel-walls, is best discussed according as the influences which alter the normal condition arise (*a*) in the blood, or (*b*) external to the vessel-wall.

(*a*) The inner wall of a vein consists of an endothelial layer, supported on a subendothelial basis of connective tissue. It is extravascular, but under certain circumstances is liable to inflammatory and other changes.

From *within* the vessel the only possible irritation must come from the blood. That fluid blood, however loaded it may be with poisonous matter, can cause an appreciable change in the coats of the vein, is not known or believed. Blood, however, when coagulated, does cause changes in the vessel-wall, and the presence of this deposited fibrin, coagulated blood, adhesive clot, or thrombus, by whichever name we prefer to call it, is the starting-point of whatever endothelial change is derived from within. When a thrombus forms, contraction of the vessel-wall and staining of the intima occur; the staining is exactly commensurate with the extent of the thrombus, and is of a uniform reddish hue. The irritation set up by the thrombus will cause a determination of blood in the vasa vasorum, and the sheath and the outer and middle coats of the vein become injected and thickened. The endothelia now swell, the sub-endothelial cells become more numerous, active, and finally find their way into the thrombus. There will in this way result an adhesion between the vessel-wall and the thrombus, especially at its lower end, where it occupies the whole calibre of the vessel.

From the contraction of the thrombus and the paralysis of the muscular fibres of the middle coat, the vein will be thrown into longitudinal folds; these effects, however, are purely mechanical, as by injecting the vein with water the folds readily disappear. The idea that a fluid lymph was effused on the inner surface of the vein was long believed. Experiments appeared to show that after irritation lymph was effused on the inner surface of the vein. The details of the experiments, however, were proved to have been inaccurately performed, as lymph was allowed to travel through the openings made in the veins, for the purpose of inducing the irritation. When this was prevented by tying firmly the mouth of the opening through which the irritating substance (say a needle) was introduced, not only no lymph was found, but the blood remained fluid, and no change took place in the vessel-wall. The end of the relationship between the thrombus and the vessel may then be one or the other of the following:—liquefaction of the thrombus and return to the normal state of the vessel; adhesion between thrombus and vessel-wall, growing more and more intimate, the vessels of the outer coat and the thrombus becoming continuous; the whole of the vein and contents may become a streak of fibrous tissue; or they may undergo calcareous infiltration.

(*b*) The sheath and the outer coat are the parts of the vein first liable to inflammatory or other changes commencing from *without*. Around superficial veins especially, the tissue is loose and areolar, and in it the lymphatics travel upwards to the glands. Pus finding its way into this loose tissue is readily conducted upwards or downwards. The old name for periphlebitis was 'suppurative' or 'diffuse' phlebitis; it is a disease allied to phlegmonous erysipelas, the pus in phlebitis travelling along the loose connective tissue surrounding the veins, instead of being diffused in the general connective tissue, as in phlegmonous erysipelas. The origin of the inflammation may be in an open wound, an ulcer, an extravasation of blood, an abscess, especially ischio-rectal; in a viscus such as the bladder or prostate; in the separation of the placenta; or as a consequence of osteomyelitis. No change need necessarily occur at the wound; the surface may remain healthy, whilst the inflammation extends along the sheath of a vein leading from it. It may be some distance above the wound that the effect of the inflammation shows itself; if on the leg the pus may develop in the region of the popliteal space, if in the forearm at the elbow or axilla. The spot is apparently largely determined by the looseness of the tissue. The inflammation set up ends in the formation of pus, which may accumulate in sufficient quantity to form a large abscess. Several effects will follow these changes on the sheath. First, the nutrition of the coats of the vein will be interfered with, through the blocking up of the vasa vasorum. Secondly, there will ensue paralysis of the muscular fibres of the middle coat. Thirdly, the nutrition of the intima will be disturbed, giving rise to cloudy swelling of the cells, loss of smooth surface, and then, as a consequence of the roughened wall presented to the passing blood, coagulation of the fibrin and the formation of a thrombus. As the change is sudden, the blood coagulates quickly, and a clot is formed which is non-laminated, and commensurate with the extent to which the vessel-wall is affected. The pus formed gradually finds its way to the surface, points, and escapes either by natural or by artificial means. That the pus found its way inwards was long believed, and the clot was spoken of as a 'suppurative' thrombus, in the belief that pus actually existed in the thrombus. At most the thrombus presents only a puriform appearance, and pus is not now believed to get from without to within a vein. The adhesion between the wall and a thrombus so formed is very loose, and easily disturbed; the consistence of the thrombus itself is loose, its tissue friable and easily broken up; and, as a consequence, particles may become detached and washed into the blood-stream, forming emboli. *See* EMBOLISM; and THROMBOSIS.

SYMPTOMS.—(*a*) *Endophlebitis*, or adhesive phlebitis, being for the most part a local disease, few constitutional symptoms are present. The vein becomes hard, swollen, and tender; opposite the valves distinct prominences occur where the blood has first become stagnant; the limb becomes stiff; and sharp, shooting, darting pains occur along the course of the vessel. The train of symptoms will vary according as the veins are superficial or deep. If they are superficial, the veins can be felt beneath the skin; the skin over them is of a livid red hue; and there is but little œdema of the tissues If, on the other hand, deep veins are affected, the results will vary according as the phlebitis involves the main venous trunk or the veins of secondary importance. Should the main venous trunk become blocked, as in phlegmasia dolens, the whole limb is swollen, the skin is pale, the superficial veins become obscured, and the extremity affected is tense and heavy. Should it be other than the main venous trunk that is affected, say the tibial instead of the common femoral, the part becomes hard and swollen, the superficial veins are full and prominent, but there need be no extensive superficial œdema in either case. The constitutional symptoms are, so long as the disease is localised, but slight; should, however, pus form, or the clot break down, pyæmia and embolism may occur and lead to a fatal result.

(*b*) *Periphlebitis*, or suppurative phlebitis, occurs only when a person who is the subject of visceral disease, or who is exposed to bad hygienic conditions, suffers some local injury. The inflammatory condition, and it may be the pus formed, can be followed along the course of the vein, until it develops in some part where the connective tissue is looser than elsewhere. Here an abscess rapidly forms; the vessel is swollen and hard; the tissues become œdematous for some distance below the inflamed spot in the vein; and the pain, at first of a shooting character, becomes throbbing as pus forms. The constitutional symptoms are of a typhoid character: a feeble fluttering pulse, foul mouth and tongue, irritable stomach, diarrhœa, fœtid breath, with muttering delirium. The majority of such cases die. The disease is only a part of pyæmia. *See* PYÆMIA.

Gouty phlebitis is a name assigned to a condition rather than to a disease. There is a tendency in persons suffering from gout to develop adhesive phlebitis; and when varicose veins exist in a gouty person, they are especially the seat of the changes that go by the name of gouty phlebitis. Whether it is the vein itself or the overlying structures that are attacked, it is impossible to say, the symptoms in each appearing together. The skin over the vein becomes of a dusky, or at times of a livid red hue, for some distance around; the vein may be felt to be hard; the limb is slightly œdematous; the temperature of the part is but little, if at all, raised; and the pain is not troublesome. The disease is peculiar, inasmuch as all the symptoms may disappear from one part and appear in another. Its apparent metastases, its indefinite symptoms, and its troublesome recurrences, have gained for this disease the epithet 'gouty.' The evidence derived from the treatment, however, with regard to the pathology of this disease, rather negatives its gouty nature, and points to a condition of loss of tone, associated with local erythema.

DIAGNOSIS.—Inflammation of the veins has to be diagnosed from inflammation of the lymphatics, and from erysipelas. In the case of the lymphatics, the glands are tender and enlarged from an early period of the disease, the streaks are rosy-red and in large numbers; in erysipelas, the redness is a general blush. But it must be remembered that both of these conditions are associated with phlebitis, and that all tend towards pyæmia.

PROGNOSIS.—In endo- or adhesive phlebitis, the prognosis, in regard to the thrombus, is that it will be gradually absorbed, or that it will become incorporated with the wall of the vein, and reduced to a cellular cord. In regard to the walls of the vein, they may return to their normal state, remain permanently thickened, become adherent to the thrombus; or the cellular cord, formed by the remains of vessel-wall and thrombus, may become perforated, allowing blood again to flow through it. In peri- or suppurative phlebitis, the prognosis is bad, in regard both to the life of the patient, and the recovery of the vessel.

TREATMENT.—In all forms of phlebitis we must insure absolute rest by confining the patient to bed, and by fixing the whole limb between sandbags, or by means of splints. This is essential to procure diminution of pain, and to lessen the chance of breaking off a fragment of the clot, whereby fatal embolism might be caused. Hot fomentations are by far the most agreeable and soothing application. When abscesses form, poultices are required; and to remove hardness, after acute symptoms are gone, salt and nitre poultices are useful. When abscesses form they must be opened. Any œdema or general thickening that may remain must be combated by Martin's elastic bandages. Medicines, except those given to support the patient's strength, such as bark and ammonia, and the like, are not indicated. Calomel and opium are not administered now as they once were, as a specific to resolve the clot and restore the vein. Opium is given only to allay pain, and the less the drug is used for that purpose, so much the better chance has the patient of recovery. The treatment of peri-, suppurative, or diffuse phlebitis is to be conducted at first on the same principles, but the further treatment is discussed under pyæmia. *See* PYÆMIA; and THROMBOSIS.

2. **Varicose Veins.**—SYNON.: Varix; Phlebectasis; Fr. *Varice*; Ger. *Krampfader*.

DEFINITION.—Veins which are increased in length, diameter, and thickness.

ÆTIOLOGY.—As the current in the veins is dependent on a free and sufficient circulation through the heart, the arteries, the capillaries, and the veins themselves, whatever interferes with the passage of blood through any of these will predispose to varicosity. Hence feeble action of the heart, obstruction of the current of blood in the arteries, the involvement of the capillaries in any inflamed or thickened mass of indurated connective tissue, will check the free passage of the blood, and so withhold the *vis-a-tergo* necessary for driving the blood along the vein. In consequence, the blood-current in the veins will be retarded, and the increased pressure on the vessel-wall will cause dilatation. In the veins themselves the onward current may be impeded by a tight garter, the pressure of a tumour, aneurismal varix, the pressure of a truss, a full rectum, a gravid uterus, dilatation of the right heart, emphysema, and prolonged standing. A person engaged in any employment that necessitates much standing, and especially when in addition there is leaning forwards, as over a counter or a wash-tub, throws most of the strain on the muscles of the calf. The continued use of these muscles will cause a determination of blood to them, and by-and-by the full current in the vein will exhaust the resisting powers of its wall, and allow of its dilatation; so that from the surfaces of the soleus and gastrocnemius, several enormous veins will be found to emerge.

Anatomical Characters.—The principal seats of varix are the extremities, especially the lower limbs; the body, when collateral circulation is set up by blocking of the venous trunks; the rectum (*see* Hæmorrhoids); and the scrotum. *See* Varicocele.

The morbid changes in the development of a varicose vein occur in the following stages:—

a. Simple dilatation of a vein occurs when excess of strain is thrown on its walls from any obstruction.

b. This may be of so long duration that actual changes in the structure of the wall ensue. These consist in a hypertrophy of the muscle-cells in the middle coat, and a hyperplasia of the connective tissue in all the coats.

c. Should the cause of the dilatation continue, the vessel becomes thicker, increases in length, and, as a consequence, becomes tortuous, wavy in its outline, and irregular in its calibre.

The valves, in harmony with the vessel-wall, become hypertrophied, and for a time perform their function; but by-and-by they are insufficient to span the widening stream, and as they become useless, are reduced to fibrous cords. Behind the valves the blood finds a quiet recess, where it frequently stagnates, and a thrombus is formed, which may remain as a partially obstructing thrombus, or by continual additions to its surface, become a completely obstructing thrombus. After long-continued dilatation the tissues around thicken, and the fibrous tissue formed will spread between outlying tissues, and, involving the blood-vessels, will encroach on their calibre and strangle them. In this way it is that the vessels of the skin over a varicose vein are destroyed, and by the removal of the skin an ulcer is formed. *See* Ulcer.

d. The vein, as it approaches the surface, may by its pressure cause thinning, instead of thickening, of the surrounding tissues; and its walls finally become thinned and ruptured. In consequence an enormous quantity of blood may be lost; and unless means are employed to arrest its flow, fatal effects may ensue.

Symptoms.—The premonitory symptoms of varicose veins in the lower extremities are but ill understood. Numbness, cramps, increased heaviness of the limbs, occasional swelling about the ankles and feet precede the actual appearance; but these symptoms might be the forerunner of other troubles, and not of varicose veins at all. It is not until the vein is seen to be varicose that the disease can be known to exist. When first seen, a small part of a superficial vein, usually about the calf or ankle, looks slightly more bluish and larger than usual. This may disappear or escape observation for some time, only, however, to recur; and by-and-by the condition will become permanent, with occasional shooting pains in the course of the vessel. The superficial veins may become wholly involved, either from below upwards, or from above downwards, according to the seat of the obstruction.

The superficial may be equally involved with the deep veins. As a consequence the whole limb is abnormally large; a solid œdema permeates all its parts; the nutrition of the limb is interfered with; and the superficial parts giving way, profuse hæmorrhage or the formation of a varicose ulcer may be the result. The hæmorrhage is at times excessive, the blood pouring from the upper instead of the lower end of the vessel. This anomaly is accounted for by the destruction of all the valves between the ruptured spot and the heart; the increased pressure, in this long column, relieving itself by the aperture at its lower extremity.

Diagnosis.—Varicose veins are unmistakable in their appearance as usually found. At times a saccular dilatation of the internal saphena vein, just below Poupart's ligament, is mistaken for a femoral hernia; but with ordinary care this is to be made out easily.

Prognosis.—A dilated vein is dangerous according as it has a tendency to rupture or become inflamed. Either of these complications may prove fatal. The chance of an extensive group of varicose veins becoming obliterated, whether by spontaneous cure or by operation, is but slight.

Treatment.—The treatment in any particular instance is to find out the cause of the veins becoming varicose, and to remove it if possible. The circulation in the dilated vessel must then be encouraged, by obtaining a good cardiac and vascular tone; by support of the blood in the vein; and by particular attention to dietary and hygienic rules for some time. The vein is best supported by an elastic stocking, or by Martin's elastic bandage, or by an ordinary roller-bandage carefully applied. The position of the limb must be attended to, so as to help the venous return; the patient sitting with the feet raised on all possible opportunities, and not neglecting at night to sleep with the lower end of the bed slightly raised. Rules of treatment such as these are no doubt beneficial, but, unfortunately, are but seldom curative. For the purpose of cure by obliteration of the vessels, numerous plans are practised. The cases in which it is considered justifiable to operate are (1) when the vein gives rise to pain and inconvenience; (2) when hæmorrhage threatens or recurs; (3) when ulceration threatens; (4) when œdema is great; (5) when a varicose ulcer will not heal.

The methods practised may be briefly noticed.

a. At two or three spots over the varicose vein, the skin is touched with caustic potash, nitric acid, or a paste consisting of five parts oxide of calcium, four parts caustic potash, with spirits of wine to the proper consistence.

b. Two or three drops of perchloride of iron may be injected into the vein. The blood at the part injected must be rendered stagnant by compression above and below.

c. Needles may be introduced through the vein, and a galvanic current passed along them.

d. Subcutaneous division may be practised, by introducing a narrow pointed bistoury beneath the vein, and dividing it.

e. The varix may be compressed, by passing a hare-lip pin beneath the vein, opposite the highest point at which obliteration is wished, and taking care not to transfix the vessel. A piece of wax bougie must next be laid over the pin lengthwise on the vein. The practitioner then twists a piece of silk over the ends of the pin, figure-of-8 manner, so as to cause the bougie to be pressed on the vein and pin. At intervals of an inch along the vessel the process is repeated as often as it is necessary, so as to obliterate the whole vein. The part must now be kept absolutely at rest, and the pins left in position for eight days.

In all these methods, the risks of phlebitis, thrombosis, and their consequences are to be remembered and well weighed, before an operation is undertaken. The result in regard to the vein operated on may be a permanent cure, but it is almost certain that the neighbouring veins may become varicose in a few months.

3. **Hypertrophy of Walls.**—This takes place when extra work is thrown on the walls of the vessel. *See* Varicose Veins.

4. **Atrophy.**—When from any cause a vein, or part of a vein, falls into disuse, as after an amputation, its calibre diminishes, and its coats atrophy until it finally disappears.

5. **Degeneration.**—That atheroma of the coats of a vein takes place is not determined. The calcareous plates found at times in the saphena veins, inferior vena cava, and uterine veins are probably a form of phlebolithes, and do not originally proceed from the wall of the vein.

6. **Phlebolithes.**—Phlebolithes, or venous calculi, have a tendency to form in veins in which, from dilatation of the coats, the circulation is abnormally slow, as in the veins of the prostate and bladder, and in varicose veins anywhere. They commence no doubt as precipitated fibrin, and to this is added the less soluble salts of the blood—chiefly phosphate of lime, and in less quantity the sulphate of lime and sulphate of potash. Phlebolithes are harmless, and they require no treatment.

7. **Wounds, and process of healing.** *Wounds.*—When a healthy superficial vein is wounded, dark venous blood flows in a uniform stream from the distal end; but in the case of a varicose vein the blood flows from both ends, and chiefly from the cardiac. At the same time a quantity of blood escapes into the subcutaneous areolar tissue, and around the sheath of the vein. When a deep vein is wounded with a breach of surface, dark, scarcely fluid, blood oozes and trickles away. When a deep vein is torn by a broken bone, without breach of surface, the part around swells, and becomes dark in colour; œdema occurs around and below the torn vein; and, according to the amount of the extravasation, and the condition of the patient and the part, so will there be a tendency to resolution, non-union or delayed union of the bone, excess of callus, or the formation of pus, followed by osteophlebitis, pyæmia, and moist gangrene associated with bullæ.

Healing process.—When gentle pressure is applied over the wound after venesection, and the limb is kept at rest, union takes place in a few days, so that no scar even can be found in the injured vein. The coats of a vein contract and retract only to a slight extent within the sheath, but still sufficiently to help in the arrest of the hæmorrhage and the formation of the clot. The extravasated blood coagulates, extends through the opening in the vein, and projects like a button into the blood-stream. The whole coagulum now contracts; the part projecting into the vein becomes organised; and finally helps to close the wound. No inflammation is necessary, no cicatrix is left, and the vessel is not obstructed. Instead of this favourable ending, there may arise, from excess of movement or inflammation, numerous troubles, such as complete obstruction of the vein, phlebitis leading to thrombosis and the dispersion of emboli, local suppuration, inflammation of the lymphatics, or pyæmia.

Treatment.—Hæmorrhage from a superficial vein is readily arrested by pressure over the wound, and elevation of the limb. In the event of persistent hæmorrhage occurring from a deep vein after the employment of pressure, elevation, and styptics, the vessel must be cut down upon and ligatured. When a large vein is pricked, and the hæmorrhage cannot be checked by ordinary means, the margins of the opening in the vein may be seized with a forceps, and tied with a catgut ligature.

8. **Air in Veins.** *See* Veins, Entrance of Air into.

9. **Parasites.**—The embryos of the Tænia and the Bilharzia hæmatobia are occasionally found in the blood of the portal vein; the latter are also found in the veins of the bladder. *See* Bilharzia.

10. **New Growths.**—Tumours do not originate in connection with veins, but the current may get checked or stopped by tumours in the neighbourhood. For venous nævi *see* Tumours—*Angiomata*.

James Cantlie.

VEINS, Entrance of Air into.—Synon.: Fr.: *Aérhémoctonie*; Ger. *Lufteintritt in die Venen.*

The fact that animals could be killed by injection of air into the veins had been known since the middle of the seventeenth century, but the first case of spontaneous entry of air in man was not recorded till 1707, by Merz. After that time numerous observations were made on animals by Nysten, Bichat, Magendie, and others, in order to ascertain the cause of death, and the conditions under which it occurred. In the present century the subject has been investigated by Amussat, Erichsen, Pirogoff, Bouillaud, Brek, Panum, Fischer, and many others.

Anatomical Characters.—The air is found in the right auricle, often greatly distending it. In the whole right side of the heart it is usual to find a frothy mixture of blood and air. Bubbles of air are also found in the pulmonary artery, even in some cases in the smaller subdivisions.

Pathology.—The result of the investigations respecting the entrance of air into veins may be summed up briefly as follows:—

1. **Amount of Air necessary to Cause Death.**—This varies with the size of the animal

experimented on, and the mode of injection of the air. A small animal requires a smaller amount of air to cause death than a large one. If slowly injected, enormous quantities may be pumped into the veins with impunity; while a quantity sufficient to fill the auricle, injected suddenly, is certainly fatal. Recovery may take place after the occurrence of very serious symptoms, and on the other hand death may occur after an interval of some hours or even days.

2. **Causes of the Spontaneous Entry of Air into a Wounded Vein.**—In inspiration the diminished pressure within the thorax causes just the same tendency for the blood in the large veins at the root of the neck and the axilla to rush into the right auricle, as there is for the air to enter the lungs by the trachea. This aspiratory force does not extend beyond the veins mentioned, and the region in which they lie is often called 'the dangerous region.' If the vein be completely divided, its lax walls fall together, and thus offer a valve-like resistance to the entrance of air; but if in any way the opening be kept patent, air will rush in at each inspiration. The opening may be kept patent by a diseased condition of the walls of the vein, as when it passes through a tumour, or is imbedded in inflammatory products; or the surgeon may pull open a half-divided vein by traction on the parts he may be removing; or the aperture may be circular, as when a small piece is cut out of the wall of the vein, or a branch is cut off close to the main trunk. The external jugular, if divided low in the neck, remains open, on account of its connection with the cervical fascia. Gas formed in the uterus, as the result of decomposition of clots left in its cavity after labour, is said in some rare cases to have got up sufficient pressure to force its way in at the open mouths of the placental veins, and thus cause death.

Symptoms.—As the air enters the opening it gives rise to a noise variously described as hissing, whistling, or lapping. If the patient be not under the influence of an anæsthetic, he cries out that he is dying, or makes use of some expression indicative of great distress. He becomes immediately pale and faint. There is intense anxiety, with the most severe dyspnœa. The dyspnœa is purely cardiac in origin, the air entering the lungs freely, with violent and hurried inspirations. The sense of want of breath is due to an interruption of the flow of blood through the lungs. The pupils are usually widely dilated. Although the patient is pale and faint, the action of the heart may at first be felt through the chest-walls to be violent and irregular, and it is said that on auscultation a peculiar churning sound may be heard. The pulse rapidly becomes weak. Convulsions have occurred in some cases, of a tetanic character; and in some violent coughing has also been noted. If a large quantity of air has entered, death may be almost instantaneous. If a small quantity only has been sucked in, the patient may recover, sometimes after some hours or days of distress; and occasionally a fatal termination may take place a considerable time after the accident. Greene (*Amer. Jour. of Med. Science*, xciii. p. 38) has collected 68 cases. Amongst these 24 died almost immediately; others died from three hours to seven days after the accident. In the cases that survived some days bronchitis supervened, and possibly the entrance of air may not have been the real cause of death.

There can be no doubt that death results from arrest of the pulmonary circulation. It is not from paralysis of the heart, as some have said, for the cardiac action continues long after the air has entered. The heart is constructed to pump onwards a fluid which, like all other fluids, is incompressible. If the right ventricle be filled with air or a frothy mixture of air and blood, a considerable part of the force of its contraction will be wasted in merely compressing the air instead of driving it on. This, however, is but a small factor in the arrest of the circulation; the chief cause being that the air, or frothy mixture of blood and air, fails to work the valves. For the pulmonary valves to act it is necessary that the artery should be filled and its coats stretched; but here we have the vessel only partly filled, and that with an elastic gas instead of an incompressible fluid. Its coats are but slightly stretched, and the valves probably lie flat against them, and are not closed by the current of air or froth regurgitating after the ventricular contraction has ceased. The tricuspid valve probably also fails to act. The want of blood in the lungs causes the sense of dyspnœa; and the flow through the lungs having ceased, the left side of the heart will become empty, and no blood reaching the brain, faintness, followed quickly by death, naturally occurs. Supposing the patient to recover, the air which may have got into the circulation, is absorbed by the blood.

Treatment.—The accidental entrance of air into the veins must be prevented by careful operating. If a vein can be seen to be in danger it is advisable to compress it on the proximal side. If it is necessary to divide it, a double ligature must first be applied. If the symptoms described should appear, a finger must be at once placed upon the wounded vein. The indications then are: 1. To get the air out of the auricle; 2. To fill the auricle with blood; 3. To keep up a supply of blood to the brain. To empty the auricle the finger must be kept on the opening in the vein during inspiration, but removed during expiration, and at the same time the chest should be forcibly compressed. By these means frothy blood and air may be made to escape in considerable quantities from the opening. This is recorded as having occurred during the violent expiratory efforts of coughing that sometimes accompany this accident. To try to suck out the air by means of a tube inserted (as has been recommended) into the right jugular vein, would probably only ensure the patient's death. The auricle may be filled with blood by applying friction to the limbs in an upward direction. In order to ensure the flow to the brain of what little blood may be leaving the left side of the heart, it has been recommended to compress the abdominal aorta and the subclavian arteries. The veins being uncompressed can empty themselves into the auricle, which thus may be filled with sufficient blood to work the valves, and so restore the circulation. Should the respiration fail, it is advisable to try artificial respiration; but if the case reaches that stage, there can be but little hope of recovery, as it is not want of air in the lungs that causes death, but want of blood in the pulmonary vessels. Those who are interested in the subject will find references to the literature in Fischer's lecture, 'Ueber die Gefahren des Lufteintritts in die Venen während einer Operation,' *Volkmanns Sammlung Klinischer Vorträge*, Series v. No. 113.

MARCUS BECK.

VENEREAL DISEASES.—A common term for all forms of contagious disease usually contracted and transmitted by impure sexual intercourse. There are three principal kinds of venereal disease; namely, *gonorrhœa*, *syphilis*, and the *local venereal sore*, or *chancre*. *See* GONORRHŒA; SYPHILIS; and VENEREAL SORE.

VENEREAL SORE.—SYNON.: Local, soft, non-infecting Chancre or Sore; Fr. *Chancre Mou*; Ger. *Schanker*. Clerc employed the term *chancroïde*, which, modified into 'chancroid,' has been adopted by many American authors.

DEFINITION.—A virulent, local, contagious ulcer, communicable only by contact of its pus with a breach of surface.

ÆTIOLOGY.—The ætiology of the local chancre is still a subject of dispute. Those who are now known as *unicists* maintain that it is connected with syphilis. Others believe that it may be caused by the products of simple inflammation. But the most generally received opinion, and that which is most in accordance with the present state of our knowledge on the subject, is that the local or soft chancre is due to a virus, distinct from that of syphilis; that it never gives rise to any special constitutional symptoms; and that its effects are limited to the neighbourhood of the sore itself, and the nearest lymphatic glands. It is from this so-called *dualist* point of view that the present article is written.

Contagion.—The local chancre, like syphilis, may be communicated by direct or by mediate contagion, but is of course never transmitted by inheritance. Syphilis is not infrequently conveyed in various ways independent of sexual intercourse (*see* SYPHILIS). The local chancre, on the other hand, is very rarely other than a venereal disorder; chiefly because, not being part of a general disease, it does not give rise to contagious lesions on distant parts of the body.

The disease may also be conveyed from one person to a third, through the medium of one whose cutaneous or mucous surface happens to be intact, and who thus escapes inoculation.

One attack of the local chancre, unlike syphilis, affords no protection for the future; hence the same person may suffer as often as he exposes himself to contagion.

DESCRIPTION.—When chancrous pus is inoculated artificially, the puncture within twenty-four hours becomes surrounded by a faint red blush; on the second day the redness extends, and the site of inoculation becomes swollen. On the third day a vesicle appears, and rapidly becomes a pustule. About the fifth day the pustule bursts, leaving a circular ulcer with well-defined, sharply cut edges; the surface of the ulcer is uneven and spongy, presenting a worm-eaten appearance; and the base is soft and surrounded by a pink areola.

Varieties.—In the most characteristic form of sore the ulceration involves the whole thickness of the skin or mucous membrane, and its characters are essentially those of the typical form produced by experimental inoculation. The edges of the sore are loose and often undermined. In another variety the characters are ill-marked. The sore is superficial, the edges are not undermined, and the discharge is thinner and less abundant than in the typical sore. What has been termed a third variety results from exuberant growth. The surface is raised above the surrounding parts by the development of prominent granulations; hence the term 'fungating sore,' or *chancre végétante* of French writers.

In all varieties of local chancre the base is supple unless inflammation is present, in which case there is more or less thickening of the surrounding parts. The discharge is readily auto-inoculable, hence a plurality of sores is very common.

The *seat* of the local chancre is nearly always the genital organs or their immediate neighbourhood. A primary sore on the body of the penis is much more likely to be syphilitic than local.

The *form* of the local chancre varies in some degree according to its position. Thus, in the furrow behind the glans penis, the sore is elongated; about the frænum, in the folds of mucous membrane around the anus, and about the female genitals it is fissure-like. Again, when exposed to the air and neglected, it may become covered by a scab. If chancrous pus gain entrance to a follicle (follicular chancre) the latter may become distended, and temporarily simulate a small abscess.

As regards *size*, uncomplicated local chancres do not usually exceed half an inch in diameter, unless two or more run together, in which case they form a large irregular ulcer. Such confluent chancres are more common in women.

COURSE, DURATION, AND TERMINATIONS.—The regular course of the local chancre usually occupies from four to eight weeks; but the superficial form may heal in a few days. This course is divided into three stages: (1) an increasing, (2) a stationary, and (3) a healing stage. The length of each is liable to vary from many causes. Roughly speaking, however, it may be said that the first period, during which the sore sensibly increases in size, occupies from a week to a fortnight; that the second lasts about a fortnight; and that at the end of from three to five weeks, the stage of repair is reached.

By appropriate treatment the duration can generally be greatly shortened. It is also much influenced by the position of the sore. Thus, at the orifice of the prepuce or urethra, the irritation of the urine retards healing, and phimosis acts in a similar manner. Chancres of the frænum, again, often continue to spread until they have destroyed it. In fact, the more mobile and exposed to irritation is the part, and the greater the difficulty of keeping the dressings in place, the longer will be the duration of the sore.

If the syphilitic poison have been inoculated as well as chancrous pus—a frequent occurrence—the course of events will remain uninfluenced, until the incubation-period of syphilis has elapsed; when if the sore be still unhealed, it will gradually change in appearance by the development of induration at its base, until finally it assumes the characters of the initial manifestation (*see* SYPHILIS). If, on the other hand, the local sore has healed before the end of the period of incubation proper to syphilis, the scar will become indurated, and erosion or ulceration will probably, though not necessarily, follow.

COMPLICATIONS.—The less serious complications of the local sore include *inflammation*, *phimosis*, and *paraphimosis.*

Phagedæna. — This graver complication of chancre may be either acute or chronic; and may attack the original sore, or the consecutive bubo, or both.

In a typical case of *acute sloughing phagedæna* the patient is usually much depressed. He soon becomes feverish, with a dry, brown tongue, quick pulse, and other signs of constitutional disturbance. The discharge from the sore diminishes, is thin, sanious and shreddy, and very offensive. The margins of the ulcer are puffy and livid at first, but soon become black and ragged, presenting a 'gnawed' appearance. As the process goes on the dead tissues separate in sloughs, which vary in size according to the rapidity of the destruction. In the most severe cases necrosis is very rapid, and attended by excruciating pain. The whole of the genital organs in either sex may thus be destroyed; while, if the groin be the seat of phagedæna, the great vessels and nerves are quickly exposed at the bottom of a deep ragged cavity. If the process be not soon checked, death may occur from hæmorrhage, from exhaustion, or from some acute intercurrent inflammation.

The course which has just been described is that of the worst form of phagedæna, which is now fortunately rare; but less severe examples, ranging in various degrees between that described and those where a sore simply becomes larger, inclined to spread, looks unhealthy and has 'gnawed' edges, are common enough in venereal practice.

In the *chronic form* of phagedæna (serpiginous ulceration) the morbid process is much less active, and is not usually attended by much pain or constitutional disturbance, at least at first. The sore spreads gradually, but the tendency is rather to extend widely and superficially than deeply. The groin is the most usual seat of serpiginous ulceration, whence it may extend upwards along the abdominal wall or down the thigh, laying bare the deep fascia, and dissecting out the superficial vessels and nerves. It often also undermines the skin extensively, before destroying it; hence the loose and irregular margins of the ulcer are detached from the deeper parts for a considerable distance. The duration of this form of ulceration is very variable. It often lasts for months and sometimes for years; at one time appearing to be stationary, while at others it spreads in one direction and heals in another. After a time the patient's health suffers more or less severely, and finally he may become exhausted by the constant and prolonged irritation and discharge. If he recover, he may be permanently crippled by the contraction of the resulting cicatrices.

The causes of phagedæna are not yet fully understood. Some of the worst cases no doubt occur in persons whose constitutions have been broken by debauchery, syphilis, starvation, &c., but in other instances the patients are, to all appearance, healthy.

Bubo.—This complication, which is much less frequent in women than in men, is said to occur in about one-third of the total number of cases of local chancre, but this is probably too high an estimate. It may be either *simple* or *virulent*, the former being most common.

Simple or sympathetic bubo arises from ordinary irritation, and is similar to that caused by simple irritation of any other kind.

Virulent (*chancrous*) *bubo* is due to the conveyance of chancrous matter from the sore along the lymphatic vessels to the gland.

Bubon d'emblée.—This term has been applied to a variety of bubo, believed by some authors to result from the absorption of chancrous pus and its conveyance to a lymphatic gland without the production of any lesion at the point of inoculation. The existence of such a bubo is not yet established beyond doubt. *See* BUBO.

Lymphangitis.—This, like bubo, may be simple or virulent, but is a less frequent complication of the local chancre. Bubo of either kind may, and frequently does, exist without any perceptible change in the lymphatics leading to it; but when the vessels are affected the glands are usually inflamed also. The thickened lymphatics can be felt as tender and often irregular cords, and their course is generally marked out by red streaks along the surface.

Simple lymphangitis may end in resolution, or one or more abscesses may form along the course of the vessel. The virulent form probably always goes on to suppuration, and the resulting sores become chancres in every respect similar to the original one.

DIAGNOSIS.—The local chancre in its ordinary forms is recognised by the characters which have been already mentioned, and which are recapitulated in the following table, where also they are contrasted with those of the initial manifestation of syphilis—the lesion to which by far the most importance attaches from a diagnostic point of view.

Local Chancre.	*Initial Manifestation of Syphilis.*
1. A local and nearly always venereal disorder, produced only by the pus of a similar ulcer.	1. The first sign of a general and not necessarily venereal disease: it may be produced by the secretion of any syphilitic lesion or by the blood during the earlier stages of the disease.
2. No period of incubation. Irritation begins within a few hours after contagion.	2. Always a period of incubation, which averages 24 days.
3. Begins as a pustule which soon bursts, leaving an excavated ulcer with sharply-cut, loose, often undermined edges, and an irregular spongy floor of a dirty yellow colour.	3. Begins as a slightly elevated papule or erosion. Ulceration may be absent throughout. Edges raised, adherent, and rounded. Surface smooth and often of a ham-red colour.
4. Base supple unless inflamed, in which case it becomes hard like that of a boil; the hardness is diffused, resistent to the touch, ill-defined, and fades gradually into the surrounding tissues.	4. Base more or less indurated. The hardness is sharply circumscribed, somewhat elastic to the touch, and independent of acute inflammatory action; it varies much in amount, being sometimes superficial and scanty, and feeling like a thin layer of parchment or paper; sometimes abundant, and feeling like a mass of cartilage.
5. Discharge abundant, purulent, and freely inoculable on the bearer as well as on others.	5. Discharge scanty, serous, and not auto-inoculable unless suppuration be produced.
6. Inoculability on certain animals possible.	6. Inoculability on animals doubtful.
7. Usually multiple.	7. Usually single.
8. Very rarely seen far away from the genital organs.	8. Not very infrequent on the lips or fingers, and on the breast in women.
9. Course acute, and attended by pain.	9. Course chronic. Pain frequently absent.
10. Duration greatly influenced by local treatment.	10. Duration usually depends on general specific treatment.
11. Inflammation and phagedæna not uncommon.	11. Inflammation and phagedæna rare.
12. Glands remain unaffected or become acutely inflamed. Suppuration common. Bubo may be simple or virulent. Only one or two glands suffer.	12. Adenopathy constant, indolent, and nearly always multiple. Suppuration rare. Bubo never virulent.
13. Never causes general infection of the system.	13. Is followed by constitutional symptoms.
14. Repeated attacks common.	14. A second attack rare.

While the characters given in the foregoing table are amply sufficient for the diagnosis of the two lesions in uncomplicated cases, it must be mentioned that the appearance of either sore may be altered in various ways, for example, by neglect of cleanliness, or by the application of irritants. Thus the local chancre may develop an amount of inflammatory thickening which cannot for a time be diagnosed from that produced by similar causes in the syphilitic initial lesion; for the specific induration may become masked by inflammation. In such cases a positive diagnosis must be postponed until the irritation has subsided. Again, even if a patient present himself with a typical local chancre, it is of course not certain that the syphilitic poison has not been imbibed as well; and the incubation period of syphilis must be allowed to elapse before the patient can be assured that his trouble is only local. Further, as regards the two most characteristic signs of primary syphilis, namely, induration of the base of the sore, and indolent multiple enlargement of the nearest lymphatic glands, these are merely signs of a general disease, and one or other may be ill-marked, or even absent, or at least inappreciable. Then, as regards number—the initial lesion of syphilis may be multiple if several abrasions happen to be inoculated; and the local chancre may be single, especially in persons of careful and cleanly habits. Inflammatory action also may mask the usually separate indolent glands; but apart from this, sometimes only one or two glands can be felt. This is most often the case when the glands have been spoiled by previous inflammation. Absence of enlargement also appears to be sometimes due to the pressure of a truss. In very fat people again the glands cannot always be felt.

Thus, in making a diagnosis, not one but all of the signs that may be present, together with the history of the case, must be taken into consideration; and if the diagnosis still remains doubtful, the case must be watched until conclusive evidence is forthcoming.

Auto-inoculation is sometimes of service in diagnosis, but in the present instance would not be of much value; for even if a typical local chancre were the result, syphilis could not be excluded until the incubation period had elapsed.

When an immediate diagnosis is imperative, the so-called *confrontation*, or comparison of the patient with the source of his disease, may set the question at rest; but many precautions are necessary in drawing conclusions from such evidence.

Ulcerating syphilides, especially mucous patches of the female genitals, occasionally resemble the local chancre, but the presence of other signs of syphilis would lead to a correct diagnosis.

Gummata about the genital region, in both sexes, after breaking down, sometimes leave ulcers which have a remarkably close resemblance to local chancres.

Besides syphilitic affections, there are a few others which require to be mentioned in connection with the diagnosis of the local chancre. *Herpes* is characterised by vesicles, or small and very superficial erosions grouped together on an inflamed area. Itching or smarting also often precedes an attack of herpes, and there is frequently a history of previous attacks, which, again, are often independent of any suspicious sexual exposure, and are liable to recur at regular intervals, or in connection with digestive disturbance. Herpes also disappears in a few days under measures of simple cleanliness, and the discharge is not auto-inoculable.

Simple abrasions are irregular in form, are usually noticed by the patient at the time of their production or very soon afterwards, and heal readily in a few days if they are not irritated. Both herpes and abrasions, however, as well as the erosions due to balano-posthitis, may, under irritation of various kinds, become suppurating and inflamed ulcers, which for a time are very difficult to distinguish from local chancres.

When *phimosis* prevents exposure of the parts, a discharge from beneath the prepuce may be due to several other causes besides the local chancre, for example, syphilis, gonorrhœa, balanitis, or warts. If the local chancre be present, its site is usually indicated by the presence of a tender spot in that situation, and pressure often causes a slight oozing of blood. Consecutive sores also quickly appear at the margin of the prepuce. In the case of *syphilis*, the presence of induration and the multiple indolent enlargement of the inguinal glands will usually render the diagnosis clear. In *gonorrhœa*, soreness of the deeper urethra, scalding during micturition, the presence of chordee and other signs of urethritis, and the absence of localised tenderness beneath the swollen prepuce, are points that will usually determine the nature of the case. In *balanitis* there will be an absence of circumscribed tenderness and of signs of urethritis. *Warts* can be felt through the prepuce, and a portion of the growth can usually be seen by putting the parts on the stretch.

In all these cases also, when the source of the discharge is doubtful, auto-inoculation may be practised, though it is rarely necessary.

Prognosis.—The prognosis of the uncomplicated local chancre is always favourable. If any complication arise, the prognosis will of course depend upon the nature and severity of the complication.

Treatment.—The treatment of the local chancre consists chiefly in the employment of local remedies; the general treatment being directed, on ordinary principles, to the maintenance of the patient's health, by tonics, regulation of the diet, moderation in, or abstinence from, alcohol, and as much rest as possible, in order to diminish the risk of complications.

A local chancre of only a few days' duration can generally be destroyed by one thorough application of heat or caustic. The advantages of such a mode of procedure are that (*a*) consecutive inoculation, and consequently multiplicity of sores, is prevented; (*b*) the risk of bubo and of other complications is much diminished; and (*c*) the duration is greatly shortened.

When the surface is large, or when the sores are numerous, destructive measures should only be employed when milder ones have failed.

The thermo-cautery is the most convenient form of actual cautery. For the treatment of small sores, caustics are least alarming to the patient; strong nitric acid, and the mixture of charcoal and sulphuric acid commonly known as 'Ricord's paste,' are the most suitable forms. Before using either caustic or cautery the following two points should be borne in mind, viz.:—1. No sore should ever be cauterised unless *the whole* of the diseased surface can be acted on. 2. The surrounding parts must be cleansed with carbolic lotion or other disinfectant, lest subsequent re-inoculation occur from any discharge that may be present.

When caustics are not used, the best application is iodoform, of which the *powdered* crystals may be sprinkled on the sore by means of a quill, or applied with a moistened camel's-hair brush twice or thrice daily, according to the amount of discharge. The sore should then be covered with a piece of lint or wool, and if the dressing cannot be kept in place by the natural conformation of the parts, a piece of oiled-silk and a narrow strip of bandage or plaster should be applied. Iodoform may also be applied as an ointment with vaseline, or with glycerine, or an ethereal solution may be painted on the part, a thin coating of iodoform being left after the evaporation of the ether.

If iodoform is not used, a lotion of sulphate of zinc, lead, tartarated iron, or nitrate of silver may be applied, according to the state of the ulcer. Whatever dressing is employed, care must always be taken to change it frequently, and to arrange it so that opposed surfaces are kept apart. Chancres beneath a phimosed prepuce must be treated by frequent injections, with a syringe having a long nozzle, of carbolic lotion (1 in 40), or acetate of lead. Any of the sores that are within reach should be dressed with iodoform, and a piece of absorbent wool placed within the preputial orifice.

Treatment of Complications.—Inflamed chancres should be treated by keeping the patient at rest, on simple diet; and by the administration of a purge, and the application of lead and opium lotion or some other soothing dressing. In phimosis, if the swelling is so great as to prevent the use of the syringe, or if sloughing is threatened, the prepuce must be slit up or removed altogether, and the case treated according to the directions given for the treatment of phagedæna.

If in paraphimosis the prepuce be naturally too narrow, or if strangulation occur, reduction should be effected.

Phagedæna.—On the first appearance of signs of acute phagedæna, the affected part should be immersed for nine or ten hours a day in water, kept as nearly as possible at 98° Fahr. This can be easily accomplished by keeping the patient in a hip bath, and alternately adding and removing small quantities of water, so that the requisite temperature is maintained. Care must of course be taken to protect the patient from

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cold, by placing the bath in a warm room, and by wrapping the exposed parts of the body in blankets. This plan has succeeded well at the Male Lock Hospital;[1] and if it be adopted at an early period the sore often becomes healthy in a few days; immersion, however, should always be continued for at least a day or two after this has occurred, to guard against relapse. The patient may generally be allowed to go to bed during the night, iodoform or some other suitable dressing being applied; but if the diseased action continue to extend, the duration of the bath must be prolonged, or even be made continuous; but in that case, as well as in those where the groin is the seat of the disease, a full-sized bath, in which the patient can lie down, will be necessary. In all cases the whole of the diseased surface must be fully exposed and thoroughly submerged.

If milder measures fail to arrest the phagedænic action, the sore may be cauterised. If the surface is large, the actual cautery will be more likely to succeed than chemical agents.

If cauterisation fail, as it sometimes does, or if it be thought unadvisable to have recourse to it, a lotion of tartarated iron (10 to 60 grains to the ounce) with extract of opium, is often of the greatest value.

Hæmorrhage from a phagedænic sore should always be checked as soon as possible. If the bleeding is slight the surface should be cleaned, and pellets of cotton wool, soaked in solution of persulphate of iron, pressed on each bleeding spot, and retained in position by a bandage applied as tightly as the patient can bear. In severe cases the actual cautery may be necessary, and in extreme instances ligature of the larger arterial trunks above the seat of disease may be required.

The general treatment of phagedæna consists in the administration of good food, tonics, and opium in sufficient quantity to relieve pain, though under the immersion plan of treatment pain usually quickly ceases, and little or no opium is required. Fresh air and good ventilation are also powerful aids to recovery.

The treatment of chronic phagedæna or serpiginous ulceration is similar to that of the acute form, but of course more time is allowed for the trial of palliative measures before having recourse to the cautery.

The treatment of simple bubo will be found under Bubo.

The management of the *virulent bubo*, after evacuation of the pus, differs in no respect from that of the local chancre, which has just been described; and the treatment here recommended for phagedæna applies equally to that morbid process, as a complication of the local chancre, of bubo, or of syphilitic ulcers, whether primary, secondary, or tertiary; but in this latter case the administration of mercury or iodine or both, according to circumstances, forms an important element in the management. In fact, in every case of obstinate phagedæna, especially of the chronic form, most careful search should be made for signs or a history of syphilis; for, if that taint be present, it not infrequently happens that all local applications fail until the constitutional malady is attacked.

Arthur Cooper.

VENESECTION (*vena*, a vein, and *secto*, I cut).—Synon.: Bleeding; Blood-letting.—Abstraction of blood, by opening a vein. *See* Blood, Abstraction of.

VENOM, Effects of: VENOMOUS ANIMALS.—Synon.: Fr. *Animaux vénéneux*; Ger. *Giftige Thiere.*

Definition.—Animals which possess the power of secreting and ejecting a poison, which, when inoculated in man or other animals, produces toxic or even fatal effects.

Venomous animals are found in many classes of the animal kingdom.

1. Reptilia.—Reptilia furnish the most numerous and important examples of venomous animals, and these are limited almost entirely to the order *Ophidia* or snakes.

Description.—The poison-apparatus of a snake consists of a composite racemose gland, situated in the temporal region, secreting a clear, slightly viscid fluid, which is poured through a duct into a grooved fang situated on a movable maxillary bone.

The fangs are longer, more curved, more movable, and more formidable in viperine than in colubrine snakes.

Snake-poison is a clear, slightly viscid fluid, very deadly in its action, probably more active in some snakes, quantity for quantity, than in others, and varying in activity in the same species or individual, according to season, temperature, and state of health. It acts most rapidly when injected into the blood; but it can be absorbed through mucous and serous membranes, as seen by its poisonous effects when applied to the conjunctiva, the stomach, and the peritoneum. It may neither be applied to the lips nor taken into the stomach with impunity; and sucking a snake-bite is by no means free from danger, though if the saliva be quickly ejected and the mouth washed, the danger is probably small. It contains an active principle, which has been described as *echidnine*, *viperine*, and *crotaline*. Analysis has shown the poison to be very nearly like albumen in composition. It is most active in its action on warm-blooded creatures. It appears that poisonous snakes are very insensible to the venom of other poisonous snakes.

Effects.—The action of the poison is *local* and *general*.

The *local* effects of snake-bite comprise pain; partial paralysis of the bitten part; ecchymosis; swelling; and if death does not rapidly follow, infiltration of other and distant parts, cellulitis, and sloughing.

Associated with these local effects are many severe *general* phenomena, such as depression, fainting, nausea, hurried respiration, vomiting, exhaustion, lethargy, loss of co-ordinating power, paralysis, loss of consciousness, hæmorrhagic discharges, relaxation of sphincters, coma, and convulsions. If the quantity of poison injected be small or its nature feeble, the earlier symptoms may give way, and recovery take place.

Snake-poison acts by paralysing the nerve-centres—sometimes the peripheral distribution of the nerves, and by altering the constitution of the blood. It takes effect through the circulation; and if inserted into a large vessel, such as the jugular, humeral, or axillary veins, it will cause almost instant death, the heart's action stopping in systolic spasm. The respiratory centres, the spinal cord, the peripheral nerve-distribution, may all be affected; in ordinary cases death seems to take place by arrest of the respiration, the heart's action continuing for some time after apparent death. The muscular fibre itself would appear in some cases to have its contractility impaired or destroyed. The poison also acts septically, producing at a later period sloughing and hæmorrhage.

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[1] See *Lancet*, May 24, 1879.

There are certain points of difference in the action of viperine and colubrine venom. In the former there is greater tendency to hæmorrhage than in the latter. Experiments on animals show that, generally, after death from cobra-poisoning the blood coagulates firmly, whilst after death from viper-poisoning the blood remains permanently fluid. In most cases of death in man the blood has been found fluid even after cobra-poisoning.

The convulsion or coma that precedes death is due to the circulation of venous blood in poisoning by colubrine snakes; probably to the direct action of the poison on the nerve-centres in poisoning by viperine snakes.

Prognosis.—In cases of moderate severity remedies, with careful nursing and tending, may prove successful; but where the bite has been thoroughly effected by the ophiophagus, cobra, daboia, echis, rattle-snake, craspedocephalus, cerastes, and others, the prognosis is very unfavourable; in no case, however, should efforts be relaxed until the last.

There is often uncertainty as to the kind of snake, its condition, and the extent to which its fangs were used. The great shock or depression which follows a snake-bite may be in a measure due to fright, and will, on reassurance, pass away. The marks of two well-defined punctures attest the insertion of two fangs, and, if the snake has not been seen, may enable one to form an opinion as to its character. Many of the innocuous snakes are fierce, and bite vigorously, but their numerous teeth leave different marks from those of the poison-fangs. There are exceptions to this rule, however; a few innocent snakes have the anterior maxillary teeth developed like poison-fangs, but bites from them are not very likely to occur.

It may be well to note some of the characters that distinguish the venomous snakes, as the form and arrangement of the teeth and an examination of the wound will reveal the true character of the bite, and serve to form a correct prognosis. On opening the mouth of a venomous colubrine snake, such as *naja* or *bungarus*, two well-developed fangs will be observed, one on either side; and close behind it there may be seen one or two smaller teeth. There is no row of teeth along the outer side of the mouth, but a double row will be found on the palatine surface. In the viperine and crotaline snakes, a large fang will be found on either side, and a double palatine row. There are no small fixed teeth behind the fangs as in colubrines, but in a fold of mucous membrane at the base of the fangs, both in vipers and colubrines, a set of loose reserve fangs will be found. In *hydrophidæ* the fangs are arranged like those of the cobra, but are very minute, and no reliance can be placed on any mark made by them. The circumstances under which a bite is inflicted will generally help to indicate the kind of snake.

Harmless snakes have a double row of equal or nearly equal-sized teeth in the maxillary and palatine bones. But, as before stated, there are certain innocent snakes that have long anterior maxillary teeth, which might cause doubt as to the nature of the bite.

Treatment.—There is reason to believe that the numerous agents that have been recommended from the earliest times as antidotes of snake-poison are useless, and have no such properties as those ascribed to them.

The rational treatment of snake-poisoning is to endeavour to prevent the entry of the virus into the circulation; to neutralize it in the wound before it is absorbed; to support the failing nervous force if it have entered; and to favour its elimination.

The application of a ligature applied tightly between the bite and the heart, and the immediate excision or destruction by cautery or caustic of the bitten spot, are essential; and other local measures subsequently may appear necessary. The injection or the application to the puncture of some decomposing agent, such as liquor potassæ or permanganate of potash, has been especially recommended in Australia, in Brazil, and in India.

The constitutional treatment requires that the strength should be supported by stimulants, such as alcohol and ammonia. Next, if the respiration be failing, artificial respiration should be resorted to. Elimination should be promoted by stimulating diuretics. The patient should be kept warm; and must not exhaust himself by walking about. Ammonia has always held a high place among remedies in snake-poisoning; and its injection into the veins has been warmly advocated in Australia, and seems to have met with success there which it had not in India.

The statement that no *lizard* is poisonous, is not strictly correct. The heloderm (*heloderma horridum*), of Mexico, possesses venomous properties, destructive to small animals, and injurious to man himself.

2. Amphibia.—None of the amphibia are known to possess a poison-apparatus like that of ophidia; but toads and salamanders secrete a fluid in glands along the back, connected with the integument, which yields an actively venomous principle, capable of causing local irritation, and when injected into the blood, death, preceded by symptoms indicating action on the cerebro-spinal nerve-centres. Dogs seizing the toad, *Bufo vulgaris*, are known to suffer from swelling of the lips and salivation; and a case of death was related in France, in 1865, of a child in whom an abrasion of the hand came in contact with the secretion of a toad; death was preceded by vertigo, vomiting, and fainting. When this poison is injected into guinea-pigs, small birds, and other animals, violent symptoms and death soon follow. It is a viscid, milky fluid, with a slight yellow tint and peculiar odour; it is exuded, and may be pressed, from glands behind the orbits. Zalesky has shown that the land and water salamanders, *S. maculatus* and *Triton cristatus*, and probably others, have also the power of secreting venom; and his experiments prove that it contains a very active principle—salamandrine, and that its action on the cerebro-spinal nerve-centres is energetic. It appears that these poisons, like those of ophidia, though effective on others, have no action on their own species.

3. **Pisces.**—Description.—Several fishes are provided with an apparatus consisting of a cavity at the base of, or a sac and duct leading to, a channelled spine, through which an irritating secretion is ejected. No true poison-gland, however, has as yet been certainly made out. This secretion is apparently connected with the secreting mucous system; and in certain species it produces marked symptoms of poisoning, though never to the same extent as in the case of the poison of venomous snakes. Fish armed with sharp or serrated opercular or fin spines can inflict severe and painful injuries, liable to cause great pain, and to be followed by the grave symptoms attributable to the lacerated or punctured nature of the wounds; and these may be aggravated by the irritating nature of the mucus with which they are contaminated. In several, however, in addition to the spine, there is a distinct receptacle in connection with it, either in the form of a sac or duct such as in the *thalassophryne*, or in a cavity in the spine itself, as in the *trachinus* or weever.

In the case of others, such as the sting-rays, which may produce severe wounds by their pointed and serrated spines, there is no distinct receptacle for the poisons in connection with them. Whilst it is well known that many spiny fish are capable of inflicting wounds that are dangerous from their lacerated and punctured character, it is recognised that others increase the danger by the inoculation of an irritating fluid, as stated above.

Effects.—The effect of fish-poison is to produce severe burning pain at and beyond the injured part, and fever. The intensity, no doubt, depends upon the quantity of poison injected, and the state of health and constitution of the person at the time. The wound alone, even without the poison, is likely to be painful and severe from its punctured character.

Treatment.—Ipecacuanha, alkalies, alum, and ammonia have all been recommended as useful external applications to allay the irritating action of such poisons. Poultices of onions, or warm applications of opium or other sedative fomentations, are likely to be useful; and prompt surgical relief, if suppuration or cellulitis occurs, is necessary to relieve tension, to evacuate pus, or give exit to sloughs.

The constitutional treatment is such as would be indicated by the condition and progress of any other inflamed punctured wound. In case of depression of the heart's action, alcohol or ammonia would be indicated. Rest, quiet, and due attention to the state of the bowels and of elimination by the skin and kidneys, with careful regulation of the diet, should be observed. *See* Post-Mortem Wounds.

4. **Mollusca.**—*Aphysia punctata*, the sea-hare, a gasteropod, is said by some to produce an irritating secretion capable of causing urtication and even severe inflammation, and of causing the hair to fall off.

5. **Arthropoda; Myriapoda**, family *Scolopendridæ*.—The centipedes possess mandibles, formed by a pair of dilated feet, joined at their origin, with perforated, hook-like points with an aperture near the apex, through which a poisonous fluid, secreted in a poison-gland, sac, and duct, is ejected when they bite, which they can severely. This, in the case of the larger tropical species, is sometimes very painful, and causes considerable local irritation, and even constitutional disturbance, fever, and delirium. That of the smaller kind generally causes only local and transient irritation. Centipedes are found all over the world nearly, in Europe, Africa, America, the East and West Indies and Islands, and in the tropics generally. Those of warm climates are the largest and most dangerous.

6. **Arachnoidea.**—*Scorpionidæ* or *Pedipalps*. Description.—Scorpions have a segmented abdomen, the last six joints of which are narrowed into a tail, terminated by a curved perforated spine or hook, with which they strike and wound. At its extremity are two small orifices, through which venom is injected from a gland-receptacle and duct at its base. Scorpions run about quickly, carrying the tail curved over the body. They live in holes in the ground, and under stones or logs of wood, in dark places. The tail is used as an offensive weapon. They seize small creatures with their palpi, and then pierce them with the sting. The venom is so active that it quickly destroys life. Those of tropical climates are most active and poisonous. They attain to the length of from two to three, four, and six inches. The European genera are smaller and less active.

Scorpions exist in all tropical countries, but extend also into the warmer regions beyond the tropics. They are found in the East and West Indies, Ceylon, and other islands, Australia, Africa, Egypt, South of Europe, and America. There are several genera, and *Buthus afer*, *Androctonus*, and *Buthus Cæsar*, are good examples of the active kinds. *Europæus* and *Occitanus* are also venomous, but those of Europe are less active than the tropical forms.

Effects.—The effects of the sting of the scorpion and of the bite of the centipede have no doubt been exaggerated; but they may produce very painful, and in the case of the larger species, severe and serious symptoms, in their character not unlike, or even more severe than, those of the sting of the wasp, namely, pain, swelling, in some cases numbness, vertigo, nausea, vomiting, temporary loss of vision, swelling of the tongue, and fever. Death may occur in delicate or sickly subjects. The local and constitutional symptoms may be severe in persons of irritable constitution, or otherwise out of health, but generally in the case of bites of ordinary scorpions or centipedes inflicted on healthy subjects, the suffering is local and soon passes away.

Treatment.—A variety of remedies have

been recommended for scorpion-poisoning. Probably the application of a ligature above the bitten part, or a cupping-glass, or suction of the wound, as in snake-bite, might be useful. Some authorities recommend that the wound should be scarified, volatile ointment rubbed in, and an emollient poultice applied. Suction of the wound, and the application of salt water, vinegar, ammonia, alum, ipecacuanha, spirits of camphor, eau de Cologne, tobacco water, turpentine, tincture of iodine, alcohol, the leaves of cruciferous plants made into poultices, solutions of opium and lead, or other sedatives, all seem to lessen pain and irritation. The use of diffusible stimulants, opiates, or other sedatives may be necessary, and such surgical interference as suppuration or cellulitis may require.

7. **Arachnida.**—DESCRIPTION.—Some spiders are venomous, and certain of the larger tropical forms are capable of inflicting painful bites. The poison-apparatus of spiders consist of falces or modified mandibles or jaws, the last joint of which is a hard curved fang, with a fissure near the point; there is an elongated poison-sac and duct in which the venom is elaborated and thence transmitted to the fang, by which it is inoculated into the flesh of its prey.

EFFECTS.—The venom of spiders is a very active principle, and apparently is capable of rapidly destroying the life of the small creatures on which the spider feeds. It also causes symptoms of poisoning in man and the lower animals. Probably all the species have some venomous secretion, but it is only the larger kinds that are obnoxious to man. It may be noted that whilst the fangs of one section of spiders move laterally, those of the Mygalidæ move vertically.

There are several species. Those reputed venomous are tropical.

Lycosa tarantula is reputed to cause extraordinary symptoms. It is poisonous, but there is no reason to believe that its effects exceed a certain amount of local irritation. *See* TARANTISM.

There are numerous families, genera, and species of spiders, all probably possessing an irritating fluid; but it is only in the larger kinds that they do so to any extent, and there is no very positive proof that even in tropical climates they inflict the grievous injuries ascribed to them, though the venom is very fatal to the creatures on which they prey.

The popular notions that the spider is very poisonous when swallowed, and that its web possesses medicinal properties, are probably exaggerated, if not altogether untrue. One species of red spider, however—perhaps a mite—called *coya*, in Popayan, is very poisonous; the juices of its body when crushed, and coming in contact with the punctured skin, cause tumours, or even it is said death. This is no doubt an exaggeration, but it is probable that the juices are acrid and irritating, and it is therefore better not to crush them when detected on the person, but to brush or blow them away.

In India, a streak of almost erysipelatous redness of the skin coming on rapidly, is often attributed to a spider. No one has defined the species; it is possible that it may be analogous to that just referred to.

TREATMENT.—The treatment of spider-bites is similar to that of centipedes and scorpions.

8. **Acarina.**—DESCRIPTION AND EFFECTS.—Some mites have the power of causing considerable irritation by a secretion ejected on the surface, or injected into the wounds they make in their burrowing operations with claws or mouth.

The *Tetranychus autumnalis*, *Leptus autumnalis*, or Harvest Bug, is brick-red in colour, and very minute. It is bred on plants, but leaves them to fasten on animals, especially man, when it adheres firmly, and causes swelling, great irritation, and severe itching, if in numbers. The intense irritation causes fever. The symptoms are not unlike the sting of a nettle, erythema or even blistering being caused. The leptus is covered with hairs, and effects entrance into the skin with its claws, and thus gives rise to the great irritation, which is probably aggravated by some acrid excretion. These animals are found in Britain, France, and other parts of Europe; varieties of them in the tropics, for example in Brazil, Honduras, on the Mosquito Coast, and in the West Indies. The *T. irritans* of the Mississippi valleys causes great irritation in the same way.

TREATMENT.—The treatment is to extract the bug with a needle or the point of a knife, and then apply some soothing lotion.

Argas persicus, a gamosid, known also as the *Teigne de Miana*, venomous bug of Miana, is common in Persia. It is found in the houses, and it is said that its puncture produces serious symptoms, such as convulsions, delirium, and gangrene, or even death. This is an exaggeration, though probably it is true that local irritation, and perhaps some constitutional disturbance, may be caused. It is blood-red in colour, spotted with white on the back, the feet yellow. *Argas moubata*, a native of Angola, is said to have much the same properties.

The *Argas talaje* of Guatemala produces great irritation. It bites like an ordinary bug, and the punctures are followed by great irritation, swelling, and pain. It lives in holes in the bamboo walls, or such-like crevices, and issues at night to attack the sleepers.

9. **Hemiptera.**—Some of the *Geocorysæ* and *Hydrocorysæ*, or land and water bugs, have irritating properties, and also an offensive odour; they have a suctorial mouth, armed with a grooved instrument or rostrum for piercing the skin.

Cimex lectularius, the bed bug, causes much irritation, and in some persons inflammatory action in the bitten part. The effects are transient.

Notonecta and *Nepa*, common in pools of water in our islands, are also capable of inflicting a painful puncture. *Cimex nemorum* causes nearly as much pain by its puncture as the sting of a wasp. The wheel bug, *Reduvius serratus*, of the West Indies, gives an electric shock to the person it touches. St. Pierre mentions a species of bug in the Mauritius whose bite is as venomous as the sting of a scorpion. The *Benchucha*, or great black bug, of the pampas of South America, is more obnoxious, it is said, than the common bed bug.

10. **Aphaniptera.**—*Pulicidæ* or Fleas comprise several families. *Pulex irritans*, the com

mon flea, is universal. It varies much in size and colour; some are almost black and very large, and are found on the sandy shores of the Mediterranean. There are many species, such as *P. canis*, *P. musculus*, *P. vespertilinus*, and others. *Pulex penetrans* of the West Indies and South America, known also as the jigger or chigoe, penetrates the skin, and beneath the nails, generally of the feet, causing great irritation. It will, if not extracted, deposit its ova, and thus give rise to severe irritation. The effects of the ordinary flea-bite are well known. Though the irritation of flea-bites is chiefly due to the wound, there is reason to believe that this is aggravated by the presence of some irritating secretion. No special treatment need be described.

11. **Diptera.**—DESCRIPTION AND EFFECTS.—To this order belong the gnats, mosquitoes, pipsas, sand-flies, and gad-flies, all more or less dreaded for their bites. They have a proboscis composed of a grooved and flexible sheath, through which long, slender, sharp darts are protruded, that pierce the skin and inoculate some venomous secretion, though its nature is not known. They draw blood, raise white lumps or swellings; some, such as the pipsa of the Cossiah Hills, India, leave a livid spot of effused blood, which gives to the sufferer the appearance of a purpureal rash. They swarm in many countries, generally near water. The principal forms are the *Culex pipiens*, *C. reptans*, *C. mosquito*, *C. laniger*, and the whame fly, *C. tabanus*. Some of these are formidable insects, and are insatiable blood-suckers. The *tsetze* or *tsimb*, *Glossina morsitans* of Africa, is one of the most remarkable. The bite of this poisonous insect is almost certain death to the horse, ox, or dog; though it appears not to trouble man more than by causing slight irritation.

The female *Simulium*, or sand-fly, is irritating to man, the bite often giving rise to painful swellings. The pipsa is probably a simulium. It appears from the great irritation and the swelling that follows the puncture of most of these insects, that some acrid secretion is injected into the wound. In young full-blooded persons, especially recent arrivals in India or the tropics, the irritation caused by mosquito-bites is often so severe as to give rise to violent inflammatory symptoms, resulting in suppuration or ulceration, and even gangrene.

TREATMENT.—The application of common salt, solution of ammonia, soda, potash, lead, oil, ipecacuanha, or alum combined with opium, allays irritation in the first stage. The more violent inflammatory symptoms are amenable to ordinary surgical treatment. Camphor, pulegium, and lime-juice, applied to the skin, are all regarded as preventives.

12. **Hymenoptera.** — DESCRIPTION AND EFFECTS.—A number of species that secrete poison are found among the different families of hymenoptera, including bees, wasps, and ants. *See also* STING.

They are distinguished by the presence of an ovipositor in the female, which not only is used for depositing the eggs, but as a weapon for injecting venom. It consists of two valves as a sheath, and three bristles which form a grooved sting. Through this groove the poison is injected into the wound, the ovipositor being connected with a poison-gland at its base.

Formicidæ.—Ants include *Formica smaragdina* and many others. The sting of the ant causes considerable irritation, especially if many. It has been suggested that formic acid is the irritating principle. There are several venomous species of ants, black and red, of various sizes. Some of the larger forms in the tropics are capable of inflicting a very painful injury. Some ants have no sting, but eject a fluid which irritates the skin.

Vespidæ.—The females and workers of the wasps and hornets are provided with a poison-sac and sting. *Vespa vulgaris* is a type of the tribe *Crabro*. It lives in communities. Its sting produces much irritation, pain, and swelling, especially when inflicted on the face, or where the cellular tissue is loose.

Apidæ.—True bees, and the *Bombidæ* or humble bees, have similar properties, their sting producing very much the same effect as that of the wasp.

Some of the parasitic *Hymenoptera* inject a poison into the wound made by their ovipositor. The best known instance is that of the genus *Ophion*. The genus *Paripla* also injects a poison in the same way, and probably others of the *Ichneumonidæ*.

TREATMENT.—Many remedies of a simple nature have been recommended to allay the pain and irritation caused by the sting of the wasp and bee, such as vinegar, eau de Luce, ammonia, solution of soda or potash, oil, indigo, eau de Cologne, alum, and all those recommended in scorpion-stings. In case of venomous stings, where constitutional disturbance is induced, stimulants or sedatives may be necessary; and as the sting is liable to be left in the wound, it ought to be picked out. In cases of wasp or bee stings in the mouth or throat, which may happen when children bite a peach or other fruit that conceals a wasp, severe consequences may arise from the œdema that supervenes, and extends to the glottis. An emetic is then useful. With the ordinary treatment of œdema, laryngotomy may become necessary. In other cases, should violent symptoms supervene, surgical aid may be required to relieve tension, or give exit to matter. Such untoward results, however, are happily rare.

Mutilla coccinea, a native of the warmer parts of North America, is said to produce loss of consciousness within five minutes of the infliction of its sting, life being in danger for some days afterwards.

13. **Lepidoptera.**—The majority of insects furnished with a sting, as a means of defence, belong to the Hymenoptera. It is but recently that a stinging Lepidopterous insect has been found. The species is not mentioned (F. Smith). The bee moth of the Cape of Good Hope is said to defend itself with a sting. Though the majority of the perfect insects of this tribe are harmless, some of the caterpillars appear to be possessed of irritating properties, residing in the fine hairs with which they are cased, and which, being sharp and brittle, break off and remain in the skin, causing irritation mechanically; but also probably from the presence of some acrid

substance concealed within the hairs. In Ceylon, a greenish hairy caterpillar, longitudinally striped, probably of the genus *Bombyx*, which frequents the leaves of *Hibiscus populneus*, alighting on the skin, causes as much irritation as the sting of a nettle. The larva of *Neæra lepida*, has similar properties. It is short and broad, of a pale green, with fleshy spines on the upper surface, each of which is charged with venom that occasions acute suffering. The larvæ of *Adolia* are also armed with venomous hairs. Another, not uncommon in certain trees in the terai of the Himalaya, is a dark-coloured hairy caterpillar, which is apt to fall on people and cause intense irritation. It is known as the *Komlah*, but the moth that produces it is not known.

14. **Coleoptera.**—Several beetles have acrid secretions capable of exciting great irritation and inflammation, raising blisters, and if absorbed causing painful strangury and great urinary irritation. Such are *Mylabris Cichorii* of India, *Cantharis* or *Lytta*, or *Meloe vesicatoria*, *Lytta gigas* of Senegal, *Lytta vitata* of America, and *Lytta ruficeps* of Chili.

15. **Echinodermata.**—The long sharp pointed spines of some of the echinids are capable of inflicting painful punctured wounds, but convey no true venom. Whether, as in the case of some spiny fishes, there may be an irritating mucous secretion inoculated is uncertain.

16. **Cœlenterata.**—Some of the *Medusæ* or jelly-fish have the power of stinging. The poison-apparatus is placed in certain tubercles on the surface. These contain a collection of granules, amongst which are small vesicles. Within these corpuscles or nematocysts a spiral thread is found, which bursts out on pressure. These corpuscles are found in the mucus exuded by the creature, and to them is attributed the urticating power it possesses. There are several stinging species, some found on our own coasts, others in other seas. It is the larger forms generally that are venomous, the small ones having no effect on man. *Cyanea capillata* of our seas is a most formidable creature, and the terror of bathers. It has a broad tawny disk, and a long train of ribbon-like streamers floating after it; it makes its way through the waters; and whatever comes in contact with these trailing trains soon writhes in torture, the effect produced being not unlike that of the nettle.

Physalea pelagica, the Portuguese man-of-war, has similar properties. It causes severe and stinging pain, extending up the limb, with feverishness, which has been known to continue for some hours, white wheals forming on the skin, as in urticaria. Several other medusæ possess these properties, and hence they have received the name of Acalephæ, or sea-nettles. The application of vinegar or olive oil is said to remove the unpleasant symptoms.

The *Actiniæ*, or sea-anemones, and the hydroid polyps, appear to possess a similar power, and are provided also with thread-cells. They cause urtication of the human skin when brought in contact with their tentacles. The *Sagartiadæ* furnish examples of sea-anemones with this property. The effects, however, of any of them are transient. In some parts of Europe the *Acalephæ* have been used therapeutically as counter-irritants, by being brought in contact with the patient immersed in a salt-water bath.

In the preceding description the writer has not attempted to treat exhaustively the subject of venomous animals, or to describe all the forms of animal life so endowed. His object has been to point out the principal forms, and to indicate generally the mode of dealing therapeutically with the effects of the venom.

JOSEPH FAYRER.

VENOUS HUM.—A peculiar murmur heard on auscultation of the larger veins, especially those of the neck and chest, in anæmia, and in cases of interference with the flow of the blood through those vessels. *See* PHYSICAL EXAMINATION.

VENTNOR, in the Isle of Wight.—A mild, dry, bracing climate. Mean winter temperature for forty years, 42·43° Fahr. Exposed to S.S.E. and S.W. winds. *See* CLIMATE, Treatment of Disease by.

VENTRICLES OF THE BRAIN, Diseases of.—SYNON.: *Maladies des Ventricules du Cerveau*; Ger. *Krankheiten der Gehirnhöhlen.*—The chief morbid states of the ventricles of the brain are (1) *new growths*, *degenerations*, and *inflammatory changes* in the lining membrane (ependyma) and velum interpositum; and (2) accumulations of *blood*, *pus*, and *serum* in the ventricular cavity.

1. **Diseases of the lining membrane and velum.**—In old age, and in degenerative brain-diseases, such as general paralysis, the ependyma of the ventricles becomes *thickened*. The surface is uniform, or, in some cases, covered by minute warty granulations. Some of the latter may attain the size of a pea, and constitute small fibrous tumours. Similar changes are sometimes found when the brain has been subjected for a long time to passive congestion. In rare cases the thickened membrane has been found *calcified* in places. A few *morbid growths* have been met with in the ependyma, the most common being the granulations of tuberculosis, which have been found both on the lining membrane and the choroid plexus. The latter and the velum interpositum frequently present thickening, and undue adhesion to the ependyma. In rare cases *fatty growth* has been met with in this situation. The choroid plexus may present partial *fatty degeneration*, and frequently contains *corpora amylacea*. Aggregations of *brain-sand* are common in the choroid plexus, and occasionally occur in the lining membrane.

Cystic degeneration is the most common morbid appearance in the choroid plexus, especially in that part which is within the descending cornu. The cysts are clear, delicate, colourless, transparent, from the size of a pea downwards. They consist of delicate cells pressed together, which are simply normal cellular elements of the part that have undergone a peculiar degeneration. In some of the larger ones these cells have become destroyed in the centre, so that a true fluid-containing cyst remains.

The adhesions sometimes met with may cut off the posterior cornu from the rest of the ventricle, and it may thus be obliterated.

The ventricles may undergo passive *congestion* in common with the intracranial organs or from pressure upon the veins of Galen, which return the blood from the velum interpositum. In the latter case considerable effusion of fluid may occur.

Inflammation involves both the ependyma and the velum interpositum. It is rarely confined to the ventricles, still more rarely to one. Commonly it is part of a general meningitis. The ependyma and the velum are thickened and pulpy, being infiltrated with cells of new formation. The velum is always injected; the ependyma may be injected or pale. Occasionally a false membrane is found upon its surface. The tissue of the brain beneath the ependyma is softened, and may be injected. The fluid in the ventricles is increased in quantity, and is turbid from pus and exudation-cells, and even *débris* of nerve-fibres. The inflammation, of which this is part, is usually fatal; but it may pass away, the ependyma and velum remaining thickened and adherent. *See* Meninges, Cerebral, Inflammation of, Tubercular.

2. **Intraventricular accumulations.**—*Hæmorrhage* rarely occurs directly into the ventricles, except by traumatic rupture of a vein; but blood may reach them from within the cerebral substance, or from the subarachnoid space. True *pus* may be found in the cavities, from the bursting into them of a cerebral abscess; and a purulent fluid may result from inflammation of the lining membrane. A slight effusion of *serum* results from inflammation, but is rarely considerable, unless the escape of that secreted by the choroid plexus is prevented by the closure of the passage to the fourth ventricle from external pressure, or by the obliteration of the foramina in the membrane closing in the fourth ventricle, by which its cavity communicates with the subarachnoid space (Hilton). *See* Hydrocephalus. In atrophy of the brain, the fluid within the ventricles (as beneath the arachnoid) undergoes a considerable compensatory increase.

Lastly, by violent commotions of the brain the septum lucidum may be *ruptured* (Wilks and Moxon).

Ventricular hæmorrhage and *hydrocephalus* are described in other parts of this work. *See* Brain, Hæmorrhage into; and Hydrocephalus.

The other conditions discussed are marked by no distinctive symptoms, and call for no special treatment. W. R. Gowers.

VENTRICLES OF THE HEART, Diseases of. *See* Heart, Diseases of.

VERDIGRIS, Poisoning by. *See* Copper, Poisoning by.

VERMES (Lat. worms).—This is a term of variable import, according to the practical or scientific stand-point from which it happens to be viewed. Thus Gegenbaur includes in this group, not only the helminths or entozoa and their allies, but also a multitude of creatures of widely differing structure, as well as the annulated animals properly so-called (*Grundzüge der Vergleich. Anatomie*, 1870, s. 155 *et seq.*). The late Professor Rolleston, in like manner, elevates the term so as to make it of *sub-kingdom* value in zoology. Practically, the term 'Vermes' is used as the equivalent of *Entozoa*, which latter term, as we have explained elsewhere, has a wider signification than its simple literal meaning implies. *See* Entozoa; Helminthes; Intestinal Worms; Parasites; and Worms.

T. S. Cobbold.

VERMICIDES (*vermis*, a worm, and *cædo*, I kill).—A group of anthelmintics which kill worms. *See* Anthelmintics.

VERMIFUGES (*vermis*, a worm, and *fugo*, I expel).—A group of anthelmintics which expel worms, but do not necessarilly kill them. *See* Anthelmintics.

VERRUCA (Lat. A wart.)—Synon.: Fr. *Verrue*; Ger. *Warze*.

Definition.—A wart or papillary growth from the skin.

Ætiology.—The wart, being an aberration of growth of certain of the constituents of the skin, must necessarily result from a want of normal power within the integument; hence it is mostly found in children and elderly persons, and is less frequently met with in the adult. As children become developed by growth, and their tissues acquire strength, these partial exuberant growths disappear. In young persons of feeble organisation they are sometimes thrown out like an exanthem, and yield to a constitutional treatment directed towards the improved innervation and nutrition of the tissues. Their direct relation with the nervous system is often evinced by their sudden disappearance under the influence of mental emotion, a circumstance which has led to the popular use of charms for their cure. In elderly persons they are often met with on the face, where their presence must be ascribed to debility of integument; and they are frequently associated with dirt and neglect. Briefly, warts may be said to be due to aberration of nutritive function of the skin, consequent on defective organisation and vitality.

Description.—Pathologically a wart is an hypertrophy or excessive growth of a small group of papillæ of the skin, with excessive production of cuticle, forming a hard prominence of the integument. Warts vary in size, and are modified according to situation. They sometimes cover a considerable extent of surface in patches several inches in diameter, but more commonly appear as tubercles, either few in number and isolated, or numerous and in clusters. One kind is remarkable for the minimum of prominence, resembling a flat, dirty-looking blotch on the skin; whilst another, as on the hands, may have a prominence of a quarter of an inch, or on the scalp of half an inch.

Warts on the hands afford the commonest illustration of verruca, as in this situation, from the greater nutritive energy of the skin and the abundance of epidermis, they are most frequent and most highly developed. When of recent growth they are convex and smooth on the surface, but when of longer standing the apex is flat, from the wearing away of the superficial cuticle, and the anatomy of the wart becomes disclosed. Then it is apparent that the wart is composed of a bundle of fibres, held together in a cylindrical form by a boundary of thickened cuticle. Each of these fibres is a vascular papilla of the skin, enclosed in a sheath of cuticle, and the collective mass forms the body of the growth. An old wart will frequently split up into several segments—*V. lobosa* or lobulated wart, and then its construction of fibres—*V. fibrosa*, is strikingly conspicuous. If a wart be cut through horizontally, the vascular papillæ will be cut across, and then the structure of a wart of papillæ and horny sheaths is still more evident. On the fingers, and especially the knuckles of children, the verruca is isolated and large, and not unfrequently confluent, and on the back of the hands and wrists, as also on the forehead, it is often developed in crops, like an eruption; but these latter never attain the dimensions of the isolated warts of the fingers.

Verrucæ are generally sessile—*V. sessilis*; but on the scalp they are frequently pedunculate, and, from a peculiarity of structure, have been denominated digitate—*V. digitata*. The digitate character of the warts of the scalp is due to the lesser quantity of epidermis occurring in that region; consequently the hypertrophous papillæ are not held together by a ring of thickened cuticle as elsewhere, but being left to themselves shoot out from the centre like fingers; the papillæ likewise grow to a greater length, and their cylinder is swollen so that the bulk of the mass greatly exceeds that of the base from which they spring. Nevertheless, the digitate verruca must be distinguished from *V. acrochordon*, and the cauliflower-shaped venereal warts, both of which are growths of the integument, and are not restricted to the papillæ cutis alone; and thereby fall into the category of molluscum, with which, especially acrochordon, they are closely allied in pathological structure.

The normal colour of warts on the hands is a yellowish-grey, but from their roughness they are apt to retain dirt in their crevices, which gives them a brownish appearance. The flat warts of the trunk of the body and face are accompanied with the production of pigment, and their dirty colour is consequently more striking. A number of warts congregated on the skin suggested to the fathers of medicine the idea of ants crawling over the body, and this appearance they designated *myrmecia*; whilst, another resemblance, which can be frequently verified, brought to the mind the blossom of the thyme, hence the term *Thymion* employed by Hippocrates.

Diagnosis.—As a simple epidermic growth enclosing hypertrophous papillæ, verruca is very distinct from other affections of the skin attended with hypertrophous growth of cuticle. The lepra of Willan is accompanied with hypertrophous papillæ and cuticle, but the latter is a morbid product, and is spread out in the form of laminated scales. Ichthyosis likewise is a combination of hypertrophous papillæ, enclosed in epidermic sheaths, with accumulation of cuticle, but is apt to be associated with filiform and branched processes of the actual integument.

True idiopathic warts must be distinguished from other diseases which sometimes put on a warty appearance, especially *carcinoma* and *syphilis*. *Epithelioma* of the skin is occasionally seen as a circumscribed warty growth, but generally with adherent scabs covering superficial ulceration. These signs, together with infiltration of adjacent tissues, implication of neighbouring glands, and pain, would arouse suspicion. It must be remembered, however, that epithelioma frequently attacks a simple wart which has remained quite passive during a lifetime; rapid increase of growth with the abovementioned symptoms would suggest the supervention of epithelioma.

Any chronic inflammatory process of the skin, especially *syphilis*, is liable to take on a papillary character. Without referring to the papillary growths of early syphilis (condylomata), which could scarcely be confounded with simple warts, on account of their position and moisture, mention may be made of the dry warty character assumed by old syphilitic lesions, especially such as have been preceded by ulceration. The history of the disease (previous ulceration, &c.), together with other concomitant symptoms of syphilis, would assist the diagnosis.

As of venereal origin, though never syphilitic, *ordinary* 'venereal warts' must also be noted. Other names by which they have been described suggest their characters, such as 'pointed condyloma,' and 'cauliflower excrescence.' They are generally bright red in colour; and the individual papillæ are pointed. The rapidity of their growth, and the situation where they usually occur (the genitals), serve to distinguish them from verrucæ. Moreover they most often accompany gonorrhœa, being caused by the irritating discharge.

Prognosis.—Verruca is a blemish rather than a disease, and unimportant in its relations to the general health. By an error of diagnosis we sometimes read of malignant warts, and warts have been confounded with those fleshy growths termed 'tegumentary nævi.' Moreover in elderly persons a warty state of the skin is sometimes associated with asthenic ulceration, and occasionally with rodent ulcer, for which the depraved state of the skin, and not the wart, is responsible.

Treatment.—The best method of treating verrucæ is to touch them with some solvent agent, such as acetic acid. This acid dissolves the epidermis, and reaching the vascular papillæ, destroys the whole structure of the wart down to its root. The pulpy mass then dries up into a scab; and when the scab falls off, the growth rarely reappears. This little operation may either be completed at one sitting, or it may be repeated daily until its purpose is effected. Where there are numerous verrucæ to be dealt with, the process is tedious, and is generally left in the hands of the patient. The writer prefers a saturated solution of potassa fusa, carefully applied by means of a minute pencil of sponge fastened to the end of a stick. The alkali acts more speedily than the acetic acid, and effects a more thorough cautery of the vascular plexus, from which the hypertrophous papillæ derive their capillary loops. The verrucæ digitatæ of the scalp are speedily and easily removed by this process. In the exanthematous form the verrucæ are too small and too numerous for the caustic application. These may be treated by frictions of sulphur ointment or tar ointment; and in this latter form the verrucæ are frequently entirely removed by a course of treatment with liquor arsenicalis, in three- or four-minim doses, taken immediately after meals, three times a day. Erasmus Wilson.

VERTIGO (*verto*, I turn).—Synon.: Giddiness; Dizziness; Swimming of the head; Fr. *Vertige*; Ger. *Schwindel*.

Definition.—The consciousness of disordered equilibration.

Physiological Relations.—To understand vertigo normal equilibration must be briefly considered. The equipoise is maintained by a sensori-motor mechanism. The coördinating centre is the cerebellum; the afferent or sensory apparatus consists of visual, tactile, and labyrinthine impressions; the efferent or motor apparatus are the muscles, chiefly those of the head, neck, and spine. Derangement of any part of this mechanism may lead to vertigo, by interruption of its power of adjustment. Vertigo is often associated with reeling or staggering, and is incorrectly said to cause it. Actually vertigo is the consciousness of disturbed locomotor coördination—a rudimentary disorder of coördination of locomotive movements (Hughlings Jackson), whilst reeling is an adaptive effort to preserve the equilibrium. A fact that supports the assertion that vertigo is a rudimentary disorder of coördination, is that when in a person, who has a sensation as if he were moving or turning in a certain direction, movements actually take place, they are always in the direction in which he previously felt he was turning when no outward movements occurred. Experimental researches and observations in disease have established the conclusion that the semicircular canals take an important share in normal equilibration; injury and disease of these parts occasioning locomotive incoördination, temporary when one side only is deranged, permanent when both sides are involved. The arrangement of the semicircular canals, and the physical principles involved in their actions, are very complicated, but have been carefully studied and explained by Flourens, Cyon, Crum-Brown and others; and it has been demonstrated by Flourens that injury of each canal is followed by definite locomotive disturbance, causing the body to tend to fall, or actually to fall, in a definite and precise direction, forwards, backwards, or to one or other side, according to which of them is injured. The sensory impressions originating in the semicircular canals are caused by varying tension of the endolymph, communicated to the vestibular division of the auditory nerve spread out on the ampullæ of the membranous canal. Variations in labyrinthine tension may be produced by alterations in the position of the head, by differences in the vascular tension of the labyrinthine blood-vessels, and by the varying pressure in the middle chamber of the ear, induced by obstruction of the Eustachian tube, spasm of the tensor tympani muscle, and other causes; and it may also be due to disease of the labyrinth itself, or communicated to the labyrinth. Visual and tactile impressions are liable to be deranged in many ways, for instance, by unexpected or unusual movements, as in swinging, being at sea, &c.; by local disease of the visual and tactile apparatus; and by disease in the nerve-trunks and spinal cord, interrupting conduction from the periphery to the centre. By disturbances in visual, tactile, or labyrinthine impressions the equilibrising centre is uninformed or misinformed, and incoördination results, outwardly shown by reeling or falling, and inwardly by the sensation we call vertigo. Loss or perversion of visual or tactile sensations may be compensated for, if the two remaining sensory processes continue intact, but nothing compensates for entire loss of labyrinthine impressions (Ferrier). The vestibular nerve which is distributed to the semi-circular canals is a branch of the auditory, the nucleus of which in the medulla is in close relation with that of the vagus; and thus the fact is explained that disturbances in the large area of distribution of the pneumogastric are found associated with labyrinthine disease, by propagation of the irritation from the nucleus of the auditory to that of the adjacent vagus; and conversely the intimate association of these two nuclei enables us to understand how disease of the stomach and other viscera occasions vertigo. It must further be borne in mind that the labyrinth receives its blood-supply from the vertebral artery, which at its origin from the subclavian is in near propinquity to the inferior cervical ganglion of the sympathetic, from which it receives a rich plexus of nervous filaments. The inferior cervical ganglion also sends communicating branches to the vagus, and branches to the heart. In this double way, therefore, the labyrinth has important nervous relations with the stomach, heart, and other organs.

Pathology.—Vertigo may be excited by variations in the local or general blood-pressure, which cause variations in the labyrinthine tension, as in anæmia, gout, and other affections. The symptom is also produced by certain drugs, such as quinine, salicin, and the salicylates, which act probably on the labyrinth through the vascular system.

Vertigo may be divided into degrees or stages, namely, (1) a feeling of confusion and instability; (2) a feeling as if objects are moving; (3) a feeling as if the individual himself is moving; and (4) actual movements of the body.

The important forms of vertigo which occur in practice will be further considered under the following heads: 1. **Ocular**; 2. **Auditory**; 3. **Gastric**; 4. **Nervous**; 5. **Epileptic**; 6. **Migrainous**; 7. **With organic brain-disease**; and 8. **Gouty**.

1. **Ocular Vertigo.**—Vertigo is frequently caused by ocular disorders, and is often mistaken for serious cerebral disease. The simplest form is in paralysis of a single muscle, as the external rectus. The vertigo is not occasioned by the diplopia, but by the incorrect notion formed of external objects by the paralysed eye, due to what is known as 'erroneous projection.' The confusion thereby produced gives rise to vertigo, and often to reeling. One of the most important varieties of ocular vertigo is that occasioned by insufficiency of the internal recti muscles—

muscular asthenopia. This is most commonly met with in myopia. During reading these muscles, which have long been overtaxed by exertions to maintain the convergence of the eyes rendered necessary when looking at near objects, suddenly give way under the strain; they relax, the eyeballs turn out, and the letters on the page become indistinct, run into each other or overlap, and a sense of confusion and giddiness occurs. It is usually accompanied by aching at the backs of the eyes, headache, and sometimes by nausea. Such cases are often misunderstood even by medical men. Muscular asthenopia may occur also with hypermetropia; and as a sequel to exhausting diseases, such as fevers and diphtheria. For the diagnosis of the particular optical defect and treatment the reader is referred to VISION, Disorders of.

2. **Auditory or Aural Vertigo.**—SYNON.: *Vertigo ab aure læsa*; Labyrinthine vertigo; Apoplectiform vertigo; *Menière's Disease.*

Auditory vertigo is very generally known by the name of Menière's disease, from the excellent description of the malady first given in 1861 by Menière. Under the term Menière's disease is grouped a class of cases in which vertigo is caused by perversion or abeyance of the labyrinthine function. The labyrinthine disturbance may be caused either (1) *directly* by an affection of the labyrinth, such as (*a*) hæmorrhage, (*b*) congestion and inflammation; or (2) *indirectly*, by (*a*) disease of the middle ear (otitis media), (*b*) obstruction of the Eustachian tube, (*c*) spasm of the tensor tympani, or paralysis of the stapedius, or (*d*) irritation or obstruction of the external auditory meatus, and pressure on the membrana tympani, as by cerumen, foreign bodies, or by syringing the ears, especially when the membrana tympani is perforated. Thus the labyrinthine affection may be either of an irritative or of a destructive nature, and the effect of the lesion will be exactly the reverse in the two cases (Ferrier). That is to say, whilst an irritative lesion would cause the tendency to fall in one direction, a destructive lesion of the same canal would cause a tendency to fall in the opposite direction. In Menière's disease, strictly speaking, there is always coincident affection of the semicircular canals and cochlea, as indicated by the three most important associated symptoms: vertigo, tinnitus, and deafness. Accompanying these cardinal symptoms there are accessory phenomena, due to secondary visceral disturbance, namely, pallor, faintness, and nausea or vomiting—a condition of syncope.

The disease makes its appearance, in a person apparently quite well, or the subject only of some chronic auditory disease, with a loud noise in the ear, compared by different persons to the whistle of a steam-engine, the firing of a gun, or the roar of the ocean. When a person, as not infrequently happens after the first attack, has an habitual noise in the ear, this at the time of the attack is greatly exaggerated. The noise, which is wholly or principally in one ear, is soon followed by the feeling of giddiness. This is generally of a high grade, causing the sensation of surrounding objects moving in some one direction, a feeling of translation of the patient's body in the same direction, or actual movements of the body. The movement, whether apparent or real, is usually *from* the side on which the ear is affected. In recurring attacks the movements, whether of objects or of the individual, are nearly always in the same direction. Usually the sensation of movement is from behind forward, or to one or the other side, or the patient has a feeling of rotation in a vertical axis. When in bed, the room, bed, and occupant are felt as if turning round and round, or rising or sinking. Accompanying the vertigo there is reeling, and the patient clings to surrounding objects for support. In some cases the movement is too rapid for the patient to obtain security in this way, and he is thrown to the ground, sometimes with such violence as to occasion serious injuries. When falling takes place, it is usually forwards or to one side. It is, however, to be especially remembered that, except in rare cases, there is no loss of consciousness; the patient being able immediately after the attack to describe the sensations he experienced, or even to answer questions in the attack itself. Following, in more or less rapid succession, the tinnitus and vertigo, there occur nausea and in most cases vomiting, accompanied by pallor of the face; the skin becomes cold and covered with a clammy sweat. In some cases oscillatory movements of the eyes are observed. It is generally asserted that objects appear to move in a direction opposite to that of the ocular movements. This is not universally true; and probably, contrary to the statements of most writers, the apparent movements of objects is in the same direction as the observed movements of the eyes. Gradually the attack passes off; the noises in the ear lessen, but deafness is left behind. The body recovers its warmth, and the pallor subsides, but vertigo and vomiting may persist for some hours or even days, both being aggravated or induced by rising from a horizontal position. Slight attacks may only last a few minutes. In cases where there is a direct lesion of the labyrinth, a certain degree of deafness—a limitation of the field of audition, that is, the loss of certain sounds in the musical scale—and tinnitus remain. The patient is in all other respects well, except for the dread of a recurrence of the attack. Occasionally, however, a certain degree of vertigo and reeling persist, liable to be aggravated by gastric derangement. A patient rarely escapes with one attack. Subsequent attacks are separated by distinct intervals, but in severe cases these may become less and less, until a permanent vertiginous state, of a most distressing character, may be reached, liable to paroxysmal exacerbations. In such very grave cases spontaneous cure may occur on the establishment of complete and permanent deafness, or relief may be obtained by therapeutical measures. When the labyrinthine disturbance is secondary to disease of some other part of the auditory apparatus, removal of the primary disease, as cerumen or tympanic catarrh, will, when practicable, promptly remove the symptoms, and the attacks may not recur.

DIAGNOSIS.—Menière's disease has to be distinguished from epilepsy, apoplexy, gastric derangement, and other causes of vertigo. From all of these it is distinguished by the invariable coexistence of tinnitus, deafness, and vertigo, with in addition syncope and nausea, or vomiting. The concurrence of the first three symptoms shows that the labyrinth is involved, a point which will be further established by testing audition with a tuning-fork and watch. The vertigo is generally of movement in a certain definite and uniform direction. There is never numbness, tingling, or any sensations analogous to an aura; but aching of the upper extremities, and discolouration of the hands may occur, from irradiation of the irritation from the inferior cervical ganglion to the brachial plexus (Woakes). As to the diagnosis of the nature of the labyrinthine affection, whether primary or secondary, some rules have been laid down by authorities. If a person who has formerly heard well becomes suddenly deaf, or hard of hearing, with the symptoms of an apoplectic attack, and if there is at the same time an uncertain and staggering gait, but no symptoms of paralysis in the nerve-tracts, and if the examination shows a normal membrana tympani, and perfectly permeable Eustachian tube, we may believe with great probability that there is an affection of the labyrinth (Tröltsch). Deafness and tinnitus occurring without vertigo indicate an affection of the middle ear. Vertigo and tinnitus without deafness may be due to an affection of the middle ear. Vertigo, tinnitus, and deafness are certainly due to an affection of the labyrinth. Careful otoscopic examination should be made, the permeability of the Eustachian tubes tested, and the tuning-fork and watch employed to ascertain the condition of the conducting apparatus, before an exact opinion can be formed as to the nature of the labyrinthine affection. Vomiting, following the ingestion of some rich or indigestible food, may be so severe and lasting as to monopolise attention, and the vertigo and tinnitus may not be complained of. In such a case, a mistake may readily occur in a first attack.

Prognosis.—Where the labyrinthine affection is due to some remediable defect, the disease will subside on removal of the cause, such as cerumen, tympanic catarrh, &c.; hence the great importance of an exact diagnosis as to the nature of the case. When the lesion is primarily of the labyrinth, a certain degree of deafness and tinnitus is nearly always left, and recurrence of the attack is to be anticipated.

Treatment.—In the attack, and for a short time following it, the recumbent position should be strictly maintained. Bromide of potassium or ammonium, in ten to twenty grains for a dose, may be administered, and small pieces of ice swallowed. Next, any gastric derangement should be corrected, for in some cases gastric affection excites a paroxysm in a person predisposed to it by some aural affection, insufficient alone to induce an attack. Alkalies and vegetable bitters, with or without bismuth, will generally be useful for this purpose. Any abnormal local condition must be treated. Subsequent to the attack quinine in full doses, 3 to 5 or 10 grains three times a day, perseveringly used, is sometimes attended with the best results (Charcot). Gelsemium and salicylate of soda have been found useful (Gowers). Counter-irritants, including the actual cautery, applied to the mastoid region, have proved serviceable in some cases, and may be used in addition to other measures.

3. Gastric Vertigo.—Synon.: *Vertigo a stomacho læso.*

Vertigo, occasionally of a high grade, sometimes accompanies chronic gastric derangement. It is more common with slight than with grave affections of the stomach, but has been met with in well-marked organic disease of this organ. An explanation of its occurrence has been given in the introductory remarks. It sometimes occurs soon after a meal, but more often when the stomach is empty (Trousseau). Associated with it are usually pain and a feeling of fulness in the stomach, increased by food; heartburn; eructations; vomiting; flatulence; and pain in the left hypochondrium and chest. The bowels may be torpid, or diarrhœa may be present. The patient often suddenly experiences a swimming in the head, objects may appear to revolve, the patient's gait becomes tottering, and he may even fall. Often there is constrictive headache, faintness and pallor with nausea, and sometimes troublesome vomiting, but there is no loss of consciousness. Visual hallucinations may be present, and buzzing in the ears experienced, but there is no deafness. The vertiginous symptoms may so predominate that the gastric symptoms may not be complained of, but treatment directed against dyspepsia cures the vertigo. When predisposing gastric disturbance is present, trivial causes, such as looking at objects which lead to confused visual impressions, may excite an attack, but this may also arise spontaneously. In many cases relief is obtained by the recumbent position, but attacks may occur when the patient is lying down.

Diagnosis.—This form of vertigo is diagnosed from epilepsy by absence of loss of consciousness; and from labyrinthine vertigo by the absence of deafness, and the physical signs of aural disease. It cannot be concluded that the vertigo is essentially gastric without thorough examination of the ears, for, as already stated, vertigo may be excited by gastric disturbance when there is labyrinthine affection insufficient alone to determine an attack. It must also be remembered that signs of gastric and intestinal derangement are induced in Menière's disease, and may be so prominent as to cause the aural affection to be overlooked.

4. Nervous Vertigo.—Synon.: Fr. *Vertige nerveuse.*

Not uncommonly vertigo is one of the most troublesome symptoms of nervous exhaustion and depression. This occurs in persons unduly taxing their nervous powers, by severe intellectual strain, especially when combined with anxiety, or by sexual excesses. It occurs also from the depressing effects of the immoderate use of tobacco, alcohol, and tea. The vertigo rarely reaches a high grade, manifesting itself by a sensation of confusion, or of objects revolving, occasionally only by the feeling of a tendency to fall. It may be associated with a slight reel, but more often the patient feels as if he were walking unsteadily, when there is no perceptible peculiarity of gait. As a rule giddiness is only experienced in the upright position, but in some cases it occurs when the subject is recumbent, and the patient often complains of sudden and violent startings when just in the act of falling asleep. It is often intensified by an elevated position, and in large buildings and assemblies. Hence it is often experienced in church. It is peculiarly distressing, owing to the sufferer's emotional equilibrium being easily disturbed, and is frequently associated with a dread of impending cerebral disease—epilepsy, apoplexy, insanity, etc. There often coexist gastric derangement and flatulence, with irritability of the heart, palpitation, and sleeplessness, the former no doubt having a share in its production. There may be slight and temporary buzzing in the ears, but deafness is absent, and no loss of consciousness occurs. In these respects it is readily distinguished from Menière's disease and *petit mal*.

Treatment.—This is to be treated by removal of the cause—over-work, excessive sexual indulgence, or the abuse of alcohol, tobacco, or tea; by correction of any dyspeptic symptoms; and by the administration of nervine tonics, such as iron, quinine, or strychnia. Bromides should be avoided if possible.

5. **Epileptic Vertigo.**—Vertigo may occur in a slight fit of epilepsy, or at the commencement of a severe attack. The symptom may replace an epileptic fit, or may coexist with epilepsy. It is more common in epileptic vertigo for the patient to imagine that he himself is moving or turning round, than for external objects to appear in motion (Russell-Reynolds). Care must be taken not to accept the patient's mere statement of 'giddiness.' The term is often loosely applied. It is necessary to ascertain his exact sensations, and only to conclude there is vertigo when actual feelings of movement are experienced. If the vertigo is related to change of position of the head, it is probably labyrinthine. The latter is not usually accompanied by loss of consciousness, and is more apt to be followed by vomiting (Gowers).

6. **Migrainous Vertigo.**—Vertigo commonly constitutes one of the phenomena of migraine, occurring as a rule after the disorders of sight, touch, and speech, when these form part of the seizure, and either attends or follows the development of the headache (Liveing). Vertigo sometimes replaces the attacks of migraine. It is apt to occur on change of posture, or on suddenly turning the head. As a rule migrainous vertigo is slight in degree, but it may be quite severe, and accompanied by nausea and vomiting. It is unassociated with noises in the ear, or with deafness. *See* Megrim.

7. **Vertigo in connexion with organic disease of the nervous system.**—Vertigo sometimes accompanies disease of the cerebrum, both acute, as apoplexy, and chronic, as tumours. There are reasons for believing that vertigo may be excited by cortical lesions, thus explaining epileptic and migrainous vertigo. Disease of the cerebellum and of its middle crura are often attended with reeling gait, and sometimes with vertigo. This symptom sometimes accompanies the ataxy of tabes dorsalis; and is a marked symptom of some cases of insular sclerosis.

8. **Gouty Vertigo.**—Vertigo, labyrinthine or other, is occasionally met with in gouty persons. It may disappear after an outburst of gouty arthritis; or be removed by alkalies, colchicum, and other proper remedies, and attention to diet.

Stephen Mackenzie.

VESICAL DISEASES. *See* Bladder, Diseases of.

VESICANTS (*vesico*, I blister).—A class of counter-irritants which produce blisters. *See* Counter-Irritants.

VESICLE (*vesicula*, diminutive of *vesica*, a bladder).—Synon.: Fr. *Vesicule*; Ger. *Bläschen*.

Definition.—An elevation of the corny layer of the epidermis, caused by a minute circumscribed collection of serum or sero-pus, between it and the mucous layer beneath.

Description.—Vesicles may be minute or of considerable dimensions; a vesicle of the size of a millet-seed gives the name to the cutaneous affection *miliaria*. The vesicles of eczema are minute and frequently confluent; those of scabies are occasionally acuminated; the vesicles of varioloid are not uncommonly umbilicated; those of herpes iris are developed in rings; the vesicles of ordinary herpes attain the bulk of a split pea; and the vesicles of pemphigus, on account of their large size, are called 'bullæ.' The contents of a vesicle are apt to modify its name, since a vesicle containing a purulent fluid or pus is termed a 'pustule.' The ordinary course of a vesicle is to lose its fluid by evaporation, absorption, or rupture of the distended cuticle; to dry up into a thin scale; and to terminate by desquamation, without further lesion of the skin.

Treatment.—The treatment of vesicles is fully described under the heads of the several diseases of which they are a symptom. *See* Chicken-pox; Herpes; Miliaria; and Pemphigus.

Erasmus Wilson.

VESICULAR EMPHYSEMA.—A form of emphysema of the lungs, in which the alveoli are distended with air. *See* Lungs, Emphysema of.

VIABLE (*vie*, life).—Synon.: Fr. *Viable*; Ger. *Lebendig*.—An epithet applied to a newly-born child, to indicate its capacity for maintaining an independent existence. Viability has chiefly to be determined by the age of the fœtus, and by its condition as regards formation, health, and strength (*see* Fœtus, Diseases of). It has also been supposed to depend in some measure upon the season of the year in which a child is born (*see* Periodicity in Disease). The question of viability has important medico-legal bearings, for which reference must be made to works upon forensic medicine.

VIBICES (*vibex*, a wale).—Synon.: Fr. *Vergetures*; Ger. *Striemen*.—A term applied to patches of discolourisation on the surface of the body, somewhat resembling the marks of stripes or wales, and due to the presence of altered blood in the part. Vibices may arise either during life, as the result of a variety of causes (*see* Extravasation); or after death, as one form of cadaveric lividity or hypostasis. *See* Death, Signs of.

VIBRATION.—This word is sometimes employed as a synonym for fremitus. *See* Fremitus.

VIBRIO (*vibro*, I shake).—Synon.: Fr. *Vibrion*; Ger. *Zitterthierchen*. *See* Bacteria.

VICARIOUS (*vicarius*, in place of another). This word signifies substitution, and in physiology and pathology implies that some part or organ performs certain functions, or is morbidly affected, instead and in the place of some other part or organ, thus becoming a substitute for it. The notion of vicariousness is chiefly associated with a discharge of blood, whether physiological or morbid. Thus, it is very common to speak about *vicarious menstruation*, which is understood to mean that the discharge of blood which takes place normally from the uterus at the menstrual period, either does not occur at all, or only imperfectly, and that its place is taken by hæmorrhage from some other part, evidenced by epistaxis, hæmoptysis, hæmatemesis, or other forms of bleeding. The same idea is extended to morbid hæmorrhages, such as bleeding from piles, when this becomes habitual in an individual at frequent or regular intervals. It is supposed that bleeding may sometimes take place from other parts as a vicarious hæmorrhage, instead of from the hæmorrhoids.

Again, discharges, whether normal or morbid, as of secretions, mucus, pus, or other materials, are believed by many to exhibit a vicarious relation to each other in some instances, coming from one part while ceasing or diminishing at another, and so on. This may be illustrated by expectoration and diarrhœa in phthisis, which appear to modify each other as to their amount in some cases of this disease. Further, secretions and excretions are regarded as acting vicariously with reference to each other. Thus some of the secretions of the alimentary canal are undoubtedly capable of acting mutually as substitutes, and this may be looked upon as an instance of vicarious action; while such a connection existing between the perspiration and urine is generally recognised.

Certain morbid conditions are also considered as having a vicarious relation. For example, congestion of or hæmorrhage from one part may take the place of congestion at another; or inflammation in one region may be the substitute for inflammation in another region.

There is probably more or less truth in these notions of vicariousness, as applied in relation to physiology and pathology. In actual practice, however, no case ought to be regarded as belonging to this category, without careful and thorough investigation. It has happened that hæmorrhages supposed to be vicarious of menstruation, have been important signs of grave diseases, such as gastric ulcer, or pulmonary phthisis. The principle may be of value in certain conditions as an indication for treatment.

Frederick T. Roberts.

VICHY, in France.—Thermal alkaline waters. *See* Mineral Waters.

VIGILIA.—Wakefulness; a term formerly applied to conditions of insomnia, but now little used and almost obsolete. *See* Sleep, Disorders of; and Coma-Vigil.

VILLOUS GROWTH (*villus*, hair).—Synon.; Fr. *Villeux*; Ger. *Villös*; *Zottig*.—A growth composed of hypertrophied villi. *See* Tumours.

VIRGINIA SPRINGS, in Virginia, United States.—Sulphur waters. *See* Mineral Waters.

VIRULENT (*virus*, a poison).—Primarily this word signifies connected with virus or poison. It is generally, however, employed to indicate great intensity or malignancy of disease; for example, *virulent inflammation*, *virulent bubo*, and *virulent small-pox*.

VIRUS (Lat.).—Literally this word signifies a poison, but in medical language it is used to designate any kind of contagious material. *See* Contagion.

VISION, Defects of.—Synon.: Fr. *Troubles de la Vision*; Ger. *Sehenstöhrungen*.

Sight may be defective as to perception of *form*, of *colour*, or of *light*; and the whole, or only a part, of the *visual field* may be affected. Sight is also disordered whenever *binocular single vision* becomes difficult or impossible (*see* Strabismus); and when *visual endurance* is impaired. The terms 'vision' and 'sight,' as commonly used, indicate acuteness of vision, and refer to the perception of form at the yellow spot. In this article disorders (A) of **perception of light**, (B) of **perception of colour**, and (C) of **the visual field**, will be shortly alluded to; but attention will be chiefly given to (D) disorders of **acuteness of vision** caused by optical defects in the eyes.

A. Disorders of Perception of Light.—Perception of light is equally good in all parts of the retinal area, except the most peripheral zone, which appears to be blind.[1] Impaired perception of light causes disproportionate defect of vision by dull light—'night-blindness' (*see* Nyctalopia). It may affect the whole field, or only its periphery. It occurs chiefly in diseases of the outer layers of the retina, especially syphilitic retinitis, and retinitis pigmentosa. Lowered light-sense over the whole field occasions the symptoms in the peculiar disease known as functional or endemic nyctalopia (*torpor retinæ*). The opposite condition, day-blindness (*see* Hemeralopia), with true retinal photophobia, is much rarer and more obscure. It is usually congenital, and accompanied by nystagmus, amblyopia, and colour-blindness; and acuteness of sight, which is defective, is best by dull light.

B. Colour-Blindness.—Synon.: *Dyschromatopsia; Achromatopsia*.—This, when congenital, is usually not related to any other defects of vision. Congenital colour-blindness occurs with greater intensity and far greater frequency in males than in females (M. 3 to 5 per cent.; F. ·2 per cent. or less). It is shown by more or less want of power to distinguish between certain complementary colours. Red and green are the two commonly confused, the perception of blue and yellow being but rarely affected. Blindness for all colours is very rare except as the result of disease. There are many degrees of colour-blindness. A red-green-blind person sees in the spectrum only two colours, separated by a neutral stripe, which is placed somewhere in the greenish-blue; all the colours on the side of the red ('warm' colours) are confused together, and all on the side of the violet ('cold' colours), but the warm and the cold are never confused (Donders).[1] In incomplete red-green-blindness, green, bluish-green, and often rose are confused with grey of corresponding shade, and red is confused with shades of brown and greenish-brown. In a complete case full green and scarlet are confused. The best test for ordinary use is the one due to Holmgren of Upsala, in which a skein of Berlin wool, of a particular colour and shade (green, rose, or red), is given to the patient, and he is required to match it with all the others which seem to him of the same or a similar colour, amongst a large bundle of skeins of many colours. He is not usually allowed to name the colours, because even the colour-blind often guess the colours of common objects correctly. A very pale, pure green is the first test used, and the colour-blind, even of slight degrees, will match with it not only other green skeins, but also shades of pale grey, buff, and pink. Slight cases may easily be overlooked, unless the wools are carefully selected, and the examiner practised. Stilling's plates of coloured letters, printed on a groundwork of complementary colours, are also very valuable. Red and green are not well seen under ordinary circumstances, even by the normal eye, except at the central part of the visual field (*i.e.* the field for these colours is smaller than for white; but even at the periphery these colours are recognised if very brightly lighted and of large size.[2] Acquired colour-blindness often comes on in degenerative or inflammatory diseases which begin in the optic nerve. It is much less common in diseases of the retina, and in glaucoma. Like the congenital form, it usually concerns only, or chiefly, red and green. It may affect the whole visual field of these colours, or only certain parts, a gap, or 'scotoma,' being present, on whose area the red and green are not perceived in their true colours. When acquired colour-blindness is well-marked in the whole extent of the field, in cases of disease of the optic nerve, the prognosis for sight is generally very bad; but if it be localised on a central scotoma, even though it there reach a high degree, the prognosis is usually good. Progressive atrophy of the optic nerve, however, occasionally reaches a very high degree without any colour-defect.

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[1] Landolt, *Arch. d'Opth.*, i. 203, 1881.

C. **Disorders of the Visual Field.**—The visual field is the whole surface visible to one eye singly whilst at rest. It forms a concave surface, all the points of which are equidistant from, and perpendicular to, their corresponding points on the retina. In the outward and downward part it reaches to 95° from the centre; inwards, upwards, and downwards only to about 60°. Projected on a flat surface it thus forms an oval. The centre of the field ('fixation point') corresponds to the yellow spot, and the 'blind spot' is about 15° outwards from this point. In order to measure the field roughly, the patient, placed with his back to the light and covering one eye, looks steadily from a distance of eighteen inches at the nose or eye of the observer, who then moves his hands about in the different parts of the field, and notes any places where the hand is invisible or badly seen. This test, carefully applied, will detect any considerable loss of the field. Or the patient may gaze at a spot on a black board about one foot off, and a piece of white chalk be moved from different points at the periphery until it just becomes visible; a line joining the various points will form the boundary of the field. For accurate measurements, however, a special instrument, the Perimeter, is necessary.

D. **Disorders of Perception of Form.**—Perception of Form, SYNON.: Acuteness of Vision; *Visus*; *V.*; Fr. *Acuité visuelle*; Ger. *Sehschärfe*; *S.*—Perception of form is normal only when the image of the object looked at falls on the bacillary layer of the retina, at the centre of the yellow spot, is clearly defined, sufficiently bright, and of a certain minimum size.

PRINCIPLES.—The size of the image depends (1) upon the size of the 'visual angle' enclosed by the two lines drawn from the extremities of the object to the 'nodal point' just behind the crystalline lens; and (2) on the distance of the nodal point from the retina, which in the normal eye is 15 mm. The form of any letter or character is distinguished by a properly formed and healthy eye, with average light, if it subtend a visual angle of five minutes, each of its separately distinguishable parts subtending an angle of one minute. If the nodal point be more than fifteen millimètres from the retina, the image will be larger, and acuteness of vision therefore increased; this occurs in myopia, and also when a convex glass is held in front of the eye. The reverse is true if the distance be less than fifteen mm., as in hypermetropia, and when a concave glass is held before the eye. Hence convex lenses always increase, and concave lenses always diminish, the size of the retinal images. Vision or 'fixation' is called *direct* or *central* when the image of the object looked at falls on the yellow spot; *indirect* or *excentric* when, in consequence of impairment of function at the yellow spot, an image falling on some other part is better seen. The clearness of the image depends (opacities of the media apart) upon the retina being exactly at the focus of the refracting (dioptric) media of the eye; it is also influenced somewhat by the size of the pupil, being, *cæteris paribus*, better when the pupil is small.

Normal acuteness of vision is expressed as unity (V. or S. = 1); subnormal vision being expressed as a fraction. Various *test-types* are in use, composed of letters, words, &c., of such a size that each subtends the minimum angle of five minutes at a certain distance. The test-types of Dr. Snellen are in most general use, and include letters visible under the standard angle at from 60 mètres to ·5 mètre. If No. 60 be read at 60 m., then $V. = \frac{60}{60}$ or 1; if No. 60 can only be seen at 6 m. $V. = \frac{6}{60}$; &c. V. therefore is expressed by a fraction whose numerator is the greatest distance at which a given type can be read, and the denominator the distance at which it ought to be seen; or the fraction may be reduced ($\frac{6}{60} = \frac{1}{10}$, &c.). The acuteness is said to become progressively lower after the age of sixty, without disease; so that at eighty it is only about $\frac{1}{2}$ (Donders).[1]

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[1] Donders, *Brit. Med. Jour.*, 1880, ii. 767.

[2] Landolt, *Examination of the Eye*, p. 213.

[1] *Anomalies of Accommodation and Refraction*, p. 190.

1. **Functional Affections of the Optic Nervous Apparatus.**—Amblyopia without ophthalmoscopic changes may be permanent or temporary, and exhibit many differences in the character of the failure of sight. The positive disuse (suppression of the retinal image) of one eye, in order to avoid diplopia or the confusion sometimes caused by opacity of the cornea or other defect, leads to permanent and great defect of that part of the visual field which is common to both eyes, '*amblyopia ex anopsiâ*.' The defect is psychical, and the eye shows no changes. It is most easily acquired early in life, and may be partly remedied by separate use of the eye. In cerebral hemianæsthesia there may be blindness, or high amblyopia with great contraction of the field and colour-blindness in the eye opposite to the lesion, with a lower degree of the same condition in the other eye. Some rare cases of permanent loss of sight in one eye without changes, in which there is a history of previous paralytic symptoms, probably belong to this group. In *hemiopia* (properly *hemianopsia*) there is usually loss of the corresponding halves of the visual fields, vision being lost on the side opposite to the lesion; when the loss of field extends quite up to the fixation-point, affecting central vision, the lesion is probably somewhere between the chiasma and corpora geniculata; but when an area of several degrees around the fixation-point remains free, it is suggested that the lesion is cerebral.[1] Loss of both temporal halves may indicate disease at the chiasma; neither this, nor loss of both nasal halves, is frequent. In hemiopia, even of long standing, the optic discs are seldom altered. In some cases of 'hemiopia' only a quarter of each field is lost. Disease of the optic nerve at a distance from the eye causes blindness or defective sight, often at first without any ophthalmoscopic changes; but if the defect remain, signs either of inflammation or atrophy appear in a few weeks. The ophthalmoscopic changes may, however, be very slight, as is shown in the common cases of central amblyopia usually caused by tobacco-smoking, in which disease of the optic nerves has now been demonstrated; with the exception of this group, cases of retro-ocular disease of the nerve are rare.

Temporary fogginess of sight, usually with the appearance of coloured rings around a candle, occurs in the premonitory stage of glaucoma; these last from half an hour to a day or more; they do not usually occur in both eyes at once (*see* EYE AND ITS APPENDAGES, Diseases of). Attacks of megrim are often ushered in by a peculiar, transient, subjective defect of sight; a small cloud, appearing near the middle of the field, quickly spreads with a quivering movement and zigzag outline over about half the field; its borders are often brilliantly coloured; it affects both eyes; is equally visible whether the eyes are open or shut; lasts about a quarter of an hour; and is generally followed by the other megrim symptoms to which the patient is subject. But some persons merely complain of a 'cloudiness' or of 'spots' before their headaches (*see* MEGRIM). Brief attacks of blindness of one eye, coming on quite suddenly, and recurring in the same eye, occasionally take place in the subjects of heart-disease. Permanent blindness, with atrophy of disc or the appearances of retinal embolism, has at length supervened in a few of these cardiac and megrim cases.[1]

Persons who suffer from severe neuralgic pain in the fifth nerve sometimes describe dimness of the same eye during an attack, but the opportunity of verifying the statement seldom occurs. In connection with severe vertex-headache in hysterical persons, sight is sometimes very bad; one eye may even appear almost blind. There is photophobia, and there may be symptoms of accommodation-spasm, and the field is, or seems to be, highly contracted. Though it may be exceedingly difficult to say that there is conscious dissimulation, the groundless nature of the ocular symptoms is sometimes proved by the fact that acuteness of vision, even in the 'blind' eye, is at once and perfectly restored by the weakest possible lens, or by a piece of flat glass mounted to resemble a trial lens. Intentionally feigned blindness of one eye can nearly always be detected by one device or another; but pretended defect of both eyes is more difficult to expose; reference must be made to works on ophthalmology for further details.

2. **Abnormalities of Refraction.**—SYNON.: *Ametropia.*—These conditions are of importance by preventing the formation of clear retinal images; in addition they often make the sustained use of the eyes difficult or impossible (*asthenopia*). They include (*a*) *hypermetropia*, (*b*) *myopia*, and (*c*) *astigmatism*. The varieties of asthenopia will receive a short separate account after 'Disorders of Accommodation.' As ametropic conditions are remedied by optical aids, it will be convenient first to refer to the subject of spectacles.

Spectacles.—*Varieties of Construction and Mode of Wearing.*—Refracting spectacles are made either of crown-glass or of rock-crystal. The latter is more expensive but harder, less breakable, and rather lighter. Ordinary spectacles are biconvex or biconcave spherical lenses. Meniscus lenses are sometimes used, and are called 'periscopic' because they give a larger field. In 'Franklin' or 'pantoscopic' spectacles the upper half is made of a different focal length from the lower; they are sometimes used by persons who need distance- and reading-glasses of different strengths in the same frame. The various non-refracting protective glasses (goggles, domed glasses, horseshoe- or D-protectors, &c.) are generally included under the term 'spectacles.' The most important points in the mounting of spectacles are that the hinges should be strong, the sides long enough to hold securely without uncomfortable pressure, and that the bridge should fit the nose well. The centres of the lenses should, unless otherwise ordered, be opposite the centres of the pupils when the glasses are in use. All concave glasses and convex distance glasses should sit as close to the eyes as possible; convex reading-glasses may be put further down the nose, and shaped to allow of looking over the top of the frame in distant vision.

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[1] See Ferrier, 'Cerebral Amblyopia and Hemiopia,' *Brain*, January, 1881. The subject, however, is far from exhausted; *see* Robin, *Troubles Oculaires dans les Mal de l'Encéphale*, p. 390, 1880, Haab, *Klin. Monatsbl. f. Augenheilk.* &c., 1882, &c.

[1] Hutchinson, *Oph. Hosp. Reps.* viii. 56; Loring, *Amer. Jour. Med. Sci.*, April 1874; the author, *Brit. Med. Jour.*, June 1879; Galezowski, *Gaz. des Hôp.*, Dec. 1881.

For 'simple' astigmatism the correcting lens is a segment of a cylinder; for 'compound' and 'mixed' cases the effect of a cylindrical and spherical lens is required, and may be obtained either by combining two suitable cylindrical curvatures at right angles to each other, or by grinding the cylinder on the flat side of a plano-convex or -concave lens; they require of course to be mounted with the curvature of the cylinder exactly in the right direction. When prisms are ordered they are mounted like ordinary spectacles, and a lens may be ground upon each surface of the prism if necessary; it is not practicable to wear prisms of more than about 8°. Spherical lenses can be made to act to a varying degree as prisms, by putting them with their centres nearer to or further from each other than the pupils.

Numbering.—Spectacle lenses are at present numbered on two different systems, namely—(1) the *inch* scale; and (2) the *metrical* scale. (1) In the old system the refractive unit is a lens of 1-inch focal length, and the inch may be English, Parisian, or other. The lenses in use being all weaker than the unit are expressed by fractions; thus the strongest in use in the trial case being a 2-inch lens is expressed as $\frac{1}{2}$ (+ or −, according as it is convex or concave); a lens of 10 inches' focus is $\frac{1}{10}$; &c. It is desirable that the series of lenses should rise by equal refraction-intervals, and here the inch scale is inconvenient because it introduces difficult fractions. (2) The inch scale is rapidly giving place to the metrical dioptric scale, in which the measure is international, the refractive unit is a weak instead of a strong lens, and the refractive intervals are equal. The unit is a lens of 1 mètre (100 cm.) focal length, and is called one *dioptre* (1 D.) Stronger lenses are written as whole numbers; thus a lens four times as strong as the unit is 4 D.; a lens equal to half the unit is ·5 D. The disadvantage of the system is that the numbers do not, as on the inch system, express the focal length of the glasses; but the latter is easily arrived at by dividing 100 by the number of the lens in dioptres; thus the focal length of 5 D. $= \frac{100}{5} = 20$ cm.

To convert a lens made by the Paris inch into its equivalent in dioptres, multiply its inch-value by 36 (1 m. = 36 Paris inches nearly); thus, $\frac{1}{36} \times 36 = 1$ D. To convert a metrical lens into its equivalent in Paris inches divide its value in D. by 36; thus 4 D. $= \frac{4}{36} = \frac{1}{9}$.

The following are the most important equivalent numbers:—

Dioptres (D.)	Focal length in Paris inches
·5	72 (written $\frac{1}{72}$, &c.)
·75	50
1·	36
1·25	30
1·5	26
2	18
2·5	14
3	12
3·5	10 (nearly)
4	9
4·5	8
5	7
6	6
7	5½
9	4
11	3½
13	3
15	2½
18	2

Several intermediate numbers found in the trial cases have been omitted.

The several abnormalities of refraction and accommodation may now be discussed in due order.

a. Hypermetropia.—In hypermetropia the retina lies within, instead of at, the principal focus of the dioptric media. Parallel rays, such as come from very distant objects, therefore meet the retina before being focussed; and divergent rays, from near objects, meet it still more in advance of their focus. Hence the hypermetropic eye, in repose, sees nothing clearly. Distant objects can be seen clearly if, by exerting accommodation, the crystalline lens be made more convex; or if the rays, before they enter the eye, be made sufficiently convergent by passing through a suitable convex lens.

Common hypermetropia, due to flatness of the posterior segment of the eyeball, called *axial hypermetropia*, is always congenital; and a large proportion of children are hypermetropic at birth—according to Ely[1] 72 per cent. In sections the circular fibres of the ciliary muscle are, or appear to be, more abundant than in the normal eye. The cornea is not flatter, but the anterior chamber is rather shallower, and the pupil rather smaller than normal. In high degrees the eyeball is too small in all directions.

The natural remedy for hypermetropia consists in the exercise of accommodation for distant sight; when in the normal or emmetropic eye it is in complete abeyance. A proportionate increase of accommodation is required by the hypermetropic eye for near vision. The absolute quantity, amplitude, or range of accommodation is not greater in hypermetropic than in normal eyes; hence in hypermetropia it becomes sooner insufficient for the needs; and the higher the degree of hypermetropia the earlier does this occur.

Symptoms.—The symptoms depend on the patient's age, occupation, and health, and on the degree of hypermetropia. The lower degrees only exceptionally cause symptoms in childhood. The higher degrees in children, and the lower degrees in young adults, cause difficulty in reading, writing, or sewing, especially by artificial light, and towards the end of the day's or week's work—'accommodative asthenopia.' The difficulty is expressed in the forms of mistiness of sight, weariness or aching of the eyes, headache, sleepiness, watering, chronic congestion and irritation of the palpebral conjunctiva. In the highest degrees the attempt to see clearly is often given up. Such persons often partly compensate for the bad definition of the images by holding the book very close, and so increasing their size, and thus they may seem to be myopic. All the symptoms are worse when the health is low. As accommodation fails with age, a time arrives for every hypermetrope when, unless aided by glasses, no clear vision is possible at any distance; but spectacles are generally adopted before this occurs.

Concomitant convergent squint often arises in hypermetropia (*see* Strabismus). It is at first, and may remain, periodic, present only during strong accommodation; but often it becomes constant.

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[1] Ely, *Knapp's Arch. d. Ophthalm.* ix. p. 4.

In either case it may alternate or may always affect the same eye. When constant and fixed the sight of the squinting eye becomes defective, as already described. This occurs most easily in squint acquired early in life. By oft-repeated separate practice of the squinting eye the defect may to a great extent be removed. The squinting eye can often be proved to have also had some original defect, as from corneal nebula or a higher degree of ametropia, which led to the other eye being used and this one being allowed to squint.

When the crystalline lens is absent (*aphakia*) the eye is very hypermetropic. Distant vision is restored by means of a convex lens of 10 or 11 D. (3¾ or 3½ inches) held about half an inch in front of the cornea; objects at, say, 25 cm. (10 inches) are clearly seen through a lens of about 15 D. (2¾ inches). Accommodation is abolished in the aphakic eye; but if the pupil be round and movable, its contraction aids a little in near vision, by cutting off the peripheral rays of light.

From the age of 55 and onwards the normal eye acquires a low degree of hypermetropia, owing to a change in the refraction of the crystalline lens.

Glaucoma is commoner in hypermetropic than in normal or myopic eyes. The habitual use of glasses by hypermetropic persons from early life may aid indirectly in preventing this disease.

Diagnosis.—The diagnosis is made subjectively by testing with glasses, or objectively by the ophthalmoscope. The former is the more generally useful. Even distant objects are seen indistinctly by the hypermetropic eye with relaxed accommodation; but they are made clear if a suitable convex lens be held in front of the cornea. 1. This test is easy to apply when the ciliary muscle is temporarily paralysed by atropia, or abolished by natural senile changes. 2. But when it is active the matter is less simple. The old-standing habit of exerting accommodation whenever clear vision, even at a distance, is needed, in many cases inseparably connects the effort to see, with the action of the ciliary muscle. Such persons cannot relax their accommodation when looking through a convex lens at a distant object. The effect of the lens is therefore added to, instead of substituted for, that of the accommodation, and distant vision made worse; no hypermetropia can be found by trial with glasses, it is entirely 'latent' (*H.l.*). 3. Between these extremes we find a large number who can partially relax their accommodation for distance in favour of a convex lens, but still use a part. They see well, or perfectly, in the distance without aid; they see equally well or better with convex lenses up to a certain strength. If now the accommodation be suspended by means of atropia we shall often find a higher degree of hypermetropia. The part that can be detected when accommodation is active is the 'manifest' (*H.m.*); the sum of the 'manifest' and the 'latent' is the 'total' (*H.*).

In testing hypermetropia, the patient being not less than ten feet from the test-types, we begin with a very weak convex lens, and if vision is *not made worse*, try successively higher lenses until we reach the highest which allows the best attainable vision. This lens represents the manifest hypermetropia if accommodation be present, the total if it be absent. A stronger lens causes indistinctness by bringing the focus in front of the retina. In general the younger the patient the less is the manifest in proportion to the latent hypermetropia, even though troublesome asthenopia be present.

Hypermetropia is diagnosed by the ophthalmoscope if an erect image of the fundus is easily seen when the observer is at a distance of 18 inches or more from the patient. The image is seen equally well when the observer comes as close as possible to the patient; and if he possess a 'refraction' ophthalmoscope, he can *in this position* measure the degree of hypermetropia by finding the strongest convex lens through which the details of the fundus still look perfectly clear. In this test the accommodation of both persons must be fully relaxed; the observer has to learn to do this, but the patient generally relaxes his ciliary muscle at once in the dark room, even though he could not do so when tried with glasses for the distant types.

Another test, *keratoscopy* or *retinoscopy*, is based on the fact that when light is thrown by the ophthalmoscope into the eye at a distance of three or four feet, slight rotation of the mirror causes a shadow to move across the illuminated field; in hypermetropia the shadow moves in the opposite direction to the rotation of the mirror. The method is sometimes useful in young or unruly children, and in skilled hands affords the means of a tolerably accurate determination.

The optic disc in hypermetropia, especially in children, often seems, and sometimes is, hazy, and is sometimes too red; and the retinal arteries are often too tortuous.

Treatment.—Treatment is necessary for hypermetropia whenever there is asthenopia, and when strabismus has arisen. Convex spectacles are ordered which, according to circumstances, neutralise a part or all of the hypermetropia, and are worn constantly, or only for near work. Periodic squint may always be cured by the constant use of fully correcting glasses; but in most cases where it has become constant, an operation is necessary (*see* Strabismus). In children with asthenopia it is usually best to order glasses for constant use, which correct almost the whole hypermetropia; but, if the symptoms are in connection with weak health and the hypermetropia be slight, the temporary use of glasses for near work alone is enough. Young adults using glasses for the first time are often satisfied with those which neutralise only the manifest hypermetropia, using them for all near work; but after some weeks or months asthenopic symptoms often recur, we find that there is more manifest hypermetropia than before, and are obliged to order stronger glasses. But ophthalmoscopic estimation will, as stated above, generally tell us correctly almost the total even at the first examination; and when this method makes it clear that the total is much greater than the manifest hypermetropia, glasses of nearly the full strength should be ordered at once. On theoretical grounds it is undoubtedly best for glasses to be worn constantly by hypermetropes, so that the accommodation may always be at rest. But a good deal of latitude must be allowed to grown-up patients in regard to wearing them for distance, unless there be constant asthenopia, and this especially with elderly persons.

Acuteness of sight is usually normal in corrected hypermetropia. In many cases of high degree, where vision is, both with and without glasses, subnormal, some astigmatism is also present; but cases occur where the defect cannot be thus accounted for, and it is then assumed to be due to defective development of the eye. But probably want of education of the retina in the perception of clear images in a great degree accounts for the phenomenon.

b. Myopia.—In myopia the retina lies beyond the principal focus of the dioptric media, generally on account of lengthening of the posterior part of the eye—*axial myopia*; it is consequently at the conjugate focus of a point at some definite distance in front of the eye, which indeed is the 'far point,' or greatest distance of distinct vision of the eye in question. The greater the elongation of the eye, the nearer is the 'far point,' the 'shorter' the sight, or the higher the degree of myopia. By using accommodation objects can be seen at a still shorter distance.

ÆTIOLOGY.—Myopia is comparatively seldom present at birth. The elongation usually comes on between about seven and fifteen years of age; progresses for a time; and stops between puberty and adult age. Myopia is often hereditary, and inheritance doubtless accounts entirely for some cases of very severe myopia where none of the other causes have operated. But habitual use of the eyes upon very close work, especially in a stooping posture, aids very strongly in its production. Its onset is sometimes determined by a severe illness in childhood. It often comes on after severe keratitis with choroiditis in children.

Myopia may also be caused by increased curvature of the cornea after keratitis, and is an invariable result of 'conical cornea.' Certain changes in the lens in the early stages of senile cataract sometimes produce myopia, even of considerable degree; and, as this form of myopia does not, like axial myopia, influence the prognosis, its possibility should always be borne in mind in a case of incipient cataract.

ANATOMICAL CHARACTERS.—The elongation occurs chiefly in the posterior part of the eye, and especially at the yellow-spot region. The sclerotic and choroid are thinned in proportion to the distension, and the choroid often locally atrophied. The term 'posterior staphyloma' is given to the bulging region; in high degrees the eye is enlarged, and its coats are thinned, in all directions. The term 'sclerotico-choroiditis posterior' is also used to indicate the supposed nature of the change. In high degrees, particularly late in life, the vitreous often becomes fluid and contains opacities; hæmorrhages may occur from the choroid; and there is a strong predisposition to detachment of the retina and to cataract. In the ciliary muscle of myopic eyes the circular fibres are deficient or wanting. The anterior chamber is often deeper, and the pupil larger than usual. Owing to their large size highly myopic eyes are often prominent, and chiefly from the same cause their mobility is somewhat impaired.

SYMPTOMS.—A low degree of stationary myopia usually causes no inconvenience. In the higher degrees advice is sought, either because distant sight is bad, or near work has to be held inconveniently close; or on account of eyeache, headache, watering, photophobia, or dimness; or for insufficiency of the internal recti (muscular asthenopia), or actual divergent squint. In the highest degrees divergent squint is nearly always present at the natural distance of distinct vision, and possibly even for distance; and in much lower degrees there is often difficulty in keeping up convergence, and consequent pain, tension, and weariness. Aching shows that the myopia is increasing; it is always made worse by use of the eyes, but is often present even when at rest in bed; it may accompany the development of a squint, or of detachment of the retina. Myopic eyes, even of low grade, are often intolerant of bright light. Acuteness of vision is frequently sub-normal in high degrees, especially in old people; such defect when not accounted for by visible structural changes, is assigned to irritative congestion of the choroid.

DIAGNOSIS.—A myopic person with healthy eyes can read the smallest print fluently at his own 'far-point' (*see below*), but not further. He gains perfect distant vision by looking through a concave lens, which gives to rays of light from distant objects a divergent direction, as if they came from his natural 'far-point.' Placing him not less than ten feet from the test types we find experimentally the *weakest* concave lens that gives the best attainable vision. A stronger lens over-corrects the myopia, producing hypermetropia, which, in its turn, is corrected by the exercise of accommodation.

Myopia is diagnosed objectively as follows:—(1) When by direct ophthalmoscopic examination at a long distance, an image of the fundus is seen, which, on the observer moving his head from side to side, seems to move in the opposite direction. This image disappears when the observer comes near to the eye examined. (2) When by direct examination close to the patient, a clear image (erect) can be obtained only by placing a concave lens behind the mirror; the *weakest* lens which gives a clear image being the measure of the myopia. (3) When in indirect examination the size of the ophthalmoscopic image increases on withdrawing the objective lens from the patient's eye. (4) By keratoscopy, the shadow moving in the same direction as the rotation of the mirror.

The ophthalmoscopic changes depend chiefly on the atrophy of the choroid, which so often takes place on some part of the staphylomatous area. The commonest change is the 'myopic crescent,' a patch of yellowish-white colour (exposed sclerotic), due to atrophy of the choroid at the true outer border of the optic disc. It is sometimes seen in eyes not myopic. When more advanced it extends all round the disc (annular staphyloma). There may also be separate patches of atrophy, or a large area of partial wasting, at the yellow-spot. In high myopia with abrupt bulging of the tunics, the disc is often tilted and then looks oval, and its outer side often becomes pale.

COURSE AND PROGNOSIS.—Axial myopia cannot diminish. Though its increase as a rule ceases about the same time as the cessation of the bodily growth, it may continue, or may take a fresh start later in life, especially if the health be bad, or the eyes be excessively used for fine work. But often its course seems to depend upon causes which are not under direct control; for we see myopia of high degree, leading to disastrous results, or blindness, in persons who have never learnt their alphabet, or strained their eyes in any way; and, on the other hand, it is common to meet with very myopic people, of studious habits and advanced age, in whom the eyes have not changed since youth. In general the prognosis is worse the higher the degree, the older the patient, and the feebler the health.

TREATMENT.—Much may doubtless be gradually done to prevent the acquisition and transmission of myopia, by improvements in the lighting of school-rooms, and construction of seats and desks, and by the choice of well-printed books. During the progress of myopia the time given to school-work should, whenever possible, be shortened; and if the disorder be quickly increasing, or if there be much aching or irritation, rest of the eye should be insisted upon for several months, or longer. Myopic children should use their eyes only as much as is comfortable, and should be forbidden to read fine print, to read by bad light, or to stoop. If there be severe aching and intolerance of light, or rapid increase of the myopia, especially with diminished acuteness of sight, prolonged rest, subdued light (or smoked glasses), and the use of the artificial leech at intervals of a few days, with derivative treatment, are of service, at least in relieving the symptoms and improving vision for a time.

The corrective treatment consists in the use of concave glasses. Myopic children should as a rule wear glasses for distance merely on educational grounds. These glasses may fully correct the defect, but it is better that they should be a little under than over the full strength. If there be muscular asthenopia, the glasses often cannot be continuously worn, unless treatment be also directed to the internal recti. Adults may use their own judgment as to wearing distance-glasses. For near work it is seldom safe, except in low degrees, to allow the fully correcting glasses, because their use calls into powerful action the function of accommodation, hitherto but little needed by the myopic eye, and also deranges the relation between this function and convergence of the visual lines. They also cause difficulty by diminishing the retinal images. If their use be persisted in for reading, &c., they may act indirectly in increasing the myopia. When the natural far-point in myopia is not nearer than 13 inches (33 cm.) reading glasses are seldom required. But for higher degrees it is often necessary to order spectacles which partly correct the myopia, that is, make the eyes less myopic, and thus remove the far point further off and allow the patient to read, &c., without stooping. As a general rule, subject to the peculiarities and needs of each case, about half the full correction may for this purpose be safely and comfortably used. For music or painting a rather stronger pair of spectacles are sometimes required. When there is muscular asthenopia, shown by the fact that in near vision one eye, if covered, deviates outwards, relief may often be given by combining prisms with their bases inwards, with the reading glasses; the prisms, by allowing the convergence to be lessened, relieve the internal recti.

c. Astigmatism.—Astigmatism may be *regular* or *irregular*. *Regular* astigmatism depends upon the refracting surfaces of the eye, chiefly of the cornea, not being spherical, but having different curvatures, that is, focal lengths, in different meridians, the meridians of greatest and least curvatures ('chief' or 'principal' meridians) being always at right angles to each other, and the others having regularly intermediate curvatures. The meridian of greatest curvature of the cornea is generally vertical or nearly so. The astigmatism of the lens, though less regular than that of the cornea, tends to correct the latter. In 'simple' astigmatism one chief meridian is normal, the other either myopic or hypermetropic; when 'compound' both chief meridians are myopic, or both hypermetropic, but in different degrees; when 'mixed,' the eye is hypermetropic in one chief meridian, and myopic in the other. When the focal difference between the chief meridians, or the degree of astigmatism, is not greater than is represented by a lens of 72 inches' focus (5 D.) it may generally be neglected; and much higher degrees often cause no trouble.

Astigmatism is to be suspected in all cases of ametropia where spherical lenses do not raise vision to the normal, no other cause of the defect being found. It is detected subjectively by numerous tests, most of which consist essentially of straight lines running in various directions, some of the lines being seen by the astigmatic eye better than others. It can also be detected and measured by the ophthalmoscope. It is corrected by cylindrical lenses which neutralise the difference of refraction of the two chief meridians; but in the higher degrees acuteness of vision often remains even then subnormal. *Irregular* astigmatism can seldom be remedied.

3. Anisometropia.—This signifies different refraction in the two eyes, and is a very common condition, the difference sometimes being extreme. When one eye is normal and the other myopic, each may be, and often is, used for vision at different distances, and each remains perfect; but if one be astigmatic, or very hypermetropic, it is generally defective from want of use.

When slight it may be neutralised by corresponding spectacles, but when the inequality is great, fully correcting glasses cause so much difference in the size of the images in the two eyes, that equalisation is seldom possible. But it should be attempted when there is any tendency to divergent squint, in order to encourage binocular vision.

Effect of blindness of one eye.—Acuteness of sight is always rather better with both eyes than with either alone; further, both eyes are necessary for the appreciation of solidity and distance. Patients often think that blindness of one eye throws 'double work' upon the other and 'weakens it.' Nearly always, however, in such a case some other cause can be found for the asthenopia of the sound eye.

4. Disorders of Accommodation.—*a. Presbyopia.*—The 'amplitude' or 'range' of accommodation is expressed by the difference between the greatest distance, 'far-point,' (*r*) and the least distance, 'near-point,' (*p*) of distinct vision. Age for age, it is nearly equal in all eyes, whatever their refraction. Its natural failure with age causes presbyopia, the onset of which has been arbitrarily fixed to begin, in the emmetropic eye, at the age of 40, when the near point is at nine inches (22 cm.), and the failure generally progresses at a constant rate. Presbyopia is corrected by the convex lens, which enables the patient to read at nine inches; the strength of this lens varies inversely as the amplitude of accommodation, and at the age of 65, the near point being removed to infinity, the correcting lens is one of nine inches' focus.

Symptoms.—Presbyopia is first shown by difficulty in reading or sewing by artificial light, or in the train or carriage; defective accommodation prevents the work being held close enough to compensate for the defective light or for the shaking, and to remedy the former the candle is often placed between the eyes and the book. When more advanced the patient becomes 'long-sighted,' and has to put his book at arm's length unless he wear glasses. If the refraction is normal, distant sight is perfect. In hypermetropia, presbyopia begins at an earlier age, less accommodation being available for near vision; and in myopia it sets in later because less accommodation is needed for seeing at a given distance. Hence a low degree of myopia is an advantage. When the far point in myopia is at or within nine inches (22 cm.) presbyopia does not occur.

Diagnosis.—Presbyopia is to be distinguished from loss of accommodation due to paralysis of the ciliary nerves, and from failure due to feeble health or other causes, both of which may occur at any age. True presbyopia, however, sometimes progresses much more quickly than usual, and especially in eyes which are about to suffer from glaucoma.

Treatment.—The treatment of presbyopia consists in ordering convex glasses which enable the patient to read at nine inches or a greater distance. Most people prefer glasses which enable them to read easily at twelve or fifteen inches, and with which reading at the standard nine inches is possible only for a very short time, if at all. The smaller the quantity of accommodation remaining, the less is the range of clear vision; and if accommodation is abolished, clear sight is possible only when the object is at the focus of the glasses. Hence the increase of strength of the glasses which becomes necessary as age advances should be made gradually, that the patient may grow accustomed to the loss of range, and to the necessity for keeping his book more and more at an unvarying distance. As the book has to be placed nearer by artificial than by day-light, it is generally best to have a rather stronger pair of glasses for evening use than for the daytime. The following table, giving the strength of the glass necessary to bring the near point to nine inches (22 cm.), at various ages, serves as a useful basis for the selection of spectacles for emmetropic persons :—

Age	Glass required to bring '*p*' to 9 in. (22 cm.)		
40	0		
45	+ $\frac{1}{36}$ inch	=	+ 1 dioptre.
50	$\frac{1}{18}$ "	=	2 "
55	$\frac{1}{12}$ "	=	3 "
60	$\frac{1}{9}$ "	=	4 "
65	$\frac{1}{8}$ "	=	4·5 "
70	1·6½	=	5·5 "

b. Paralysis of Accommodation.—Synon.: *Cycloplegia.*—Paralysis of the ciliary muscle occurs in paralysis of the whole third nerve. But it may occur without affection of the extrinsic muscles of the eyeball; in these cases it is generally combined with paralysis, more or less complete, of the iris (*ophthalmoplegia interna*); but it may be present as an isolated symptom, the pupils being normal, and of this the commonest example is post-diphtheritic cycloplegia. The failure of accommodation in glaucoma may be accounted for in acute cases by compression of the ciliary nerves, but in old cases is doubtless due to the atrophy of the ciliary muscle which always exists. Cycloplegia, usually with some affection of the iris, is a common result of blows on the eye; generally recoverable, it is however occasionally permanent. Lowered endurance of sight, pain, and sudden temporary failures of accommodation, are amongst the most important phenomena of sympathetic irritation.

c. Spasm of Accommodation.—Temporary spasmodic action of the ciliary muscle, often exceeding the necessary amount, frequently occurs in hypermetropia, with every effort to see clearly, it usually ceases at once on going into a dark room. In low myopia with irritative symptoms, the ciliary muscle often acts unnecessarily; and such spasm, when persistent, is probably one cause of further elongation of the eye. Spasm of accommodation also occurs in some functional and hysterical affections of the eyes, with other symptoms of ocular irritation. The function of accommodation is closely associated with that of convergence, although the two can be exerted separately to a limited extent ('relative accommodation'). The accommodation of one eye cannot be exercised without, and probably not in a different degree from, that of the other; nor is it proved that any part of the ciliary muscle can act independently of the rest.

d. Micropsia.—Definition.—Any condition of sight in which objects seem lessened in size, without diminution in the size of the retinal images. This indicates either an extreme effort of accommodation, and may be thus complained of when this function is weakened; or disease of the retina, especially syphilitic retinitis.

5. Asthenopia.—Asthenopia is any condition in which the eyes cannot be used for long without fatigue, pain, or other symptoms.

Muscular asthenopia is caused by difficulty in maintaining the convergence of the visual lines, and is commonest in myopia, though it is often seen with normal refraction, especially in youths and young adults. It causes, besides aching of the eyes, 'dancing' or 'confusion' of the print, and sometimes double vision. In slight cases, with myopia, partially neutralising glasses, which enable the book to be held at a greater distance, will often give relief. In many cases, with or without myopia, spectacles, consisting of prisms with their bases inwards, are of great service, by lessening the convergence necessary for vision at a given distance. In high degrees, tenotomy of the external rectus is called for (*see* STRABISMUS).

Asthenopia from defective accommodation is also shown by inability to read for long, but there is no 'moving' or 'dancing' of the letters, nor any diplopia. The object simply becomes 'misty' or 'the sight goes' for a time, returning when the eyes are rested for a few minutes; or the eyes feel tired and hot, and ache. Headache and occasionally even vomiting may follow neglect of such symptoms. It is commonest in hypermetropia (asthenopia from excessive demand on accommodation); but is also seen in emmetropic, and even in slightly myopic, eyes, if the tone of the ciliary muscle is low (asthenopia from weakness of accommodation). Asthenopic symptoms are not common in presbyopia. The above forms of asthenopia often give rise to chronic congestion and irritation of the palpebral conjunctiva, with watering and soreness, the symptoms disappearing when glasses are worn. On the other hand an irritable and hyperæsthetic state of conjunctiva and cornea, and perhaps of the retina, with photophobia, often causes irritable weakness of the ciliary muscle, even when there is scarcely any ametropia (asthenopia from hyperæsthesia); these cases are difficult to cure.

Retinal Asthenopia.—Functional exhaustion of the retina or optic nerve is sometimes seen in optic neuritis, and other diseases of the optic nerve; sight being good, but becoming duller after a short period of use. It is not, on the whole, a very important diagnostic symptom.

E. NETTLESHIP.

VIS MEDICATRIX NATURÆ (Latin). An expression formerly much used to indicate the innate power possessed by Nature of healing or curing disease. *See* DISEASE, Treatment of; and THERAPEUTICS.

VITILIGO (*vitulus*, a spotted calf).—SYNON.: Leucopathia; Leucasmus; Leucoderma; 'Piebald skin'; Fr. and Ger. *Vitiligo.*

DESCRIPTION.—This disease occurs as spots, which are white, resulting from absence of pigment (*achroma*), of a circular figure, and various in number and dimensions. The pigmentless skin is pale, but otherwise healthy; and the immediately adjacent integument is more deeply coloured near the margin of the spots than on the rest of the surface. At their first appearance the spots are small; they increase by their circumference; and, by continuous growth, or by the blending of several spots, they cover a surface of greater or less extent.

DIAGNOSIS.—Vitiligo is distinguished from other forms of absence of pigment of the skin by the otherwise healthy condition of the integument. Morphœa and scleroma, the two affections for which it might be mistaken, both present manifest indications of disorganisation of the derma. Leucoderma has been confounded with the white patches of true leprosy. In this disease, however, the patches are anæsthetic, and there are constitutional symptoms which are never present in leucoderma.

TREATMENT.—Aberration of the pigment-function of the skin, and especially arrest of pigment-formation, imply feebleness of tissue, and suggest, as the indication for treatment, the strengthening of the individual, and through the individual the strengthening of the faulty organ. We may expect to derive advantage from tonic remedies, particularly from arsenic; whilst externally we must have recourse to mild stimulation, either by friction or by some stimulant local application, such as tar or sulphur, which will induce hyperæmia, a more active circulation of blood, and a more healthy nutrition of the skin.

ERASMUS WILSON.

VITILIGOIDEA (*vitulus*, a spotted calf). A term which has been applied by Addison and Sir William Gull to the disease now known as *xanthoma* and *xanthelasma*. *See* XANTHOMA.

VOCAL FREMITUS.—The sensation of vibration conveyed to the hand when applied over any part of the respiratory organs during vocalisation both in health and in disease. *See* PHYSICAL EXAMINATION.

VOCAL RESONANCE.—The sound heard on auscultation over certain parts of the respiratory organs, during vocalization, both in health and in certain forms of disease. *See* PHYSICAL EXAMINATION.

VOICE, Disorders of.—SYNON.: Fr. *Troubles de la Voix*; Ger. *Stöhrungen der Stimme.*

INTRODUCTION.—Voice is the sound produced in the larynx by air driven from the lungs through the rima glottidis, modified in accordance with acoustic laws in the upper air-passages. Vocalization is a function needing for its perfect production a healthy condition of the respiratory muscles, of the lungs, trachea, and larynx, of the pharyngeal, oral, and nasal cavities, and of the nerves and nervous centres on which these parts depend for their isolated or co-ordinated muscular movements and their normal sensitiveness. For the production of the simplest vocal tone the cords must be free to approximate within a line of one another, while the co-ordinated action of about one hundred muscles is required, to regulate their tension and that of the walls of the air-passages, to modify the form of the latter, and to produce the current of air.

Acoustically the organ of the voice must be regarded as a combined reed and pipe; and for the production of a perfect note, it is necessary that the pipe should be in perfect unison with the reed. This unison depends not only on the shape of the various cavities, but on the relative rigidity or flexibility, and the tension of their walls; every variation in the number, size, or form of vibrations of the vocal cords, effected by the intrinsic laryngeal muscles, calling for similar modifications of the shape, size, and tension of the consonating cavities.

The word 'voice,' when used alone, always implies the presence of a musical tone (periodic vibrations), but sound sufficient for every purpose of speech and articulation may be produced

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without a musical tone. This is the *whispering voice*, caused by the rustling of air through the half-open rima and relaxed air-passages. To this condition—absence of musical tone in the voice—the term *aphonia* is applied, and it must be distinguished from the actual inability to produce sound, which we see after tracheotomy, where in the effort to speak, the organs of articulation and sound are seen to move, but neither noise nor musical sound is heard.

Pathological Relations.—The morbid modifications of vocalisation are necessarily numerous, in proportion to its complexity and the number of parts concerned in its production; but it may be generally stated that, in consequence of disease or perverted action in any of these parts, the voice may be altered either (1) in *loudness* or *force* (size of sound-waves); (2) in *pitch*, or relative height of its note (rate of sound-waves); or (3) in *quality* (shape of sound-waves). And even before there is obvious change in any of these respects, the power of passing rapidly and easily from one pitch to another, constituting melody, may be seriously impaired. The morbid alterations of the voice in these several directions will now be discussed; and brief reference will also be made to (4) *stammering of the vocal cords*; (5) *aphonia*, and (6) the *vocal signs in the chest.*

1. **Changes in Force.**—The voice is weakened in every disease which lowers the general muscular tone, or depresses the nervous system. The gradual change is well seen in phthisis without laryngeal affection, where at last even the effort to approximate the vocal cords is too much for the patient, and he speaks in only a whispering voice. In the same way painful affections of any of the parts enumerated above, interfering with muscular effort, weaken the voice. Speaking generally, mere diminished loudness of the voice depends usually on general rather than on laryngeal disease.

2. **Alterations in Pitch.**—The note of ordinary speech may be habitually raised or lowered, and the range of the singing voice may be seriously limited. The note of the voice depends primarily on the rate of vibration of the vocal cords; and this is the mean result of the tension, the length, the density, and the thickness of the cords at the time the tone is produced, and the force of the current of air sent through the rima. Structural changes, therefore, in any one of these respects, will alter the pitch of the voice; and change in the ordinary vocal note is usually to be referred either to an affection of the tensor muscles of the larynx, to structural change in the mucous membrane covering the cords, or in the cords themselves. Lowering of the pitch of the speaking and the range of the singing voice occurs with any condition which relaxes the mucous membrane, weakens the nervous and muscular system, or makes the tense condition of the vocal cords and the consonating cavities painful. Paralysis of the intrinsic muscles, which admit of the approach of the vocal cords but interfere with their tension and density, affects the pitch as well as the quality, the voice being rough and deep in the paresis of the tensors (superior laryngeal nerve) and of the abductors of the larynx (recurrent nerve).

The imperceptible transition from the chest to the falsetto voice, in which, whilst the condition of the vocal cords is suddenly altered, the form of the larynx, trachea, and other consonating cavities is simultaneously changed, requires a perfect control of the vocal organs, attained only by accomplished vocalists. On this change of register occurring involuntarily, the cracked voice in speaking is the result; and being referable to imperfect co-ordination, it is common in males about puberty, when the form of the larynx is changing, or may even persist occasionally throughout life. A curious affection of the pitch of the voice, in speaking, when two tones of different pitch are simultaneously produced (diplophonia), appears to depend on the division of the rima into an anterior and posterior opening, either by small morbid growths, strings of mucus, or irregular action of the muscles.

3. **Change of Quality.**—The quality of the voice is affected by every alteration either in the cords or in the consonating cavities, the purity and character of the tone being liable to numerous modifications, until, the musical note disappearing entirely, mere noise (aphonia or whispering) remains.

Hoarseness.—Hoarseness and huskiness, a combination of whispering and a badly sustained musical note, imply imperfect and irregular approximation of the vocal cords. Over-exertion of the voice, catarrh, &c., produce it temporarily, giving rise to irregular tension of the cords, to shreds of mucus, and to swellings of the mucous lining, which interfere with their regular approximation; while all changes short of those which absolutely prevent the closure of the cords, may cause it as a persistent phenomenon. To the larynx itself we look therefore for the source of persistent hoarseness. Amongst the pathological conditions of which hoarseness is a symptom are chronic swelling of the mucous membrane, general or local, interfering with the closure of the rima; exudation or ulceration, and therefore inflammation, simple, specific, or diphtheritic; neoplasms; old cicatricial contractions; paralysis of the adductors of one cord, which necessitates the crossing of the normal cord beyond the median line to meet its fellow, as well as other forms of paralysis; fixing of one vocal cord by anchylosis of the crico-arytænoid joint. The paralysis may of course depend on disease of the nervous centres, on the nerves themselves, or on pressure by intra-thoracic or other tumours on the nerve-trunks. Hoarseness, short of aphonia, is also a symptom of general exhaustion, as seen in phthisis and cholera.

The character of the speaking voice is also altered by any change in the resonating cavities. Thus the voice is said to have a *nasal twang* when the upper pharyngeal and nasal cavities are not completely shut off in vocalisation; while, on the other hand, obstruction in the nares, preventing the passage of the air through them and the formation of the nasal consonant sounds, is popularly, though wrongly, called 'speaking through the nose.' If the obstruction be situated in front of the nares, the sounds can be produced, but not continued; if the obstruction be in the upper pharynx, or at the back of the nares, they cannot be produced at all. When with obstruction in the nares there is swelling of the pharynx and the soft palate, the voice assumes the character so familiar in cases of quinsy.

Changes in the walls of the chest and the pectoral cavities also alter the character of the voice, the hollow voice of the emaciated phthisical patient illustrating this. The phonation, on inspiration, of spasmodic croup and of child-crowing or laryngismus stridulus must be referred to as the result of spasm of the vocal cords, though this involuntary function hardly comes within the definition of voice, which term should be limited to sound produced in the vocal organs to establish communication between living beings.

4. Stammering of the Vocal Cords.—Spasm and defective co-ordination are the source of this peculiar affection of the voice, in which there are sudden interruptions of the voice without affection of the articulation (Prosser James).

5. Aphonia.—The various modifications of voice hitherto considered only occur where the vocal chords are free to meet more or less perfectly. Aphonia or complete loss of the musical tone, occurs where the cords cannot meet. Amongst the conditions which will prevent the approximation of the cords and cause aphonia are paralyis or paresis of the adductor muscles, on whatever cause it may depend; fixation of the cords by cicatricial contractions, or by anchylosis of the crico-arytænoid joints; their destruction by ulceration; any painful affection which makes the patient involuntarily rest them; or coating with false membrane. But by far the most frequent cause of this aphonia is the abrogation or perversion of the will, occurring in the morbid mental condition of hysteria or other nervous disease; perfect power of phonation existing, but the patient, for months or years, declining to exercise the power, or to make the necessary effort. The intimate relations of the voice to the higher functions of the brain would lead us to expect that it would be influenced by the emotions. Thus we have a person hoarse with rage, speechless with terror, &c., and the origin of these cases of nervous aphonia is frequently some sudden emotion, causing loss of control over the voice. Von Ziemssen believes that, even where the vocal cords cannot meet, by a great effort the patient may produce a hoarse, monotonous tone by vicarious vibrations of the ventricular bands.

Treatment. — The local treatment of the various diseases of the respiratory organs which give rise to disorders of the voice, is fully discussed in the several articles on these subjects (*see* Larynx, Diseases of; Stammering; Throat Diseases of; Trachea, Diseases of). The *general* treatment will depend upon the constitutional state. *See* Hysteria; and Phthisis.

6. Vocal Signs in Chest.—Some consideration must be given to the changes in the voice which are audible when the stethoscope is applied to the chest. Normally the vibrations of the vocal cords are conveyed to the ear applied to the chest by propagation along the contained air, the rigid portions of the air-chambers, and the thoracic walls, the voice being heard as a feeble, buzzing, musical tone. This sound is weakened when the original tone is weakened by laryngeal disease; when fluid is interposed between the lung and the chest-wall, pus and less homogeneous fluids forming a more complete obstacle than simple serum; and when the bronchial tubes are obstructed by secretions or other cause, preventing the conveyance of the vibrations. The sound may, on the contrary, be exaggerated, giving rise to the phenomena of *bronchophony*, *amphoric* voice, and *ægophony*. Bronchophony is simple increase in the vocal resonance, and is heard under the same conditions which give rise to bronchial breathing, that is, over lung consolidated by exudation or condensed by compression, and over cavities with solid walls. The term *pectoriloquy* is commonly applied to excessive bronchophony, but Dr. Bristowe would limit it to the rare instances in which not only the laryngeal tone, but the articulate sounds produced in the mouth, are conveyed back to the chest, and thence through the chest-wall to the ear. Amphoric voice (*amphorophony*) is the term applied where the vocal resonance is not only increased, but acquires a metallic ring, from the addition of a consonant tone acquired in large cavities of the lungs. This is sometimes heard in a marked degree in pneumothorax, though in other cases of the same disease the vocal resonance may be absent or greatly diminished.

Œgophony is heard where there is a thin layer of fluid between the ear and the lung, as in small effusions or at the margin of larger effusions. It is a bleating, tremulous tone, supposed by Bristowe to result from the interposed fluid preventing the fundamental note-vibrations from reaching the ear, while it permits the finer and closer vibrations of harmonics to penetrate. *See* Physical Examination.

Thomas J. Walker.

VOLITION, Disorders of.—Synon.: Fr. *Troubles de la Volition*; Ger. *Stöhrungen des Wollens.*

Various lesions of the cortex of the hemispheres may arrest or interfere with volition at its source, and that not solely when the lesions occur in the so-called 'motor regions.' If we assume that these particular regions of the cortex are the parts whence motor incitations pass off on their way to lower centres, it is only necessary to bear in mind, on the one hand, the continuity of molecular actions through definite tracts of the brain-tissue, and, on the other hand, the frequency with which volitions are immediately aroused by some antecedent sensorial processes, to understand that damages to certain sensorial centres or internuncial fibres within the hemispheres are almost as liable to interfere with certain classes of volition as are those which occur in the so-called motor region itself. After all, volition is only, and must always be, a result of sense and intellect in action. Its manifestations may, therefore, be *impeded* either by disease at the sources in which it originates, or in one or other portion of the tracks along which its initial incitations are conducted on their way to motor centres, and thence to the muscles whose activity is to be awakened.

In other cases, with *exalted* activity of some of the centres in which volitional incitations arise, we may have, especially in acute mania and violent delirium, the birth of impulses which are absolutely 'uncontrollable.' Where these conditions are absent, however, and whether the persons in question have been accustomed or not to exhibit evidences of a weak or defective *morale*, it is most important not to confound 'uncontrolled' with 'uncontrollable' impulses. This is the kind of question which becomes all-important in many criminal cases—cases, that is, in which persons are under trial for murder, manslaughter, or theft, and in which 'unsoundness of mind' is pleaded in extenuation. *See* CRIMINAL IRRESPONSIBILITY.

On the other hand, a *dormant* or *sluggish* volition is met with in some other forms of insanity, as well as in hysteria, the subjects of which cannot or do not rouse themselves to perform the most ordinary actions. They may from this cause be speechless, or they may experience the most extreme difficulty in arriving at any decision even in reference to the most trivial circumstances. *See* INSANITY, Varieties of.

Again, so-called defects of memory and *defects* of volition are sometimes inextricably involved in many forms of brain-disease; so that the same disability may, from one point of view, be regarded as an instance of defective memory of a special kind, or from another as a peculiar and limited interference with volition. *See* MEMORY, Disorders of.

In very many cases of apparent *loss* of volitional power—that is, in multitudes of instances of complete paralysis of a part or of a muscle—where the causal lesion is situated in regions below the cortex cerebri (*e.g.*, in lower motor centres, cerebral or spinal, or in motor nerves), there is not an arrest of volition, but rather an impediment to the actuation of volitions (*see* PARALYSIS, MOTOR). But whether volition itself is nipped in the bud, or whether, though really existent, it is rendered abortive, the patient is practically reduced to the same condition—since his power of responding to sense or thought through particular muscles may be equally interfered with in either case. *See* SPEECH, Disorders of.

H. CHARLTON BASTIAN.

VOLVULUS (*volvo*, I roll).—A synonym for intussusception. *See* INTESTINAL OBSTRUCTION.

VOMICA (*vomo*, I vomit, I cast up).—SYNON.: Fr. *Vomique*; Ger. *Lungengeschwür*.

DEFINITION.—A term applicable to all ulcerative spaces in the lung in open communication with bronchi.

ÆTIOLOGY.—The multifarious agencies leading to excavation may be grouped as follows:—

I. *Destructive processes*: (*a*) injury, (*b*) gangrene.

II. *Suppurative processes*: (*c*) acute pulmonary abscess; (*d*) suppuration around inhaled foreign bodies; (*e*) suppuration around new formations (including hydatids); (*f*) extension of abscesses, (1) from the pleural cavity; (2) from the abdominal cavity, or from the abdominal organs; and (3) from the mediastina.

III. *Degenerative processes*: (*g*) ulceration of cancerous or sarcomatous growths; (*h*) ulceration of syphilomas; (*i*) ulceration of tubercle; (*j*) softening of chronic inflammatory consolidations (catarrhal pneumonia and caseous pneumonia); (*k*) softening of intensely congested or œdematous tissues (a condition sometimes due to pressure from aneurisms or tumours); (*l*) liquefaction of ancient deposits—caseous, pultaceous or hæmorrhagic (hæmorrhagic nodules—Dr. R. E. Thompson).

Phthisis being the cause of the immense majority of pulmonary excavations, the ensuing remarks will be chiefly devoted to phthisical vomicæ.

ANATOMICAL CHARACTERS.—*Varieties in size and in shape.*—Vomicæ may be sub-lobular (then aptly termed *cavernules*), lobular, lobar, or they may involve the whole of one lung. Tubercular deposits, being usually smaller than catarrhal infiltrations, lead to smaller cavities. Catarrhal inflammation gives rise to the lobular, caseous pneumonia to the lobar excavations, and to the wholesale destruction of a lung. Œdematous forms of catarrhal pneumonia often undergo rapid and extensive softening; the interlobular septa escaping liquefaction, whilst the parenchyma is carried away. This dissecting excavation forms the counterpart of caseous pneumonia, where the tissues are destroyed *en masse*, with the sole exception of the larger branches of the pulmonary artery.

When strictly confined to a lobule, the excavation is roughly spherical. If many lobules should be simultaneously involved, their coalescence may give rise to irregular vomicæ; but the ultimate shape of cavities chiefly depends upon the peculiarities of the bronchial distribution to the district affected.

Vomicæ are frequently trabeculated. Trabeculæ (clearly to be distinguished from denuded branches of the pulmonary artery) invariably consist of blood-vessels and of collapsed or indurated alveolar substance. They are the remains of intervals of spongy tissue, originally separating distinct cavities. Their ulceration and partial absorption often give rise to a knobbed condition of the internal surface of cavities.

During the period of formation and of extension the walls of cavities are rough and ulcerous. But the completed cavity becomes surrounded by a fibro-vascular zone, the outer surface of which is continuous with the pulmonary tissue, whilst its innermost stratum constitutes, during the active stages, a pyogenic layer, and subsequently an exfoliating false membrane. Vomicæ thus invested are said to be *encapsulated*.

Important differences are noticeable in the condition of tissues around cavities. The capsule of a vomica may be immediately surrounded by alveolar substance, the expansion of which may exert a favourable amount of pressure upon it; or it may be continuous with inflamed and thickened tissue, or with tubercular infiltrations. In extreme cases the lung is to such an extent invaded by the fibrous growth from an adherent pleura, that the vomicæ present the appearance of having been formed at the expense of the fibrous tissue itself ('fibroid phthisis').

Situations.—No appreciable difference exists between the liability to excavation of the right and that of the left lung. Primary excavation almost invariably attacks the upper part of the upper lobe: its most common seat is the central part of the subclavicular region, not the apex proper; it may, however, extend to the very summit of the lung, or involve the greater part of the upper lobe. Phthisical destruction very rarely has its starting-point in the middle or in the lower third of the lung. The base of the lung, on the other hand, is the most common seat of those cavities which are not due to phthisis (for example, abscesses by extension, gangrene, and syphilitic ulceration).

The common form of phthisis, originally attacking the apex, implicates, almost without exception, the mid-dorsal region secondarily; this the writer has shown to be due to the transmission of irritating matter along the bronchus supplying that district. Similarly the base becomes affected in the latest stages of excavating disease, if life should be sufficiently prolonged.

Bronchi in relation to vomicæ.—Cavities not smaller than a lobule inevitably open into a bronchus. The communication may be temporarily obliterated, or it may in rare instances become permanently sealed. Most cavities exceeding the size of a single lobule intercept more than one bronchus; and the air-tubes ulcerate within them at an early period of the softening. Thus two sets of bronchial orifices may be recognised in vomicæ, the proximal and the distal, forming as many small islands of mucous membrane on the internal surface of cavities.

Blood-vessels in relation to vomicæ.—Trabeculæ always contain either patent or obliterated vascular branches. More resistant than all other structures, these vessels may become completely exposed and finally eroded. But aneurism or erosion more commonly has its seat in those branches of the pulmonary artery which ramify in the thickness of the cavity wall, a fact readily explained by the persistence of circulation within these vessels, by their inability to retract, by the uneven support which their coats receive at different points of their circumference, and by their diseased condition. Fatal hæmorrhage may occur without any warning from the erosions or from the aneurisms. More habitually premonitory bleeding of limited extent recurs at short intervals prior to the fatal rupture. Pulmonary aneurisms sometimes undergo spontaneous cure when their growth is limited by the small size of the cavity which contains them; or the pressure of the extravasated blood may effect the same result subsequently to their rupture. It is almost the rule for aneurisms to occur simultaneously at different parts of the same lung.

Extension of vomicæ.—Cavities increase in size by the gradual necrosis of their inner wall; by the fusion of adjacent excavations; and by their encroachment upon fresh bronchial territories, which become the seat of similar ulceration.

Retrocession of vomicæ.—The *contraction* of cavities is essentially due to the shrinking of their capsule. This force is assisted in some cases by the expansion of the neighbouring spongy tissue, or even of the hypertrophied healthy lung; in other cases by the constricting pressure from a thick zone of fibrous tissue; indirectly also by the falling-in of the ribs, by the rise of the diaphragm, and by the abundant growth of new fibrous tissue in the thickness of the pleural adhesions.

The *retraction* towards the root of the lung, which is so commonly observed in chronic vomicæ, is partly due to the inflammatory thickening and shortening of the bronchus; it is often opposed by adhesions of the corresponding pulmonary surface to the chest-wall.

In their contracted state vomicæ may remain dormant for years. Final obliteration is rarely attained, chiefly owing to their deficient granulating power, and to the superficial necrosis of their opposed surfaces, both these conditions being the outcome of imperfect drainage.

Consequences of Excavation.—Amongst the *general* consequences of pulmonary excavation are loss of breathing surface; exhausting suppuration, often leading to lardaceous degeneration of the organs; and tuberculosis. The chief *local* consequences are secondary deposits (pneumonic or tubercular) in the healthy portions of the lungs, as a result of the inhalation of the secretion of cavities, and of other products. Lastly, as the result of the contraction of cavities, we meet with local shrinking of the lung and collateral emphysema; various involutions of the pulmonary surface; various deformities of the thorax, &c.

Among the fatal accidents incidental to excavation rupture of aneurisms has already been referred to. Perforation of the lung, leading to pneumothorax, is a danger special to the more insidious varieties, in which the softening is rapid, whilst the inflammation is of low type and unaccompanied with the usual tissue-reaction.

Diagnosis.—The ordinary methods of physical examination, by which the presence of cavities may be detected, are described in other articles (*see* Phthisis; and Physical Examination). A few points only claim specially to be noticed. Cavernous sounds are seldom given by cavities smaller than an ordinary filbert, probably owing to the small size of their bronchus. Cavities even of larger size are not infrequently completely masked by the interposition of spongy tissue; this is more especially the case in the tubercular forms. In the opposite condition of cirrhosis, cavernous sounds may be absent or very feeble, in consequence of deficient inspiratory movements. Lastly, the accidental blocking of a bronchus may suspend for a time all auscultatory evidence of excavation. The distance of the vomica from the surface may be roughly estimated from the intensity of the sounds; its degree of fulness from their liquid character; the smoothness of its walls from their amphoric nature; its compressibility by surrounding spongy substance, and its elastic resiliency, from the suction-sound sometimes heard during the respiratory pause following cough, aptly termed by Dr. Mitchell Bruce the *indiarubber-ball sound.*

A determination of the extent of the vomica can generally be attained by careful investigation. Sometimes, however, cavernous sounds are propagated beyond the excavated region by consolidation. Occasionally they are re-echoed at a symmetrical point in the sound lung, especially at the base. Phantom-caverns of this nature may be suspected whenever absolute identity in the position and in the auscultatory quality of the sounds on either side coincides with great disparity in percussion-resonance and in vocal fremitus.

Valuable information is derivable from the *sputa*. Abundant purulent discharge always indicates an active condition; if mixed with much mucus, it points to a co-existing bronchial catarrh; if shreddy and fœtid, to a cavity of some magnitude, imperfectly drained. The intimate admixture of blood indicates a congested state of the membrane. From the presence of abundant, well-preserved, elastic elements it is possible to diagnose the moister forms of necrosis; caseous lumps argue the existence of caseous pneumonia; the expectoration of calcareous particles shows that excavation is progressing at the expense of more or less fibrosed tissue resulting from former disease; and, according to Koch, the presence of bacilli staining deeply with methylene-blue and not decolorised by vesuvin, is a test for tubercle. Lastly the cessation of all secretion is indicative of a perfect quiescence of the vomica.

Prognosis.—In cavities not due to phthisis, the absence of the constitutional element greatly favours recovery; and their progress is mainly governed by the nature of their cause, by their size, by their situation, and by other influences enumerated below. Where healing is much delayed in such cases, the eventual development of phthisis is rendered probable.

The prognosis of phthisical vomicæ is intimately bound up with the prognosis of phthisis, a subject too wide for discussion here, but fully treated in the article Phthisis, and in Dr. James Pollock's work on *The Elements of Prognosis in Consumption*. Most unfavourable are the vomicæ due to a breaking up of tuberculo-pneumonic deposits. Vomicæ originating in pure tubercle, although they may contract, seldom heal. Where hæmorrhage occurring in a lung previously quite free from disease, subsequently leads to excavation, the closure of the cavity is encouraged by the contraction which characterises these cases. But the pneumonic class, which comprises the most rapidly fatal cases of excavation, also supplies the most striking instances of recovery. There exists a large clinical group in which the affection is limited to a small portion of one lung, and in which the disease is rather local than constitutional. On careful analysis of these favourable cases, the chief elements of their fortunate termination will be found to be the following:—1st, unilateral character of the affection; 2nd, its small extent; 3rd, comparatively rapid occurrence of softening; 4th, complete removal of the whole consolidation; 5th, absence of close adhesions to the thoracic parietes; and 6th, facilities afforded for collateral expansion.

Treatment.—The ideal treatment of cavities would have for its objects:—(1) to restore healthy action to their surface; (2) to prevent a stagnation of their secretions; and (3) to encourage their contraction.

For the fulfilment of these indications various *surgical* measures have been practised:—1st, free incision and injections (Barry, 1727); 2nd, paracentesis (Ramadge, 1836); 3rd, free incision and drainage (Hastings and Storks, 1845); 4th, paracentesis and injections (Mosler, 1873); and 5th, needle-injections of medicated fluids (Pepper, 1874).

Much may yet be expected of modern surgery in the treatment of excavating disease. Hitherto, however, there exists but meagre evidence to show that any good has resulted from surgical interference, and the range within which such interference is justifiable is very limited.

The *ordinary* methods of treatment comprise, in addition to the use of constitutional remedies:—

1st. Treatment by *inhalation* of medicated spray, of medicated vapours, of air charged with the natural exhalations from the sea, from pine-forests, &c. *See* Inhalation; and Climate, Treatment of Disease by.

2nd. Treatment by *posture*, sometimes facilitating, as it does, the drainage of cavities.

3rd. Treatment directed to the enlargement of the thorax and to the *expansion* of the lungs, such as passive exercise of the thoracic muscles, inhalation of rarefied air, and especially residence at high altitudes.

Wm. Ewart.

VOMIT: Examination of Vomited Matters.—Vomited matters may consist either of substances present in the stomach when vomiting begins, or of substances entering it during the process. Those present in the stomach *when vomiting begins* include articles of food and drink, or other ingesta, more or less altered by digestion or fermentation; saliva, epithelium, mucus, pus, or blood from the nasal passages, mouth, pharynx, or œsophagus; fluid or mucus secreted by the stomach itself, epithelium-cells, casts of tubules, or even shreds of gastric mucous membrane, blood more or less altered proceeding from the walls of the stomach, cells or small pieces from morbid growths, and occasionally, as mentioned by Dr. Quain, the whole of a pedunculated morbid growth; fungi, as torulæ and sarcinæ; parasitic worms; bile; pancreatic juice; pus from abscess of the stomach or liver; fæculent matter from the intestine. *During vomiting* much saliva may be swallowed; and bile, pancreatic juice, pus or fæces, not originally present in the stomach, may be pressed into it by the straining. Effusion of blood into its cavity may also be caused by the efforts of retching.

Method of Examination.—In examining the vomited matters it is advisable, first, to separate the larger pieces of undigested food by filtering the vomit through canvas or muslin.

The *solid residue* may be investigated by washing the larger pieces and tearing them up, or making sections of them, so that their nature may be ascertained. Partially digested curd is sometimes not very easy to recognise. When a large quantity of milk has been drunk at one time, the curd which it forms in the stomach may, when vomited, have the appearance of a piece of thick dense grey felt.

The *filtrate* should be put into a conical glass and allowed to settle. The reaction of the fluid is to be ascertained by litmus paper. The presence of free hydrochloric acid may be tested for, by putting one drop into a watch-glass containing a one per cent. solution of tropeolin, the yellow colour of which is converted into a wine red if hydrochloric acid be present. The total acidity may be estimated by filtering and adding a standard solution of caustic soda or potash to a measured quantity of the filtrate, until it is neutralised. For the methods of examining more particularly the various acids — lactic, acetic, butyric, &c.—and other volatile substances, text books of chemistry must be consulted.

To ascertain the presence of pepsin in the vomit we add to it its own bulk of dilute hydrochloric acid (ten minims of dilute hydrochloric acid, B.P., to an ounce of water) and a flock of fibrin or a piece of hard-boiled white of egg; let it stand for several hours in a warm place; and then see whether or not the fibrin or albumen is dissolved.

To test for trypsin, we proceed in the same manner, but use the vomit without the addition of acid; and if it be already acid, neutralize it with bi-carbonate of soda.

To test the vomit for peptone, we must put some of it into a small dialyzer, and let it stand for some hours. We then add to the water in which the dialyzer has stood, solution of corrosive sublimate, which gives a precipitate with peptones; or some liquor potassæ and a drop of very dilute sulphate of copper solution, which gives a precipitate dissolving on shaking, and forming a red solution, changing to purple when more copper is added.

Bile is tested for in the filtered liquid by Gmelin's and Pettenkofer's tests.

For blood in the vomit *see* HÆMATEMESIS.

If the vomited matter be too thick to allow the sediment to subside, a little of it should be mixed with some distilled water and allowed to settle. A drop of the sediment is then to be examined microscopically; and the examination is facilitated by adding to one specimen a drop of iodine solution, and to another a drop of aniline red or blue solution. The substances most likely to occur are partially digested fibres of voluntary or involuntary muscle, elastic fibres, connective-tissue bundles from meat in the food, spiral fibres and green chlorophyll granules from vegetables, starch-granules — stained blue by iodine, torulæ or sarcinæ, blood-corpuscles, leucocytes, scaly epithelium from the mouth, cylindrical epithelium from the stomach, and casts of the gastric follicles—sometimes fibrinous, sometimes composed of cells and granules, which take up the aniline colour, and are thus rendered more easily visible.

Clinical and Pathological Indications.—If the vomited food be unchanged, or but little changed, it indicates either that the vomiting has occurred soon after a meal, or that the secretion of gastric juice is deficient either in quantity or quality. The food is usually comparatively little changed in nervous vomiting, or in cancer of the cardiac extremity of the stomach. In vomiting from cancer of the pylorus, or duodenal ulceration, the food is much more digested, as it remains much longer in the stomach. If undigested food be vomited some hours after a meal, the vomit should be examined in order to ascertain whether pepsin or acid is deficient. Complete absence of hydrochloric acid has been observed in cases of amyloid degeneration of the stomach, and a deficiency of acid has been found experimentally in acute anæmic and febrile conditions. Abnormal acidity from fermentation of saccharine or farinaceous articles of food, and the consequent production of acetic, lactic, and butyric acids, occurs in chronic catarrhal conditions. In some cases of gastric catarrh starch appears to undergo a mucous fermentation, and large quantities of glairy material are formed. When fermentation has gone on to a great extent, the vomit may have a yeasty look, and should then be examined for sarcinæ and torulæ. *See* SARCINÆ; and STOMACH, Dilatation of.

Sometimes large quantities of a watery fluid are vomited. This is occasionally alkaline or neutral, contains potassium sulphocyanide, and digests starch. It consists of saliva, which has been secreted abundantly on account of reflex irritation arising from the stomach, and swallowed. At other times it is strongly acid, and appears to be secreted by the stomach. Sometimes the vomit appears to be a mixture of both of these fluids. Such vomiting may occur from nervous disturbance of the stomach, but may be symptomatic also of catarrh, ulcer, or cancer. Mucus in the vomit indicates catarrh of the gastric mucous membrane; and the more acute the inflammation, the more leucocytes occur in the mucus. Bile may be vomited pure, in the form of a tasteless golden-yellow substance like yolk of egg, from the action of poisons, but this rarely happens. Vomiting of bile, more or less green and diluted, or mixed with digestive secretions or food, occurs as a symptom in congestion of the liver; but it may take place in all kinds of vomiting, whatever its cause. Large quantities of bile, mixed with the secretions from the mouth and stomach, and forming a grass-green liquid (*vomitus æruginosus*), may be vomited in peritonitis and cerebral affections. The writer has also observed this character of vomit in opium-eaters. Constant absence of bile when vomiting is persistent, points to pyloric stenosis. Pus may get into vomit from the bursting of an abscess in the mouth or tonsils; it sometimes, though rarely, may arise from an abscess in the walls of the stomach; but it is more likely to come from abscess of the liver. Blood vomited in large quantity, and of a bright red colour, usually indicates ulceration of the stomach or cirrhosis of the liver. More or less altered, and in smaller quantity, it occurs in the diseases just mentioned, and also in cancer and yellow fever (*see* BLACK VOMIT; and YELLOW FEVER). It may also be present in hysterical persons who have swallowed blood, obtained from external sources, or by sucking hollow teeth. Cancer-cells in the vomited matters are diagnostic of the presence of that disease. T. LAUDER BRUNTON.

VOMITING (Lat. *vomo*).—SYNON.: Fr. *Vomissement*; Ger. *Erbrechen*.

DEFINITION.—Forcible expulsion of the contents of the stomach through the œsophagus.

ÆTIOLOGY AND PATHOLOGY.—The contents of

the stomach are expelled from it by the mechanical pressure brought to bear upon it by the diaphragm and abdominal parietes, which contract simultaneously. When these muscles contract, if the cardiac orifice of the stomach remains closed, an ineffectual effort at vomiting, or retching, occurs; but if the cardiac orifice dilate, the gastric contents are expelled. When the diaphragm and abdominal muscles are paralysed, vomiting is impossible, though the stomach may be in active movement. The stomach is not necessary to vomiting, which will occur when that organ is excised, and a simple bladder tied in its place; but when the stomach is present, mere pressure upon it by the diaphragm and abdominal muscles, as in coughing, does not expel its contents. The cardiac orifice is relaxed by means of the longitudinal fibres, which run along the under end of the œsophagus below the diaphragm, and then radiate completely over the stomach. When they contract they dilate the cardiac orifice, and at the same time aid the evacuation of the stomach by drawing the whole viscus towards the diaphragm. In the act of vomiting, then, the simultaneous contraction of three sets of muscles is required:—(1) of the diaphragm, (2) of the abdominal wall, and (3) of the muscular fibres just mentioned in the stomach itself. The movements of these muscles are coordinated by a nervous centre, situated in the floor of the fourth ventricle in the medulla oblongata. This centre is closely associated with, though of course not identical with, the respiratory centre. The motor impulses from these centres are sent to the abdominal muscles, diaphragm, stomach, and œsophagus, by the intercostal, phrenic, and pneumogastric nerves respectively. The reasons for supposing that the nervous centre for vomiting is closely associated with the respiratory centre, are that the movements of vomiting are modified respiratory movements, that emetics excite the respiratory centre, and that their action is usually preceded by increased respiratory movement, while depression of the activity of the respiratory centre stops vomiting. When the blood is rendered very arterial by excessive respiration, a condition of apnœa, in which no need of respiration is felt, and no respiratory movements are made, is produced; but if emetics are then injected into the veins, respiration not only becomes more frequent, but apnœa can no longer be induced, unless the activity of the respiratory centre be lowered by narcotics.

The vomiting centre is usually excited to action by irritation of certain *afferent nerves.* These may either act directly upon it, or through the medium of the brain. The nerves of special sense act through the brain. The sight of a disgusting object, a disagreeable stench, or an unpleasant taste, may excite vomiting, and it may also be produced by the simple thought of such subjects. Blows on the head, or inflammation of the brain or its membranes, also excite vomiting. According to Budge, the cerebral centres for the movements of the stomach are in the right corpus striatum, and especially in the right optic thalamus. When these parts are irritated the stomach moves. Irritation of the corresponding parts on the left side of the brain does not affect the stomach. Vomiting occurs in certain cerebral conditions, either affecting the brain itself or its membranes, such as cancer or tubercle of the brain, apoplexy, cerebellar hæmorrhage, softening of the cerebral substance, sometimes encephalitis, poisoning by narcotics, melancholia, profuse hæmorrhage, or tubercular meningitis. It is also one of the symptoms of Menière's disease of the semi-circular canals. It also occurs in various diseases, in which, however, it is difficult to say whether the vomiting be due to direct affection of the brain itself, or to reflex action upon it from other organs. Such diseases are typhus, plague, yellow fever, cholera, and the cold stage of ague. Very painful impressions on sensory nerves throughout the body may excite vomiting. This is seen in cases of loose cartilages in the knee, in dislocation of a joint, or in a painful wound or operation. Here, also, it is uncertain whether the vomiting be produced through a direct connection of sensory nerves with the vomiting centre, or whether the irritation acts indirectly through the cerebrum.

Certain afferent nerves appear to have a more direct connection with the vomiting centre than others, and these require special consideration:—

(1) *Branches of the glosso-pharyngeal nerve to the soft palate, the root of the tongue, and the pharynx.*—These parts have a very close connection with the vomiting centre, and tickling them with the finger or with a feather is one of the readiest means of inducing vomiting.

We find vomiting occurring in inflammation of the soft palate or tonsils, and also of the pharynx, especially in children.

(2) *The nerves of the stomach.*—The sensory nerves of the stomach are chiefly branches of the vagi, but they belong partly also to the sympathetic system. When the vagi are cut vomiting becomes difficult, but efforts at retching occur, and vomiting will even take place from the action of emetics after section of the vagi. It is therefore evident that irritation of the stomach produces vomiting reflexly through other nerves than the vagi. Vomiting may occur from irritant substances in the stomach, whether introduced into the stomach, or formed within it; from irritation within the stomach, from an inflamed or irritated condition of its walls; or from mechanical pressure, from without or from within. Thus it may occur from the presence of undigested food, from irritating substances produced by imperfect digestion, or from irritant poisons within the stomach. It may be due to catarrh or congestion of the mucous membrane itself, to softening of the mucous membrane, or to cancer in the gastric wall. It may be produced by extreme distension of the stomach, by gas, liquids, or solids; by compression of a part of it within the body, as in hernia of the stomach; or by the pressure of a tumour upon it. It may be caused by violent compression externally with the hands; by the pressure of a too tightly laced corset; by the pressure against the abdominal walls of hard tools or benches in certain trades. It frequently occurs in cough, especially the cough of phthisis; but here it is probable that the vomiting is due partly to the violent compression between the diaphragm and abdominal walls, and partly to the congestion of the vessels which the continued

interruption of the circulation during the fit of coughing brings on.

(3) *The nerves of the liver and gall-ducts.*—These consist chiefly of branches of the vagus and sympathetic. From their irritation vomiting occurs in hepatitis, or during the passage of a biliary calculus. It is from irritation of these branches, also, that vomiting may occur in pleurisy of the right side, the congestion of the pleura on the upper surface of the diaphragm having led to congestive changes in the liver.

(4) *Intestinal nerves.*—Ligature of the intestine in animals produces vomiting, which is arrested by dividing the nerves passing from the ligatured parts. In man it is the almost invariable accompaniment of strangulated hernia or intussusception, and it may even occur in obstruction of the bowel by fæcal matters in cases of obstinate constipation. It also takes place in peritonitis from irritation of these nerves.

(5) *The renal nerves.*—From irritation of these nerves vomiting occurs in nephritis, or by calculi in the pelvis of the kidney or passing down the ureter.

(6) *Vesical nerves.*—In cystitis vomiting occurs. It may possibly be due, however, not to irritation of the vesical nerves, but to extension of inflammation to neighbouring parts.

(7) *Uterine nerves.*—Irritation of these nerves is one of the commonest causes of reflex vomiting. It may be produced in animals on irritation of the uterine plexus, and occurs in the human subject during pregnancy or in metritis.

(8) *Ovarian nerves.*—Vomiting is a symptom of inflammation of the ovaries.

(9) *The nerves of the testicle.*—A blow on this organ tends very readily to produce nausea and vomiting.

The cause of vomiting in *sea-sickness* is uncertain, but it appears to the writer to be partly due to the condition of the nerve-centres, and partly to that of the viscera. *See* SEA-SICKNESS.

TREATMENT.—The treatment of vomiting is to be directed to two ends (1) *to remove the cause* if possible; and (2) to *lessen the irritability of the vomiting centre.* The chief drugs which lessen the irritability of the vomiting centre are opium, morphia, bromide of potassium, chloral, and probably also hydrocyanic acid and belladonna. Strychnia and small doses of ipecacuanha are also useful in vomiting, and they probably owe their power to their action on the vomiting centre. Most of these drugs have a local sedative action on the stomach, and therefore it is advantageous to give them by the mouth when possible. Even when the stomach is very irritable, they may be retained by giving them in a concentrated form. When the stomach will not retain them, they must be given by the rectum or by subcutaneous injection. In sea-sickness the effect of the position of the head is sometimes very marked, and the vomiting may sometimes be arrested completely by removing all pillows and putting the head on a level with, or rather lower than, the body.

In cases of disease of the brain or its membranes, where it is difficult or impossible to remove the cause, we must try to lessen the congestion by means of leeches and cold applications to the head; and also to soothe the vomiting centre by hydrocyanic acid, or by bromide of potassium. At the same time, however, considerable benefit is obtained from the use of remedies which act locally on the stomach, these seeming to have some reflex effect upon the vomiting centre. One of the most useful is ice, which may be constantly sucked, and also swallowed in small lumps. Where the vomiting is dependent on the action of poisons circulating in the blood, as in the later stages of contracting kidney, we must endeavour to eliminate these by increasing the action of the kidneys and the skin. In vomiting dependent on inflammation of the mouth and fauces, we lessen the irritability by soothing or astringent gargles, confections, or glycerines. A confection or glycerine is often better than a gargle, inasmuch as it remains longer attached to the parts, and thus exercises a more prolonged effect upon them. When vomiting is due to irritant substances in the cavity of the stomach, such as indigestible food, and acrid fluids or poisons, it is best treated by evacuating them. A large draught of lukewarm water, alone or mixed with a teaspoonful of mustard, is one of the best means. Large draughts of warm water alone, even if they are not ejected, may give relief by diluting the acrid substances in the stomach so much as to prevent their irritating the mucous membrane. In this way they sometimes relieve sick-headaches. It is of great importance sometimes, not only to prevent the formation of acrid substances by slow and imperfect digestion, but to prevent the mechanical irritation of the mucous membrane by undigested food. For example, we not unfrequently notice that sickness and vomiting will occur in susceptible individuals after meals containing such substances as are not only slowly digested, but are swallowed in lumps. Examples of these are uncooked apples and cheese, or even potatoes, especially when imperfectly boiled or new. These articles, instead of being crushed to a powder by the teeth, are swallowed in lumps of considerable size, and apparently, instead of passing the pylorus, are retained in the stomach, and, partly by the mechanical irritation, and partly by their giving rise to acrid products, cause sickness. Milk, when swallowed in large draughts, or when there is too much acidity in the stomach, instead of falling in fine flakes will coagulate in large lumps, which have a similar effect to the cheese. To relieve this it is advisable to mix the milk with soda-water or lime-water, or to take it, as in the whey cure, by sipping.

When vomiting is due to slow or imperfect digestion, which allows decomposition or fermentation of food to take place in the stomach, it may be arrested by improving the digestion. Thus five grains of calomel, by acting on the stomach through the liver, may arrest vomiting; and tincture of walnut (the active principle of which, juglandin, is an hepatic stimulant) has also been recommended. Pepsine also, by facilitating digestion, may prevent vomiting; and bitters, such as calumba, may do so also, by preventing putrefaction or fermentation.

When decomposition or fermentation of food, with formation of acrid or irritating products, has once set in, it may continue a long time, as the organisms which cause it remain constantly in the stomach, and renew the process in every fresh supply of food. It may be stopped by antiseptics. Where the vomited matters are frothy and yeasty-looking, the sulphurous acid of the Pharmacopœia, in doses of one fluid drachm, diluted with half a wine-glassful of water, often arrests such vomiting like a charm. Creasote has a similar action, but possibly has some additional action on the nervous system, as it is useful even in cases where the vomiting does not appear to be due to decomposition of food.

For the treatment of irritant poisoning *see* POISONING.

When the mucous membrane of the stomach itself is inflamed or irritated, we must try to lessen the irritation. The best drugs for this purpose are ice, hydrocyanic acid, opium, and bismuth. The insoluble salts of bismuth, and especially the sub-nitrate, are to be preferred to the solutions; and it is advisable to combine them with magnesia, potash, soda, or carbonate of lime, according to the condition of the intestines, preferring the magnesia when the bowels are confined, and carbonate of lime when they are too loose. Sometimes the tendency to vomit is increased by lying on the right side. This is probably partly due to the drag of the stomach itself upon the cardiac extremity, and partly to the difficulty with which gaseous eructations escape from the stomach in this position. When there is a tendency to vomit, therefore, the patient should lie down on the left side after a meal. In the vomiting of hepatitis, in addition to opium and hydrocyanic acid, we may use ice-water, or ice swallowed, and leeches over the liver. In biliary calculus, we may give, along with opium, a full dose of ether internally, and in addition may employ ether or chloroform by inhalation; similar treatment may be adopted in cases of renal calculus.

In intussusception or hernia we must remove the cause, if possible. In peritonitis full doses of opium are best. For the vomiting in cystitis and ovarian diseases, we must lessen the sensibility of the vomiting centres by the drugs already mentioned, and treat the local conditions.

In the vomiting of pregnancy we trust partly to the drugs already mentioned to act on the vomiting centre, and partly to local applications. It is sometimes arrested by the application of a 10 per cent. solution of nitrate of silver to the os uteri, or by slight detachment of the membranes around the margin of the internal os. Where all other methods fail, the induction of premature labour must be resorted to. *See* PREGNANCY, Diseases and Disorders of.

T. LAUDER BRUNTON.

VULVA, Diseases of.—SYNON. Fr. *Maladies de la Vulve*; Ger. *Krankheiten der Schamritze.*—The vulva or external genitals of the female comprise all the structures external to the hymen, having the navicular fossa and perineum behind, the urethral orifice, vestibule, clitoris, and mons Veneris in front, and at the two sides the nymphæ and labia majora. These organs may be the seat of many diseases, which will be described in the following order.

1. **Atresia Vulvæ.**—Closure of the genital fissure is sometimes found as a *congenital* malformation. This is usually of itself of no great importance, as it is almost always associated with other defects in development, as with atresia ani, hermaphroditisms, extroversion of the bladder, &c. *Acquired* atresia results from mismanagement of infantile vulvitis, from injuries of the pudenda in childhood, or from cicatrisation following upon some ulcerative process. It may give rise to trouble in micturition if the urethral orifice be involved. In rare cases it is only after puberty that trouble arises, from retention of the menses, or after marriage, from dyspareunia; or even during labour, from narrowness of the orifice delaying the escape of the infant. In the slighter and more recent cases, where the labia have only been agglutinated, they may be torn apart by pressure with the thumbs; or by passing a probe or sound behind the line of adhesion and tearing it up with the handle of a scalpel, or with the nail. Where the union has become organised, the edge of the knife must be employed. In any case the patient should be anæsthetised; and care must be taken subsequently to prevent the reproduction of the adhesions.

2. **Inflammation.**—SYNON.: *Vulvitis.*—Inflammation of the vulva may be (*a*) *general*; or (*b*) *localised.*

(*a*) *General vulvitis.*—This variety is found affecting the apposed aspects of the labia, and the whole of the mucous surface they enclose, up to the borders of the hymen. It may be due to gonorrhœal infection, in which case the catarrhal process is apt to extend to the urethra and the vagina. In infants and young children of strumous constitution, it sometimes arises from exposure to cold, want of cleanliness, or irritation from ascarides that have passed out of the anus. In the adult it may result from injury, or rude coition; or from the escape of acrid uterine or vaginal discharges. It shows itself with heat, and tenderness or sometimes itching in the part; a discharge of viscid glairy mucus bathes the surfaces, which sometimes becomes purulent, and glues together the labia. When the labia are separated the seat of the mischief is exposed, and is seen to be red, and sometimes resentful of touch. Apart from the constitutional remedies that may be indicated in individual cases, the treatment consists in keeping the parts at rest, and carefully clean; and in bathing or douching the surface with hot water, followed by an astringent lotion or dusting powder.

(*b*) *Localised vulvitis.*—The vulvitis may be localised—(α) in the *vestibule*; (β) in the *navicular fossa*; or (γ) in the muciparous *follicles* and *glands*, and especially in the *Bartholinian glands.* (α) and (β) occur under the same conditions as the more diffused inflammation, and may be a source of considerable distress in walking or when the part is touched, without being attended by any leucorrhœal discharge. Such cases require the same treatment as cases of general vulvitis; only it is important to make the applications directly to the affected spot, and hence it is usually best to apply sulphate of copper, in the form of a solid crystal. (γ) Inflammation in the Bartholinian glands is the commonest cause of *labial abscess.* It may attack females at any age, but is most frequently seen in women from twenty to thirty, whether married or unmarried. It may arise during pregnancy, and some women are liable to repeated attacks, the glands becoming swollen and cystic whenever the patient gets a chill. In some cases there is profuse secretion, which escapes freely. Far more frequently the swelling in the lining of the duct leads to occlusion. This occlusion is in some instances transitory, and when the swelling in the duct and around its orifice subsides, the secretion that had accumulated escapes. In other instances the duct becomes permanently closed. These are the cases where the patient acquires a swelling in the labium majus of the affected side, varying in size from a pigeon's to a hen's egg. The accumulated fluid may be clear and limpid; but often it is turbid and distinctly purulent. In all the suppurative cases, if the cyst be evacuated through a small opening, the fluid is apt to reaccumulate, and the cyst-walls are now more likely to be the seat of a mischievous inflammation. So that the treatment consists first in trying to reduce the inflammation with hot fomentations or poultices, perhaps aided by sedative lotions containing belladonna or laudanum, with the view of getting the orifice relaxed; and where the contents do not escape through the duct, the cyst should be freely opened, and the cavity cauterised. Huguier's suggestion, to extirpate the gland, is not ordinarily required, especially if the evacuation be effected with a Paquelin's thermo-cautery, which first makes a large and safe cut into the cyst, and can then be applied to the interior, so as to destroy the secreting surface.

Specific inflammations.—The specific inflammations, *gonorrhœal* and *syphilitic*, are treated of in their respective articles. But it is to be noted that the vulva may be the seat of *erysipelas*; and female children have sometimes suffered from a gangrenous vulvitis or *noma*, of the same nature as the noma of the mouth and cheeks, which may come on after some of the eruptive fevers, such as scarlatina, and require the same kind of treatment, with chlorate of potash and tincture of the muriate of iron and stimulants, from an early stage of the mischief.

3. **Eruptions.**—Various forms of eruption may be met with in the vulva, sometimes on the nymphæ or internal aspect of the labia majora, sometimes on the external aspect, and extending to the mons Veneris, or inside of the thighs. The commonest are *eczema*, *erythema*, *herpes*, *prurigo*, and *acne*. They are diagnosed and treated in the same way as the same affections in other situations. It is to be remembered, however, that the tendency to chronicity, which is a marked feature of inflammatory processes in the sexual apparatus generally, is apt to show itself in these vulvar eruptions, and that patients, from motives of delicacy, are apt to allow them to remain untreated for too great a length of time. Further, many of them give rise to itching, which tempts the patient to rub and scratch herself to obtain relief, and may thus cause pruritus.

4. **Pruritus.**—ÆTIOLOGY.—Itching of the vulva is a not infrequent symptom of some of the eruptive and inflammatory affections of the part, either when these are healing or have got into a chronic stage, and it may remain as a permanent trouble after healing has taken place, if the patient have acquired the habit of relieving herself by friction. Sometimes it is reflex, from oxyuric irritation in the rectum, or when the worms have travelled from the anus to the vulva. Or it may be associated with disease of the vagina or uterus, as in cases of chronic colpitis or carcinoma of the cervix, in which the itching may either be due to irritation from the nature of the discharge, or be a reflex phenomenon. In some instances it can be traced to circulatory disturbance in the labia, as when the veins are enlarged, and in the congestion of early pregnancy. In others the renal secretion is at fault; and it is such a common phenomenon in women who are the subjects of diabetes, that in every patient who suffers from pruritus vulvæ, the urine should be tested for sugar. Lastly, there are some cases that can only be described as idiopathic.

SYMPTOMS.—The itching may be localised on the internal aspects of the nymphæ, or of the labia majora, or around the clitoris or the perinæum. In most cases of long standing it becomes diffused all around to the anus and inside of the thighs. Sometimes it is temporary, as in the pruritus of pregnancy, which passes off under careful management in a few weeks, or in rarer cases during the puerperium; in other patients it becomes chronic, and constitutes one of the most distressing troubles to which the female is liable. The itching may come on only occasionally. For the most part it is likeliest to prove distressing when the patient is warm, as at bedtime, or after exercise; but with some the feeling is never quite in abeyance, and the patient has the almost constant desire to relieve herself, as for a time she can do, by scratching, or rather, rubbing the parts with her dress or a towel, until the pain overcomes the feeling of itch, or sometimes until the collapse consequent on the onanistic orgasm which she has involuntarily produced, renders her for a time less sensitive to her trouble. The result of such friction, however, is to keep up the local irritation; so that even in cases where there may not originally have been any local pathological change, but where the itching and friction have persisted for months or years, the skin and mucous membrane become thickened and indurated, and a condition resembling that of a chronic eczema becomes induced. In two cases the writer has seen epitheliomatous nodules develop at the sides of the clitoris and in the vestibule.

TREATMENT.—When diabetes is present it must be combated; and if the patient is gouty, or have her urine too acid or alkaline, these conditions must be rectified. Morbid processes that may be present in the vulva or other neighbouring structures must be treated according to the requirements of the case. A carefully regulated non-stimulating diet should be enjoined, and a due amount of exercise. The internal remedies that have been found most helpful are bromide of potassium and arsenic. Then, for the relief of the itching, the patient must be warned against the danger of rubbing the parts, and be taught to soothe it by bathing with very warm or sometimes with cold water, and drying the parts with a soft towel or napkin. It can be still better allayed by mopping with a lotion containing infusion of tobacco or belladonna or opium; or by applying afterwards a piece of lint soaked in black lotion, or a lotion of acetate of lead. The most effectual sedatives are ointments containing sulphur, camphor, tar, carbolic acid, thymol, iodide of lead, bichloride of mercury, bismuth, prussic acid, or iodoform (deodorised with tonquin bean).

5. Tumours.—The following enlargements may be found in the vulva:—

(*a*) *Hypertrophy.*—The clitoris has sometimes been found of a size sufficient to cause discomfort, and warrant its removal. Far more frequently the nymphæ are of unusual dimensions, their margins projecting beyond the labia, and then they are liable to become the seat of ulcerative processes, and require to be trimmed, which may be done with the knife or scissors, but better with the thermo-cautery. Enlargements of the labia majora, in the form of elephantiasis, are met with among Hindu women. The mass is sometimes of enormous size, and in consequence of the calibre of the nutrient vessels, ablation is apt to be attended with dangerous hæmorrhage, so that the application of an elastic ligature is in most cases the best means of effecting its removal.

(*b*) *Hernia.*—Hernial protrusions may occur into the labia, and be found among the swellings of this part. The detection and treatment are to be effected and conducted as in the case of other herniæ.

(*c*) *Cysts.*—Cystic swellings are found in the upper part of the labia, when the canal of Nuck becomes the seat of an accumulation of fluid, which corresponds to hydrocele of the cord in the male; or lower down, when the duct of a Bartholinian gland has become occluded, and the secretion of the acini accumulates so as to distend the gland without its becoming inflamed. If a complete aspiration in either case is not followed by perfect cure, and the fluid reaccumulates, as it is apt to do, the second tapping should be accompanied with an injection of iodine; and in the case of the Bartholinian cyst, the wall of which is formed of a mucous rather than of a serous membrane, the evacuation may require to be effected through a larger opening, and followed by the application of a more powerful escharotic.

(*d*) *New growths.*—Various neoplasms may have their seat in the vulva. At the orifice of the urethra not infrequently small red-flesh growths, the so-called *urethral caruncles*, make their appearance. They are sometimes unattended with any symptom; more frequently they cause intense suffering during micturition, during coitus, or when the patient takes exercise. The pain is usually referred to the urethral orifice, but it is sometimes reflected to distant parts, as, to the heel. Relief from suffering may be temporarily obtained by application of sulphate of copper or nitrate of silver; but cure is only effected by removal of the growth. It is imperatively necessary to remove not only the small red body, but the portion of the urethra from which it springs, and the raw surface should be freely cauterised if the ablation have not been effected with a thermo-cautery. *Specific* swellings, warty or gummatous, are, of course, frequently to be met with on the vulva. *Lipomata* sometimes grow under the skin of the labia pudendi. More frequently *fibromata* occur, which may attain considerable size, and demand removal. Lastly, the law that *carcinomata* have a predilection for surfaces where a transition takes place from one variety of epithelium to another, is illustrated by the frequency with which different forms of cancer affect the vulva. Their development, symptoms, and treatment present no special features. Only it is well to remember that when the mischief is met with in a stage where there is still hope of its eradication, it is best to effect the removal of the neoplasm by some of the bloodless methods with which modern surgery has become familiar. The tissues in which the growth develops are very vascular; and whilst in some situations—as at and around the clitoris—it is comparatively easy to control hæmorrhage by pressure against the pubic bones, in the parts immediately to the side and back of the vaginal aperture the bleeding from a cut surface is apt to be uncontrollable and dangerous. Hence commencing carcinomata ought to be extirpated with the écraseur, or better still with Paquelin's thermo-cautery, which is the most serviceable of all instruments for the removal of the different varieties of neoplasm that infest the vulva.

Alexander Russell Simpson.

W

WAKEFULNESS. *See* Sleep, Disorders of.

WARTS. *See* Verrucæ.

WASTING.—A synonym for atrophy. *See* Atrophy, General; and Atrophy, Local.

WASTING PALSY.—A synonym for progressive muscular atrophy. *See* Progressive Muscular Atrophy.

WATER, Ætiological Relations of. *See* Disease, Causes of; and Public Health.

WATER, Therapeutics of. *See* Baths, Hydrotherapeutics; Mineral Waters; and Sea Air, Sea Baths, and Sea Voyages.

WATER BRASH.—A popular synonym for pyrosis. *See* Pyrosis.

WATER CANKER.—A synonym for cancrum oris. *See* Cancrum Oris.

WATER ON THE BRAIN.—A popular synonym for hydrocephalus. *See* Hydrocephalus, Chronic.

WATERS, MINERAL. *See* Mineral Waters.

WAXY DISEASE.—One of the synonyms for albuminoid disease. *See* Albuminoid Disease.

WEAL, WALE, or WHEAL.—This is an Old-English word signifying the mark of a stripe, that is, the prominent pale ridge caused by the stroke of a lash upon the skin. The term is applicable especially to the prominent risings of a lengthened figure which are met with in urticaria, in contradistinction to the button-like tubercles or protuberances of that affection. *See* Urticaria.

WEILBACH, in Germany.—Sulphur waters. *See* Mineral Waters.

WEN.—A popular term for a tumour of the integument, without reference to its pathological structure. Wens are commonly fleshy or encysted; in the latter case proceeding from distension of the sac or excretory duct of a cutaneous gland, more especially a sebiparous gland.

WET-PACK. *See* Hydrotherapeutics.

WHEEZING.—A peculiar sound, of a dry piping or whistling character, which may be heard in connection with the respiratory organs during the act of breathing, and caused by certain forms of obstruction to the passage of air. *See* Asthma; Bronchi, Diseases of; and Physical Examination.

WHIFFING.—A peculiar quality of a murmur heard in connection with the heart and vessels. *See* Heart, Valves of, Diseases of; and Physical Examination.

WHIP-WORM.—This term is not unfrequently applied to the small human nematode that is better known to the profession as the *Trichocephalus dispar*. Several of the older writers, following Büttner, supposed that the whip-like portion of the body formed the tail; hence the generic term *Trichuris* under which they described the parasite. Whip-worms not only infest man, but also several of our domesticated animals, which latter, however, as in the case of the human host, rarely suffer in consequence of the invasion. *See* Trichocephalus.

T. S. Cobbold.

WHISPERING PECTORILOQUY.—A form of pectoriloquy in which the whispered voice is distinctly heard. *See* Pectoriloquy; and Physical Examination.

WHITE GUM.—A popular name for the white form of strophulus, *S. albidus*. *See* Strophulus.

WHITE LEG.—A synonym for phlegmasia dolens. *See* Phlegmasia Dolens.

WHITE SWELLING.—A synonym for scrofulous disease of a joint. *See* Joints, Diseases of.

WHITES.—A common synonym for leucorrhœa. *See* Leucorrhœa.

WHITLOW.—Synon.: Paronychia; Fr. *Panaris; Tourniole*; Ger. *Paronychia.*

Definition.—Whitlow is a term somewhat loosely applied to any acute inflammation of the finger or thumb, which tends rapidly to terminate in suppuration, and is not limited to the matrix of the nail, in which case it would be called *onychia.*

Whitlow may be divided into four chief varieties, but these often merge into one another.

1. **Paronychia ungualis.**—Synon.: Superficial whitlow of Abernethy.—This form is limited to the ungual phalanx. The skin only is affected, and frequently at the side of the nail. It commences usually as the result of some slight injury, such as a bruise or puncture, or from the inoculation of septic or other irritating matter. The first signs are heat, tenderness, and itching in the inflamed part. The pain is not severe. On the third or fourth day pus forms, raising the epithelium from the cutis vera, and as it cannot point through the dead cuticle it remains pent up, and the tension so caused increases the pain, and if unrelieved leads to ulceration of the true skin, the pus then finding its way into the cellular tissue beneath. The whitlow then merges into the second variety. It may also spread to the matrix of the nail, and so become complicated with onychia. If relieved early, by cutting away the cuticle which has been raised by the pus, it seldom leads to any unpleasant consequences.

Treatment.—The treatment consists in bathing the finger frequently in hot water, and applying lint soaked in hot water, which is cleaner and better than a poultice. A combination of equal parts of glycerine and extract of belladonna will be found an invaluable application, frequently cutting the inflammation short, and always relieving the pain. As soon as there is any sign of the cuticle being raised by fluid beneath, it should be cut away with a pair of scissors, or a razor or sharp knife. An incision is never necessary.

A form of superficial whitlow is sometimes seen occurring without any apparent cause, and attacking one finger after another. The fluid beneath the cuticle is not always purulent—sometimes being merely albuminous, and mixed with flakes of lymph. It never leads to any deep suppuration. It is most common in children and females, and is consequent upon general debility. It is described by the French under the name of *Tourniole* or *Panaris phlycténoïde.* It is a troublesome affection, and difficult to get rid of. Tonics and iron are the most important remedies. Sometimes arsenic is of use.

2. **Paronychia cellulosa.**—The inflammation in this variety commences in the cellular tissue of the pulp of the ungual phalanx. It arises almost invariably as the result of some slight puncture or other injury, or as the consequence of neglecting the variety just described. The tip of the finger is swollen, tense, and excessively tender. There is severe burning, throbbing pain, and possibly red lines spread-

ing from the inflamed part in the course of the lymphatics. There is more or less fever, with general constitutional disturbance. Pus forms by the third or fourth day. It tends to point through the skin, but the thick cuticle usually resists its pressure for some time, and if this be not cut away early the gravest results may ensue. The pus may find its way into the sheath of the flexor tendons; or the bone may be exposed, and necrosis may follow, the disease then merging into the two following varieties. If an incision be made about the fourth or fifth day, a large slough will usually be found beneath the skin.

Treatment.—A free incision must be made longitudinally into the pulp of the finger as soon as the condition is recognised, and by this means all complications will be averted. If the pus have already found its way through the cutis, and be pent up beneath the epidermis, it is often sufficient merely to cut away the loosened cuticle with scissors. In other respects the treatment is the same as for the first variety.

3. **Paronychia tendinosa.**—Synon.: Thecal abscess.—This is usually classed with whitlow, and is often secondary to the other varieties. It frequently begins, however, as a primary inflammation of the sheath of the flexor tendons. It is supposed by some to be related to erysipelas, and in many cases it probably is so; but frequently its cause is uncertain. It may arise from a wound opening the sheath of the tendon, but then would hardly be called a whitlow. The whole finger swells, and becomes tense and red. The pain is most severe, usually shooting up the hand and arm. Pus forms early, and if not evacuated by incision, exposes the bones, destroys the tendons, burrows into the joints, and rapidly destroys the finger. If affecting the thumb or little finger, the sheaths of which are continuous with the common sheath at the wrist, the suppuration rapidly extends to the palm of the hand, and to the forearm above the annular ligament. The wrist-joint may then be opened, and destruction of the whole hand result. The constitutional disturbance and fever are usually very marked. The disease is most common after middle life, and in patients of a broken constitution. The affected finger or hand seldom recovers perfect utility; and death is not uncommon, either from exhaustion or from some secondary complication.

Treatment.—Hot baths to the hand, fomentations and poultices, and free and early incisions are required. Glycerine and belladonna is a most useful application, Stimulants, good diet, and tonics are always necessary.

4. **Paronychia osseosa.**—This is a somewhat rare variety of whitlow, arising sometimes from injury, sometimes without apparent cause. It is an acute inflammation of the periosteum of the ungual phalanx. It is characterised by redness and swelling, with most intense aching and tensive pain, and acute tenderness. If an incision be made as soon as pus is recognised, the bone will be found to be already bare and necrosed. This condition can only be averted by cutting down to the bone before suppuration has occurred, and this is rarely possible.

Treatment.—This is the same as in the other varieties, namely, hot applications and free incisions. The necrosed phalanx must be removed as soon as it is loose. If more than one phalanx be affected, amputation may be necessary.

One or two points common to the treatment of all varieties require further notice. All incisions should be made as far as possible in the middle line, so as to avoid wounding the digital arteries. The sheath of the flexor tendons should on no account be opened, unless there is pus within it. In all doubtful cases an anæsthetic should be administered, the limb made bloodless by Esmarch's method, and the incision carried carefully towards the flexor tendons. In this way the exact situation of the pus can with certainty be ascertained, and an unnecessary wound of the sheath of the tendon avoided. Incisions are frequently made into the pulp of the ungual phalanx of the finger when the pus is really on the dorsum. This arises from the sense of fluctuation yielded by a swollen finger covered by somewhat thick cuticle. In all cases the cuticle should be cut away as soon as it is loose, and not allowed to hang about in shreds caked with putrid pus and linseed meal. The best application in all cases is boracic acid lint, three or four layers thick, wetted with hot water, and covered by oiled-silk and cotton wool. This is perfectly clean, and in every way as efficient as a poultice. Soaking the hand frequently for an hour at a time in an arm-bath usually gives great relief in the more severe forms.

Marcus Beck.

WHOOPING-COUGH. — Synon.: Kin-cough; Hooping-cough; Pertussis; Fr. *Coqueluche*; Ger. *Keuchhusten.*

Definition.—An infectious specific disease, chiefly affecting children, lasting six or eight weeks, rarely attacking the same person twice, and accompanied by a peculiar spasmodic cough. The cough, not characteristic till the second week, comes on suddenly with some quick, short, forcible expirations, and flushed face; then a long, shrill inspiration, or whoop, and several rapid coughing efforts in repeated paroxysms occur, ending in the expulsion of viscid mucus, or in vomiting. A return of cough is readily excited for some time after the disease has subsided.

Ætiology.—Infectious particles thrown off by the cough, and carried to the air-passages of the susceptible, there fixing and multiplying, set up the same series of disturbances by which they are produced, reproducing abundantly more infectious material. Whooping-cough occurs in epidemics, chiefly prevalent in the spring, extending over a large part of any town or district associated by various means of intercommunication, or by common educational establishments, and spreads as long as young children who have not had the disease before are brought within its influence. For a disease of this kind, attacking the respiratory surfaces, and then exciting a specific secretion, with violent cough to scatter it, a more widely diffused air-borne infection might be imagined than for other infectious diseases. There is no proof that such infection is ever carried across any wide distances; what the limit may be for such transportation is quite uncertain. From the reception of infection to the evidence of its effects, an interval for incubation always intervenes. When children are said to have been attacked soon after exposure to keen air, this has only roused into activity a cause already in operation. Some quality of the air or season may act as a predisposing cause. Certain bodily states—the condition of teething, and that left after measles and some other diseases—predispose the mucous surfaces to receive and foster the germs of whooping-cough. This infection is often received with that of measles, and the characteristic cough of the one disease is not recognised till the rash of the other has passed away. Three weeks may elapse before children, who have been exposed to infection, show signs of it by the whoop; they, therefore, should not mix with others who are susceptible till this period is safely over. Infection persists for six or eight weeks after the disease is declared; after this there may be a return of cough or spasm without fresh danger of infection. During the illness any bit of mucus thrown off by the cough may be the medium of infection; whether other secretions are infectious is a matter of doubt; emanations from the sufferers may be so even after death. The disease is readily propagated by *fomites*; it is frequently carried from house to house by the clothes of visitors; the sick create an atmosphere around themselves into which the susceptible cannot enter without danger of being seized; a portion of this atmosphere is easily removed and carried in the folds of dress to other houses and rooms. Some infectious particles cling to the clothing of convalescents for a long time. Active infection is given off by those affected slightly, or only beginning to be so, while sickening for the disease; even the insusceptible, who are not liable to suffer in the same way again, may have slight cough or irritable throat after being with the sick, and so, ailing little or nothing themselves, be the means of carrying infection elsewhere.

Whooping-cough prevails so extensively in early childhood, that it is rare to find anyone grow up without having been exposed to it. Those who escape infection in childhood mostly escape it altogether. Adults are rarely seized. When this happens—and no age is exempt—the disease goes through its full course with the same symptoms as in infancy, but with none of the dangers then arising, only with the vexations of a tiresome and embarrassing ailment.

The greatest number of cases occur in children under eight years of age. It is one of the three diseases most fatal to young infants, and like the bronchitis of cold weather, and the diarrhœa of summer, is most fatal to the youngest; it differs from these in not being more fatal either in very hot or in very cold years. Whooping-cough comes next to scarlet-fever in the number of deaths attributable to it in this country, the proportional mortality from this cause being five or six per ten thousand of population, and nearly 2½ per cent. (one-fortieth) of yearly deaths from all causes. Three-fourths of all the deaths from it are of children under two years of age; yet more than 40 per cent. of all the mortality falls in the first year, over 30 in the second, about 15 in the third, 6 in the fourth, 4 in the fifth year, and less than 4 per cent in the next five years. Sex has a marked influence on the fatality of whooping-cough. Girls suffer more than boys. While half the attacks of boys are severe, five-sixths of the attacks among girls are so; the deaths of girls being nearly one-third more than of boys. If the proportion of deaths to attacks is put at 2½ per cent., so great is the difference made by age, that the range must be from 10 per cent. or more in the first two years to a decreasingly lower rate afterwards, with a smaller variation for sex. Race and climate make little or no difference as to the liability to whooping-cough. Season has an influence on its epidemic extension; this with us is always in the spring. Cold indirectly adds to the intensity of the disease; it is increased by overcrowding, bad ventilation, and the confinement of the sick in close apartments. All the hygienic defects which lead to rickets in that way add greatly to the bad effects of whooping-cough.

The period of incubation is well-marked in all cases, and extends from four days as the shortest limit, to ten days or a fortnight as the longest; in the latter instance, a solitary one, no catarrhal symptoms were noticed till thirteen days after a single limited exposure, the whoop appearing ten days after that. Usually some catarrhal and febrile symptoms, with or without cough, appear from the fourth to the seventh day after exposure to infection. The invasion, or catarrhal, stage lasts a week. The whoop mostly begins ten days from the ingress, unless accidentally delayed; it has been heard as early as the eighth day, or as late as the twenty-fifth and even later, or not at all. A healthy infant, born amidst whooping-cough, sickened at the end of the first week, and survived a fortnight; another, it is said, was infected on the second day, and whooped on the eighth. A child, whose mother had herself been four weeks ill with this disease, is stated to have been born with whooping-cough. The complaint has not been directly produced by inoculation.

Pathology and Anatomical Characters.—The course and duration of all the symptoms of pertussis are too constant and definite for the cough and other results of the disease to be deduced from the effects of any kind of local irritant on the mucous surfaces of the air-passages. A specific catarrh with hyperæsthesia is admitted by all. Is this located chiefly in the bronchi (Broussais and Guersant); limited in the first instance to the laryngo-pharyngeal mucous crypts (Gendrin); or confined within the larynx (Beau)? The latter view is supported by the redness seen extending from the epiglottis to the vocal cords; and by the tumefaction, and viscid or puriform secretion, found in the larynx after death. But the larnyx may redden only when the cough begins, and this may be excited by mucus rising into the trachea from below as well as by that touching the glottis from above. As neither laryngitis nor bronchitis in children is attended with persistent spasm, a cause for this has been sought in the swelling of the bronchial lymphatic glands so often associated with spasmodic cough. This source of reflex excitement of the vagus is applied by Dr. Noël Guéneau de Mussy to explain the recurrence of spasm long after the usual term, rather than advanced as an explanation of the character of the cough throughout the disease; he suggests, however, that the absence of spasm from the first stage of the disease, or its delay, may be from the bronchial glands not being very much enlarged in such cases. The small lymphatic glands in the neck and along the trachea and bronchi are affected early both in this disease and in measles; their enlargement is much less marked in adults than in children, yet adults have the same spasm in the second stage of whooping cough; and in the serious pulmonary lesions after measles children have not the same kind of cough. The explanation is in the specific or contagious element. In ordinary catarrh or bronchitis the spasm yields when secretion begins. Here the same contagious matter that began the irritation not only keeps it up by local increase, but, multiplying vastly for a certain time, is thrown off by the surfaces where it proliferates, or to which it is carried, perhaps with added virulence and activity. A less permanent, less energetic, or less extended irritation of all the sensory terminations of the pneumogastric nerve would not so excite and increase the susceptibility of the nerve, while diminishing and exhausting its power, thus modifying the nutrition and function of its centre; the change so impressed continuing long after the original exciting cause has ceased. A special influence may from the first be attributed to the specific cause. A certain degree of hyperæmia would determine fever, distend the lymphatics, and excite cough by irritation of the peripheral nerves. But the nerve-centres both of the respiratory and sympathetic system are disturbed in the earlier stages, and the vagus specially implicated before the enlarged bronchial glands or other local causes of excitation are established. The impaired function of the pneumogastric is shown by the rapid and weak pulse, epigastric tenderness, loss of appetite, weak respiration, and pulmonary congestion; this aids the impulsion of morbid products to the bronchial surface, hence a specific secretion and a further source of reflex irritation, hyperæsthesia, and the special characters of the cough. The element of contagion whatever it may be, is reproduced abundantly in this catarrhal secretion, for a definite time, after which it does not reappear; the cough or spasm may return for months, but no real relapse of the disease. One attack is protective against a recurrence. The disease then is zymotic, and essentially neither a neurosis nor a bronchitis, though both of these conditions are excited by it. Zymosis may be either by a local proliferation, or a general infection, or both; it has been thought sufficient in this case that contagia should reach to the surfaces of the air-passages; these acting locally upon the mucous membrane may entail all the consequences of the disease in the former mode only; and some altered ciliated cells, which could not possibly enter the blood, have been figured as the infecting and infected bodies. On the other hand, bacteria, as seen by V. Potain, and micrococci, described by Letzerich as in mucus only, and seen by others, abound in the secretions, penetrate the cell-structures, and are found in the leucocytes of the blood and tissues. These differ little, if at all, from those of ordinary occurrence, except in their number and rapidity of increase. It is unlikely that the common forms could acquire special quality from accidental inflammation around them; but these, derived from a special source, may carry with them special qualities setting up the same action in a suitable medium as that in the tissue from whence they were derived; they permeate freely, and the process has ceased to be local before the signs of disease are observed. The part taken by the white corpuscles of the blood, as agents of absorption and infection, cannot be overrated.

As in the exanthemata the rash shows impaired vaso-motor nerve-control, so in whooping-cough the irritability of the surface of the pharynx, glottis, and trachea is early evidence of disturbed innervation. There is no deep-seated congestion of the fauces; the catarrhal state is more marked below the glottis than above, the trachea is often pale, the bronchi are always congested, and the smaller lymphatic glands along their course, and beside the trachea, as well as the larger bronchial glands, are red and swollen, so as to be constantly pathognomonic; later these or the mediastinal glands may show centric softening. The bronchial membrane is thickened, red, and covered with sticky masses of secretion, in which groups of micrococci are found; the viscid secretion in the smaller bronchi is an almost constant condition, and its liability to be drawn into the pulmonary alveoli a prominent character of the disease; such blocked alveoli look like tubercles under the pleura; if punctured the contents will squeeze out. Ecchymoses are seen on the pleuræ, and sometimes in the pericardium. The œsophagus is pale, but the mucous membrane of the stomach is often swollen and red, with punctiform injection or petechial spots; effused blood has been found in the bowels; a follicular inflammation of the intestines is associated with gastric catarrh; and there is some enlargement of the mesenteric and retro-peritoneal glands. The liver is more often hyperæmic than the spleen, with some fatty cells; or is large, with yellowish-grey fatty change in the tuberculous or rachitic. There is no definite kidney-lesion. Cerebral effusions, like chemosis or œdema of the face, are the accidents of cough and dyspnœa. Spasmodic cough is not merely a reflex from the upper laryngeal nerve; shallow respiration and insufficient oxygenation excite respiratory efforts, but if no more air gets to the blood, expiration is accentuated, and goes on in a convulsive repetition, due to the stimulation of the medulla by the venous blood; this happens on any interference with the supply of oxygenated blood to the respiratory centre, and from these efforts exhaustion results. When the centre recovers its excitability, inspiratory effort follows, and on the rapid alternations of these states much of the frequency, force, and duration of the paroxysms depend. Repeated distension of the right cavities of the heart in the fit cause various venous hæmorrhages. Obstructed air-cells, catarrhal pneumonia, and lobular collapse of lung, with surrounding emphysema, also occur as secondary phenomena. These, with cerebral congestion, result from futile cough. Impeded respiration leads to convulsions in children; most, if not all, of the cerebral symptoms during the illness are indicative of some further mischief in the lung. In rickety subjects these complications, together with the greater tendency to spasm in this diathesis, produce bending in of the ribs and contraction of the chest, often interfering greatly with healthy development in later years.

Symptoms.—The invasion of whooping-cough is insidious, rarely with chills. Some fever or cough is first noticed at night; the child is better next day, but loses appetite, is fretful, or looks pale and languid; the pulse is quick, and the respiration shallow; there may be sneezing or signs of catarrh, but these mostly appear after another night of fever, or of teasing, frequent cough, which may be croupy before secretion begins; the glandulæ concatenatæ are perceptible to touch; instead of a freer secretion relieving the symptoms, as in ordinary catarrh, it is thin, and they increase; there may be high fever, with pulmonary congestion, or the fever subsides, and bronchial *râles* are heard on deep inspiration. This is known as the *catarrhal stage*. It lasts eight or ten days, the whoop being seldom heard till the end of the second week. But the period is not definite, for the fever of this, as of the other two stages of whooping cough, is marked by great irregularity, with intervals quite free from fever; in this stage it may be prolonged by various complications, or be very little noticeable. In the latter case the cough is sooner distinctive; it comes on in fits, mostly at night; in the day there are intervals without cough. When the cough is coming, the child's face reddens, as if trying to suppress it, till it bursts out in a series of short, quick forcible efforts; then the breath is drawn in with a shrill whistling sound, again followed by the boisterous cough; after a short pause comes a less severe and shorter fit, and then another, till a quantity of whitish viscid mucus is expelled, some perhaps through the nose, and some swallowed, or the child vomits at the same time, ejecting the contents of the stomach.

When the secretion is free the catarrhal stage is over, and the *spasmodic stage* begins. At this time laryngoscopic observation has shown the mucous membrane pale to the lower third of the trachea; before the cough whitish mucus has been seen to rise to the bifurcation of the bronchi; then cough begins; some time after it is over the vocal cords have been observed to be redder than before. Bronchial catarrh is as much a feature of this stage as the spasm. When the cough seems to have come on without cause, the secretion has risen to the trachea; children are often old enough to describe a tickling in the throat before the cough, they show dread of its approach, and prepare for the attack, by steadying themselves, or clinging to others for support; they are glad when it is over, and seem afterwards cheerful in the day, and go to sleep again at night. Not so with younger children; before the attack the pulse quickens, the breathing is short and insufficient, *râles* are heard, spasm closes the glottis, the air is forced out in sudden jerks, and then enters with the loud long-drawn whoop; this is repeated till the face becomes livid and swollen, and the child exhausted or semi-conscious. Frequent attacks of this kind keep the face puffy; may produce small ulcers on the frænum linguæ; and make the eyes red and watery, often with small hæmorrhages into the conjunctivæ. Or blood starts from the nose and mouth in the paroxysm, and is seen in the matters vomited, while both urine and fæces may be passed involuntarily. In some cases diarrhœa and vomiting are serious symptoms. While the cough forces air from the lung, the percussion note is dulled, and becomes again resonant after the sibilant inspiration is heard. The heart's action is impeded, sometimes interrupted by the passive congestion reacting on its cavities during the cough, or from irritation of the vagus; neither endocardial nor pericardial lesion is found in whooping-cough, and nothing is found wrong with the heart after the fit is over.

Examination of the chest in the intervals of cough reveals the usual signs of whatever pulmonary complication is present. In most cases mucous rhonchus is heard over the larger bronchi, and some finer rhonchi on deep inspiration, with weak respiratory sounds; moist or dry crepitation replaces these in places where the finer bronchioles or alveoli are affected; this may occur without much capillary bronchitis or pneumonia in the following way:—Violent spasm prevents air entering some of the smallest tubes, the epithelium thus loses its cilia, and, mixed with muco-purulent secretion, blocks a small lobule or fills an alveolus; this happens when the fits of cough are worst and most frequent; with closed glottis the forcible expiratory efforts compress the contents of the alveoli, and squeeze out the fluid parts, leaving the débris to caseate; a dry crackle, rather than moist bubbling *râles*, may be indicative of this. Meanwhile air in some peripheral lobules, compressed in the same way, gives rise to vesicular emphysema; this state of lung can recover itself sooner than the other. A more extensive capillary bronchitis or catarrhal pneumonia is shown by grave general symptoms, restless tossing, rapid breathing, dusky face, coma, and convulsions.

Without these complications, the *third stage*, of subsiding spasm and loose expectoration with returning health and strength, may be reached in from four to six weeks. The mildest cases may seem to be over sooner, with one week for the catarrhal stage, and two for the spasmodic; but any little want of care will intensify the symptoms; and relapses are common until six weeks are accomplished, even in cases where the second stage has not been prolonged beyond four weeks. The disease often lasts two months, and is followed by a tedious convalescence. The pulmonary deposits may originate tuberculosis. The disturbances of nutrition and innervation are long in being restored; some of the accidents of rickets never.

Diagnosis.–Influenza has dry, frequent cough, paroxysmal, and worse at night, with gastric and febrile symptoms, hardly distinguishable at first from those of the ingress of whooping-cough; but influenza prevails as a widely spread epidemic, not limited to children only and to a particular neighbourhood, but affecting persons of all ages; there is more coryza; it has a crisis in five days, and is mostly over in ten days, and relapses are frequent; the same persons are attacked more than once, sometimes even in the same epidemic. In children if cough persists, it is without whoop; the conjunctivæ may be red, but have no blood-effusions; no small ulcers form under the tongue. Bronchitis comes on in cold weather directly after exposure or chill; the breathing is quickened from the first. Infantile laryngitis also has no stage of incubation. Laryngeal diphtheria has no remissions. Both alter the voice and cry. Some catarrhal attacks among children, coming on with fever, often with laryngeal irritation, and with fulness of the small cervical glands, are less readily recognisable; in these, if the breathing at first be less quickened than the pulse, this difference ceases as soon as lung-mischief begins. An opinion can only be given after some delay and caution, unless, as is also the case with measles, the child is known already to have had these diseases. A first question is, What infantile ailments are over? the next, What have been the chances of exposure? Hay fever occurs in the summer, mostly in adults; it attacks certain people only, and these every summer; if the first attack were supposed to be whooping-cough, the mistake could not be made a second time. The spasmodic cough of hysteria is incessant, and without whoop; it is only contagious by imitation.

Prognosis.—Young children under defective hygienic conditions, or the subjects of rickets, are least likely to make the favourable recovery generally expected in uncomplicated whooping-cough. Many young infants die from laryngeal spasm, sometimes in the earlier stages of the disease, but mostly in the second stage, when it is readily excited both by pulmonary causes and by bad ingesta, such as bits of orange-peel or other irremovable irritant in the stomach. With good sanitary surroundings and individual care the youngest may escape, unless debilitated by previous illness, such as measles, or a defective state of nutrition, at the time of the attack. The risks diminish with each year of childhood, excepting that the impaired resistance of the chest-walls in rickets may place a child of seven much in the state of another at two or three years old. Constitutional defects, or the accidents of nurture may lead to wasting diseases which begin in the third stage, and prove fatal some time after, or at any age. High fever during invasion is a warning of severe complications in the subsequent stages. Convulsions in any stage of whooping-cough are of the worst significance; somnolence, or a listless condition between the attacks, and persistent high temperature, are bad signs. The danger of the second stage is in proportion to the severity of the spasm. It may be estimated by noting the number of attacks in the twenty-four hours, their intensity, and duration; in bad attacks the expulsive efforts are more rapid, and there is a shrill or repeated whoop; in mild attacks there is less spasm, and the whoop is not always heard, or perhaps only once. The duration may be from a few seconds to some minutes. The number of attacks may be raised from twelve to twenty in the twenty-four hours without danger, if the intervals are complete enough for the child to seem bright and take food in the day, and to get sleep by night; as many as 60 to 80, or even 140 have been counted; they may be so incessant as to interfere with both food and sleep, and are very exhausting. When the nutrition is enfeebled, and the tongue often protruded over the teeth in violent cough, small ulcers are found; they are proofs of the severity of the spasm, and mostly indicative of a danger that is over. Capillary bronchitis and pneumonia are the complications most often fatal; œdema of the glottis or of the lung surely so, but these conditions are rare. Chronic pneumonia is apt to result in dilated bronchi, or in phthisis. Emphysema tends to disappear. Partial collapse may largely recover itself on air regaining admission to the lobule. Blocked alveoli set up a circumscribed pneumonia; their contents caseate; and tuberculosis results from these centres, or from degeneration of the enlarged bronchial and mediastinal glands. Tubercular meningitis and acute tuberculosis during or after the third stage are rapidly fatal.

Treatment.—We have no specific for whooping cough; no drug to check its onset or stop its progress. The disease is of long duration; the patient a child. Hygienic conditions must be observed, and means used to prevent distress, reserving the more active remedies for special occasion. Rest and warmth, with much individual care, and the utmost attention to a sufficiency of pure air, are requisite from the first, and indeed throughout the illness. It is not merely exposure to cold, but fatigue and injudicious food, that determine the accessions of fever so frequent in the course of whooping-cough. These accessions have always with them an increase of the germs of the disease, more as a result than as a cause; they are better lessened or prevented by whatever aids the resisting powers of the child, than by close cosseting indoors, or the use of special germicides, except as a means of freshening the air of the room; an aggravation of all the symptoms follows the confinement of one or two sufferers to a single chamber. The diet is to be light and nutritious, milk forming an important element in the meal, and some addition to the ordinary food has often to be sought, whilst all things hard of digestion or irritating are to be avoided. Broth should be made with vegetables and without condiments; stewed fruit, orange juice or lemon, and grapes are grateful; some extra diluent is always requisite. Each child wants a good deal of help and ready assistance; some one should be near to calm from fright when the cough begins, and to raise and hold the child till the fit is over.

In the *catarrhal stage*, if the ingress be febrile, a day in bed may be right; the child is better indoors till this stage is over; the room must be changed two or three times a day, so that one is thrown open and freshened while the other is occupied, and then closed and warmed, in its turn to be ready for use. Some simple saline, as acetate of ammonia, may be required, or ammonia in any dilute form. A sip of cold water often relieves cough, but at night some ipecacuanha will be needed; a teaspoonful of the wine, mixed with an ounce or two of sweetened water for the night, can be given by spoonfuls till the cough either lulls or ends in sickness. The bromide of potassium or ammonium in repeated doses, gr. iij–v. to the spoonful of water, gives relief at night in this stage, though more suitable to the next, when antispasmodics, of which chloral is the chief, are most wanted. No form of opium or of belladonna is to be used till the first stage is over, and secretion is free; nor while there is any local congestion or other source of irritation to be removed. A warm poultice of crushed linseed across the back of the chest is often of the greatest use when the cough is teasing, and should always be applied if fine *râles* be heard, or if there be deficient expansion over any part of the lung. The first extension of bronchitis to the finer tubes excites bad spasm, for which a few small doses of any antimonial may be proper, if the child be robust and plethoric. In most cases ipecacuanha can be continued in small doses for some time; the emetic dose at night often soothes by emptying the stomach; this relief must not be sought too frequently, though children's stomachs soon recover from this effect of ipecacuanha after a sleep. The bromides of potassium or of ammonium can be continued throughout all the first and second stages with advantage. A solution of carbolic acid, 2 or 3 grains to the ounce, may be beneficially given to children for several days together at the end of the catarrhal stage, in doses of a teaspoonful to an infant, and a tablespoonful to a child eight years of age, every six hours. The mode of action of carbolic acid is probably very much like that of hydrocyanic acid, once so much recommended in this complaint; it not only lessens spasm, but exerts some influence on the white corpuscles. Some of the soothing effect of spraying this solution of carbolic acid with a small steam vaporizer in a room may be from a part being absorbed. In very many cases no medicinal treatment is needed, but there are others in which the child is obviously ill with more than the usual fever; or, just when amendment is expected and a freer secretion should come on, there is an increase of fever, with no marked complication. In these cases quinine should be given; one grain *per diem* in powder for each year of age, continued for two or three days only, answers best; double this quantity at a single dose, and that repeated, has been given with good effect during the first four or five days of the spasmodic stage. The power of quinine in opposing the pyrogenic force of infection may be exercised through the white corpuscles, as explained by Binz; it has been proved to control reflex excitability. Some priority in the use of quinine and of chloral may be claimed by the writer, in *Temperature Observations in Whooping Cough*, published twelve years ago. Six grains of quinine given to a boy 4 years old, in the afternoon of March 27, 1869, reduced temperature 3° in a few hours. A girl, 5 years old, took thirty grains of chloral on April 12, 1870, in three doses with relief to spasm. The usual dose of chloral required by children is one grain for each year, given two, three, or four times in the twenty-four hours, in proportion to the frequency and severity of the spasm. One great advantage in the use of both these remedies is that they can be given in enemata, either nutrient or stimulant.

Relief of spasm is the main object of treatment in the second or *spasmodic stage*, the efficacy of the means employed being measured by the diminution in the number of daily attacks. By this test belladonna comes next to chloral, if given in large and continued doses; with a child of three years old, $\frac{1}{8}$th to $\frac{1}{4}$th a grain of the extract, or 10 to 15 minims of the tincture, is reached before the pupil is dilated; atropine divided into doses of $\frac{1}{80}$th or $\frac{1}{100}$th of a grain with sugar of milk, or drop doses of the sulphate in solution, is a more certain way of getting the effect required, and regulating the quantity necessary to produce it. Minute doses of morphia, $\frac{1}{80}$th of a grain given with the atropia, or small doses of any opiate with belladonna, answer better than if given uncombined; but this addition is only permissible when the secretions are free, and the means of relief do not require frequent repetition; it is specially useful near meals, when food is ejected with the cough. Oxalate of cerium, 2 or 3 grains for children, 10 grains night and morning for older persons, is of use here; or strong coffee given after meals. The liquid extract of ergot, one drachm a day, given in divided doses to children for two or three days, is said to control spasm. Conium reduces spinal irritability; a lozenge made with one grain of the extract, one-sixth of a grain of ipecacuanha, and one-sixtieth of a grain of morphia, mixed with powdered sugar or treacle, can be given in the earlier spasmodic attacks of cough with advantage. A child of three years old can take three or four of these in one day without nausea. Ten minims of the succus conii are equal to one grain of the extract. The tincture is equally active. Hydrobromate of conia, $\frac{1}{12}$ grain for a child, has been given. The inhalation of ether, ethyl-bromide, or of chloroform is not suitable for children. Croton-chloral, in doses half those of chloral, one or two grains in weak solution, or disguised in powder, given to children three or four times a day, lessens the force and frequency of the spasm. Bromide of ammonium is often all that is required, but nothing is so efficacious as chloral hydrate. Most of the remedies vaunted for cure of whooping-cough owe their repute to having been administered in the fifth or sixth week of illness, when other agents are said to have failed, and the disease is nearly over. Frictions across the back and chest with an oily liniment, to which oil of amber is often added, or with belladonna and opium liniments combined, are useful. Spinal friction, or repeated use of a narrow poultice with a little mustard along the spine every night to cause temporary redness, has seemed to be of service. All the more potent means of counter-irritation, croton oil, blisters, and mustard poultices, are to be avoided, as well as leeches to the head.

In the *third stage* of whooping-cough some astringents are often of great use; and restorative means are much wanted. Alum is of decided benefit when excessive secretion is troublesome. So is tolu or ammoniacum. Tannin, and also oil of turpentine are used. Zinc in small doses is useful. One or two grains of the oxide may be given three or four times a day in powder, or half a grain of the sulphate in solution. An emetic may be required, to remove excess of mucus; zinc can at this time be added to the ipecacuanha, which alone is best for the earlier stages, when emesis is more often required. Purgatives are at no time advisable. A drop of laudanum before food stays sickness. The mineral acids make an agreeable aid to digestion. Bark or iron may be required, and cod-liver oil. Minute doses of arsenic with meals, and iodine externally over small spaces on alternate days to back and front on either side, counteract obstinate adenopathy. Change of air has a remarkable effect in restoring appetite, and removing spasm, after the disease is quite over; it should not be sought before six weeks, and is often better deferred till two months from the commencement of illness. If the tubercular diathesis have been set up or evoked, the greatest care in nursing, and the most perfect quietude, are essential. Great risks, without benefit, have been run by taking children to gasworks during the course of the complaint. Attempts to cut short the disease by inhalation or insufflations of germicides fail. A weak spray of carbolic acid in the room, or a solution of it, or of peroxide of hydrogen, on cloths or near the child's couch, or sprinkled about, do good by purifying the air.

W. SQUIRE.

WIESBADEN, in Germany.—Thermal salt waters. *See* MINERAL WATERS.

WIGHT, Isle of. *See* UNDERCLIFF; VENTNOR; and CLIMATE, Treatment of Disease by.

WILDBAD, in Germany.—Simple thermal waters. *See* MINERAL WATERS.

WILDUNGEN, in Germany.—Earthy waters. *See* MINERAL WATERS.

WINDPIPE, Diseases of. *See* LARYNX, Diseases of; and TRACHEA, Diseases of.

WINKING, Involuntary.—SYNON.: Nictitation. *See* FACIAL SPASM.

WINTER-COUGH.—This expression is associated with those cases in which a patient is subject to more or less cough during the winter season, being free, or almost free, during the warmer portion of the year. It may come on at any period in the course of the winter, and is generally referable to some obvious cause, which produces 'a cold.' The attacks tend as a rule to become more aggravated and difficult to cure, as well as more easily excited, as time progresses. There is no valid reason why cases of winter-cough should receive any special designation. At any rate this should not prevent them from receiving due attention, instead of being summarily dismissed as mere cases of 'winter-cough'; and it is important in every instance that satisfactory investigation should be carried out, so that the exact conditions which produce the cough may be determined, and the proper treatment pursued which these conditions indicate.

Without entering into details, it may be stated that cases of winter-cough belong chiefly to the following classes:—1. Not uncommonly it is merely due to a slight catarrh, affecting the throat and main air-passages. 2. Most frequently the cough depends on bronchial catarrh or bronchitis in various degrees, usually associated with more or less emphysema. 3. Winter-cough may characterise some chronic phthisical cases, this symptom subsiding during the warmer season. 4. There are certain forms of cardiac disease, of which winter-cough may be a prominent phenomenon.

TREATMENT.—The treatment of winter-cough must depend on the nature of the cause which gives rise to it, and will be found discussed in the special articles descriptive of the several conditions.

FREDERICK T. ROBERTS.

WOMB, Diseases of.—SYNON.: Fr. *Maladies de l'Utérus*; Ger. *Krankheiten der Gebärmutters.*

There is probably no department of practical medicine in which more progress has been made within the last twenty years, than that comprehended under this article; and it was only after the invention of exact methods of physical examination, such as the speculum and the uterine sound, that its advance towards the prominent position it now holds commenced. Indeed until these came into use the gynæcologist was much in the same position, with regard to diseases of the uterus, as the general physician with regard to diseases of the chest before Laennec's immortal discovery. In the one case, as in the other, the practitioner had of old to trust to general symptoms only, and these were very apt to mislead. As it is only by an accurate examination of the uterine organs that any certain knowledge of their condition can be acquired, the method of making this forms an essential preliminary to the study of uterine disease.

Methods of Physical Examination.—1. *Digital Examination.*—Of all methods of examining the uterine organs, the most important is by the finger alone, nor is the necessary *tactus eruditus* by any means easy to acquire. In this country the lateral position is generally adopted, and, except under special circumstances, is preferable, as involving less exposure than the dorsal. The patient should lie on her left side, with her hips as near the edge of the bed as possible. The semi-prone position is the most convenient, the patient lying more or less on her face, her knees being flexed, the upper one more so than the lower. A good position much facilitates a complete examination of the pelvic cavity, and attention to these details is never superfluous. The index finger of the right hand is now carefully introduced, at first in the axis of the vaginal outlet, and then in that of the pelvic brim. The unimpregnated uterus is suspended, as it were, at the top of the vaginal canal, with the cervix projecting into it. The latter is the part of the uterus which the finger first reaches. As the normal direction of the uterus corresponds with the axis of the upper part of the pelvis, or, roughly speaking, with a line extending from the umbilicus to the coccyx, the cervix, in a healthy state, projects into the vagina, and points backwards towards the sacrum. Its shape varies in women who have had children, and in the unmarried or nulliparous. In the latter it is conical or nipple-shaped, and the opening of the os uteri is felt at the apex of the cone, as a circular aperture about the size of a pea. The anterior and posterior boundaries of the os uteri are known as the lips of the cervix, and they are very liable to alterations in size, becoming congested or enlarged under various morbid states, one often to a greater extent than the other. In women who have borne children the shape of the cervix is altered, and it becomes shorter and less regularly conical. The os is also changed from a circular opening into a transverse fissure, which is often more or less nodular and irregular at its edges, from lacerations of its tissues during labour; and is sometimes sufficiently open to admit the tip of the finger. When healthy, the mucous membrane covering the cervix is smooth and velvety to the touch; and through the speculum it is seen to be of a uniform rose-pink colour. Under various morbid conditions it becomes rough, granular, stript of its epithelium, and covered with hypertrophied papillæ, and these alterations are of much importance from a diagnostic point of view. Having ascertained the conditions of the cervix, paying particular attention to its size, shape, density, sensibility, and to the shape of the os uteri, we may next proceed to examine the body of the uterus, passing the finger for this purpose past the cervix into the vaginal *cul-de-sac* behind, in front, and on either side of the uterus. In this way we feel whether the uterus is of normal size, or hypertrophied, as it often is; whether it is painful on pressure, or not; whether the uterus is freely movable by the finger, as it ought to be; or whether it be fixed and immovable in any part of its contour, as is often the case from inflammatory adhesion in its vicinity. Then again, in the same examination, we ascertain if any swelling exists in any of the vaginal *culs-de-sac*, in front, behind, or at either side; and if so we try to determine its form, density, mobility, sensibility, and whether it is attached to the uterus, or is independent of it—all points of importance in arriving at an accurate diagnosis.

2. *Palpation.*—In this part of the examination we may often gain much assistance by combining *abdominal palpation* with vaginal examination. This method of bi-manual examination is always of great utility, and is sometimes indispensable for accurate diagnosis, and it is not so generally practised as it ought to be. It may be used to some extent while the patient is still lying on her side, the left hand being passed over her right hip. But to practise it thoroughly we must make the patient turn over on her back, and then by pressing down the abdominal parietes with the left hand, and acting in concert with the examining finger, we may thus thoroughly explore the pelvic cavity, and ascertain much more completely the form and relations of any tumour within it, than by vaginal examination alone. In some cases valuable information can be obtained by a rectal examination, especially when there is a swelling or tumour in Douglas's pouch, or attached to the posterior part of the uterus, which may often be more accurately examined in this way than *per vaginam*. Simple abdominal palpation is often necessary in investigating the nature of any tumour supposed to be uterine. This is best used by laying the patient on her back, with her knees elevated, so as to relax the abdominal parietes. Percussion may often be advantageously combined with palpation. By using one or two fingers of the left hand as a pleximeter, and percussing with the right, we get a dull or tympanitic sound. If the latter is marked where there is much abdominal distension, we know that it indicates bowel distended with gas, and that there is probably no tumour. If there be dulness we can limit its area, and thus verify the results of palpation by mapping out abdominal swelling met with. By these means also we discover the existence of fluid, either free in the abdomen, as in ascites, or contained in an ovarian cyst, the presence of fluctuation being often very readily determined.

3. *Use of the Speculum.*—We now proceed to consider the means at our disposal for examining the lower segment of the uterus with the eye; and from the re-invention of the speculum by Recamier, in the early part of the present century, we may date the commencement of the accurate study of uterine diseases. Numerous varieties of specula have been used. One very generally employed is Cusco's bi-valve speculum (fig. 134). This has the advantage of being easy to introduce, and of being adapted for either a capacious or a narrow vagina. It exposes the cervix well. The objections to it are its expense, and the fact that the metal is apt to be affected by various applications made to the cervix. Personally the writer prefers the tubular (Fergusson's) speculum (fig. 135) made of glass, and covered with caoutchouc; and that which is bevelled at the end is the easiest to introduce, and the best to expose the cervix. For cleanliness and brilliancy of illumination nothing can equal it. It is unaffected by any remedy used for local application, and has the advantage, which is wanting in all other specula, of embracing and steadying the cervix. In certain cases requiring local medication this is of great value. The objection to this form of speculum is its fragility, and the necessity of having instruments of various sizes, adapted to vaginæ

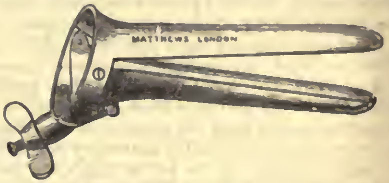

Fig. 134. Cusco's bi-valve speculum.

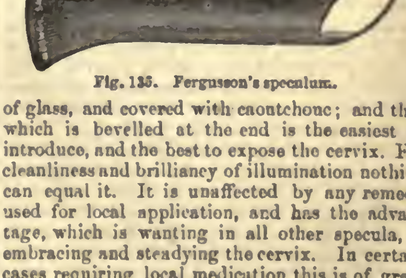

Fig. 135. Fergusson's speculum.

of different dimensions. Practitioners, therefore, at a distance from surgical-instrument makers, will do well to provide themselves with the more expensive instrument. Another form of speculum much used of late years, and in some cases superior to all others, is the 'duck-bill' speculum (fig. 136). This acts on the principle of drawing aside the perinæum and posterior vaginal wall, so as to allow air to distend the canal, and thus expose the cervix. For certain operations it is invaluable, and is most valuable even in ordinary examinations if the practitioner be skilled in its use. Considerable practice is required, however, to employ it satisfactorily, and it has the further drawback of necessitating the assistance of a second person.

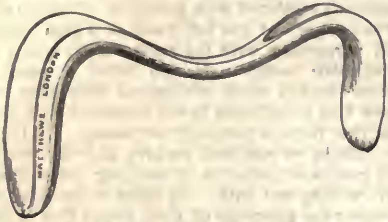

FIG. 136. The Duck-bill Speculum.

The passing of a speculum, without pain, is an operation requiring some little practice to perform skilfully. In using a tubular glass speculum we must first choose one corresponding to the size of the vagina. This is a point of some importance; for the attempt to pass a large speculum into a small vagina causes much suffering; and if, on the other hand, too small an instrument be used, the cervix is not properly exposed. The patient should lie in the ordinary lateral position. The speculum should then be taken in the hollow of the right hand, its bevelled extremity resting on the under surface of the index finger, the point of which should project a little over its edge, so as to guide it through the ostium vaginæ. The point of the finger having been inserted into the vagina, the mouth of the speculum, the centre of which is grasped gently by the other fingers of the right hand, is held by the left hand, and the instrument, guided along the under surface of the right index finger, is gently insinuated into the vagina, pressing back the perinæum as it enters. When it is fully introduced, it is turned gently round until the cervix is well exposed.

By the speculum we can speedily recognise any changes in the cervix and os uteri; we can see if the mucous membrane covering the former be pale or congested, smooth or abraded, or perhaps covered with granulations which bleed on being touched. The character and amount of discharge should be noted, and it may be wiped away with cotton wool held in the speculum forceps. If the discharge come in great measure from the interior of the cervix and body of the womb, it is glairy, transparent, and very tenacious, and it may often be seen oozing out of the os uteri like white of egg. This is a certain sign of some morbid state of the mucous lining of the uterus. If the discharge come from the surface of the cervix it is yellow and purulent in appearance. We can also recognise any abnormal growth that exists about the cervix, as, for instance, small gelatinous polypi which have evaded the sense of touch.

4. *Examination with the Sound.*—In certain cases in which more accurate information regarding the state of the uterus is required, other accessory means of examination are used. One of these is the uterine sound (fig. 137), by means of which we can explore the interior of the uterus, measure its length, ascertain its direction, &c. The instrument is a thin rod of flexible metal, which can be bent into any desired shape, as it is sometimes necessary to adapt it to the altered curve of the uterine cavity. Its length is divided into inches by means of small notches in the metal, and at two and a half inches from its point is a small knob, indicating the normal length of the healthy uterus. In introducing the sound, the index finger of the right hand is passed into the vagina until its tip rests on the opening of the os uteri, which can be felt as a dimple or depression at the extremity of the cervix. The handle of the sound being lightly held in the left hand, its point, previously warmed and oiled, is guided along the palmar surface of the index finger of the right hand, until it enters the os uteri. It is a good plan to pass the sound through the vagina with its concavity looking towards the perinæum, and after it has entered the os, to turn it gently round, so that its further progress may be in the ordinary direction of the uterine cavity. It is now gently pushed on, no force whatever being used, until its point is arrested by the fundus uteri. The tip of the right index finger is now placed at the os, and withdrawn in contact with the sound, so that the exact length to which it has entered may be ascertained. Considerable practice is required to pass the sound easily and without pain. Gentleness is necessary above all, and the sound should be coaxed to pass, being withdrawn if any resistance is met with, and never pushed on by force. Sometimes the sound will not pass in the ordinary direction, and then an endeavour must be made to adapt it to the curve of the uterine cavity, by bending it, or by passing it with its concavity backwards, as in the cases of retroflexion. The kind of information to be derived from the use of the sound will be best appreciated when treating of the separate diseases of the uterus.

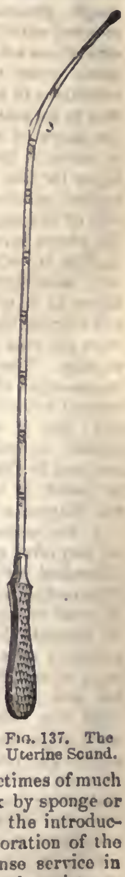

FIG. 137. The Uterine Sound.

5. *Dilatation of the Cervix.*—Another mode of examination, sometimes of much use, is the dilatation of the cervix by sponge or laminaria tents, so as to admit of the introduction of a finger and complete exploration of the uterine cavity. This is of immense service in cases of profuse menorrhagia, when the existence of an intra-uterine polypus, or portion of retained placenta, is suspected. The tent is a mass of

compressed sponge, or a cylinder of laminaria digitata, sufficiently small to enter the cervix, where it swells by the imbibition of moisture, and, in doing so, expands the surrounding tissues. The best way of effecting the desired object is by passing side by side into the cervix a bundle of laminaria bougies, sufficiently long to reach the fundus. These, if left *in situ* for twenty-four hours, dilate not only the cervix, but the whole uterine cavity, and admit of its being thoroughly explored under an anæsthetic. In order to effect this early, the cervix should be exposed by a duck-bill speculum. Dilatation of the cervix is an operation that should not be undertaken without due consideration, as it is occasionally followed by considerable irritation.

General Ætiology and Pathology of Uterine Disease.—Much as is the attention which has been paid to uterine disease of late years, the opinions of the profession are as yet far from being decided on many elementary facts connected with it. It is beyond doubt that in this class of disease there are a series of symptoms common to all cases alike, such as pain in the lower part of the abdomen and back, inability to walk, leucorrhœal discharge, and disordered menstruation. If, however, modern writers on gynæcology are consulted, it will be at once seen how various and irreconcileable are the explanations given of these symptoms. Thus we have a school who teach that in inflammation and congestion, either of the cervix alone, or of the body or lining membrane of the uterus, we have the key to uterine pathology, and that all other changes detected in the uterus, such as displacements or flexions, are merely secondary results of the primary affection. On the other hand, there are many influential gynæcologists who refer all uterine disease to mechanical causes; who consider displacements to be the primary cause of nearly every morbid state of the uterus, inflammation and congestion being merely secondary results; and who naturally limit their treatment to an endeavour to replace and support the uterus in its normal position. The want of sufficient pathological study of morbid states of the uterus accounts for these varying opinions, which are much to be regretted; for, while one set of theorists apply themselves to an endeavour to relieve the inflammatory symptoms they find, and which undoubtedly generally exist, by leeches, rest, and suitable local applications, they are apt to undervalue and neglect the mechanical means by which the displaced organ may be supported and steadied, on which their opponents too exclusively rely, but the real value of which it is impossible to call in question. Hence it follows that these partial and one-sided views lead to neglect of really important measures in one direction or the other, and an amount of uncertainty in the mind of the profession which materially impedes a due recognition of the true importance of uterine disease. The fact, no doubt, is that neither of these opposing views is entirely right, but that there is a large measure of truth in both. Of the importance of inflammatory conditions no one, who impartially studies the clinical history of cases coming under his care, can entertain any reasonable doubt. The large, tender, and congested uterus, with its thickened and hypertrophied walls, the inflamed and granular mucous membrane covering the cervix, and pouring out abundance of morbid secretion, are conditions too obvious to be overlooked, and which are very frequently indeed associated with displacements, resulting from alterations in portions of the hypertrophied and over-weighted organ. In some of these cases treatment directed to the original inflammatory condition may, of itself, suffice to effect a cure; in others this fails, unless attention be at the same time paid to the secondary displacements. On the other hand it is equally impossible to ignore the occasional remarkable influence of a simple displacement in producing disease. Who, for example, that has witnessed the long chain of distressing symptoms following a traumatic displacement, such as retroflexion from a fall, and the instantaneous relief sometimes following the introduction of a suitable pessary, can doubt this? In fact all these conditions act and re-act on each other, and too excessive attention to one set of symptoms, based on theoretical dogmas, is as fallacious in uterine as in all other forms of disease.

The causes of uterine disease are very numerous. Among the most common may be mentioned errors in the mode of life consequent on the habits of modern society, such as tight-lacing, want of proper exercise, heated rooms, imprudence during menstruation, and the like. By far the most prolific source of uterine disease is to be found in the changes in the uterus consequent on parturition. Many accidental circumstances are apt to check and arrest the fatty degeneration of the hypertrophied muscles, which normally occurs after delivery. Hence the uterus remains large, congested, heavy, tender, and in the condition known as sub-involution, its cavity, as measured by the uterine sound, being elongated. In such cases the symptoms of uterine disease creep on insidiously after abortion or child-bearing, and, in a large proportion of cases, it will be possible to trace its origin to this source.

In considering the diseases of the uterus, it will economise space if we divide them into four classes, namely:—

1. **Inflammatory and congestive diseases**, with their results.
2. **Displacements.**
3. **Malignant diseases.**
4. **Tumours.**

1. Inflammatory and Congestive Diseases. Under this heading we may consider together those morbid states of the uterus, which are variously described under such terms as *acute* and *chronic metritis*, *chronic parenchymatous metritis*, *areolar hyperplasia*, *acute* and *chronic endo-metritis*, *endo-cervicitis*, *chronic uterine catarrh*, *granular degeneration of the cervix*, *ulceration of the cervix*, *congestion of the uterus*, and others.

This course involves the disadvantage of describing together diseases which, whilst they are very generally associated, and have much that is common in their symptomatology and treatment, may often, on the other hand, repeatedly occur, and require important modifications in their management, according to the particular parts of the uterus affected. It is impossible, however, in so short an article, to discuss their individual peculiarities, as would naturally be done in a systematic treatise.

Acute inflammatory affections of the uterus, whether of its body or of its lining membrane, are of comparatively rare occurrence when unconnected with the puerperal state, and if a contrary opinion is expressed in many of our gynæcological works, it is probably because various other inflammatory diseases, especially localised inflammations of the peritoneum and cellular tissue near the uterus, have been confounded with inflammations of the uterus itself. No practical harm will result, therefore, if we limit ourselves to the consideration of the more *chronic* conditions which are of such common occurrence, and produce such important consequences. One of the most common is undoubtedly congestion of the uterus, associated with enlargement of its vessels, and very often leading secondarily to more important and lasting disease, such as inflammation of its lining membrane, and the condition described as *areolar hyperplasia* or *chronic parenchymatous metritis.*

Ætiology and Anatomical Characters.—The causes of such congestions are very numerous, and indeed they occur normally in connection with every menstrual period, and may readily be perpetuated. By far the most important, however, is some interference with the proper involution of the uterus after delivery or abortion, to which a large proportion of such disease may be traced. If such congestion continue to be repeated, whatever be its cause, it very often leads to inflammation of the mucous membrane lining the cervix or body of the uterus; and then the diseases known as *endo-metritis* or *endo-cervicitis* are established, which are of much importance. In these the largely developed glandular structures of the mucous membrane are the parts chiefly involved. On microscopic examination they are found altered in character, dilated at their mouths, and pouring out abundantly the transparent spongy mucus which is so characteristic of these affections. The villi of the cervix, both those within the canal and in its exterior, become altered, stript of their epithelium, and eventually hypertrophied. These enlarged and abraded papillæ on the surface of the cervix, when seen through the speculum, form the characteristic red, strawberry-like, abrasions round the os, which, under the name of ulceration, have formed so fruitful a subject of controversy in uterine disease. The detection of this condition—which is in no sense of the word an ulceration, since the epithelium is the only structure destroyed—is of much importance from a diagnostic point of view, but chiefly as leading to a knowledge of the more deep-seated changes which have produced it as a secondary result, which are themselves beyond the sphere of observation, but which are truly at the root of the evil. Hence the granular and abraded state of the cervix must be looked upon as a mere indication of disease elsewhere, not as being in itself a primary disease. Moreover, it is to be noted, as specially pointed out of late by American gynæcologists, that many apparent abrasions of the cervix are really due to laceration of its tissue, and eversion of its altered lining membrane, a condition which can only be satisfactorily made out when the duck-bill speculum is used.

In more advanced stages of these inflammations of the mucous membrane deeper-seated alterations occur. The glands become obliterated or atrophied, and sometimes undergo cystic degeneration; and the whole mucous membrane may become adherent, stript of its epithelium, covered with granulations, or finally converted into a layer of connective tissue covered with polymorphous cells (Klebs). In no long time, moreover, other morbid states of the uterus are developed. The organ becomes enlarged, tender to touch, and very often there is more or less forward or backward displacement. The cervix especially is apt to be hypertrophied, the os patulous, much leucorrheal discharge is present, and all the distressing chain of symptoms accompanying confirmed uterine disease is established. Pathologically, this enlarged and tender state of the body and cervix of the uterus is, by most recent writers, believed to depend on excessive growth of the connective tissue, associated with vascular hyperæmia and hyperæsthesia of the nerves. It should be remembered, however, that it is identical with the condition commonly described as *chronic metritis*, the essentially inflammatory origin of which has long been an axiom in gynæcology.

Symptoms.—The symptoms accompanying these morbid states of the uterus are, in a great measure, those which are common to a large number of uterine complaints. Pain in the lower part of the abdomen and back, increased by exercise of any kind; pain in defæcation or micturition, and in married women, on sexual intercourse; profuse glairy, tenacious, or purulent discharge, in old-standing cases very abundant; disordered menstruation, either scanty or irregular, or more often profuse, and frequently very painful; and, eventually, if the true character of the disease be not recognised, a long and distressing catalogue of general symptoms, such as dyspepsia, hysteria, sickness or vomiting, headache, and others too protean in their character to be described, are among those which are most commonly observed.

The conditions met with on physical examination vary with the duration and extent of the disease, and the tissues of the uterus chiefly implicated. In the simpler cases the uterus is merely somewhat heavy and enlarged, and tender to the touch. When there is endo-metritis or endo-cervicitis to any extent, the cervix is somewhat puffy and enlarged, and the external os patulous, so that the sound passes easily; and, in the same way, a dilated state of the cervical canal and internal os is recognised. Very generally also the surface of the cervix is rough, granular, and greatly abraded, bleeding on being touched, while strings of the characteristic gelatinous discharge are seen to exude from the cervix, and the cervix may be extensively fissured. Lastly, on bi-manual examination, in the more chronic and confirmed cases, the whole uterus will be found to be distinctly enlarged, probably somewhat elongated when measured by the sound, and very commonly the subject of some of the forms of displacement to be presently described.

Prognosis.—The prognosis of these diseases must, of course, depend on their extent and duration. In their earlier stages they are readily susceptible of improvement and cure. In old-standing cases, which have lasted for years, and produced all the local and general results above described, the treatment is surrounded with difficulties, and the prospect is far from encouraging. It is of such states that Scanzoni speaks when he says: 'We do not remember a single case in which we have cured an abundant uterine leucorrhœa of several years' standing'—a dictum which was doubtless true with reference to the methods of treatment generally employed, but which fortunately cannot be endorsed by those who have employed more radical means of cure, applied directly to the seat of the disease.

Treatment.—The treatment resolves itself into *general* and *local*. With regard to the former, the indications are to do all in our power to improve the nutrition and general health by ordinary means of treatment, such as attention to diet, fresh air, and the administration of appropriate remedies, amongst which such drugs as quinine, small doses of arsenic or strychnia, various ferruginous preparations, and bromide of potassium, either alone or in combination with other remedies, especially when there is much nervous irritability, are amongst the most generally useful. In old-standing cases resort to some of the Continental watering-places is occasionally of much service. These points, however, all depend on general principles, and cannot be further dwelt upon. Among the local measures one of the first and most important to attend to is *rest*. If moving about produce pain, repose in the recumbent attitude ought certainly to be enforced, and in recent and acute cases, it should be absolute. In chronic cases continuous rest leads to the evils of deterioration of the general health, and the risk of acquiring habits of chronic invalidism. This must, then, be decided by the exigencies of the particular case, and the judgment of the practitioner. Generally, some daily gentle exercise, short of fatigue, should be advised, such as walking a little distance, driving in an easy carriage or bath-chair, or sitting in the open air. We may safely assume that exercise which does not produce or increase pain is doing good.

In cases of simple hyperæmia, especially when not of old standing, and when the uterus is tender to the touch, the local abstraction of blood is often of marked benefit. This may be effected either by applying from two to four leeches to the cervix through a cylindrical glass speculum, or, still better, by puncturing the cervix with a scarificator made for the purpose. Another very effectual means of relieving congestion and tenderness of the uterus, is the use of pledgets of cotton wool, to which a string is attached, thoroughly soaked in glycerine. If one of these is introduced into the vagina at night, and removed by means of the string in the morning, it will be found to produce an abundant watery discharge which saturates the linen of the patient. Great relief is thus given, and there is hardly any form of congestive uterine disease which is not benefited by this treatment, which most women can apply for themselves. The glycerine pledgets may be used every night, and they do not interfere with other modes of treatment. Continuous irrigations of hot water at 110°, night and morning, are also most serviceable, but to be of use not less than from one to two gallons must be used, with a suitable cistern syringe. When properly applied these give immense relief. When the uterus is enlarged as well as tender, much benefit may be derived from the application of a pledget of iodised cotton to the cervix once a week. This should be passed through the speculum, and retained in position by a large pledget soaked in glycerine. It rarely causes pain; if it do, it should be at once removed; and it often remarkably reduces the size of the sub-involuted and hypertrophied womb.

When there is evidence of endo-metritis or endo-cervicitis other treatment is required. Now the desideratum is the application of alterative remedies to the diseased mucous membrane, not with the view of destroying it, but of so modifying its circulation and nutrition as to set up healthy action. The want of success so common in treating these cases may be traced to the fact that remedies have not been applied directly to the interior of the cervix or uterus, but that practitioners have contented themselves with treating the abraded or granular condition of the cervix, thus leaving the real seat of the disease untouched. Of late years much advance has been made, and we need not now talk of these chronic inflammatory affections of the lining membrane of the uterus in the same hopeless strain as before. One of the earliest modes of intra-uterine medication was the injection of fluids into the uterine cavity, such as tincture of iodine, or solutions of nitrate of silver. It was soon found that such injections, when the cervix had not been previously dilated, were apt to be followed by very alarming and dangerous symptoms; and it is now generally admitted that they are inadmissible, unless the cervix has been previously dilated with sponge or laminaria tents. This in itself is a procedure not to be lightly undertaken; and to repeat it frequently for a length of time—as would be essential in the treatment of these chronic cases—would be altogether out of the question. Some other method of attaining the desired object is, therefore, necessary, and this we obtain in perfection in the local application of the desired alteratives on suitable probes covered with a thin layer of cotton wool. By this means we can reach the mucous membrane at any part of the uterine cavity, and apply our remedies to it, without the necessity of any preliminary dilatation. The probes used by the writer are made of flexible metal (fig. 138), attached to a wooden handle, and of such a size that when tightly wrapped round with a thin film of wool, they are not thicker than an ordinary uterine sound. They are covered by teasing out a small portion of wool, which is flattened between the palms of the hands. The probe is then dipped in water, to cause the wool to adhere, and by twisting round the handle, the wool being held between the forefinger and thumb of the left hand, the wool is smoothly and firmly wrapped round it. A little practice enables us to effect this with great neatness. The cervix being generally abnormally patulous, there is no diffi culty in passing the probes through the os, previously exposed by the speculum, so as to reach the entire uterine cavity. The writer is in the habit of using a mixture of equal parts of crystallised carbolic acid and glycerine, as a local alterative, than which, he believes, there is no better application. Others, however, employ tincture of iodine, strong solutions of nitrate of silver, or even, as recommended by Courty of Montpellier, pass a solid piece of nitrate of silver into the uterine cavity, leaving it there to melt and flow over the mucous membrane. The writer first swabs out the uterine cavity with one or two probes covered with dry wool, so as to remove the glutinous discharge as much as possible, and then passes in another probe, covered with the carbolic solution, so as to paint over the lining membrane of the cervix and body of the uterus, the external abrasions on the cervix being subsequently swabbed over with the same solution. This rarely gives rise to any pain or discomfort, and may be combined with the other plans of treatment already mentioned. Intra-uterine medication is most useful in the week immediately succeeding menstruation, when the superficial layer of the mucous membrane has been shed. If used too near the advent of the next period it may prove too irritating, and may bring on menstruation prematurely. As a rule, two applications, at intervals of a few days, in the early part of the intra-menstrual interval are amply sufficient, and it may be necessary to continue the treatment for many weeks or months, Should laceration of the cervix and ectropion exist, Emmett's operation of tracheloraphé may be indicated. In very severe and obstinate cases of this kind Recamier used to scrape the uterine mucous membrane with a curette, so as to remove the granulations, especially when there was much metrorrhagia, and where there was reason to suspect the existence of a granular condition of the intra-uterine mucous membrane. The Dublin physicians recommend the application of fuming nitric acid, the cervix having been first dilated with tents. This is a very strong measure, which we would not willingly adopt; but it is only fair to say that in the cases in which the writer has used it, he has found it exceedingly useful. Scraping the uterine cavity with the dull wire curette also occasionally has an admirable result in such conditions, and, so far as the writer's experience goes, this is a perfectly safe procedure. Before concluding this subject, a word of caution is necessary. Valuable as intra-uterine medication certainly is in suitable cases, it should never be rashly or indiscriminately employed, and the writer would strongly insist that, before resorting to it, we should satisfy ourselves that the uterus is likely to bear it with impunity. Whenever, therefore, there is much tenderness of the womb on being touched, even when the case is otherwise suitable, the writer deems it advisable first to remove the congested condition by rest, the local abstraction of blood, the use of glycerine pledgets, hot-water irrigations, and other appropriate means; and, above all, the slightest evidence of any concomitant mischief or irritation, recent or of old standing, in the neighbourhood of the uterus, as shown by tenderness on pressure in the region of the broad ligaments, or fixity of the uterus, should be an absolute contra-indication.

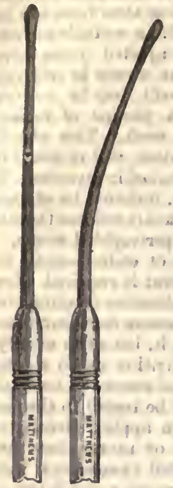

FIG. 138. Uterine Probes.

2. **Displacements.**—Under this head we have to discuss a variety of diseases which have furnished a fruitful theme for controversy among gynæcoolgists. Practically physicians have divided themselves into two great schools with regard to these affections. One of these schools teaches that deviations of the uterus, in whatever direction they occur, whether forwards, backwards, or to either side (for descent of the uterus is of a different character, and must be separately discussed), form of themselves serious maladies accompanied by definite symptoms; and, as a logical deduction, have their treatment primarily in the endeavour to replace the dislocated uterus in its normal position, and maintain its position by mechanical contrivances known as *pessaries*. The other, and perhaps larger, school holds that versions or flexions are not *per se* the cause of the undoubted symptoms which are met with in the cases in which they are found to be present; that flexions may, and often do, exist without giving rise to any symptoms at all; that in all cases the symptoms may be traced to the uterine engorgements and congestions which accompany the deviations, and are their primary cause; and that, therefore, it is unnecessary to pay attention to the displacement, which may be left to itself, while associated conditions are remedied by appropriate treatment. As is generally the case in all such controversies, it is probable that neither side is entirely in the right, and that the truth is to be found between the two. It is certain that in some cases, and under certain peculiarities of constitution, flexions produce symptoms which cannot be explained by the accompanying condition of the uterine structures, which can only be relieved by mechanically supporting the dislocated womb, and frequently are so relieved in the most remarkable manner. It is unquestionable, however, that marked flexions often exist without producing any appreciable symptoms, and as these are only found out accidentally, when, from some other cause, an examination is made, it is not improbable that such cases are much more common than is generally supposed. Upon the whole, the writer is inclined to think that displacements are rather the result than the cause of the associated morbid state of the uterus, and that one of the chief elements of treatment is to get rid of the congested, hypertrophied, or sub-involuted state of the organ which produces them. But even if this be admitted, it by no means follows that proper mechanical support is not needed. So far from this

being the case, the writer believes it to be of the greatest possible value in supporting and steadying the overweighted and misplaced organ, thereby facilitating the removal of its morbid states, as well as relieving its most urgent symptoms.

Properly speaking, displacements of the uterus should be divided into two classes, *versions* and *flexions*. In the former the body of the uterus retains its normal shape, but not its normal direction, the entire organ being displaced either forwards (*ante-version*), backwards (*retroversion*), or to one side (*latero-version*). In the latter the shape of the uterus is altered, and its body is more or less acutely bent over the cervix in the form of a retort, producing the analogous conditions of *ante-flexion*, *retro-flexion*, or *latero-flexion*. But these states are very closely related to each other. Very often they are combined, they arise from similar causes, and they produce similar results. For the sake of brevity, therefore, they will be discussed together.

Ætiology and Pathology.—In order to understand how uterine displacements are produced, it is necessary to remember the means by which the uterus is maintained in its natural position. In the healthy state the uterus is situated high in the pelvic cavity, its fundus projecting somewhat above the plane of the pelvic brim, to the axis of which—that is, to a line drawn from the umbilicus to the coccyx—its own axis corresponds. It is maintained in this position partly by the muscular column of the vagina below, on which it is, as it were, poised; partly by the folds of the peritoneum forming Douglas's pouch behind, especially that portion of them called the utero-sacral ligaments; and partly by fibrous portions of pelvic fascia in front, attached to the pubes and passing by the side of the bladder. These are fixed to the uterus abo [illegible] the points of junction of the internal os with its body, which is, therefore, the part of the organ least liable to change of position, and that at which flexions almost invariably take place. The fundus and body are much more mobile, but their movements are somewhat controlled by the round ligaments in front, and the broad ligaments at the side. The shape of the uterus is further maintained by the well-marked inherent rigidity of its tissue, and when this is altered by disease, or by congestion, sub-involution, and the like, displacements are much more apt to occur. The axis of the uterus is naturally apt to alter its position under various conditions. Thus it falls less or more forwards, according as the bladder is distended or otherwise. The uterus is also so placed that it ascends or descends with more or less freedom, and, as it does so, its axis corresponds with the axis of the plane of that part of the pelvis in which it lies. This fact has been especially pointed out by the late Dr. Squarey, and it goes far to explain why similar causes should at one period produce a forward, and at another a backward, displacement. The causes of displacements are chiefly any conditions which weaken the supports, or the resisting power, of the uterus. They are, therefore, most frequently found in association with the results of parturition, sub-involution, congestion, hyperplasia, and endo-metritis, which all diminish the inherent tonicity of the uterine walls, as well as weaken its supports, and prevent its regaining its natural shape when accidentally altered. The displacement itself may be caused or favoured by a variety of conditions, such as blows, falls, tight clothing, fibroid tumours developed in the uterine walls, and many other analogous states. When a flexion has been produced, the venous capillaries at the point of flexion are more or less obstructed, and the return of blood through them hindered, while the arteries continue to supply blood. The fundus, therefore, becomes congested, and subsequent structural alterations are developed. This point has been insisted on by Dr. Graily Hewitt, and there can be no doubt of its accuracy. This explains the fact that, even when flexions are secondary, it is impossible to treat them satisfactorily by general means alone, and that, in course of time, a flexion, originally secondary in its causation, may require to be the chief object of treatment.

Symptoms.—The symptoms of flexion of the uterus are in no way special. They are very much those which have already been described as accompanying the inflammatory varieties of uterine disease, and there are none which would enable the practitioner to foretell its existence with certainty. Amongst those most commonly observed are pain, weight, and bearing down, often decidedly increased by exercise of any kind, not unfrequently rendering locomotion an impossibility; pain in one or other ovarian region; pain, and sometimes difficulty, in micturition; and various disorders of the menstrual function, more especially dysmenorrhœa and menorrhagia. After these have lasted some time the secondary derangements of the general health, so common in uterine disease, become established, and they lead to very serious consequences.

Diagnosis.—The diagnosis of displacements is not difficult on vaginal examination. Supposing we have to do with a flexion, the cervix is found in its normal position; but either in front, behind, or, more rarely, at either side, is a rounded swelling about the size of half an orange, which can be pushed away by the examining finger. This might be confounded with various other conditions, such as small uterine fibroids, inflammatory exudation, hæmatocele, small ovarian tumours, &c. The diagnosis can, however, be readily cleared up by the sound, which will only pass in the direction in which the uterus is flexed; and, on turning it gently and cautiously round, the flexed fundus is lifted with it, and can no longer be felt in its former position. In ante- or retro-version, in addition to feeling the body of the uterus in its abnormal situation, we also find that the cervix is lifted out of its usual central position, and points either forwards or backwards.

Treatment.—In arranging a plan of treatment for uterine displacements, the concomitant conditions should be carefully attended to, and endometritis, congestion, and other complications relieved, if they exist. Unless this is done, the treatment may entirely fail, or may be very unnecessarily prolonged. Here we must limit ourselves to a very brief description of the best plans of mechanical treatment, strongly insisting, however, that they should not be too exclusively relied on. In backward displacements we have a very satisfactory means of supporting the misplaced organ in the well-known Hodge's pessary numerous modifications of which exist. The important point to bear in mind is to select an instrument not too bulky, nor too long for the individual case; the best material being either wire covered with soft india-rubber, vulcanite, or Britannia-metal. The treatment often fails from want of proper selection; since a pessary, to be thoroughly useful, should be fitted as accurately as a shoe to a foot. Before introducing it the sound should be gently passed, and the uterus replaced and held in its proper direction for a few minutes; and this manœuvre should be repeated at intervals of about a week, until the uterus does not re-assume its abnormal position. Even then, however, the pessary should be worn continuously for several months, until we feel quite sure that the misplacement is permanently relieved. In many cases relief is instantaneous and remarkable; in others the fundus is too tender to bear the pressure of the pessary at all. When this is the case it should be removed, and an endeavour should be made to prepare the uterus for the use of this support by the local abstraction of blood, hot irrigations, the application of glycerine pledgets, or sedative pessaries. In introducing the Hodge's pessary, care should be taken to guide its upper part into its proper position behind the cervix, so as to press up the fundus; and, as the case improves, a larger instrument should be introduced, so as to follow up the retreating fundus. Reposition of the uterus must, of course, never be attempted if there is reason to think that the fundus is bound down by adhesions, or if the uterus is very tender. In suitable cases, however, it materially facilitates the cure.

Anterior displacements must be treated on the same principles. Unfortunately, we do not possess anything like an equally good means of mechanical support, and a thoroughly efficient ante-flexion pessary is still a desideratum. After trying a good many the writer has come to the conclusion that the best is Dr. Graily Hewitt's vulcanite cradle pessary, of a size suitable to the case. It is, however, difficult to introduce and remove. Nor can it always be borne. A well-fitting abdominal belt—and the best is that known as the American belt—is often of great assistance, by removing the weight of the superincumbent intestines. When all other means of restoring a flexed uterus fail, an intra-uterine stem pessary may possibly succeed. Great caution, however, is necessary, and it should never be used unless the patient is under constant supervision, so that it may be removed on the slightest appearance of undue irritation. During the treatment of all flexions, rest is of paramount importance, not absolute, but as much as possible, and exercise should be very sparingly permitted, and only in a tentative manner.

Prolapsus.—The only other displacement of the uterus requiring special mention is descent or *prolapsus*, for the corresponding condition of undue elevation is of little practical importance. Descent of the uterus is far from rare, and it sometimes causes much discomfort. In it the uterus descends from its normal position to a varying extent, so that the prolapsus may be only partial, or it may be complete. When the entire uterus lies without the vulva, along with the everted vagina, the mass is known as *procidentia uteri*.

Ætiology and Pathology.—Descent of the uterus depends upon a variety of causes which lead to a weakening of the uterine supports, either from above or below. These supports are chiefly, above, the various uterine ligaments, with the cellular tissue of the pelvis; below, the muscular column of the vagina. When from any cause, such as imperfect recovery after childbirth, senile absorption of adipose tissue, or rupture of the perinæum tending to prolapse of the vagina, they are no longer able to support the uterus efficiently, a comparatively slight cause may suffice to allow the womb to be pushed or drawn out of its place, as, for example, straining, lifting heavy weights, undue weight of the organ itself, and many other causes. As soon as the organ is prolapsed, to whatever degree this may occur, various morbid alterations are pretty sure to follow. The uterus becomes irritated, congested, and hypertrophied; and the everted mucous membrane of the vagina, which then covers it, becomes greatly altered, and assumes almost the appearance of skin. The most characteristic change, however, is generally elongation of the cervix, through traction from below, especially in cases in which prolapse follows previous descent of the vaginal walls. This elongation is due to yielding of the elastic tissue of the cervix, especially that portion above the roof of the vagina, which becomes greatly elongated, so that the sound introduced into the procident organ may pass for six or seven inches. When the uterus is replaced, the normal elasticity again comes into play, and the cervix rapidly contracts. This is the condition described by Hugier as *hypertrophic elongation of the cervix*, and it is rarely absent.

Symptoms and Diagnosis.—The symptoms of prolapse of the womb are mainly due to the mechanical discomfort attending it, such as weight, difficulty in progression, interference with micturition, and much general inconvenience. The diagnosis is a matter of no difficulty. In the greater degrees the procident organ, covered with the hardened and altered vaginal mucous membrane, is at once apparent. The only condition it is at all likely to be confounded with, is old-standing inversion of the uterus, and from this mistake the presence of the os uteri at the apex of the tumour will at once guard us. In the slighter degrees the cervix will be felt low in the vagina, or even at its orifice.

Treatment.—The treatment comprises two principal indications:—First, rest, and consequent reduction of the size and weight of the procident organ; thereby greatly facilitating the second indication, namely, re-position, and maintenance of the uterus in its normal position. The effect of mere rest in diminishing the size of a prolapsed uterus is often very remarkable. A week or ten days in bed will often, of itself, reduce the cervical elongation to a considerable amount. Re-position is generally easily effected, and the chief difficulty is in support. In devising mechanical contrivances for keeping the uterus in position, the chief thing to bear in mind is that we should strengthen the natural uterine supports, so that they may regain their lost power of keeping the organ in its place. Hence the old ring or ball pessaries, which greatly distend the vagina, are absolutely inadmissible. In the slighter degrees an ordinary Hodge may answer every purpose, an endeavour being, at the same time, made to give better support from below. This is generally best done by a perineal pad, and also sometimes by using an astringent to the vagina, so as to make it a more efficient column of support, such as alum or oak-bark injections. In the greater degrees the best kind of pessary is that known as the 'vaginal stem,' which is in the shape of the cup of the ordinary toy known as the cup-and-ball, on the extremity of which the cervix rests, the other end being attached to a perineal band. If this does not answer, the pessary known as Swancke's may succeed. This has the advantage of supporting the uterus without unduly distending the vagina. These measures are merely palliative, and a more radical cure may be hoped for by various operative procedures, into the details of which it is impossible to enter. It may suffice to say that they consist of:—First, the removal of a small portion of the elongated cervix, either by the galvano-caustic wire or the écraseur, in the hope of stimulating the remainder to contract, a procedure only occasionally required, but sometimes of undoubted utility. Secondly, the making of a new perinæum, in cases in which the prolapse seems secondary to undue descent of the vagina—a very valuable resource. Thirdly, narrowing of the vagina itself, for which a variety of operations are practised, which, like removal of a portion of the cervix, are rarely required.

3. **Malignant Disease.**—Malignant diseases are of common occurrence in the generative organs of females, and indeed they are more often met with in these than in any other part of the body.

ÆTIOLOGY.—Malignant disease of the uterus is most common about the middle period of life, the largest number of cases occurring between forty and fifty years of age. Occasionally we meet with rapidly advancing cases in younger women under thirty years of age, or in old women who have long ceased to menstruate. Hereditary predisposition apparently plays some part in its production, but not so much as was formerly believed. Frequent child-bearing has a decided influence in favouring its development, since the proportion of cases is larger in multiparæ. To this may be added any causes of constitutional debility, since it unquestionably occurs more often in weak and unhealthy than in strong and robust women.

ANATOMICAL CHARACTERS.—All the recognised forms of malignant disease occur in the uterus, but some of them are more common than others. Scirrhus is that which is least frequently observed, and the medullary carcinoma most often. Klebs, however, has pointed out that in the earliest stages of carcinomatous disease the fibrous element preponderates in the affected part; while, as the malady progresses, cell-growth rapidly advances, so that in old-standing cases, and on *post-mortem* examinations, the medullary carcinoma is that which is found, although, at first, the scirrhous form may probably have existed. Another common variety of malignant disease is the epithelial cancer, which chiefly affects the mucous membrane of the cervix. The so-called colloid cancer is rarely met with. In the large majority of cases the cervix is the part first affected, although, in exceptional instances, the disease may originate in the body of the uterus, the cervix being at first unimplicated.

At the commencement of the more ordinary variety the cervix is hard, somewhat nodular, and hypertrophied. It is comparatively rare for the disease to be seen at so early a stage, and, as the uterus is then quite movable, it is impossible to distinguish it from enlargement of the cervix due to congestive forms of disease. As the disease progresses, the carcinomatous degeneration advances rapidly; more and more tissue is involved; and the roof of the vagina becomes implicated, so that the uterus is fixed in a mass of new growth. Before long a destructive process commences; portions of the growth slough and come away; hæmorrhage takes place from the opening of vessels; and, in advanced stages of the disease, the cervix may be entirely destroyed, and even the bladder or rectum opened, so as to form a common opening with the vagina. The epithelial variety of cancer commences on the mucous surface of the cervix by the growth of its villi into a papillary tumour, which, at first, it may be impossible to distinguish from similar growths of a foreign character. It rapidly spreads however, soon forming a fungating soft mass, not unlike the flower of a cauliflower in appearance, hence its popular name 'the cauliflower excrescence.' As in medullary carcinoma, destructive changes soon occur; ulceration progresses; and, as the disease advances, the neighbouring structures are implicated. When the disease involves the more deeply-seated tissues, *post-mortem* examination shows that the malignant growth there assumes more of the character of medullary cancer.

SYMPTOMS.—The earliest sign that arouses suspicion as to the existence of malignant disease is generally the occurrence of hæmorrhage, at first merely an excessive menstrual flow, subsequently loss of blood, sometimes very great in amount, at irregular intervals. Sometimes it is brought on by trivial causes, and a not unfrequent complaint is that it always occurs after sexual intercourse. Excessive hæmorrhages, which are sometimes very alarming in amount, do not, as a rule, occur until advanced stages of the disease, when destruction of tissue is taking place. Another marked symptom is profuse discharge, often having a peculiar and pathognomonic fœtor, from the admixture of minute portions of sloughing tissue. In medullary carcinoma the discharge is not usually abundant, but it is sometimes very ichorous in character, producing excoriations, intense pruritus, or other disagreeable symptoms, in consequence of its irritating property. In epithelioma it is often very abundant, watery in character, and tinged with blood. Pain is sometimes excessive. The writer has often, however, seen cases terminate fatally without any pain at all. General constitutional disturbance soon results; the peculiar cachexia of malignant disease is developed; and the patient becomes sallow, emaciated, and extremely debilitated.

Diagnosis.—In advanced cases vaginal examination at once clears up the nature of the case. The cervix and roof of the vagina are infiltrated with the characteristic hard growth, and the uterus is quite fixed. If ulceration has advanced, the ragged broken edges of the cervix are apparent, bleeding on being touched, and breaking down under the finger. In a case of this kind mistake is hardly possible. In the earlier stages, before fixation and ulceration have advanced, error is easy, and it is far from uncommon to find non-malignant alterations of the cervix which have been mistaken for cancer, and even the reverse. Nothing but time will clear up such doubtful cases, and care should be taken not to give a positive diagnosis, unless the character of the case is marked and undoubted. The most difficult cases to diagnose are those in which the body of the uterus is alone affected. Here hæmorrhage, fœtid discharge, and recurrent attacks of spasmodic pain (probably caused by the efforts of the uterus to expel discharge collected in its cavity) may arouse suspicion; but nothing except dilatation of the cervix, and thorough exploration of the uterine cavity, can clear up the nature of the case. On account of the friability of the tissues, this must always be done with great caution. In epithelial cancer the soft, fungating, bleeding, and easily broken-down mass can hardly be mistaken for anything else.

Prognosis.—The prognosis is, of course, most unfavourable. There are, no doubt, a few authentic cases on record in which the patients have recovered after amputation of the cervix, but these are of the utmost rarity. In the vast majority death takes place, in a time varying from a few months to one or two years. Probably the disease advances most rapidly in younger patients, but few last longer than two years. Death takes place either from exhaustion, hæmorrhage, septicæmia, or some other complication. The writer has seen it on one or two occasions result from uræmia, the consequence of occlusion of the ureters through extension of the cancerous growth.

Treatment.—In the large majority of cases seen for the first time at an advanced stage, treatment must, of necessity, be palliative only. Here there are two chief indications—the maintenance of the general health; and the relief of pain, fœtor, or other distressing local complications. For the former we must rely mainly on a suitable diet, and the administration of some tonic which may be found to agree with the patient. The preparations of arsenic, as a rule, answer better then either iron or quinine. For the relief of pain the use of opiates, either in the form of morphia suppositories or administered subcutaneously, must be our sheet anchor, and, when the pain is severe, it may be necessary to exhibit them in large doses. Fœtor may be best arrested by the local use of antiseptics. The plan which the writer has found to answer best for the purpose is to introduce at night into the vagina a pledget of cotton wool, soaked in the glycerine of tannin, to which a small quantity of the glycerine of carbolic acid has been added, in the proportion of about one ounce of the latter to eight ounces of the former. This effectually destroys fœtor, while the astringent property of the tannin serves to check unduly rapid cell-growth, and prevent hæmorrhage. In the morning the vagina may be syringed out with Condy's fluid and water. Iodoform pessaries are also extremely useful for this purpose. When hæmorrhage is excessive local hæmostatics, such as the diluted liquor ferri perchloridi, must be used, and, if necessary, the vagina plugged. Surgical treatment may be adopted, either in the hope of entirely removing the disease, or of lessening the hæmorrhage and discharges, and so retarding its progress. Either indication is most easily fulfilled in epithelial cancer. When this is limited to the cervix, when there is a fair margin of healthy tissue between the diseased portion of the cervix and the body of the uterus, amputation by the galvano-caustic wire or wire écraseur should be resorted to, the actual cautery being subsequently freely applied to the stump, to destroy, as much as possible, any infiltrated cancer-cells. Even when this fails to prevent the recurrence of the disease, it will certainly prolong the life of the patient, and increase her comfort. In other cases destruction of the exuberant growth, both in epithelial and medullary cancer, may be advantageously effected by local caustic applications, such as strong solutions of chloride of zinc, nitric acid, or bromine. Of late years the same object has been sought by excising the diseased tissue, or by scraping it away as much as possible by peculiar scoop-shaped curettes made for the purpose, after which one of the above-mentioned caustics, or the actual cautery, may be applied. It is in the epitheliomatous form of malignant disease that this procedure is most valuable, and a carefully performed operation may prolong life for months or years. The more radical operations for extirpation of the entire uterus, as practised by Freund and Billroth, are too little known to justify discussion in this place. These procedures, however useful they may be in the earlier stages of the disease, are clearly inapplicable when it is advanced, and when the bladder, rectum, or vagina is involved in its spread.

4. **Tumours.**—(1.) *Fibroid Tumour.*—By far the most common variety of uterine tumours—so common that, according to some authorities, it is found in 60 per cent. of women who die after middle age—is the so-called fibroid tumour (myoma, fibroma).

Ætiology.—Fibroid tumours are most common after twenty years of age, and in certain races, the African especially, they occur with great frequency. Beyond this nothing is known of the causes which produce or favour their growth.

Anatomical Characters.—Fibromata are limited hypertrophies of the substance of the uterus, existing in the form of more or less globular tumours, contained loosely in a capsule of fibro-cellular tissue. Structurally they are homologous with the tissue of the uterus itself, consisting of connective tissue, mixed with unstriped muscular fibres. They are found of every size, varying from dimensions scarcely larger than a millet-seed, up to enormous masses weighing as much as fifty pounds. Most generally they occupy the fundus and body of the womb, and they are conveniently divided into three classes, according to the position they occupy, namely, the *sub-peritoneal*, occupying chiefly the outer surface of the uterus; the *intra-mural*, chiefly developed in the substance of the walls; and the *sub-mucous*, which project into its cavity, and these may be either completely sessile, with a broad base of attachment, or they may have become more or less pedunculated, and then approach in character to the fibroid polypi.

When once formed, the future progress of fibroids of the womb varies much. Generally they are of very slow growth, and, although malignant degeneration of their structure has been observed in rare instances, they most commonly exist for the rest of the patient's life, without giving rise to any troublesome effects, beyond those resulting from mechanical pressure, provided they are not accompanied by hæmorrhage. They are, however, subject to certain occasional alterations, such as inflammation and even sloughing, when mechanically injured, fatty and calcareous degeneration, and even to complete abortion. The possibility of their entire spontaneous disappearance has been strongly questioned. The writer has published several instances coming under his own observation, and the fact is now pretty generally admitted, the explanation probably being that on account of similarity of texture to that of the tissues of the uterus, they are subject to a process of involution like that which the tissue of the uterus undergoes after delivery.

SYMPTOMS.—The symptoms of fibroids of the womb depend to a great extent on their position. The sub-peritoneal and interstitial varieties, when not very large, are often unaccompanied by any symptoms whatever, and those that exist are chiefly the result of mechanical pressure, such as weight, difficulty in walking, irritability of the bladder, constipation, and the like. In the sub-mucous variety, the prominent symptom is hæmorrhage, which sometimes occurs to a very alarming extent, and may even put the patient's life in danger. The source of the hæmorrhage is probably, in the majority of cases, minute capillary vessels in the mucous membrane covering the tumour, which keeps up irritation and congestion in its neighbourhood. It is similar in its origin, therefore, to the discharge in menstruation, and is greatest in amount at the menstrual period. The more severe hæmorrhages are probably caused by openings in various tissues developed in the periphery of the tumour, where the vessels are increased in size, just as they are in pregnancy.

The physical signs vary with the size and situation of the tumours. If large enough to be perceptible on abdominal palpation, they have generally a more or less rounded or lobular outline, and a hard, firm feel, without any fluctuation, which serves to distinguish them from other varieties of abdominal growth. Small tumours, however, growing from the sides of the uterus, may be easily confounded with other conditions, especially flexions of the uterus, and deposits or exudations in its vicinity, such as hæmatocele, or pelvic cellulitis or peritonitis. The mobility of the uterus, which in the latter conditions is generally impaired, and the use of the uterine sound, which shows, in tumours, that the cavity of the uterus is considerably elongated, ought to enable us to avoid such mistakes.

TREATMENT.—The treatment resolves itself into *medical* and *surgical*. The former may be said to be powerless, all the so-called absorbents—iodides, bromides, preparations of lime, Kreuznach and other waters, being admitted to be of no reliable value whatever. The only plan which merits further study is the subcutaneous injection of ergotine, in doses of from gr. ss. to gr. j. daily, which is said by Hildebrandt to be of great value, and is favourably spoken of by Atthill and other authors. In a case at present under the writer's care, in which hæmorrhage had been continuous for two years, and in which a mass of fibroid reached half-way up to the umbilicus, under the continuous use of this method for several months, the abdominal tumours are no longer to be made out, although those formerly felt in the pelvis still exist, and the hæmorrhages have entirely ceased. In one or two other cases the writer has been obliged to discontinue the treatment, on account of the severe cutaneous irritation the injections produced. Surgical methods of treatment are only called for when the hæmorrhages are excessive and exhausting. To discuss them at length is impossible in so limited a space, and the writer can do little more than merely enumerate them, referring the reader to any recent systematic work for complete details.

a. Injection of *styptics* into the uterine cavity, such as tincture of iodine, or diluted tincture of the perchloride of iron, is valuable when the hæmorrhage is excessive, but a plan which should not be tried unless the cervix has been previously dilated.

b. Incision of the cervix is decidedly beneficial when the hæmorrhage is frequent and severe, which is supposed to act by allowing the uterine fibres to contract upon the tumour.

c. Incision of the capsule of the tumour itself is useful in certain sessile tumours projecting into the uterine cavity, certainly diminishing the hæmorrhage, and facilitating subsequent enucleation.

d. Removal of as much as possible of the tumour, with the écraseur or galvano-caustic wire, may be undertaken, when it is so situated as to be within reach.

e. Enucleation is very valuable when the tumour is projecting into the uterine cavity, and is already partially separated from its attachments. Under such circumstances, it may be shelled out from its capsule *en masse.* The operation, however, is difficult and severe, and must be reserved for very urgent cases.

f. Gastrotomy, with the removal of the mass of the tumour, and even of the entire uterus—is one of the most formidable of all operations, but one which has recently been occasionally successfully performed, and which is justifiable when the patient's life is seriously endangered from uncontrollable hæmorrhage.

g. The artificial production of the menopause by *removal of the ovaries* is an operation which has of late been highly recommended.

2. *Polypus.*—Polypus of the uterus may be

considered in connection with this subject, since the large majority of polypi are merely *fibroid* tumours, to a great extent enucleated from their capsules, and attached to the uterus by a narrow pedicle. There are, however, two other varieties described, the *glandular*, and the *cellular* polypi.

Anatomical Characters.—The *glandular* polypus is a localised hypertrophy of connective tissue, rarely larger than an egg, and generally attached to the cervix; the *cellular* is a hypertrophy of some of the glandular structures of the cervix, either of the Nabothian follicles or the utricular glands, and it is generally of small size. *Fibroid* polypi, like fibroid tumours, may be of any dimensions, but they are commonly met with about the size of a small pear.

Symptoms and Diagnosis.—Polypi are only important because of the hæmorrhage which so frequently accompanies them. When extruded from the cervix, or growing from it, they offer no difficulty in diagnosis. Nor is there any condition apt to be mistaken for them, except a chronic inversion of the womb, which can be readily differentiated by tracing the pedicle through the os, and finding that the sound enters the uterus to its usual depth. Intra-uterine polypi are much more difficult to discover, and here the only plan is complete dilatation of the cervix, and thorough exploration of the uterine cavity. This procedure is essential in all cases of severe hæmorrhage resisting ordinary hæmostatic treatment.

Treatment.—When once a polypus has been detected, the only treatment is its removal. In cases in which the polypus is chiefly in the vagina, this is easy enough, the wire of an écraseur being passed round the pedicle, which is separated in this way from its attachment. It is not essential that the wire should touch the base of the pedicle, since the part left, after the bulk of the polypus is removed, always shrivels up and disappears. In intra-uterine polypi it is sometimes difficult to pass the wire round the pedicle, but by thoroughly anæsthetising the patient, and using a single wire, it can generally be managed. No other method of removing polypi is so good. Excision may give rise to hæmorrhage, and the old method of ligature is dangerous from the risk of inducing septicæmia.

3. *Fibro-cystic and Sarcomatous Tumours.*—The only other uterine growths requiring mention are the fibro-cystic tumours (cysto-fibroma, cysto-sarcoma), and the sarcomatous tumours.

The *fibro-cystic* tumour is specially important on account of its great resemblance to cystic tumours of the ovary, and the extreme difficulty of differential diagnosis, which is so great that probably there is no ovariotomist of any experience who has not mistaken the one for the other. The fibro-cystic tumour is a fibroid tumour of the uterus, generally of the sub-peritoneal variety, which has grown to a large size from the development of cysts in its substance. This is most usually effected by degeneration of its tissue, which becomes liquefied and transformed into an albumino-serous fluid. Thus we have a tumour partially solid, partially fluctuating—although rarely so distinctly so as an ovarian tumour—from which fluid can be drawn by an exploratory puncture, and which may obtain dimensions, and produce constitutional effects, not less marked than those of ovarian cystic disease. The differential diagnosis may well baffle even the most expert gynæcologist. The sound may possibly enable us to ascertain the uterine character of the growth, as it enters for a considerable length, and on moving it the connection of the tumour with the uterus may be demonstrated. Athill has recently laid stress on the character of the fluid removed on puncture as diagnostic, since, unlike ovarian fluid, it coagulates spontaneously on standing, and on microscopic examination elongated fibre-cells, similar to those of the uterus itself, are found in it. The prognosis of these growths is unfavourable, since they produce all the evil effects of ovarian tumours, and the risk attending their removal by operation, which is the only available method of treatment, is much greater than that of ovariotomy.

Sarcomatous tumours of the uterus have been but little studied. They are in many respects like fibroid growths, but have a marked tendency to fungate and ulcerate, and to return after removal. Hence, they hold a place midway between the benign fibroid and the malignant cancerous growths, and they generally spring from the uterine tissue, like the sub-mucous fibroids, but without any distinct capsule. The symptoms are chiefly those of fibroid in that situation, namely, hæmorrhage; profuse watery discharges, occasionally differing in character; and sometimes pain, probably the result of uterine contractions. The treatment must consist in the removal of as much as is possible of the tumour by the écraseur or galvano-caustic wire; and, if the nature of the tumour be ascertained, its attachment should be thoroughly cauterised with strong nitric acid.

W. S. Playfair.

WOMEN, Diseases of.—Synon.: Fr. *Maladies des Femmes*; Ger. *Frauenkrankheiten.*

The intention of this article is to indicate what is comprehended under its title: to define the proper limits of the subject; to show broadly the relations of the subject to general pathology; and to set out some connected points and general principles which could hardly be so usefully stated in the special articles into which the subject is necessarily subdivided.

It is impossible to draw an arbitrary line that shall clearly separate what are commonly regarded as the special diseases of women from the domain of general pathology. The study of the diseases centred in the sexual system of women is no more than the application of general pathology to this particular system. Any disease occurring in a woman will almost certainly involve some modifications in the work of her sexual system. On the other hand, the ordinary or disturbed work of her sexual system will influence the course of any disease which may assail her, however independent this disease may seem to be in its origin. Still, bearing in mind the foregoing fundamental facts, it may be stated broadly that the diseases of women embrace more especially those morbid processes and mechanical deviations of which the principal seat is in the sexual system, that is, in the ovaries, uterus, and breasts. Yet even this is a narrow and misleading

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view to take. It is no more possible to imagine an isolated pathology of the ovaries or uterus, than of the liver, kidney, or heart. If any one of these organs be damaged or working imperfectly, the blood, the nervous centres, the other organs, the whole body suffer. No one organ can withdraw itself from its solidarity with the rest. And it is often an impossible task to analyse what appears at first sight to be a simple case, say of disease of the kidney, into its component elements, and to bring home to the kidney the initial fault. The controversy concerning arterial fibrosis, heart-disease, and Bright's disease, is a striking, but by no means exceptional, illustration of this proposition. The same thing is equally true of many apparently special disorders of the ovaries or uterus. The disturbance in function of these organs may be so obtrusively prominent that attention is concentrated upon them; and thus we may be led to regard them as the exclusive or principal seat of morbid action, and so to expend upon them our remedial care. The physician, in search of a diagnosis, is greatly guided by the observation of function. Disturbed function raises a presumption that the organ disturbed is itself at fault, and we are instinctively inclined to help that organ in its difficulty. But the primary or efficient cause may be elsewhere. This is as true of the ovaries and uterus as it is of the heart, kidney, or any other organ. One illustration will suffice. A woman suffers an abortion. There is the uterus obviously disturbed in its function, acting, in fact, in an improper manner. But we cannot in all cases affirm that the uterus is diseased. The causes of abortion are multitudinous. An efficient cause may indeed be found in some mechanical or structural fault of the uterus; but more often it will be found in the impeded work of some remote organ, or in an empoisoned state of the blood. Nor is any case often simple. Commonly several causes concur, local conditions acting and reacting upon each other. Thus, when the immediate cause is found in some alteration of tissue in the uterus, we may still have to look for the original cause in some antecedent constitutional disorder, for example, struma or syphilis, inherited or acquired, or perhaps in some long past transient morbid process, whose action can only be traced back—if traced at all—through the fallacious records and conjectures of history. Nor even then shall we be justified in concluding that we have discovered the whole secret of the abortion, that we are masters of the situation, able to take a right view of its clinical significance, and competent to deal with it on rational principles. Abortion is not seldom a conservative process, a remedy adopted by Nature to avert urgent distress in the circulation or in vital organs. There may be no appreciable disease in the uterus or embryo; but the embryo is cast out, the uterus is emptied, in order to relieve the system of a source of danger. Here, then, is proof of the danger of treating disorders of the sexual organs as a detached bit of pathology.

Here we may make particular application of a general law. The case may be formulated aphoristically. An organ so made to work against obstruction, in excess, or in an unnatural manner, is prone to organic disease. This is remarkably true of the uterus. It may be said indeed that a very large proportion of the structural abnormalities of the uterus arise in this way. Hence the importance of looking at disturbed function, not necessarily as evidence of disease of its correlated organ, but always as a warning that disease of that organ is in course of induction or of aggravation. This applies most strongly to the history of dysmenorrhœa, in which the transition from physiology in difficulty into pathology is often conspicuously manifested.

The widest and perhaps the best definition of the subject is expressed in the word 'Gynæcology.' It embraces indeed far more than is expressed in the term 'diseases of women.' In its full etymological meaning it is comprehensive beyond the strict domain of medicine; but experience and thought will show that it does not go beyond the philosophical conception of the care of the 'health of women.' Without accepting the doctrine of Michelet, that the life of woman is a history of disease, it is undeniable that to appreciate justly the pathology of woman we must observe her in all her social relations, study minutely her moral and intellectual characteristics—that we must, in short, never for a moment lose sight of those physical attributes which indelibly stamp her as woman, which direct, control, and limit the exercise of her faculties. This collateral study is of infinitely more importance in the pathological history of woman than it is in that of man. A very large, perhaps a preponderating, proportion of all the diseases to which women are subject, arise out of, or are in intimate reactive relation with the play of her sexual system. The key to many of the disorders of woman, especially of the nervous system, will be found here. The essence of her mental life is responsiveness; the emotional, the reflex, or diastaltic functions play an infinitely more active part than in man. It may further be said that the reciprocal action of the brain and spinal cord and ganglionic nerves is quicker and more intimate than in man, especially that the brain is more strictly subservient to the animal functions. Abstraction from corporeal impulse, initiation, enterprise are masculine faculties.

There is one *primâ-facie* limitation of the subject. The proper diseases of woman occur during her sexual life; that is, during the functional activity of the ovaries, uterus, and breasts. Before this epoch sets in the female is not a woman but a child; and when this epoch is over, those organs shrivel up and no longer affect the system as before. Practically, however, the physical defects of the sexual organs in course of development, as in girls, and in course of atrophic degeneration, as in old women, are so closely related by continuity of history with their state in the epoch of functional activity, that all three epochs are but linked chapters of the same history. To cut out arbitrarily the consideration of the child and the old woman must needs invalidate our knowledge of the physiology and pathology of the woman proper. But for the gynæcologist this study need not embrace more than the development and diseases of the sexual organs. In the child, and up to the advent of puberty, these diseases are few, and may be regarded as accidental. The developmental faults even rarely acquire importance until the advent of puberty. Then if the organs are faulty, and their relations to surrounding organs are abnormal, the performance of their functions may be so hindered that distress may ensue in the organs themselves, in their immediate surroundings, or in distant organs; or disorders of hæmatosis, nutrition, or other general processes may be induced. In the old woman the sexual organs, having fulfilled their functions, undergo what may be called senile atrophy. The ovaries, the uterus, the vagina often, and the breasts shrink: they are no longer the centres of active nervous and blood distribution; they become inert, and henceforth exercise but feeble influence upon the general organism. Unhappily this normal course is not always observed. Towards the climacteric there is too often developed a tendency to certain morbid processes in the ovaries, uterus, vagina, and breasts, which compel the attention of the gynæcologist. Instead of undergoing what may be described as the normal process of quiet extinction, their tissues exhibit aberrant forms of nutrition and degeneration, as fibroma or cancer, and then again the pelvic organs become active foci of blood-distribution and growth, entailing local distress, and general, it may be life-imperilling, disorder. And even when no morbid tissue-change occurs, when the organs yield to the process of extinction, various phenomena commonly show themselves, always more or less distressing; and which often assume pathological import. The sexual apparatus no longer dominating the system, the balance of healthy action and reaction being lost, the nervous force not finding its long-accustomed use, wanders off in strange paths, and in its erratic play reveals various nervous phenomena, not seldom mistaken for special neuroses—as neuralgia, hysteria, syncopal attacks, or vertigo, or even convulsive attacks simulating or even merging into epilepsy, hemianæsthesia, or hemiplegia, single or combined, and mimicking apoplexy or paralysis; and various mental aberrations more or less rebellious to the will, a very common phenomenon being enfeebled memory and unsteady volition. Associated or not with some of the foregoing phenomena are various subjective phenomena of sensation. Illusive pregnancy—the *pseudocyesis* of Mason Good—is one of the most familiar. Certain peripheral sensations, as tingling, pricking, numbness of the limbs, chills and flushings, sometimes profuse perspirations, itching—when occurring in the pudenda assuming the character of pruritus—this in many cases associated with, and apparently dependent upon, irritating discharges from the uterus and vagina, the expression often of organic disease, in other cases with glycosuria, but in all probably with some perturbation of the glandular system. Here we see proof of the intimate connection of innervation, nutrition, and glandular action. This origin of glycosuria is but one example of the influence of perverted or diverted nerve-force, in altering the constitution of the blood, and disturbing the work of the glandular organs. To trace these and their allied physiologico-pathological processes with any approach to completeness—and the theme is tempting—would lead us far beyond the narrow scope necessarily assigned to this article. Here we can only afford to give them a passing glance. One remark to emphasize the lesson the philosophical contemplation of them conveys is, that these phenomena taken together are integral parts of the play of the female economy, linking the climacteric and senile epochs of woman with that of her sexual vigour; that, occurring as they do in subjects of known sound organisation, at a definite time and under conditions exceptionally easy to trace, they throw an independent and strong light upon the genesis and nature of like disorders in the male, thus showing how what is called special pathology may help to solve many of the problems of general pathology. If we were to extend this reasoning so as to embrace illustrations from the processes of pregnancy and childbed, the argument would be greatly strengthened. We should see the strongest evidence that since such affections as glycosuria and albuminuria may begin in subjects whose liver and kidneys are sound, and disappear leaving them sound, we may certainly infer in many cases, and so presumably in more if not in all, that these and other aberrant processes do not depend for their origin upon change in the organic tissue of the organs which appear to be their immediate and necessary seats. These affections may be defined as evidences of disturbance in the work of the system. To regard them as disease is arbitrary and unphilosophical. It may then be safely affirmed that the study of gynæcology, pursued in a liberal spirit, bears the most instructive testimony to the law which declares that there is no proper boundary between physiology and pathology; that pathology is but a chapter in the history of physiology; a proposition which may be otherwise expressed by the aphorism: *Pathology is simply physiology in difficulty.*

We must bear in mind that all the great pathological processes may assail the ovaries, uterus, or breasts; that all the diatheses may stamp their work upon these organs. And this they may do apparently primarily or with especial activity; or secondarily, in the course of the development of the morbid process in other organs, or in the system at large. Thus we are familiar with cases of cancer starting to all appearance in the uterus; the disease from this centre or focus invading the surrounding structures, and empoisoning the blood. To form a just appreciation of these cases, it is obvious that a clear knowledge of the general history of cancer, as well as of its special local history, is necessary. A similar proposition may be affirmed with regard to struma, although the general and local relations may be more obscure. But the gynæcologist is familiar with the clinical fact that in a considerable proportion of cases of endometritis, of hyperplasia, and subinvolution of the uterus, and of perimetric inflammations and effusions, cure is extremely difficult—difficult beyond what his experience of simple uncomplicated cases of nominally the same kind would lead him to expect. He may safely assume that in a large proportion of these cases there is an underlying diathesis, frequently the strumous, which stamps its mark upon the tissues, modifying the progress of the morbid action, and challenging general as well as local therapeutical aid. In this connection an incidental observation may be made. Some of the most obstinate cases of endometritis and hyperplasia the writer has met with were in women who had resided in the East, and whose constitutions had been damaged by endemic disease. These women had in fact acquired a diathesis deeply affecting the nutrition and the tissue-constitution of the body, which revealed its influence most conspicuously in the uterus, an organ whose integrity had been severely tested by pregnancy and the other conditions of married life.

Another law is of deep import, from a scientific as well as from a clinical point of view. Almost all the constituent elements of the body are represented in the uterus, modified of course in arrangement, and assuming certain peculiar characters in order to subserve the particular functions of the organ. But the modifications so acquired do not deprive these fundamental elements of their original and essential properties. By these fundamental properties these elements are attached indissolubly to general pathology; by these specially adapted modifications these elements become the seat of our so-called special pathology. Thus the fibro-muscular tissue of the uterus is liable to all those departures from the healthy type, as fibroma, myoma, fibro-myoma, hyperplasia, hypertrophy, and the degenerations, to which like tissues elsewhere are liable. They may indeed assume special importance because, occurring in the uterus, they almost necessarily disorder the proper functions of the organ. They belong to the domain of general pathology nevertheless. But in this special disturbance of function we find the special aspect of the tissue-change. The retention of the essential properties of the component tissues of the body is strikingly manifested in the vascular, lymphatic, mucous, and connective tissues of the uterus. They are not only subject to the like physiological and pathological changes which the same tissues elsewhere are subject to; they link the pelvic organs to the general system partly by continuity of tissue, as especially in the case of the vascular, lymphatic, and connective tissues; but they carry morbific elements from the uterus into the general system by absorption. They thus are '*poison-routes*'—channels by which poison or noxious matter, forming in, or inoculated in, them, enters the blood, and thus empoisons the entire organism. It will not escape attention that the mucous membrane of the vagina and uterus is in pre-eminent degree exposed to contamination from external sources. It is needless to do more than refer to the direct infection from the gonorrhœal and syphilitic poisons. The gonorrhœal poison implanted on the mucous membrane of the vagina or cervix uteri sets up *in loco* its specific inflammation, and may spread along the mucous tract through the cavity of the uterus, and the Fallopian tubes; and the empoisoned secretion escaping into the abdominal cavity, may set up a severe form of pelvic or even general peritonitis. The syphilitic poison in like manner, first attacking the mucous membrane, may from this point of departure invade the general sytem. Then there are the more subtle instances of local and general syphilisation, through an ovum impregnated by the tainted male. The connective tissue again is of far more than merely local importance. Like the same tissue elsewhere, it is a most active poison-route, mainly no doubt through its relations with the lymphatic system.

There is a therapeutical corollary from this law, that deserves earnest practical attention. A great part of the treatment of uterine diseases in which there is change of tissue, as hyperplasia of the mucous membrane and muscular wall, is surgical, that is, it consists in the topical application of caustics, absorbifacients, or antiseptics, as iodine, carbolic acid, bromine, and so forth. These no doubt act in the first place directly *in loco* upon the tissues touched, modifying their state. But what is not so well known, and is rarely if ever designed or contemplated, is that some remedies so applied—notably iodine—are absorbed, and thus may affect the system. Under some conditions, as where the mucous surface is large, or when the epithelium-investment is lost, or where the quantity of the agent is large, and more especially when the absorbing function is in a state of peculiar activity, the general intoxication may be excessive, even dangerous. The writer has seen the most intense iodism produced in this way, and cases are recorded of poisoning by chromic acid. But if this law, and the conditions under which it acts, are borne in mind, remedies can generally be so applied as to draw from them both local and constitutional benefits in the happiest manner.

There are two modes in which iodine, for example, may invade the system: first by imbibition or endosmosis, the tissues becoming permeated or soaked by the fluid; secondly, by absorption into the lymphatics and veins. There is a local iodism, and a general iodism. By analysis we may resolve the complex action at work into the following factors; first, there is the direct mechanical or chemical action of the iodine upon the surface touched by it; secondly, there is the action upon the submucous and muscular tissues of the uterus, the effect of their permeation; thirdly, there is the constitutional action upon distant organs, upon general tissue-nutrition, in which the tissues of the uterus share, the remedy being brought round again to it by the circulation; and fourthly, there is an action little thought of, from which the most useful effects have been often unconsciously drawn—namely, the antidotal action of the remedy topically applied upon certain septic matters originating in the uterus, and thence invading the system. The same channel that gave entrance to the poison is made to serve as a channel for the antidote. Thus the poison-route is in turn made a remedy-route, the antidote closely chasing the poison. The application of this principle is seen most strikingly in the treatment of syphilis and cancer, but it may be turned to useful account in the treatment of other morbid conditions.

Pregnancy and child-bed constitute the most indisputable part of the territory assigned to the gynæcologist. In the careful study of the parturient process, we shall discover the secret of many of the disorders of menstruation, and arrive at a clearer understanding of the relations.

physiological and pathological, of the sexual organs to the general system, than could otherwise be attained. This is to say, that the study of obstetrics is inseparable from the proper study of the diseases of women. Parturition is the culminating point in the functional work of the ovaries and uterus. All the other points in this work are subservient to parturition. It is true that in many cases this ultimate aim is not reached. But it is not the less true that this is the aim which Nature is always striving at. She may fail at any stage of the journey. Every menstrual nisus is truly a mimic or missed pregnancy. The points of analogy, or homology, are striking. Descending from the observation of parturition at term to the observation of premature delivery and abortion, we shall find strictly related and similar phenomena in ordinary menstruation; and then passing from the ordinary or healthy type of parturition to the so-called abnormal types, again we shall find reproduced homologous processes in the various forms of paramenia, especially in dysmenorrhœa. And this is so true that the most effective principles of treatment flow from this comparative study. Many cases of nervous disorder, as vomiting, convulsion, neuralgia, such as we see in the most definite relation to pregnancy and childbed, have their exact counterparts in some forms of dysmenorrhœa; various blood-diseases, as anæmia, septicæmia, thrombosis, embolism, which we have so many sad opportunities of observing in childbed, are produced in the non-pregnant state from disturbed menstruation, or uterine disease, notably from cancer; blood-poisonings associated with glandular disorder or disease, as glycosuria, albuminuria, jaundice, simple and malignant, of which the most striking types occur in pregnancy and childbed, find their representation in the non-pregnant state.

Making liberal allowance for the proverbial difficulty of framing definitions that shall be proof against criticism, and against the infinite complications of natural history, we may cite the following as presenting a minimum view of the work of the gynæcologist. It embraces the study and treatment of the disorders and diseases of the female generative organs and their immediate surroundings—including pregnancy and parturition, and the disorders and lesions, general and local, which result from these processes.

We may set out some of these heads more particularly, as follows:—

Scheme of the Diseases of Women.

1. In infancy and childhood. Faults of development of the sexual organs; and the accidents from injury or disease to which they are liable.

2. At puberty and during the virginal state. Some of these are consequences of the developmental faults of the first order; others arise from functional difficulties, from diatheses, &c.

3. The normal and abnormal history of pregnancy and parturition.

4. The injuries and diseases consequent on parturition and childbed.

5. Mechanical or strictly surgical affections of the ovaries, uterus, and vagina, original or acquired. These include displacements or malformations of the uterus, and diseases of the ovary and broad ligaments.

6. The disorders of senility, subdivided into two classes:—(*a*) Those of the climacteric, more immediately attending and following the menopause. (*b*) Those of senility proper.

7. Those general diseases which are strictly associated with error of function of the ovaries and uterus; and those cases of general disease, of which the chief action is expended upon these organs. The former will include cases of chloro-anæmia, &c.; and the latter cases of struma, syphilis, cancer, &c., affecting the ovaries, uterus, and vagina.

8. The diseases of the breast, as mastitis, and the conditions immediately connected with pregnancy, childhood, and lactation. Most of the other diseases of this organ have fallen by a natural process of selection to the surgeon.

The special diseases of women will be found fully discussed in other parts of this work, under their respective headings.

Robert Barnes.

WOODHALL, in Lincolnshire.—Common salt waters, containing iodine and bromine. *See* Mineral Waters.

WOOLSORTERS' DISEASE.—A form of anthracoid disease. *See* Pustule, Malignant.

WORMS.—This is a popular term, which in medical practice is applied in a restricted sense, as embracing only certain forms of entozoa or internal parasites that reside in the intestines. The word, as thus employed, originated from an entire misconception in regard to the supposed affinities subsisting between the round-worms or lumbricoids and common earth-worms. Structurally these kinds of creatures, though both vermiform, are essentially distinct. In a wider and purely technical sense, however, many distinguished zoologists (Gegenbauer, Rolleston, &c.) retain the term as an expression of high group value, embracing all sorts of annulose animals, parasitic and free. By some practitioners the employment of the term 'worms' merely signifies that a patient is suffering from ascarides or thread-worms. *See* Entozoa; Helminthes; and Vermes. T. S. Cobbold.

WRIST-DROP.—A form of paralysis, chiefly affecting the extensors and supinators of the wrist, and due almost exclusively to chronic lead-poisoning. *See* Lead, Poisoning by.

WRITER'S CRAMP.—Synon.: Scrivener's Palsy; Fr. *Crampe des Écrivains*; Ger. *Schreibekrampf.*

This disease may be taken as the most common form and most typical representative of a class of diseases which Duchenne has called 'functional impotences.' In them we find the patient complaining of inability to execute some complicated act, the power to perform which had taken him perhaps years (in the case of writing) to acquire. As a rule there is no other trouble, and, as far as the patient's observation goes, all muscular acts, however delicate or however complicated, are accomplished without difficulty, with the exception of one, which unfortunately is usually that with which the patient earns his living. Not only have cases of 'writer's cramp' been described, but English and foreign physicians have furnished accounts of 'piano-player's cramp' in which an inability to strike chords with correctness is present; of violinists who have lost the power of holding the violin, and fingering with the left hand; of violoncello-players who have become powerless to 'make the nut' with the phalangeal joint of the left thumb; of tailors who can no longer use the needle; of dairymen who fail in milking; of bricklayers who cannot wield the trowel; of smiths who cannot use the hammer; of compositors who cannot place the type; and lately we have had accounts of telegraphists who have become unable any longer to work at their calling. 'Writer's cramp,' however, is by far the most common of these diseases, and while the others which we have mentioned must be regarded as the rarest of medical curiosities, the one which we have chosen to illustrate the class is tolerably often met with.

Symptoms and Course.—The symptoms and course in a typical case of writer's cramp are as follows:—A clerk, who from his painstaking and energetic habits has been tempted by his employers to work over-time or possibly against time, and who perhaps (as the history of these cases often shows) is harassed by domestic troubles, discovers that he does not write quite as easily as he did, that his hand possibly aches after prolonged writing, and he finds it convenient to adopt some new method of holding his pen. At first the trouble is hardly noticeable, and then he finds himself obliged to grasp his pen with unusual tightness to prevent its becoming unsteady. Then his handwriting begins to suffer: perhaps his forefinger refuses to remain steadily upon the penholder, and while he is making every effort to control it, the pen somehow or other eludes his grasp and falls from his hand. If he persevere—probably he is one of those who would sooner die than give in—his progress downhill is rapid and certain. Every possible method of holding the pen is adopted by turns, such as interlacing it between the fingers, grasping it firmly with the whole hand, using only the first and second fingers without the thumb, or the thumb and second finger without the first, but these subterfuges quickly fail to be of service. He cannot steady the pen by means of them, and he finds that the arm rolls possibly inwards or outwards, and that he can only form his letters by moving the whole arm from the shoulder, or lastly by fixing the arm to the side and swaying the whole body to and fro. The handwriting soon becomes illegible; and lastly the patient is almost unable, even by the most strenuous efforts, to make a mark upon paper. To write a word legibly in extreme cases is impossible, and there are few spectacles more distressing than to see a patient, whose handwriting was perhaps his means of livelihood, drip with perspiration while making an ineffectual effort to sign his name. His loss of writing power may be his only symptom, as was the case with an American sufferer who wrote thus to the writer: 'that fingers which could guide razor and needle, wield oar and musket, and, though numb with cold, knot and cast off reef-points on a wet sail, should yet strike work when called on for the familiar characters of their owner's name, seemed utterly beyond comprehension.' Patients should be closely questioned as to their ability to perform acts other than writing. In the writer's experience it is usual to find that some other act or acts is affected. If the patient be asked if he can wind up his watch, carry a full tea-spoon steadily to his mouth, or perform some similar act requiring a *delicate* use of the thumb and forefinger, it will very commonly be found that he has lost his deftness in performing such acts, although in using a knife or wielding a hammer, and in performing functions requiring a coarse use of muscles other than those used in writing, he may find no difficulty whatever. Frequently there are neuralgic pains, or a sense of extreme fatigue in the hand and arm; and in some cases the effort to write has been followed by pain in the back, or severe headache. In some cases the mental distress caused by the loss of power has produced a condition bordering on melancholia. Slight tremor of the hand is not uncommon, and these tremors sometimes occur independently of writing. Tenderness of the nerve-trunks (median, ulnar, or musculo-spiral) is very often present, and should always be carefully looked for, as indicative of congestion of the nerves, or neuritis. Occasionally there is objective spasm of some of the muscles of the arm when the effort to write is made; and one case has been reported by the writer, in which the symptoms at first were those of simple loss of writing power, but which terminated in a general clonic spasm of all the muscles of the arm, apparently at last independently of any writing effort.

Although the above is a typical case of 'writer's cramp,' other cases are by no means uncommon, in which impairment of writing power supervenes quite independently of any unusual writing effort, and even in persons who have done rather less than an average amount of writing. These latter cases are not usually so severe as the former, since they are not obliged, as is the professional scrivener, to goad the unwilling hand to make those efforts which are so detrimental. It has been the writer's experience too, that in this latter class of cases it is more usual than in the former to find that the trouble is not very strictly limited to the act of writing, but that there is a certain amount of inability or clumsiness in the performance of other acts requiring minuteness and nicety.

Pathology.—The morbid anatomy of writer's cramp is unknown, and consequently the pathology of the disease is a matter of speculation. Mr. Solly, from the fact that 'pain in the back was a not unfrequent concomitant symptom,' was of opinion that degenerative changes probably occurred in the spinal cord, which is possibly not unfrequently the case, the failure of writing power being merely the prelude to more severe and more general symptoms. Dr. Reynolds says: 'It cannot be doubted that some changes take place in the nutrition of the parts through which the lines of nerve-action regulating the secondarily automatic movements run. It seems probable that the association of movements is effected by ganglia which are common to fibres passing through distinct but contiguous nerve-trunks, and that it is owing to some nutritive change in them, the result of persevering and forced effort, that the perfection of movement is produced; associations at first caused by the will are at length produced unconsciously. What happens, then, in such maladies as writers' cramp is a perverted nutrition of these parts.' Duchenne believes that the change is in the nerve-centres first, because localised faradisation applied to the hands has no good effect on the trouble; and he is confirmed in this opinion because the malady very quickly affects the left hand if it be used to supply the place of the right. The writer has ventured to suggest that the lesion is, in typical cases at least, situated at the periphery, either in the muscles themselves, or in the terminal motor nerves supplying these muscles. In real cases of writer's cramp (the loss of writing power occurring in an overworked scrivener) it is rare to find any sign of central change; neither wasting or true paralysis of muscle, nor fibrillary tremor, nor general tremor of the limb, nor pain, nor spasm (except during, or immediately after, the attempt to write). It is generally observed that the disease progresses from the periphery towards the centre; that the muscles of the fingers are the first to fail, then those of the forearm, then those of the arm, and lastly, in extreme cases, those of the trunk. It is probable that the muscles of pen-prehension, as opposed to those of pen-movement (consisting of the adductor pollicis, first dorsal interosseous, &c.) drift into a condition of 'chronic fatigue' owing to the *prolonged strain* to which they are subjected when holding a pen for long periods at a time. When these normal muscles of pen-prehension are exhausted, others are used to supply their place, such as the superficial and deep flexors in the forearm, &c., which in their turn give out, and thus the trouble steadily progresses. The writer has had no small experience of this disease, and he has never failed to find that a careful electrical investigation of the muscles has shown a certain diminished irritability to faradisation in the muscles of pen-prehension on the diseased side, when compared with those of the sound side. This loss of irritability is due, in many cases, he believes, to sheer over-use of the muscles, the intervals of relaxation between the long periods of contraction not being sufficient to allow of their proper nutrition. In many cases of 'writer's cramp' no over-use of the muscles has taken place, and in such cases we must suppose that, from some condition, either constitutional or situated locally in the nerves, the muscles are so deficient in 'staying power' (notwithstanding their ability to contract forcibly for a short time) that they become useless, or nearly so, when called on for prolonged steady contraction. It is obvious that the failure of one muscle (however small) which had been taught, by years of laborious education, to act in harmony with many others for the accomplishing of a complicated and delicate act, such as writing, would produce a true want of co-ordination. In other words muscles which have been induced *to work in order together* no longer do so if one of them fails, and the failure of one must be fatal to the accomplishment of the co-ordinated act.

Diagnosis.—Diagnosis is of great importance, since failure of writing power is often an early symptom of disease the prognosis of which is very different from that of 'writer's cramp.' Evidence of chronic alcoholism is often afforded by the handwriting. So again paralysis agitans and disseminated sclerosis of the spinal cord may very early give a want of steadiness to the pen. Dr. Reynolds records a case of lead-palsy, which was sent to him as a case of writer's cramp. Paralysis of any of the nerves supplying the hand or forearm, such as the ulnar, median, or musculo-spiral, will make writing difficult; and the writer has seen cases of progressive muscular atrophy, in which the shrunken and quivering interossei had made a firm grasp of the pen impossible.

Treatment.—The chief remedy is rest. Without it nothing can be done, and if rest be taken in the earliest stages of the disease, complete recovery not unfrequently results. For such writing as is absolutely necessary, the patient should be advised to use a pencil or soft quill pen, so that any violent grasp becomes impossible. In many cases the writer has found the rhythmical exercise of those muscles whose irritability is impaired, together with the employment of a mild galvanic current, of the greatest service, and he has recorded a few cases treated in this way which rapidly improved, after having resisted every other known method of treatment for years. Injection of morphia is of no use, but in America some good has been said to result from the injection of atropine. If any of the nerve-trunks be tender, these should be blistered.

G. V. Poore.

WRY-NECK. — Synon.: Torticollis; Fr. *Torticolis*; Ger. *Steifer Hals.*

Definition.—A twisting of the neck to one side.

Ætiology.—Wry-neck is a symptom which may be produced by very different conditions; and it is usual to distinguish between the varieties of this disease, which may either be *congenital* or *acquired.*

The *congenital wry-neck* arises either from faulty development of the muscles on one side of the neck (in which case there are not unfrequently evidences of faulty development in other regions of the body, and notably in the neighbouring parts, such as the face); or from paralysis of the muscles on one side, often due to accidental injury during labour. In these cases the head is fixed in its abnormal position. *Acquired wry-neck* may be a mere passing condition, due to 'muscular rheumatism,' brought on by exposure to cold, and under the name of 'stiff-neck' it is familiar to everybody (*see* Rheumatism, Muscular). The most formidable variety is *spasmodic wry-neck*, which makes its appearance, usually in persons otherwise healthy, about the middle period of life. The muscles on one side of the neck are the seat of spasm, sometimes tonic, but usually clonic in character. The muscle chiefly affected is generally the sterno-cleido-mastoid, and its constantly recurring contractions have the effect of turning the head away from the side which is the seat of spasm; drawing the occiput slightly downwards, and the chin slightly upwards. Other muscles, such as the scaleni, splenius, and trapezius, are not unfrequently affected also, and then, in addition to the rotatory twisting of the neck, we get a lateral downward bending, and an elevation of the shoulder. At the commencement of the disease the trouble may be slight, and cause but a trifling amount of inconvenience, the impressions produced on a bystander being that the patient's movements are caused by some malarrangement of the dress, which he is seeking to remedy. In its advanced form the disease is a very terrible one, and may make life hardly supportable. The writer has seen one case in which the spasm was so violent, that the constant forcible impinging of the chin upon the shoulder of the sound side had produced a sore place as big as a shilling. The spasm ceases during sleep; and when the patient is undisturbed, and his mind pre-occupied, it is not unusual, even in the worst cases, for considerable remissions of the symptoms to occur. In the presence of others, especially strangers, the spasm is usually intensified, and in this it presents a striking similarity to stammering and writer's cramp.

Pathology.—The pathology of spasmodic torticollis is very doubtful. It must be regarded in almost all cases as a true neurosis, and must take its stand alongside of histrionic spasm of the face, writer's cramp, and stammering. That it is due in many cases to an irritable condition of the spinal accessory nerve there can be no doubt, but how this condition of nerve is brought about we are unable to say. Want of proper antagonisation is another factor which is always present, for without it the symptoms could not occur. In certain nervous constitutions a weakened action of one sterno-mastoid would seem of itself to be almost sufficient to excite irregular contractions in its fellow. The writer has seen one case in which it seemed tolerably clear that the sterno-mastoid and trapezius on one side had become weakened by overwork, and had drifted into a condition of chronic fatigue, while their antagonists were constantly in a state of clonic spasm, twisting the neck to the weakened side. An electrical examination of the muscles generally shows that, while those which are the seat of spasm have their irritability greatly increased, their antagonists are below their normal state as to irritability. Torticollis is usually, but not always, uncomplicated. That condition known as 'irritable spine' has been observed in some few female patients; histrionic spasm, or spasm of the limbs, has occurred as a complication, and it is not a little remarkable, as showing connection between the two diseases, that Dr. Reynolds has recorded three cases of torticollis in which the patient had suffered previously from writer's cramp. A difficulty of deglutition was observed in one of Dr. Reynolds's cases; and in another there was swelling of the arm, from pressure upon the subclavian vein.

Prognosis.—The prognosis of these cases is bad, it being very unusual for recovery to take place after the disease has become well established.

Diagnosis.—The diagnosis of wry-neck, as a rule, is not difficult, but care must be taken that simple torticollis is not confounded with cases of caries of the cervical spine, in which there is frequently a tendency for the head to twist to one side. It should be borne in mind, also, that in some few cases of organic brain-disease, in which synergic movements of the eyeballs have occurred, a spasmodic rhythmic movement of the neck has also been observed. The other symptoms of brain-disease, however, would usually prevent any such mistake.

Treatment.—This necessarily depends upon the cause of wry-neck. In those cases in which the head is fixed by contraction or faulty development of the muscles, tenotomy has been of service, and although it has been practised also in those cases in which there has been definite clonic spasm, and notwithstanding that temporary relief has in some cases followed, it is found that the deep-lying muscles are almost certain to take on a spasmodic action, and that in the end the patient's discomfort is increased rather than diminished. Various mechanical contrivances for steadying the head have been devised, but few patients are able to bear the constant pressure of the apparatus, and the remedy has been found in most cases worse than the disease. Some good has resulted from the long-continued use of hypodermic injections of morphia, and Dr. John Harley has recently reported some cases which have been greatly benefited by the exhibition of large doses (℥j. and over) of the succus conii. Electricity has not been particularly serviceable in the treatment of torticollis. The galvanic current has been used to control the spasm, while the weakened antagonising muscles have been stimulated by faradisation, and although improvement has been produced by these means, it has generally been of very short duration. The writer has lately had a very severe case under his charge, which was successfully treated by the employment of the continuous galvanic current, combined with the rhythmical exercise of the affected muscles. The positive pole being placed behind the ear, the negative pole was applied over the sterno-mastoid and trapezius, and at the same time the patient was made to exercise these muscles by shrugging the shoulder, twisting the head, &c. The result was very rapid and permanent improvement. Another case has also been no less successfully treated by the writer by faradising the antagonist muscles, which were somewhat wasted and decidedly deficient in irritability. This patient completely recovered; although tenotomy of the sternomastoid, which was the seat of spasm, had afforded only temporary relief.

G. V. Poore.

X

XANTHELASMA (ξανθὸς, yellow, and ἔλασμα, a lamina).—A yellow growth in the superficial layer of the skin, assuming the form of a lamina or plate, and more frequently met with in the eyelids than elsewhere. *See* XANTHOMA.

XANTHOMA (ξανθὸς, yellow).—SYNON.: *Xanthelasma.*

DEFINITION.—A peculiar kind of yellow growth, originally observed in the integument, but subsequently in the areolo-fibrous tissues elsewhere.

ÆTIOLOGY.—Xanthoma must be referred to a defect of vital power, affecting the nutrition and growth of certain of the tissues of the body—in the present instance the connective tissue, and especially that of the surface membranes of the body. A similar cause will serve to explain the concentration of pigment which is observable in the integument of the eyelids in these cases. It is deemed probable that this affection may be related to a morbid function, if not to a morbid organic condition of the liver. The latter organ has frequently been found diseased in association with these cases, and in one instance every organ of the body would seem to have been in a state of disease. On the other hand, xanthoma has been seen in persons apparently sound in every other respect; therefore it would seem that there is nothing to prevent it from affecting the sound as well as the diseased. Some curious cases have lately been recorded of xanthoma in children in whom the disease had been present from birth or early infancy. Instances of heredity of the disease have been noted.

ANATOMICAL CHARACTERS.—Pathologically, xanthoma is a new growth of harmless character, a form of degeneration taking place in the superficial integuments—cutaneous, mucous, and serous, and in some instances in the subjacent areolo-fibrous tissue. The morbid structure is composed of an areolar network of connective tissue, enclosing areolæ filled with cell-germs, and traversed by a scanty plexus of minute bloodvessels. The process is accompanied by fatty degeneration of the young cells, and the formation of cholesterine crystals. The papulæ are not due to a collection of sebum within the follicles, as Hebra suggested; neither is the colour dependent on the absence of pigment in the rete mucosum, as in vitiligo.

DESCRIPTION.—Xanthoma presents itself under two forms: first, as isolated nodules, *X. tuberosum*; and, secondly, as smooth plates or laminæ of moderate dimensions, *X. planum*. It is to this latter form that the term 'xanthelasma' was intended to apply; and in consequence of the greater frequency of the disease in the eyelids than elsewhere, the term *X. palpebrarum* was invented to distinguish such cases from those in which it occurs in both its forms, and on other parts besides the eyelids, and to which the term *X. multiplex* has been applied.

On the eyelids xanthoma may be recognised as a yellow spot, slightly elevated, with a rounded outline, oblong and generally solitary, but sometimes accompanied with several papulæ of similar colour scattered around the circumference. It occurs most commonly near the inner angle of the upper eyelids, and is usually symmetrical on both eyes. Next it is met with at the inner extremity of the lower eyelids, and in extreme cases surrounds the opening of the eyelids more or less completely. Its colour varies from that of cream or a pale primrose to a deep orange-yellow. On careful examination with a lens, the patch may sometimes be seen to be granulated (*X. granulosum*) on the surface, many of the granules or nodules being punctated by the aperture of a follicle; and in the isolated papules this structure is even more distinct. There is some slight variety in the degree of prominence; usually there is no redness or indication of hyperæmia, and the surrounding integument has a dusky or brownish tint of various degrees of depth. There is no pain of a spontaneous character, but instances are no record where nodules about the hands have been so tender as to prevent the patient handling anything.

Independently of its presence on the eyelids, with which it wss formerly specially identified, the disease has likewise been seen, in order of frequency, on the palms and soles, knuckles, ears, flexures of joints, nose, and cheeks; in advanced cases on the back and abdomen, as well as the face and limbs. It frequently attacks the mucous membrane, and has been seen on the lips, tongue, and palate; also on the trachæa and bile-ducts; in the subcutaneous areolo-fibrous tissue; and in the subperitoneal tissue of the abdomen and of certain of the abdominal viscera.

DIAGNOSIS.—The diagnosis of xanthoma is determined by its colour, its situation, its material structure, and its predominant forms—always circumscribed, sometimes occurring as rounded papules or tubercles, sometimes as laminæ, smooth on the surface or granulated and nodulated.

PROGNOSIS.—Xanthoma is essentially chronic in its nature, but otherwise harmless, uninfluenced by constitutional treatment, but removable by surgical operation when limited in extent. It rarely gives rise to inconvenience, and is chiefly objectionable from its appearance. A noted instance of the spontaneous disappearance of xanthoma nodules has been recorded by Wickham Legge.

TREATMENT.—Assuming that no local disease can occur without some constitutional derangement, and having our attention drawn to a probable defect of function of the liver and possibly of the digestive organs, it is not unreasonable to direct our treatment to the regulation of those functions. Nitro-hydrochloric acid with a bitter, and the occasional use of blue pill, are both indicated. Subsequent to these remedies we may have recourse to arsenic, as a nutritive tonic possessing special properties of peripheral action. Locally, destruction of the morbid tissue by means of caustics naturally occurs to the mind; and where the extent of the disease is limited, it may be effectually removed by potassa fusa. The case is hardly grave enough for the use of the knife, although it is sometimes resorted to; and excision would probably be attended by the after-inconvenience of contraction of the integument.

Erasmus Wilson.

XERODERMA (ξηρὸς, dry, and δέρμα, the skin).—Description.—Xeroderma is a state of defective nutrition or atrophy of the integument, distinguished by dryness, roughness, and greyish discolouration. The skin is poor and starved, hard and wrinkled; the epidermis is thickened, sometimes desquamating, and sometimes accumulated in crust-like masses, corresponding in figure with the area of motion of the integument. The disease is unaccompanied by any subjective sensation. The perspiratory function is impaired. Xeroderma is congenital and sometimes hereditary, and may vary considerably in degree, entitling itself in its more severe forms to be considered as ichthyosis, the latter disease being always accompanied by xeroderma. The term has also been applied by German writers to a rare form of atrophy of the skin, with disturbance of pigment and nævoid changes. *See* Ichthyosis.

Erasmus Wilson.

Y

YAWNING (A.-S. *gânian*).—Synon.: Fr. *Bâillement*; Ger. *Gähnen*.—Yawning is one of the physiological expressions of fatigue. It consists, when fully developed, of the following phenomena:—1. A deep inspiration, with elevation of the uvula and palate. 2. A forcible spasmodic depression of the lower jaw. 3. A flow of tears. 4. A clicking sound in both ears. 5. A tendency (sometimes irresistible) to stretch the limbs, especially the arms. 6. An expiration, often accompanied by a sound, the character of which has probably given the name to the act.

Ætiology and Pathology.—This strange and complicated act suggests many reflections. Why, when we are tired, should we take a deep breath? It may be that the need of oxygen experienced by the fatigued tissues, laden with waste products, prompts the instinctive and forcible descent of the diaphragm; but, on the other hand, the facts that yawning is common when we are merely *ennuyé* and not genuinely fatigued, and that it is decidedly infectious, are both unaccountable on such a theory. Why should the lower jaw be spasmodically depressed when we are fatigued? The elevators of the lower jaw are the temporal, masseter, and internal pterygoid muscles, and it is probable that the external pterygoid (whose main functions it is to move the jaw forward) has also some share in keeping the teeth in contact. These muscles are constantly in action, having to support the jaw against the force of gravity; and it is not surprising that, as in other cases of prolonged muscular action, they should be prone to evince fatigue by failure of function. Were it not for the fact that this work of supporting the jaw is divided amongst eight muscles (four on either side), it is probable that the jaw would fall more often than it does. When one set of muscles is fatigued, it is quite in accordance with experience that their antagonists should take on a spasmodic action; and we may fairly look upon the spasm of the depressors of the jaw, when the elevators are fatigued, as the physiological expression of an occasional pathological phenomenon. These considerations again do not apply to those instances of infectious (emotional) yawning in which we are impelled to imitate what we see in others.

A fact of considerable interest in connection with yawning is the great extent to which its phenomena are limited to the area of the fifth nerve. The four muscles mentioned above, as concerned in the negative phase of yawning, are all supplied by the fifth; and the anterior belly of the digastric and the mylo-hyoid muscles, which are connected with its positive phase, are also supplied by the fifth. The flow of tears and the 'click' in the ears, which is probably due to a contraction of the tensor tympani, are also referable to the influence of the same nerve. The tensor palati is likewise in action; so that we may say that every muscle supplied by the fifth is concerned in yawning. Possibly yawning may be regarded as a reflex phenomenon, of which the most ordinary stimulus is the fatigued condition of the elevators of the lower jaw. The reflex effects are largely manifested in the area of the fifth nerve, but they clearly spread beyond it, and produce contraction of the diaphragm, palatal muscles, depressors of the hyoid bone and larynx, and sometimes of the muscles of the body generally, but mainly of the extensors. That the contraction of the body muscles at least is a purely reflex phenomenon, may be gathered from the interesting fact which has been often observed in cases of hemiplegia, namely, that when a hemiplegic arm is entirely beyond the control of the will, and its flexor muscles are contracted, this contracted helpless hand will often open during yawning, the stimulus having reached the extensors of the fingers, not through the ordinary path of the will, but through the spinal cord by a reflex action travelling along some other path of nervous energy.

Treatment.—Yawning is generally only a passing phenomenon, which is removed by rest. An undue tendency to yawn may indicate that the body is too easily fatigued; and then it may be necessary to inquire whether the demands upon it (mental, physical, or sexual) are too great. These may have to be removed or avoided. At the same time the bodily health should be carefully attended to. Iron tonics may be given; the foul atmosphere of crowded assemblies should be forbidden; the diet should be nutritious and digestible; and the amount of alcohol should be carefully restricted to that physiological minimum which may be necessary to aid digestion.

G. V. Poore.

YAWS. *See* Frambœsia.

YELLOW FEVER.—Synon.: Fr. *Fièvre jaune*: Ger. *Gelbes Fieber*.

Definition.—A pestilential contagious fever of a continuous and special type; originally developed in tropical and insular America; occurring only in regions between 45° N. and 35° S. lat.; and dependent for its origin and spread upon a temperature not lower than 70° Fahr. Yellow fever presents two well-defined stages. The first extends from 36 to 150 hours, according to the severity of the disease, and is marked by rapid circulation, and elevated temperature. The second is characterised by depression of the nervous and muscular powers, and of the circulation, with slow and often intermittent pulse; jaundice; suppression of urine, albuminuria, and desquamation of the renal epithelium; diminution of the fibrin of the blood, capillary congestion, passive hæmorrhages from the mucous surfaces, and black vomit; fatty degeneration of the heart and liver; and convulsions, delirium, and coma. The fever is not dependent for its origin or propagation on those causes and conditions which generate malarial paroxysmal fever, from which it differs essentially in symptoms and pathology. As a general rule it occurs but once during life.

History.—The origin of the American plague, or yellow fever, is involved in doubt, in consequence of the prevalence in regions in which it occurs, both amongst natives and foreigners, of severe forms of malarial fever, often attended with jaundice, passive hæmorrhages, and black vomit. In the eleventh century, a disease closely resembling yellow fever, known as the Matlazahuutl, made great ravages amongst the Mexicans, but it was peculiar to the aborigines, never attacking white people, whilst, on the contrary, Mexican Indians seldom suffer from yellow fever. According to authors, the first trace of yellow fever was observed at the end of the fifteenth or beginning of the sixteenth century, at San Domingo and Porto Rico; and Columbus, landing at the former place in 1493, lost the greater number of his men, within a year after their arrival, from a disease described as being 'yellow as saffron or gold.' From 1544 to 1635, when it appeared at Guadeloupe, there is no record of any outbreak, but thenceforward it occurred at irregular intervals. In the seventeenth century it spread along the east coast of America, as far as 8° S. lat. and 42° N. lat., appearing for the first time in the United States at Boston in 1693. In the eighteenth century it appeared on the west coast of South America, and extended even to Europe and Madagascar; the great commercial and military activity of this time doubtless favouring its spread, and increasing the frequency of the epidemics, eighteen being recorded as having occurred in San Domingo within the century. Early in 1700 it reached New York. At the beginning of the present century it reached 47° N. lat. in America, and also prevailed in the Canary Islands, in Leghorn, and in the maritime cities of Spain and Portugal. In 1853, 1867, 1873, and 1878 it spread to a large number of cities, towns, and villages in the interior of the American continent, being transported by railroads and ships. During this century it appears to have relinquished its hold upon the northern cities of the Atlantic coasts, and has been concentrated chiefly along the southern borders of the Atlantic and Gulf coasts. Yellow fever has prevailed almost annually as an endemic at Havana from April to December; and from time immemorial it has been endemic at Vera Cruz.

Geographical Distribution.—At an early day it was established that yellow fever is emphatically the disease of strangers in the warm, moist climates of insular and tropical America. It is endemic in the West Indies, and is rarely, if ever, absent, the seasons of the year having but little influence in eradicating it, though the disease is most fatal from May to August. On the other hand, the history of the settlements along the shores of the Gulf of Mexico and Atlantic Ocean has demonstrated that in the more temperate regions it is a disease of occasional occurrence, and not in the strict sense of the term endemic. Since the disease is dependent in a great measure upon an elevated temperature, its occurrence is limited to tropical and subtropical regions, or to countries having a tropical climate, or a summer of sufficient length and heat. Within these prescribed limits the exciting cause seems to exist, but still the fever has seldom, if ever, shown itself except in maritime regions, elevated but a few feet above the sea. From Brazil to Vera Cruz in one direction, and from Barbadoes to Tampico in another, the exciting causes are in constant, though unequal force, depending on differences of seasons, localities, and constitutions. On the Atlantic coast it has extended as far north as Boston, Massachusetts, and Portland, Maine, while in the Mississippi valley it has three times appeared as high as Memphis, Tennessee, in latitude 35° N. In an eastern direction, but within the same parallels, it has extended to Cadiz, Xeres, Carthagena, Malaga, Alicant, Seville, Barcelona, and other cities on the coast and in the interior of Spain. It has prevailed several times at Gibraltar, once at Rochefort, twice at Lisbon, and once at Leghorn. It prevailed at Monte Video, lat. 34° 54' S. in 1857 and 1872; in Buenos Ayres in 1858 and 1871; once at Panama and Callao, and at Lima and Cuzco in Peru, in 1854 and 1856. In America it reaches from lat. 36° S. to 45° N. on the Atlantic coast, and to 35° N. in the Mississippi valley. On the Pacific coast it extends from 15° S. to 9° N. Longitudinal limits in the same country, 60° to 97° W. In the eastern hemisphere it occurs within the limits of 42° N. and 8° S. It is said not to appear in the East Indies or China.

Perpendicular distribution.—The older statements, that yellow fever never extended beyond the height of 2,500 ft., are shown to be incorrect; for it has prevailed in the elevated table-lands of Caracas, 3,000 ft. above the sea-level, on more than one occasion; and in 1854 and 1856, it committed fearful ravages in Cuzco at an elevation of 11,378 ft., and even in other places in the Andes at 14,000 ft. Great variety, however, exists in this respect, for at Xalapa, in Mexico, in the same parallel with Vera Cruz, 4,330 ft. above the sea, it has never prevailed as an epidemic; and the hills in Jamaica and San Domingo are free from the pestilence which rages in the low lands.

Ætiology and Pathology.—*Relation to population.*—A certain degree of density of population appears to be essential to the production of yellow fever, which never originates in country districts, but is a disease of crowded cities on the shores of the ocean or large rivers, and of ships. Its origin and spread are favoured by the congregation of persons born in a cold climate; and where developed in strangers who have landed in a port in which it is not prevailing, it appears to be referable to the action of endemic causes upon highly susceptible individuals.

Relation to temperature.—However violent the disease may be at any place, yellow fever is arrested from the day on which the earth is frozen, and such localities may then be visited with impunity by strangers. The singular occurrence of the disease at the high elevations in the Andes above mentioned, appears to be due to the fact that, whilst in those regions the night and morning are excessively cold, intense heat prevails in the afternoon.

Incubation.—The period of incubation appears to vary in different epidemics, and in different individuals in the same epidemic, and may extend from twenty-four hours to weeks or even months. In this respect yellow fever resembles diseases of malarial origin, and differs from the well-defined contagious maladies. Whilst in some a few hours' exposure to an infected atmosphere is sufficient to determine the disease, others may remain unaffected until the end of, or even through, several epidemics. Cases have been known to occur in the winter, weeks after it is supposed that the disease was entirely checked, the poison being looked upon as lying dormant in the system. Like many other contagious diseases, it may be communicated to the fœtus, and this is supposed to partially explain the immunity enjoyed by the natives of localities in which it is endemic.

Essential cause.—The various opinions on this point fall under three heads: 1. That yellow fever is a disease induced essentially and solely by contagion. 2. That it is essentially of endemic origin. 3. That being of endemic origin, it afterwards becomes contagious.

The idea has been extensively entertained that intermittent, remittent, and pernicious paroxysmal malarial fevers, as well as yellow fever, assume more or less, according to circumstances, the type of one another, and are essentially the same, modified only by the intensity of the cause, and by the prevailing constitution. The marked exemption from the disease of the natives of districts where yellow fever is endemic, with their liability to mild intermittent and remittent attacks, is regarded as supporting this view.

The following facts have been cited to sustain the opinion that yellow fever arises from miasmata. 1. It always appears simultaneously with bilious remittent. 2. A high range of temperature is essential to the generation of its cause. 3. Its first appearance is almost always in the lowest and most filthy parts of towns; and in localities favourable to the production of miasmata. 4. The supervention of storms, heavy rains, or cold weather puts an immediate check to its progress.

With some writers it is still even a disputed question whether certain fevers which have, or are supposed to have, their source in vegetable miasmata, or in effluvia from marshes, or from infusoria or fungi, developed and propagated under certain combinations of heat, moisture, and putrefying vegetable and animal matters, are subsequently spread by contagion; whilst other writers contend that within the tropics yellow fever may at any time, under certain conditions of moisture and temperature, arise *de novo*, in the impure atmosphere of the crowded and filthy ship or city. Others again as strenuously uphold the doctrine that yellow fever is a specific, contagious, pestilential disease, which, like small-pox or measles, may be transferred and communicated from one ship or city to others, thus following the great avenues of commerce. A third class adopt and advocate a doctrine which embraces the main features of both propositions. Some who hold that yellow fever may be engendered *de novo* in the holds or atmosphere of ships navigating in the warm, moist, tropical regions, have coupled with this view the doctrine that if this poisoned atmosphere be allowed to escape at the wharves of cities situated beyond the yellow fever zone, those only who come within the sphere of its influence will be affected, and its subsequent spread will depend upon conditions of filth and crowding of such localities, the disease never spreading endemically, but falling harmless among the inhabitants of a salubrious locality. According to this view, the development of this malignant fever requires the conjoint operation of both local and general causes, constituting an endemico-epidemic which is unsusceptible of propagation by specific contagion, and in the summer atmosphere of a city lying beyond the yellow-fever zone there must exist some peculiar combination of circumstances, or some peculiar agency, favourable to its development. In these cases it is affirmed that there is generally found an infected district, which slowly and regularly extends its boundaries, rendering all who come within its limits subject to this form of fever.

It has been said that the experience of several centuries leads to the view that the cause of this fever is perennially present in the tropical and subtropical cities of America; that it maintains the same relation towards the human system as the other malarial emanations of swamps and low lands; and that it is liable to be developed at any time, in different degrees of intensity, by the combined operation of heat and other agents. Amongst the most striking circumstances in the ætiology of yellow fever are the marked geographical boundaries within which it is confined, and the circumscribed localities in which it prevails; its more frequent prevalence in the western than in the eastern hemisphere; its almost universal limitation to commercial sea-ports, elevated but a few feet above the level of the sea, although it occasionally spreads to towns and cities in the neighbourhood of the latter, situated in the interior of the country, on the banks of navigable rivers; and the fact that it is very frequently circumscribed within certain limited and well-defined portions of the locality or city in which it prevails. To these may be added the vastly greater susceptibility of strangers over the natives of regions in which the disease is endemic, although this susceptibility is liable to diminution by residence in the proscribed regions.

Anatomical Characters.—In cases of death from yellow fever the features are frequently bloated; the skin of the face and upper part of the trunk of a golden-yellow colour; whilst dependent parts present a mottled purple, and a yellow ecchymosed appearance. Considerable quantities of dark fluid blood escape on section of the muscles, becoming bright scarlet on exposure. Putrefactive changes set in early, appearing sometimes to do so before death.

The *nervous system* presents no characteristic appearances beyond general congestion. Urea, bile, and leucin have been obtained, by analysis, from the brain.

The *heart* is in a condition of acute fatty degeneration, of a pale yellow or brownish-yellow colour. This degeneration is more extensive and more rapid than in any other disease. The cavities are usually filled with dark fluid blood, which contains an excess of urea, ammonia, and extractives, with a great diminution of fibrin. No such appearances are found in the heart in malarial fever.

The *lungs* present extreme congestion of dependent portions, and sometimes circumscribed hæmorrhages into the pulmonary tissue.

The mucous membrane of the *stomach* is frequently intensely congested, softened, and eroded, often containing large quantities of black vomit of an alkaline reaction, from the presence of ammonia, resulting from *ante-mortem* decomposition of the urea. Microscopically the vomit is seen to contain red blood-corpuscles, gastric epithelial cells, dark masses of hæmatin, and sometimes vibriones and other organisms.

The *intestines*, as a general rule, are dark-coloured and distended with gas, sometimes containing large quantities of dark altered blood, of an alkaline reaction. Bile is always absent from the intestinal contents. Intussusception of the bowels is by no means unfrequent.

The *liver* is yellow and bloodless, and the stroma and secreting cells are infiltrated with fat, though the organ is firmer than is the case in ordinary fatty degeneration. None of the pigment deposited in the portal capillary system in malarial fevers, is found in yellow fever. When yellow fever has been preceded by or engrafted on malarial fever, the liver presents the appearances of both these diseases, and hence some confusion has occurred in the recognition of the normal pathological appearances proper to each. The golden-yellow colour of the yellow-fever liver can be extracted both by alcohol and water. A similar decoction of the malarial liver is of a brownish-yellow colour; in the latter case also the organ is softer, contains more blood, and is readily dissolved by liquor potassæ, forming a solution of the appearance of venous blood, which is not the case in yellow fever. Large quantities of urea and fat, as well as glycogen and glucose, may be obtained from the yellow-fever liver, whilst, as a general rule, grape-sugar is absent from the malarial form.

As a general rule the *gall-bladder* is contracted and flaccid, and contains but very little bile; but sometimes it is distended with dark grumous blood, and occasionally an albuminous mucoid liquid, without a trace of bile. In malarial fever, on the contrary, the gall-bladder is usually full of dark greenish-black bile.

The *spleen* is but slightly enlarged as a rule, and is frequently normal in size and appearance internally as well as outside.

The *kidneys* are of a brownish-yellow colour, and loaded with fat. The Malpighian corpuscles and tubuli uriniferi are filled with granular albuminoid and fatty matter, detached epithelial cells, and oil-globules.

The *urinary bladder* is almost always empty; the little urine that it may contain is of a light yellow colour, free from crystalline deposit, and loaded with albumen.

Symptoms.—*Invasion.*—The symptoms of yellow fever at this stage are uncertain and ill-defined. Attacking a community, as this disease does, without discrimination of age, sex, or state of health, those only being exempt who have already suffered from the malady, it of necessity offers the greatest variety of manifestations. The onset, as occurring suddenly in apparent health, is marked by intense headache, rigors, pain in the limbs and back, rapid rise of temperature, eyes glistening and suffused, congested countenance, intense thirst, anorexia, uneasiness at the epigastrium, nausea, and vomiting.

Stage of chill, or primary depression.—Here, also, the symptoms are not uniform. In some cases, and even in those of the greatest violence, chills are entirely absent, or amount only to a sense of coldness. In others they are deep, penetrating, and stupefying, or alternate with flashes of heat and crawling sensations; or the constriction of peripheral vessels may be extreme, causing a shrivelled appearance of the skin. In some cases, again, the disease is ushered in by giddiness, and in others with convulsions. Neither the presence nor absence of chills, therefore, can be regarded as characteristic. The chills, when they do occur, differ from those occurring in true malarial fever, and rather resemble those which may take place at the onset of such diseases as small-pox or pneumonia.

Stage of reaction.—The stage of active febrile excitement follows the chills, or the premonitory symptoms of uneasiness, prostration, and languor, with severe pain in the head and limbs, in the form of a rapid elevation of temperature. This ranges in the first day of the disease, according to its severity, from 102° to 110° Fahr. in the axilla; and it is probable that the internal organs attain in some cases a temperature of 112°. As a general rule, from the third to the fifth day it falls to the normal standard, and even below it; in some fatal cases it rises again towards the end, rarely, however, exceeding 104° Fahr., and never attaining the high degree reached at first. The supervention of any inflammatory condition, or the occurrence of an abscess, will also cause a rise of temperature, with slight evening exacerbations; but as a rule the secondary elevation thus caused never equals the maximum of the stage of active febrile excitement. When malarial paroxysmal fever is engrafted upon yellow fever, in its later stages, or during the period of convalescence, the temperature during the hot stage may even exceed the maximum of that of yellow fever, but it will be characterised by sudden periodic depressions and elevations recurring at definite intervals. The pulse when reaction has set in is rapid, strong, tense, and full, though occasionally feeble and compressible. The increase of the frequency of the pulse does not however, as a general rule, continue to correspond with the elevation of the temperature; and in many cases the remarkable phenomenon is witnessed of the pulse progressively decreasing in frequency, and even descending below the normal standard, while the temperature is maintained at an elevated degree. This singular circumstance is of great diagnostic value, as serving to distinguish yellow fever from other diseases, and especially from malarial paroxysmal fever, and also as indicating the presence in the blood of a poison possessing a specially depressing influence on the heart. On the other hand, the pulse may increase in frequency, but diminish in force, near the fatal issue, with a fall in temperature, particularly if there have occurred free hæmorrhage from the stomach.

The stage of febrile excitement is not of fixed duration, and may in some of the gravest cases appear to be comparatively mild and unimportant. At the same time the pains may be so slight and there may be such an absence of delirium, and but small failure of strength, that both patient and physician may be deceived, and yet the former may die without taking to his bed. In most of these so-called 'walking cases,' the kidneys have been involved from the inception of the disease, and complete suppression of the urine has supervened before death. This latter symptom is almost invariably fatal, and is a chief cause of the hæmorrhages from the stomach and bowels, and also of the marked blood-changes, leading to severe nervous disturbances, and frequently to sudden death. There is no doubt but that the fever-poison directly interferes with the nutrition of the gastro-intestinal mucous membrane, liver, and kidneys, loading thereby the already vitiated blood with the abnormal products of their disintegration, whilst the circulation of the impure blood necessarily affects all the tissues of the body, and intensifies the morbid changes in those organs primarily attacked by the specific poison. The action of the poison of yellow fever, during the stage of acute febrile excitement, is manifested not only by intense pain in the head and back, and the florid congestion of the eyes and skin, the anorexia and nausea, the pyrexia and increased frequency of pulse, but also by the albuminuria, which is rarely entirely absent in severe cases, and may make its appearance on the first day of the febrile state.

The congestion, so marked upon the conjunctiva and skin, extends also to the internal organs, and is well seen in the injected nares, crimson lips, scarlet tip and edges of the tongue. As a general rule, in the stage of febrile excitement the tongue is pointed, red at the tip and edges, and coated with thick white and yellow fur in the centre and over the roots. After the febrile excitement has continued for over three days, in some cases the tongue may present a corrugated, cracked, and bloody appearance. We never observe in specific yellow fever the broad tongue with indented edges, which often characterises the prolonged action of the malarial or paludal poison. The gums are red, spongy, and often bleed upon pressure, and the fauces brilliantly congested. The fact that mere examination of the throat and depression of the tongue is sufficient to cause nausea and retching, is an important diagnostic sign.

Stage of depression and exhaustion.—In cases which terminate favourably, the deleterious substances generated during the stage of febrile excitement are gradually eliminated, and the organs especially affected by the poison resume their healthy actions. In those cases which end fatally at this stage, the issue appears to be mainly determined by heart-failure from acute fatty degeneration, as well as the profound blood-changes induced by the specific poison, and the retention of the secretions of the liver and kidneys, the functions of which are arrested. There appear to be no just grounds for the subdivision of this fourth stage, in accordance with the presence or absence of hæmorrhage, coma, jaundice, uræmic poisoning and convulsions, for these are simply effects and aggravations of the preceding symptoms, and must be regarded as the maximum phenomena of the stage. Neither is this stage to be regarded as similar to, or identical with, the intermission or remission of malarial fever, or as an abortive repetition of the febrile stage, in which the disease ends from adynamic incompetency to carry out the phenomena.

The black vomit.—The ejection of altered blood from the stomach—black vomit—during the period of depression, although not absolutely characteristic of yellow fever, is still of such frequent occurrence as to demand special consideration, both of its nature and origin. The character of the matters vomited varies in different stages of the disease, as also with the degree of its severity. Whilst yellow fever is characterised, in common with several other diseased states, by an irritation of the gastric mucous membrane, the peculiar nature of the vomited matters does not rest entirely upon this irritation and congestion, but is influenced to a greater or less extent by the changes in the blood, liver, kidneys, and nervous system. The vomiting also may be regarded as, to a certain extent, salutary, and as an effort for the elimination of excrementitious materials from the blood. For in some cases distinct improvement follows the vomiting, as seen in the abatement of the pyrexia, and the cleaner condition of the tongue; and it would almost seem that, were it not for the profound changes in the blood and organs lying at the back of this almost universally fatal symptom, recovery might start from its occurrence. The first ejections generally consist of the ordinary gastric secretions, followed by a mucoid fluid, which is frequently at first tinged with bile, sometimes of an acid, sometimes of an alkaline reaction. The acidity is not due to the presence of any peculiar acid, but to hydrochloric or lactic acid, and is mainly determined in intensity by the nature of the ingesta. After the first vomiting the stomach may remain tolerably quiet until the subsidence of the fever on the third, fourth, or fifth day, when, without any premonitory symptoms of nausea, the stomach, on any trifling provocation, may eject a quantity of clear, pale, almost limpid, and slightly acid, opalescent fluid. At this period the disease may terminate, as if this excretion were similar to the perspiration of intermittent fever. If the vomiting continue, it becomes first streaked with dark flocculi of altered blood, and acquires an alkaline reaction, due to carbonate of ammonia, arising from the decomposition of the urea, which is eliminated from the gastric mucous membrane. The black vomit varies in specific gravity from near that of distilled water to that of blood; and it consists of the secretion of the mucous membrane, mixed with food, altered blood, epithelial cells, and excrementitious products, such as urea and carbonate of ammonia.

The urine.—The reaction of the urine is invariably acid, even in the gravest cases. As a rule, the specific gravity ranges from 1,009 to 1,028. In those specimens of the highest density the increase appeared to be due to the amount of albumen. During the early stages of the disease, the urine is normal in colour, clearness, and quantity; as the disease proceeds it becomes of a deep yellow colour, from the admixture of bile; and on the fourth or fifth day appears turbid from the presence of renal epithelial cells, tube-casts, and yellow granular albuminoid matter. The colour may deepen to orange-red, or even to reddish-brown; and the urine sometimes presents an oily appearance. The quantity may be much diminished, up to complete suppression. As a general rule, the amount is diminished in the active stages of the fever. If the case advance favourably the urine is copious, and the colour progressively increases in depth even to almost black. In grave cases it is much less abundant, and at the same time of a much lighter colour. Albumen is an almost invariable constituent, and may appear as early as the first day of the disease, but most generally from the second to the fifth. When convalescence is protracted, the albuminuria may continue long after all symptoms but debility have left the patient. When precipitated by heat or nitric acid, the albumen appears of a golden yellow or light brownish colour. As much as one ounce of dried albumen has been excreted in twenty-four hours, representing the albumen of nearly one pound of blood. Associated with the albumen are renal epithelial cells, and casts of tubules, but the albuminuria must not be wholly referred to an acute desquamation of the excretory cells, nor to mere capillary congestion, but is equally due to chemical changes effected by the poison of yellow fever in the albumen and fibrin of the blood. The albumen appears in large amount in the urine, in cases where there is no apparent failure in the excretory action of the kidneys, and in which the urine is abundant, and laden with urea, as well as bile. The presence in the urine of red corpuscles and the colouring matter of the blood is not so characteristic in this disease as in the so-called malarial hæmaturia, where renal casts and epithelium may occur in considerable amount, but with only sufficient albumen to correspond to the exuded blood; whilst in yellow fever, when blood does appear in the urine, the amount of albumen is much greater than could thereby be accounted for. In the former disease also, the urinary casts contain red corpuscles, and are of a brownish colour, in place of the golden-yellow tint which these oil-laden bodies present in yellow fever.

Throughout the disease, when there is no suppression, the amount of urea is much increased, reaching as much as a thousand grains *per diem.* There is a similar increase in the phosphoric and sulphuric acids, up to as much as fifty and sixty grains respectively.

PATHOLOGY.—The various manifestations of yellow fever, as the intense capillary congestion, cardiac depression, delirium, coma, and convulsions, vomiting, hæmorrhage, urinary suppression, and jaundice, may all be referred to the action of the specific poison, and should not be erected into distinct types of disease, however prominent any one of these symptoms may be, and however much cases may differ from one another. The action of the yellow-fever poison is the same in all cases, whether mild or severe; the progress and termination, and the manifestation of the various symptoms, depending on the degree of action of the poison, the condition of the system at the time of its introduction, the peculiarities of constitution, the various agencies to which the patient is subjected during the course of the disease, and the supervention of other maladies.

Yellow fever, according to this view, partakes of the nature of a continued pestilential fever, presenting two well-defined stages: the first characterised by active chemical change in the blood and organs, attended with elevation of temperature, which may constitute the entire malady, and prove fatal in a manner similar to other acute specific fevers; the second, or stage of depression, resulting from the action of the poison, and the blood-changes induced by the suppressed functions of certain organs.

From a consideration of the foregoing symptoms, it is manifest that the blood must have undergone profound changes, which seem to consist chiefly of the following:—

1. Such an alteration of the chemico-physical properties of the fibrin and albumen, as leads to the transudation of the latter, through the excretory structures of the kidney.

2. Various degrees of diminution of the fibrin, in some cases amounting to almost entire disappearance; and this apparently due more to the direct action of the specific poison than to the retained urea, bile-acids, &c. As a result the blood coagulates imperfectly; and the clot is soft and bulky, exuding but little serum, and often breaking down on standing into a grumous fluid.

3. Whilst the red blood-corpuscles are not specially diminished, they are much altered in appearance.

4. Increase of fatty and extractive matters.

5. Accumulation of the biliary constituents, as shown by the golden-yellow colour of the serum.

6. Accumulation of the urinary constituents, especially the urea, carbonate of ammonia, chloride of sodium, and phosphoric and sulphuric acids. The alkaline reaction of the blood during life rapidly changes after death to acid.

7. Rapid dissolution of the red blood-corpuscles, with corresponding diminution of their oxygen-carrying power.

8. Rapid putrefraction, after its abstraction from the body.

The various causes of black vomit may be thus summarised:—1. The irritation and structural alteration of the gastric mucous membrane, which is a part of the general tissue-degradation, consisting of granular and fatty degeneration of the secreting cells and of the walls of the smaller blood-vessels and capillaries, as well as the general congestion of the organ. 2. The changes in the blood, especially the marked diminution of the fibrin. 3. The suppression of the action of the kidneys, and the retention in the blood of urea and similar bodies. It may be noted that black vomit rarely occurs in those cases where the kidneys act continuously and freely. 4. The direct irritation of the urea and its derivatives, which are eliminated vicariously from the gastro-intestinal mucous membrane. 5. The irritant, nauseating effects of the bile retained in the blood.

In yellow fever, acute atrophy of the liver, and acute phosphorus-poisoning—diseased states which have many symptoms and pathological lesions in common—it would seem that the oxidation of albuminoids is not so complete as in health, and besides the formation of leucin, tyrosin, and other similar bodies, a large amount of fat is produced, which may extensively infiltrate the tissues. It is clear that one effect of suppression of urine is to determine the retention in the blood of a large excess of urea. This may in part be eliminated by the gastro-intestinal mucous membrane, and the black vomit may be intensely alkaline from carbonate of ammonia derived from this substance; and it is further evident that in many cases of yellow fever the fatal issue is determined chiefly by the retention in the blood of the constituents of the urine. To the same cause also must be attributed, to a great extent, the nervous irritation, delirium, convulsions, and coma which characterise the stage of depression. Certain of the blood-changes may be referred also to the same cause.

Duration.—The several stages of yellow fever which have been described are not uniform in their duration, and there may be a marked diversity in the manifestation of the symptoms in individual cases, some presenting apparently but the stage of febrile excitement, whilst others, overwhelmed as it were by the poison, at once pass into a condition of hopeless prostration. In mild cases, especially in children, the disease may be so slight as barely to attract attention, and convalescence may be established in two or three days. The stage of febrile excitement may continue from two to six days, rarely beyond three or four, and the patient may pass almost imperceptibly into convalescence during the stage of depression. The severest cases may prove fatal in two or three days, with an axillary temperature of 110° Fahr.; or later from hæmorrhage, urinary suppression, general prostration, or an adynamic state, accompanied with parotid abscess, revival of old complaints, or the supervention of some other disease, such as malarial fever. The fourth stage may be of long duration, extending over weeks and even months. It is, however, true that convalescence is usually comparatively rapid, and in striking contrast to the tedious recovery from malarial fever. In some cases vomiting may be the prominent symptom; in others hæmorrhage from the stomach and bowels, or from the gums, eyes, and ears; in others, again, the cerebral symptoms may be most marked.

Terminations and Mortality.—In fatal cases death may be referred to a variety of causes, namely:—1. The direct action of the fever-poison upon the blood and nervous system. 2. The disturbance or suppression of function of certain organs, as the kidneys and liver. 3. Syncope from cardiac degeneration. 4. Profuse hæmorrhages from the stomach and bowels. 5. Blood-poisoning from absorption of putrid black vomit in the stomach. 6. The formation of abscesses with sequential pyæmia.

The mortality occasioned by yellow fever appears to be as great as that caused by any known epidemic or endemic disease, and varies in different localities and epidemics from 10 to 70 per cent. of those attacked.

Prognosis.—Continuous observations of the temperature should be made, as by that means prognosis and treatment may best be regulated. If the axilla temperature rise in the first stage above 105°, the patient is in imminent danger; and if it reach from 109° to 110° death is almost inevitable. Cases however have recovered in which the temperature has reached the latter point. When the temperature rapidly rises to 106° and upwards, death sometimes occurs suddenly, and apparently solely from the effects of the high temperature upon the blood, heart, and nervous system, as in sunstroke.

Treatment.—1. *Prophylactic.*—Experience has established the possibility of excluding yellow fever from localities in which it has prevailed as an epidemic, subsequent to introduction from other regions, by means of an absolutely strict quarantine. But, hitherto, it has been almost impossible to arrive at any definite conclusions as to the value of quarantine in those regions in which the disease is endemic and indigenous.

Much difference of opinion has existed as to the value of disinfectants, such as chlorine, carbolic acid, and sulphurous acid. In arresting the spread of the fever it is very doubtful whether much of the benefit that has been attributed to them is not rather to be ascribed to other causes; and, in estimating the value of any such sanitary measures, the following facts in the history of yellow fever should be considered:—

(*a*) Yellow fever may prevail in one or more cities, and at the same time be entirely absent from other cities in the same zone, and subjected to very nearly the same hygienic conditions. The mere absence of yellow fever from a particular city, whilst it is prevailing elsewhere, proves nothing as to the more sanitary condition and measures of the city enjoying the immunity.

(*b*) One of the most essential elements for the origin and spread of yellow fever within and immediately around its recognised geographical limits, is the influx of strangers and immigrants, or an unacclimatized population.

(*c*) It is not provable that a wide-spread epidemic would ever arise in a city within the recognised zone, in which the vast proportion of the inhabitants are acclimatized, and have been subjected to the action of the specific poison.

(*d*) Yellow fever has been entirely absent from many cities, where serious epidemics have occurred, during long series of years; and at other times has prevailed to a very limited extent, and with but slight mortality, when no disinfectants have been used.

2. *Curative.*—Yellow fever is a 'self-limited' disease, and cannot be arrested by drugs. Every case should be regarded as serious, however slight the symptoms may appear; and on account of the structural alterations in the blood and organs, the closest medical attendance and most careful nursing are required. Since so many of the symptoms are due to arrest of the functions of the skin and kidneys, efforts should be directed to promote the activity of these organs during the progress of the disease. Stimulant diuretics should, as a rule, be avoided, but benefit often follows the free use of hot mustard foot-baths, vapour baths, and sometimes warm baths. Diaphoresis and diuresis may be further promoted by large draughts of lemonade, decoctions of orange leaf and sage tea, and water charged with carbonic acid. Absolute rest in the recumbent posture must be maintained as far as possible. The necessity for this is especially indicated by the cardiac weakness, fatal results having followed rising from bed and walking during the period of calm.

The maintenance of free ventilation, and the avoidance at the same time of sudden changes of temperature, by proper coverings, is essential. Experience shows that many fatal cases from urinary suppression have followed sudden changes and falls of temperature. Each case of yellow fever should have at least 2,000 cubic feet of space; and hospitals, where practicable, should be constructed on elevated situations. All discharges should be immediately removed from the sick-room; the bedding frequently changed; and the soiled clothing boiled, or baked at a temperature of not less than 230° Fahr.

The practice of covering patients with heavy blankets, and at the same time giving large quantities of hot drinks, with the object of inducing profuse sweating, frequently appears to be injurious, not only from the debilitating effect, but also from the greater susceptibility of the skin, and the increased tendency to renal congestion thereby induced.

The diet should be light and nutritious. Beef-tea, chicken-tea, corn flour and rice gruel, barley water, iced milk, and milk and lime-water are the best forms of nourishment, and should be continued at regular intervals throughout the active stages of the disease. Solid food and even bread should be avoided.

In many cases the preceding measures, accompanied by absolute rest in bed, and the careful and continuous attention of an experienced nurse, will be all that is required.

Alcoholic stimulants should be used with caution. They have proved beneficial in cases attended with great prostration, champagne appearing to be the best form.

The treatment for hyperpyrexia consists in the giving of such cardiac sedatives as aconite, veratrum viride, or gelseminum; the injection of large quantities of ice-cold water into the rectum; sponging the surface with cold water, or with water, acetic acid, and alcohol; and blood-letting. It appears also that an active purgative, such as calomel or castor oil, followed immediately by one or two full doses of quinine in the first twenty-four hours of the fever, may reduce the temperature.

Efficient but gentle purgation in the early part of the first stage may be beneficial. Mercurials should not be given later than the second day for an adult; eight to twelve grains of calomel or blue pill, or an ordinary dose of castor oil, will be sufficient. Purgatives, as a general rule, should not be administered in the stage of depression. An emetic may be useful at the very beginning, if the stomach be loaded. Local blood-letting, whilst of occasional benefit for the relief of congestion in the first stage, is most injurious later. Dry-cuppings and sinapisms are usually sufficiently effective.

The internal administration of the mineral acids or the tincture of the sesquichloride of iron, from their supposed beneficial effects upon the jaundice and black vomit respectively, is of doubtful propriety, and sometimes directly injurious.

The value of quinine in yellow fever is not nearly so great as in paroxysmal malarial fever; and notwithstanding statements to the contrary, the writer fails to discover any facts or cases by which the power of large doses of quinine to abort this disease can be fully and unequivocally established, though its efficacy, not only in arresting, but in warding off paroxysmal fever, is undoubted. It is rather as an antidote to the effects of the poison, than to the poison itself, that quinine is of use.

Opium, in whatever form, should be administered with great caution, from its poisonous effects when the kidney-action is arrested, but may be of advantage when sleeplessness and restlessness are prominent. Arrest of the function of the kidneys, owing to the grave alterations in their structure, is beyond relief by drugs. The tincture of ergot, which has been recommended, has often failed; but much good has been accomplished, and the function of the kidneys restored, by the injection at regular intervals of a pint or more of ice-cold water into the rectum.

When there is a threatening of black vomit ice should be swallowed, and bags of the same applied to the epigastrium. Septic poisoning has been known to follow decomposition of the blood effused into the gastro-intestinal tract, and to prevent this, scruple doses of sulpho-carbolate of soda, repeated every three or four hours, have been given with advantage.

During the period of calm, active medication, beyond what has been indicated, should be abstained from. The diet should still be of the simplest, most nutritious, and most digestible character. In this stage there is often a morbid craving for food, and in some instances relapse and death have been the result of the unrestrained indulgence of the appetite.[1]

JOSEPH JONES.

Z

ZINC, Poisoning by.—SYNON.: Fr. *Empoisonnement par le Zinc*; Ger. *Zinkvergiftung.*

Poisoning by compounds of zinc is rare, if we except poisoning by the chloride (Sir W. Burnett's Fluid), which acts as a corrosive poison, like the mineral acids (*see* POISONS). Zinc sulphate (white vitriol) is the only other salt of zinc of importance from a toxicological point of view; this salt has proved fatal in a few instances.

ANATOMICAL CHARACTERS.—These are of the same nature as those of the mineral irritants—gastro-intestinal inflammation, ecchymoses, and softening. Ecchymoses have also been observed in the pleura.

SYMPTOMS.—The symptoms of poisoning by zinc are similar to those produced by tartar emetic. They include an astringent, metallic, and burning taste in the mouth; early and violent vomiting; pain in the abdomen; purging; great prostration and anxiety; a small and feeble pulse; shallow respirations; cold perspirations; and collapse and exhaustion, ending in death. The intellect is unaffected.

DIAGNOSIS.—In the absence of any history of the administration of zinc sulphate, the diagnosis cannot be made between this and other forms of irritant poisoning, such as by blue vitriol, except by the aid of chemical analysis.

PROGNOSIS.—The prognosis of zinc-poisoning is generally favourable.

TREATMENT.—Demulcent drinks, sedatives, and alcoholic stimulants should be immediately given. The administration of a solution of the common phosphate of soda, largely diluted, is advisable. It acts as an excellent precipitant of zinc, in the form of an insoluble phosphate. Opiate enemata may prove serviceable.

THOMAS STEVENSON.

ZONA or ZOSTER (ζώνη, a girdle).—SYNON.: Shingles; Fr. *Zona;* Ger. *Zoster; Gürtelrose.*

This term applies correctly only to that form of herpes which runs round one half of the trunk of the body, usually in the region of the waist. In other situations the eruption is named in accordance with the region; for example, *Herpes facialis; H. collaris; H. brachialis; H. cruralis;* &c. Latterly, however, the term zoster has crept into our dermatological literature as a generic appellation, and we read of *Zoster facialis*, *brachialis*, &c., names which philologically are evidently inaccurate. *See* HERPES.

ERASMUS WILSON.

ZYMOTIC: ZYME (ζυμόω, I ferment: ζύμη, ferment).—SYNON.: Fr. *Zymotique: Zymase*; Ger. *Gährungsfähig: Gährstoff.*—The terms *zyme, zymine, zymotic,* and *zymosis* were introduced by Dr. Farr, in a letter to the Registrar-General in 1842, and employed by him to denote, in a general way, the poison (and pathological processes excited by it) of 'epidemic, endemic, and contagious diseases.' In using the word ζύμα, he was careful to point out that he did not consider the morbific process to be absolutely identical with the ordinary phenomena of fermentation, and that he wished the terms *zymosis*, *zymotic*, &c., to be employed in English, 'not in

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[1] In the epidemic of yellow fever in New Orleans during 1878, when, in a population of 210,000 the deaths numbered 4,056, the writer had an extensive experience of the disease, himself treating 256 cases, of whom 18 died. The plan of treatment was based upon the preceding principles. The alimentary canal was cleared at the outset by an emetic of ipecacuanha, and a powder of 10 to 20 grains each of calomel and quinine, followed by a full dose of castor oil. The action of the skin was excited by hot mustard foot-baths and mild diuretics. The function of the kidneys was maintained by the regular use of cold water, by attention to the covering of the patient, and avoiding cold currents of air. Absolute rest, in all cases, in a well-ventilated room, for from eight to fourteen days, or even longer, was strictly enforced, supplemented with careful nursing night and day, and the most exact record of the progressive state of the patient. During the period of febrile excitement the patients were confined to barley water. When the initial temperature was high, 2 to 4 drops of tinctura veratri viridis, or 5 to 10 drops of tinctura gelsemii, were administered every two or four hours, combined with friction with a liniment composed of from 1 to 2 drachms of the sulphate of quinine mixed with 3 fluid ounces each of soap liniment and olive oil. Ten grains of sulpho-carbolate of soda in orange-leaf tea were given every four hours. Where the head was very hot and there was much nervous irritability, cold applications were employed. Gastric irritation was treated by sinapisms to the epigastrium, with carbonate of lime and creasote internally. Except in cases attended with great nervous excitement, without urinary suppression, opiates and chloral were not given; but in such cases they were apparently beneficial. Cupping over the loins and bromide of potassium were used when the urine was diminished in quantity. After the subsidence of the febrile excitement, iced champagne and beef-tea were administered in small quantities, at regular intervals. In cases which assumed the 'typhoid state,' attended with tympanites, ice-cold enemas, containing small quantities of tincture of assafœtida and oil of turpentine, were found to be beneficial, by reducing the temperature, stimulating the bowels to expel the flatus, and promoting the action of the kidneys. When secondary fever ensued, and presented an intermittent or remittent type, the sulphate and bromide of quinine were freely used. And when the stomach would tolerate nourishment and stimulants, beef-tea, chicken tea, beefsteak, and port wine or brandy were administered. When convalescence was prolonged, or life endangered by abscesses or carbuncles, iron and other tonics were given, together with a nutritious diet, and the local application of carbolic acid, tincture of iodine, &c. Relapses were avoided by confining the patient to bed until the heart had regained its usual vigour.

Trinity Medical College.

the sense which they have in Greek, but as general designations of the morbid processes and their exciters.' With this qualification clearly expressed, the use of the root-form ζυμ- has become general, not only in scientific literature, but also in the public press—almost invariably, however, in the adjectival form *zymotic.*

Fourteen years later (1856), in the *Sixteenth Annual Report of the Registrar-General,* Dr. Farr described the diseases of the zymotic class as conveniently referable to four groups. These are:—1. The *Miasmatic,* diffusible through the air or water, attended by fevers of various forms; the matter by which they are communicated is derived from the human body, as in small-pox, or from the earth (as in ague). These two diseases are types of this class. 2. The *Enthetic* diseases, which may properly be called *contagious,* being communicated by contact, puncture, or inoculation. Syphilis and glanders are types of this class. 3. The *Dietic* diseases, which arise when the blood is supplied with improper or bad food. Scurvy and ergotism are the types of this class. 4. The *Parasitic* diseases, which attack especially dirty populations, and infest the skin, the intestinal canal, and all the structures of the body.

This classification is open to serious objections. It is quoted here rather because it continues to be employed in official reports, than on account of its intrinsic importance. Modern pathology will probably soon necessitate its revision.

Recently, indeed, the word zymotic has been restricted to the acute specific diseases, included under the first group (miasmatic) in the above classification; and at the present time it is in this limited sense that it is most commonly used.

Another important application of the term must now be referred to. Within the last few years the root-form ζυμ- has been introduced into the terminology of normal physiology by Heidenhain in Germany, to designate the active substance (precursor of trypsin, &c.), contained in gland-cells as *zymogen,* which develops the ferment by its metamorphosis. Thus, unfortunately for the purposes of exact description, the same root-form is employed by pathologists and physiologists to designate two apparently distinct processes. Although the intimate relationship of these two processes was recognised as early as the seventeenth century, by such authorities as Sydenham and Morton, they cannot at present be considered identical, notwithstanding the fact that the similarity becomes more striking with every fresh addition to experimental physiology.

Corresponding with the adjective *zymotic* is the substantive *zyme.* This is a useful name, by which we refer to the poisonous cause of zymotic diseases. It is simpler than the word *zymine,* originally proposed by Dr. Farr; and (what is much more important) to speak of the contagious poison as 'a zyme,' does not imply the acceptance of any particular theory of disease; while, on the other hand, the use of the word 'germ' distinctly conveys the idea of some organised structure, itself the cause of the disease by subsequent growth and multiplication. *See* GERMS OF DISEASE.

The necessity for employing the word *zymosis* does not seem to be felt as yet; but the same reasons that lead us to speak of the agent as a zyme should also guide us to use *zymosis* in the place of more usual periphrases.

ANALOGY BETWEEN FERMENTATION AND INFECTIVE PROCESSES.—Such being the derivation of the word *zymotic* and the terms related to it, it is natural to inquire how far an analogy can be traced between the life-history of the diseases thus designated, and the process of fermentation. This subject, which has an important bearing upon the doctrine of contagious diseases, is discussed at length in the article on CONTAGION (page 290).[1] It is there shown how far the two processes resemble each other, and in what respects they appear to be different, at least in some kinds of zymotic disease. It must not be forgotten that fermentation deals with a comparatively simple substance, for instance dead organic or inorganic compounds, and the disease-process with a more complex one, namely, the living animal organism, although the elements of action (the ferment on the one hand, and the zyme or zymine on the other) seem to have identical characters. By interposing the consideration of putrefaction between that of fermentation and zymosis, it is easy to see, from examining the products of each, how similar must be the individual agencies; but, the actual working of the agent in each, or indeed the real nature of each, being unknown, the whole problem remains unsettled.

VICTOR HORSLEY.

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[1] Although it is four years since the article CONTAGION was written by Mr. Simon, he has thought it desirable to leave that article unaltered, preferring that it should be supplemented, in respect of the intervening years, by the present article, and others on related objects. In discussing the subject of the organic constitution of the metabolic contagia, Mr. Simon says:—'Though it would be at least premature to say of these diseases' [erysipelas, pyæmia, tuberculosis, enteric fever, cholera, diphtheria, and the smallpox of man and beast], 'that they certainly have as their contagia *mycrophytes respectively specific* to them, it seems at present not too much to say, that probably such will be found the case. How far these anticipations have already been realised may be learned by reference to the articles BACTERIA; BACILLI (in *Appendix*); MICROCOCCUS; PUSTULE, MALIGNANT; and on the several diseases in which the presence of such organisms has been recognised. *See also* ANTISEPTIC TREATMENT.—ED. (September 1882).

APPENDIX.

ACONITE, Poisoning by.—Synon.: Fr. *Empoisonnement par l'Aconit*; Ger. *Eisenhutvergiftung.*—The common garden-plant, *Aconitum napellus*, known also as 'wolfsbane' or 'blue-rocket,' as well as other species of aconitum, are poisonous, and owe their poisonous properties to the presence of an alkaloid, *aconitine* or *aconitia*, or perhaps to a mixture of alkaloids passing under this name. A similar alkaloid, *pseudaconitine*, has been obtained from the Indian aconite, *A. ferox*; and another alkaloid, *japaconitine*, from Japanese aconite roots. All parts of *A. napellus* are poisonous. The three alkaloids, aconitine, pseudaconitine, and japaconitine, are perhaps the most poisonous alkaloids known. All parts of the aconite plant when chewed, and aconitine when placed upon the lips or tongue, produce, after a few minutes, a disagreeable acrid burning sensation, followed by numbness, loss of sensibility of the part, salivation, and an after-sensation of searedness. These sensations may last for several hours.

The fresh root of aconite has frequently been eaten in mistake for horse-radish, to which it bears a remote resemblance. The root of horse-radish is whitish on the exterior, is long and of fairly uniform diameter, has a pungent odour when scraped, and the scraped surface retains its white appearance; whereas aconite root is brown and conical, is destitute of pungent odour, and speedily acquires a pink colour when scraped and exposed to the air. Mistakes more frequently occur from liniments containing aconite being swallowed in error. In two cases the root has been administered with homicidal intent; and in a recent case a young man was killed by the administration of, as it is supposed, two grains of English aconitine. Accidents have also arisen from the administration of the potent English aconitine in mistake for the impure inert exotic or German alkaloid, or mixture of alkaloids passing under that name.

Anatomical Characters.—After poisoning by aconite there may be gastric congestion or inflammation; but these may be absent.

Symptoms.—When aconite, or any of its preparations, is taken by the mouth, the first sensation, transitory and mainly due to the action of the solvent, is followed in about three minutes by an intolerable burning and numbing pain, extending from the place of application to all the surrounding parts of the mucous membrane. There is salivation; and the burning sensation extends down the gullet to the stomach. Occasionally, when the poison has been rapidly swallowed, no marked symptoms may supervene for half an hour. The general symptoms are very varied, but may all be referred to weakening of the heart's action, disturbances of respiration, and paralysis of sensation on the surface of the body. This last may be described as 'numbness' or 'drawing of the skin,' or by some equivalent term. There is pain in the epigastrium, violent vomiting, occasionally purging; the pulse, at first rapid, quickly diminishes in frequency and force till it is imperceptible; the skin is cold, clammy, and livid; respiration is laboured. The pupils, at first contracted, afterwards dilate; and this dilatation sometimes occurs suddenly and transitorily, and is accompanied by blindness. Convulsions are not common; but vomiting is often due to spasmodic contraction of the diaphragm, causing frothing at the mouth. Consciousness is retained till near the end of life.

Diagnosis.—The peculiar sensation in the mouth—burning, feeling of searedness, numbness, &c.—the great cardiac depression, and the difficulty of respiration, will generally serve to determine the nature of the case.

Prognosis.—Death usually occurs within four or five hours. If the patient survive twelve hours, recovery is usually rapid and complete.

Fatal dose.—Of the *root* sixty grains—probably much less might suffice. Of the pharmacopœial *tinctura aconiti* (1 in 8) two or three fluid drachms. *Fleming's tincture* is about six times as strong as the officinal tincture, and twenty-five minims have proved fatal. Four grains of *alcoholic extract* have proved a fatal dose. English *aconitine* or *aconitia* (the alkaloid) is terribly potent: 1-2000th grain will produce a very decided sensation on the tongue, and it is probably as poisonous as the crystallised French aconitine-nitrate, one-sixteenth of a grain of which has killed an adult within five hours.

Treatment.—In proceeding to treat a case of poisoning by aconite we must, first, wash out the stomach by means of the stomach-pump, and promote vomiting by warm emetics, of which carbonate of ammonia is the best. Stimulants must be freely administered; also strong black coffee or tea. Brandy and ether may be injected subcutaneously. Digitalis is a counter-poison, and may be administered with effect subcutaneously, in doses of twenty minims of the tincture, repeated in an hour or so if necessary. Inhalations of nitrite of amyl may afford some relief. The patient must be kept strictly in the recumbent position, warmth being applied to the surface; and, as a last resort, artificial respiration must be used.

THOMAS STEVENSON.

AINHUM (Nat., to saw). — This disease was first described by Dr. da Silva Lima of Bahia in 1867. It is peculiar to the African race, being found not only amongst the inhabitants of the West Coast of Africa, but also amongst the Hindoos of African descent, as well as amongst the slave population of South America. At its commencement, a groove or furrow is seen at the base of the little toe (the part almost invariably attacked), situated on its inner and inferior aspect, and corresponding to the digito-plantar fold. The furrow soon extends to the entire circumference of the toe, and becoming gradually deeper, the latter is left hanging by a slender pedicle, which can only be brought into view by separating the walls of the furrow. The distal portion swells into an ovoid mass, about twice its natural size; finally some accident snaps the pedicle, and the toe drops off, in from four to ten years from the commencement of the disease.

The furrow is caused by a constricting band of hardened and contracted skin—a local scleroderma—which leads to faulty nutrition and degenerative changes in the parts beyond.

Ainhum is not a painful affection in itself, but the extreme mobility of the little toe causes trouble and inconvenience, for which patients often seek relief in amputation.

Occasionally the sides and bottom of the furrow ulcerate; not unfrequently both little toes are attacked by the disease. Males are more subject to it than females. The microscope reveals only atrophic and degenerative changes. The cause of ainhum is entirely obscure. It has been cured by the early division of the constricting band.

A. SANGSTER.

AMBULANCE (*ambulo*, I walk about).—DEFINITION.—A vehicle for the conveyance of invalid or wounded persons. The term is generally applied to such of these vehicles as are drawn by one or more horses. The French use it to designate a field military hospital.

The writer has described the requirements of an ambulance carriage as follows:—1. Ease of entrance and exit; 2. Freedom from jar during locomotion; 3. Protection against weather, with facilities for regulating air and light; 4. Lightness of structure, consistent with strength; 5. Facility of turning, and of transferring the vehicle to or from a railway-truck or steamship, without disturbing the patient.

Military ambulances are adapted for carrying patients both sitting and lying, along with an attendant; as well as food, water, medicine, and other appliances. In the ambulance designed by the writer, the litter, which is slid noiselessly on india-rubber rollers, rests on a tramway, between which and the body of the vehicle are intermediate counterpoise springs, which intercept shock and jar.

Every ambulance should be provided with a litter-sheet, which can be used without its stretcher poles, for carrying the patient through places too narrow or tortuous for other modes of conveyance.

BENJAMIN HOWARD.

ANÆSTHETICS.—The two following substances have been introduced as anæsthetics since the article on the subject was written, and call for brief description.

Bromide of Ethyl (C_2H_5Br).—This substance has been recommended and moderately used as an anæsthetic. Its merits are that it exhilarates and produces rapid anæsthesia. Its effects pass off quickly, without any tendency to depress the action of the heart. The objections to the use of bromide of ethyl are that it is liable to decompose, leaves a strong smell and taste of bromine, and sometimes produces headache and sickness. Two deaths from it in America have been reported. Its use has been abandoned in England.

Dichloride of Ethidene ($C_2H_4Cl_2$).—This substance is obtained by distilling aldehyde and pentachloride of phosphorus. The effects of this agent are intermediate between those of chloroform and ether. Its odour is usually preferred to that of either of the former. The writer has used it very extensively; and in minor cases, in which the operation has lasted only five minutes, the recovery is rarely attended by sickness or excitement. In the more prolonged cases it was found to cause vomiting, but this ceased much more rapidly than when chloroform had been given. Its effect upon the heart when given in large doses is depressing, and the pulse should be carefully watched during its administration.

This anæsthetic was used by Dr. Snow, but abandoned chiefly on account of its expense. It was reported upon favourably by the Glasgow Anæsthetic Committee of the British Medical Association. They found that the blood-pressure was diminished by it as well as by chloroform, but that it was more regular in its action, and less potent also, so that they found it much easier to keep a dog alive whilst profoundly under its influence than whilst under chloroform.

Ether.—The following point is of importance in connexion with the employment of ether as an anæsthetic. Under ether, bleeding is more rapid than usual; and this may produce syncope when the stimulating effect of the anæsthetic is passing off. To prevent this result, whenever hæmorrhage is likely to be great, temporary ligatures should be applied to the arms and thighs, so as to detain blood in the veins until the chief vessels that have been severed have been tied.

J. T. CLOVER.

ARKANSAS SPRINGS, in Arkansas, United States.—Thermal waters. *See* MINERAL WATERS.

AUSTRALASIA.—The portion of Polynesia lying between 10° and 50° S. latitude and 110° E. and 170° W. longitude, which may be said to include Australia, Tasmania, New Zealand, the Fiji Islands, the New Hebrides, and some less important islands.

Australia.—The climate of the vast contisent of Australia, which is partly temperate and partly tropical, depends, first, on its latitude, and, secondly, on its conformation, the mountain ranges being distributed along the coast lines, especially on the eastern shores. In the interior, which is comparatively flat, and for the most part a sandy desert, there is great heat and little rain. The hot winds from the east are often sufficient in the summer to raise the thermometer to 127° Fahr. There are also sea winds from the N. and N.E. The southerly winds, prevailing chiefly from November to February, are winds of great velocity, ending in heavy thunderstorms. In the tropical part the rainfall is from November to April, and in the temperate, which lies to the east and south, it prevails only in the winter season.

The following are among the principal towns or centres to which invalids proceed:—

Adelaide, the capital of South Australia, lat. 35° S., long. 135½° E. It suffers from great heat and drought. The mean temperature is 65°, the maximum 115°, and the minimum 34°; the range being 81°, and the mean daily range 20°. The humidity is 60 per cent., and the rainfall 21 inches. The soil is sandy.

Brisbane, the chief town of Queensland, lat. 27½° S., long. 153° E. The climate is almost tropical. The mean temperature is 70°, the maximum 108°, the minimum, 34°; the range 74°, with a mean daily range of 21°. The rainfall is 51 inches, and the mean humidity 76 per cent. Queensland is for the most part elevated; and the climate of the Darling Downs is considered very fine.

Melbourne, the capital of Victoria, lat. 38° S., long. 145° E. It has the reputation of being a healthy and agreeable residence; the climate being dry and temperate, and far cooler in summer than that of Sydney. Mean temperature 57°, maximum 111°, minimum 27°, showing a range of 84°; daily range 18°. Mean humidity 72 per cent. Rainfall, 26 inches.

Perth, in Western Australia, very healthy, but as yet little suited to the requirements of invalids. The temperature is 63° (mean), and rainfall 30 inches in 110 days.

Sydney, the capital of New South Wales, lat. 24° S. and long. 151° E. The climate of New South Wales is clear and dry, the temperature depending more on the altitude than on the latitude. The plains in the interior, swept by hot winds, are very dry, while the coast districts have abundant rain. Mean temperature 62·5°, maximum 107°, minimum 36°; range 71°; mean daily range 14°. Humidity 72 per cent., and rainfall 50 inches.

Tasmania.—Tasmania lies 150 miles south of Australia, between lat. 40° 40′ and 43° 38′, and is mountainous, with a deeply indented coastline. The climate is more temperate and equable than that of the south coast of Australia. In winter the cold is sufficient to produce thin ice in the low lands, and snow showers in the higher ranges. The mean temperature of *Hobart Town* on the S.E. coast is 54°, the summer mean being 62° and the winter 47°. The rainfall varies greatly, from 100 inches at Macquarie Harbour on the W. coast, to 24 inches at Hobart Town, distributed over 145 days. The prevalent winds are from the N.E. and S.W. The climate is favourable to infant life, and the country is regarded as a sanatorium for invalids.

New Zealand.—New Zealand lies between 34° 50′ and 47° 50′ S. lat., and consists of a North and a South besides smaller Islands. The Northern Island is for the most part volcanic, and abounds in hot springs, which promise to become extensively useful, and active craters, which impart an important influence to its climate. The Southern Island contains a lofty range of snowclad mountains, whose lower slopes form on the eastern shore a series of terraces known as the Canterbury Plains, and other fertile regions.

The climate is mild and bracing, but decidedly of a windy character, and not suited for all invalids: at Auckland in 1876 no calm day was recorded, the prevalent winds being W.S.W. The mean temperature of the North Island is 58°, of the South 54°. The maximum varies from 87° at Christ Church to 75° at Hokitika, and the minimum from 25° to 34° in the Southern Island. Cold is as a rule unknown in the North Island, while in the South there are a few snowy days each year on the coast. The rainfall varies from 32 inches in 135 days at Christ Church, to 131 inches in 186 days at Hokitika.

Fiji Islands.—The Fiji Islands, partly of volcanic and partly of coraline origin, have a tropical climate, moderated by the trade winds, so that the mean temperature does not exceed 80°, the minimum being given as 65°. The rainfall is chiefly from October to April—the hot season, and varies from 124 to 215 inches in 170 days. *See* CLIMATE, Treatment of Disease by.

C. THEODORE WILLIAMS.

BACILLI (*bacillus*, a little rod or staff).—SYNON.: Fr. *Baciles*; Ger. *Bacillen*.

DEFINITION.—Rod-shaped vegetable micro-organisms, consisting of single cells, the length of which exceeds twice the breadth.

DESCRIPTION.—The bacilli, thus roughly defined, form a group of algæ which, until lately, were classified under the general terms of *Bacteria* and *Schizomycetæ*. At present, in accordance with the necessities of description, the word bacterium is limited empirically to mean a short rod-shaped organism, whose breadth is not less than half its length; and, moreover, as the term Schizomycetæ does not fully represent the mode of reproduction in the bacilli, its value as a comprehensive term is thereby lessened. It will, therefore, be well to regard bacilli as a distinct order. From differences in their habitat and nutritive requirements, they may be held to be specifically distinct from one another, although this may not be evident morphologically with our present methods of research.

In common with the rest of micro-organisms, bacilli consist of a protoplasmic body, surrounded by a sheath, probably of the nature of cellulose. The protoplasm is albuminous, granular, and occasionally shows brightly refracting fat granules within it; while the sheath or envelope is clear, with a sharp outline, and capable of resisting very powerfully the action of reagents.

The sides of the rod are parallel straight lines in the adult form, while the extremities may be either rounded or square. Notice has been taken of this fact in attempting to establish diagnostic points of difference among the bacilli; but the shape of the extremities varies in the same kind of bacillus, so as to suggest that the rounded end is but an advance on the square surface left immediately after fission of the parent organism.

Although the breadth of each bacillus appears to be constant for the same kind, the length, as may be expected, varies considerably, so that measurements in this direction are of but relative value. The difference of breadth would afford a means of classification, but at present the bacilli are named after the diseases and other conditions with which they are found to be in relation.

Development.—The bacilli multiply by two distinct methods, namely, simple transverse *fission*, and *spore-formation*. The process of *fission*, as it occurs in the adult rod, appears to consist, first, in a contraction of the protoplasm at the centre, followed by an involution of the cellulose envelope, and subsequent separation of the two halves. The rod may grow to twice its length before dividing; but when rapid multiplication is occurring, it is common to find rods of half the adult length. The process of *spore-formation* commences by steady growth of the rod into a long wavy and flexible filament, which, with others, may form a thick feltwork. In the next stage bright points appear in the protoplasm, which increase in size, and, from being first cylindrical in shape, become ovoid, and so form spores imbedded in the filaments. The protoplasmic spore then becomes covered with an envelope similar to that covering the adult rod, and, getting free from the filament, develops into a rod by outgrowth from one end.

Adult Life-History.—The vital changes of the bacilli are similar to those of other vegetable micro-organisms, that is, they require a moderate temperature (30° to 40° C.), a nitrogenous pabulum, and the admission of free oxygen for their full development. The different kinds of bacilli vary with regard to their pabulum; thus one (*Bacillus subtilis*) flourishes best in a hay infusion, where another (*Bacillus anthracis*) finds it hard to live. Diminution of the supply of oxygen leads to abortive growth. With respect to temperature, they are unaffected (as regards actual vitality) by extreme cold, but probably all varieties enter into heat-rigor at 60° C.

Pathological Relations and Classification. The general characters of the bacilli so far have been considered apart from their most important bearing on disease, a preface to which division of the subject will best be afforded by enumerating the kinds of bacilli that have as yet been described. They are as follows:—

Bacillus subtilis } not found in living
,, ulna } animal tissues
,, anthracis
,, malariæ
,, septicæmiæ (experimental)
,, lepræ
,, tuberculosis.

Of these kinds of bacilli, the Bacillus anthracis, found constantly in splenic fever, has been very thoroughly investigated (*see* Pustule, Malignant), and may be accepted as an illustration of the relation borne by the different bacilli to the diseases enumerated in the above list. The conditions under which certain symptoms appear synchronously with definite organisms is discussed elsewhere, and it only remains to draw attention to the nature of the classification, as being purely empirical, and of a temporary character.

Diagnosis.—If it were possible, it would be desirable to show how a bacillus, found in connection with definite symptoms, may be identified as peculiar to a particular pathological process. Morphologically we may arrange the so-called pathogenetic bacilli in terms of their breadth, commencing with the narrowest, in the following order—B. septicæmiæ, lepræ, tuberculosis, malariæ, and anthracis; whilst, as regards length, B. tuberculosis is shortest, and between this and the remainder we may place B. septicæmiæ. But the distinctions here given are only of very general value; and as the bacilli differ somewhat in their reaction to staining fluids, we have in this another point of diagnostic value. Thus, B. tuberculosis can only be shown in tubercular fluids or tissues after these have been treated with a solution of an aniline salt, also containing pure aniline, and then washed in moderately strong nitric acid, a process which would be destructive to the other forms of bacilli. A complete means of diagnosis would rest on their physiological properties, but in the present state of knowledge this is impossible.[1]

Victor Horsley.

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[1] Note on the mode of demonstrating bacilli.

1. *In fluids, such as blood and sputum.*—An exceedingly thin layer of the fluid is first obtained, by placing a drop between two perfectly clean cover glasses, which are then separated by a rapid drawing movement, thus leaving a delicate film on each. The fluid is next evaporated to dryness, by passing the cover glass a few times through the flame of a Bunsen burner. The coagulation of the albumen thus effected is an important step in the success of the staining process. The dry film may now be stained, by pouring on it a concentrated solution of methyl-violet, or by floating it on a solution of fuchsin, to which some pure aniline has been added. This solution is prepared by dissolving the dye in equal proportions of alcohol and water, to which $\frac{1}{10}$th part of aniline is added, thus making the solution alkaline. The preparation is then washed with a 10 per cent. solution of nitric acid, until all the colour has disappeared. Finally, it is washed with a concentrated aqueous solution of aniline to restore the alkaline reaction; or the ground substance may be stained with a fluid of the same chemical reaction, namely, vesuvin or chrysoidin; the superfluous reagent is washed off with distilled water; and the cover-glass mounted (after drying) in Canada balsam, or in a mixture of glycerine, glucose and alcohol, having an index of refraction = 1·37. See Brun, *Revue Médicale de la Suisse Romande*, August 1882.

Bacilli can also be shown in albuminous fluids by treating the dried film with a 1 per cent. solution of caustic potash in water. In the case of tubercle, they may be distinguished from the ordinary bacilli of putrefaction by gently re-drying the potash-treated film, and then staining with an aniline dye. Under these circumstances the tubercle bacilli show up distinctly *unstained*, whilst the putrefactive organisms are deeply coloured (Baumgarten, *Centbl. f. d. med. Wiss.* S. 257, 1882.)

2. *In tissues.*—The organs are hardened in alcohol, and very thin sections from these are stained by a similar process to that detailed above. In practice it will be found necessary to use a weak solution of acid for the sections; and although the section appears quite white after its removal from the acid fluid, its colour partly returns on washing with water, again to be removed in the subsequent stages of passing the section

CANTHARIDES, Poisoning by.—SYNON.: Fr. *Empoisonnement par la Cantharide*; Ger. *Canthariden vergiftung.* — Cantharides or the Spanish fly owes its poisonous properties to the presence of *cantharidin*, a non-alkaloidal body. All the preparations of the drug are highly poisonous.

SYMPTOMS.—Soon after taking a poisonous dose of cantharides, the patient is seized with burning pain in the pharynx, and a sense of constriction in the œsophagus. The pain soon extends to the abdomen, and vomiting ensues; the abdominal pain becomes aggravated; and usually purging sets in. The stools are numerous, often scanty, passed with great pain and straining; they are at first mucous, and finally bloody. If carefully examined, little iridescent specks—portions of the elytra of the beetle—may be observed in the fæces and vomited matters. These are of course only observable when the powdered insect has been broken; and they frequently escape observation. Up to this period of the case, should portions of the beetle not have been detected, there is nothing to distinguish the case from one of ordinary irritant poisoning; except, perhaps, that salivation and swelling of the salivary glands are usually prominent symptoms. The gastro-intestinal inflammation may be so intensely and rapidly developed, that death may occur from collapse before strangury, the diagnostic symptom, is developed. Generally, however, the course is somewhat different, genito-urinary irritation and inflammation setting in; the symptoms of which are aching pains in the lumbar region, frequent desire to micturate, with violent tenesmus of the bladder, till eventually a few drops of albuminous or bloody urine only can be passed, or none at all. Priapism, erotic excitement, and swelling of the genitals are of frequent, though not of constant, occurrence. Delirium, tetanic convulsions, or paraplegia, may be noted in some cases. Eventually the intolerable agony gives way to collapse, stupor, coma, and death. Abortion not infrequently occurs in pregnant women, the drug being one in common use as an abortifacient.

DIAGNOSIS.—The intense strangury, the swelling of the genitals, and the bloody stools, will leave little or no doubt as to the nature of the case; and the presence of particles of the drug in the ejecta will be conclusive.

Fatal dose.—Less than half a drachm of the powder, and an ounce of the tincture, have alike proved fatal.

TREATMENT.—Evacuation of the stomach by the use of the stomach-pump, syphon-tube, or an emetic is the first indication in poisoning by cantharides. It is best to wash out the stomach well. Mucilaginous drinks, white of egg (not the yolk), and demulcents, may be freely given; but oil in any form is to be avoided, as tending to dissolve cantharidin. Opium by the mouth or rectum, or the hypodermic injection of one-third of a grain of morphia, is advisable. Leeches to the region of the bladder, warm fomentations, and warm sitz-baths may afford relief. Chloral should also be given, or the patient kept cautiously under the influence of chloroform. Collapse may be met by ammonia and other stimulants. The hypodermic injection of a few drops of ether is useful. There is no known antidote for cantharidin.

THOMAS STEVENSON.

through alcohol, oil of cloves, and mounting it in balsam.

Illumination.—For the complete demonstration of the more difficult bacilli, for instance, B. tuberculosis, it is advisable to employ oil-immersion objectives, and a dispersive illumination such as that afforded by Abbe's condenser.

CHLORAL HYDRATE, Poisoning by.—SYNON.: Fr. *Empoisonnement par l'Hydrate de Chloral*; Ger. *Chloralhydratvergiftung.*

Poisoning by chloral hydrate is a very common occurrence, this medicament being frequently taken in fatal quantity by misadventure. There is reason to think that it is also largely used for suicidal purposes. The so-called 'chloral habit' is a growing evil. A syrup of chloral hydrate, containing about twenty-two grains of this substance per fluid drachm, is largely sold in this country under a patent-medicine stamp.

ANATOMICAL CHARACTERS.—There may be an entire absence of any characteristic appearances after death by hydrate of chloral; and at most these consist in more or less modified signs of asphyxia—especially a dark colour of the blood, and pulmonary and cerebral hyperæmia.

SYMPTOMS.—The most striking symptom of poisoning by chloral hydrate is the rapid supervention of quiet sleep, at first simulating natural sleep. In this stage the patient can be easily roused, but he speedily drops off again. The pupils are contracted; the respirations are full, deep, and regular; the pulse is not much affected. This condition rapidly deepens into full coma. The respirations slacken; and the pulse is either weak and slow, or, more commonly, rapid and irregular. The temperature of the body is reduced; the muscular system is totally relaxed. The pupils now dilate; and with feeble thready pulse, the anæsthesia and paralysis gradually end in death, preceded by lividity and collapse. Exceptionally, in fatal cases, burning pain in the mouth, fauces, and throat, and symptoms of gastritis have been observed. In one case of recovery the patient became idiotic.

DIAGNOSIS.—The history of the case, or the finding of a vessel containing the medicine, coupled with the symptoms, will usually set all doubts at rest. Otherwise the case may be mistaken for poisoning by opium or other narcotic, for carbolic acid poisoning, or for cerebral congestion. The pupil is not so contracted as in opium-poisoning; and, as the coma deepens, it dilates instead of undergoing further contraction. There is an absence of the olive-green or black urine so commonly noticed in carbolic acid poisoning, of the peculiar odour of the breath, and of stains about the mouth and lips.

PROGNOSIS.—This will depend upon the state in which the patient is found, and upon the length of time which has elapsed since the ingestion of the poison.

TREATMENT.—Evacuation of the stomach by the aid of the stomach-pump is the first step in the treatment of a case of poisoning by chloral hydrate. Emetics, unless given early, usually fail to excite vomiting. The patient must be roused, if possible, as in opium-poisoning (*see*

Opium, Poisoning by). The temperature of the body must be kept up by warm applications. Stimulants may be freely given, and hot coffee injected into the rectum. Strychnia ($\frac{1}{25}$ gr.) has been recommended for use as a counter-poison, by subcutaneous injection; also picrotoxine. The former is a dangerous remedy; the latter also would not perhaps be a safe antidote, if given in full doses. Inhalations of amyl nitrite, and artificial respiration are advisable.

Thomas Stevenson.

CHOLESTERINE (χολὴ, bile, and στερὸς, solid).—Synon.: Fr. *Cholestérine*; Ger. *Cholesterin; Gallenfett.*

Chemical and Physical Properties.—Cholesterine is a monatomic alcohol, represented by the empirical formula $C_{26}H_{44}O$, occurring as a normal constituent of the nervous tissue (51·9 per cent. of the solids of the white matter and 18·6 per cent. of the solids of the grey matter of ox-brain); and in minute quantities in bile (·25 per cent.); and in blood (·5 to 2·0 per 1000). When pure it occurs as white glittering scales, which consist of needles, when crystallised out from ethereal solutions; and of rhombic plates, often deficient at one corner, when derived from alcoholic solutions (*see* Microscope in Medicine). It is insoluble in water, alkalies, and dilute acids; but readily dissolves in ether, boiling alcohol, benzol, chloroform, and solutions of the bile-acids. It melts at 145° Fahr., and its solutions are lævo-rotatory. The crystals, heated with a drop of strong sulphuric acid, give a carmine-red colour.

Sources.—The exact physiological significance of cholesterine is not known, but it is generally regarded as a product of the metabolism of the nervous tissues which should be eliminated by the liver in the bile. Since little or none is found in the fæces, it is believed to undergo a change in the intestine into stercorin (Flint). It is also found in the yolk of egg; in some vegetables, such as peas and maize; and in olive and almond oils.

Pathological Relations.—The pathological occurrence of cholesterine is varied. It is increased in amount in all acute febrile conditions, and especially in those diseases of the liver leading to the retention in the blood of the bile-constituents, producing in such cases a condition known as *cholesteræmia.* The fluid of cysts, especially hydatid and ovarian, seems to be more liable to contain it than effusions into serous cavities; and on this ground it has been referred to in the differential diagnosis of ascites from ovarian dropsy. But it sometimes occurs in considerable quantities in hydrocele fluids, and it has been met with in old pleural and peritoneal effusions.

Cholesterine forms the greater bulk of most gall-stones, being formed into coherent masses by inspissated mucus.

In the caseous degeneration of pus and other inflammatory products, crystals of this substance are to be found.

In the urine cholesterine is never found in health, but it occasionally occurs in morbid states, and is especially likely to be met with when there is advanced renal degeneration.

W. H. Allchin.

CONIUM, Poisoning by.—Synon.: Fr. *Empoisonnement par la Ciguë*; Ger. *Schierlingvergiftung.*—All parts of the hemlock plant (*Conium maculatum*) are poisonous. Both the leaves and fruit are used in medicine. Its toxic properties were known in ancient times: the plant was used for the destruction of criminals by the ancient Greeks, and there is no doubt that Socrates was poisoned by it. Death from conium in this country has perhaps always been the result of misadventure or suicide; but on the Continent the active principle of the plant, *conia*, an alkaloid, has been administered for the purpose of wilful homicide, death resulting from a dose of 10 to 15 drops.

Anatomical Characters.—The signs of asphyxia, engorgement of lungs and of the right heart, and a general venous condition of the blood, appear to be constant after death from conium. There is nothing else specially noticeable.

Symptoms.—Preparations of conium, as well as the alkaloid, or mixture of alkaloids, known as *conia*, when taken in toxic doses, produce excessive muscular weakness, beginning in the lower limbs, and extending gradually upwards, with giddiness and disordered vision. These symptoms are in some cases preceded by nausea and vomiting, with dryness or burning pain in the mouth and fauces. There is a desire to remain quiet, and a peculiar heaviness or drooping of the eyelids, the patient lying with his eyes shut. This, and the impairment of vision, appear to be due to paralysis of the ocular muscles. The pupils may be natural, but later they become dilated. The pulse is slow till death is actually impending. The paralysis progresses gradually upwards, till eventually heart and respiration are affected, more especially the former. Convulsions, and impairment of the mental faculties—hitherto intact—now set in; finally sensation is impaired, and death ensues from asphyxia.

Diagnosis.—The paralysis of motion, progressing gradually upwards, with unimpaired sensation, and the peculiar drooping of the eyelids, are perhaps diagnostic of the nature of the poison.

Prognosis.—As no antidote is known which counteracts the effects of conia, the prognosis must always be a guarded one, and will depend entirely upon the general condition of the patient.

Treatment.—The stomach must be emptied by the stomach-pump or syphon-tube, and well washed out. Emetics may also be used to evacuate the stomach. Tannin and astringents must be freely administered, to precipitate the active alkaloid, and prevent its absorption. Castor oil, by the mouth or rectum, may aid the removal of the alkaloid when it has been rendered insoluble by tannin. Strong coffee, brandy, ammonia, and stimulants generally are serviceable, as may also be the hypodermic injection of ether. Hypodermic injections of 1-40th grain of sulphate of atropia are very promising, especially in the later stages; atropia acting as a respiratory and cardiac stimulant. Artificial respiration, and stimulation of the respiratory and cardiac functions by the use of electricity, ought not to be neglected when these are affected.

Thomas Stevenson.

DISTOMA RINGERI.—Under this name there has lately been described by the writer (*Medical Times and Gazette*, July 8, 1882), a new species of fluke, the mature form of which inhabits the human lung, where it was first found by Dr. B. S. Ringer in Formosa, in 1879. The ova of the parasite have frequently been found by Prof. Baely, of Tokio, and the writer, and by them are associated with a peculiar form of recurrent hæmoptysis, to which the term *parasitical hæmoptysis* has been applied.

SYMPTOMS AND PATHOLOGY.—The symptoms of the disease associated with the presence of the distoma Ringeri are slight cough; the expectoration of a characteristic rusty brown, viscid mucus; and at times hæmoptysis, either to an insignificant or an alarming extent. The hæmorrhage occurs at irregular intervals during many years. The expectoration of rusty bronchial mucus is persistent, and in this the ova are readily discovered with the microscope. These ($\frac{1}{300}$ in. × $\frac{1}{500}$ in.) are pale brown bodies, oval, double-outlined, operculated at the broad end, and contain protoplasmic globules having very active molecular movements. If the sputum is occasionally shaken up in fresh water, in the course of six weeks to two months an active ciliated embryo is developed in most of the ova, which in time escapes by forcing back the operculum. It may be concluded from this that drinking water, or a fresh-water animal acting as intermediary host, is the medium by which the disease passes from one human subject to another. *See* DISTOMA.

This disease has hitherto been found only in Japan and Formosa, but its distribution is probably much more extended than this.

The mature distoma measures $\frac{14}{32}$ in. × $\frac{5}{32}$ in. × $\frac{1}{32}$ in. The particular tissue of the lung it inhabits has yet to be determined. It certainly communicates with the bronchi, as the bronchial mucus is the medium by which the ova are conveyed to suitable incubating media; but whether the animal is free in the bronchi, or is jammed into a branch of the pulmonary artery, has yet to be ascertained.

TREATMENT.—Inhalations of sulphurous acid, and sprays of turpentine, kousso, quassia, and santonine, have been administered with apparent benefit. PATRICK MANSON.

FILARIA SANGUINIS-HOMINIS.—Whilst the article FILARIA SANGUINIS-HOMINIS (p. 512) contains a sufficiently full account of the structure of this parasite, recent investigations enable us to furnish a more complete description of the life-history of the mature and embryo worm, and of their pathological relations to chyluria and elephantiasis. It is now known that the parent worm lives in the lymphatics; that the embryo while *in utero*, by dint of vigorous movements, stretches its oval chorional envelope, to form the long tubular sheath in which it lies extended, as we see it in the blood and lymph; and that, after this stretching of the chorion is complete, the embryo is born into the lymph-stream, which carries it through the glands, along the thoracic duct, and thus into the blood. Under ordinary circumstances of health and habit, the embryo cannot be found in the blood during the day, but at evening it appears there, in numbers gradually increasing up to midnight (when in some cases as many as 200 may be found in a single drop) and diminishing towards morning. About 8 or 9 A.M. it disappears for the day. This phenomenon ('filarial periodicity') is apparently an adaptation of the habits of the parasite to those of the female of a particular species of mosquito, which preys on the blood at night, and thus imbibes the young filaria, to which it acts as intermediary host. Having entered the stomach of the mosquito, the filaria undergoes a metamorphosis, eventuating in its becoming possessed of an alimentary canal, rudimentary organs of generation, increased size, great activity, and a circumoral crown of papillæ. The latter is the boring apparatus, which enables the animal to leave the body of the mosquito, when this insect dies, after depositing her eggs on water; and to traverse the human tissues, to which it gains access, probably by being swallowed in drinking water.

PATHOLOGICAL RELATIONS.—Chyluria, nævoid elephantiasis or lymph-scrotum, varicose and indurated groin-glands, galactocele, ascites with milky fluid, *craw-craw*, and certain kinds of abscess, lymphangitis, and lymphatic fever, are almost invariably accompanied by the presence of the filaria in the blood or lymph.

As tropical elephantiasis is often associated with, or supervenes on, some of these affections, has the same geographical distribution, attacks the same parts, and is a disease of the lymphatics, it is therefore—though the filaria is not usually found in developed elephantiasis—believed to be caused by this parasite. But from the fact that in many countries where the filaria is endemic, quite 10 per cent. of the adult population harbour it, yet only a small proportion of these have any of the diseases enumerated, it is evident that the parasite does not necessarily give rise to disease. Evidence has been adduced which shows that, as long as the parent worm is healthy, it is innocuous, but that if it dies, it acts as a foreign body, causing abscess; and that the obstruction of the lymphatics, which eventuates in and causes the diseases above enumerated, is brought about by the premature birth of the embryo, before the chorional envelope has undergone the stretching process alluded to—that is, when ova (seven or eight times the diameter of the outstretched embryo) are prematurely launched into the lymph-stream. The ova act as emboli, and being very numerous, effectually plug the glands connected, directly or by anastomosis, with the lymphatic vessel in which the aborting parent lies. The location of the worm, the degree of embolism, and other circumstances, determine the site and exact character of the resulting disease.

TREATMENT.—*a. Curative.*—No means of killing the filaria have been discovered. The indications for treatment, when disease has developed, are supplied by the pathology. Rest, elevation of the affected parts, elastic bandaging, and other means to facilitate the flow of lymph through the damaged lymphatics are of great benefit. *See* CHYLURIA; and ELEPHANTIASIS.

b. Preventive.—The fact that the mosquito acts as intermediary host, indicates the direction that preventive measures should take. Drinking water, in districts where the filaria is endemic, ought to be boiled or filtered; wells, cisterns, and receptacles for drinking water ought to be covered by fine wire gauze, to prevent the access of the mosquito; and persons known to harbour the parasite, ought to sleep under properly constructed mosquito-curtains. By any or all of these means, this parasite in the course of a single generation could be exterminated, and the diseases it produces made things of the past. PATRICK MANSON.

LARYNX, Diseases of.—The chief neuroses connected with the larynx, and the various forms of paralysis affecting the organ of voice, require more consideration than they have received in the principal article, LARYNX, Diseases of.

1. Sensory Neuroses of the Larynx.—*Hyperæsthesia* of the laryngeal mucous membrane is a usual accompaniment of inflammation, acute and chronic, and is a not unfrequent hysterical symptom. *Anæsthesia* occurs in cases where the superior laryngeal nerve or its centres are affected, and especially as a sequel of diphtheria. It is usually associated with paralysis of the muscles of deglutition, and of the depressors of the epiglottis, and still further contributes to the dysphagia accompanying the lesion, leading to pulmonary complications, owing to food passing into the larynx deprived of its reflex sensibility. If necessary, food must be administered by the œsophageal tube, while the nervous lesion is suitably treated.

2. Paralysis of the Larynx.—DEFINITION.—Loss of power in the laryngeal muscles, occurring in connection with disease or poisoning of the nervous centres, or with pressure upon or disease of the laryngeal nerves or their parent trunks, caused by aneurism, enlarged cervical or bronchial glands, or other tumours; more rarely of muscular origin.

VARIETIES AND SYMPTOMS.—Paralysis of the superior laryngeal nerve, supplying the crico-thyriod muscle, in addition to the symptoms mentioned under anæsthesia, prevents due tension of the vocal cords, and causes dysphonia. Complete paralysis of the muscles supplied by both recurrent laryngeals, the motor nerves of the larynx, causes the vocal cords to remain immovable and semi closed, as in the dead body; but disease or pressure upon this nerve most commonly paralyses only certain groups or individual muscles. The most serious, and perhaps most common, lesion is paralysis of the *ab*ductors (posterior crico-arytænoids, &c.), causing the vocal cords to approximate in the middle line in a relaxed state. Even in phonation they are not tense; and during respiration only a narrow chink is left, with relaxed edges, causing very stridulous breathing, and possibly fatal asphyxia. Paralysis of the *ad*ductors, when one or both vocal cords are seen at all times relaxed and drawn aside, leading in the latter case to complete aphonia, and in the former to aphonia more or less complete, is not necessarily attended with much dyspnœa. When these conditions are of long standing, the muscles become atrophied; but many cases have been reported where the paresis of individual muscles has been of true muscular origin.

DIAGNOSIS.—The several varieties of paralysis of the larynx must be recognised by the laryngoscope, the symptoms to which they give rise being common to various diseased conditions. The dyspnœa and stridulous breathing of paralysis of the abductors is unaccompanied by the pain and other symptoms which attend them in the various inflammatory affections, but may without physical examination be undistinguishable from those caused by neoplasm or by passive œdema.

Functional aphonia has been considered in the body of the work (*see* LARYNX, Diseases of). Organic aphonia is not only a frequent symptom of painful inflammation, of ulcerations, neoplasms, and other affections of the larynx; but it may be the only symptom, not only of paralysis of the adductors, from disease of the nerves or muscles, but of other conditions closely simulating this, such as anchylosis of the crico-arytænoid joints (Dr. F. Semon), contracted cicatrices, and other mechanical obstacles to the approximation of the vocal cords.

TREATMENT.—The paralysed condition usually depending on serious disease outside the larynx, local treatment is of little avail. Tracheotomy may be called for to avert asphyxia. Cases where the local use of electricity is supposed to have cured paralysis were probably cases of simulated disease. *See* LARYNX, Diseases of; and PNEUMOGASTRIC NERVE, Diseases of.[1]

THOMAS J. WALKER.

LICHEN.—The general pathology of lichen is discussed in the body of this work. Here it is thought desirable to describe the several species of lichen, and to refer to certain other diseases which were formerly associated with each other under this generic name.

The somewhat loose definition given by the older writers to the word 'papule,' caused them to include under the head of *lichen* diseases, or rather conditions of the skin, many of which belong to other categories. Thus Willan's list included seven species:—1, *Lichen simplex*, 2. *L. pilaris*, 3. *L. circumscriptus*, 4. *L. agrius*, 5. *L. lividus*, 6. *L. tropicus*, and 7. *L. urticatus*.

Lichen simplex is merely a temporary lichenous condition—in short, the papular stage preceding the vesicular stage of eczema. *L. agrius* and *L. tropicus* may be disposed of in like manner.

Lichen or *Pityriasis pilaris* is an affection which is differently classed by authors; it is essentially a chronic condition, characterised by a heaping up of epidermis in horny masses round the hair-follicles, giving the part affected the feel of a rasp. The outer surfaces of the extremities, the backs of the hands and phalanges, are the seats of election; its alliances are with the squamous affections.

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[1] It seems desirable to refer here to the following points which have not been noticed in the article LARYNX, Diseases of.

Dilatation of contractions by bougies and plugs has been frequently attempted, and recently successfully practised by Schrötter and others.

Perichondritis, and consequent formation of *abscess*, with consecutive caries and necrosis of the cartilages, have been alluded to as complicating tubercular, syphilitic, and the worst forms of non-specific laryngitis (typhus, &c.); rarely it occurs as a primary affection, giving rise to a limited suppuration. Abscess is so rare a complication of simple laryngitis that its occurrence almost invariably indicates perichondritis, with its formidable results—necrosis, caries, &c.

Lichen circumscriptus or *circinatus* is a well-defined affection, in which small red papules are seen arranged in groups, and especially in segments of circles. The area enclosed by the segments of circles is minutely scaly, and of a buff-pink colour. The seats of election are the sternal region, between the mammæ, and the interscapular region; from these, however, it may spread. The affection is very itchy, and has a strongly marked parasitic appearance, though the existence of fungus is extremely difficult, if not impossible, to demonstrate by ordinary methods. Dr. Crocker has, however, described and figured a fungus which he has found associated with L. circumscriptus. The affection readily yields to a little creasote ointment (♏ vj-x to the ounce of lard).

Lichen lividus is a purpuric condition, in which the purpuric spots appear as papules round hair-follicles. *See* PURPURA.

Lichen urticatus is an affection which is now classed as a variety of urticaria.

In accordance with the teaching of Hebra, modern dermatologists are disposed to restrict the term lichen to papular affections in which the papules retain their character as papules, and do not undergo any further evolution. There is another condition imposed, namely, that the papule must be inflammatory. The group Lichen is thus narrowed down to one of Willan's list, namely, *Lichen circumscriptus*; and two newly-described diseases, *Lichen ruber* and *Lichen scrofulosorum.*

Lichen ruber is a disease first described by Hebra, in Vienna, and in this country by Sir Erasmus Wilson, under the name of *Lichen planus.* Although denied by some, the essential identity of the two conditions described under these names is generally admitted. The characteristic feature of L. planus or ruber is the development round the hair-follicles of lilac-red, flat-topped, somewhat quadrangular, shining papules; in early stages a central depression or umbilication is recognisable in the centre of each papule. At first the papules remain discrete, but they soon tend to group themselves in patches, or run together in lines; the patches increase in size by the development of fresh papules in the immediate vicinity of the old ones. In this way whole areæ may become affected, the skin being then much thickened and slightly scaly. The patches itch intensely; and the clinical alliances of the disease are probably with psoriasis (Hutchinson). In its severest types, where the entire surface is affected, the patient's life may be threatened; but in milder forms it is very manageable by the internal administration of arsenic, combined with the local inunction of a mild tar ointment, such as ℞ Liquoris Carbonis detergentis ʒij. Adipis ℥i. Misce, et fiat unguentum.

Lichen scrofulosorum is another disease, first described by Hebra. It is extremely rare in this country, although it undoubtedly exists, especially amongst the poorer classes. It is characterised by pale papules, approaching the colour of the skin; these tend to range themselves in circular patches, not circles, generally on the trunk rather than the extremities. Here and there a papule inflames, and becomes acne-like. There is little itching. The disease is said to occur in young scrofulous subjects. Cod-liver oil is the remedy internally, and also externally by inunction. ALFRED SANGSTER.

LUPUS, Local Treatment of.—Volkmann has recently introduced a method of treating lupus locally, namely, by *scraping* or *puncture.*

1. *Scraping* has for its object, first, the removal of products of secretion, scabs, and crusts; and, secondly, the removal of neoplasms formed in or on the skin. For this purpose 'spoons' or 'scrapers' of various sizes are made by the instrument-makers. It is difficult to make any impression on the sound skin with such blunt instruments, and on this fact the simplicity and safety of scraping mainly depend. It is almost impossible to do harm, for all that can be made to break down (using moderate force), under the scraper or spoon, is best removed.

2. *Multiple punctiform scarification* is the second mechanical method employed by Volkmann. By this the practitioner seeks, first, to destroy newly-formed vessels; and, secondly, to favour absorption of the neoplasm, by traumatic irritation of the part. It is practised by making hundreds of punctures close together, about two lines in depth. For this purpose a narrow-bladed bistoury may be used; or the same end is gained in less time by employing an instrument composed of two or more knives set close together. This method of treatment is more applicable to non-ulcerated parts, where the cell-infiltration is diffuse, or where the part is swollen and vascular. Such tissue might in some cases be made to break down under the spoon, but less scarring or deformity results if the neoplasm can be made to disappear by the method of puncture.

There is considerable bleeding at first, after either scraping or puncture. This, however, is soon controlled, by the application of sponges squeezed out in iced water. The part may be dressed after operation with some simple dressing, for instance, carbolized oil or lead lotion.

It is but rational to follow up the scraping by the application of caustics; for in most cases there must exist, deep in the skin, prolongations of lupus-tissue, extending from the mass on the surface along the hair-follicles and other vascular structures. ALFRED SANGSTER.

NUCLEUS OF CELLS, The.—SYNON. Fr. *le Noyau*; Ger. *der Kern.*

DEFINITION.—A minute mass of protoplasm imbedded in the substance of nearly all cells.

The nucleus differs from the cell-substance in its optical characters, and in its behaviour to certain chemical reagents; being, for example, more readily stained by various colouring matters, and presenting, as a rule, greater resistance to weak acids and alkalies. Until recently it was believed to form an essential part of all cells. *See* Cell.

Chemical Characters.—Regarding the chemical characters of nuclei but little is known, beyond the fact that they contain, in all probability, an albuminous body.

Microscopical Characters.—The intimate structure of the nucleus is very complex. In many animal cells, more especially gland-, epithelial, and endothelial cells, it is made up of a delicate network of fibres running in all directions, in the meshes of which is a substance of more or less fluid consistence, the whole being surrounded by a membranous envelope from which the fibres spring.

Physiological Properties.—It has long been believed that the nucleus plays a predominating *rôle* in the process of cell-multiplication; and this view has recently been materially strengthened by the discovery of the so-called *indirect division* of the nuclei of epithelial cells. Indirect division of the nucleus, or, as it is called by Flemming, *karyokinesis* (*κάρυον*, a nucleus, and *κίνησις*, movement) is the name applied to a complicated series of structural changes accompanying the division of the nucleus into two halves; and is employed in contradistinction to the term *direct division*, in which the nucleus, without any accompanying visible changes of structure, divides into two or more parts, called 'daughter-nuclei.'

The changes in karyokinesis consist chiefly in thickening of the intranuclear fibrils above referred to, and in disappearance of the nuclear membrane, accompanied by increase in the size of the nucleus as a whole, this being followed by a complicated series of changes in the form and arrangement of the intra-nuclear fibres, in the course of which they often present the most regular stellate, fan-shaped, or wreath-like figures, ending in their dividing into two bundles of fibrils which draw apart from one another. This is followed by separation into two halves of the nucleus as a whole, each daughter-nucleus containing a more or less complicated bundle of fibres in its interior. The division of the nucleus is followed by that of the cell, while the fibres of the nucleus gradually diminish in thickness, and arrange themselves in the form which they present in the 'resting cell.'

In cell-multiplication by *direct division* of the nucleus, no change in the intimate structure of the nucleus is to be observed; all that is to be seen is that the nucleus becomes enlarged, and, after assuming a dumb-bell shape, divides into two halves, which may themselves be again divided into two.

Pathological Relations.—Karyokinesis is of considerable pathological importance, having been found to take place in the cell-multiplication of certain forms of epithelial cancer. On the other hand, direct division is the mode by which the nuclei of pus-cells multiply.

The nucleus is, as a rule, more resistant of retrogressive changes than the rest of the cell, often remaining apparently intact after the whole of the cell-substance and of the cell-wall has disappeared. In other cases the destruction of the nucleus goes hand in hand with that of the rest of the cell. Vacuolation of the nucleus is by no means rare, in cases of commencing retrogressive metamorphosis of cells, and also in cases of inflammation, for instance, of the skin.

Charles S. Roy.

PTOMAINES (*πτῶμα*, a dead body).—Synon: Cadaveric Alkaloids; Fr. *Ptomaïnes.*—Under this name a class of bodies has been described, which are stated to be the basic products of the decay of animal matters, and to which Selmi and others have assigned poisonous properties. It is right, however, to state that although the existence of basic or alkaloidal bodies among the products of decay is highly probable, the definite toxic properties of these substances are by no means generally admitted; and their preparation, in a state of even approximate purity, has perhaps not hitherto been achieved.

Panum first showed that by the putrefaction of albuminous matters a soluble ferment is produced, which is poisonous. Fagge and the writer also showed, in 1865, that the alcoholic extracts of many *post-mortem* liquids taken from the human body are, even after exposure to the temperature of the water-bath, poisonous when injected beneath the skin of animals. Bergmann, Schwenninger, Sonnenschein, and Zuelzer more or less confirmed these observations, and added to them. Selmi is, nevertheless, the observer who has chiefly worked at the cadaveric alkaloids.

According to Selmi ptomaines are alkaloids, generated during decay, and closely resembling the vegetable alkaloids, not only in their chemical reactions, but also in their physiological properties. Some ptomaines appear to be poisonous; and others to act as counter-poisons to well-known vegetable alkaloids. The conditions under which they are formed are entirely unknown, except that they may be found in alcoholic anatomical maceration liquids, and that exclusion of air possibly favours their formation. Some ptomaines have no marked physiological activity. Some are formed even in the living body, during the progress of such diseases as peritonitis.

The chief interest attaching to the ptomaines arises from their liability to be confounded with other and well-known natural alkaloids, such as morphia, strychnia, &c.; and hence to lead to mistakes in medico-legal practice. Brouardel and Boutmy nevertheless have, as they assert, discovered chemical reactions by which the ptomaines as a class may be distinguished from the natural alkaloids.

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